schedula Documentation

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https://github.com/vinci1it2000/schedula

https://pypi.org/project/schedula/

https://schedula.readthedocs.io/

https://github.com/vinci1it2000/schedula/wiki/

https://github.com/vinci1it2000/schedula/releases/

flow-based programming, dataflow, parallel, async, scheduling, dispatch, functional programming, dataflow programming

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CHAPTER

ONE

ABOUT SCHEDULA

schedula is a dynamic flow-based programming environment for python, that handles automatically the control flow of the program. The control flow generally is represented by a Directed Acyclic Graph (DAG), where nodes are the operations/functions to be executed and edges are the dependencies between them.

The algorithm of **schedula** dates back to 2014, when a colleague asked for a method to automatically populate the missing data of a database. The imputation method chosen to complete the database was a system of interdependent physical formulas - i.e., the inputs of a formula are the outputs of other formulas. The current library has been developed in 2015 to support the design of the CO_2MPAS tool - a CO_2 vehicle simulator. During the developing phase, the physical formulas (more than 700) were known on the contrary of the software inputs and outputs.

1.1 Why schedula?

The design of flow-based programs begins with the definition of the control flow graph, and implicitly of its inputs and outputs. If the program accepts multiple combinations of inputs and outputs, you have to design and code all control flow graphs. With normal schedulers, it can be very demanding.

While with **schedula**, giving whatever set of inputs, it automatically calculates any of the desired computable outputs, choosing the most appropriate DAG from the dataflow execution model.

Note: The DAG is determined at runtime and it is extracted using the shortest path from the provided inputs. The path is calculated based on a weighted directed graph (dataflow execution model) with a modified Dijkstra algorithm.

schedula makes the code easy to debug, to optimize, and to present it to a non-IT audience through its interactive graphs and charts. It provides the option to run a model asynchronously or in parallel managing automatically the Global Interpreter Lock (GIL), and to convert a model into a web API service.

1.2 Dataflow Execution Model

The `Dispatcher` is the main model of **schedula** and it represents the dataflow execution model of your code. It is defined by a weighted directed graph. The nodes are the operations to be executed. The arcs between the nodes represent their dependencies. The weights are used to determine the control flow of your model (i.e. operations' invocation order).

Conceptually, when the model is executed, input-data flows as tokens along the arcs. When the execution/`dispatch()` begins, a special node (`START`) places the data onto key input arcs, triggering the computation of the control flow. The latter is represented by a Directed Acyclic Graph (DAG) and it is defined as the shortest path from the provided inputs. It is computed using the weighted directed graph and a modified Dijkstra algorithm. A node is executed when its inputs and domain are satisfied. After the node execution, new data are placed on some or all of its output arcs. In presence of cycles in the graph, to avoid undesired infinite loops, the nodes are computed only once. In case of an execution failure of a node, the algorithm searches automatically for an alternative path to compute the desired outputs. The nodes are differentiated according to their scope. **schedula** defines three node's types:

- **data node**: stores the data into the solution. By default, it is executable when it receives one input arch.
- **function node**: invokes the user defined function and place the results onto its output arcs. It is executable when all inputs are satisfied and it has at least one data output to be computed.
- **sub-dispatcher node**: packages particular dataflow execution model as sub component of the parent dispatcher. Practically, it creates a bridge between two dispatchers (parent and child) linking some data nodes. It allows to simplify your model, reusing some functionality defined in other models.

The key advantage is that, by this method, the scheduling is not affected by the operations' execution times. Therefore, it is deterministic and reproducible. Moreover, since it is based on flow-based programming, it inherits the ability to execute more than one operation at the same time, making the program executable in parallel. The following video shows an example of a runtime dispatch.

CHAPTER

TWO

INSTALLATION

To install it use (with root privileges):

```
$ pip install schedula
```

or download the last git version and use (with root privileges):

```
$ python setup.py install
```

2.1 Install extras

Some additional functionality is enabled installing the following extras:

- `io`: enables to read/write functions.
- `plot`: enables the plot of the Dispatcher model and workflow (see *plot()*).
- `web`: enables to build a dispatcher Flask app (see *web()*).
- `sphinx`: enables the sphinx extension directives (i.e., autosummary and dispatcher).
- `parallel`: enables the parallel execution of Dispatcher model.

To install **schedula** and all extras, do:

```
$ pip install 'schedula[all]'
```

Note: `plot` extra requires **Graphviz**. Make sure that the directory containing the `dot` executable is on your systems' path. If you have not you can install it from its download page.

CHAPTER

THREE

TUTORIAL

Let's assume that we want develop a tool to automatically manage the symmetric cryptography. The base idea is to open a file, read its content, encrypt or decrypt the data and then write them out to a new file. This tutorial shows how to:

1. *define* and *execute* a dataflow execution model,
2. *extract* a sub-model, and
3. *deploy* a web API service.

Note: You can find more examples, on how to use the **schedula** library, into the folder examples.

3.1 Model definition

First of all we start defining an empty `Dispatcher` named *symmetric_cryptography* that defines the dataflow execution model:

```
>>> import schedula as sh
>>> dsp = sh.Dispatcher(name='symmetric_cryptography')
```

There are two main ways to get a key, we can either generate a new one or use one that has previously been generated. Hence, we can define three functions to simply generate, save, and load the key. To automatically populate the model inheriting the arguments names, we can use the decorator `add_function()` as follow:

```
>>> import os.path as osp
>>> from cryptography.fernet import Fernet
>>> @sh.add_function(dsp, outputs=['key'], weight=2)
... def generate_key():
...     return Fernet.generate_key().decode()
>>> @sh.add_function(dsp)
... def write_key(key_fpath, key):
...     with open(key_fpath, 'w') as f:
...         f.write(key)
>>> @sh.add_function(dsp, outputs=['key'], input_domain=osp.isfile)
... def read_key(key_fpath):
...     with open(key_fpath) as f:
...         return f.read()
```

Note: Since Python does not come with anything that can encrypt/decrypt files, in this tutorial, we use a third party module named `cryptography`. To install it execute `pip install cryptography`.

To encrypt/decrypt a message, you will need a key as previously defined and your data *encrypted* or *decrypted*. Therefore, we can define two functions and add them, as before, to the model:

```
>>> @sh.add_function(dsp, outputs=['encrypted'])
... def encrypt_message(key, decrypted):
...     return Fernet(key.encode()).encrypt(decrypted.encode()).decode()
>>> @sh.add_function(dsp, outputs=['decrypted'])
... def decrypt_message(key, encrypted):
...     return Fernet(key.encode()).decrypt(encrypted.encode()).decode()
```

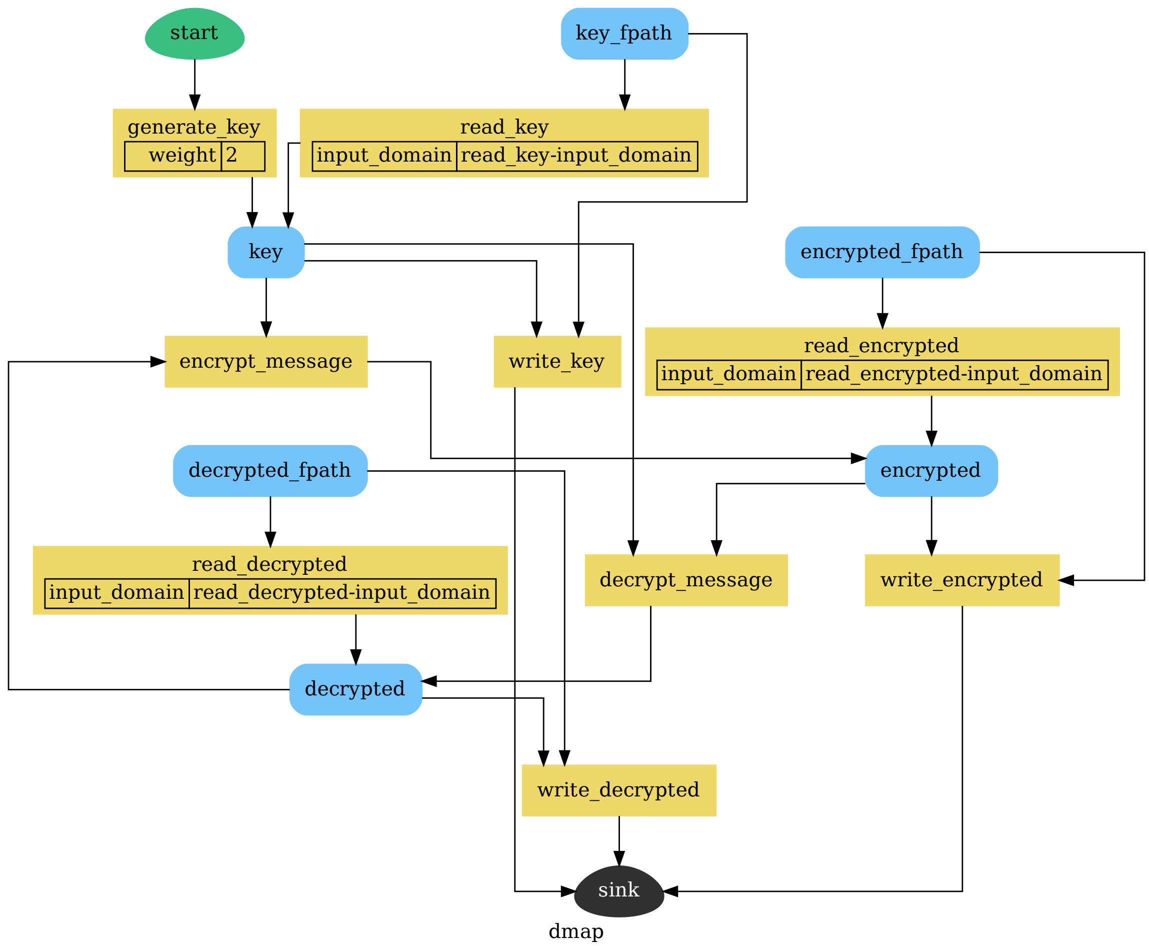
Finally, to read and write the encrypted or decrypted message, according to the functional programming philosophy, we can reuse the previously defined functions `read_key` and `write_key` changing the model mapping (i.e., *function_id*, *inputs*, and *outputs*). To add to the model, we can simply use the *add_function* method as follow:

```
>>> dsp.add_function(
...     function_id='read_decrypted',
...     function=read_key,
...     inputs=['decrypted_fpath'],
...     outputs=['decrypted']
... )
'read_decrypted'
>>> dsp.add_function(
...     'read_encrypted', read_key, ['encrypted_fpath'], ['encrypted'],
...     input_domain=osp.isfile
... )
'read_encrypted'
>>> dsp.add_function(
...     'write_decrypted', write_key, ['decrypted_fpath', 'decrypted'],
...     input_domain=osp.isfile
... )
'write_decrypted'
>>> dsp.add_function(
...     'write_encrypted', write_key, ['encrypted_fpath', 'encrypted']
... )
'write_encrypted'
```

Note: For more details on how to create a *Dispatcher* see: *add_data()*, *add_func()*, *add_function()*, *add_dispatcher()*, *SubDispatch*, *MapDispatch*, *SubDispatchFunction*, *SubDispatchPipe*, and *DispatchPipe*.

To inspect and visualize the dataflow execution model, you can simply plot the graph as follow:

```
>>> dsp.plot()
```

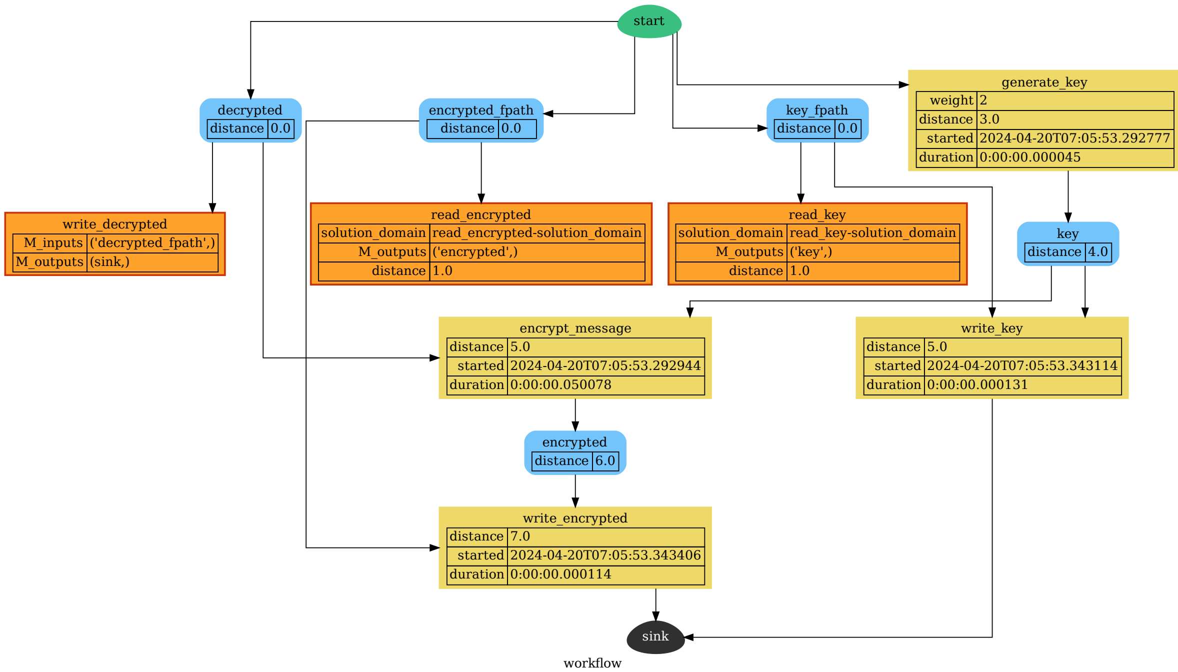


Tip: You can explore the diagram by clicking on it.

3.2 Dispatching

To see the dataflow execution model in action and its workflow to generate a key, to encrypt a message, and to write the encrypt data, you can simply invoke *dispatch()* or `__call__()` methods of the `dsp`:

```
>>> import tempfile
>>> tempdir = tempfile.mkdtemp()
>>> message = "secret message"
>>> sol = dsp(inputs=dict(
...     decrypted=message,
...     encrypted_fpath=osp.join(tempdir, 'data.secret'),
...     key_fpath=osp.join(tempdir,'key.key')
... ))
>>> sol.plot(index=True)
```



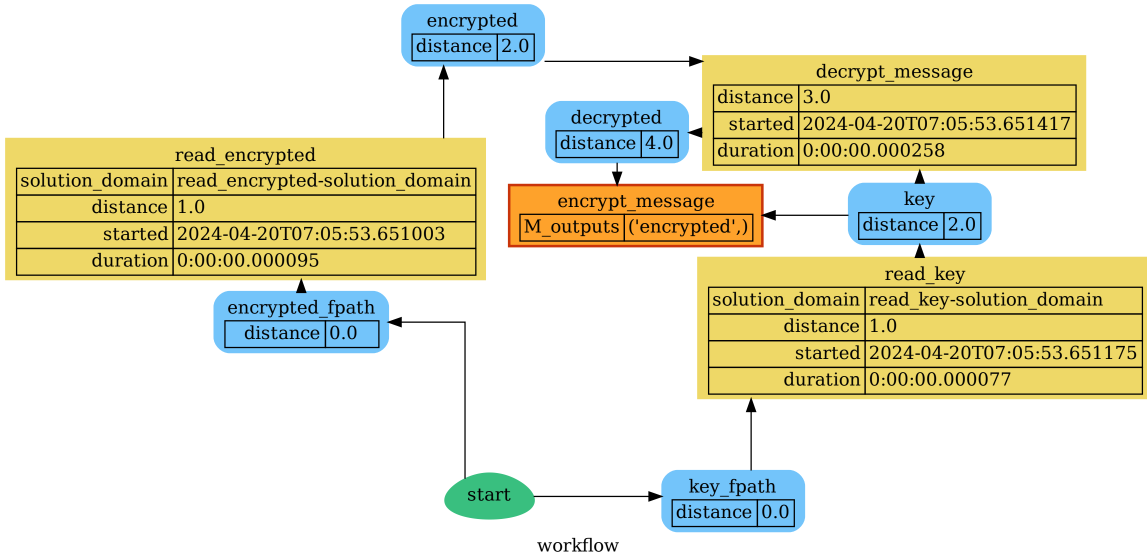
Note: As you can see from the workflow graph (orange nodes), when some function's inputs does not respect its domain, the Dispatcher automatically finds an alternative path to estimate all computable outputs. The same logic applies when there is a function failure.

Now to decrypt the data and verify the message without saving the decrypted message, you just need to execute again the `dsp` changing the *inputs* and setting the desired *outputs*. In this way, the dispatcher automatically selects and executes only a sub-part of the dataflow execution model.

```
>>> dsp(
...     inputs=sh.selector(('encrypted_fpath', 'key_fpath'), sol),
...     outputs=['decrypted']
... )['decrypted'] == message
True
```

If you want to visualize the latest workflow of the dispatcher, you can use the *plot()* method with the keyword `workflow=True`:

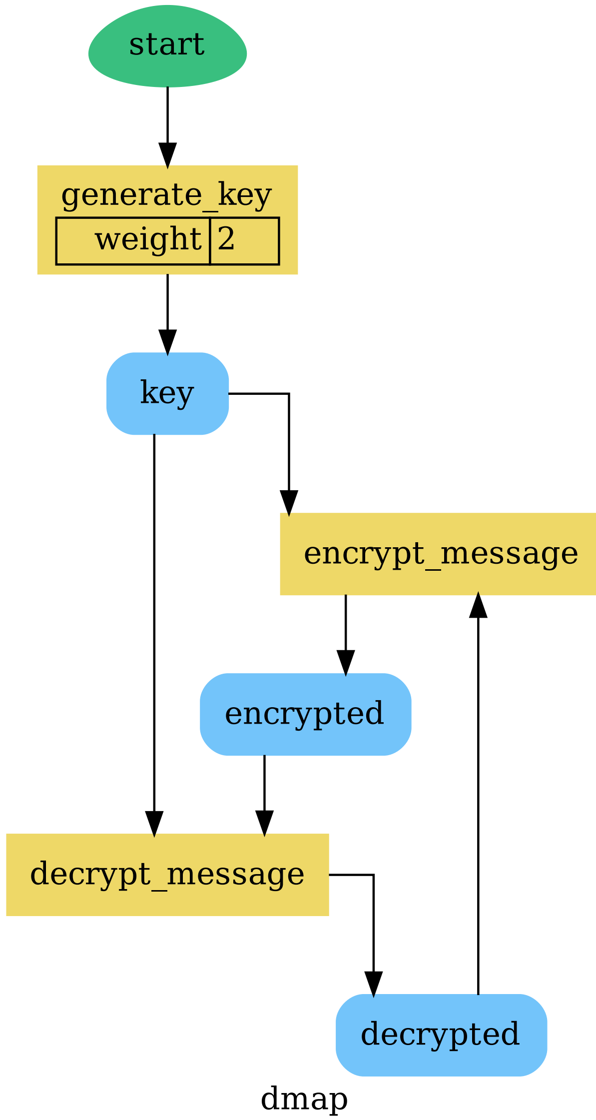
```
>>> dsp.plot(workflow=True, index=True)
```



3.3 Sub-model extraction

A good security practice, when design a light web API service, is to avoid the unregulated access to the system's reading and writing features. Since our current dataflow execution model exposes these functionality, we need to extract sub-model without read/write of key and message functions:

```
>>> api = dsp.get_sub_dsp((
...     'decrypt_message', 'encrypt_message', 'key', 'encrypted',
...     'decrypted', 'generate_key', sh.START
... ))
```



Note: For more details how to extract a sub-model see: *shrink_dsp()*, *get_sub_dsp()*, *get_sub_dsp_from_workflow()*, *SubDispatch*, *MapDispatch*, *SubDispatchFunction*, *DispatchPipe*, and *SubDispatchPipe*.

3.4 API server

Now that the `api` model is secure, we can deploy our web API service. **schedula** allows to convert automatically a *Dispatcher* to a web API service using the `web()` method. By default, it exposes the *dispatch()* method of the Dispatcher and maps all its functions and sub-dispatchers. Each of these APIs are commonly called endpoints. You can launch the server with the code below:

```
>>> server = api.web(run=False).site(host='127.0.0.1', port=5000).run()
>>> url = server.url; url
'http://127.0.0.1:5000'
```

Note: When `server` object is garbage collected, the server shutdowns automatically. To force the server shutdown, use its method `server.shutdown()`.

Once the server is running, you can try out the encryption functionality making a JSON POST request, specifying the *args* and *kwargs* of the *dispatch()* method, as follow:

```
>>> import requests
>>> res = requests.post(
...     'http://127.0.0.1:5000', json={'args': [{'decrypted': 'message'}]}
... ).json()
```

Note: By default, the server returns a JSON response containing the function results (i.e., `'return'`) or, in case of server code failure, it returns the `'error'` message.

To validate the encrypted message, you can directly invoke the decryption function as follow:

```
>>> res = requests.post(
...     '%s/symmetric_cryptography/decrypt_message?data=input,return' % url,
...     json={'kwargs': sh.selector(('key', 'encrypted'), res['return'])}
... ).json(); sorted(res)
['input', 'return']
>>> res['return'] == 'message'
True
```

Note: The available endpoints are formatted like:

- `/` or `/{dsp_name}`: calls the *dispatch()* method,
- `/{dsp_name}/{function_id}`: invokes the relative function.

There is an optional query param `data=input,return`, to include the inputs into the server JSON response and exclude the possible error message.

CHAPTER

FOUR

ASYNCHRONOUS AND PARALLEL DISPATCHING

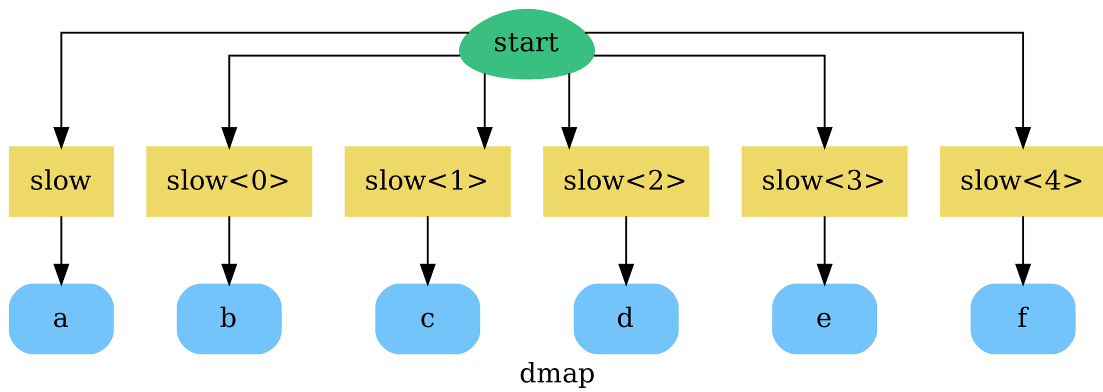
When there are heavy calculations which takes a significant amount of time, you want to run your model asynchronously or in parallel. Generally, this is difficult to achieve, because it requires an higher level of abstraction and a deeper knowledge of python programming and the Global Interpreter Lock (GIL). Schedula will simplify again your life. It has four default executors to dispatch asynchronously or in parallel:

- `async`: execute all functions asynchronously in the same process,
- `parallel`: execute all functions in parallel excluding *SubDispatch* functions,
- `parallel-pool`: execute all functions in parallel using a process pool excluding *SubDispatch* functions,
- `parallel-dispatch`: execute all functions in parallel including *SubDispatch*.

Note: Running functions asynchronously or in parallel has a cost. Schedula will spend time creating / deleting new threads / processes.

The code below shows an example of a time consuming code, that with the concurrent execution it requires at least 6 seconds to run. Note that the `slow` function return the process id.

```
>>> import schedula as sh
>>> dsp = sh.Dispatcher()
>>> def slow():
...     import os, time
...     time.sleep(1)
...     return os.getpid()
>>> for o in 'abcdef':
...     dsp.add_function(function=slow, outputs=[o])
'...'
```



while using the `async` executor, it lasts a bit more then 1 second:

```
>>> import time
>>> start = time.time()
>>> sol = dsp(executor='async').result()  # Asynchronous execution.
>>> (time.time() - start) < 2  # Faster then concurrent execution.
True
```

all functions have been executed asynchronously, but on the same process:

```
>>> import os
>>> pid = os.getpid()  # Current process id.
>>> {sol[k] for k in 'abcdef'} == {pid}  # Single process id.
True
```

if we use the `parallel` executor all functions are executed on different processes:

```
>>> sol = dsp(executor='parallel').result()  # Parallel execution.
>>> pids = {sol[k] for k in 'abcdef'}  # Process ids returned by ``slow``.
>>> len(pids) == 6  # Each function returns a different process id.
True
>>> pid not in pids  # The current process id is not in the returned pids.
True
>>> sorted(sh.shutdown_executors())
['async', 'parallel']
```

CHAPTER

FIVE

CONTRIBUTING TO SCHEDULA

If you want to contribute to **schedula** and make it better, your help is very welcome. The contribution should be sent by a *pull request*. Next sections will explain how to implement and submit a new functionality:

- clone the repository
- implement a new functionality
- open a pull request

5.1 Clone the repository

The first step to contribute to **schedula** is to clone the repository:

- Create a personal fork of the schedula repository on Github.
- Clone the fork on your local machine. Your remote repo on Github is called `origin`.
- Add the original repository as a remote called `upstream`, to maintain updated your fork.
- If you created your fork a while ago be sure to pull `upstream` changes into your local repository.
- Create a new branch to work on! Branch from `dev`.

5.2 How to implement a new functionality

Test cases are very important. This library uses a data-driven testing approach. To implement a new function I recommend the test-driven development cycle. Hence, when you think that the code is ready, add new test in `test` folder.

When all test cases are ok (`python setup.py test`), open a pull request.

Note: A pull request without new test case will not be taken into consideration.

5.3 How to open a pull request

Well done! Your contribution is ready to be submitted:

- Squash your commits into a single commit with git's interactive rebase. Create a new branch if necessary. Always write your commit messages in the present tense. Your commit message should describe what the commit, when applied, does to the code – not what you did to the code.
- Push your branch to your fork on Github (i.e., `git push origin dev`).
- From your fork open a *pull request* in the correct branch. Target the project's `dev` branch!
- Once the *pull request* is approved and merged you can pull the changes from `upstream` to your local repo and delete your extra branch(es).

CHAPTER

SIX

DONATE

If you want to support the **schedula** development please donate.

CHAPTER

SEVEN

API REFERENCE

The core of the library is composed from the following modules: It contains a comprehensive list of all modules and classes within schedula.

Docstrings should provide sufficient understanding for any individual function.

Modules:

dispatcher	It provides Dispatcher class.
utils	It contains utility classes and functions.
ext	It provides sphinx extensions.
cli	Define the command line interface.

7.1 dispatcher

It provides Dispatcher class.

Classes

Dispatcher	It provides a data structure to process a complex system of functions.

7.1.1 Dispatcher

class Dispatcher(**args*, ***kwargs*)

It provides a data structure to process a complex system of functions.

The scope of this data structure is to compute the shortest workflow between input and output data nodes.

A workflow is a sequence of function calls.

Example:

As an example, here is a system of equations:

$b - a = c$

$log(c) = d_{from-log}$

$d = (d_{from-log} + d_{initial-guess})/2$

that will be solved assuming that $a = 0$, $b = 1$, and $d_{initial-guess} = 4$.

Steps

Create an empty dispatcher:

```
>>> dsp = Dispatcher(name='Dispatcher')
```

Add data nodes to the dispatcher map:

```
>>> dsp.add_data(data_id='a')
'a'
>>> dsp.add_data(data_id='c')
'c'
```

Add a data node with a default value to the dispatcher map:

```
>>> dsp.add_data(data_id='b', default_value=1)
'b'
```

Add a function node:

```
>>> def diff_function(a, b):
...     return b - a
...
>>> dsp.add_function('diff_function', function=diff_function,
...                  inputs=['a', 'b'], outputs=['c'])
'diff_function'
```

Add a function node with domain:

```
>>> from math import log
...
>>> def log_domain(x):
...     return x > 0
...
>>> dsp.add_function('log', function=log, inputs=['c'], outputs=['d'],
...                  input_domain=log_domain)
'log'
```

Add a data node with function estimation and callback function.

- function estimation: estimate one unique output from multiple estimations.
- callback function: is invoked after computing the output.

```
>>> def average_fun(kwargs):
...     """
...     Returns the average of node estimations.
...
...     :param kwargs:
...         Node estimations.
...     :type kwargs: dict
...
...     :return:
```

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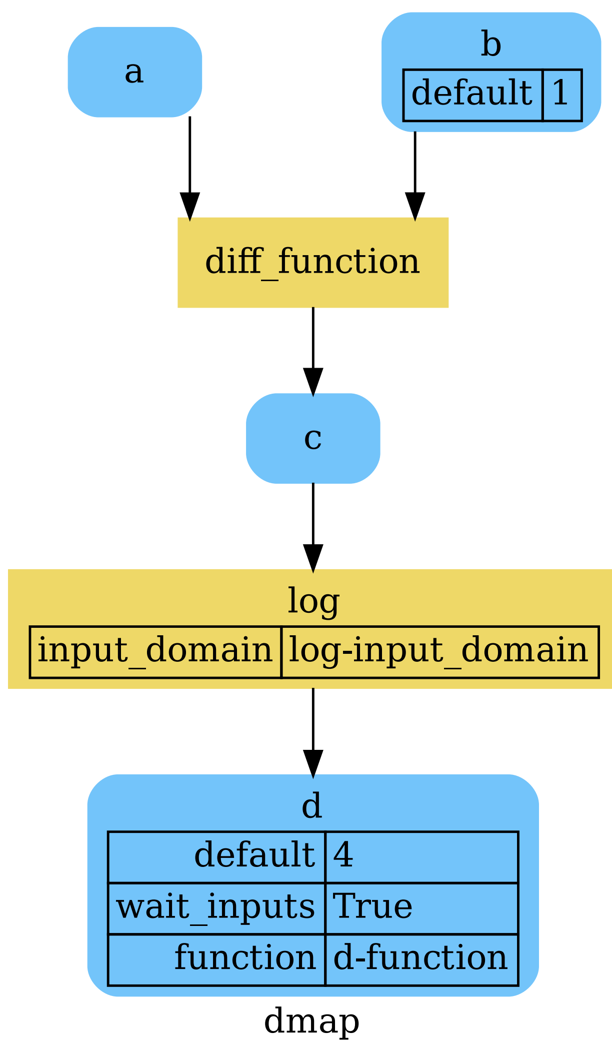
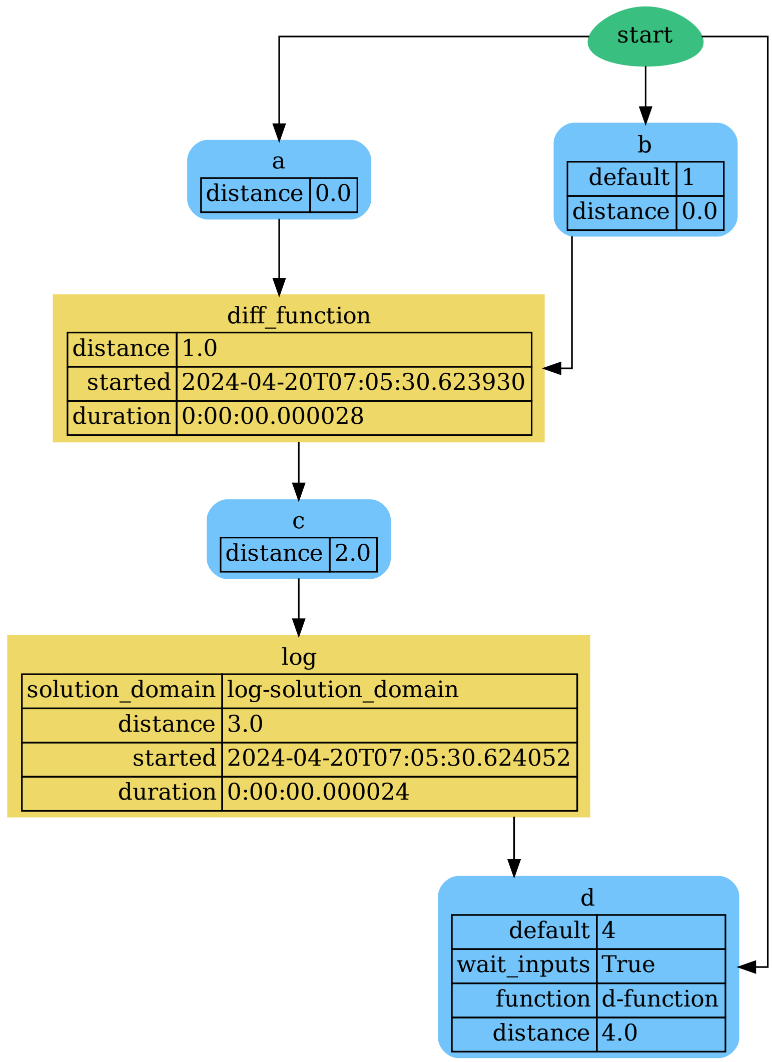
```
...         The average of node estimations.
...     :rtype: float
...     '''
...
...     x = kwargs.values()
...     return sum(x) / len(x)
...
>>> def callback_fun(x):
...     print('(log(1) + 4) / 2 = %.1f' % x)
...
>>> dsp.add_data(data_id='d', default_value=4, wait_inputs=True,
...              function=average_fun, callback=callback_fun)
'd'
```



Dispatch the function calls to achieve the desired output data node *d*:

```
>>> outputs = dsp.dispatch(inputs={'a': 0}, outputs=['d'])
(log(1) + 4) / 2 = 2.0
>>> outputs
Solution([('a', 0), ('b', 1), ('c', 1), ('d', 2.0)])
```



workflow

Methods

`__init__`	Initializes the dispatcher.
`add_data`	Add a single data node to the dispatcher.
`add_dispatcher`	Add a single sub-dispatcher node to dispatcher.
`add_from_lists`	Add multiple function and data nodes to dispatcher.
`add_func`	Add a single function node to dispatcher.
`add_function`	Add a single function node to dispatcher.
`blue`	Constructs a BlueDispatcher out of the current object.
`copy`	Returns a deepcopy of the Dispatcher.
`copy_structure`	Returns a copy of the Dispatcher structure.
`dispatch`	Evaluates the minimum workflow and data outputs of the dispatcher model from given inputs.
`extend`	Extends Dispatcher calling each deferred operation of given Blueprints.
`form`	Creates a dispatcher Form Flask app.
`get_node`	Returns a sub node of a dispatcher.
`get_sub_dsp`	Returns the sub-dispatcher induced by given node and edge bunches.
`get_sub_dsp_from_workflow`	Returns the sub-dispatcher induced by the workflow from sources.
`plot`	Plots the Dispatcher with a graph in the DOT language with Graphviz.
`set_default_value`	Set the default value of a data node in the dispatcher.
`shrink_dsp`	Returns a reduced dispatcher.
`web`	Creates a dispatcher Flask app.

__init__

`Dispatcher.__init__`(*dmap=None*, *name=''*, *default_values=None*, *raises=False*, *description=''*, *executor=False*)

Initializes the dispatcher.

Parameters

- **dmap** (`schedula.utils.graph.DiGraph`, *optional*) – A directed graph that stores data & functions parameters.
- **name** (*str*, *optional*) – The dispatcher's name.
- **default_values** (*dict[str, dict]*, *optional*) – Data node default values. These will be used as input if it is not specified as inputs in the ArciDispatch algorithm.
- **raises** (*bool|callable|str*, *optional*) – If True the dispatcher interrupt the dispatch when an error occur, otherwise if raises != '' it logs a warning. If a callable is given it will be executed passing the exception to decide to raise or not the exception.
- **description** (*str*, *optional*) – The dispatcher's description.
- **executor** (*str*, *optional*) – A pool executor id to dispatch asynchronously or in parallel.

  There are four default Pool executors to dispatch asynchronously or in parallel:

- *async*: execute all functions asynchronously in the same process,
- *parallel*: execute all functions in parallel excluding `SubDispatch` functions,
- *parallel-pool*: execute all functions in parallel using a process pool excluding `SubDispatch` functions,
- *parallel-dispatch*: execute all functions in parallel including `SubDispatch`.

add_data

`Dispatcher.add_data`(*data_id=None*, *default_value=empty*, *initial_dist=0.0*, *wait_inputs=False*, *wildcard=None*, *function=None*, *callback=None*, *description=None*, *filters=None*, *await_result=None*, ***kwargs*)

Add a single data node to the dispatcher.

Parameters

- **data_id** (*str, optional*) – Data node id. If None will be assigned automatically ('unknown<%d>') not in dmap.
- **default_value** (*T, optional*) – Data node default value. This will be used as input if it is not specified as inputs in the ArciDispatch algorithm.
- **initial_dist** (*float, int, optional*) – Initial distance in the ArciDispatch algorithm when the data node default value is used.
- **wait_inputs** (*bool, optional*) – If True ArciDispatch algorithm stops on the node until it gets all input estimations.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **function** (*callable, optional*) – Data node estimation function. This can be any function that takes only one dictionary (key=function node id, value=estimation of data node) as input and return one value that is the estimation of the data node.
- **callback** (*callable, optional*) – Callback function to be called after node estimation. This can be any function that takes only one argument that is the data node estimation output. It does not return anything.
- **description** (*str, optional*) – Data node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits data results before assigning them to the solution. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns
Data node id.

Return type
str

See also:

add_func(), *add_function()*, *add_dispatcher()*, *add_from_lists()*

Example:

Add a data to be estimated or a possible input data node:

```
>>> dsp.add_data(data_id='a')
'a'
```

Add a data with a default value (i.e., input data node):

```
>>> dsp.add_data(data_id='b', default_value=1)
'b'
```

Create a data node with function estimation and a default value.

- function estimation: estimate one unique output from multiple estimations.
- default value: is a default estimation.

```
>>> def min_fun(kwargs):
...     '''
...     Returns the minimum value of node estimations.
...
...     :param kwargs:
...         Node estimations.
...     :type kwargs: dict
...
...     :return:
...         The minimum value of node estimations.
...     :rtype: float
...     '''
...
...     return min(kwargs.values())
...
>>> dsp.add_data(data_id='c', default_value=2, wait_inputs=True,
...              function=min_fun)
'c'
```

Create a data with an unknown id and return the generated id:

```
>>> dsp.add_data()
'unknown'
```

add_dispatcher

Dispatcher.**add_dispatcher**(*dsp*, *inputs=None*, *outputs=None*, *dsp_id=None*, *input_domain=None*, *weight=None*, *inp_weight=None*, *description=None*, *include_defaults=False*, *await_domain=None*, *inputs_prefix=''*, *outputs_prefix=''*, ***kwargs*)

Add a single sub-dispatcher node to dispatcher.

Parameters

- **dsp** (Dispatcher | *dict[str, list]*) – Child dispatcher that is added as sub-dispatcher node to the parent dispatcher.
- **inputs** (*dict[str, str | list[str]] | tuple[str] | (str, ..., dict[str, str | list[str]])*) – Inputs mapping. Data node ids from parent dispatcher to child sub-dispatcher. If *None* all child dispatcher nodes are used as inputs.
- **outputs** (*dict[str, str | list[str]] | tuple[str] | (str, ..., dict[str, str | list[str]])*) – Outputs mapping. Data node ids from child sub-dispatcher to parent dispatcher. If *None* all child dispatcher nodes are used as outputs.
- **dsp_id** (*str, optional*) – Sub-dispatcher node id. If None will be assigned as <dsp.name>.
- **input_domain** (*(dict) -> bool, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the a dictionary with the inputs of the sub-dispatcher node and returns True if input values satisfy the domain, otherwise False.

  Note: This function is invoked every time that a data node reach the sub-dispatcher node.

- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, int | float], optional*) – Edge weights from data nodes to the sub-dispatcher node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Sub-dispatcher node's description.
- **include_defaults** (*bool, optional*) – If True the default values of the sub-dispatcher are added to the current dispatcher.
- **await_domain** (*bool|int|float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **inputs_prefix** (*str*) – Add a prefix to parent dispatcher inputs nodes.
- **outputs_prefix** (*str*) – Add a prefix to parent dispatcher outputs nodes.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns
Sub-dispatcher node id.

Return type
str

See also:

add_data(), *add_func()*, *add_function()*, *add_from_lists()*

Example:

Create a sub-dispatcher:

```
>>> sub_dsp = Dispatcher()
>>> sub_dsp.add_function('max', max, ['a', 'b'], ['c'])
'max'
```

Add the sub-dispatcher to the parent dispatcher:

```
>>> dsp.add_dispatcher(dsp_id='Sub-Dispatcher', dsp=sub_dsp,
...                    inputs={'A': 'a', 'B': 'b'},
...                    outputs={'c': 'C'})
'Sub-Dispatcher'
```

Add a sub-dispatcher node with domain:

```
>>> def my_domain(kwargs):
...     return kwargs['C'] > 3
...
>>> dsp.add_dispatcher(dsp_id='Sub-Dispatcher with domain',
...                    dsp=sub_dsp, inputs={'C': 'a', 'D': 'b'},
...                    outputs={('c', 'b'): ('E', 'E1')},
...                    input_domain=my_domain)
'Sub-Dispatcher with domain'
```

add_from_lists

`Dispatcher.`**`add_from_lists`**(*data_list=None*, *fun_list=None*, *dsp_list=None*)

Add multiple function and data nodes to dispatcher.

Parameters

- **data_list** (*list[dict], optional*) – It is a list of data node kwargs to be loaded.
- **fun_list** (*list[dict], optional*) – It is a list of function node kwargs to be loaded.
- **dsp_list** (*list[dict], optional*) – It is a list of sub-dispatcher node kwargs to be loaded.

Returns

- Data node ids.
- Function node ids.

- Sub-dispatcher node ids.

Return type

(list[str], list[str], list[str])

See also:

add_data(), *add_func()*, *add_function()*, *add_dispatcher()*

Example:

Define a data list:

```
>>> data_list = [
...     {'data_id': 'a'},
...     {'data_id': 'b'},
...     {'data_id': 'c'},
... ]
```

Define a functions list:

```
>>> def func(a, b):
...     return a + b
...
>>> fun_list = [
...     {'function': func, 'inputs': ['a', 'b'], 'outputs': ['c']}
... ]
```

Define a sub-dispatchers list:

```
>>> sub_dsp = Dispatcher(name='Sub-dispatcher')
>>> sub_dsp.add_function(function=func, inputs=['e', 'f'],
...                      outputs=['g'])
'func'
>>>
>>> dsp_list = [
...     {'dsp_id': 'Sub', 'dsp': sub_dsp,
...      'inputs': {'a': 'e', 'b': 'f'}, 'outputs': {'g': 'c'}},
... ]
```

Add function and data nodes to dispatcher:

```
>>> dsp.add_from_lists(data_list, fun_list, dsp_list)
(['a', 'b', 'c'], ['func'], ['Sub'])
```

add_func

`Dispatcher.`**`add_func`**(*function*, *outputs=None*, *weight=None*, *inputs_defaults=False*, *inputs_kwargs=False*, *filters=None*, *input_domain=None*, *await_domain=None*, *await_result=None*, *inp_weight=None*, *out_weight=None*, *description=None*, *inputs=None*, *function_id=None*, ***kwargs*)

Add a single function node to dispatcher.

Parameters

- **inputs_kwargs** (*bool*) – Do you want to include kwargs as inputs?
- **inputs_defaults** (*bool*) – Do you want to set default values?
- **function_id** (*str, optional*) – Function node id. If None will be assigned as <fun.__name__>.
- **function** (*callable, optional*) – Data node estimation function.
- **inputs** (*list, optional*) – Ordered arguments (i.e., data node ids) needed by the function. If None it will take parameters names from function signature.
- **outputs** (*list, optional*) – Ordered results (i.e., data node ids) returned by the function.
- **input_domain** (*callable, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the same inputs of the function and returns True if input values satisfy the domain, otherwise False. In this case the dispatch algorithm doesn't pass on the node.
- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, float | int], optional*) – Edge weights from data nodes to the function node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **out_weight** (*dict[str, float | int], optional*) – Edge weights from the function node to data nodes. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Function node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_domain** (*bool|int|float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits output results before assigning them to the workflow. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns

Function node id.

Return type

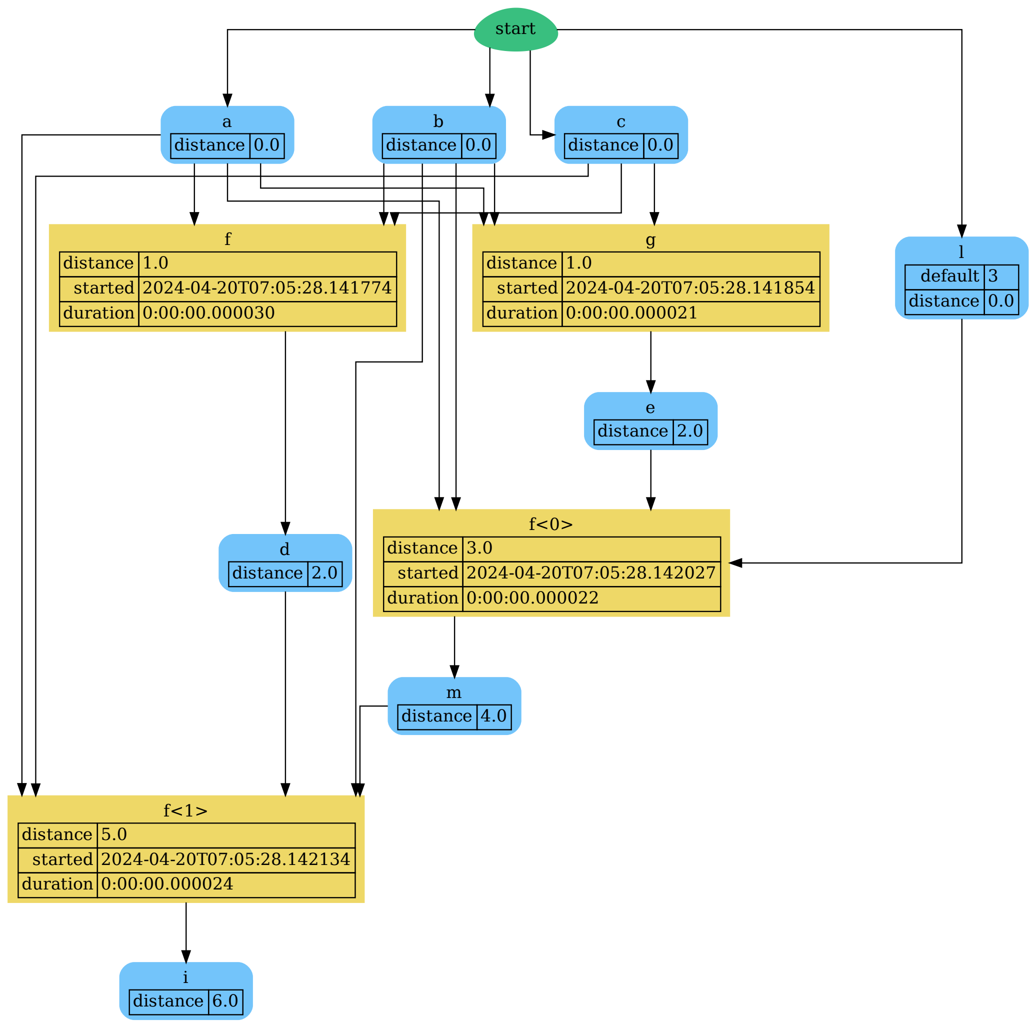
str

See also:

add_func(), *add_function()*, *add_dispatcher()*, *add_from_lists()*

Example:

```
>>> import schedula as sh
>>> dsp = sh.Dispatcher(name='Dispatcher')
>>> def f(a, b, c, d=3, m=5):
...     return (a + b) - c + d - m
>>> dsp.add_func(f, outputs=['d'])
'f'
>>> dsp.add_func(f, ['m'], inputs_defaults=True, inputs='beal')
'f<0>'
>>> dsp.add_func(f, ['i'], inputs_kwargs=True)
'f<1>'
>>> def g(a, b, c, *args, d=0):
...     return (a + b) * c + d
>>> dsp.add_func(g, ['e'], inputs_defaults=True)
'g'
>>> sol = dsp({'a': 1, 'b': 3, 'c': 0}); sol
Solution([('a', 1), ('b', 3), ('c', 0), ('l', 3), ('d', 2),
          ('e', 0), ('m', 0), ('i', 6)])
```



workflow

add_function

`Dispatcher.add_function(`*function_id=None, function=None, inputs=None, outputs=None, input_domain=None, weight=None, inp_weight=None, out_weight=None, description=None, filters=None, await_domain=None, await_result=None, **kwargs*`)`

Add a single function node to dispatcher.

Parameters

- **function_id** (*str, optional*) – Function node id. If None will be assigned as <fun.__name__>.
- **function** (*callable, optional*) – Data node estimation function.
- **inputs** (*list, optional*) – Ordered arguments (i.e., data node ids) needed by the function.

- **outputs** (*list, optional*) – Ordered results (i.e., data node ids) returned by the function.
- **input_domain** (*callable, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the same inputs of the function and returns True if input values satisfy the domain, otherwise False. In this case the dispatch algorithm doesn't pass on the node.
- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, float | int], optional*) – Edge weights from data nodes to the function node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **out_weight** (*dict[str, float | int], optional*) – Edge weights from the function node to data nodes. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Function node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_domain** (*bool|int|float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits output results before assigning them to the workflow. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns
Function node id.

Return type
str

See also:

add_data(), *add_func()*, *add_dispatcher()*, *add_from_lists()*

Example:

Add a function node:

```
>>> def my_function(a, b):
...     c = a + b
...     d = a - b
...     return c, d
...
>>> dsp.add_function(function=my_function, inputs=['a', 'b'],
...                  outputs=['c', 'd'])
'my_function'
```

Add a function node with domain:

```
>>> from math import log
>>> def my_log(a, b):
...     return log(b - a)
...
>>> def my_domain(a, b):
...     return a < b
...
>>> dsp.add_function(function=my_log, inputs=['a', 'b'],
...                  outputs=['e'], input_domain=my_domain)
'my_log'
```

blue

`Dispatcher.blue(memo=None, depth=-1)`

Constructs a BlueDispatcher out of the current object.

Parameters

- **memo** (*dict[T,schedula.utils.blue.Blueprint]*) – A dictionary to cache Blueprints.
- **depth** (*int, optional*) – Depth of sub-dispatch blue. If negative all levels are bluprinted.

Returns
A BlueDispatcher of the current object.

Return type
schedula.utils.blue.BlueDispatcher

copy

`Dispatcher.copy()`

Returns a deepcopy of the Dispatcher.

Returns
A copy of the Dispatcher.

Return type
Dispatcher

Example:

```
>>> dsp = Dispatcher()
>>> dsp is dsp.copy()
False
```

copy_structure

Dispatcher.**copy_structure**(***kwargs*)

Returns a copy of the Dispatcher structure.

Parameters
kwargs (*dict*) – Additional parameters to initialize the new class.

Returns
A copy of the Dispatcher structure.

Return type
Dispatcher

dispatch

Dispatcher.**dispatch**(*inputs=None*, *outputs=None*, *inputs_dist=None*, *wildcard=False*, *no_call=False*, *shrink=False*, *rm_unused_nds=False*, *select_output_kw=None*, *_wait_in=None*, *stopper=None*, *executor=False*, *sol_name=()*, *verbose=False*)

Evaluates the minimum workflow and data outputs of the dispatcher model from given inputs.

Parameters

- **inputs** (*dict[str, T], list[str], iterable, optional*) – Input data values.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **no_call** (*bool, optional*) – If True data node estimation function is not used and the input values are not used.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.

  See also:

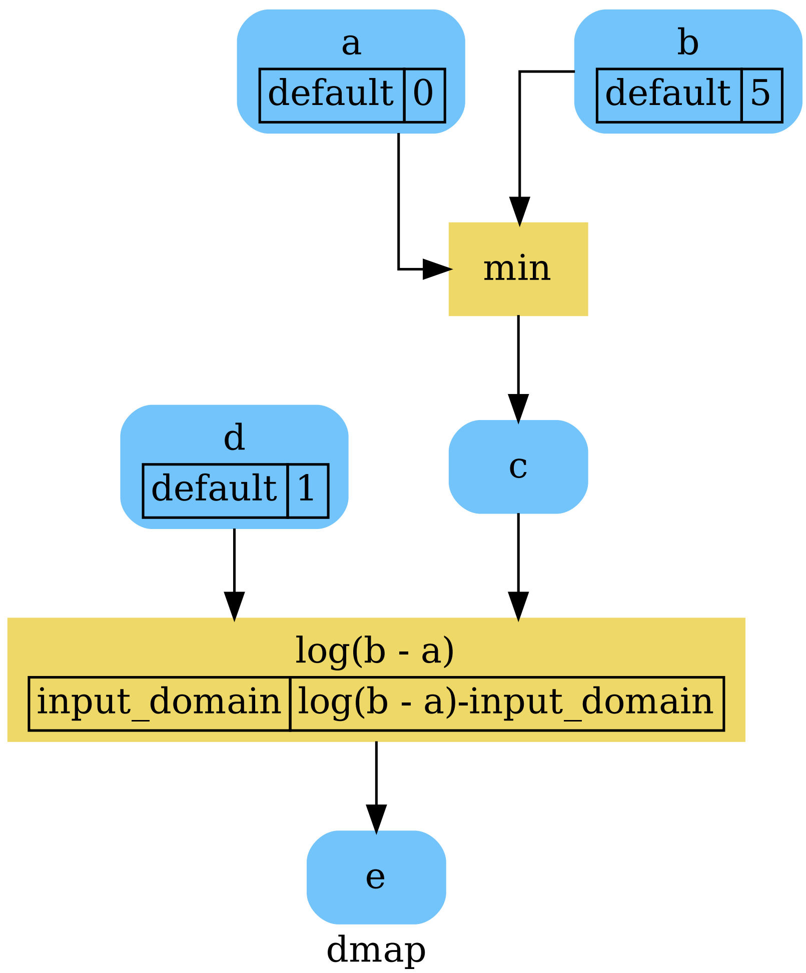
  shrink_dsp()
- **rm_unused_nds** (*bool, optional*) – If True unused function and sub-dispatcher nodes are removed from workflow.
- **select_output_kw** (*dict, optional*) – Kwargs of selector function to select specific outputs.
- **_wait_in** (*dict, optional*) – Override wait inputs.
- **stopper** (*multiprocess.Event, optional*) – A semaphore to abort the dispatching.
- **executor** (*str, optional*) – A pool executor id to dispatch asynchronously or in parallel.
- **sol_name** (*tuple[str], optional*) – Solution name.
- **verbose** (*str, optional*) – If True the dispatcher will log start and end of each function.

Returns
Dictionary of estimated data node outputs.

Return type
schedula.utils.sol.Solution

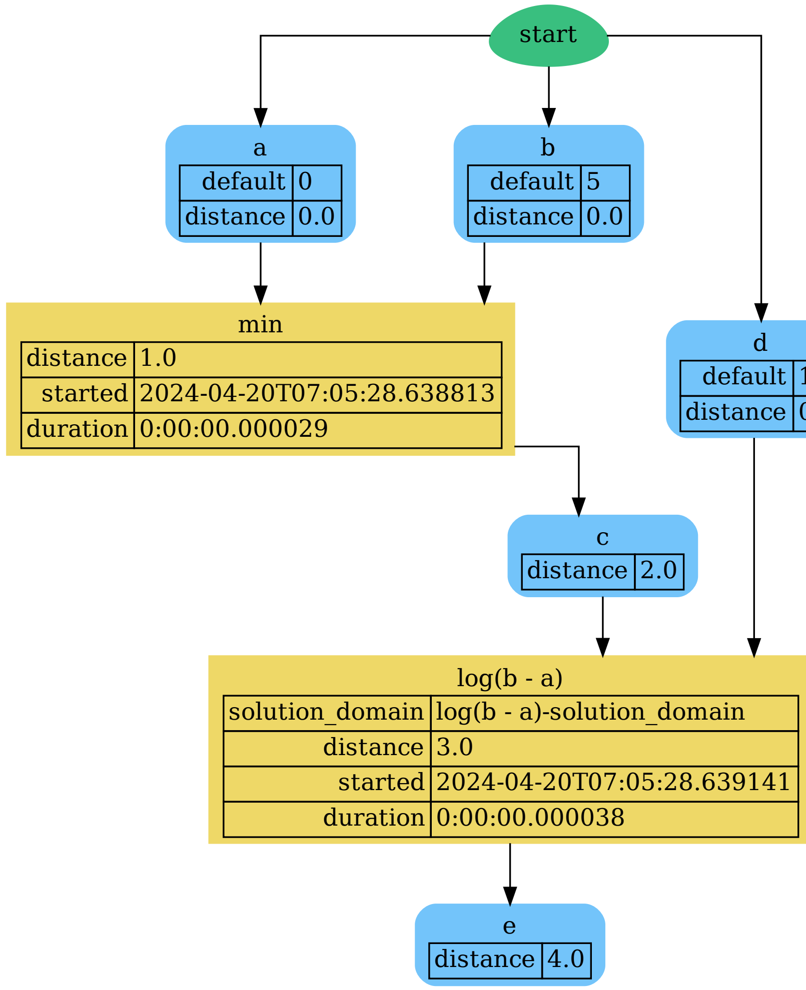
Example:

A dispatcher with a function $log(b - a)$ and two data a and b with default values:



Dispatch without inputs. The default values are used as inputs:

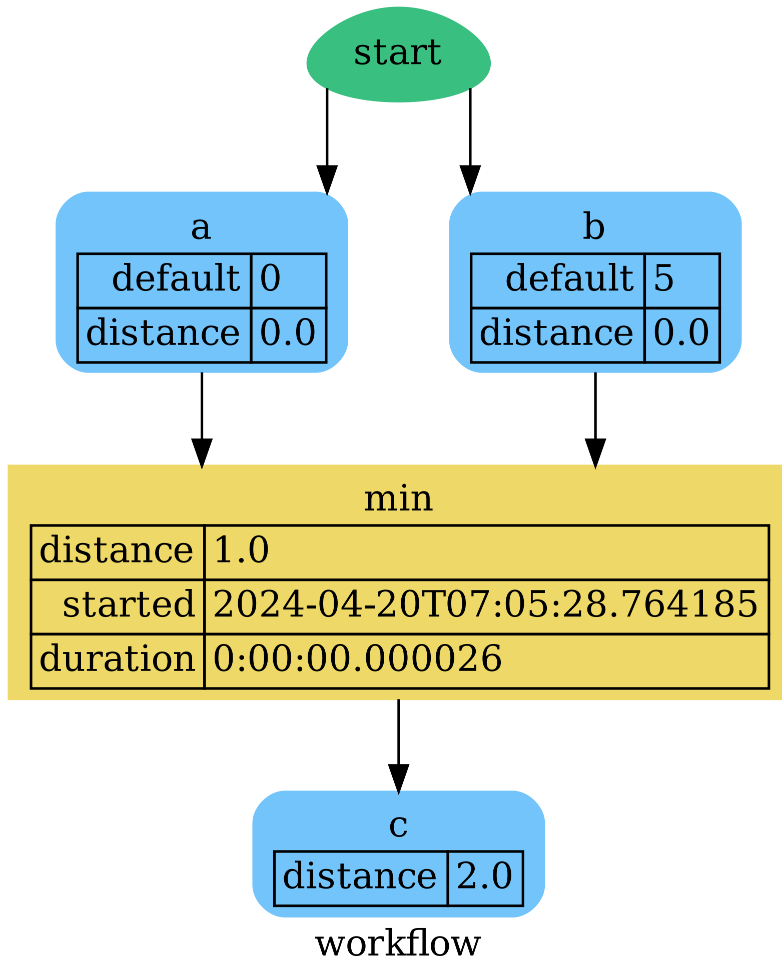
```
>>> outputs = dsp.dispatch()
>>> outputs
Solution([('a', 0), ('b', 5), ('d', 1), ('c', 0), ('e', 0.0)])
```



workflow

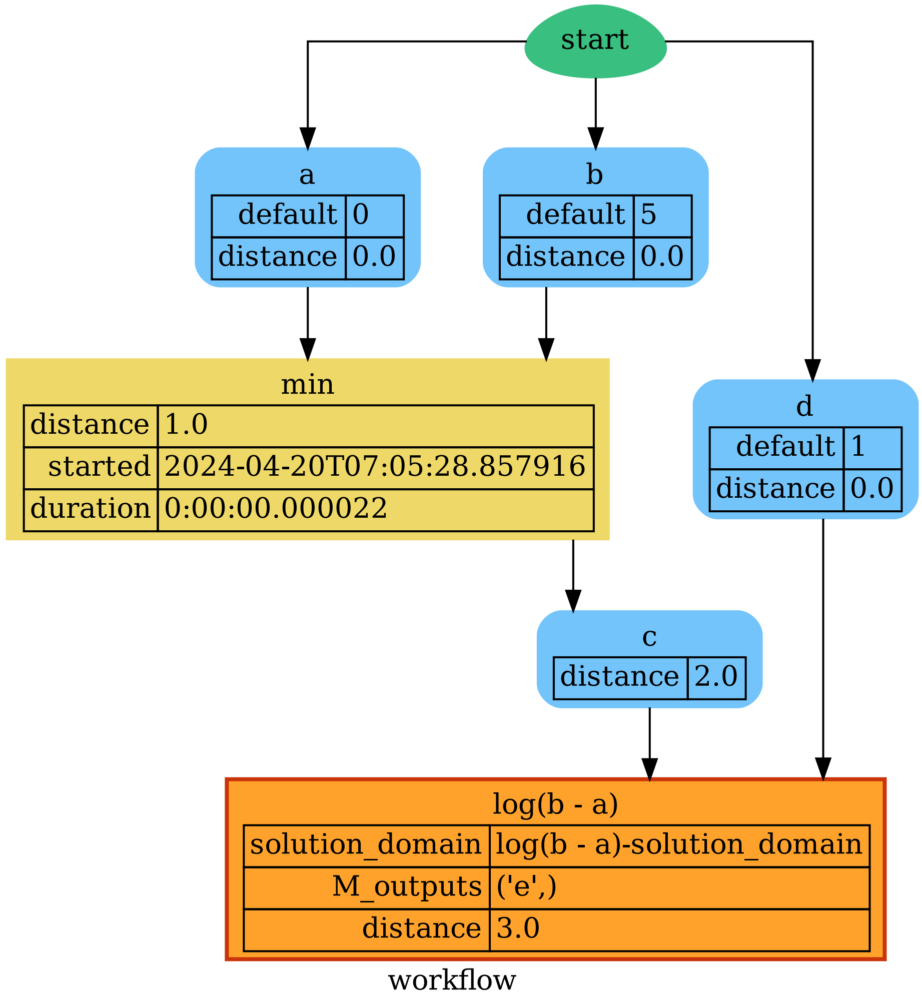
Dispatch until data node *c* is estimated:

```
>>> outputs = dsp.dispatch(outputs=['c'])
>>> outputs
Solution([('a', 0), ('b', 5), ('c', 0)])
```



Dispatch with one inputs. The default value of *a* is not used as inputs:

```
>>> outputs = dsp.dispatch(inputs={'a': 3})
>>> outputs
Solution([('a', 3), ('b', 5), ('d', 1), ('c', 3)])
```



extend

`Dispatcher.`**`extend`**(**blues*, *memo=None*)

Extends Dispatcher calling each deferred operation of given Blueprints.

Parameters

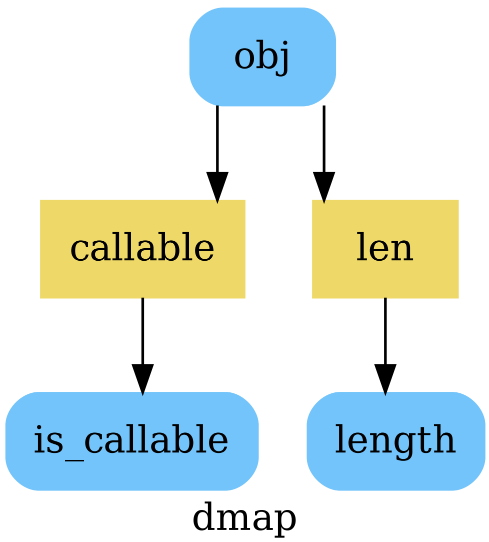
- **blues** (`Blueprint | schedula.dispatcher.Dispatcher`) – Blueprints or Dispatchers to extend deferred operations.
- **memo** (*dict*[*T*, `schedula.utils.blue.Blueprint`|`Dispatcher`]) – A dictionary to cache Blueprints and Dispatchers.

Returns
Self.

Return type
Dispatcher

Example:

```
>>> import schedula as sh
>>> dsp = sh.Dispatcher()
>>> dsp.add_func(callable, ['is_callable'])
'callable'
>>> blue = sh.BlueDispatcher().add_func(len, ['length'])
>>> dsp = sh.Dispatcher().extend(dsp, blue)
```



form

`Dispatcher.form`(*depth=1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *view=True*, *get_context=none*, *get_data=none*, *subsite_idle_timeout=600*, *basic_app_config=None*, *stripe_event_handler=<function Base.<lambda>>*)

Creates a dispatcher Form Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.

- **run** (*bool, optional*) – Run the backend server?
- **view** (*bool, optional*) – Open the url site with the sys default opener.
- **get_context** (*function | dict, optional*) – Function to pass extra data as form context.
- **get_data** (*function | dict, optional*) – Function to initialize the formdata.
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.
- **basic_app_config** (*object, optional*) – Flask app config object.
- **stripe_event_handler** (*function, optional*) – Stripe event handler function.

Returns
A FormMap or a Site if *sites is None* and *run or view is True*.

Return type
FormMap | Site

get_node

`Dispatcher.get_node(*node_ids, node_attr=none)`

Returns a sub node of a dispatcher.

Parameters

- **node_ids** (*str*) – A sequence of node ids or a single node id. The id order identifies a dispatcher sub-level.
- **node_attr** (*str, None, optional*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  – for data node: its output, and if not exists, all its attributes.

  – for function and sub-dispatcher nodes: the 'function' attribute.

  When 'description', returns the "description" of the searched node, searching also in function or sub-dispatcher input/output description.

  When 'output', returns the data node output.

  When 'default_value', returns the data node default value.

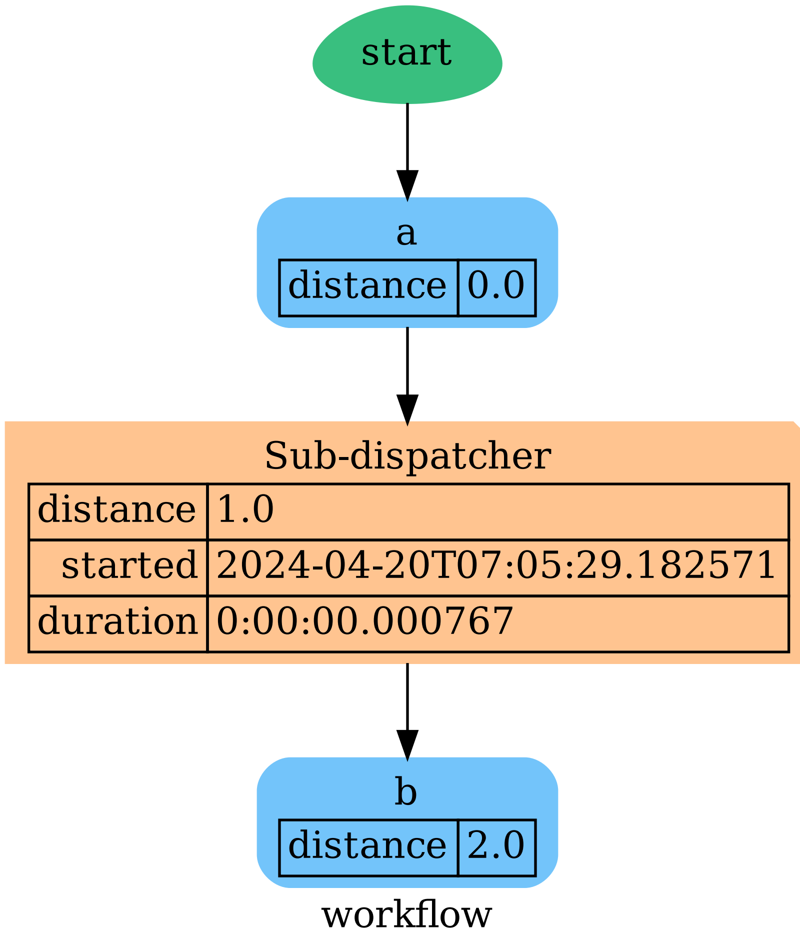
  When 'value_type', returns the data node value's type.

  When *None*, returns the node attributes.

Returns
Node attributes and its real path.

Return type
(T, (str, ...))

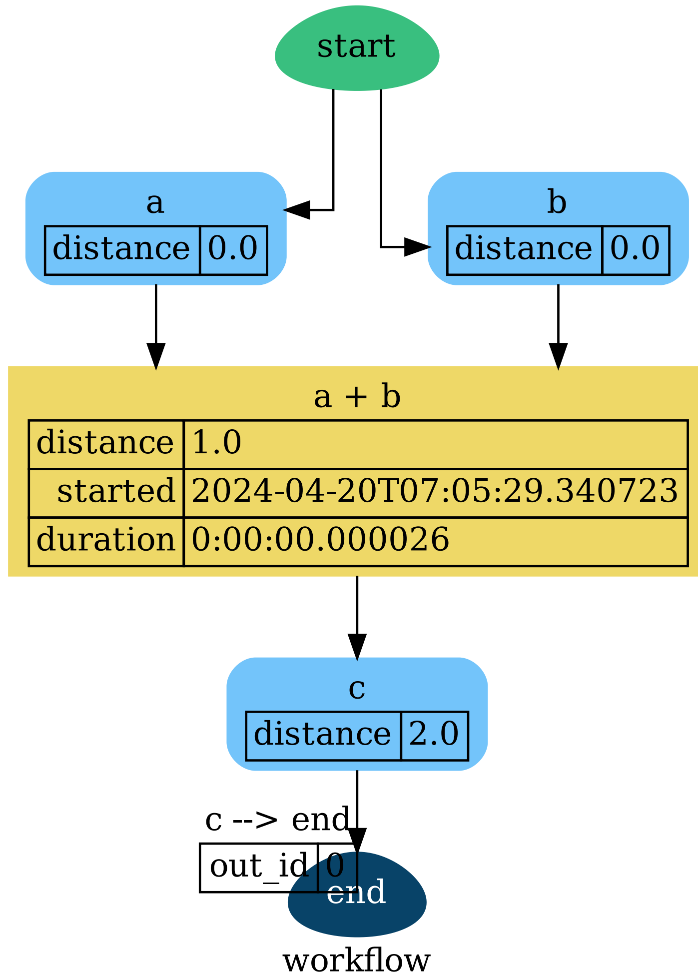
Example:



Get the sub node output:

```
>>> dsp.get_node('Sub-dispatcher', 'c')
(4, ('Sub-dispatcher', 'c'))
>>> dsp.get_node('Sub-dispatcher', 'c', node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

```
>>> sub_dsp, sub_dsp_id = dsp.get_node('Sub-dispatcher')
```



get_sub_dsp

`Dispatcher.`**`get_sub_dsp`**(*nodes_bunch*, *edges_bunch=None*)

Returns the sub-dispatcher induced by given node and edge bunches.

The induced sub-dispatcher contains the available nodes in nodes_bunch and edges between those nodes, excluding those that are in edges_bunch.

The available nodes are non isolated nodes and function nodes that have all inputs and at least one output.

Parameters

- **nodes_bunch** (*list[str], iterable*) – A container of node ids which will be iterated through once.
- **edges_bunch** (*list[(str, str)], iterable, optional*) – A container of edge ids that will be removed.

Returns
A dispatcher.

Return type
Dispatcher

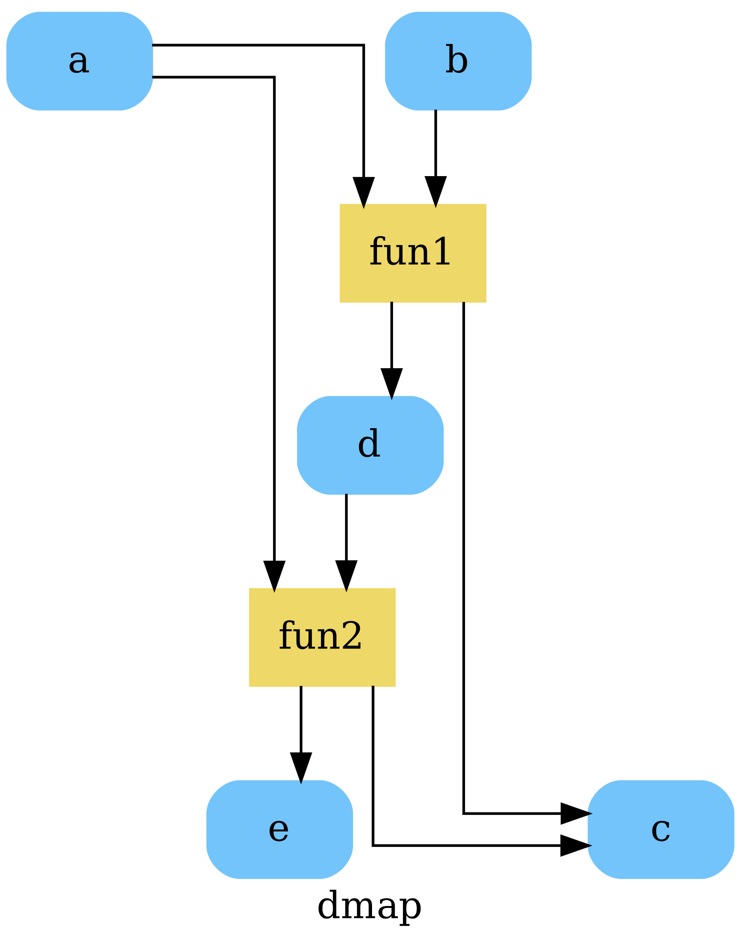
See also:

get_sub_dsp_from_workflow()

Note: The sub-dispatcher edge or node attributes just point to the original dispatcher. So changes to the node or edge structure will not be reflected in the original dispatcher map while changes to the attributes will.

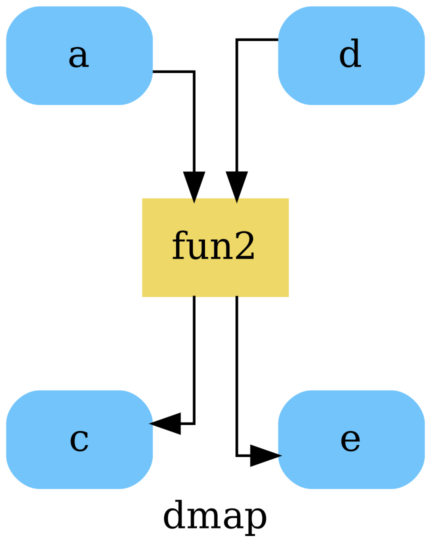
Example:

A dispatcher with a two functions *fun1* and *fun2*:



Get the sub-dispatcher induced by given nodes bunch:

```
>>> sub_dsp = dsp.get_sub_dsp(['a', 'c', 'd', 'e', 'fun2'])
```



get_sub_dsp_from_workflow

`Dispatcher.`**`get_sub_dsp_from_workflow`**(*sources*, *graph=None*, *reverse=False*, *add_missing=False*, *check_inputs=True*, *blockers=None*, *wildcard=False*, *_update_links=True*, *avoid_cycles=False*)

Returns the sub-dispatcher induced by the workflow from sources.

The induced sub-dispatcher of the dsp contains the reachable nodes and edges evaluated with breadth-first-search on the workflow graph from source nodes.

Parameters

- **sources** (*list[str], iterable*) – Source nodes for the breadth-first-search. A container of nodes which will be iterated through once.
- **graph** (schedula.utils.graph.DiGraph, *optional*) – A directed graph where evaluate the breadth-first-search.
- **reverse** (*bool, optional*) – If True the workflow graph is assumed as reversed.
- **add_missing** (*bool, optional*) – If True, missing function' inputs are added to the sub-dispatcher.
- **check_inputs** (*bool, optional*) – If True the missing function' inputs are not checked.
- **blockers** (*set[str], iterable, optional*) – Nodes to not be added to the queue.

- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **_update_links** (*bool, optional*) – If True, it updates remote links of the extracted dispatcher.

Returns
A sub-dispatcher.

Return type
Dispatcher

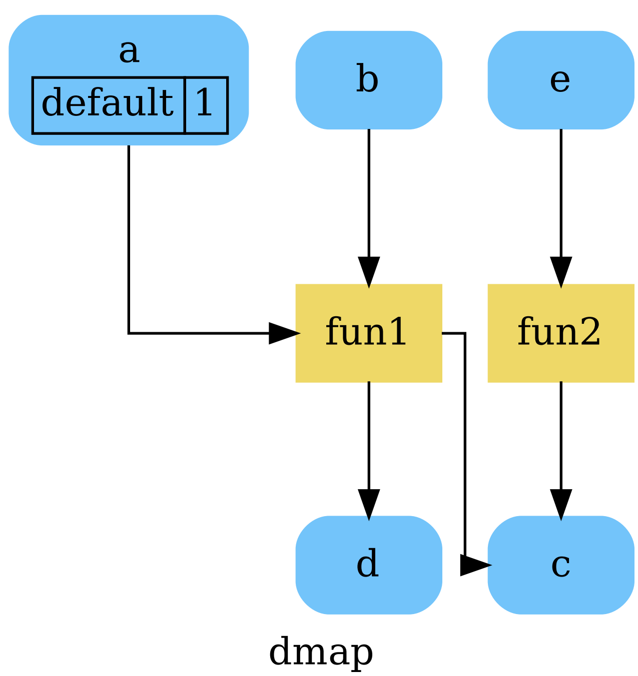
See also:

get_sub_dsp()

Note: The sub-dispatcher edge or node attributes just point to the original dispatcher. So changes to the node or edge structure will not be reflected in the original dispatcher map while changes to the attributes will.

Example:

A dispatcher with a function *fun* and a node *a* with a default value:

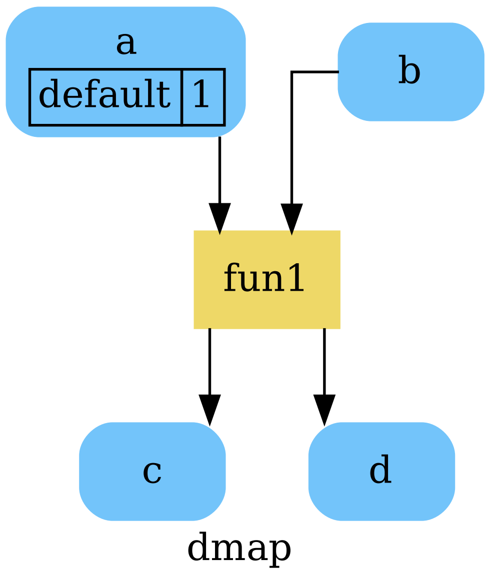


Dispatch with no calls in order to have a workflow:

```
>>> o = dsp.dispatch(inputs=['a', 'b'], no_call=True)
```

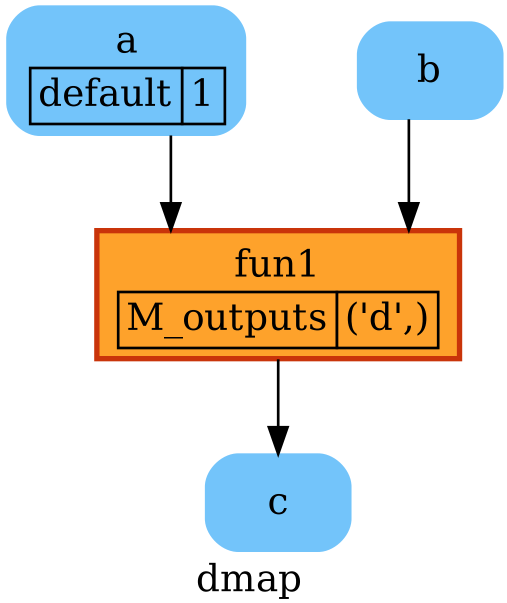
Get sub-dispatcher from workflow inputs *a* and *b*:

```
>>> sub_dsp = dsp.get_sub_dsp_from_workflow(['a', 'b'])
```



Get sub-dispatcher from a workflow output *c*:

```
>>> sub_dsp = dsp.get_sub_dsp_from_workflow(['c'], reverse=True)
```



plot

`Dispatcher.plot`(*workflow=None*, *view=True*, *depth=-1*, *name=none*, *comment=none*, *format=none*, *engine=none*, *encoding=none*, *graph_attr=none*, *node_attr=none*, *edge_attr=none*, *body=none*, *raw_body=none*, *node_styles=none*, *node_data=none*, *node_function=none*, *edge_data=none*, *max_lines=none*, *max_width=none*, *directory=None*, *sites=None*, *index=True*, *viz=False*, *short_name=None*, *executor='async'*, *render=False*, *run=False*)

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (*bool, optional*) – If True the latest solution will be plotted, otherwise the dmap.
- **view** (*bool, optional*) – Open the rendered directed graph in the DOT language with the sys default opener.
- **edge_data** (*tuple[str], optional*) – Edge attributes to view.
- **node_data** (*tuple[str], optional*) – Data node attributes to view.
- **node_function** (*tuple[str], optional*) – Function node attributes to view.
- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int, optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.
- **name** (*str*) – Graph name used in the source code.

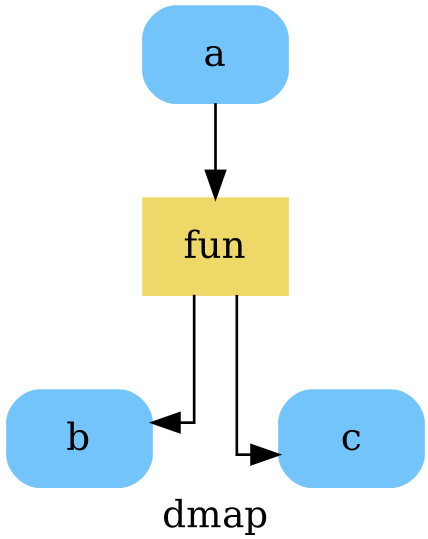
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str, optional*) – (Sub)directory for source saving and rendering.
- **format** (*str, optional*) – Rendering output format ('pdf', 'png', …).
- **engine** (*str, optional*) – Layout command used ('dot', 'neato', …).
- **encoding** (*str, optional*) – Encoding for saving the source.
- **graph_attr** (*dict, optional*) – Dict of (attribute, value) pairs for the graph.
- **node_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict, optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list, optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of *Site* to maintain alive the backend server.
- **index** (*bool, optional*) – Add the site index as first page?
- **max_lines** (*int, optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int, optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool, optional*) – Render all pages statically?
- **viz** (*bool, optional*) – Use viz.js as back-end?
- **short_name** (*int, optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str, optional*) – Pool executor to render object.
- **run** (*bool, optional*) – Run the backend server?

Returns
A SiteMap or a Site if .

Return type
schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



set_default_value

Dispatcher.**set_default_value**(*data_id*, *value=empty*, *initial_dist=0.0*)

Set the default value of a data node in the dispatcher.

Parameters

- **data_id** (*str*) – Data node id.
- **value** (*T, optional*) – Data node default value.

  Note: If *EMPTY* the previous default value is removed.

- **initial_dist** (*float, int, optional*) – Initial distance in the ArciDispatch algorithm when the data node default value is used.

Example:

A dispatcher with a data node named *a*:

```
>>> import schedula as sh
>>> dsp = sh.Dispatcher(name='Dispatcher')
...
>>> dsp.add_data(data_id='a')
'a'
```

Add a default value to *a* node:

```
>>> dsp.set_default_value('a', value='value of the data')
>>> list(sorted(dsp.default_values['a'].items()))
[('initial_dist', 0.0), ('value', 'value of the data')]
```

Remove the default value of *a* node:

```
>>> dsp.set_default_value('a', value=sh.EMPTY)
>>> dsp.default_values
{}
```

shrink_dsp

`Dispatcher.shrink_dsp`(*inputs=None*, *outputs=None*, *inputs_dist=None*, *wildcard=True*)

Returns a reduced dispatcher.

Parameters

- **inputs** (*list[str], iterable, optional*) – Input data nodes.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.

Returns
A sub-dispatcher.

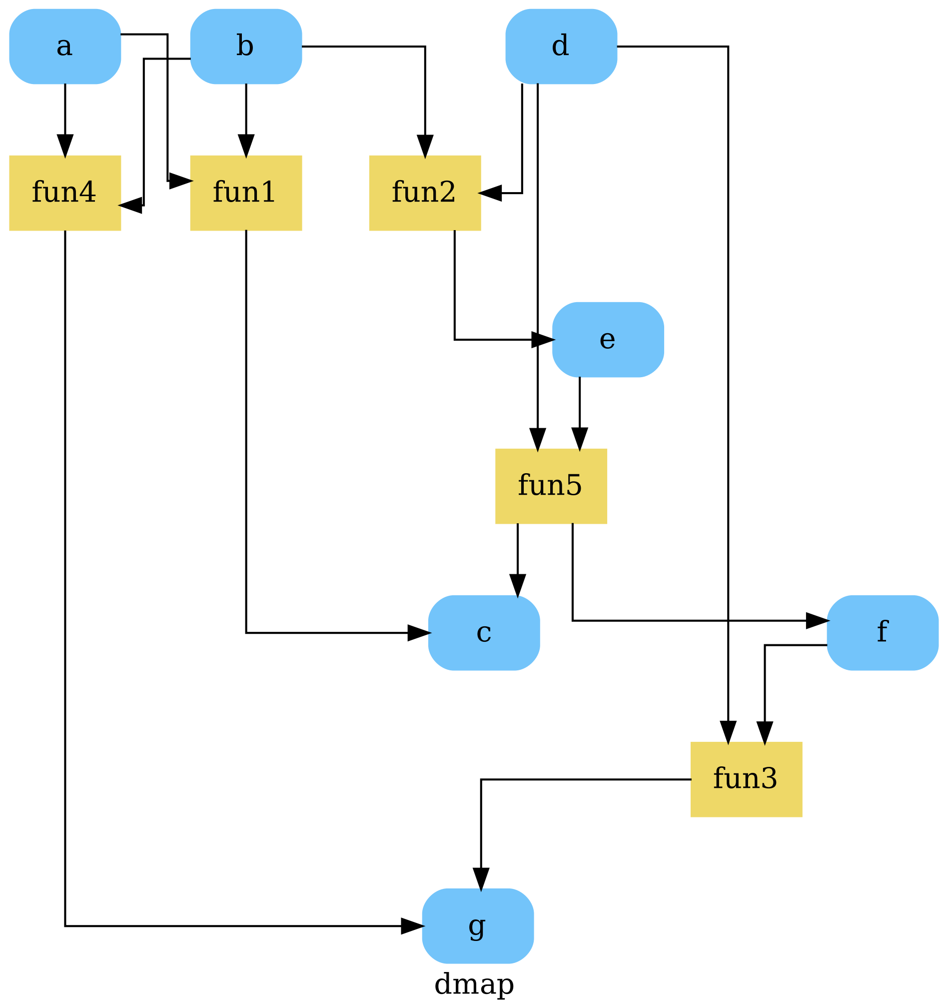
Return type
Dispatcher

See also:

dispatch()

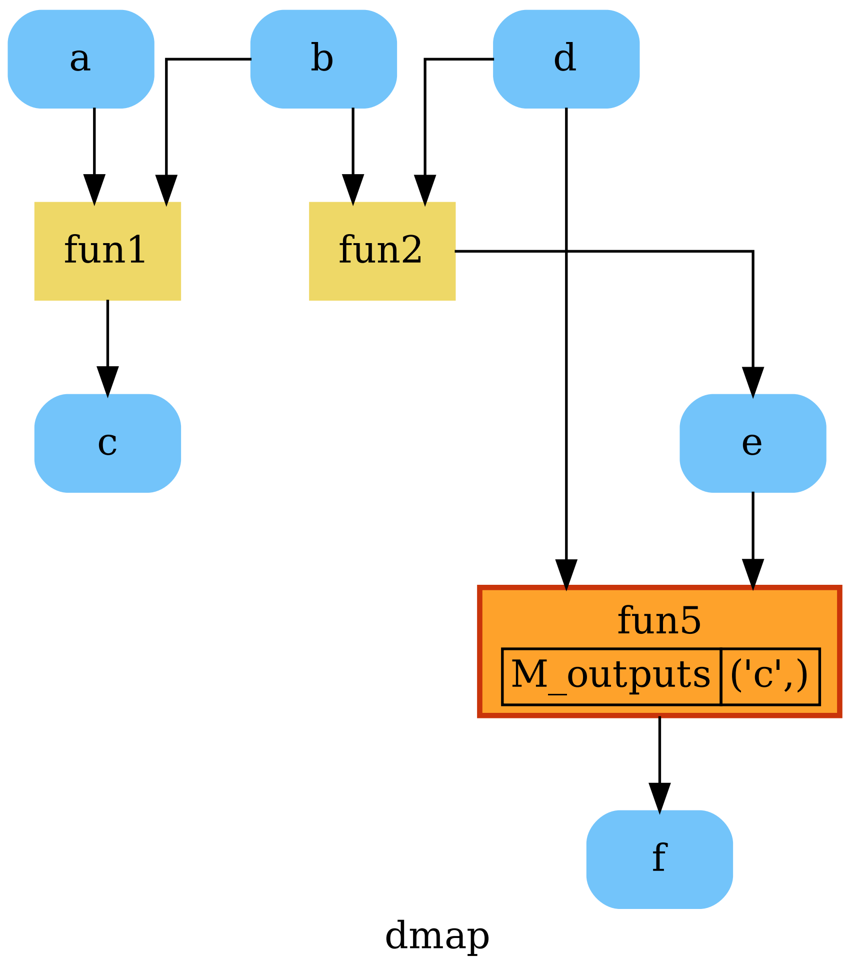
Example:

A dispatcher like this:



Get the sub-dispatcher induced by dispatching with no calls from inputs *a*, *b*, and *c* to outputs *c*, *e*, and *f*:

```
>>> shrink_dsp = dsp.shrink_dsp(inputs=['a', 'b', 'd'],
...                             outputs=['c', 'f'])
```



web

`Dispatcher.web`(*depth=-1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *subsite_idle_timeout=600*)

Creates a dispatcher Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?

- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.

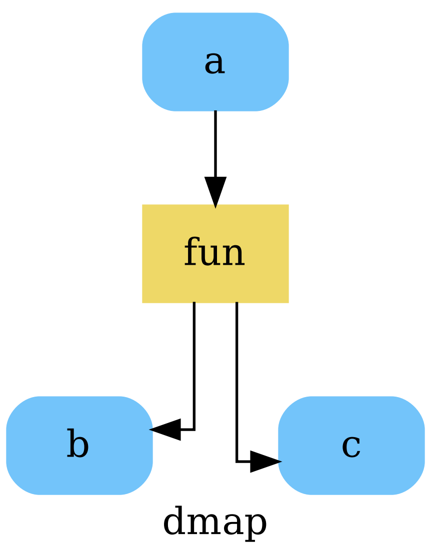
Returns
A WebMap.

Return type
WebMap

Example:

From a dispatcher like this:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
```



You can create a web server with the following steps:

```
>>> print("Starting...\n"); site = dsp.web(); site
Starting...
Site(WebMap([(Dispatcher, WebMap())]), host='localhost', ...)
>>> import requests
>>> url = '%s/%s/%s' % (site.url, dsp.name, fun.__name__)
```

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```
>>> requests.post(url, json={'args': (0,)}).json()['return']
[1, -1]
>>> site.shutdown()  # Remember to shutdown the server.
True
```

Note: When `Site` is garbage collected, the server is shutdown automatically.

`__init__`(*dmap=None*, *name=''*, *default_values=None*, *raises=False*, *description=''*, *executor=False*)

Initializes the dispatcher.

Parameters

- **dmap** (`schedula.utils.graph.DiGraph`, *optional*) – A directed graph that stores data & functions parameters.
- **name** (*str*, *optional*) – The dispatcher's name.
- **default_values** (*dict[str, dict]*, *optional*) – Data node default values. These will be used as input if it is not specified as inputs in the ArciDispatch algorithm.
- **raises** (*bool | callable | str*, *optional*) – If True the dispatcher interrupt the dispatch when an error occur, otherwise if raises != '' it logs a warning. If a callable is given it will be executed passing the exception to decide to raise or not the exception.
- **description** (*str*, *optional*) – The dispatcher's description.
- **executor** (*str*, *optional*) – A pool executor id to dispatch asynchronously or in parallel.

  There are four default Pool executors to dispatch asynchronously or in parallel:

  - *async*: execute all functions asynchronously in the same process,
  - *parallel*: execute all functions in parallel excluding `SubDispatch` functions,
  - *parallel-pool*: execute all functions in parallel using a process pool excluding `SubDispatch` functions,
  - *parallel-dispatch*: execute all functions in parallel including `SubDispatch`.

Attributes

data_nodes	Returns all data nodes of the dispatcher.
function_nodes	Returns all function nodes of the dispatcher.
sub_dsp_nodes	Returns all sub-dispatcher nodes of the dispatcher.
dmap	The directed graph that stores data & functions parameters.
name	The dispatcher's name.
nodes	The function and data nodes of the dispatcher.
default_values	Data node default values.
raises	If True the dispatcher interrupt the dispatch when an error occur.
executor	Pool executor to dispatch asynchronously.
solution	Last dispatch solution.
counter	Counter to set the node index.

data_nodes

property Dispatcher.**data_nodes**

Returns all data nodes of the dispatcher.

Returns
All data nodes of the dispatcher.

Return type
dict[str, dict]

function_nodes

property Dispatcher.**function_nodes**

Returns all function nodes of the dispatcher.

Returns
All data function of the dispatcher.

Return type
dict[str, dict]

sub_dsp_nodes

property Dispatcher.**sub_dsp_nodes**

Returns all sub-dispatcher nodes of the dispatcher.

Returns
All sub-dispatcher nodes of the dispatcher.

Return type
dict[str, dict]

dmap

`Dispatcher.dmap`

The directed graph that stores data & functions parameters.

name

`Dispatcher.name`

The dispatcher's name.

nodes

`Dispatcher.nodes`

The function and data nodes of the dispatcher.

default_values

`Dispatcher.default_values`

Data node default values. These will be used as input if it is not specified as inputs in the ArciDispatch algorithm.

raises

`Dispatcher.raises`

If True the dispatcher interrupt the dispatch when an error occur.

executor

`Dispatcher.executor`

Pool executor to dispatch asynchronously.

solution

`Dispatcher.solution`

Last dispatch solution.

counter

`Dispatcher.counter`

Counter to set the node index.

`dmap`

The directed graph that stores data & functions parameters.

`name`

The dispatcher's name.

nodes
The function and data nodes of the dispatcher.

default_values
Data node default values. These will be used as input if it is not specified as inputs in the ArciDispatch algorithm.

raises
If True the dispatcher interrupt the dispatch when an error occur.

executor
Pool executor to dispatch asynchronously.

solution
Last dispatch solution.

counter
Counter to set the node index.

copy_structure(***kwargs*)
Returns a copy of the Dispatcher structure.

Parameters
kwargs (*dict*) – Additional parameters to initialize the new class.

Returns
A copy of the Dispatcher structure.

Return type
Dispatcher

add_data(*data_id=None*, *default_value=empty*, *initial_dist=0.0*, *wait_inputs=False*, *wildcard=None*, *function=None*, *callback=None*, *description=None*, *filters=None*, *await_result=None*, ***kwargs*)
Add a single data node to the dispatcher.

Parameters

- **data_id** (*str, optional*) – Data node id. If None will be assigned automatically ('unknown<%d>') not in dmap.
- **default_value** (*T, optional*) – Data node default value. This will be used as input if it is not specified as inputs in the ArciDispatch algorithm.
- **initial_dist** (*float, int, optional*) – Initial distance in the ArciDispatch algorithm when the data node default value is used.
- **wait_inputs** (*bool, optional*) – If True ArciDispatch algorithm stops on the node until it gets all input estimations.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **function** (*callable, optional*) – Data node estimation function. This can be any function that takes only one dictionary (key=function node id, value=estimation of data node) as input and return one value that is the estimation of the data node.
- **callback** (*callable, optional*) – Callback function to be called after node estimation. This can be any function that takes only one argument that is the data node estimation output. It does not return anything.
- **description** (*str, optional*) – Data node's description.

- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits data results before assigning them to the solution. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns
Data node id.

Return type
str

See also:

add_func(), *add_function()*, *add_dispatcher()*, *add_from_lists()*

Example:

Add a data to be estimated or a possible input data node:

```
>>> dsp.add_data(data_id='a')
'a'
```

Add a data with a default value (i.e., input data node):

```
>>> dsp.add_data(data_id='b', default_value=1)
'b'
```

Create a data node with function estimation and a default value.

- function estimation: estimate one unique output from multiple estimations.
- default value: is a default estimation.

```
>>> def min_fun(kwargs):
...     '''
...     Returns the minimum value of node estimations.
...
...     :param kwargs:
...         Node estimations.
...     :type kwargs: dict
...
...     :return:
...         The minimum value of node estimations.
...     :rtype: float
...     '''
...
...     return min(kwargs.values())
...
>>> dsp.add_data(data_id='c', default_value=2, wait_inputs=True,
...              function=min_fun)
'c'
```

Create a data with an unknown id and return the generated id:

```
>>> dsp.add_data()
'unknown'
```

add_function(*function_id=None*, *function=None*, *inputs=None*, *outputs=None*, *input_domain=None*, *weight=None*, *inp_weight=None*, *out_weight=None*, *description=None*, *filters=None*, *await_domain=None*, *await_result=None*, ***kwargs*)

Add a single function node to dispatcher.

Parameters

- **function_id** (*str, optional*) – Function node id. If None will be assigned as <fun.__name__>.
- **function** (*callable, optional*) – Data node estimation function.
- **inputs** (*list, optional*) – Ordered arguments (i.e., data node ids) needed by the function.
- **outputs** (*list, optional*) – Ordered results (i.e., data node ids) returned by the function.
- **input_domain** (*callable, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the same inputs of the function and returns True if input values satisfy the domain, otherwise False. In this case the dispatch algorithm doesn't pass on the node.
- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, float | int], optional*) – Edge weights from data nodes to the function node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **out_weight** (*dict[str, float | int], optional*) – Edge weights from the function node to data nodes. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Function node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_domain** (*bool|int|float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits output results before assigning them to the workflow. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns

Function node id.

Return type

str

See also:

add_data(), *add_func()*, *add_dispatcher()*, *add_from_lists()*

Example:

Add a function node:

```
>>> def my_function(a, b):
...     c = a + b
...     d = a - b
...     return c, d
...
>>> dsp.add_function(function=my_function, inputs=['a', 'b'],
...                  outputs=['c', 'd'])
'my_function'
```

Add a function node with domain:

```
>>> from math import log
>>> def my_log(a, b):
...     return log(b - a)
...
>>> def my_domain(a, b):
...     return a < b
...
>>> dsp.add_function(function=my_log, inputs=['a', 'b'],
...                  outputs=['e'], input_domain=my_domain)
'my_log'
```

add_func(*function*, *outputs=None*, *weight=None*, *inputs_defaults=False*, *inputs_kwargs=False*, *filters=None*, *input_domain=None*, *await_domain=None*, *await_result=None*, *inp_weight=None*, *out_weight=None*, *description=None*, *inputs=None*, *function_id=None*, ***kwargs*)

Add a single function node to dispatcher.

Parameters

- **inputs_kwargs** (*bool*) – Do you want to include kwargs as inputs?
- **inputs_defaults** (*bool*) – Do you want to set default values?
- **function_id** (*str, optional*) – Function node id. If None will be assigned as <fun.__name__>.
- **function** (*callable, optional*) – Data node estimation function.
- **inputs** (*list, optional*) – Ordered arguments (i.e., data node ids) needed by the function. If None it will take parameters names from function signature.
- **outputs** (*list, optional*) – Ordered results (i.e., data node ids) returned by the function.
- **input_domain** (*callable, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the same inputs of the function and returns True if input values satisfy the domain, otherwise False. In this case the dispatch algorithm doesn't pass on the node.
- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.

- **inp_weight** (*dict[str, float | int], optional*) – Edge weights from data nodes to the function node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **out_weight** (*dict[str, float | int], optional*) – Edge weights from the function node to data nodes. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Function node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_domain** (*bool|int|float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits output results before assigning them to the workflow. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns
Function node id.

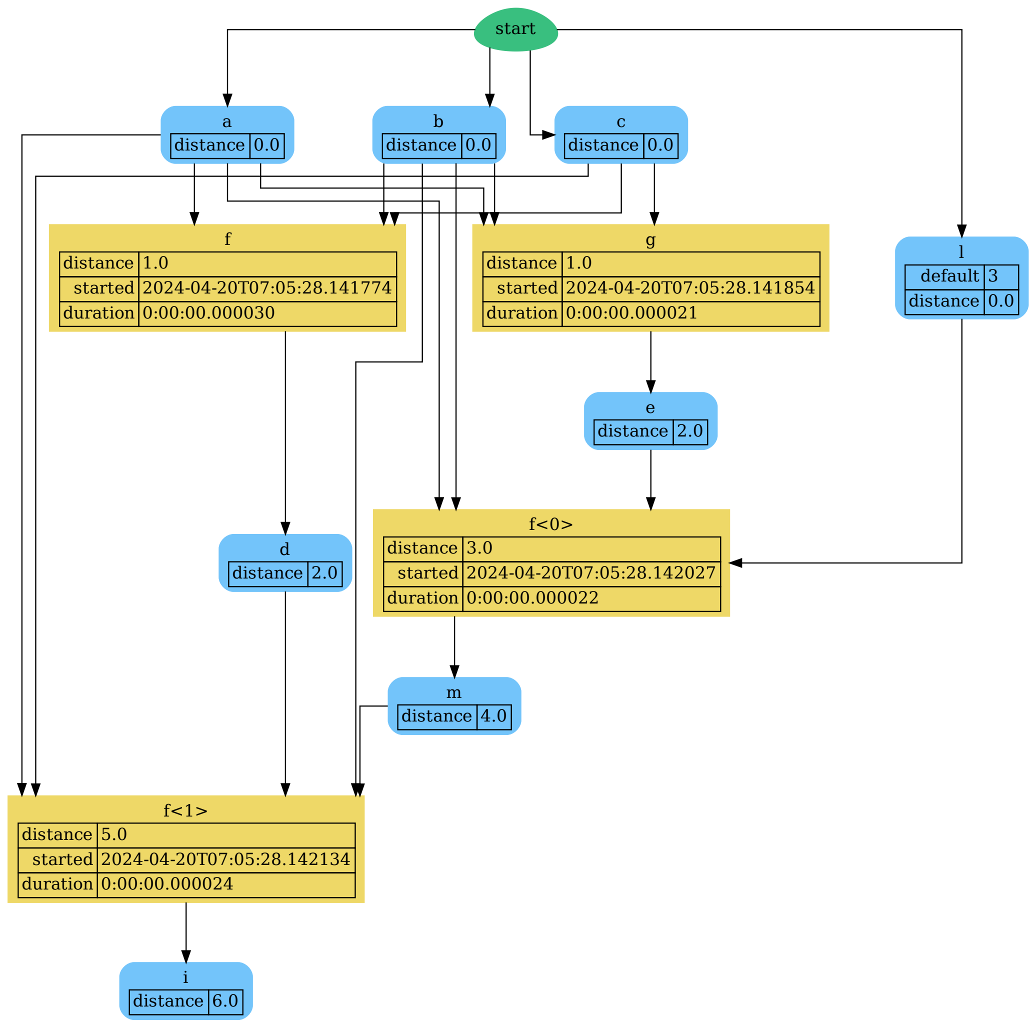
Return type
str

See also:

add_func(), *add_function()*, *add_dispatcher()*, *add_from_lists()*

Example:

```
>>> import schedula as sh
>>> dsp = sh.Dispatcher(name='Dispatcher')
>>> def f(a, b, c, d=3, m=5):
...     return (a + b) - c + d - m
>>> dsp.add_func(f, outputs=['d'])
'f'
>>> dsp.add_func(f, ['m'], inputs_defaults=True, inputs='beal')
'f<0>'
>>> dsp.add_func(f, ['i'], inputs_kwargs=True)
'f<1>'
>>> def g(a, b, c, *args, d=0):
...     return (a + b) * c + d
>>> dsp.add_func(g, ['e'], inputs_defaults=True)
'g'
>>> sol = dsp({'a': 1, 'b': 3, 'c': 0}); sol
Solution([('a', 1), ('b', 3), ('c', 0), ('l', 3), ('d', 2),
          ('e', 0), ('m', 0), ('i', 6)])
```



workflow

add_dispatcher(*dsp*, *inputs=None*, *outputs=None*, *dsp_id=None*, *input_domain=None*, *weight=None*, *inp_weight=None*, *description=None*, *include_defaults=False*, *await_domain=None*, *inputs_prefix=''*, *outputs_prefix=''*, ***kwargs*)

Add a single sub-dispatcher node to dispatcher.

Parameters

- **dsp** (`Dispatcher` | *dict[str, list]*) – Child dispatcher that is added as sub-dispatcher node to the parent dispatcher.
- **inputs** (*dict[str, str | list[str]] | tuple[str] | (str, ..., dict[str, str | list[str]])*) – Inputs mapping. Data node ids from parent dispatcher to child sub-dispatcher. If *None* all child dispatcher nodes are used as inputs.
- **outputs** (*dict[str, str | list[str]] | tuple[str] | (str, ..., dict[str, str | list[str]])*) – Outputs mapping. Data node ids from child sub-dispatcher to parent dispatcher. If *None* all child dispatcher nodes are used as outputs.

- **dsp_id** (*str, optional*) – Sub-dispatcher node id. If None will be assigned as <dsp.name>.
- **input_domain** (*(dict) -> bool, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the a dictionary with the inputs of the sub-dispatcher node and returns True if input values satisfy the domain, otherwise False.

  Note: This function is invoked every time that a data node reach the sub-dispatcher node.

- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, int | float], optional*) – Edge weights from data nodes to the sub-dispatcher node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Sub-dispatcher node's description.
- **include_defaults** (*bool, optional*) – If True the default values of the sub-dispatcher are added to the current dispatcher.
- **await_domain** (*bool|int|float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **inputs_prefix** (*str*) – Add a prefix to parent dispatcher inputs nodes.
- **outputs_prefix** (*str*) – Add a prefix to parent dispatcher outputs nodes.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns
Sub-dispatcher node id.

Return type
str

See also:

add_data(), *add_func()*, *add_function()*, *add_from_lists()*

Example:

Create a sub-dispatcher:

```
>>> sub_dsp = Dispatcher()
>>> sub_dsp.add_function('max', max, ['a', 'b'], ['c'])
'max'
```

Add the sub-dispatcher to the parent dispatcher:

```
>>> dsp.add_dispatcher(dsp_id='Sub-Dispatcher', dsp=sub_dsp,
...                    inputs={'A': 'a', 'B': 'b'},
```

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```
...                    outputs={'c': 'C'})
'Sub-Dispatcher'
```

Add a sub-dispatcher node with domain:

```
>>> def my_domain(kwargs):
...     return kwargs['C'] > 3
...
>>> dsp.add_dispatcher(dsp_id='Sub-Dispatcher with domain',
...                    dsp=sub_dsp, inputs={'C': 'a', 'D': 'b'},
...                    outputs={('c', 'b'): ('E', 'E1')},
...                    input_domain=my_domain)
'Sub-Dispatcher with domain'
```

add_from_lists(*data_list=None*, *fun_list=None*, *dsp_list=None*)

Add multiple function and data nodes to dispatcher.

Parameters

- **data_list** (*list[dict], optional*) – It is a list of data node kwargs to be loaded.
- **fun_list** (*list[dict], optional*) – It is a list of function node kwargs to be loaded.
- **dsp_list** (*list[dict], optional*) – It is a list of sub-dispatcher node kwargs to be loaded.

Returns

- Data node ids.
- Function node ids.
- Sub-dispatcher node ids.

Return type

(list[str], list[str], list[str])

See also:

add_data(), *add_func()*, *add_function()*, *add_dispatcher()*

Example:

Define a data list:

```
>>> data_list = [
...     {'data_id': 'a'},
...     {'data_id': 'b'},
...     {'data_id': 'c'},
... ]
```

Define a functions list:

```
>>> def func(a, b):
...     return a + b
```

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```
...
>>> fun_list = [
...     {'function': func, 'inputs': ['a', 'b'], 'outputs': ['c']}
... ]
```

Define a sub-dispatchers list:

```
>>> sub_dsp = Dispatcher(name='Sub-dispatcher')
>>> sub_dsp.add_function(function=func, inputs=['e', 'f'],
...                      outputs=['g'])
'func'
>>>
>>> dsp_list = [
...     {'dsp_id': 'Sub', 'dsp': sub_dsp,
...      'inputs': {'a': 'e', 'b': 'f'}, 'outputs': {'g': 'c'}},
... ]
```

Add function and data nodes to dispatcher:

```
>>> dsp.add_from_lists(data_list, fun_list, dsp_list)
(['a', 'b', 'c'], ['func'], ['Sub'])
```

set_default_value(*data_id*, *value=empty*, *initial_dist=0.0*)

Set the default value of a data node in the dispatcher.

Parameters

- **data_id** (*str*) – Data node id.
- **value** (*T, optional*) – Data node default value.

  Note: If *EMPTY* the previous default value is removed.

- **initial_dist** (*float, int, optional*) – Initial distance in the ArciDispatch algorithm when the data node default value is used.

Example:

A dispatcher with a data node named *a*:

```
>>> import schedula as sh
>>> dsp = sh.Dispatcher(name='Dispatcher')
...
>>> dsp.add_data(data_id='a')
'a'
```

Add a default value to *a* node:

```
>>> dsp.set_default_value('a', value='value of the data')
>>> list(sorted(dsp.default_values['a'].items()))
[('initial_dist', 0.0), ('value', 'value of the data')]
```

Remove the default value of *a* node:

```
>>> dsp.set_default_value('a', value=sh.EMPTY)
>>> dsp.default_values
{}
```

get_sub_dsp(*nodes_bunch*, *edges_bunch=None*)

Returns the sub-dispatcher induced by given node and edge bunches.

The induced sub-dispatcher contains the available nodes in nodes_bunch and edges between those nodes, excluding those that are in edges_bunch.

The available nodes are non isolated nodes and function nodes that have all inputs and at least one output.

Parameters

- **nodes_bunch** (*list[str], iterable*) – A container of node ids which will be iterated through once.
- **edges_bunch** (*list[(str, str)], iterable, optional*) – A container of edge ids that will be removed.

Returns

A dispatcher.

Return type

Dispatcher

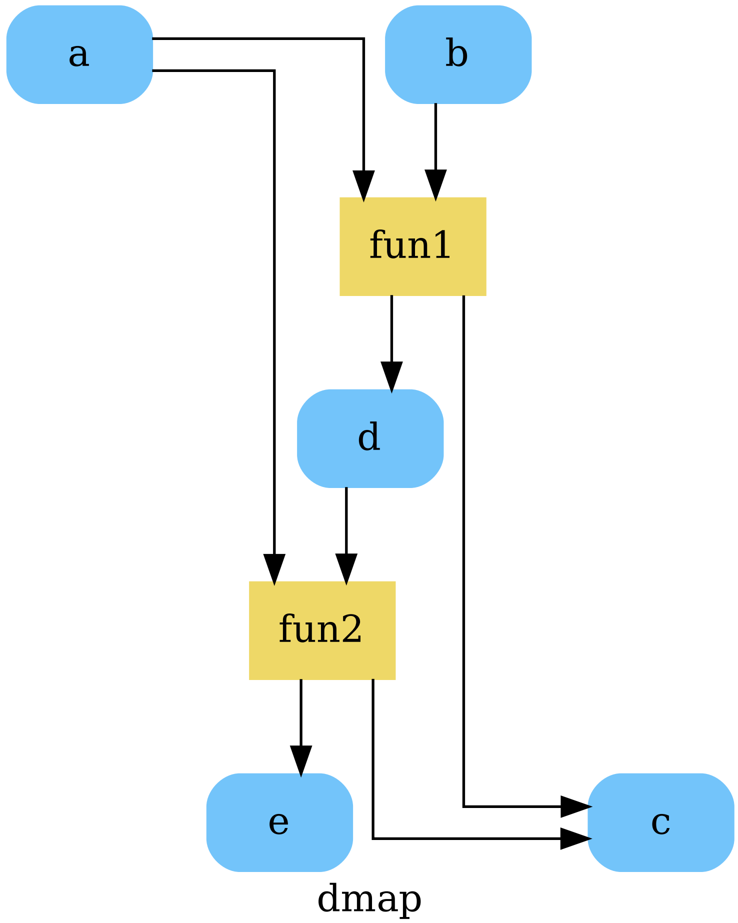
See also:

get_sub_dsp_from_workflow()

Note: The sub-dispatcher edge or node attributes just point to the original dispatcher. So changes to the node or edge structure will not be reflected in the original dispatcher map while changes to the attributes will.

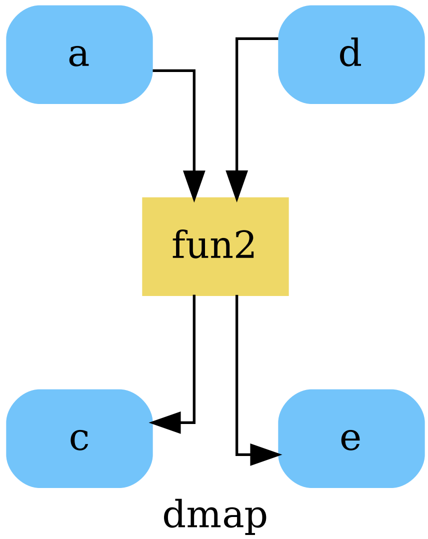
Example:

A dispatcher with a two functions *fun1* and *fun2*:



Get the sub-dispatcher induced by given nodes bunch:

```
>>> sub_dsp = dsp.get_sub_dsp(['a', 'c', 'd', 'e', 'fun2'])
```



get_sub_dsp_from_workflow(*sources*, *graph=None*, *reverse=False*, *add_missing=False*, *check_inputs=True*, *blockers=None*, *wildcard=False*, *_update_links=True*, *avoid_cycles=False*)

Returns the sub-dispatcher induced by the workflow from sources.

The induced sub-dispatcher of the dsp contains the reachable nodes and edges evaluated with breadth-first-search on the workflow graph from source nodes.

Parameters

- **sources** (*list[str], iterable*) – Source nodes for the breadth-first-search. A container of nodes which will be iterated through once.
- **graph** (schedula.utils.graph.DiGraph, *optional*) – A directed graph where evaluate the breadth-first-search.
- **reverse** (*bool, optional*) – If True the workflow graph is assumed as reversed.
- **add_missing** (*bool, optional*) – If True, missing function' inputs are added to the sub-dispatcher.
- **check_inputs** (*bool, optional*) – If True the missing function' inputs are not checked.
- **blockers** (*set[str], iterable, optional*) – Nodes to not be added to the queue.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **_update_links** (*bool, optional*) – If True, it updates remote links of the extracted dispatcher.

Returns
A sub-dispatcher.

Return type
Dispatcher

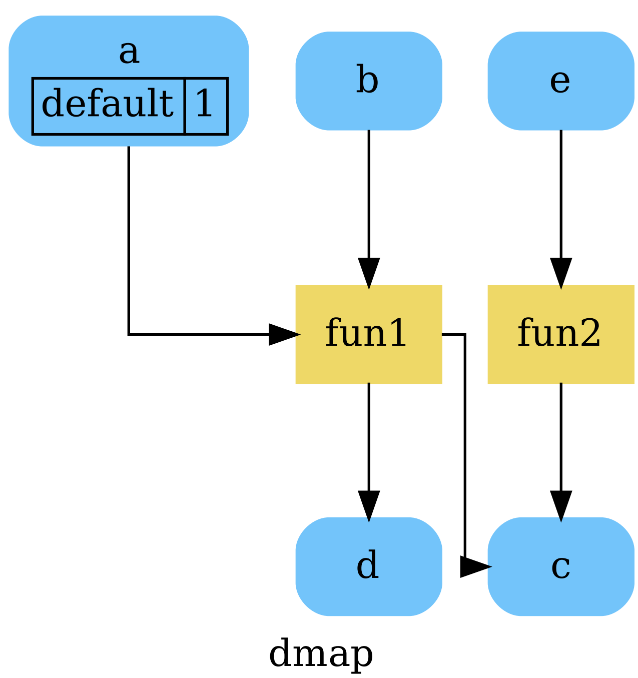
See also:

get_sub_dsp()

Note: The sub-dispatcher edge or node attributes just point to the original dispatcher. So changes to the node or edge structure will not be reflected in the original dispatcher map while changes to the attributes will.

Example:

A dispatcher with a function *fun* and a node *a* with a default value:

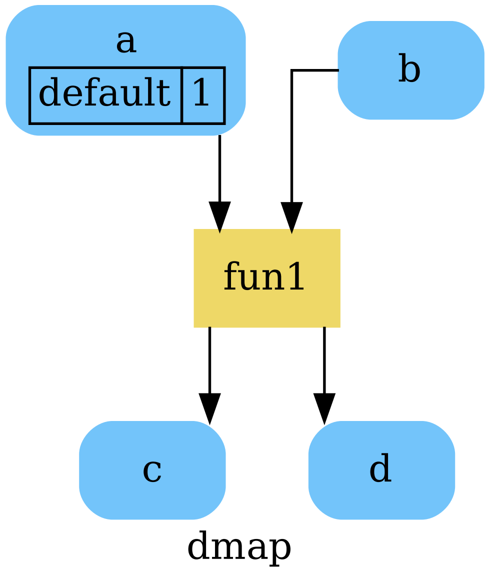


Dispatch with no calls in order to have a workflow:

```
>>> o = dsp.dispatch(inputs=['a', 'b'], no_call=True)
```

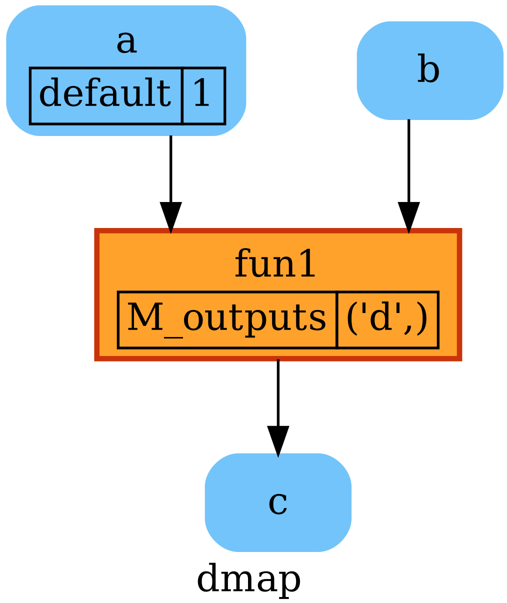
Get sub-dispatcher from workflow inputs *a* and *b*:

```
>>> sub_dsp = dsp.get_sub_dsp_from_workflow(['a', 'b'])
```



Get sub-dispatcher from a workflow output *c*:

```
>>> sub_dsp = dsp.get_sub_dsp_from_workflow(['c'], reverse=True)
```



property data_nodes

Returns all data nodes of the dispatcher.

Returns
All data nodes of the dispatcher.

Return type
dict[str, dict]

property function_nodes

Returns all function nodes of the dispatcher.

Returns
All data function of the dispatcher.

Return type
dict[str, dict]

property sub_dsp_nodes

Returns all sub-dispatcher nodes of the dispatcher.

Returns
All sub-dispatcher nodes of the dispatcher.

Return type
dict[str, dict]

copy()

Returns a deepcopy of the Dispatcher.

Returns
A copy of the Dispatcher.

Return type
Dispatcher

Example:

```
>>> dsp = Dispatcher()
>>> dsp is dsp.copy()
False
```

blue(*memo=None*, *depth=-1*)

Constructs a BlueDispatcher out of the current object.

Parameters

- **memo** (*dict[T,schedula.utils.blue.Blueprint]*) – A dictionary to cache Blueprints.
- **depth** (*int, optional*) – Depth of sub-dispatch blue. If negative all levels are bluprinted.

Returns
A BlueDispatcher of the current object.

Return type
schedula.utils.blue.BlueDispatcher

extend(**blues*, *memo=None*)

Extends Dispatcher calling each deferred operation of given Blueprints.

Parameters

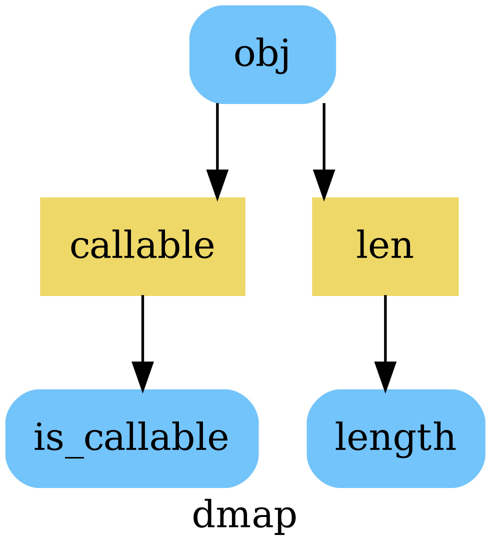
- **blues** (Blueprint | schedula.dispatcher.Dispatcher) – Blueprints or Dispatchers to extend deferred operations.
- **memo** (*dict[T,schedula.utils.blue.Blueprint|Dispatcher]*) – A dictionary to cache Blueprints and Dispatchers.

Returns
Self.

Return type
Dispatcher

Example:

```
>>> import schedula as sh
>>> dsp = sh.Dispatcher()
>>> dsp.add_func(callable, ['is_callable'])
'callable'
>>> blue = sh.BlueDispatcher().add_func(len, ['length'])
>>> dsp = sh.Dispatcher().extend(dsp, blue)
```



dispatch(*inputs=None*, *outputs=None*, *inputs_dist=None*, *wildcard=False*, *no_call=False*, *shrink=False*, *rm_unused_nds=False*, *select_output_kw=None*, *_wait_in=None*, *stopper=None*, *executor=False*, *sol_name=()*, *verbose=False*)

Evaluates the minimum workflow and data outputs of the dispatcher model from given inputs.

Parameters

- **inputs** (*dict[str, T], list[str], iterable, optional*) – Input data values.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **no_call** (*bool, optional*) – If True data node estimation function is not used and the input values are not used.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.

  See also:

  shrink_dsp()
- **rm_unused_nds** (*bool, optional*) – If True unused function and sub-dispatcher nodes are removed from workflow.
- **select_output_kw** (*dict, optional*) – Kwargs of selector function to select specific outputs.
- **_wait_in** (*dict, optional*) – Override wait inputs.

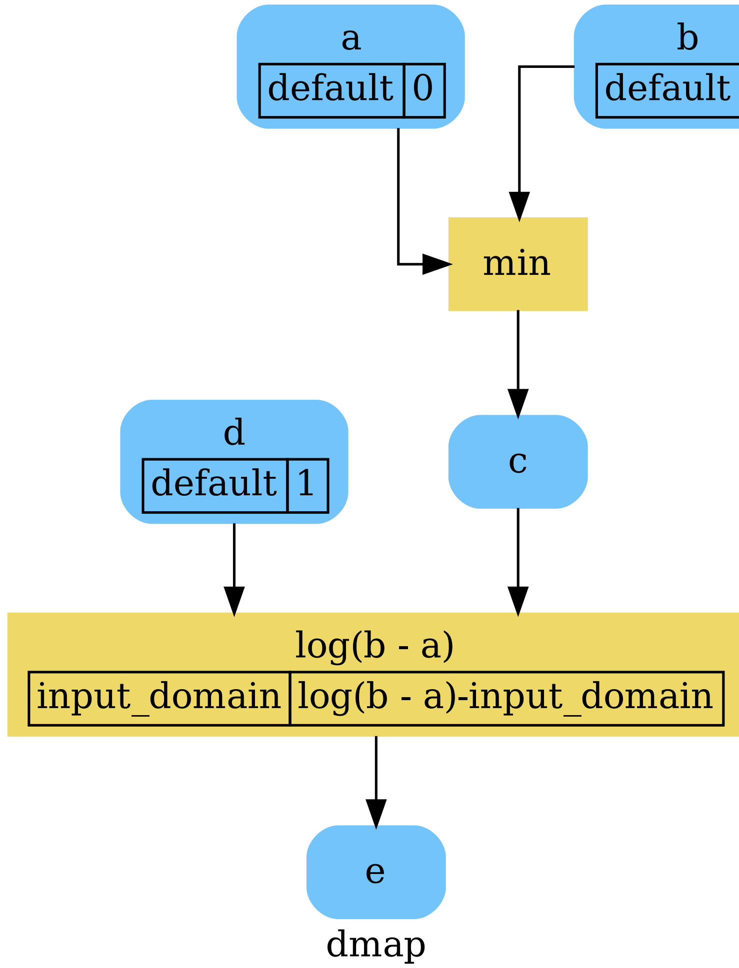
- **stopper** (*multiprocess.Event, optional*) – A semaphore to abort the dispatching.
- **executor** (*str, optional*) – A pool executor id to dispatch asynchronously or in parallel.
- **sol_name** (*tuple[str], optional*) – Solution name.
- **verbose** (*str, optional*) – If True the dispatcher will log start and end of each function.

Returns
Dictionary of estimated data node outputs.

Return type
schedula.utils.sol.Solution

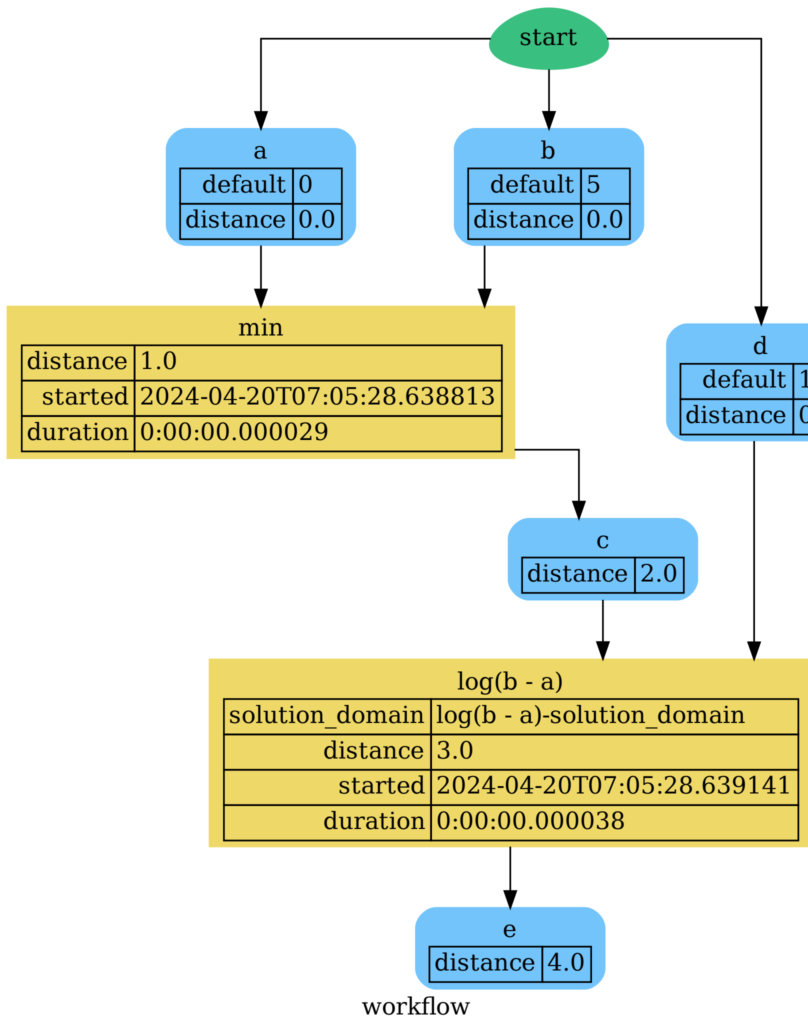
Example:

A dispatcher with a function $log(b - a)$ and two data a and b with default values:



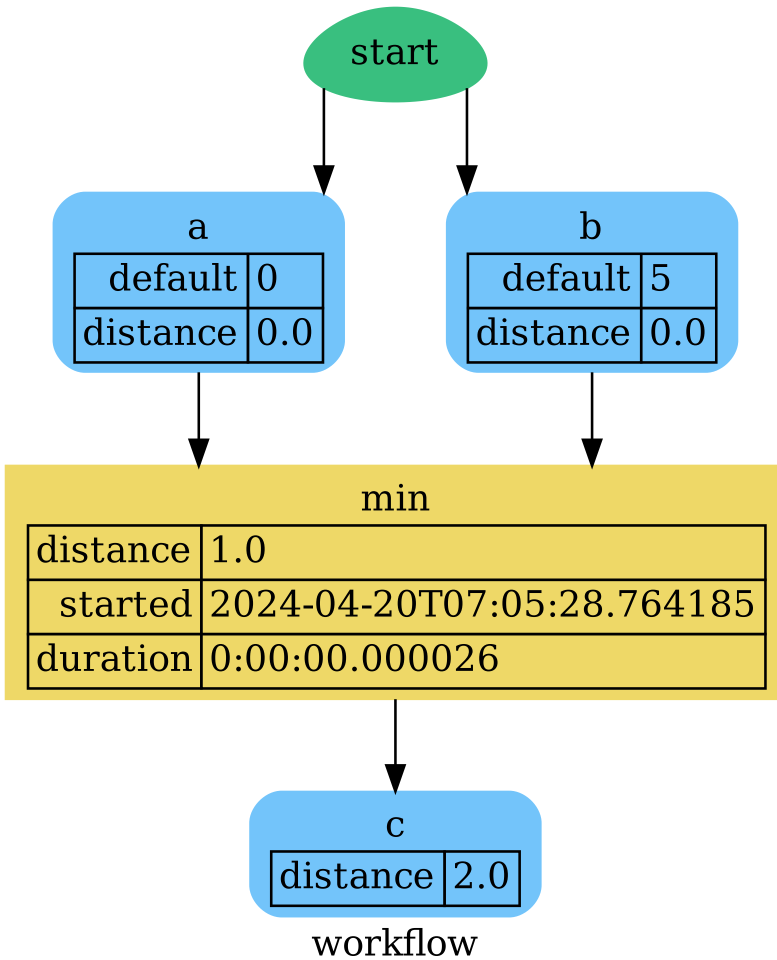
Dispatch without inputs. The default values are used as inputs:

```
>>> outputs = dsp.dispatch()
>>> outputs
Solution([('a', 0), ('b', 5), ('d', 1), ('c', 0), ('e', 0.0)])
```



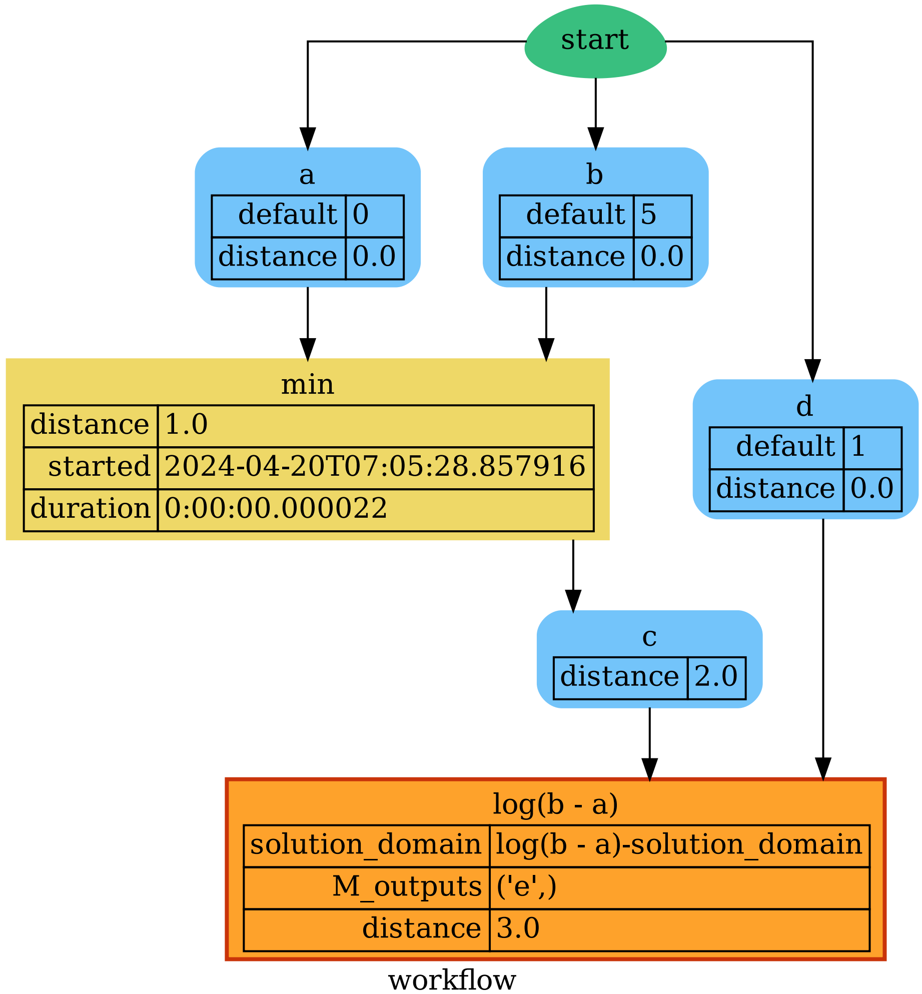
Dispatch until data node *c* is estimated:

```
>>> outputs = dsp.dispatch(outputs=['c'])
>>> outputs
Solution([('a', 0), ('b', 5), ('c', 0)])
```



Dispatch with one inputs. The default value of *a* is not used as inputs:

```
>>> outputs = dsp.dispatch(inputs={'a': 3})
>>> outputs
Solution([('a', 3), ('b', 5), ('d', 1), ('c', 3)])
```



shrink_dsp(*inputs=None*, *outputs=None*, *inputs_dist=None*, *wildcard=True*)

Returns a reduced dispatcher.

Parameters

- **inputs** (*list[str], iterable, optional*) – Input data nodes.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.

Returns

A sub-dispatcher.

Return type

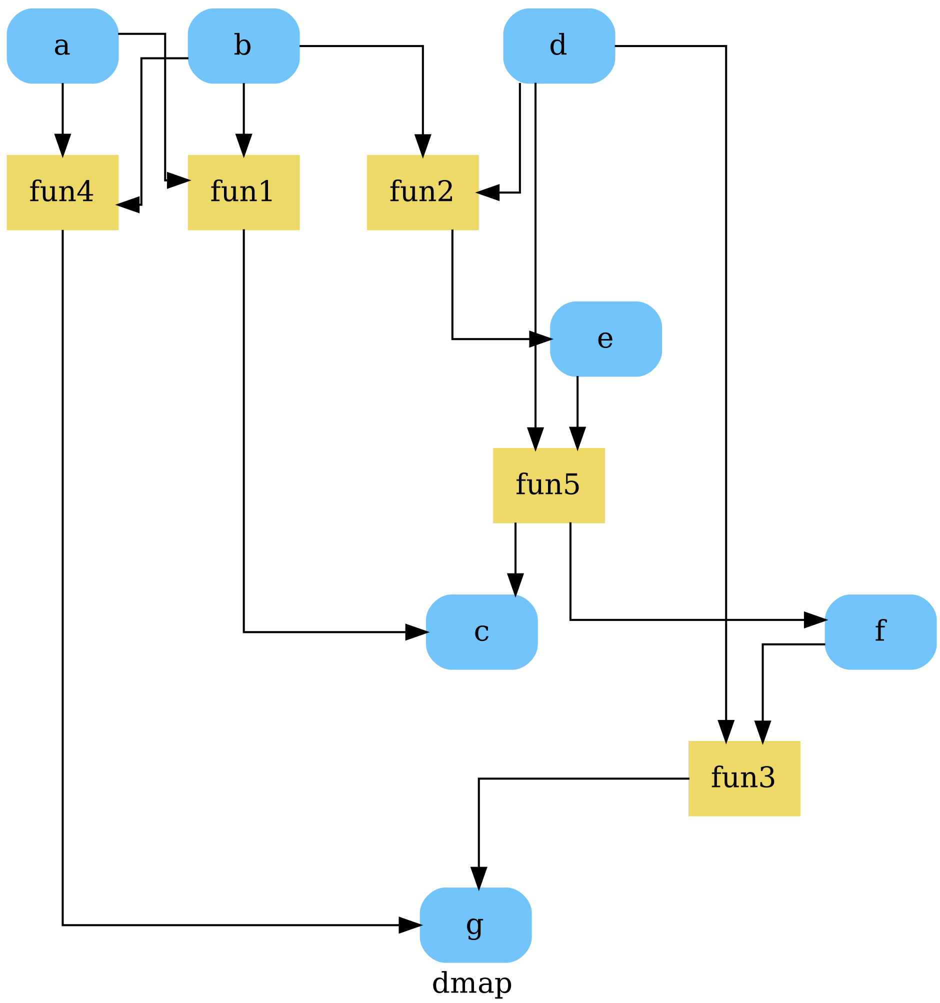
Dispatcher

See also:

dispatch()

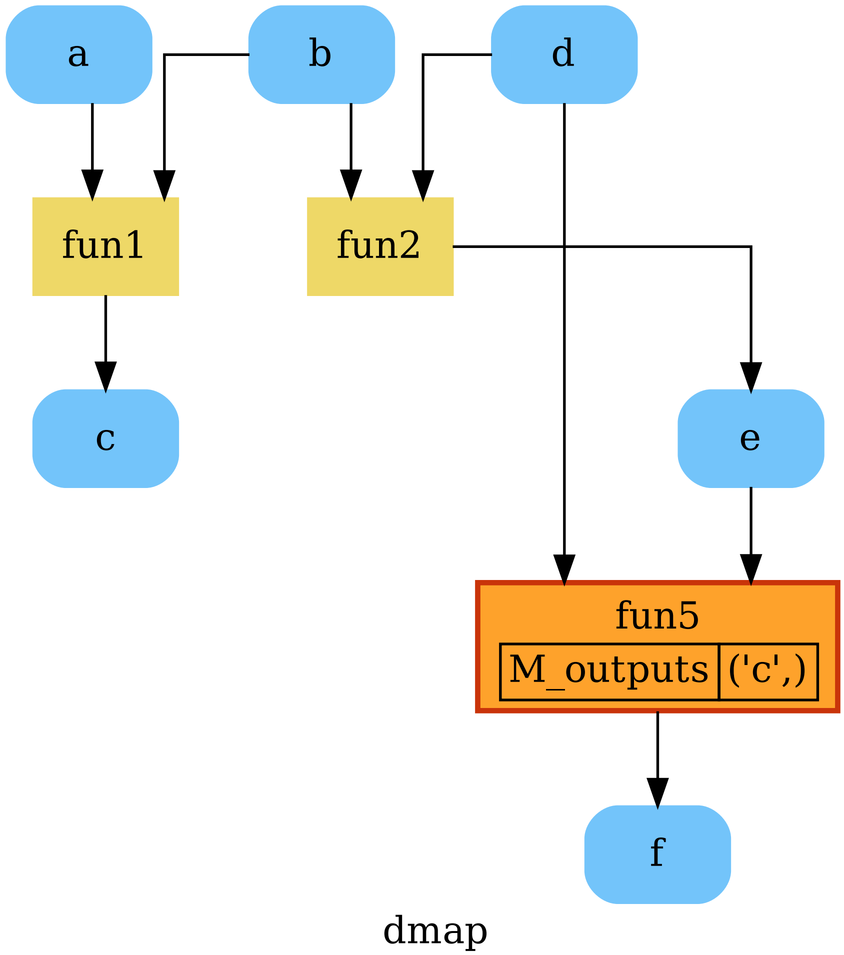
Example:

A dispatcher like this:



Get the sub-dispatcher induced by dispatching with no calls from inputs *a*, *b*, and *c* to outputs *c*, *e*, and *f*:

```
>>> shrink_dsp = dsp.shrink_dsp(inputs=['a', 'b', 'd'],
...                              outputs=['c', 'f'])
```



7.2 utils

It contains utility classes and functions.

The utils module contains classes and functions of general utility used in multiple places throughout *schedula*. Some of these are graph-specific algorithms while others are more python tricks.

The utils module is composed of submodules to make organization clearer. The submodules are fairly different from each other, but the main uniting theme is that all of these submodules are not specific to a particularly schedula application.

Note: The `utils` module is composed of submodules that can be accessed separately. However, they are all also included in the base module. Thus, as an example, schedula.utils.gen.Token and schedula.utils.Token are different names for the same class (Token). The schedula.utils.Token usage is preferred as this allows the internal organization to be changed if it is deemed necessary.

Sub-Modules:

alg	It contains basic algorithms, numerical tricks, and data processing tasks.
asy	It contains functions to dispatch asynchronously and in parallel.
base	It provides a base class for dispatcher objects.
blue	It provides a Blueprint class to construct a Dispatcher and SubDispatch objects.
cst	It provides constants data node ids and values.
des	It provides tools to find data, function, and sub-dispatcher node description.
drw	It provides functions to plot dispatcher map and work-flow.
dsp	It provides tools to create models with the *Dispatcher*.
exc	Defines the dispatcher exception.
form	It provides functions to build a form flask app from a dispatcher.
gen	It contains classes and functions of general utility.
graph	It contains the *DiGraph* class.
imp	Fixes ImportError for MicroPython.
io	It provides functions to read and save a dispatcher from/to files.
sol	It provides a solution class for dispatch result.
utl	It provides some utility functions.
web	It provides functions to build a flask app from a dispatcher.

7.2.1 alg

It contains basic algorithms, numerical tricks, and data processing tasks.

Functions

add_func_edges	Adds function node edges.
get_full_pipe	Returns the full pipe of a dispatch run.
get_sub_node	Returns a sub node of a dispatcher.

add_func_edges

add_func_edges(*dsp*, *fun_id*, *nodes_bunch*, *edge_weights=None*, *input=True*, *data_nodes=None*)

Adds function node edges.

Parameters

- **dsp** (*schedula.Dispatcher*) – A dispatcher that identifies the model adopted.
- **fun_id** (*str*) – Function node id.
- **nodes_bunch** (*iterable*) – A container of nodes which will be iterated through once.
- **edge_weights** (*dict, optional*) – Edge weights.
- **input** (*bool, optional*) – If True the nodes_bunch are input nodes, otherwise are output nodes.
- **data_nodes** (*list*) – Data nodes to be deleted if something fail.

Returns

List of new data nodes.

Return type

list

get_full_pipe

get_full_pipe(*sol*, *base=()*)

Returns the full pipe of a dispatch run.

Parameters

- **sol** (*schedula.utils.Solution*) – A Solution object.
- **base** (*tuple[str]*) – Base node id.

Returns

Full pipe of a dispatch run.

Return type

DspPipe

get_sub_node

get_sub_node(*dsp*, *path*, *node_attr='auto'*, *solution=none*, *_level=0*, *_dsp_name=none*)

Returns a sub node of a dispatcher.

Parameters

- **dsp** (*schedula.Dispatcher | SubDispatch*) – A dispatcher object or a sub dispatch function.
- **path** (*tuple, str*) – A sequence of node ids or a single node id. Each id identifies a sub-level node.
- **node_attr** (*str | None*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  - for data node: its output, and if not exists, all its attributes.

  - for function and sub-dispatcher nodes: the 'function' attribute.
- **solution** (*schedula.utils.Solution*) – Parent Solution.
- **_level** (*int*) – Path level.
- **_dsp_name** (*str*) – dsp name to show when the function raise a value error.

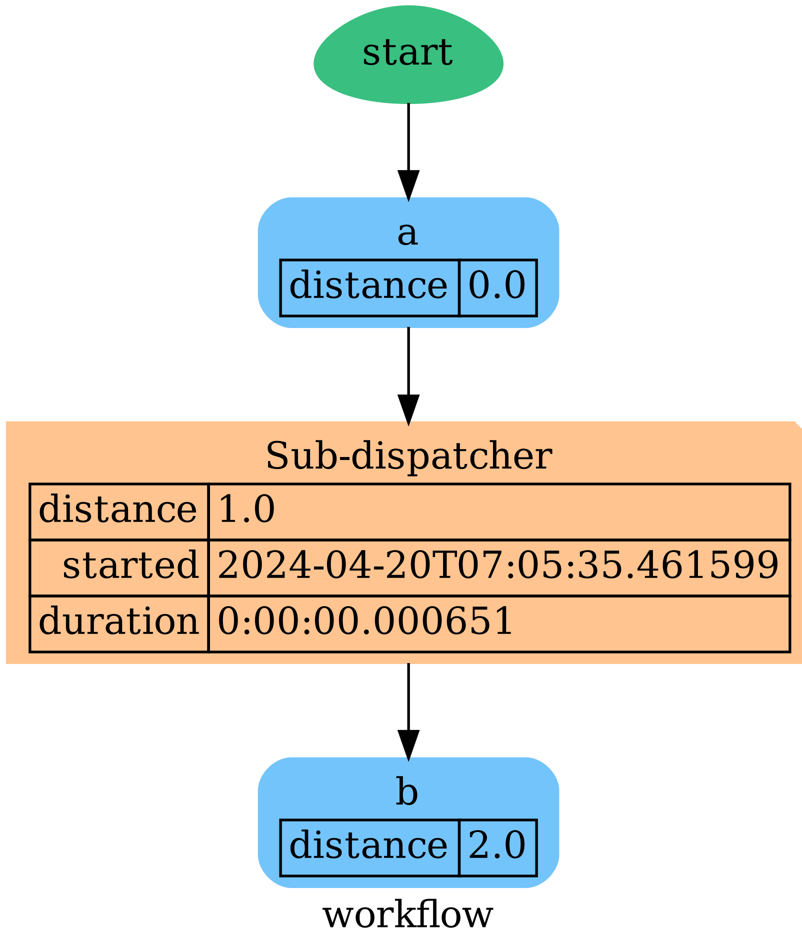
Returns
A sub node of a dispatcher and its path.

Return type
dict | object, tuple[str]

Example:

```
>>> from schedula import Dispatcher
>>> s_dsp = Dispatcher(name='Sub-dispatcher')
>>> def fun(a, b):
...     return a + b
...
>>> s_dsp.add_function('a + b', fun, ['a', 'b'], ['c'])
'a + b'
>>> dispatch = SubDispatch(s_dsp, ['c'], output_type='dict')
>>> dsp = Dispatcher(name='Dispatcher')
>>> dsp.add_function('Sub-dispatcher', dispatch, ['a'], ['b'])
'Sub-dispatcher'
```

```
>>> o = dsp.dispatch(inputs={'a': {'a': 3, 'b': 1}})
...
```

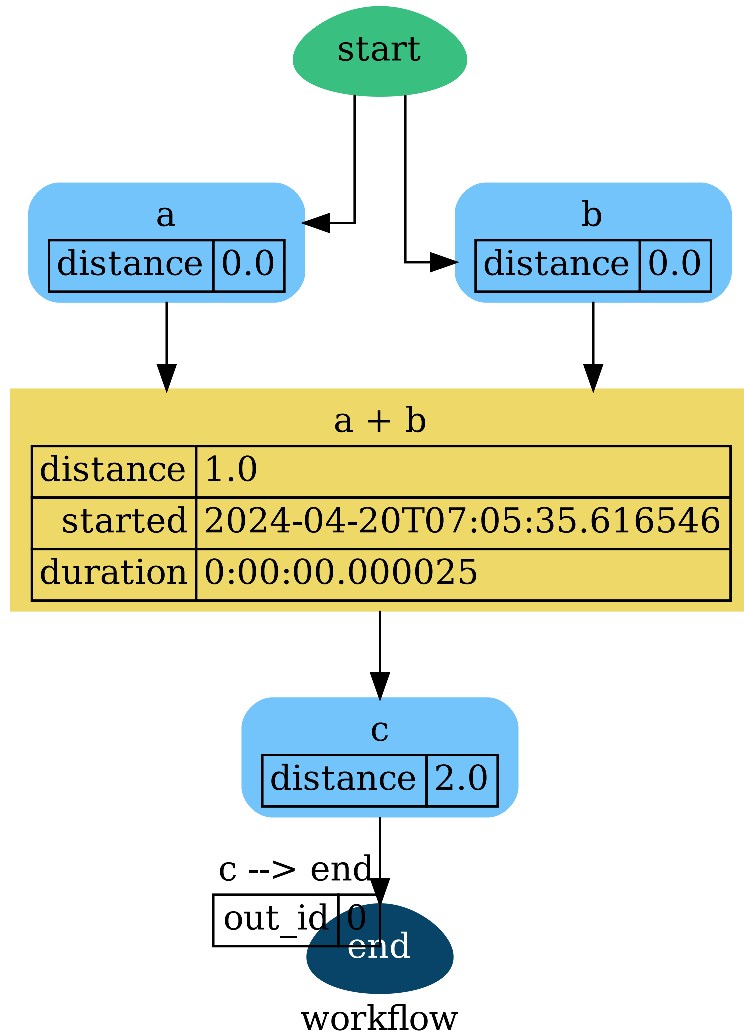


Get the sub node 'c' output or type:

```
>>> get_sub_node(dsp, ('Sub-dispatcher', 'c'))
(4, ('Sub-dispatcher', 'c'))
>>> get_sub_node(dsp, ('Sub-dispatcher', 'c'), node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

Get the sub-dispatcher output:

```
>>> sol, p = get_sub_node(dsp, ('Sub-dispatcher',), node_attr='output')
>>> sol, p
(Solution([('a', 3), ('b', 1), ('c', 4)]), ('Sub-dispatcher',))
```



Classes

DspPipe

DspPipe

class DspPipe

Methods

__init__	
clear	
copy	
fromkeys	Create a new ordered dictionary with keys from iterable and values set to value.
get	Return the value for key if key is in the dictionary, else default.
items	
keys	
move_to_end	Move an existing element to the end (or beginning if last is false).
pop	If the key is not found, return the default if given; otherwise, raise a KeyError.
popitem	Remove and return a (key, value) pair from the dictionary.
setdefault	Insert key with a value of default if key is in the dictionary.
update	If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]
values	

__init__

DspPipe.**__init__**(**args*, ***kwargs*)

clear

DspPipe.**clear**() → None. Remove all items from od.

copy

`DspPipe.copy()` → a shallow copy of od

fromkeys

`DspPipe.fromkeys(value=None)`

Create a new ordered dictionary with keys from iterable and values set to value.

get

`DspPipe.get(key, default=None, /)`

Return the value for key if key is in the dictionary, else default.

items

`DspPipe.items()` → a set-like object providing a view on D's items

keys

`DspPipe.keys()` → a set-like object providing a view on D's keys

move_to_end

`DspPipe.move_to_end(key, last=True)`

Move an existing element to the end (or beginning if last is false).

Raise KeyError if the element does not exist.

pop

`DspPipe.pop(key[, default])` → v, remove specified key and return the corresponding value.

If the key is not found, return the default if given; otherwise, raise a KeyError.

popitem

`DspPipe.popitem(last=True)`

Remove and return a (key, value) pair from the dictionary.

Pairs are returned in LIFO order if last is true or FIFO order if false.

setdefault

`DspPipe.setdefault(key, default=None)`

Insert key with a value of default if key is not in the dictionary.

Return the value for key if key is in the dictionary, else default.

update

`DspPipe.update([E, ]**F)` → None. Update D from dict/iterable E and F.

If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]

values

`DspPipe.values()` → an object providing a view on D's values

`__init__(*args, **kwargs)`

7.2.2 asy

It contains functions to dispatch asynchronously and in parallel.

Sub-Modules:

executors	It defines the executors classes.
factory	It defines the *ExecutorFactory* class.

executors

It defines the executors classes.

Classes

Executor	Base Executor
PoolExecutor	General PoolExecutor to dispatch asynchronously and in parallel.
ProcessExecutor	Process Executor
ProcessPoolExecutor	Process Pool Executor
ThreadExecutor	Multi Thread Executor

Executor

class Executor

Base Executor

Methods

__init__	
shutdown	
submit	

__init__

Executor.**__init__**()

shutdown

Executor.**shutdown**(*wait=True*)

submit

Executor.**submit**(*func*, **args*, ***kwargs*)

__init__()

PoolExecutor

class PoolExecutor(*thread_executor*, *process_executor=None*, *parallel=None*)

General PoolExecutor to dispatch asynchronously and in parallel.

Methods

__init__	**param thread_executor**
add_future	
get_futures	
process	
process_funcs	
shutdown	
thread	
wait	

__init__

PoolExecutor.**__init__**(*thread_executor*, *process_executor=None*, *parallel=None*)

Parameters

- **thread_executor** (ThreadExecutor) – Thread pool executor to dispatch asynchronously.
- **process_executor** (ProcessExecutor | ProcessPoolExecutor) – Process pool executor to execute in parallel the functions calls.
- **parallel** (*bool*) – Run *_process_funcs* in parallel.

add_future

PoolExecutor.**add_future**(*sol_id*, *fut*)

get_futures

PoolExecutor.**get_futures**(*sol_id=empty*)

process

PoolExecutor.**process**(*sol_id*, *fn*, **args*, ***kwargs*)

process_funcs

PoolExecutor.**process_funcs**(*exe_id*, *funcs*, **args*, ***kw*)

shutdown

PoolExecutor.**shutdown**(*wait=True*)

thread

PoolExecutor.**thread**(*sol_id*, **args*, ***kwargs*)

wait

PoolExecutor.**wait**(*timeout=None*)

__init__(*thread_executor*, *process_executor=None*, *parallel=None*)

Parameters

- **thread_executor** (ThreadExecutor) – Thread pool executor to dispatch asynchronously.
- **process_executor** (ProcessExecutor | ProcessPoolExecutor) – Process pool executor to execute in parallel the functions calls.
- **parallel** (*bool*) – Run *_process_funcs* in parallel.

ProcessExecutor

class **ProcessExecutor**(**args*, ***state*)

Process Executor

Methods

__init__
init
shutdown
submit

__init__

ProcessExecutor.**__init__**(**args*, ***state*)

init

ProcessExecutor.**init**()

shutdown

ProcessExecutor.**shutdown**(*wait=True*)

submit

ProcessExecutor.**submit**(*func*, **args*, ***kwargs*)

__init__(**args*, ***state*)

ProcessPoolExecutor

class ProcessPoolExecutor(**args*, ***state*)

Process Pool Executor

Methods

__init__
init
shutdown
submit

__init__

ProcessPoolExecutor.**__init__**(**args*, ***state*)

init

ProcessPoolExecutor.**init**()

shutdown

ProcessPoolExecutor.**shutdown**(*wait=True*)

submit

ProcessPoolExecutor.**submit**(*func*, **args*, ***kwargs*)

__init__(**args*, ***state*)

ThreadExecutor

class ThreadExecutor

Multi Thread Executor

Methods

__init__
shutdown
submit

__init__

ThreadExecutor.**__init__**()

shutdown

ThreadExecutor.**shutdown**(*wait=True*)

submit

`ThreadExecutor.submit(func, *args, **kwargs)`

`__init__()`

factory

It defines the *ExecutorFactory* class.

Classes

ExecutorFactory

ExecutorFactory

`class ExecutorFactory(*args, **kwargs)`

Methods

__init__	
clear	
copy	
executor_id	
fromkeys	Create a new dictionary with keys from iterable and values set to value.
get	Return the value for key if key is in the dictionary, else default.
get_executor	
items	
keys	
pop	If the key is not found, return the default if given; otherwise, raise a KeyError.
pop_active	
popitem	Remove and return a (key, value) pair as a 2-tuple.
set_active	
set_executor	
setdefault	Insert key with a value of default if key is not in the dictionary.
shutdown_executor	
update	If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]
values	

__init__

ExecutorFactory.**__init__**(**args*, ***kwargs*)

clear

ExecutorFactory.**clear**() → None. Remove all items from D.

copy

ExecutorFactory.**copy**() → a shallow copy of D

executor_id

static ExecutorFactory.**executor_id**(*name*, *sol*)

fromkeys

ExecutorFactory.**fromkeys**(*value=None*, */*)

Create a new dictionary with keys from iterable and values set to value.

get

ExecutorFactory.**get**(*key*, *default=None*, */*)

Return the value for key if key is in the dictionary, else default.

get_executor

ExecutorFactory.**get_executor**(*exe_id*)

items

ExecutorFactory.**items**() → a set-like object providing a view on D's items

keys

ExecutorFactory.**keys**() → a set-like object providing a view on D's keys

pop

`ExecutorFactory.pop(k[, d])` → v, remove specified key and return the corresponding value.

If the key is not found, return the default if given; otherwise, raise a KeyError.

pop_active

`ExecutorFactory.pop_active(sol_id)`

popitem

`ExecutorFactory.popitem()`

Remove and return a (key, value) pair as a 2-tuple.

Pairs are returned in LIFO (last-in, first-out) order. Raises KeyError if the dict is empty.

set_active

`ExecutorFactory.set_active(sol_id, value=True)`

set_executor

`ExecutorFactory.set_executor(name, value)`

setdefault

`ExecutorFactory.setdefault(key, default=None, /)`

Insert key with a value of default if key is not in the dictionary.

Return the value for key if key is in the dictionary, else default.

shutdown_executor

`ExecutorFactory.shutdown_executor(name=empty, sol_id=empty, wait=True)`

update

`ExecutorFactory.update([E, ]**F)` → None. Update D from dict/iterable E and F.

If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]

values

`ExecutorFactory.values()` → an object providing a view on D's values

`__init__(*args, **kwargs)`

Functions

async_process	Execute *func(*args)* in an asynchronous parallel process.
async_thread	Execute *sol._evaluate_node* in an asynchronous thread.
atexit_register	
await_result	Return the result of a *Future* object.
register_executor	Register a new executor type.
shutdown_executor	Clean-up the resources associated with the Executor.
shutdown_executors	Clean-up the resources of all initialized executors.

async_process

async_process(*funcs*, **args*, *executor=False*, *sol=None*, *callback=None*, ***kw*)

Execute *func(*args)* in an asynchronous parallel process.

Parameters

- **funcs** (*list[callable]*) – Functions to be executed.
- **args** (*tuple*) – Arguments to be passed to first function call.
- **executor** (*str | bool*) – Pool executor to run the function.
- **sol** (schedula.utils.sol.Solution) – Parent solution.
- **callback** (*callable*) – Callback function to be called after all function execution.
- **kw** (*dict*) – Keywords to be passed to first function call.

Returns

Functions result.

Return type

object

async_thread

async_thread(*sol*, *args*, *node_attr*, *node_id*, **a*, ***kw*)

Execute *sol._evaluate_node* in an asynchronous thread.

Parameters

- **sol** (schedula.utils.sol.Solution) – Solution to be updated.
- **args** (*tuple*) – Arguments to be passed to node calls.
- **node_attr** (*dict*) – Dictionary of node attributes.
- **node_id** (*str*) – Data or function node id.

- **a** (*tuple*) – Extra args to invoke *sol._evaluate_node*.
- **kw** (*dict*) – Extra kwargs to invoke *sol._evaluate_node*.

Returns
Function result.

Return type
concurrent.futures.Future | *AsyncList*

atexit_register

atexit_register(**args*, ***kwargs*)

await_result

await_result(*obj*, *timeout=None*)

Return the result of a *Future* object.

Parameters

- **obj** (*concurrent.futures.Future | object*) – Value object.
- **timeout** (*int*) – The number of seconds to wait for the result if the future isn't done. If None, then there is no limit on the wait time.

Returns
Result.

Return type
object

Example:

```
>>> from concurrent.futures import Future
>>> fut = Future()
>>> fut.set_result(3)
>>> await_result(fut), await_result(4)
(3, 4)
```

register_executor

register_executor(*name*, *init*, *executors=None*)

Register a new executor type.

Parameters

- **name** (*str*) – Executor name.
- **init** (*callable*) – Function to initialize the executor.
- **executors** (ExecutorFactory) – Executor factory.

shutdown_executor

shutdown_executor(*name=empty*, *sol_id=empty*, *wait=True*, *executors=None*)

Clean-up the resources associated with the Executor.

Parameters

- **name** (*str*) – Executor name.
- **sol_id** (*int*) – Solution id.
- **wait** (*bool*) – If True then shutdown will not return until all running futures have finished executing and the resources used by the executor have been reclaimed.
- **executors** (ExecutorFactory) – Executor factory.

Returns

Shutdown pool executor.

Return type

dict[concurrent.futures.Future,Thread|Process]

shutdown_executors

shutdown_executors(*wait=True*, *executors=None*)

Clean-up the resources of all initialized executors.

Parameters

- **wait** (*bool*) – If True then shutdown will not return until all running futures have finished executing and the resources used by the executors have been reclaimed.
- **executors** (ExecutorFactory) – Executor factory.

Returns

Shutdown pool executor.

Return type

dict[str,dict]

Classes

AsyncList	List of asynchronous results.

AsyncList

class AsyncList(***, *future=None*, *n=1*)

List of asynchronous results.

Methods

__init__	
append	Append object to the end of the list.
clear	Remove all items from list.
copy	Return a shallow copy of the list.
count	Return number of occurrences of value.
extend	Extend list by appending elements from the iterable.
index	Return first index of value.
insert	Insert object before index.
pop	Remove and return item at index (default last).
remove	Remove first occurrence of value.
reverse	Reverse *IN PLACE*.
sort	Sort the list in ascending order and return None.

__init__

AsyncList.**__init__**(*, *future=None*, *n=1*)

append

AsyncList.**append**(*object*, /)

Append object to the end of the list.

clear

AsyncList.**clear**()

Remove all items from list.

copy

AsyncList.**copy**()

Return a shallow copy of the list.

count

AsyncList.**count**(*value*, /)

Return number of occurrences of value.

extend

`AsyncList.extend(iterable, /)`

Extend list by appending elements from the iterable.

index

`AsyncList.index(value, start=0, stop=9223372036854775807, /)`

Return first index of value.

Raises ValueError if the value is not present.

insert

`AsyncList.insert(index, object, /)`

Insert object before index.

pop

`AsyncList.pop(index=-1, /)`

Remove and return item at index (default last).

Raises IndexError if list is empty or index is out of range.

remove

`AsyncList.remove(value, /)`

Remove first occurrence of value.

Raises ValueError if the value is not present.

reverse

`AsyncList.reverse()`

Reverse *IN PLACE*.

sort

`AsyncList.sort(*, key=None, reverse=False)`

Sort the list in ascending order and return None.

The sort is in-place (i.e. the list itself is modified) and stable (i.e. the order of two equal elements is maintained).

If a key function is given, apply it once to each list item and sort them, ascending or descending, according to their function values.

The reverse flag can be set to sort in descending order.

`__init__(*, future=None, n=1)`

7.2.3 base

It provides a base class for dispatcher objects.

Classes

Base	Base class for dispatcher objects.

Base

class Base(**args*, ***kwargs*)

Base class for dispatcher objects.

Methods

__init__	
form	Creates a dispatcher Form Flask app.
get_node	Returns a sub node of a dispatcher.
plot	Plots the Dispatcher with a graph in the DOT language with Graphviz.
web	Creates a dispatcher Flask app.

__init__

Base.**__init__**()

form

Base.**form**(*depth=1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *view=True*, *get_context=none*, *get_data=none*, *subsite_idle_timeout=600*, *basic_app_config=None*, *stripe_event_handler=<function Base.<lambda>>*)

Creates a dispatcher Form Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of *Site* to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?

- **view** (*bool, optional*) – Open the url site with the sys default opener.
- **get_context** (*function | dict, optional*) – Function to pass extra data as form context.
- **get_data** (*function | dict, optional*) – Function to initialize the formdata.
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.
- **basic_app_config** (*object, optional*) – Flask app config object.
- **stripe_event_handler** (*function, optional*) – Stripe event handler function.

Returns
A FormMap or a Site if *sites is None* and *run or view is True*.

Return type
FormMap | Site

get_node

`Base.get_node(*node_ids, node_attr=none)`

Returns a sub node of a dispatcher.

Parameters

- **node_ids** (*str*) – A sequence of node ids or a single node id. The id order identifies a dispatcher sub-level.
- **node_attr** (*str, None, optional*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  - for data node: its output, and if not exists, all its attributes.
  - for function and sub-dispatcher nodes: the 'function' attribute.

  When 'description', returns the "description" of the searched node, searching also in function or sub-dispatcher input/output description.

  When 'output', returns the data node output.

  When 'default_value', returns the data node default value.

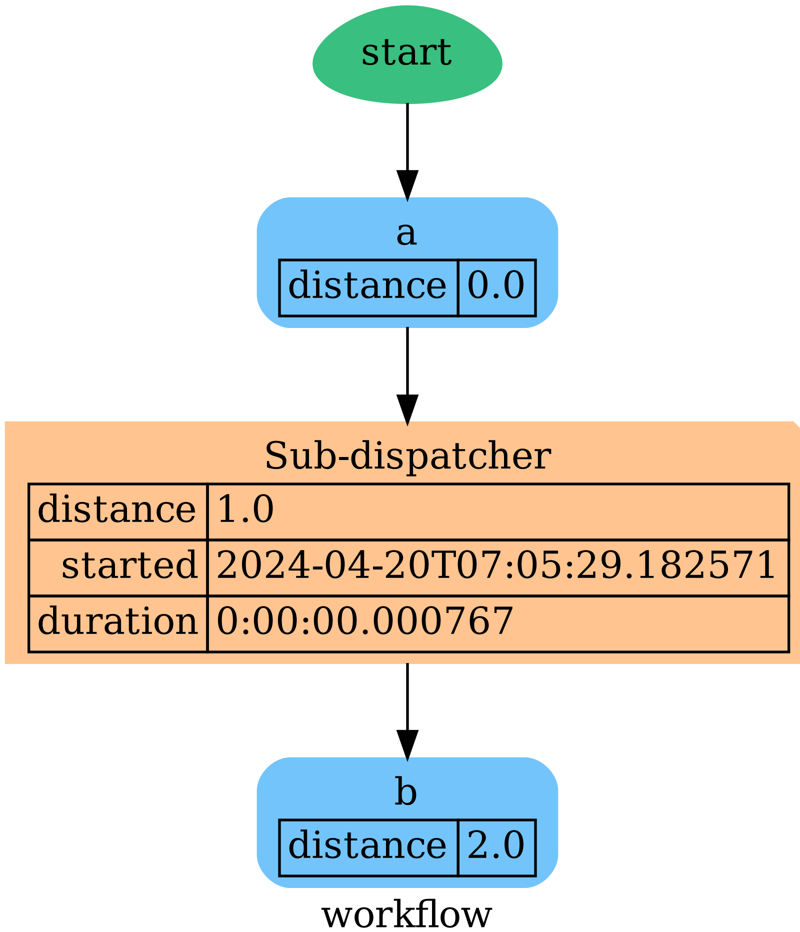
  When 'value_type', returns the data node value's type.

  When *None*, returns the node attributes.

Returns
Node attributes and its real path.

Return type
(T, (str, ...))

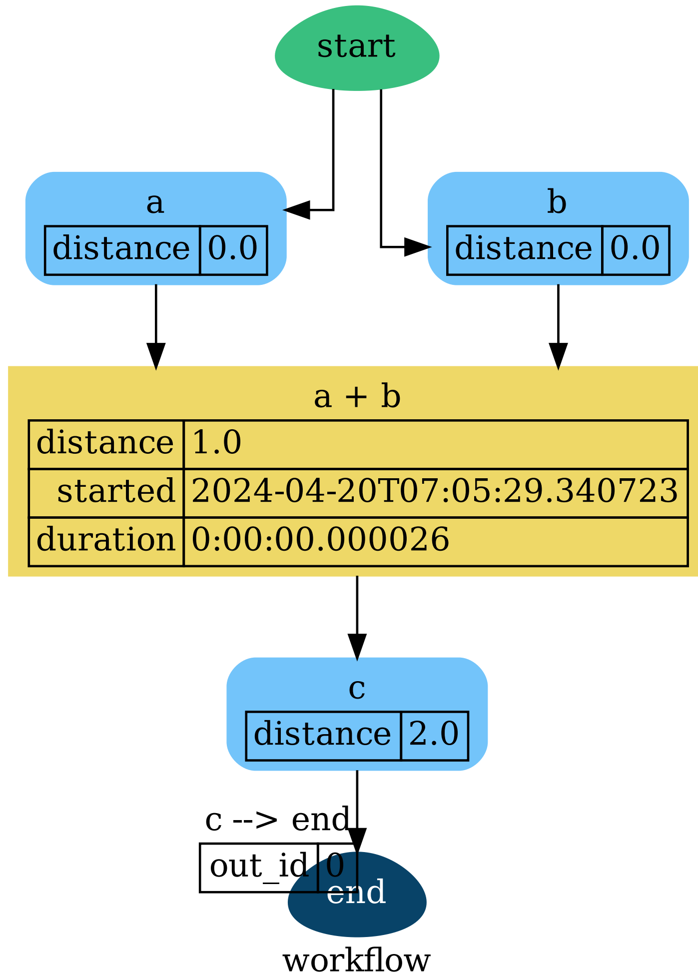
Example:



Get the sub node output:

```
>>> dsp.get_node('Sub-dispatcher', 'c')
(4, ('Sub-dispatcher', 'c'))
>>> dsp.get_node('Sub-dispatcher', 'c', node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

```
>>> sub_dsp, sub_dsp_id = dsp.get_node('Sub-dispatcher')
```



plot

`Base.plot`(*workflow=None*, *view=True*, *depth=-1*, *name=none*, *comment=none*, *format=none*, *engine=none*, *encoding=none*, *graph_attr=none*, *node_attr=none*, *edge_attr=none*, *body=none*, *raw_body=none*, *node_styles=none*, *node_data=none*, *node_function=none*, *edge_data=none*, *max_lines=none*, *max_width=none*, *directory=None*, *sites=None*, *index=True*, *viz=False*, *short_name=None*, *executor='async'*, *render=False*, *run=False*)

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (`bool, optional`) – If True the latest solution will be plotted, otherwise the dmap.
- **view** (`bool, optional`) – Open the rendered directed graph in the DOT language with the sys default opener.

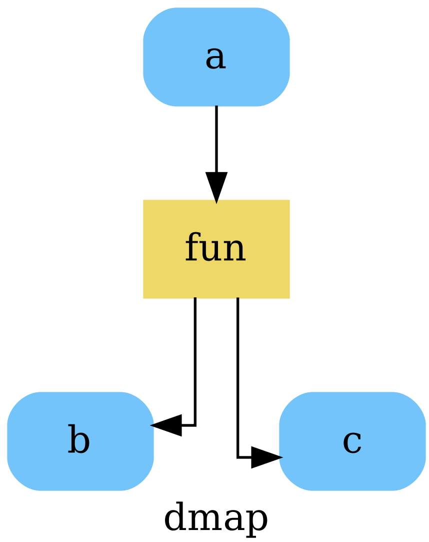
- **edge_data** (*tuple[str], optional*) – Edge attributes to view.
- **node_data** (*tuple[str], optional*) – Data node attributes to view.
- **node_function** (*tuple[str], optional*) – Function node attributes to view.
- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int, optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.
- **name** (*str*) – Graph name used in the source code.
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str, optional*) – (Sub)directory for source saving and rendering.
- **format** (*str, optional*) – Rendering output format ('pdf', 'png', . . .).
- **engine** (*str, optional*) – Layout command used ('dot', 'neato', . . .).
- **encoding** (*str, optional*) – Encoding for saving the source.
- **graph_attr** (*dict, optional*) – Dict of (attribute, value) pairs for the graph.
- **node_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict, optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list, optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of *Site* to maintain alive the backend server.
- **index** (*bool, optional*) – Add the site index as first page?
- **max_lines** (*int, optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int, optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool, optional*) – Render all pages statically?
- **viz** (*bool, optional*) – Use viz.js as back-end?
- **short_name** (*int, optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str, optional*) – Pool executor to render object.
- **run** (*bool, optional*) – Run the backend server?

Returns
A SiteMap or a Site if .

Return type
schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



web

Base.**web**(*depth=-1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *subsite_idle_timeout=600*)

Creates a dispatcher Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of Site to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?

- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.

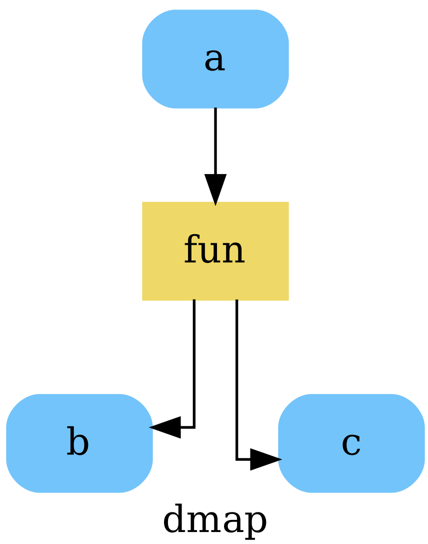
Returns
A WebMap.

Return type
WebMap

Example:

From a dispatcher like this:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
```



You can create a web server with the following steps:

```
>>> print("Starting...\n"); site = dsp.web(); site
Starting...
Site(WebMap([(Dispatcher, WebMap())]), host='localhost', ...)
>>> import requests
>>> url = '%s/%s/%s' % (site.url, dsp.name, fun.__name__)
>>> requests.post(url, json={'args': (0,)}).json()['return']
[1, -1]
>>> site.shutdown()  # Remember to shutdown the server.
True
```

Note: When *Site* is garbage collected, the server is shutdown automatically.

__init__()

web(*depth=-1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *subsite_idle_timeout=600*)

Creates a dispatcher Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of *Site* to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.

Returns

A WebMap.

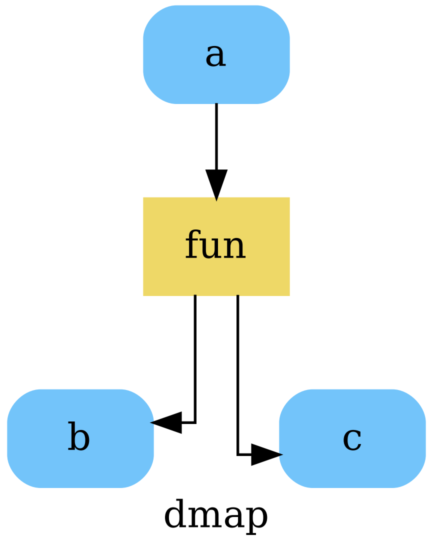
Return type

WebMap

Example:

From a dispatcher like this:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
```



You can create a web server with the following steps:

```
>>> print("Starting...\n"); site = dsp.web(); site
Starting...
Site(WebMap([(Dispatcher, WebMap())]), host='localhost', ...)
>>> import requests
>>> url = '%s/%s/%s' % (site.url, dsp.name, fun.__name__)
>>> requests.post(url, json={'args': (0,)}).json()['return']
[1, -1]
>>> site.shutdown()  # Remember to shutdown the server.
True
```

Note: When `Site` is garbage collected, the server is shutdown automatically.

form(*depth=1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *view=True*, *get_context=none*, *get_data=none*, *subsite_idle_timeout=600*, *basic_app_config=None*, *stripe_event_handler=<function Base.<lambda>>*)

Creates a dispatcher Form Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?

- **sites** (*set[Site], optional*) – A set of *Site* to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?
- **view** (*bool, optional*) – Open the url site with the sys default opener.
- **get_context** (*function | dict, optional*) – Function to pass extra data as form context.
- **get_data** (*function | dict, optional*) – Function to initialize the formdata.
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.
- **basic_app_config** (*object, optional*) – Flask app config object.
- **stripe_event_handler** (*function, optional*) – Stripe event handler function.

Returns
A FormMap or a Site if *sites is None* and *run or view is True*.

Return type
FormMap | Site

`plot`(*workflow=None, view=True, depth=-1, name=none, comment=none, format=none, engine=none, encoding=none, graph_attr=none, node_attr=none, edge_attr=none, body=none, raw_body=none, node_styles=none, node_data=none, node_function=none, edge_data=none, max_lines=none, max_width=none, directory=None, sites=None, index=True, viz=False, short_name=None, executor='async', render=False, run=False*)

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (*bool, optional*) – If True the latest solution will be plotted, otherwise the dmap.
- **view** (*bool, optional*) – Open the rendered directed graph in the DOT language with the sys default opener.
- **edge_data** (*tuple[str], optional*) – Edge attributes to view.
- **node_data** (*tuple[str], optional*) – Data node attributes to view.
- **node_function** (*tuple[str], optional*) – Function node attributes to view.
- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int, optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.
- **name** (*str*) – Graph name used in the source code.
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str, optional*) – (Sub)directory for source saving and rendering.
- **format** (*str, optional*) – Rendering output format ('pdf', 'png', …).
- **engine** (*str, optional*) – Layout command used ('dot', 'neato', …).
- **encoding** (*str, optional*) – Encoding for saving the source.
- **graph_attr** (*dict, optional*) – Dict of (attribute, value) pairs for the graph.

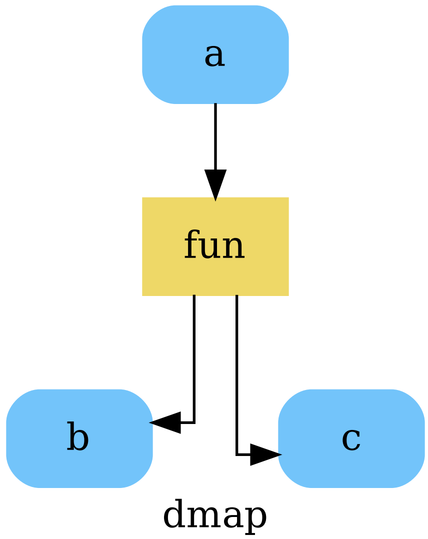
- **node_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict, optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list, optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.
- **index** (*bool, optional*) – Add the site index as first page?
- **max_lines** (*int, optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int, optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool, optional*) – Render all pages statically?
- **viz** (*bool, optional*) – Use viz.js as back-end?
- **short_name** (*int, optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str, optional*) – Pool executor to render object.
- **run** (*bool, optional*) – Run the backend server?

Returns
A SiteMap or a Site if .

Return type
schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



get_node(**node_ids*, *node_attr=none*)

Returns a sub node of a dispatcher.

Parameters

- **node_ids** (*str*) – A sequence of node ids or a single node id. The id order identifies a dispatcher sub-level.
- **node_attr** (*str, None, optional*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  – for data node: its output, and if not exists, all its attributes.

  – for function and sub-dispatcher nodes: the 'function' attribute.

  When 'description', returns the "description" of the searched node, searching also in function or sub-dispatcher input/output description.

  When 'output', returns the data node output.

  When 'default_value', returns the data node default value.

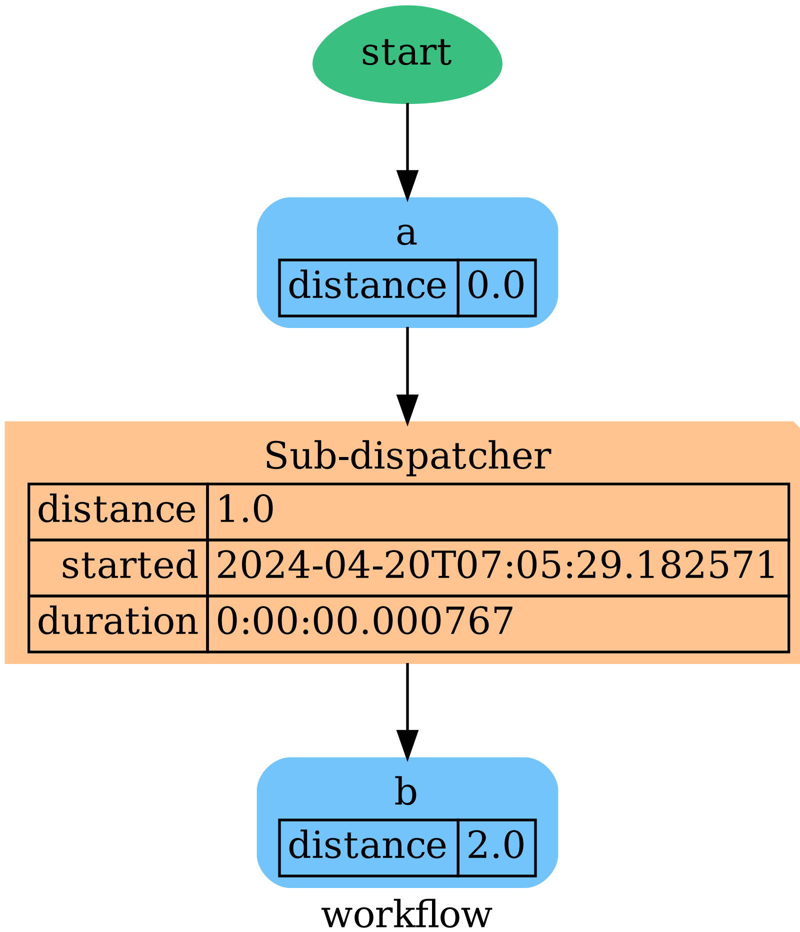
  When 'value_type', returns the data node value's type.

  When *None*, returns the node attributes.

Returns
Node attributes and its real path.

Return type
(T, (str, ...))

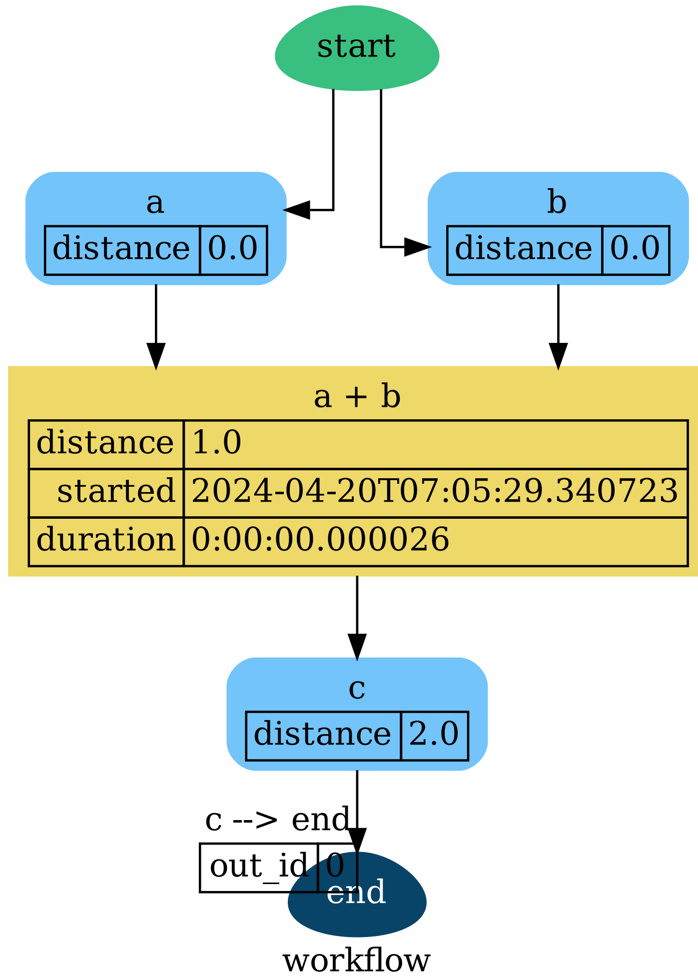
Example:



Get the sub node output:

```
>>> dsp.get_node('Sub-dispatcher', 'c')
(4, ('Sub-dispatcher', 'c'))
>>> dsp.get_node('Sub-dispatcher', 'c', node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

```
>>> sub_dsp, sub_dsp_id = dsp.get_node('Sub-dispatcher')
```



7.2.4 blue

It provides a Blueprint class to construct a Dispatcher and SubDispatch objects.

Classes

BlueDispatcher	Blueprint object is a blueprint of how to construct or extend a Dispatcher.
Blueprint	Base Blueprint class.

BlueDispatcher

class BlueDispatcher(*dmap=None*, *name=''*, *default_values=None*, *raises=False*, *description=''*, *executor=False*)

Blueprint object is a blueprint of how to construct or extend a Dispatcher.

Example:

Create a BlueDispatcher:

```
>>> import schedula as sh
>>> blue = sh.BlueDispatcher(name='Dispatcher')
```

Add data/function/dispatcher nodes to the dispatcher map as usual:

```
>>> blue.add_data(data_id='a', default_value=3)
<schedula.utils.blue.BlueDispatcher object at ...>
>>> @sh.add_function(blue, True, True, outputs=['c'])
... def diff_function(a, b=2):
...     return b - a
...
>>> blue.add_function(function=max, inputs=['c', 'd'], outputs=['e'])
<schedula.utils.blue.BlueDispatcher object at ...>
>>> from math import log
>>> sub_blue = sh.BlueDispatcher(name='Sub-Dispatcher')
>>> sub_blue.add_data(data_id='a', default_value=2).add_function(
...     function=log, inputs=['a'], outputs=['b']
... )
<schedula.utils.blue.BlueDispatcher object at ...>
>>> blue.add_dispatcher(sub_blue, ('a',), {'b': 'f'})
<schedula.utils.blue.BlueDispatcher object at ...>
```

You can set the default values as usual:

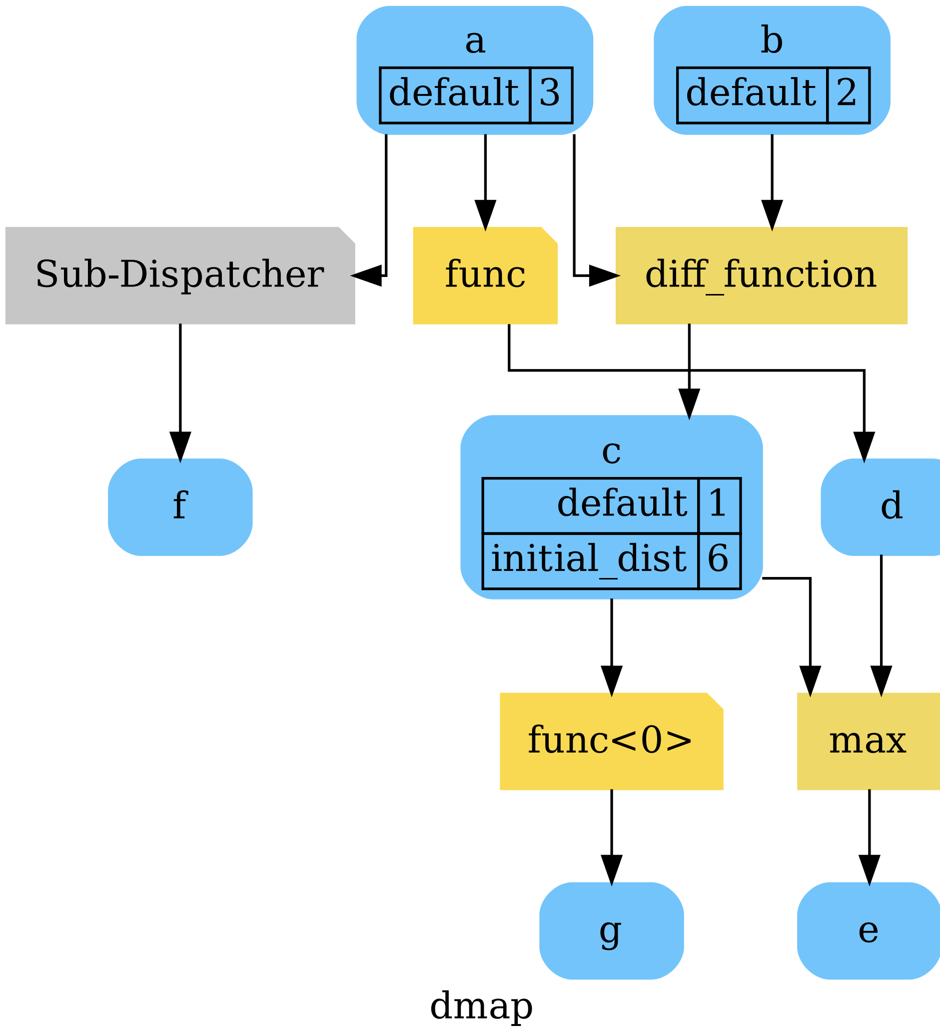
```
>>> blue.set_default_value(data_id='c', value=1, initial_dist=6)
<schedula.utils.blue.BlueDispatcher object at ...>
```

You can also create a *Blueprint* out of *SubDispatchFunction* and add it to the *Dispatcher* as follow:

```
>>> func = sh.SubDispatchFunction(sub_blue, 'func', ['a'], ['b'])
>>> blue.add_from_lists(fun_list=[
...     dict(function=func, inputs=['a'], outputs=['d']),
...     dict(function=func, inputs=['c'], outputs=['g']),
... ])
<schedula.utils.blue.BlueDispatcher object at ...>
```

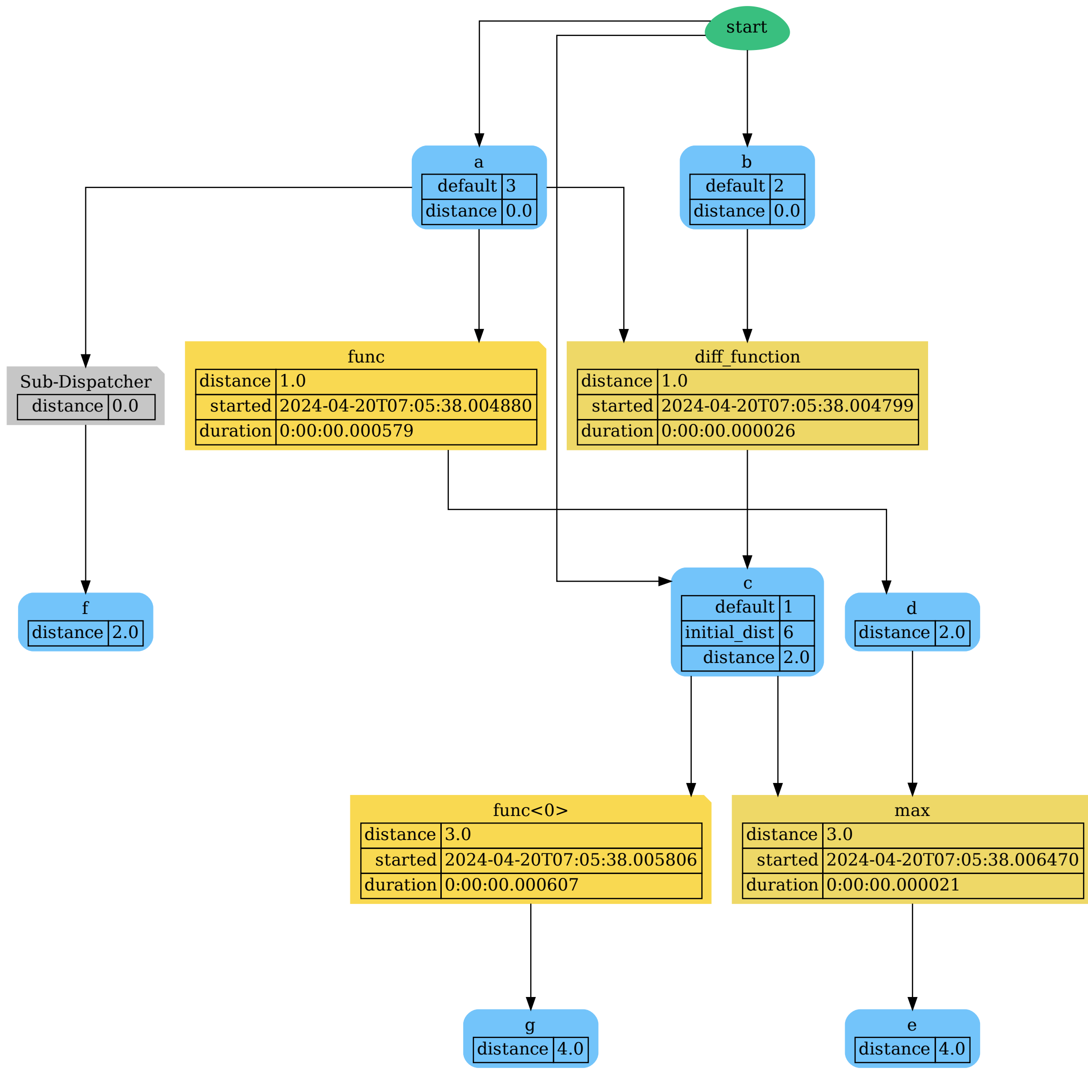
Finally you can create the dispatcher object using the method *new*:

```
>>> dsp = blue.register(memo={}); dsp
<schedula.dispatcher.Dispatcher object at ...>
```



Or dispatch, calling the Blueprint object:

```
>>> sol = blue({'a': 1}); sol
Solution([('a', 1), ('b', 2), ('c', 1), ('d', 0.0),
          ('f', 0.0), ('e', 1), ('g', 0.0)])
```


start
a
default 3
distance 0.0
b
default 2
distance 0.0
Sub-Dispatcher
distance 0.0
func
distance 1.0
started 2024-04-20T07:05:38.004880
duration 0:00:00.000579
diff_function
distance 1.0
started 2024-04-20T07:05:38.004799
duration 0:00:00.000026
f
distance 2.0
c
default 1
initial_dist 6
distance 2.0
d
distance 2.0
func<0>
distance 3.0
started 2024-04-20T07:05:38.005806
duration 0:00:00.000607
max
distance 3.0
started 2024-04-20T07:05:38.006470
duration 0:00:00.000021
g
distance 4.0
e
distance 4.0

workflow

Methods

__init__	
add_data	Add a single data node to the dispatcher.
add_dispatcher	Add a single sub-dispatcher node to dispatcher.
add_from_lists	Add multiple function and data nodes to dispatcher.
add_func	Add a single function node to dispatcher.
add_function	Add a single function node to dispatcher.
extend	Extends deferred operations calling each operation of given Blueprints.
register	Creates a *Blueprint.cls* and calls each deferred operation.
set_default_value	Set the default value of a data node in the dispatcher.

__init__

`BlueDispatcher.`**`__init__`**(*dmap=None*, *name=''*, *default_values=None*, *raises=False*, *description=''*, *executor=False*)

add_data

`BlueDispatcher.`**`add_data`**(*data_id=None*, *default_value=empty*, *initial_dist=0.0*, *wait_inputs=False*, *wildcard=None*, *function=None*, *callback=None*, *description=None*, *filters=None*, *await_result=None*, ***kwargs*)

Add a single data node to the dispatcher.

Parameters

- **data_id** (*str, optional*) – Data node id. If None will be assigned automatically ('unknown<%d>') not in dmap.
- **default_value** (*T, optional*) – Data node default value. This will be used as input if it is not specified as inputs in the ArciDispatch algorithm.
- **initial_dist** (*float, int, optional*) – Initial distance in the ArciDispatch algorithm when the data node default value is used.
- **wait_inputs** (*bool, optional*) – If True ArciDispatch algorithm stops on the node until it gets all input estimations.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **function** (*callable, optional*) – Data node estimation function. This can be any function that takes only one dictionary (key=function node id, value=estimation of data node) as input and return one value that is the estimation of the data node.
- **callback** (*callable, optional*) – Callback function to be called after node estimation. This can be any function that takes only one argument that is the data node estimation output. It does not return anything.
- **description** (*str, optional*) – Data node's description.

- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits data results before assigning them to the solution. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns
Self.

Return type
BlueDispatcher

add_dispatcher

BlueDispatcher.**add_dispatcher**(*dsp*, *inputs=None*, *outputs=None*, *dsp_id=None*, *input_domain=None*, *weight=None*, *inp_weight=None*, *description=None*, *include_defaults=False*, *await_domain=None*, *inputs_prefix=''*, *outputs_prefix=''*, ***kwargs*)

Add a single sub-dispatcher node to dispatcher.

Parameters

- **dsp** (BlueDispatcher | Dispatcher | *dict[str, list]*) – Child dispatcher that is added as sub-dispatcher node to the parent dispatcher.
- **inputs** (*dict[str, str | list[str]] | tuple[str] | (str, ..., dict[str, str | list[str]])*) – Inputs mapping. Data node ids from parent dispatcher to child sub-dispatcher. If *None* all child dispatcher nodes are used as inputs.
- **outputs** (*dict[str, str | list[str]] | tuple[str] | (str, ..., dict[str, str | list[str]])*) – Outputs mapping. Data node ids from child sub-dispatcher to parent dispatcher. If *None* all child dispatcher nodes are used as outputs.
- **dsp_id** (*str, optional*) – Sub-dispatcher node id. If None will be assigned as <dsp.name>.
- **input_domain** (*(dict) -> bool, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the a dictionary with the inputs of the sub-dispatcher node and returns True if input values satisfy the domain, otherwise False.

  Note: This function is invoked every time that a data node reach the sub-dispatcher node.

- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, int | float], optional*) – Edge weights from data nodes to the sub-dispatcher node. It is a dictionary (key=data node id) with

the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.

- **description** (*str*, *optional*) – Sub-dispatcher node's description.
- **include_defaults** (*bool*, *optional*) – If True the default values of the sub-dispatcher are added to the current dispatcher.
- **await_domain** (*bool*|*int*|*float*, *optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **inputs_prefix** (*str*) – Add a prefix to parent dispatcher inputs nodes.
- **outputs_prefix** (*str*) – Add a prefix to parent dispatcher outputs nodes.
- **kwargs** (*keyword arguments*, *optional*) – Set additional node attributes using key=value.

Returns
Self.

Return type
BlueDispatcher

add_from_lists

`BlueDispatcher.`**`add_from_lists`**(*data_list=None*, *fun_list=None*, *dsp_list=None*)

Add multiple function and data nodes to dispatcher.

Parameters

- **data_list** (*list[dict]*, *optional*) – It is a list of data node kwargs to be loaded.
- **fun_list** (*list[dict]*, *optional*) – It is a list of function node kwargs to be loaded.
- **dsp_list** (*list[dict]*, *optional*) – It is a list of sub-dispatcher node kwargs to be loaded.

Returns
Self.

Return type
BlueDispatcher

add_func

`BlueDispatcher.`**`add_func`**(*function*, *outputs=None*, *weight=None*, *inputs_kwargs=False*, *inputs_defaults=False*, *filters=None*, *input_domain=None*, *await_domain=None*, *await_result=None*, *inp_weight=None*, *out_weight=None*, *description=None*, *inputs=None*, *function_id=None*, ***kwargs*)

Add a single function node to dispatcher.

Parameters

- **inputs_kwargs** (*bool*) – Do you want to include kwargs as inputs?
- **inputs_defaults** (*bool*) – Do you want to set default values?
- **function_id** (*str, optional*) – Function node id. If None will be assigned as <fun.__name__>.
- **function** (*callable, optional*) – Data node estimation function.
- **inputs** (*list, optional*) – Ordered arguments (i.e., data node ids) needed by the function. If None it will take parameters names from function signature.
- **outputs** (*list, optional*) – Ordered results (i.e., data node ids) returned by the function.
- **input_domain** (*callable, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the same inputs of the function and returns True if input values satisfy the domain, otherwise False. In this case the dispatch algorithm doesn't pass on the node.
- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, float | int], optional*) – Edge weights from data nodes to the function node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **out_weight** (*dict[str, float | int], optional*) – Edge weights from the function node to data nodes. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Function node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_domain** (*bool|int|float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits output results before assigning them to the workflow. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns
Self.

Return type
BlueDispatcher

add_function

BlueDispatcher.**add_function**(*function_id=None*, *function=None*, *inputs=None*, *outputs=None*, *input_domain=None*, *weight=None*, *inp_weight=None*, *out_weight=None*, *description=None*, *filters=None*, *await_domain=None*, *await_result=None*, ***kwargs*)

Add a single function node to dispatcher.

Parameters

- **function_id** (*str, optional*) – Function node id. If None will be assigned as <fun.__name__>.
- **function** (*callable, optional*) – Data node estimation function.
- **inputs** (*list, optional*) – Ordered arguments (i.e., data node ids) needed by the function.
- **outputs** (*list, optional*) – Ordered results (i.e., data node ids) returned by the function.
- **input_domain** (*callable, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the same inputs of the function and returns True if input values satisfy the domain, otherwise False. In this case the dispatch algorithm doesn't pass on the node.
- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, float | int], optional*) – Edge weights from data nodes to the function node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **out_weight** (*dict[str, float | int], optional*) – Edge weights from the function node to data nodes. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Function node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_domain** (*bool|int|float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits output results before assigning them to the workflow. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

extend

`BlueDispatcher.extend(*blues, memo=None)`

Extends deferred operations calling each operation of given Blueprints.

Parameters

- **blues** (`Blueprint` | `schedula.dispatcher.Dispatcher`) – Blueprints or Dispatchers to extend deferred operations.
- **memo** (*dict*[*T*, `Blueprint`]) – A dictionary to cache Blueprints.

Returns
Self.

Return type
Blueprint

Example:

```
>>> import schedula as sh
>>> blue = sh.BlueDispatcher()
>>> blue.extend(
...     BlueDispatcher().add_func(len, ['length']),
...     BlueDispatcher().add_func(callable, ['is_callable'])
... )
<schedula.utils.blue.BlueDispatcher object at ...>
```

register

`BlueDispatcher.register(obj=None, memo=None)`

Creates a *Blueprint.cls* and calls each deferred operation.

Parameters

- **obj** (*object*) – The initialized object with which to call all deferred operations.
- **memo** (*dict*[`Blueprint`, *T*]) – A dictionary to cache registered Blueprints.

Returns
The initialized object.

Return type
Blueprint.cls | *Blueprint*

Example:

```
>>> import schedula as sh
>>> blue = sh.BlueDispatcher().add_func(len, ['length'])
>>> blue.register()
<schedula.dispatcher.Dispatcher object at ...>
```

set_default_value

BlueDispatcher.**set_default_value**(*data_id*, *value=empty*, *initial_dist=0.0*)

Set the default value of a data node in the dispatcher.

Parameters

- **data_id** (*str*) – Data node id.
- **value** (*T, optional*) – Data node default value.

Note: If *EMPTY* the previous default value is removed.

- **initial_dist** (*float, int, optional*) – Initial distance in the ArciDispatch algorithm when the data node default value is used.

Returns
Self.

Return type
BlueDispatcher

__init__(*dmap=None*, *name=''*, *default_values=None*, *raises=False*, *description=''*, *executor=False*)

add_data(*data_id=None*, *default_value=empty*, *initial_dist=0.0*, *wait_inputs=False*, *wildcard=None*, *function=None*, *callback=None*, *description=None*, *filters=None*, *await_result=None*, ***kwargs*)

Add a single data node to the dispatcher.

Parameters

- **data_id** (*str, optional*) – Data node id. If None will be assigned automatically ('unknown<%d>') not in dmap.
- **default_value** (*T, optional*) – Data node default value. This will be used as input if it is not specified as inputs in the ArciDispatch algorithm.
- **initial_dist** (*float, int, optional*) – Initial distance in the ArciDispatch algorithm when the data node default value is used.
- **wait_inputs** (*bool, optional*) – If True ArciDispatch algorithm stops on the node until it gets all input estimations.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **function** (*callable, optional*) – Data node estimation function. This can be any function that takes only one dictionary (key=function node id, value=estimation of data node) as input and return one value that is the estimation of the data node.
- **callback** (*callable, optional*) – Callback function to be called after node estimation. This can be any function that takes only one argument that is the data node estimation output. It does not return anything.
- **description** (*str, optional*) – Data node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.

- **await_result** (*bool | int | float, optional*) – If True the Dispatcher waits data results before assigning them to the solution. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns
Self.

Return type
BlueDispatcher

add_function(*function_id=None*, *function=None*, *inputs=None*, *outputs=None*, *input_domain=None*, *weight=None*, *inp_weight=None*, *out_weight=None*, *description=None*, *filters=None*, *await_domain=None*, *await_result=None*, ***kwargs*)

Add a single function node to dispatcher.

Parameters

- **function_id** (*str, optional*) – Function node id. If None will be assigned as <fun.__name__>.
- **function** (*callable, optional*) – Data node estimation function.
- **inputs** (*list, optional*) – Ordered arguments (i.e., data node ids) needed by the function.
- **outputs** (*list, optional*) – Ordered results (i.e., data node ids) returned by the function.
- **input_domain** (*callable, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the same inputs of the function and returns True if input values satisfy the domain, otherwise False. In this case the dispatch algorithm doesn't pass on the node.
- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, float | int], optional*) – Edge weights from data nodes to the function node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **out_weight** (*dict[str, float | int], optional*) – Edge weights from the function node to data nodes. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Function node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_domain** (*bool | int | float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **await_result** (*bool | int | float, optional*) – If True the Dispatcher waits output results before assigning them to the workflow. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.

- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

add_func(*function*, *outputs=None*, *weight=None*, *inputs_kwargs=False*, *inputs_defaults=False*, *filters=None*, *input_domain=None*, *await_domain=None*, *await_result=None*, *inp_weight=None*, *out_weight=None*, *description=None*, *inputs=None*, *function_id=None*, ***kwargs*)

Add a single function node to dispatcher.

Parameters

- **inputs_kwargs** (*bool*) – Do you want to include kwargs as inputs?
- **inputs_defaults** (*bool*) – Do you want to set default values?
- **function_id** (*str, optional*) – Function node id. If None will be assigned as <fun.__name__>.
- **function** (*callable, optional*) – Data node estimation function.
- **inputs** (*list, optional*) – Ordered arguments (i.e., data node ids) needed by the function. If None it will take parameters names from function signature.
- **outputs** (*list, optional*) – Ordered results (i.e., data node ids) returned by the function.
- **input_domain** (*callable, optional*) – A function that checks if input values satisfy the function domain. This can be any function that takes the same inputs of the function and returns True if input values satisfy the domain, otherwise False. In this case the dispatch algorithm doesn't pass on the node.
- **weight** (*float, int, optional*) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (*dict[str, float | int], optional*) – Edge weights from data nodes to the function node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **out_weight** (*dict[str, float | int], optional*) – Edge weights from the function node to data nodes. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (*str, optional*) – Function node's description.
- **filters** (*list[function], optional*) – A list of functions that are invoked after the invocation of the main function.
- **await_domain** (*bool|int|float, optional*) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **await_result** (*bool|int|float, optional*) – If True the Dispatcher waits output results before assigning them to the workflow. If a number is defined this is used as *timeout* for *Future.result* method [default: False]. Note this is used when asynchronous or parallel execution is enable.
- **kwargs** (*keyword arguments, optional*) – Set additional node attributes using key=value.

Returns

Self.

Return type
BlueDispatcher

`add_dispatcher`(*dsp*, *inputs=None*, *outputs=None*, *dsp_id=None*, *input_domain=None*, *weight=None*, *inp_weight=None*, *description=None*, *include_defaults=False*, *await_domain=None*, *inputs_prefix=''*, *outputs_prefix=''*, ***kwargs*)

Add a single sub-dispatcher node to dispatcher.

Parameters

- **dsp** (`BlueDispatcher | Dispatcher | dict[str, list]`) – Child dispatcher that is added as sub-dispatcher node to the parent dispatcher.
- **inputs** (`dict[str, str | list[str]] | tuple[str] | (str, ..., dict[str, str | list[str]])`) – Inputs mapping. Data node ids from parent dispatcher to child sub-dispatcher. If *None* all child dispatcher nodes are used as inputs.
- **outputs** (`dict[str, str | list[str]] | tuple[str] | (str, ..., dict[str, str | list[str]])`) – Outputs mapping. Data node ids from child sub-dispatcher to parent dispatcher. If *None* all child dispatcher nodes are used as outputs.
- **dsp_id** (`str, optional`) – Sub-dispatcher node id. If None will be assigned as <dsp.name>.
- **input_domain** (`(dict) -> bool, optional`) – A function that checks if input values satisfy the function domain. This can be any function that takes the a dictionary with the inputs of the sub-dispatcher node and returns True if input values satisfy the domain, otherwise False.

  Note: This function is invoked every time that a data node reach the sub-dispatcher node.

- **weight** (`float, int, optional`) – Node weight. It is a weight coefficient that is used by the dispatch algorithm to estimate the minimum workflow.
- **inp_weight** (`dict[str, int | float], optional`) – Edge weights from data nodes to the sub-dispatcher node. It is a dictionary (key=data node id) with the weight coefficients used by the dispatch algorithm to estimate the minimum workflow.
- **description** (`str, optional`) – Sub-dispatcher node's description.
- **include_defaults** (`bool, optional`) – If True the default values of the sub-dispatcher are added to the current dispatcher.
- **await_domain** (`bool|int|float, optional`) – If True the Dispatcher waits all input results before executing the *input_domain* function. If a number is defined this is used as *timeout* for *Future.result* method [default: True]. Note this is used when asynchronous or parallel execution is enable.
- **inputs_prefix** (`str`) – Add a prefix to parent dispatcher inputs nodes.
- **outputs_prefix** (`str`) – Add a prefix to parent dispatcher outputs nodes.
- **kwargs** (`keyword arguments, optional`) – Set additional node attributes using key=value.

Returns
Self.

Return type
BlueDispatcher

add_from_lists(*data_list=None*, *fun_list=None*, *dsp_list=None*)
Add multiple function and data nodes to dispatcher.

Parameters

- **data_list** (*list[dict], optional*) – It is a list of data node kwargs to be loaded.
- **fun_list** (*list[dict], optional*) – It is a list of function node kwargs to be loaded.
- **dsp_list** (*list[dict], optional*) – It is a list of sub-dispatcher node kwargs to be loaded.

Returns
Self.

Return type
BlueDispatcher

set_default_value(*data_id*, *value=empty*, *initial_dist=0.0*)
Set the default value of a data node in the dispatcher.

Parameters

- **data_id** (*str*) – Data node id.
- **value** (*T, optional*) – Data node default value.

  Note: If *EMPTY* the previous default value is removed.

- **initial_dist** (*float, int, optional*) – Initial distance in the ArciDispatch algorithm when the data node default value is used.

Returns
Self.

Return type
BlueDispatcher

Blueprint

class Blueprint(**args*, ***kwargs*)
Base Blueprint class.

Methods

`__init__`	
`extend`	Extends deferred operations calling each operation of given Blueprints.
`register`	Creates a `Blueprint.cls` and calls each deferred operation.

__init__

`Blueprint.__init__(*args, **kwargs)`

extend

`Blueprint.extend(*blues, memo=None)`

Extends deferred operations calling each operation of given Blueprints.

Parameters

- **blues** (`Blueprint | schedula.dispatcher.Dispatcher`) – Blueprints or Dispatchers to extend deferred operations.
- **memo** (`dict[T,Blueprint]`) – A dictionary to cache Blueprints.

Returns

Self.

Return type

Blueprint

Example:

```
>>> import schedula as sh
>>> blue = sh.BlueDispatcher()
>>> blue.extend(
...     BlueDispatcher().add_func(len, ['length']),
...     BlueDispatcher().add_func(callable, ['is_callable'])
... )
<schedula.utils.blue.BlueDispatcher object at ...>
```

register

Blueprint.**register**(*obj=None*, *memo=None*)

Creates a `Blueprint.cls` and calls each deferred operation.

Parameters

- **obj** (*object*) – The initialized object with which to call all deferred operations.
- **memo** (*dict[Blueprint, T]*) – A dictionary to cache registered Blueprints.

Returns

The initialized object.

Return type

Blueprint.cls | *Blueprint*

Example:

```
>>> import schedula as sh
>>> blue = sh.BlueDispatcher().add_func(len, ['length'])
>>> blue.register()
<schedula.dispatcher.Dispatcher object at ...>
```

__init__(**args*, ***kwargs*)

cls

alias of `Dispatcher`

register(*obj=None*, *memo=None*)

Creates a `Blueprint.cls` and calls each deferred operation.

Parameters

- **obj** (*object*) – The initialized object with which to call all deferred operations.
- **memo** (*dict[Blueprint, T]*) – A dictionary to cache registered Blueprints.

Returns

The initialized object.

Return type

Blueprint.cls | *Blueprint*

Example:

```
>>> import schedula as sh
>>> blue = sh.BlueDispatcher().add_func(len, ['length'])
>>> blue.register()
<schedula.dispatcher.Dispatcher object at ...>
```

extend(**blues*, *memo=None*)

Extends deferred operations calling each operation of given Blueprints.

Parameters

- **blues** (`Blueprint | schedula.dispatcher.Dispatcher`) – Blueprints or Dispatchers to extend deferred operations.

- **memo** (*dict[T,Blueprint]*) – A dictionary to cache Blueprints.

Returns
Self.

Return type
Blueprint

Example:

```
>>> import schedula as sh
>>> blue = sh.BlueDispatcher()
>>> blue.extend(
...     BlueDispatcher().add_func(len, ['length']),
...     BlueDispatcher().add_func(callable, ['is_callable'])
... )
<schedula.utils.blue.BlueDispatcher object at ...>
```

7.2.5 cst

It provides constants data node ids and values.

7.2.6 des

It provides tools to find data, function, and sub-dispatcher node description.

Functions

get_attr_doc
get_link
get_summary
search_node_description

get_attr_doc

get_attr_doc(*doc*, *attr_name*, *get_param=True*, *what='description'*)

get_link

get_link(**items*)

get_summary

get_summary(*doc*)

search_node_description

search_node_description(*node_id*, *node_attr*, *dsp*, *what='description'*)

7.2.7 drw

It provides functions to plot dispatcher map and workflow.

Sub-Modules:

nodes	It provides docutils nodes to plot dispatcher map and workflow.

nodes

It provides docutils nodes to plot dispatcher map and workflow.

Functions

autoplot_callback	
autoplot_function	
before_request	
cached_view	
get_match_func	
jinja2_format	
parse_funcs	
render_output	
run_server	
site_view	
uncpath	
update_filenames	
valid_filename	

autoplot_callback

autoplot_callback(*res*)

autoplot_function

autoplot_function(*kwargs*)

before_request

before_request(*mute*)

cached_view

cached_view(*node*, *directory*, *context*, *rendered*, *viz=False*, *executor='async'*, ***render_ctx*)

get_match_func

get_match_func(*expr*)

jinja2_format

jinja2_format(*source*, *context=None*, ***kw*)

parse_funcs

parse_funcs(*expr*, *funcs*)

render_output

render_output(*out*, *pformat*)

run_server

run_server(*app*, *options*)

site_view

site_view(*context*, *rendered*, *rules*, *root*, *filepath=None*, *viz=False*, *executor='async'*)

uncpath

uncpath(*p*)

update_filenames

update_filenames(*node*, *filenames*)

valid_filename

valid_filename(*item*, *filenames*, *ext=None*)

Classes

FolderNode
IdleContainer
NoView
ReverseProxied
ServerThread
Site
SiteFolder
SiteIndex
SiteMap
SiteNode
SiteViz

FolderNode

class FolderNode(*folder*, *node_id*, *attr*, ***options*)

Methods

__init__	
counter	Implement next(self).
dot	
href	
items	
parent_ref	
render_funcs	
render_size	
style	
yield_attr	

__init__

`FolderNode.__init__(folder, node_id, attr, **options)`

counter

`FolderNode.counter()`

Implement next(self).

dot

`FolderNode.dot(context=None)`

href

`FolderNode.href(context, link_id)`

items

`FolderNode.items()`

parent_ref

`FolderNode.parent_ref(context, node_id, attr=None)`

render_funcs

`FolderNode.render_funcs()`

render_size

`FolderNode.render_size(out)`

style

`FolderNode.style()`

yield_attr

FolderNode.**yield_attr**(*name*)

__init__(*folder*, *node_id*, *attr*, ***options*)

Attributes

edge_data
max_lines
max_width
node_data
node_function
node_map
node_styles
pprint
re_node
title
type

edge_data

FolderNode.**edge_data = ('?', '+wildcard', 'inp_id', 'out_id', 'weight')**

max_lines

FolderNode.**max_lines = 5**

max_width

FolderNode.**max_width = 200**

node_data

FolderNode.**node_data = ('-', '.tooltip', '!default_values', 'wait_inputs', 'await_result', '+function|solution', 'weight', 'remote_links', '+filters|solution_filters', 'distance', '!error', '*output')**

node_function

FolderNode.**node_function = ('-', '.tooltip', 'await_domain', 'await_result', '+input_domain|solution_domain', 'weight', '+filters|solution_filters', 'missing_inputs_outputs', 'distance', 'started', 'duration', '!error', '*function|solution')**

node_map

FolderNode.**node_map = {'': ('dot', 'table'), '!': ('dot', 'table'), '*': ('link',), '+': ('dot', 'table'), '-': (), '.': ('dot',), '?': ()}**

node_styles

FolderNode.**node_styles** =
{'error': {empty: {'fillcolor': '#FFFFFF', 'label': 'empty', 'shape': 'egg'}, end: {'color': '#084368', 'fillcolor': '#084368', 'fontcolor': '#FFFFFF', 'label': 'end', 'ordering': 'in', 'shape': 'egg'}, none: {'data': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'penwidth': 2, 'shape': 'box', 'style': 'rounded,filled'}, 'dispatcher': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'dispatchpipe': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'edge': {None: None}, 'function': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'box'}, 'function-dispatcher': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note'}, 'mapdispatch': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'run_model': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note'}, 'subdispatch': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'subdispatchfunction': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'subdispatchpipe': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}}, plot: {'color': '#fcf3dd', 'fillcolor': '#fcf3dd', 'label': 'plot', 'shape': 'egg'}, self: {'color': '#C1A4FE', 'fillcolor': '#C1A4FE', 'label': 'self', 'shape': 'egg'}, sink: {'color': '#303030', 'fillcolor': '#303030', 'fontcolor': '#FFFFFF', 'label': 'sink', 'shape': 'egg'}, start: {'color': '#39bf7f', 'fillcolor': '#39bf7f', 'label': 'start', 'ordering': 'out', 'shape': 'egg'}}, 'info': {empty: {'fillcolor': '#FFFFFF', 'label': 'empty', 'shape': 'egg'}, end: {'color': '#084368', 'fillcolor': '#084368', 'fontcolor': '#FFFFFF', 'label': 'end', 'ordering': 'in', 'shape': 'egg'}, none: {'data': {'color': '#73c4fa', 'fillcolor': '#73c4fa', 'shape': 'box', 'style': 'rounded,filled'}, 'dispatcher': {'color': '#c6c6c6', 'fillcolor': '#c6c6c6', 'shape': 'note', 'style': 'filled'}, 'dispatchpipe': {'color': '#e8c268', 'fillcolor': '#e8c268', 'ordering': 'in', 'shape': 'note', 'style': 'filled'}, 'edge': {None: None}, 'function': {'color': '#eed867', 'fillcolor': '#eed867', 'ordering': 'in', 'shape': 'box'}, 'function-dispatcher': {'color': '#eed867', 'fillcolor': '#eed867', 'ordering': 'in', 'shape': 'note'}, 'mapdispatch': {'color': '#f4bd6a', 'fillcolor': '#f4bd6a', 'ordering': 'in', 'shape': 'note', 'style': 'filled'}, 'run_model': {'color': '#eed867', 'fillcolor': '#eed867', 'ordering': 'in', 'shape': 'note'}, 'subdispatch': {'color': '#ffc490', 'fillcolor': '#ffc490', 'shape': 'note', 'style': 'filled'}, 'subdispatchfunction': {'color': '#f9d951', 'fillcolor': '#f9d951', 'ordering': 'in', 'shape': 'note', 'style': 'filled'}, 'subdispatchpipe': {'color': '#f1cd5d', 'fillcolor': '#f1cd5d', 'ordering': 'in', 'shape': 'note', 'style': 'filled'}}, plot: {'color': '#fcf3dd', 'fillcolor': '#fcf3dd', 'label': 'plot', 'shape': 'egg'}, self: {'color': '#C1A4FE', 'fillcolor': '#C1A4FE', 'label': 'self', 'shape': 'egg'}, sink: {'color': '#303030', 'fillcolor': '#303030', 'fontcolor': '#FFFFFF', 'label': 'sink', 'shape': 'egg'}, start: {'color': '#39bf7f', 'fillcolor': '#39bf7f', 'label': 'start', 'ordering': 'out', 'shape': 'egg'}}, 'warning': {empty: {'fillcolor': '#FFFFFF', 'label': 'empty', 'shape': 'egg'}, end: {'color': '#084368', 'fillcolor': '#084368', 'fontcolor': '#FFFFFF', 'label': 'end', 'ordering': 'in', 'shape': 'egg'}, none: {'data': {'color': '#C9340A', 'fillcolor': '#fea22b', 'penwidth': 2, 'shape': 'box', 'style': 'rounded,filled'}, 'dispatcher': {'color': '#C9340A', 'fillcolor': '#fea22b', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'dispatchpipe': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'edge': {None: None}, 'function': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'box'}, 'function-dispatcher': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'note'}, 'mapdispatch': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'run_model': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'note'},

pprint

`FolderNode.pprint = <pprint.PrettyPrinter object>`

re_node

`FolderNode.re_node = '^([.*+!]?)([\\w ]+)(?>\\|([\\w ]+))?$'`

title

`property FolderNode.title`

type

`property FolderNode.type`

`counter()`

Implement next(self).

IdleContainer

`class IdleContainer(interval=1)`

Methods

__init__	This constructor should always be called with keyword arguments.
add	
getName	Return a string used for identification purposes only.
isDaemon	Return whether this thread is a daemon.
is_alive	Return whether the thread is alive.
join	Wait until the thread terminates.
run	Method representing the thread's activity.
setDaemon	Set whether this thread is a daemon.
setName	Set the name string for this thread.
start	Start the thread's activity.

__init__

`IdleContainer.__init__(interval=1)`

This constructor should always be called with keyword arguments. Arguments are:

group should be None; reserved for future extension when a ThreadGroup class is implemented.

target is the callable object to be invoked by the run() method. Defaults to None, meaning nothing is called.

name is the thread name. By default, a unique name is constructed of the form "Thread-N" where N is a small decimal number.

args is a list or tuple of arguments for the target invocation. Defaults to ().

kwargs is a dictionary of keyword arguments for the target invocation. Defaults to {}.

If a subclass overrides the constructor, it must make sure to invoke the base class constructor (Thread.__init__()) before doing anything else to the thread.

add

`IdleContainer.add(site)`

getName

`IdleContainer.getName()`

Return a string used for identification purposes only.

This method is deprecated, use the name attribute instead.

isDaemon

`IdleContainer.isDaemon()`

Return whether this thread is a daemon.

This method is deprecated, use the daemon attribute instead.

is_alive

`IdleContainer.is_alive()`

Return whether the thread is alive.

This method returns True just before the run() method starts until just after the run() method terminates. See also the module function enumerate().

join

`IdleContainer.join(timeout=None)`

Wait until the thread terminates.

This blocks the calling thread until the thread whose join() method is called terminates – either normally or through an unhandled exception or until the optional timeout occurs.

When the timeout argument is present and not None, it should be a floating point number specifying a timeout for the operation in seconds (or fractions thereof). As join() always returns None, you must call is_alive() after join() to decide whether a timeout happened – if the thread is still alive, the join() call timed out.

When the timeout argument is not present or None, the operation will block until the thread terminates.

A thread can be join()ed many times.

join() raises a RuntimeError if an attempt is made to join the current thread as that would cause a deadlock. It is also an error to join() a thread before it has been started and attempts to do so raises the same exception.

run

`IdleContainer.run()`

Method representing the thread's activity.

You may override this method in a subclass. The standard run() method invokes the callable object passed to the object's constructor as the target argument, if any, with sequential and keyword arguments taken from the args and kwargs arguments, respectively.

setDaemon

`IdleContainer.setDaemon(daemonic)`

Set whether this thread is a daemon.

This method is deprecated, use the .daemon property instead.

setName

`IdleContainer.setName(name)`

Set the name string for this thread.

This method is deprecated, use the name attribute instead.

start

`IdleContainer.start()`

Start the thread's activity.

It must be called at most once per thread object. It arranges for the object's run() method to be invoked in a separate thread of control.

This method will raise a RuntimeError if called more than once on the same thread object.

__init__(*interval=1*)

This constructor should always be called with keyword arguments. Arguments are:

group should be None; reserved for future extension when a ThreadGroup class is implemented.

target is the callable object to be invoked by the run() method. Defaults to None, meaning nothing is called.

name is the thread name. By default, a unique name is constructed of the form "Thread-N" where N is a small decimal number.

args is a list or tuple of arguments for the target invocation. Defaults to ().

kwargs is a dictionary of keyword arguments for the target invocation. Defaults to {}.

If a subclass overrides the constructor, it must make sure to invoke the base class constructor (Thread.__init__()) before doing anything else to the thread.

Attributes

`daemon`	A boolean value indicating whether this thread is a daemon thread.
`ident`	Thread identifier of this thread or None if it has not been started.
`name`	A string used for identification purposes only.
`native_id`	Native integral thread ID of this thread, or None if it has not been started.

daemon

property `IdleContainer.`**`daemon`**

A boolean value indicating whether this thread is a daemon thread.

This must be set before start() is called, otherwise RuntimeError is raised. Its initial value is inherited from the creating thread; the main thread is not a daemon thread and therefore all threads created in the main thread default to daemon = False.

The entire Python program exits when only daemon threads are left.

ident

property `IdleContainer.`**`ident`**

Thread identifier of this thread or None if it has not been started.

This is a nonzero integer. See the get_ident() function. Thread identifiers may be recycled when a thread exits and another thread is created. The identifier is available even after the thread has exited.

name

property IdleContainer.**name**

A string used for identification purposes only.

It has no semantics. Multiple threads may be given the same name. The initial name is set by the constructor.

native_id

property IdleContainer.**native_id**

Native integral thread ID of this thread, or None if it has not been started.

This is a non-negative integer. See the get_native_id() function. This represents the Thread ID as reported by the kernel.

run()

Method representing the thread's activity.

You may override this method in a subclass. The standard run() method invokes the callable object passed to the object's constructor as the target argument, if any, with sequential and keyword arguments taken from the args and kwargs arguments, respectively.

NoView

class NoView

Methods

__init__	

__init__

NoView.**__init__**()

__init__()

ReverseProxied

class ReverseProxied(*app*, *script_name*)

Methods

`__init__`	

__init__

`ReverseProxied.__init__`(*app*, *script_name*)

`__init__`(*app*, *script_name*)

ServerThread

`class ServerThread`(*application*, *threaded=True*, ***kwargs*)

Methods

`__init__`	This constructor should always be called with keyword arguments.
`getName`	Return a string used for identification purposes only.
`isDaemon`	Return whether this thread is a daemon.
`is_alive`	Return whether the thread is alive.
`join`	Wait until the thread terminates.
`run`	Method representing the thread's activity.
`setDaemon`	Set whether this thread is a daemon.
`setName`	Set the name string for this thread.
`shutdown`	
`start`	Start the thread's activity.

__init__

`ServerThread.__init__`(*application*, *threaded=True*, ***kwargs*)

This constructor should always be called with keyword arguments. Arguments are:

group should be None; reserved for future extension when a ThreadGroup class is implemented.

target is the callable object to be invoked by the run() method. Defaults to None, meaning nothing is called.

name is the thread name. By default, a unique name is constructed of the form "Thread-N" where N is a small decimal number.

args is a list or tuple of arguments for the target invocation. Defaults to ().

kwargs is a dictionary of keyword arguments for the target invocation. Defaults to {}.

If a subclass overrides the constructor, it must make sure to invoke the base class constructor (Thread.__init__()) before doing anything else to the thread.

getName

`ServerThread.getName()`

Return a string used for identification purposes only.

This method is deprecated, use the name attribute instead.

isDaemon

`ServerThread.isDaemon()`

Return whether this thread is a daemon.

This method is deprecated, use the daemon attribute instead.

is_alive

`ServerThread.is_alive()`

Return whether the thread is alive.

This method returns True just before the run() method starts until just after the run() method terminates. See also the module function enumerate().

join

`ServerThread.join(timeout=None)`

Wait until the thread terminates.

This blocks the calling thread until the thread whose join() method is called terminates – either normally or through an unhandled exception or until the optional timeout occurs.

When the timeout argument is present and not None, it should be a floating point number specifying a timeout for the operation in seconds (or fractions thereof). As join() always returns None, you must call is_alive() after join() to decide whether a timeout happened – if the thread is still alive, the join() call timed out.

When the timeout argument is not present or None, the operation will block until the thread terminates.

A thread can be join()ed many times.

join() raises a RuntimeError if an attempt is made to join the current thread as that would cause a deadlock. It is also an error to join() a thread before it has been started and attempts to do so raises the same exception.

run

`ServerThread.run()`

Method representing the thread's activity.

You may override this method in a subclass. The standard run() method invokes the callable object passed to the object's constructor as the target argument, if any, with sequential and keyword arguments taken from the args and kwargs arguments, respectively.

setDaemon

`ServerThread.setDaemon(daemonic)`

Set whether this thread is a daemon.

This method is deprecated, use the .daemon property instead.

setName

`ServerThread.setName(name)`

Set the name string for this thread.

This method is deprecated, use the name attribute instead.

shutdown

`ServerThread.shutdown()`

start

`ServerThread.start()`

Start the thread's activity.

It must be called at most once per thread object. It arranges for the object's run() method to be invoked in a separate thread of control.

This method will raise a RuntimeError if called more than once on the same thread object.

`__init__(application, threaded=True, **kwargs)`

This constructor should always be called with keyword arguments. Arguments are:

group should be None; reserved for future extension when a ThreadGroup class is implemented.

target is the callable object to be invoked by the run() method. Defaults to None, meaning nothing is called.

name is the thread name. By default, a unique name is constructed of the form "Thread-N" where N is a small decimal number.

args is a list or tuple of arguments for the target invocation. Defaults to ().

kwargs is a dictionary of keyword arguments for the target invocation. Defaults to {}.

If a subclass overrides the constructor, it must make sure to invoke the base class constructor (Thread.__init__()) before doing anything else to the thread.

Attributes

daemon	A boolean value indicating whether this thread is a daemon thread.
ident	Thread identifier of this thread or None if it has not been started.
name	A string used for identification purposes only.
native_id	Native integral thread ID of this thread, or None if it has not been started.

daemon

property ServerThread.**daemon**

A boolean value indicating whether this thread is a daemon thread.

This must be set before start() is called, otherwise RuntimeError is raised. Its initial value is inherited from the creating thread; the main thread is not a daemon thread and therefore all threads created in the main thread default to daemon = False.

The entire Python program exits when only daemon threads are left.

ident

property ServerThread.**ident**

Thread identifier of this thread or None if it has not been started.

This is a nonzero integer. See the get_ident() function. Thread identifiers may be recycled when a thread exits and another thread is created. The identifier is available even after the thread has exited.

name

property ServerThread.**name**

A string used for identification purposes only.

It has no semantics. Multiple threads may be given the same name. The initial name is set by the constructor.

native_id

property ServerThread.**native_id**

Native integral thread ID of this thread, or None if it has not been started.

This is a non-negative integer. See the get_native_id() function. This represents the Thread ID as reported by the kernel.

run()

Method representing the thread's activity.

You may override this method in a subclass. The standard run() method invokes the callable object passed to the object's constructor as the target argument, if any, with sequential and keyword arguments taken from the args and kwargs arguments, respectively.

Site

class Site(*sitemap*, *host='localhost'*, *port=0*, *delay=0.1*, *until=30*, *run_options=None*, *idle_timeout=0*, *url_prefix=None*, ***kwargs*)

Methods

`__init__`	
`alive_view`	
`app`	
`format`	
`get_port`	
`run`	
`shutdown_site`	
`update_last_activity`	
`wait_server`	

__init__

Site.**__init__**(*sitemap*, *host='localhost'*, *port=0*, *delay=0.1*, *until=30*, *run_options=None*, *idle_timeout=0*, *url_prefix=None*, ***kwargs*)

alive_view

static Site.**alive_view**()

app

Site.**app**()

format

`Site.format(string)`

get_port

`Site.get_port(host=None, port=None, **kw)`

run

`Site.run(**options)`

shutdown_site

`static Site.shutdown_site(shutdown, subsites)`

update_last_activity

`Site.update_last_activity(response=None)`

wait_server

`Site.wait_server(elapsed=0)`

`__init__(sitemap, host='localhost', port=0, delay=0.1, until=30, run_options=None, idle_timeout=0, url_prefix=None, **kwargs)`

Attributes

is_running
url

is_running

`property Site.is_running`

url

property Site.**url**

SiteFolder

class SiteFolder(*item*, *dsp*, *graph*, *obj*, *name=''*, *workflow=False*, *digraph=None*, *parent=None*, *short_name=None*, ***options*)

Methods

`__init__`	
`counter`	Implement next(self).
`dot`	
`view`	

__init__

SiteFolder.**__init__**(*item*, *dsp*, *graph*, *obj*, *name=''*, *workflow=False*, *digraph=None*, *parent=None*, *short_name=None*, ***options*)

counter

SiteFolder.**counter**()

Implement next(self).

dot

SiteFolder.**dot**(*context=None*)

view

SiteFolder.**view**(*filepath*, *context=None*, *viz=False*, ***kwargs*)

__init__(*item*, *dsp*, *graph*, *obj*, *name=''*, *workflow=False*, *digraph=None*, *parent=None*, *short_name=None*, ***options*)

Attributes

digraph
ext
filename
inputs
label_name
name
outputs
title
view_id

digraph

SiteFolder.**digraph = {'body': {'splines': 'ortho', 'style': 'filled'}, 'edge_attr': {}, 'format': 'svg', 'graph_attr': {'bgcolor': 'transparent', 'nslimit': '1', 'nslimit1': '1'}, 'node_attr': {'style': 'filled'}}**

ext

SiteFolder.**ext = 'html'**

filename

property SiteFolder.**filename**

inputs

property SiteFolder.**inputs**

label_name

`property SiteFolder.label_name`

name

`property SiteFolder.name`

outputs

`property SiteFolder.outputs`

title

`property SiteFolder.title`

view_id

`property SiteFolder.view_id`

`counter()`

Implement next(self).

SiteIndex

`class SiteIndex(sitemap, node_id='index')`

Methods

`__init__`	
`counter`	Implement next(self).
`legend`	
`render`	
`view`	

__init__

`SiteIndex.__init__(sitemap, node_id='index')`

counter

`SiteIndex.counter()`

Implement next(self).

legend

`static SiteIndex.legend(viz=False, executor='async', **kwargs)`

render

`SiteIndex.render(context, *args, **kwargs)`

view

`SiteIndex.view(filepath, *args, **kwargs)`

`__init__(sitemap, node_id='index')`

Attributes

ext
filename
name
pprint
title
view_id

ext

`SiteIndex.ext = 'html'`

filename

`property SiteIndex.filename`

name

`property SiteIndex.name`

pprint

`SiteIndex.pprint = <pprint.PrettyPrinter object>`

title

`property SiteIndex.title`

view_id

`property SiteIndex.view_id`

SiteMap

`class SiteMap`

Methods

`__init__`	
`add_items`	
`app`	
`basic_app`	
`clear`	
`copy`	
`fromkeys`	Create a new ordered dictionary with keys from iterable and values set to value.
`get`	Return the value for key if key is in the dictionary, else default.
`get_directory`	
`get_dsp_from`	
`get_sol_from`	
`items`	
`keys`	
`move_to_end`	Move an existing element to the end (or beginning if last is false).
`pop`	If the key is not found, return the default if given; otherwise, raise a KeyError.
`popitem`	Remove and return a (key, value) pair from the dictionary.
`render`	
`rules`	
`setdefault`	Insert key with a value of default if key is not in the dictionary.
`site`	
`update`	If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]
`values`	

__init__

SiteMap.**__init__**()

add_items

SiteMap.**add_items**(*item*, *workflow=False*, *depth=-1*, *folder=None*, *memo=None*, ***options*)

app

SiteMap.**app**(*root_path=None*, *depth=-1*, *index=True*, *mute=True*, *viz_js=False*, *executor='async'*, *blueprint_name=None*, ***kw*)

basic_app

SiteMap.**basic_app**(*root_path*, *mute=True*, *blueprint_name=None*, ***kwargs*)

clear

SiteMap.**clear**() → None. Remove all items from od.

copy

SiteMap.**copy**() → a shallow copy of od

fromkeys

SiteMap.**fromkeys**(*value=None*)

Create a new ordered dictionary with keys from iterable and values set to value.

get

SiteMap.**get**(*key*, *default=None*, */*)

Return the value for key if key is in the dictionary, else default.

get_directory

SiteMap.**get_directory**(*directory*)

get_dsp_from

static SiteMap.**get_dsp_from**(*item*)

get_sol_from

static SiteMap.**get_sol_from**(*item*)

items

SiteMap.**items**() → a set-like object providing a view on D's items

keys

SiteMap.**keys**() → a set-like object providing a view on D's keys

move_to_end

SiteMap.**move_to_end**(*key*, *last=True*)

Move an existing element to the end (or beginning if last is false).

Raise KeyError if the element does not exist.

pop

SiteMap.**pop**(*key*[, *default*]) → v, remove specified key and return the corresponding value.

If the key is not found, return the default if given; otherwise, raise a KeyError.

popitem

SiteMap.**popitem**(*last=True*)

Remove and return a (key, value) pair from the dictionary.

Pairs are returned in LIFO order if last is true or FIFO order if false.

render

SiteMap.**render**(*depth=-1*, *directory='static'*, *view=False*, *index=True*, *viz=False*, *viz_js=False*, *executor='async'*)

rules

SiteMap.**rules**(*depth=-1*, *index=True*, *viz_js=False*)

setdefault

SiteMap.**setdefault**(*key*, *default=None*)

Insert key with a value of default if key is not in the dictionary.

Return the value for key if key is in the dictionary, else default.

site

SiteMap.**site**(*root_path=None*, *depth=-1*, *index=True*, *view=False*, *run=False*, ***kw*)

update

SiteMap.**update**([*E*,]***F*) → None. Update D from dict/iterable E and F.

If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]

values

SiteMap.**values**() → an object providing a view on D's values

__init__()

Attributes

blueprint_name
directory
include_folders_as_filenames
nodes
options
short_name

blueprint_name

`SiteMap.blueprint_name = None`

directory

`SiteMap.directory = None`

include_folders_as_filenames

`SiteMap.include_folders_as_filenames = True`

nodes

`property SiteMap.nodes`

options

`SiteMap.options = {'digraph', 'edge_data', 'max_lines', 'max_width', 'node_data', 'node_function', 'node_styles'}`

short_name

`SiteMap.short_name = None`

SiteNode

class SiteNode(*folder*, *node_id*, *item*, *obj*, *dsp_node_id*, *short_name=None*)

Methods

__init__	
counter	Implement next(self).
render	
view	

__init__

SiteNode.**__init__**(*folder*, *node_id*, *item*, *obj*, *dsp_node_id*, *short_name=None*)

counter

SiteNode.**counter**()

Implement next(self).

render

SiteNode.**render**(**args*, ***kwargs*)

view

SiteNode.**view**(*filepath*, **args*, ***kwargs*)

__init__(*folder*, *node_id*, *item*, *obj*, *dsp_node_id*, *short_name=None*)

Attributes

ext
filename
name
pprint
title
view_id

ext

SiteNode.**ext** = **'html'**

filename

property SiteNode.**filename**

name

property SiteNode.**name**

pprint

SiteNode.**pprint** = **<pprint.PrettyPrinter object>**

title

property SiteNode.**title**

view_id

property SiteNode.**view_id**

counter()

Implement next(self).

SiteViz

class SiteViz(*sitemap*, *node_id='viz'*)

Methods

__init__	
counter	Implement next(self).
render	
view	

__init__

SiteViz.**__init__**(*sitemap*, *node_id='viz'*)

counter

SiteViz.**counter**()

Implement next(self).

render

SiteViz.**render**(*context*, **args*, ***kwargs*)

view

SiteViz.**view**(*filepath*, **args*, ***kwargs*)

__init__(*sitemap*, *node_id='viz'*)

Attributes

ext
filename
name
pprint
title
view_id

ext

SiteViz.**ext** = **'js'**

filename

property SiteViz.**filename**

name

property SiteViz.**name**

pprint

SiteViz.**pprint** = <pprint.PrettyPrinter object>

title

property SiteViz.**title**

view_id

property SiteViz.**view_id**

7.2.8 dsp

It provides tools to create models with the *Dispatcher*.

Functions

add_function	Decorator to add a function to a dispatcher.
are_in_nested_dicts	Nested keys are inside of nested-dictionaries.
bypass	Returns the same arguments.
combine_dicts	Combines multiple dicts in one.
combine_nested_dicts	Merge nested-dictionaries.
get_nested_dicts	Get/Initialize the value of nested-dictionaries.
kk_dict	Merges and defines dictionaries with values identical to keys.
map_dict	Returns a dict with new key values.
map_list	Returns a new dict.
parent_func	Return the parent function of a wrapped function (wrapped with `functools.partial` and *add_args*).
replicate_value	Replicates *n* times the input value.
selector	Selects the chosen dictionary keys from the given dictionary.
stack_nested_keys	Stacks the keys of nested-dictionaries into tuples and yields a list of k-v pairs.
stlp	Converts a string in a tuple.
summation	Sums inputs values.

add_function

add_function(*dsp*, *inputs_kwargs=False*, *inputs_defaults=False*, ***kw*)

Decorator to add a function to a dispatcher.

Parameters

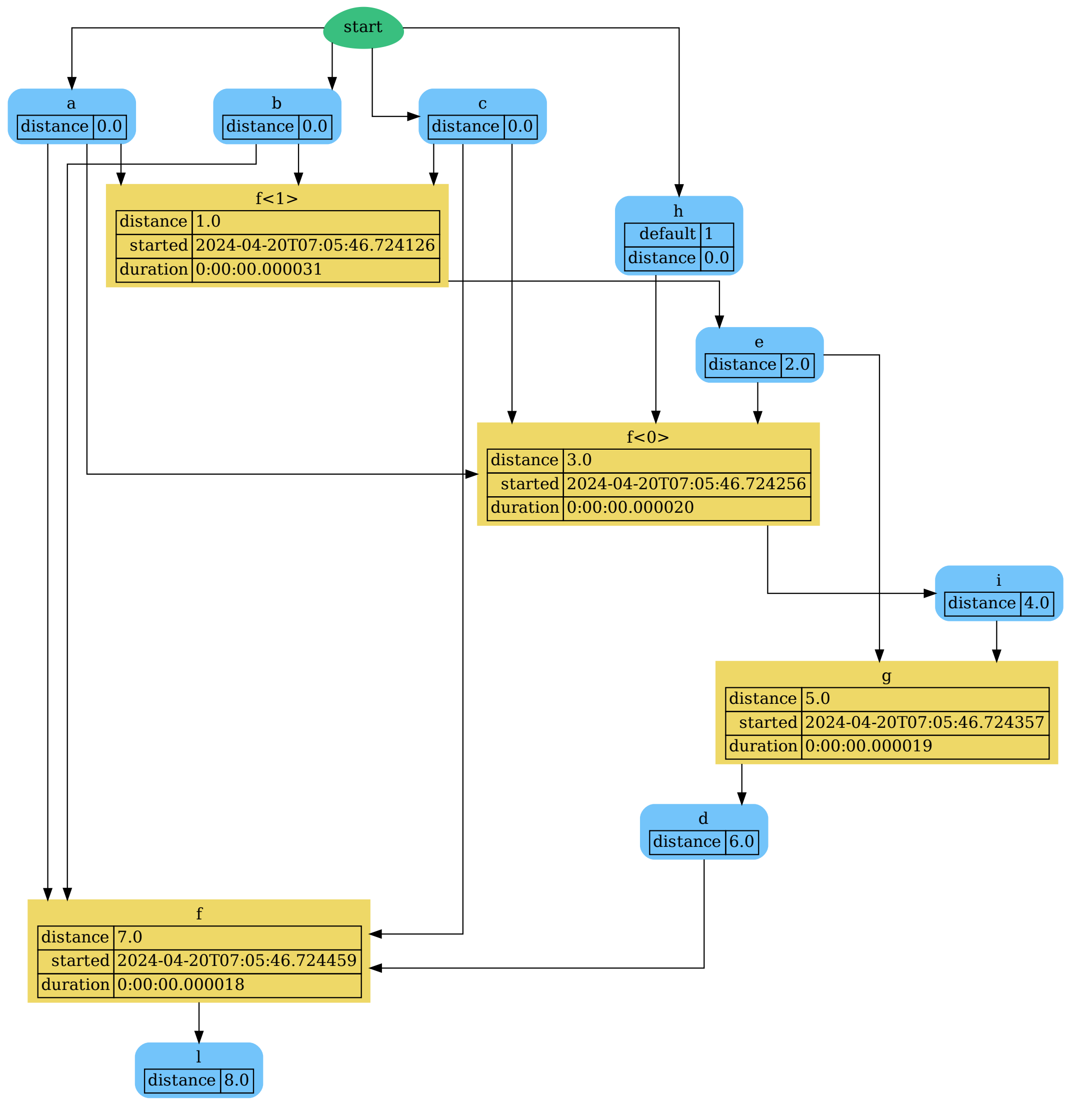
- **dsp** (*schedula.Dispatcher | schedula.blue.BlueDispatcher*) – A dispatcher.
- **inputs_kwargs** (*bool*) – Do you want to include kwargs as inputs?
- **inputs_defaults** (*bool*) – Do you want to set default values?
- **kw** – See :func:~`schedula.dispatcher.Dispatcher.add_function`.

Returns
Decorator.

Return type
callable

Example:

```
>>> import schedula as sh
>>> dsp = sh.Dispatcher(name='Dispatcher')
>>> @sh.add_function(dsp, outputs=['e'])
... @sh.add_function(dsp, False, True, outputs=['i'], inputs='ecah')
... @sh.add_function(dsp, True, outputs=['l'])
... def f(a, b, c, d=1):
...     return (a + b) - c + d
>>> @sh.add_function(dsp, True, outputs=['d'])
... def g(e, i, *args, d=0):
...     return e + i + d
>>> sol = dsp({'a': 1, 'b': 2, 'c': 3}); sol
Solution([('a', 1), ('b', 2), ('c', 3), ('h', 1), ('e', 1), ('i', 4),
          ('d', 5), ('l', 5)])
```



workflow

are_in_nested_dicts

are_in_nested_dicts(*nested_dict*, **keys*)

Nested keys are inside of nested-dictionaries.

Parameters

- **nested_dict** (*dict*) – Nested dictionary.
- **keys** (*object*) – Nested keys.

Returns

True if nested keys are inside of nested-dictionaries, otherwise False.

Return type

bool

bypass

bypass(**inputs*, *copy=False*)

Returns the same arguments.

Parameters

- **inputs** (*T*) – Inputs values.
- **copy** (*bool, optional*) – If True, it returns a deepcopy of input values.

Returns

Same input values.

Return type

(T, …), T

Example:

```
>>> bypass('a', 'b', 'c')
('a', 'b', 'c')
>>> bypass('a')
'a'
```

combine_dicts

combine_dicts(**dicts*, *copy=False*, *base=None*)

Combines multiple dicts in one.

Parameters

- **dicts** (*dict*) – A sequence of dicts.
- **copy** (*bool, optional*) – If True, it returns a deepcopy of input values.
- **base** (*dict, optional*) – Base dict where combine multiple dicts in one.

Returns

A unique dict.

Return type

dict

Example:

```
>>> sorted(combine_dicts({'a': 3, 'c': 3}, {'a': 1, 'b': 2}).items())
[('a', 1), ('b', 2), ('c', 3)]
```

combine_nested_dicts

combine_nested_dicts(**nested_dicts*, *depth=-1*, *base=None*)

Merge nested-dictionaries.

Parameters

- **nested_dicts** (*dict*) – Nested dictionaries.
- **depth** (*int, optional*) – Maximum keys depth.
- **base** (*dict, optional*) – Base dict where combine multiple dicts in one.

Returns

Combined nested-dictionary.

Return type
dict

get_nested_dicts

get_nested_dicts(*nested_dict*, **keys*, *default=None*, *init_nesting=<class 'dict'>*)

Get/Initialize the value of nested-dictionaries.

Parameters

- **nested_dict** (*dict*) – Nested dictionary.
- **keys** (*object*) – Nested keys.
- **default** (*callable, optional*) – Function used to initialize a new value.
- **init_nesting** (*callable, optional*) – Function used to initialize a new intermediate nesting dict.

Returns
Value of nested-dictionary.

Return type
generator

kk_dict

kk_dict(**kk*, ***adict*)

Merges and defines dictionaries with values identical to keys.

Parameters

- **kk** (*object | dict, optional*) – A sequence of keys and/or dictionaries.
- **adict** (*dict, optional*) – A dictionary.

Returns
Merged dictionary.

Return type
dict

Example:

```
>>> sorted(kk_dict('a', 'b', 'c').items())
[('a', 'a'), ('b', 'b'), ('c', 'c')]

>>> sorted(kk_dict('a', 'b', **{'a-c': 'c'}).items())
[('a', 'a'), ('a-c', 'c'), ('b', 'b')]

>>> sorted(kk_dict('a', {'b': 'c'}, 'c').items())
[('a', 'a'), ('b', 'c'), ('c', 'c')]

>>> sorted(kk_dict('a', 'b', **{'b': 'c'}).items())
Traceback (most recent call last):
 ...
ValueError: keyword argument repeated (b)
>>> sorted(kk_dict({'a': 0, 'b': 1}, **{'b': 2, 'a': 3}).items())
Traceback (most recent call last):
```

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```
...
ValueError: keyword argument repeated (a, b)
```

map_dict

map_dict(*key_map*, **dicts*, *copy=False*, *base=None*)

Returns a dict with new key values.

Parameters

- **key_map** (*dict*) – A dictionary that maps the dict keys ({old key: new key}.
- **dicts** (*dict*) – A sequence of dicts.
- **copy** (*bool, optional*) – If True, it returns a deepcopy of input values.
- **base** (*dict, optional*) – Base dict where combine multiple dicts in one.

Returns

A unique dict with new key values.

Return type

dict

Example:

```
>>> d = map_dict({'a': 'c', 'b': 'd'}, {'a': 1, 'b': 1}, {'b': 2})
>>> sorted(d.items())
[('c', 1), ('d', 2)]
```

map_list

map_list(*key_map*, **inputs*, *copy=False*, *base=None*)

Returns a new dict.

Parameters

- **key_map** (*list[str | dict | list]*) – A list that maps the dict keys ({old key: new key}
- **inputs** (*iterable | dict | int | float | list | tuple*) – A sequence of data.
- **copy** (*bool, optional*) – If True, it returns a deepcopy of input values.
- **base** (*dict, optional*) – Base dict where combine multiple dicts in one.

Returns

A unique dict with new values.

Return type

dict

Example:

```
>>> key_map = [
...     'a',
...     {'a': 'c'},
...     [
```

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```
...         'a',
...         {'a': 'd'}
...     ]
... ]
>>> inputs = (
...     2,
...     {'a': 3, 'b': 2},
...     [
...         1,
...         {'a': 4}
...     ]
... )
>>> d = map_list(key_map, *inputs)
>>> sorted(d.items())
[('a', 1), ('b', 2), ('c', 3), ('d', 4)]
```

parent_func

parent_func(*func*, *input_id=None*)

Return the parent function of a wrapped function (wrapped with `functools.partial` and *add_args*).

Parameters

- **func** (*callable*) – Wrapped function.
- **input_id** (*int*) – Index of the first input of the wrapped function.

Returns
Parent function.

Return type
callable

replicate_value

replicate_value(*value*, *n=2*, *copy=True*)

Replicates *n* times the input value.

Parameters

- **n** (*int*) – Number of replications.
- **value** (*T*) – Value to be replicated.
- **copy** (*bool*) – If True the list contains deep-copies of the value.

Returns
A list with the value replicated *n* times.

Return type
list

Example:

```
>>> import schedula as sh
>>> fun = sh.partial(replicate_value, n=5)
>>> fun({'a': 3})
({'a': 3}, {'a': 3}, {'a': 3}, {'a': 3}, {'a': 3})
```

selector

selector(*keys*, *dictionary*, *copy=False*, *output_type='dict'*, *allow_miss=False*)

Selects the chosen dictionary keys from the given dictionary.

Parameters

- **keys** (*list, tuple, set*) – Keys to select.
- **dictionary** (*dict*) – A dictionary.
- **copy** (*bool*) – If True the output contains deep-copies of the values.
- **output_type** – Type of function output:
  - 'list': a list with all values listed in *keys*.
  - 'dict': a dictionary with any outputs listed in *keys*.
  - **'values': if output length == 1 return a single value otherwise a**
    tuple with all values listed in *keys*.

    type output_type
    str, optional
- **allow_miss** (*bool*) – If True it does not raise when some key is missing in the dictionary.

Returns
A dictionary with chosen dictionary keys if present in the sequence of dictionaries. These are combined with `combine_dicts()`.

Return type
dict

Example:

```
>>> import schedula as sh
>>> fun = sh.partial(selector, ['a', 'b'])
>>> sorted(fun({'a': 1, 'b': 2, 'c': 3}).items())
[('a', 1), ('b', 2)]
```

stack_nested_keys

stack_nested_keys(*nested_dict*, *key=()*, *depth=-1*)

Stacks the keys of nested-dictionaries into tuples and yields a list of k-v pairs.

Parameters

- **nested_dict** (*dict*) – Nested dictionary.
- **key** (*tuple, optional*) – Initial keys.
- **depth** (*int, optional*) – Maximum keys depth.

Returns
List of k-v pairs.

Return type
generator

stlp

stlp(*s*)

Converts a string in a tuple.

summation

summation(**inputs*)

Sums inputs values.

Parameters

inputs (*int*, *float*) – Inputs values.

Returns

Sum of the input values.

Return type

int, float

Example:

```
>>> summation(1, 3.0, 4, 2)
10.0
```

Classes

DispatchPipe	It converts a *Dispatcher* into a function.
MapDispatch	It dynamically builds a *Dispatcher* that is used to invoke recursivelly a *dispatching function* that is defined by a constructor function that takes a *dsp* base model as input.
NoSub	Class for avoiding to add a sub solution to the workflow.
SubDispatch	It dispatches a given *Dispatcher* like a function.
SubDispatchFunction	It converts a *Dispatcher* into a function.
SubDispatchPipe	It converts a *Dispatcher* into a function.
add_args	
inf	Class to model infinite numbers for workflow distance.
run_model	It is an utility function to execute dynamically generated function/models and - if Dispatcher based - add their workflows to the parent solution.

DispatchPipe

class DispatchPipe(*dsp=None*, **args*, ***kwargs*)

It converts a *Dispatcher* into a function.

This function takes a sequence of arguments as input of the dispatch.

Returns

A function that executes the pipe of the given *dsp*, updating its workflow.

Return type

callable

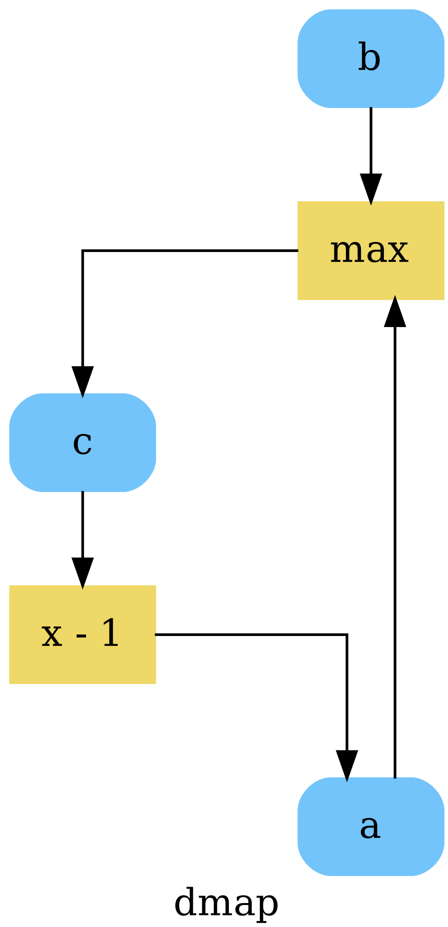
Note: This wrapper is not thread safe, because it overwrite the solution.

See also:

dispatch(), *shrink_dsp()*

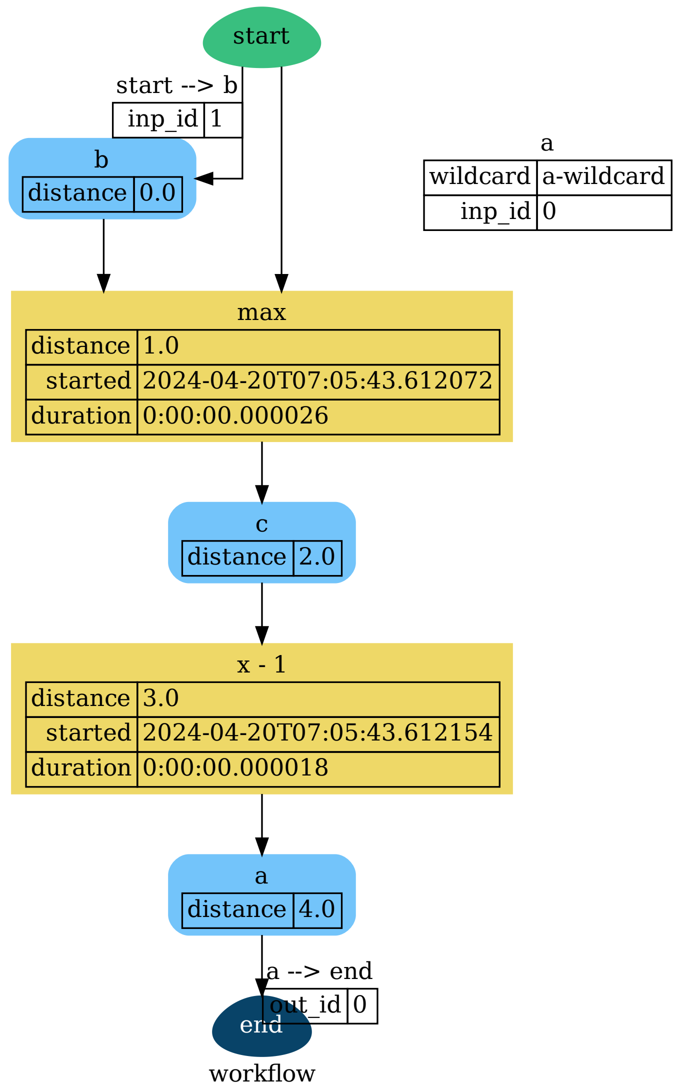
Example:

A dispatcher with two functions *max* and *min* and an unresolved cycle (i.e., *a* –> *max* –> *c* –> *min* –> *a*):



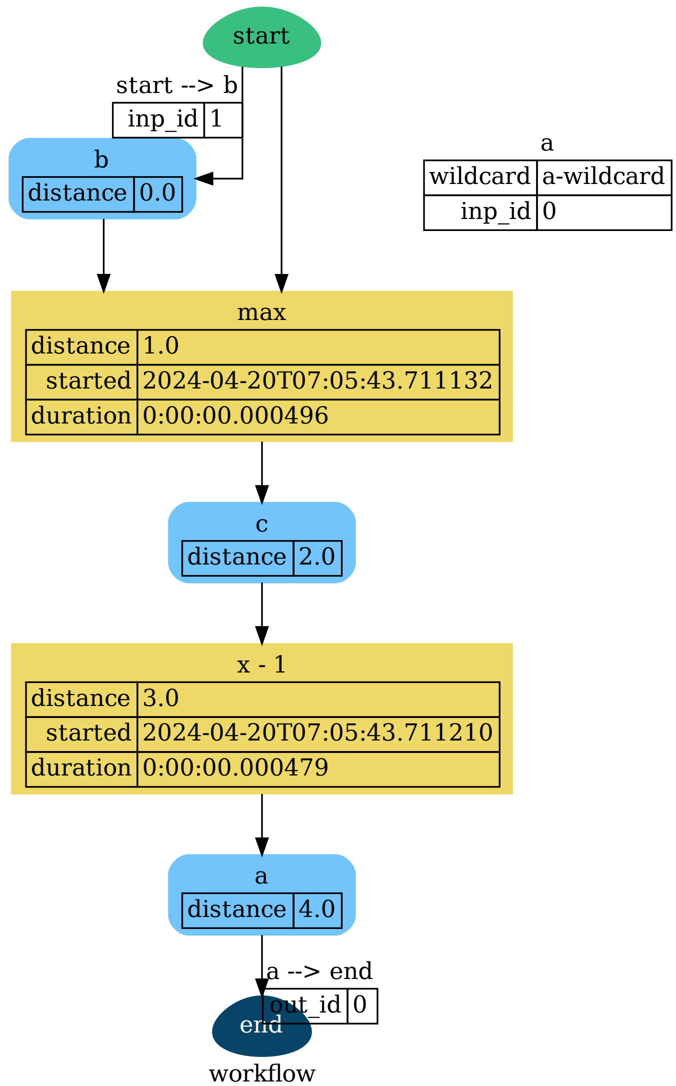
Extract a static function node, i.e. the inputs *a* and *b* and the output *a* are fixed:

```
>>> fun = DispatchPipe(dsp, 'myF', ['a', 'b'], ['a'])
>>> fun.__name__
'myF'
>>> fun(2, 1)
1
```



The created function raises a ValueError if un-valid inputs are provided:

```
>>> fun(1, 0)
0
```



Methods

__init__	Initializes the Sub-dispatch Function.
`blue`	Constructs a Blueprint out of the current object.
`copy`	
`form`	Creates a dispatcher Form Flask app.
`get_node`	Returns a sub node of a dispatcher.
plot	Plots the Dispatcher with a graph in the DOT language with Graphviz.
`web`	Creates a dispatcher Flask app.

__init__

DispatchPipe.**__init__**(*dsp*, *function_id=None*, *inputs=None*, *outputs=None*, *inputs_dist=None*, *no_domain=True*, *wildcard=True*, *shrink=True*, *output_type=None*, *output_type_kw=None*, *first_arg_as_kw=False*)

Initializes the Sub-dispatch Function.

Parameters

- **dsp** (*schedula.Dispatcher | schedula.utils.blue.BlueDispatcher*) – A dispatcher that identifies the model adopted.
- **function_id** (*str*) – Function name.
- **inputs** (*list[str], iterable*) – Input data nodes.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **no_domain** (*bool, optional*) – Skip the domain check.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **output_type** (*str, optional*) – Type of function output:
  - 'all': a dictionary with all dispatch outputs.
  - 'list': a list with all outputs listed in *outputs*.
  - 'dict': a dictionary with any outputs listed in *outputs*.
- **output_type_kw** (*bool*) – Extra kwargs to pass to the *selector* function.
- **first_arg_as_kw** – Converts first argument of the __call__ method as *kwargs*.

blue

DispatchPipe.**blue**(*memo=None*, *depth=-1*)

Constructs a Blueprint out of the current object.

Parameters

- **memo** (*dict[T,schedula.utils.blue.Blueprint]*) – A dictionary to cache Blueprints.
- **depth** (*int, optional*) – Depth of sub-dispatch blue. If negative all levels are bluprinted.

Returns

A Blueprint of the current object.

Return type

schedula.utils.blue.Blueprint

copy

DispatchPipe.**copy**()

form

DispatchPipe.**form**(*depth=1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *view=True*, *get_context=none*, *get_data=none*, *subsite_idle_timeout=600*, *basic_app_config=None*, *stripe_event_handler=<function Base.<lambda>>*)

Creates a dispatcher Form Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of Site to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?
- **view** (*bool, optional*) – Open the url site with the sys default opener.
- **get_context** (*function | dict, optional*) – Function to pass extra data as form context.
- **get_data** (*function | dict, optional*) – Function to initialize the formdata.
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.
- **basic_app_config** (*object, optional*) – Flask app config object.
- **stripe_event_handler** (*function, optional*) – Stripe event handler function.

Returns
A FormMap or a Site if *sites is None* and *run or view is True*.

Return type
FormMap | Site

get_node

DispatchPipe.**get_node**(**node_ids*, *node_attr=none*)

Returns a sub node of a dispatcher.

Parameters

- **node_ids** (*str*) – A sequence of node ids or a single node id. The id order identifies a dispatcher sub-level.

- **node_attr** (*str, None, optional*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  - for data node: its output, and if not exists, all its attributes.
  - for function and sub-dispatcher nodes: the 'function' attribute.

  When 'description', returns the "description" of the searched node, searching also in function or sub-dispatcher input/output description.

  When 'output', returns the data node output.

  When 'default_value', returns the data node default value.

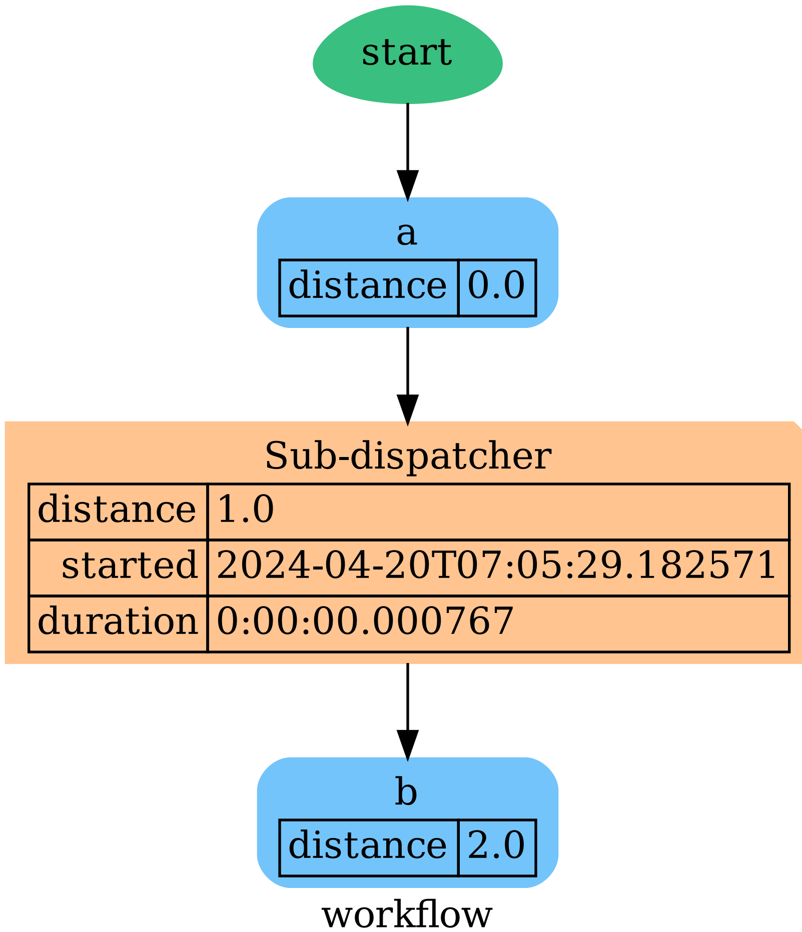
  When 'value_type', returns the data node value's type.

  When *None*, returns the node attributes.

Returns
Node attributes and its real path.

Return type
(T, (str, ...))

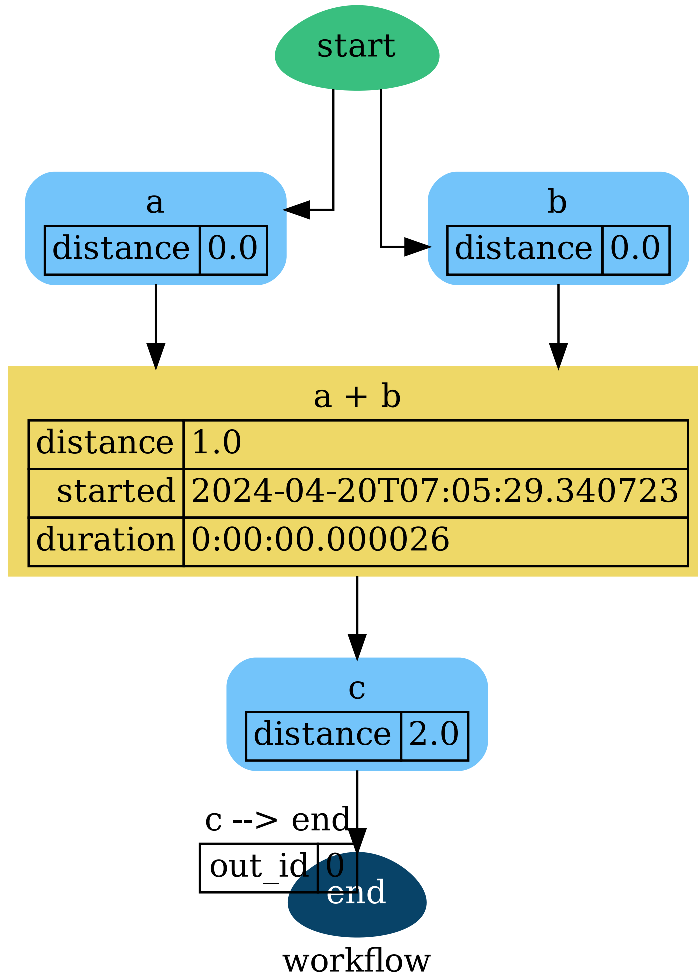
Example:



Get the sub node output:

```
>>> dsp.get_node('Sub-dispatcher', 'c')
(4, ('Sub-dispatcher', 'c'))
>>> dsp.get_node('Sub-dispatcher', 'c', node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

```
>>> sub_dsp, sub_dsp_id = dsp.get_node('Sub-dispatcher')
```



plot

DispatchPipe.**plot**(*workflow=None*, **args*, ***kwargs*)

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (*bool*, *optional*) – If True the latest solution will be plotted, otherwise the dmap.
- **view** (*bool*, *optional*) – Open the rendered directed graph in the DOT language with the sys default opener.
- **edge_data** (*tuple[str]*, *optional*) – Edge attributes to view.
- **node_data** (*tuple[str]*, *optional*) – Data node attributes to view.
- **node_function** (*tuple[str]*, *optional*) – Function node attributes to view.

- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int, optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.
- **name** (*str*) – Graph name used in the source code.
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str, optional*) – (Sub)directory for source saving and rendering.
- **format** (*str, optional*) – Rendering output format ('pdf', 'png', . . .).
- **engine** (*str, optional*) – Layout command used ('dot', 'neato', . . .).
- **encoding** (*str, optional*) – Encoding for saving the source.
- **graph_attr** (*dict, optional*) – Dict of (attribute, value) pairs for the graph.
- **node_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict, optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list, optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.
- **index** (*bool, optional*) – Add the site index as first page?
- **max_lines** (*int, optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int, optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool, optional*) – Render all pages statically?
- **viz** (*bool, optional*) – Use viz.js as back-end?
- **short_name** (*int, optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str, optional*) – Pool executor to render object.
- **run** (*bool, optional*) – Run the backend server?

Returns
A SiteMap or a Site if .

Return type
schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
```

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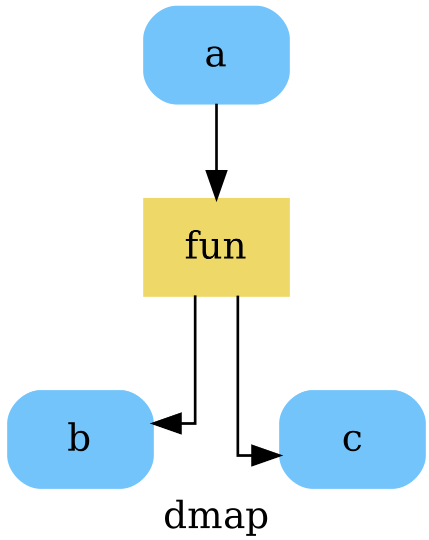
```
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



web

DispatchPipe.**web**(*depth=-1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *subsite_idle_timeout=600*)

Creates a dispatcher Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of Site to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.

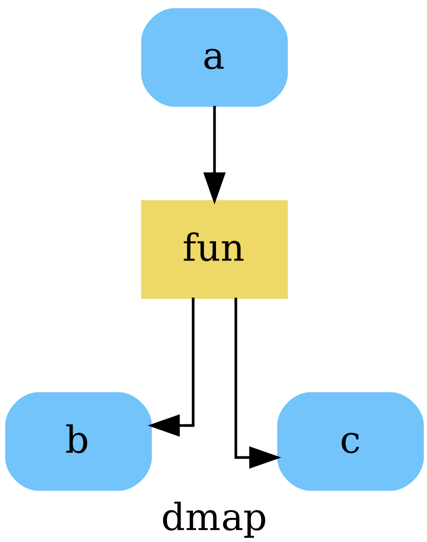
Returns
A WebMap.

Return type
WebMap

Example:

From a dispatcher like this:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
```



You can create a web server with the following steps:

```
>>> print("Starting...\n"); site = dsp.web(); site
Starting...
Site(WebMap([(Dispatcher, WebMap())]), host='localhost', ...)
>>> import requests
>>> url = '%s/%s/%s' % (site.url, dsp.name, fun.__name__)
>>> requests.post(url, json={'args': (0,)}).json()['return']
[1, -1]
>>> site.shutdown()  # Remember to shutdown the server.
True
```

Note: When `Site` is garbage collected, the server is shutdown automatically.

__init__(*dsp*, *function_id=None*, *inputs=None*, *outputs=None*, *inputs_dist=None*, *no_domain=True*, *wildcard=True*, *shrink=True*, *output_type=None*, *output_type_kw=None*, *first_arg_as_kw=False*)

Initializes the Sub-dispatch Function.

Parameters

- **dsp** (*schedula.Dispatcher | schedula.utils.blue.BlueDispatcher*) – A dispatcher that identifies the model adopted.
- **function_id** (*str*) – Function name.
- **inputs** (*list[str], iterable*) – Input data nodes.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **no_domain** (*bool, optional*) – Skip the domain check.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **output_type** (*str, optional*) – Type of function output:
  - 'all': a dictionary with all dispatch outputs.
  - 'list': a list with all outputs listed in *outputs*.
  - 'dict': a dictionary with any outputs listed in *outputs*.
- **output_type_kw** (*bool*) – Extra kwargs to pass to the *selector* function.
- **first_arg_as_kw** – Converts first argument of the __call__ method as *kwargs*.

Attributes

var_keyword

var_keyword

DispatchPipe.**var_keyword = None**

plot(*workflow=None*, **args*, ***kwargs*)

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (*bool, optional*) – If True the latest solution will be plotted, otherwise the dmap.
- **view** (*bool, optional*) – Open the rendered directed graph in the DOT language with the sys default opener.
- **edge_data** (*tuple[str], optional*) – Edge attributes to view.

- **node_data** (*tuple[str], optional*) – Data node attributes to view.
- **node_function** (*tuple[str], optional*) – Function node attributes to view.
- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int, optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.
- **name** (*str*) – Graph name used in the source code.
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str, optional*) – (Sub)directory for source saving and rendering.
- **format** (*str, optional*) – Rendering output format ('pdf', 'png', …).
- **engine** (*str, optional*) – Layout command used ('dot', 'neato', …).
- **encoding** (*str, optional*) – Encoding for saving the source.
- **graph_attr** (*dict, optional*) – Dict of (attribute, value) pairs for the graph.
- **node_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict, optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list, optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.
- **index** (*bool, optional*) – Add the site index as first page?
- **max_lines** (*int, optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int, optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool, optional*) – Render all pages statically?
- **viz** (*bool, optional*) – Use viz.js as back-end?
- **short_name** (*int, optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str, optional*) – Pool executor to render object.
- **run** (*bool, optional*) – Run the backend server?

Returns

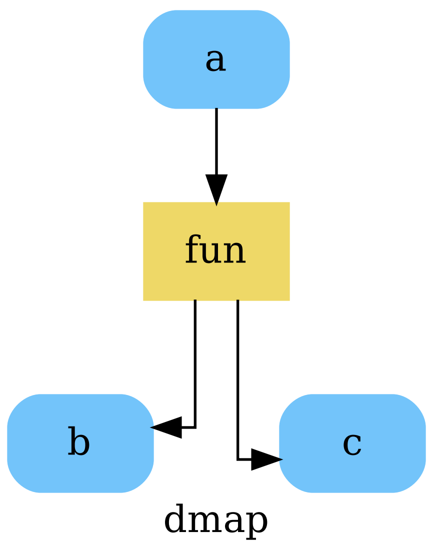
A SiteMap or a Site if .

Return type

schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



MapDispatch

class MapDispatch(*dsp=None*, **args*, ***kwargs*)

It dynamically builds a `Dispatcher` that is used to invoke recursivelly a *dispatching function* that is defined by a constructor function that takes a *dsp* base model as input.

The created function takes a list of dictionaries as input that are used to invoke the mapping function and returns a list of outputs.

Returns

A function that executes the dispatch of the given `Dispatcher`.

Return type

callable

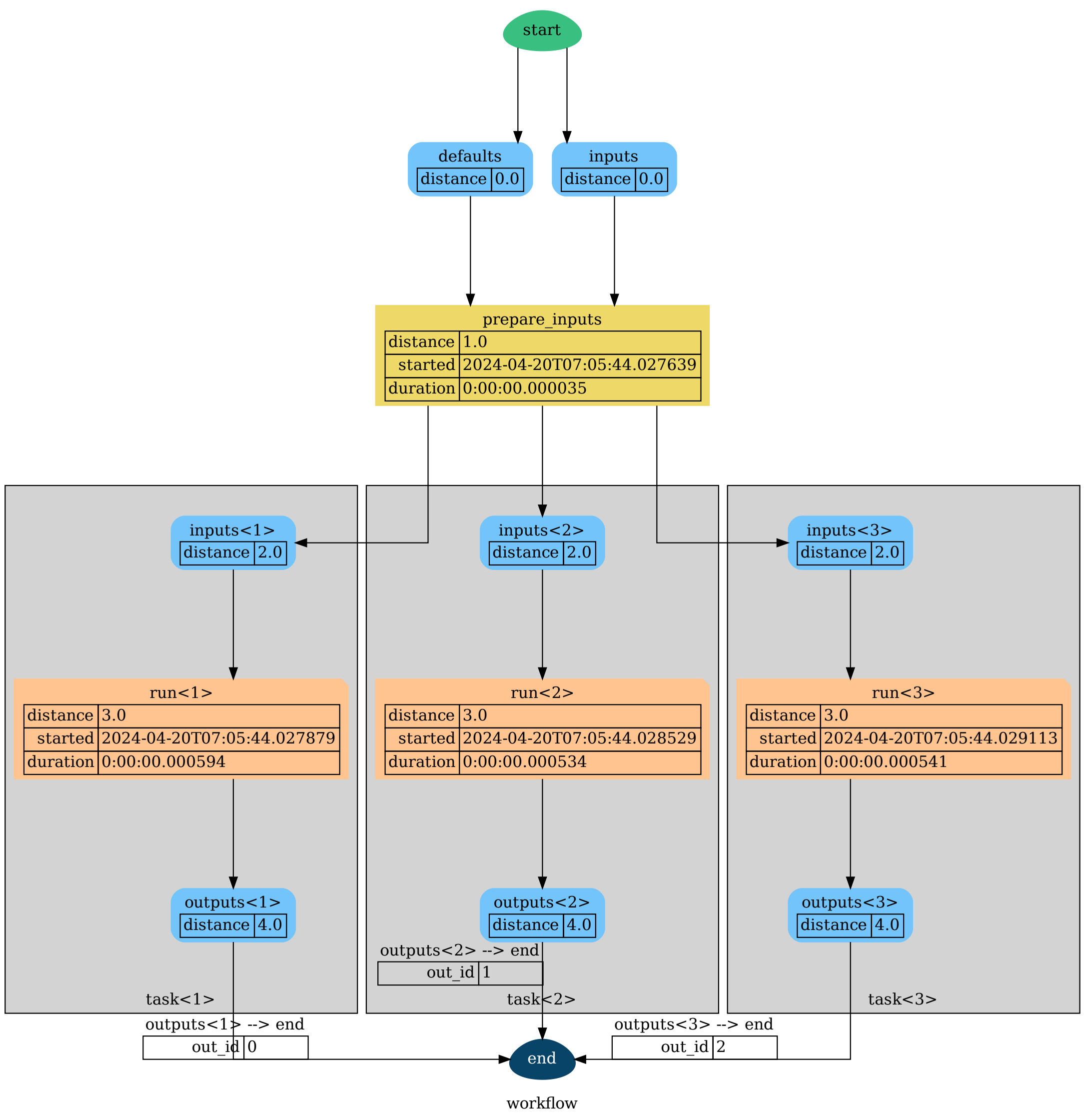
See also:

`SubDispatch()`

Example:

A simple example on how to use the `MapDispatch()`:

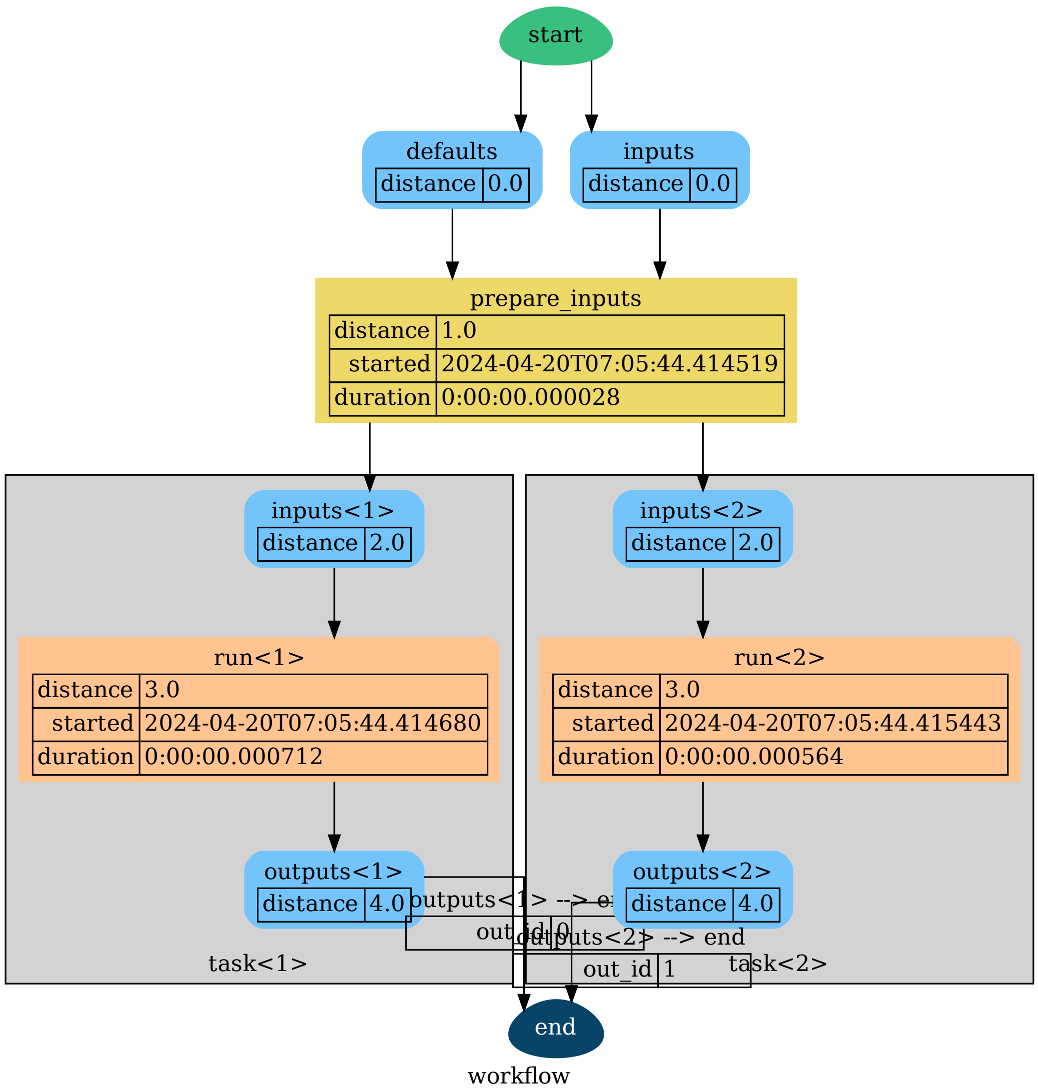
```
>>> from schedula import Dispatcher, MapDispatch
>>> dsp = Dispatcher(name='model')
...
>>> def fun(a, b):
...     return a + b, a - b
...
>>> dsp.add_func(fun, ['c', 'd'], inputs_kwargs=True)
'fun'
>>> map_func = MapDispatch(dsp, constructor_kwargs={
...     'outputs': ['c', 'd'], 'output_type': 'list'
... })
>>> map_func([{'a': 1, 'b': 2}, {'a': 2, 'b': 2}, {'a': 3, 'b': 2}])
[[3, -1], [4, 0], [5, 1]]
```



The execution model is created dynamically according to the length of the provided inputs. Moreover, the

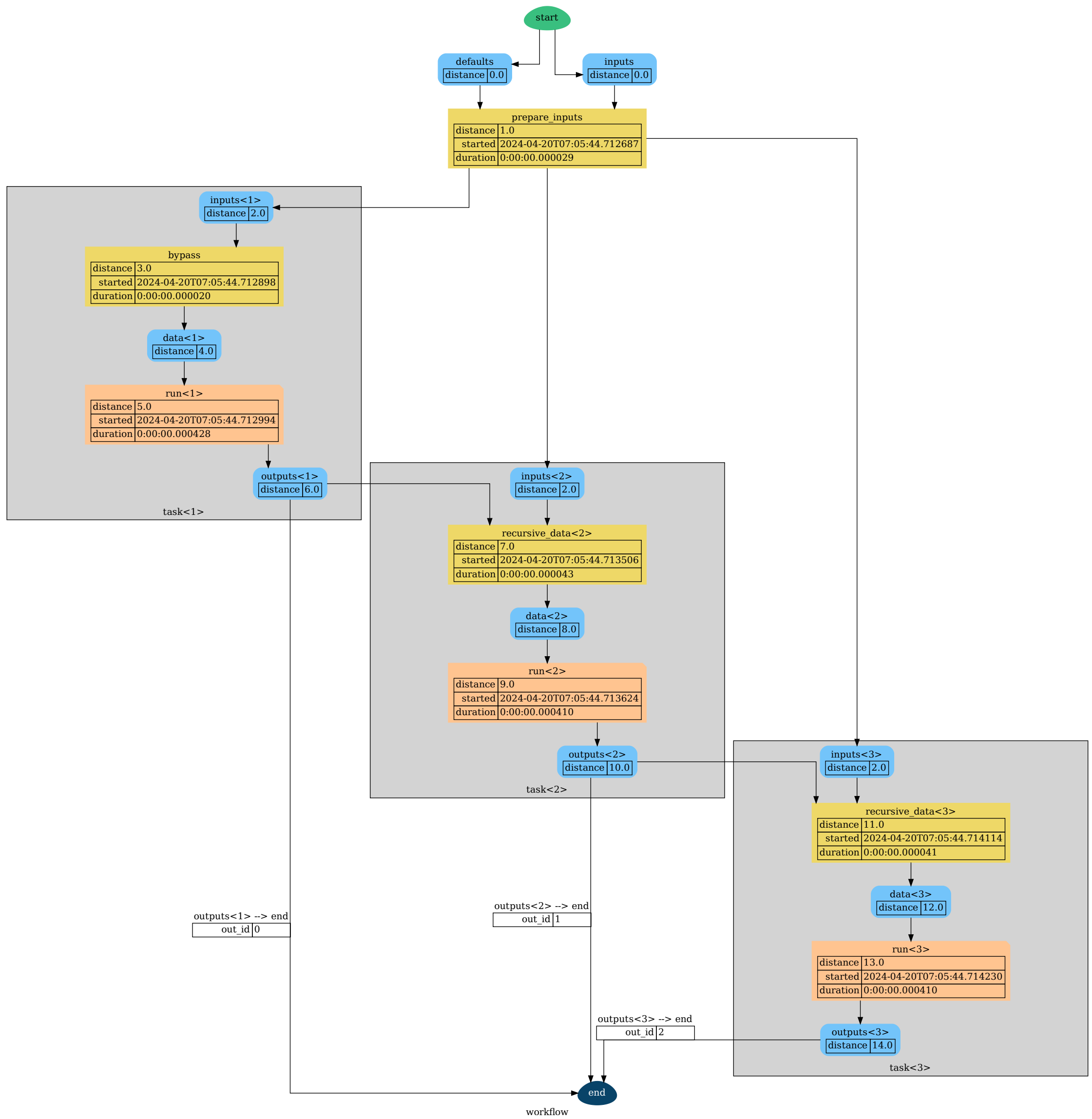
MapDispatch() has the possibility to define default values, that are recursively merged with the input provided to the *dispatching function* as follow:

```
>>> map_func([{'a': 1}, {'a': 3, 'b': 3}], defaults={'b': 2})
[[3, -1], [6, 0]]
```



The *MapDispatch()* can also be used as a partial reducing function, i.e., part of the outpus of the previous step are used as input for the successive execution of the *dispatching function*. For example:

```
>>> map_func = MapDispatch(dsp, recursive_inputs={'c': 'b'})
>>> map_func([{'a': 1, 'b': 1}, {'a': 2}, {'a': 3}])
[Solution([('a', 1), ('b', 1), ('c', 2), ('d', 0)]),
 Solution([('a', 2), ('b', 2), ('c', 4), ('d', 0)]),
 Solution([('a', 3), ('b', 4), ('c', 7), ('d', -1)])]
```


start
defaults
distance 0.0
inputs
distance 0.0
prepare_inputs
distance 1.0
started 2024-04-20T07:05:44.712687
duration 0:00:00.000029
inputs<1>
distance 2.0
bypass
distance 3.0
started 2024-04-20T07:05:44.712898
duration 0:00:00.000020
data<1>
distance 4.0
run<1>
distance 5.0
started 2024-04-20T07:05:44.712994
duration 0:00:00.000428
outputs<1>
distance 6.0
task<1>
inputs<2>
distance 2.0
recursive_data<2>
distance 7.0
started 2024-04-20T07:05:44.713506
duration 0:00:00.000043
data<2>
distance 8.0
run<2>
distance 9.0
started 2024-04-20T07:05:44.713624
duration 0:00:00.000410
outputs<2>
distance 10.0
task<2>
inputs<3>
distance 2.0
recursive_data<3>
distance 11.0
started 2024-04-20T07:05:44.714114
duration 0:00:00.000041
data<3>
distance 12.0
run<3>
distance 13.0
started 2024-04-20T07:05:44.714230
duration 0:00:00.000410
outputs<3>
distance 14.0
task<3>
outputs<1> --> end
out_id 0
outputs<2> --> end
out_id 1
outputs<3> --> end
out_id 2
end
workflow

Methods

__init__	Initializes the MapDispatch function.
blue	Constructs a Blueprint out of the current object.
copy	
form	Creates a dispatcher Form Flask app.
format_clusters	
format_labels	
get_node	Returns a sub node of a dispatcher.
plot	Plots the Dispatcher with a graph in the DOT language with Graphviz.
prepare_inputs	
recursive_data	
web	Creates a dispatcher Flask app.

__init__

MapDispatch.**__init__**(*dsp*, *defaults=None*, *recursive_inputs=None*, *constructor=<class 'schedula.utils.dsp.SubDispatch'>*, *constructor_kwargs=None*, *function_id=None*, *func_kw=<function MapDispatch.<lambda>>*, *input_label='inputs<{}>'*, *output_label='outputs<{}>'*, *data_label='data<{}>'*, *cluster_label='task<{}>'*, ***kwargs*)

Initializes the MapDispatch function.

Parameters

- **dsp** (*schedula.Dispatcher | schedula.utils.blue.BlueDispatcher*) – A dispatcher that identifies the base model.
- **defaults** (*dict*) – Defaults values that are recursively merged with the input provided to the *dispatching function*.
- **recursive_inputs** (*list | dict*) – List of data node ids that are extracted from the outputs of the *dispatching function* and then merged with the inputs of the its successive evaluation. If a dictionary is given, this is used to rename the data node ids extracted.
- **constructor** (*function | class*) – It initializes the *dispatching function*.
- **constructor_kwargs** (*function | class*) – Extra keywords passed to the constructor function.
- **function_id** (*str, optional*) – Function name.
- **func_kw** (*function, optional*) – Extra keywords to add the *dispatching function* to execution model.
- **input_label** (*str, optional*) – Custom label formatter for recursive inputs.
- **output_label** (*str, optional*) – Custom label formatter for recursive outputs.

- **data_label** (*str, optional*) – Custom label formatter for recursive internal data.
- **kwargs** (*object*) – Keywords to initialize the execution model.

blue

MapDispatch.**blue**(*memo=None*, *depth=-1*)

Constructs a Blueprint out of the current object.

Parameters

- **memo** (*dict[T,schedula.utils.blue.Blueprint]*) – A dictionary to cache Blueprints.
- **depth** (*int, optional*) – Depth of sub-dispatch blue. If negative all levels are bluprinted.

Returns
A Blueprint of the current object.

Return type
schedula.utils.blue.Blueprint

copy

MapDispatch.**copy**()

form

MapDispatch.**form**(*depth=1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *view=True*, *get_context=none*, *get_data=none*, *subsite_idle_timeout=600*, *basic_app_config=None*, *stripe_event_handler=<function Base.<lambda>>*)

Creates a dispatcher Form Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of Site to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?
- **view** (*bool, optional*) – Open the url site with the sys default opener.
- **get_context** (*function | dict, optional*) – Function to pass extra data as form context.
- **get_data** (*function | dict, optional*) – Function to initialize the formdata.

- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.
- **basic_app_config** (*object, optional*) – Flask app config object.
- **stripe_event_handler** (*function, optional*) – Stripe event handler function.

Returns
A FormMap or a Site if *sites is None* and *run or view is True*.

Return type
FormMap | Site

format_clusters

`static MapDispatch.format_clusters(it, label)`

format_labels

`static MapDispatch.format_labels(it, label)`

get_node

`MapDispatch.get_node(*node_ids, node_attr=none)`

Returns a sub node of a dispatcher.

Parameters

- **node_ids** (*str*) – A sequence of node ids or a single node id. The id order identifies a dispatcher sub-level.
- **node_attr** (*str, None, optional*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  - for data node: its output, and if not exists, all its attributes.
  - for function and sub-dispatcher nodes: the 'function' attribute.

  When 'description', returns the "description" of the searched node, searching also in function or sub-dispatcher input/output description.

  When 'output', returns the data node output.

  When 'default_value', returns the data node default value.

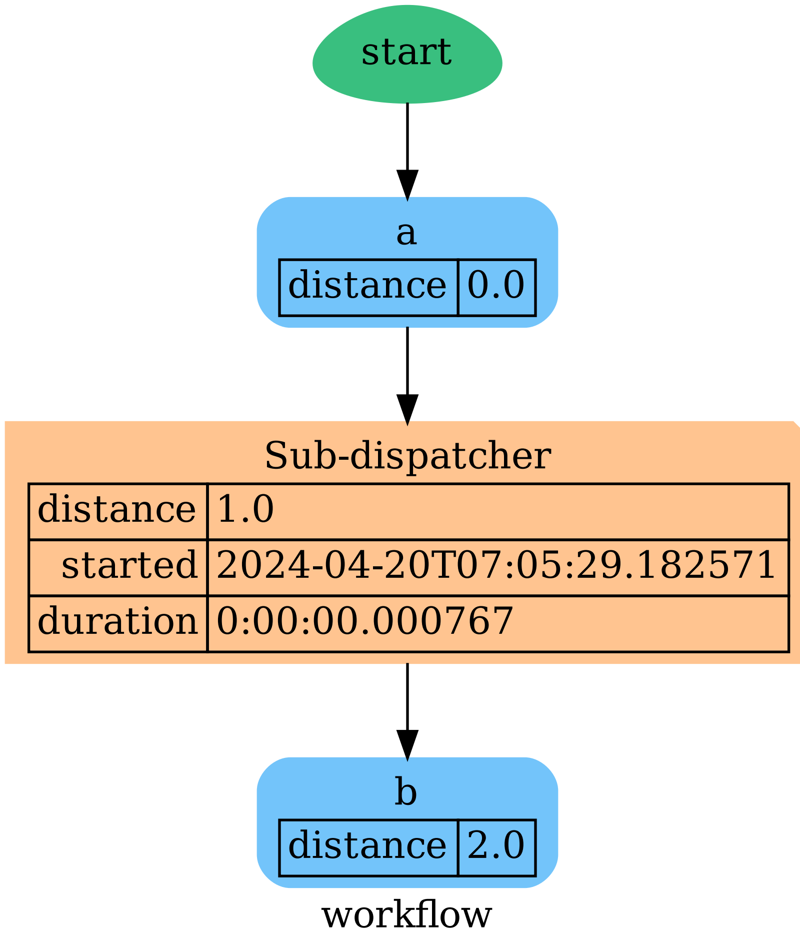
  When 'value_type', returns the data node value's type.

  When *None*, returns the node attributes.

Returns
Node attributes and its real path.

Return type
(T, (str, ...))

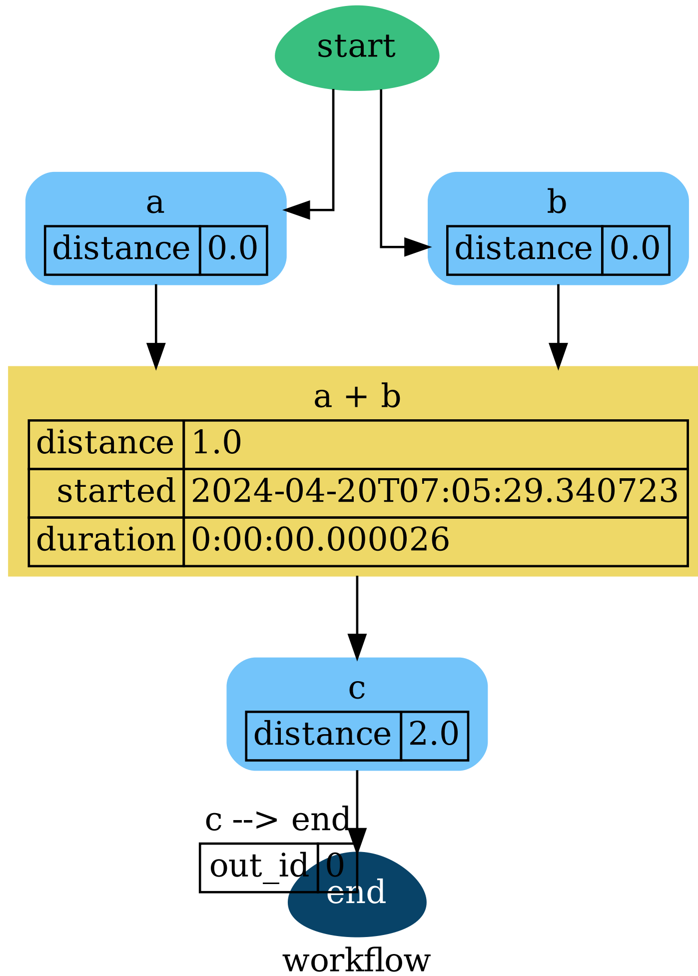
Example:



Get the sub node output:

```
>>> dsp.get_node('Sub-dispatcher', 'c')
(4, ('Sub-dispatcher', 'c'))
>>> dsp.get_node('Sub-dispatcher', 'c', node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

```
>>> sub_dsp, sub_dsp_id = dsp.get_node('Sub-dispatcher')
```



plot

`MapDispatch.plot(`*workflow=None*, *view=True*, *depth=-1*, *name=none*, *comment=none*, *format=none*, *engine=none*, *encoding=none*, *graph_attr=none*, *node_attr=none*, *edge_attr=none*, *body=none*, *raw_body=none*, *node_styles=none*, *node_data=none*, *node_function=none*, *edge_data=none*, *max_lines=none*, *max_width=none*, *directory=None*, *sites=None*, *index=True*, *viz=False*, *short_name=None*, *executor='async'*, *render=False*, *run=False*`)`

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (*bool, optional*) – If True the latest solution will be plotted, otherwise the dmap.
- **view** (*bool, optional*) – Open the rendered directed graph in the DOT language

with the sys default opener.

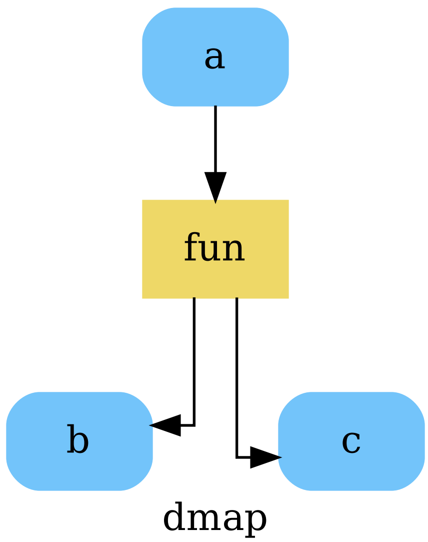
- **edge_data** (*tuple[str], optional*) – Edge attributes to view.
- **node_data** (*tuple[str], optional*) – Data node attributes to view.
- **node_function** (*tuple[str], optional*) – Function node attributes to view.
- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int, optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.
- **name** (*str*) – Graph name used in the source code.
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str, optional*) – (Sub)directory for source saving and rendering.
- **format** (*str, optional*) – Rendering output format ('pdf', 'png', …).
- **engine** (*str, optional*) – Layout command used ('dot', 'neato', …).
- **encoding** (*str, optional*) – Encoding for saving the source.
- **graph_attr** (*dict, optional*) – Dict of (attribute, value) pairs for the graph.
- **node_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict, optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list, optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of *Site* to maintain alive the backend server.
- **index** (*bool, optional*) – Add the site index as first page?
- **max_lines** (*int, optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int, optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool, optional*) – Render all pages statically?
- **viz** (*bool, optional*) – Use viz.js as back-end?
- **short_name** (*int, optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str, optional*) – Pool executor to render object.
- **run** (*bool, optional*) – Run the backend server?

Returns
A SiteMap or a Site if .

Return type
schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



prepare_inputs

static MapDispatch.**prepare_inputs**(*inputs*, *defaults*)

recursive_data

static MapDispatch.**recursive_data**(*recursive_inputs*, *input_data*, *outputs*)

web

MapDispatch.**web**(*depth=-1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *subsite_idle_timeout=600*)

Creates a dispatcher Flask app.

Parameters

- **depth** (*int*, *optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str]*, *optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str]*, *optional*) – Function node attributes produce API.
- **directory** (*str*, *optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site]*, *optional*) – A set of Site to maintain alive the backend server.
- **run** (*bool*, *optional*) – Run the backend server?
- **subsite_idle_timeout** (*int*, *optional*) – Idle timeout of a debug subsite in seconds.

Returns

A WebMap.

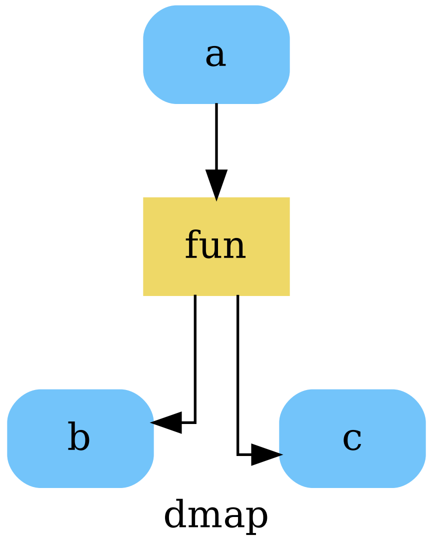
Return type

WebMap

Example:

From a dispatcher like this:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
```



You can create a web server with the following steps:

```
>>> print("Starting...\n"); site = dsp.web(); site
Starting...
Site(WebMap([(Dispatcher, WebMap())]), host='localhost', ...)
>>> import requests
>>> url = '%s/%s/%s' % (site.url, dsp.name, fun.__name__)
>>> requests.post(url, json={'args': (0,)}).json()['return']
[1, -1]
>>> site.shutdown()  # Remember to shutdown the server.
True
```

Note: When `Site` is garbage collected, the server is shutdown automatically.

`__init__`(*dsp*, *defaults=None*, *recursive_inputs=None*, *constructor=<class 'schedula.utils.dsp.SubDispatch'>*, *constructor_kwargs=None*, *function_id=None*, *func_kw=<function MapDispatch.<lambda>>*, *input_label='inputs<{}>'*, *output_label='outputs<{}>'*, *data_label='data<{}>'*, *cluster_label='task<{}>'*, ***kwargs*)

Initializes the MapDispatch function.

Parameters

- **dsp** (*schedula.Dispatcher* | `schedula.utils.blue.BlueDispatcher`) – A dispatcher that identifies the base model.
- **defaults** (*dict*) – Defaults values that are recursively merged with the input provided to the *dispatching function*.
- **recursive_inputs** (*list* | *dict*) – List of data node ids that are extracted from the outputs of the *dispatching function* and then merged with the inputs of the its

successive evaluation. If a dictionary is given, this is used to rename the data node ids extracted.

- **constructor** (*function | class*) – It initializes the *dispatching function*.
- **constructor_kwargs** (*function | class*) – Extra keywords passed to the constructor function.
- **function_id** (*str, optional*) – Function name.
- **func_kw** (*function, optional*) – Extra keywords to add the *dispatching function* to execution model.
- **input_label** (*str, optional*) – Custom label formatter for recursive inputs.
- **output_label** (*str, optional*) – Custom label formatter for recursive outputs.
- **data_label** (*str, optional*) – Custom label formatter for recursive internal data.
- **kwargs** (*object*) – Keywords to initialize the execution model.

NoSub

class NoSub

Class for avoiding to add a sub solution to the workflow.

Methods

__init__

__init__

NoSub.**__init__**()

__init__()

SubDispatch

class SubDispatch(*dsp=None*, **args*, ***kwargs*)

It dispatches a given *Dispatcher* like a function.

This function takes a sequence of dictionaries as input that will be combined before the dispatching.

Returns
A function that executes the dispatch of the given *Dispatcher*.

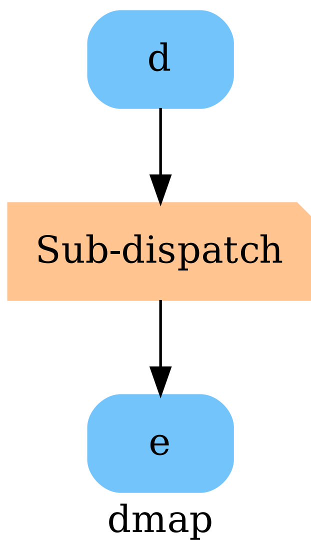
Return type
callable

See also:

dispatch(), *combine_dicts()*

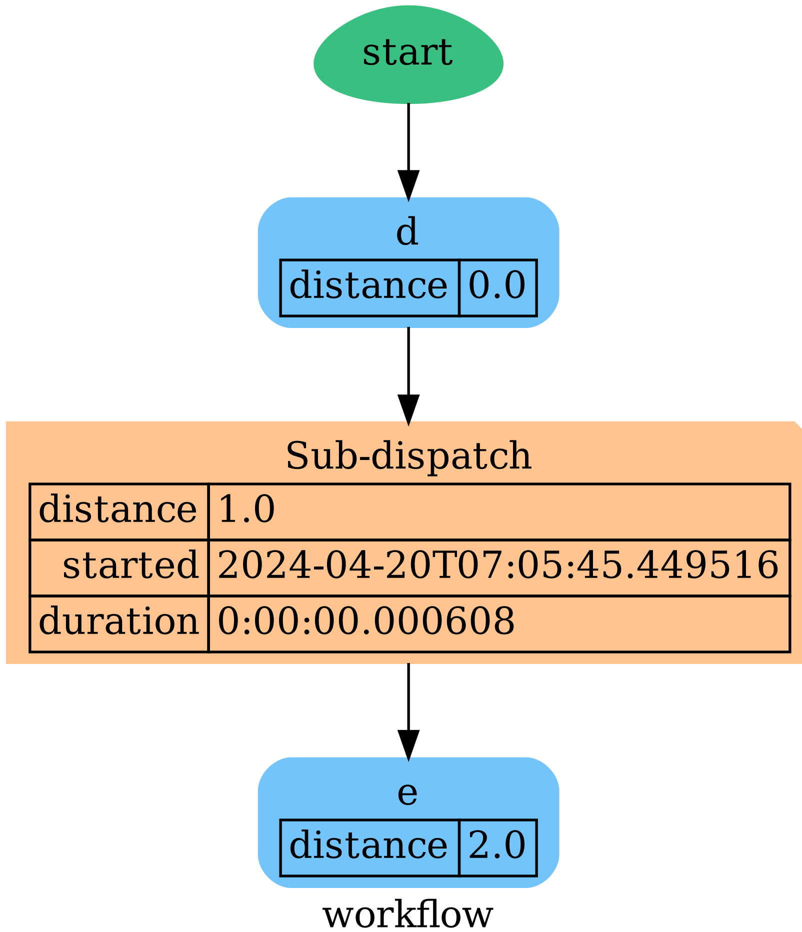
Example:

```
>>> from schedula import Dispatcher
>>> sub_dsp = Dispatcher(name='Sub-dispatcher')
...
>>> def fun(a):
...     return a + 1, a - 1
...
>>> sub_dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dispatch = SubDispatch(sub_dsp, ['a', 'b', 'c'], output_type='dict')
>>> dsp = Dispatcher(name='Dispatcher')
>>> dsp.add_function('Sub-dispatch', dispatch, ['d'], ['e'])
'Sub-dispatch'
```



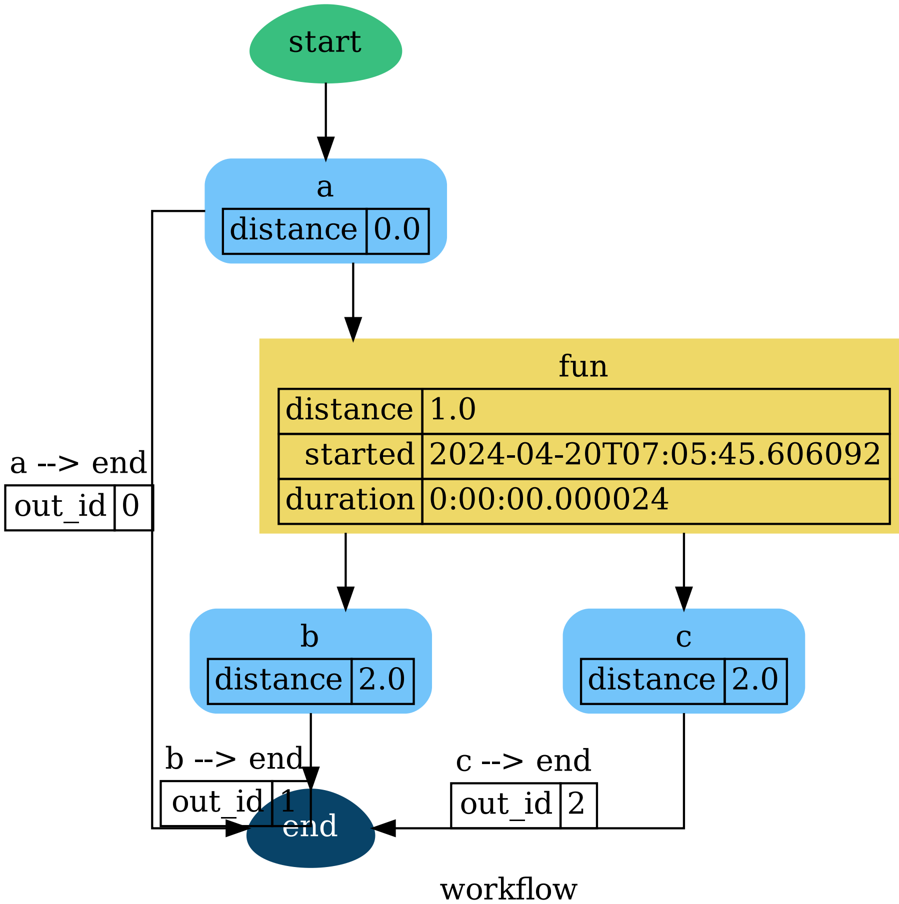
The Dispatcher output is:

```
>>> o = dsp.dispatch(inputs={'d': {'a': 3}})
```



while, the Sub-dispatch is:

```
>>> sol = o.workflow.nodes['Sub-dispatch']['solution']
>>> sol
Solution([('a', 3), ('b', 4), ('c', 2)])
>>> sol == o['e']
True
```



Methods

__init__	Initializes the Sub-dispatch.
blue	Constructs a Blueprint out of the current object.
`copy`	
`form`	Creates a dispatcher Form Flask app.
`get_node`	Returns a sub node of a dispatcher.
`plot`	Plots the Dispatcher with a graph in the DOT language with Graphviz.
`web`	Creates a dispatcher Flask app.

__init__

SubDispatch.**__init__**(*dsp*, *outputs=None*, *inputs_dist=None*, *wildcard=False*, *no_call=False*, *shrink=False*, *rm_unused_nds=False*, *output_type='all'*, *function_id=None*, *output_type_kw=None*)

Initializes the Sub-dispatch.

Parameters

- **dsp** (*schedula.Dispatcher | schedula.utils.blue.BlueDispatcher*) – A dispatcher that identifies the model adopted.
- **outputs** (*list[str], iterable*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **no_call** (*bool, optional*) – If True data node estimation function is not used.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.
- **rm_unused_nds** (*bool, optional*) – If True unused function and sub-dispatcher nodes are removed from workflow.
- **output_type** (*str, optional*) – Type of function output:
  - 'all': a dictionary with all dispatch outputs.
  - 'list': a list with all outputs listed in *outputs*.
  - 'dict': a dictionary with any outputs listed in *outputs*.
- **output_type_kw** (*dict, optional*) – Extra kwargs to pass to the *selector* function.
- **function_id** (*str, optional*) – Function name.

blue

SubDispatch.**blue**(*memo=None*, *depth=-1*)

Constructs a Blueprint out of the current object.

Parameters

- **memo** (*dict[T,schedula.utils.blue.Blueprint]*) – A dictionary to cache Blueprints.
- **depth** (*int, optional*) – Depth of sub-dispatch blue. If negative all levels are bluprinted.

Returns

A Blueprint of the current object.

Return type

schedula.utils.blue.Blueprint

copy

`SubDispatch.copy()`

form

`SubDispatch.form`(*depth=1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *view=True*, *get_context=none*, *get_data=none*, *subsite_idle_timeout=600*, *basic_app_config=None*, *stripe_event_handler=<function Base.<lambda>>*)

Creates a dispatcher Form Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?
- **view** (*bool, optional*) – Open the url site with the sys default opener.
- **get_context** (*function | dict, optional*) – Function to pass extra data as form context.
- **get_data** (*function | dict, optional*) – Function to initialize the formdata.
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.
- **basic_app_config** (*object, optional*) – Flask app config object.
- **stripe_event_handler** (*function, optional*) – Stripe event handler function.

Returns
A FormMap or a Site if *sites is None* and *run or view is True*.

Return type
FormMap | Site

get_node

`SubDispatch.get_node`(**node_ids*, *node_attr=none*)

Returns a sub node of a dispatcher.

Parameters

- **node_ids** (*str*) – A sequence of node ids or a single node id. The id order identifies a dispatcher sub-level.

- **node_attr** (*str, None, optional*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  - for data node: its output, and if not exists, all its attributes.
  - for function and sub-dispatcher nodes: the 'function' attribute.

  When 'description', returns the "description" of the searched node, searching also in function or sub-dispatcher input/output description.

  When 'output', returns the data node output.

  When 'default_value', returns the data node default value.

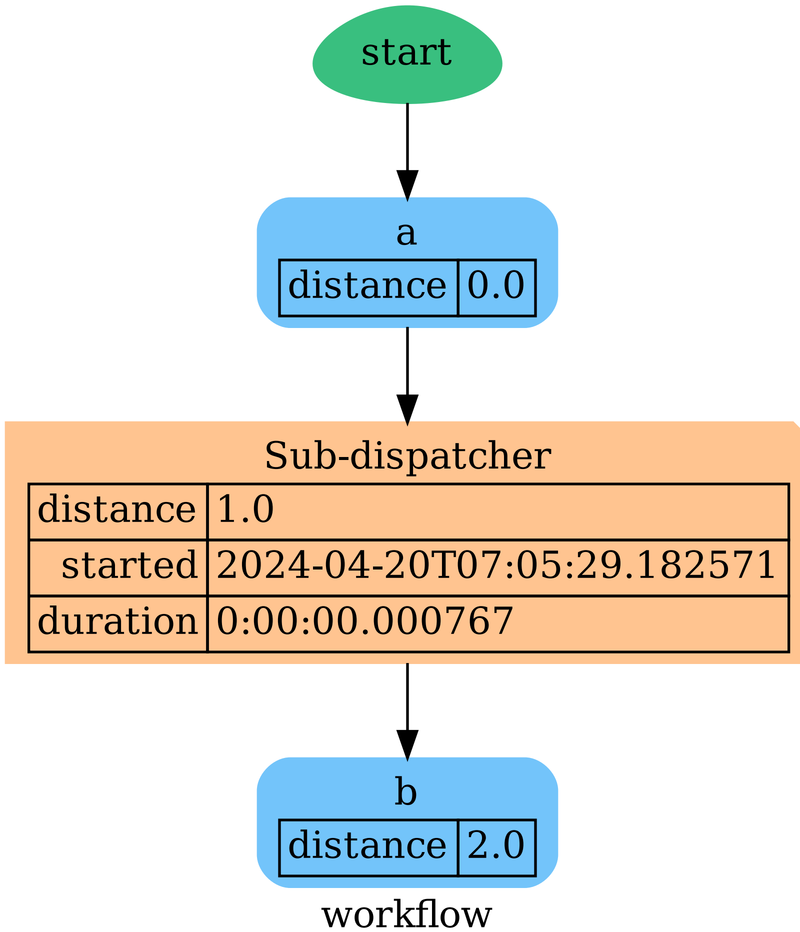
  When 'value_type', returns the data node value's type.

  When *None*, returns the node attributes.

Returns
Node attributes and its real path.

Return type
(T, (str, . . .))

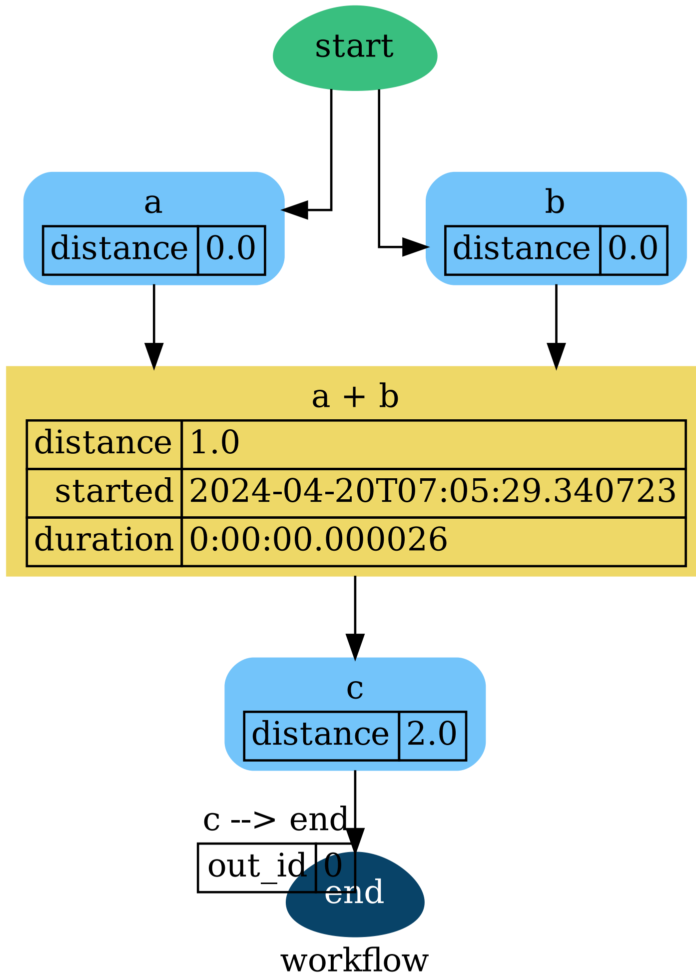
Example:



Get the sub node output:

```
>>> dsp.get_node('Sub-dispatcher', 'c')
(4, ('Sub-dispatcher', 'c'))
>>> dsp.get_node('Sub-dispatcher', 'c', node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

```
>>> sub_dsp, sub_dsp_id = dsp.get_node('Sub-dispatcher')
```



plot

SubDispatch.**plot**(*workflow=None*, *view=True*, *depth=-1*, *name=none*, *comment=none*, *format=none*, *engine=none*, *encoding=none*, *graph_attr=none*, *node_attr=none*, *edge_attr=none*, *body=none*, *raw_body=none*, *node_styles=none*, *node_data=none*, *node_function=none*, *edge_data=none*, *max_lines=none*, *max_width=none*, *directory=None*, *sites=None*, *index=True*, *viz=False*, *short_name=None*, *executor='async'*, *render=False*, *run=False*)

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (*bool, optional*) – If True the latest solution will be plotted, otherwise the dmap.
- **view** (*bool, optional*) – Open the rendered directed graph in the DOT language

with the sys default opener.

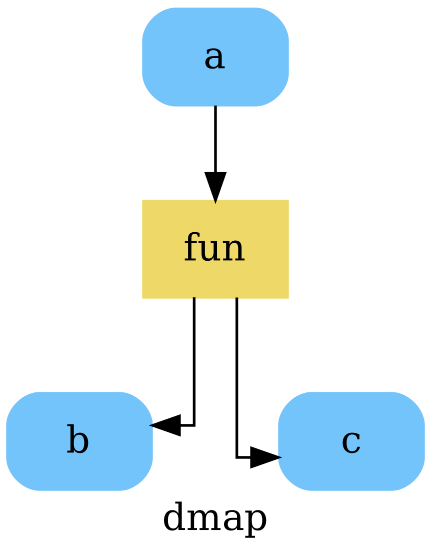
- **edge_data** (*tuple[str], optional*) – Edge attributes to view.
- **node_data** (*tuple[str], optional*) – Data node attributes to view.
- **node_function** (*tuple[str], optional*) – Function node attributes to view.
- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int, optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.
- **name** (*str*) – Graph name used in the source code.
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str, optional*) – (Sub)directory for source saving and rendering.
- **format** (*str, optional*) – Rendering output format ('pdf', 'png', …).
- **engine** (*str, optional*) – Layout command used ('dot', 'neato', …).
- **encoding** (*str, optional*) – Encoding for saving the source.
- **graph_attr** (*dict, optional*) – Dict of (attribute, value) pairs for the graph.
- **node_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict, optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list, optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.
- **index** (*bool, optional*) – Add the site index as first page?
- **max_lines** (*int, optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int, optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool, optional*) – Render all pages statically?
- **viz** (*bool, optional*) – Use viz.js as back-end?
- **short_name** (*int, optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str, optional*) – Pool executor to render object.
- **run** (*bool, optional*) – Run the backend server?

Returns
A SiteMap or a Site if .

Return type
schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



web

SubDispatch.**web**(*depth=-1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *subsite_idle_timeout=600*)

Creates a dispatcher Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of Site to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?

- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.

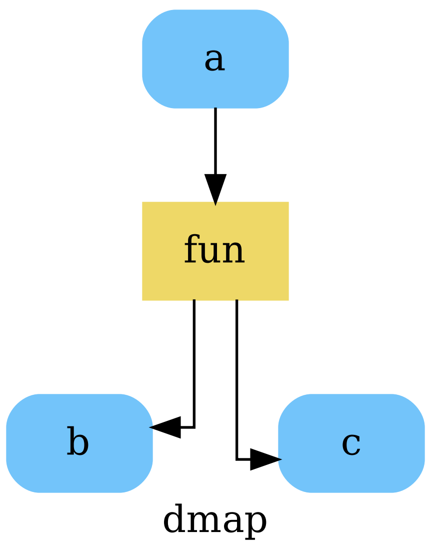
Returns
A WebMap.

Return type
WebMap

Example:

From a dispatcher like this:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
```



You can create a web server with the following steps:

```
>>> print("Starting...\n"); site = dsp.web(); site
Starting...
Site(WebMap([(Dispatcher, WebMap())]), host='localhost', ...)
>>> import requests
>>> url = '%s/%s/%s' % (site.url, dsp.name, fun.__name__)
>>> requests.post(url, json={'args': (0,)}).json()['return']
[1, -1]
>>> site.shutdown()  # Remember to shutdown the server.
True
```

Note: When `Site` is garbage collected, the server is shutdown automatically.

`__init__`(*dsp*, *outputs=None*, *inputs_dist=None*, *wildcard=False*, *no_call=False*, *shrink=False*, *rm_unused_nds=False*, *output_type='all'*, *function_id=None*, *output_type_kw=None*)

Initializes the Sub-dispatch.

Parameters

- **dsp** (*schedula.Dispatcher* | `schedula.utils.blue.BlueDispatcher`) – A dispatcher that identifies the model adopted.
- **outputs** (*list[str], iterable*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **no_call** (*bool, optional*) – If True data node estimation function is not used.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.
- **rm_unused_nds** (*bool, optional*) – If True unused function and sub-dispatcher nodes are removed from workflow.
- **output_type** (*str, optional*) – Type of function output:
  - 'all': a dictionary with all dispatch outputs.
  - 'list': a list with all outputs listed in *outputs*.
  - 'dict': a dictionary with any outputs listed in *outputs*.
- **output_type_kw** (*dict, optional*) – Extra kwargs to pass to the *selector* function.
- **function_id** (*str, optional*) – Function name.

`blue`(*memo=None*, *depth=-1*)

Constructs a Blueprint out of the current object.

Parameters

- **memo** (*dict[T,*`schedula.utils.blue.Blueprint`*]*) – A dictionary to cache Blueprints.
- **depth** (*int, optional*) – Depth of sub-dispatch blue. If negative all levels are bluprinted.

Returns

A Blueprint of the current object.

Return type

schedula.utils.blue.Blueprint

SubDispatchFunction

`class SubDispatchFunction(dsp=None, *args, **kwargs)`

It converts a `Dispatcher` into a function.

This function takes a sequence of arguments or a key values as input of the dispatch.

Returns
A function that executes the dispatch of the given *dsp*.

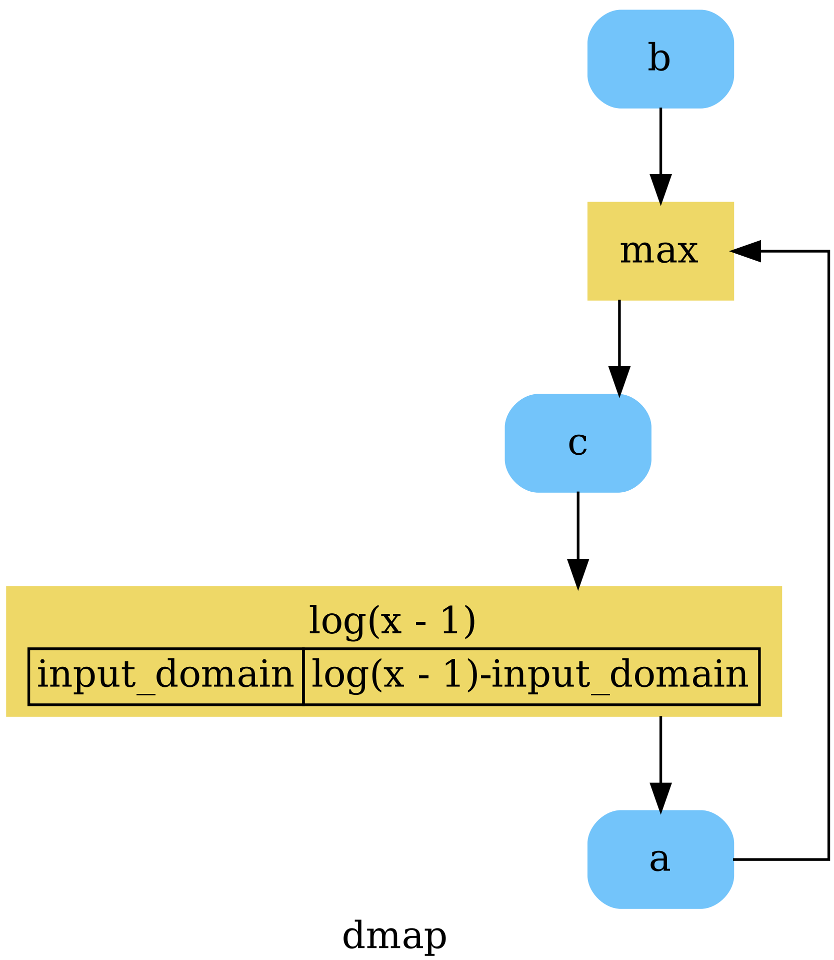
Return type
callable

See also:

`dispatch()`, `shrink_dsp()`

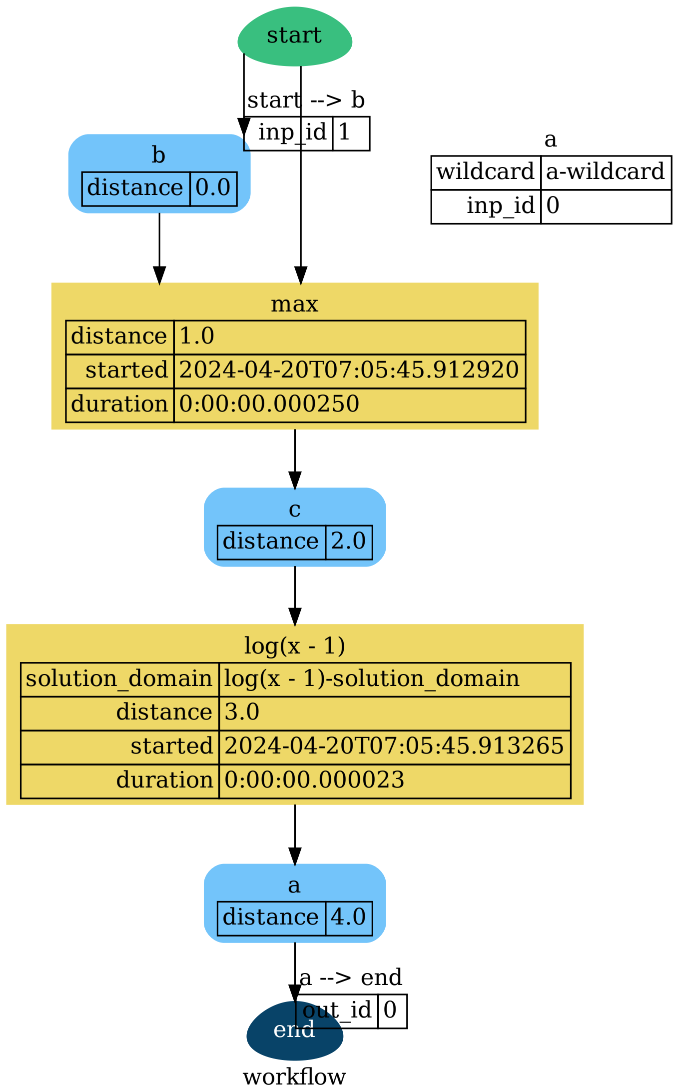
Example:

A dispatcher with two functions *max* and *min* and an unresolved cycle (i.e., *a* –> *max* –> *c* –> *min* –> *a*):



Extract a static function node, i.e. the inputs *a* and *b* and the output *a* are fixed:

```
>>> fun = SubDispatchFunction(dsp, 'myF', ['a', 'b'], ['a'])
>>> fun.__name__
'myF'
>>> fun(b=1, a=2)
0.0
```



The created function raises a ValueError if un-valid inputs are provided:

```
>>> fun(1, 0)
Traceback (most recent call last):
...
DispatcherError:
  Unreachable output-targets: ...
```

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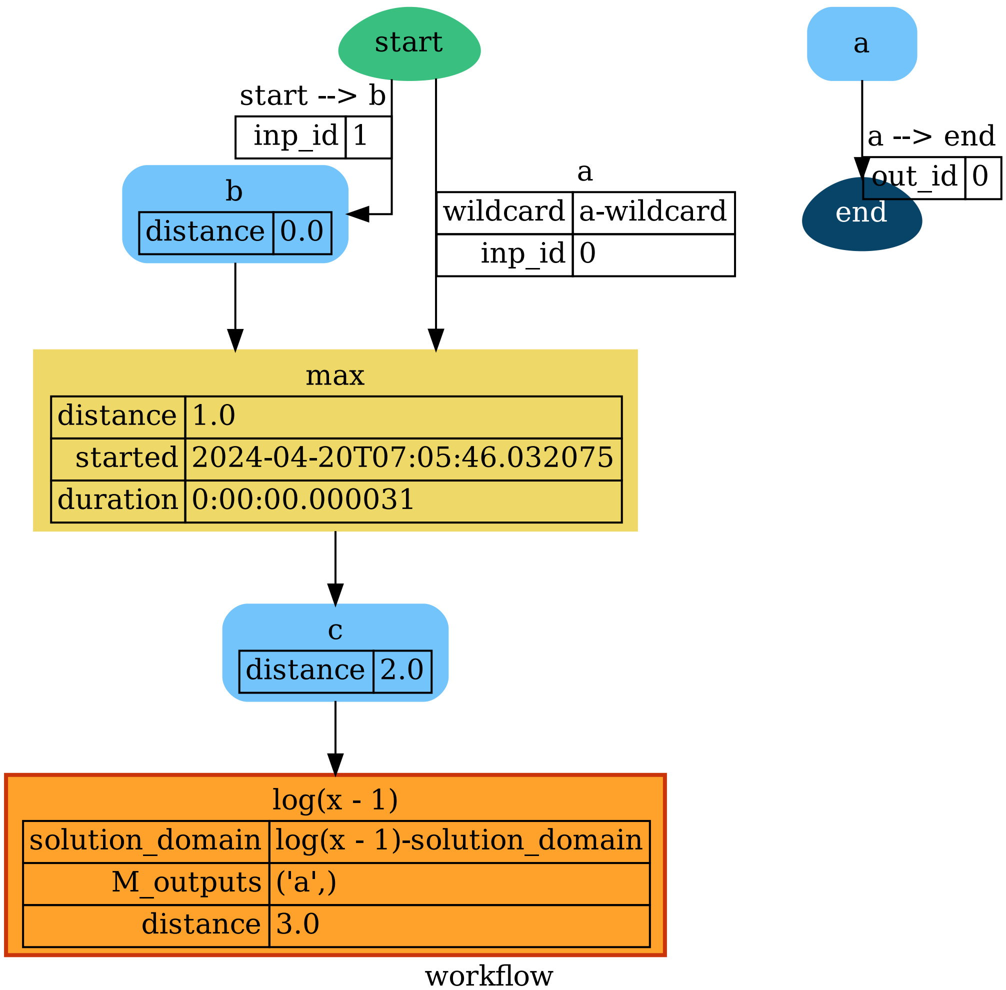
```
Available outputs: ...
```



Methods

__init__	Initializes the Sub-dispatch Function.
`blue`	Constructs a Blueprint out of the current object.
`copy`	
`form`	Creates a dispatcher Form Flask app.
`get_node`	Returns a sub node of a dispatcher.
`plot`	Plots the Dispatcher with a graph in the DOT language with Graphviz.
`web`	Creates a dispatcher Flask app.

__init__

SubDispatchFunction.**__init__**(*dsp*, *function_id=None*, *inputs=None*, *outputs=None*, *inputs_dist=None*, *shrink=True*, *wildcard=True*, *output_type=None*, *output_type_kw=None*, *first_arg_as_kw=False*)

Initializes the Sub-dispatch Function.

Parameters

- **dsp** (*schedula.Dispatcher | schedula.utils.blue.BlueDispatcher*) – A dispatcher that identifies the model adopted.
- **function_id** (*str, optional*) – Function name.
- **inputs** (*list[str], iterable, optional*) – Input data nodes.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **output_type** (*str, optional*) – Type of function output:
  - 'all': a dictionary with all dispatch outputs.
  - 'list': a list with all outputs listed in *outputs*.
  - 'dict': a dictionary with any outputs listed in *outputs*.
- **output_type_kw** (*bool*) – Extra kwargs to pass to the *selector* function.
- **first_arg_as_kw** – Uses the first argument of the __call__ method as *kwargs*.

blue

SubDispatchFunction.**blue**(*memo=None*, *depth=-1*)

Constructs a Blueprint out of the current object.

Parameters

- **memo** (*dict[T,schedula.utils.blue.Blueprint]*) – A dictionary to cache Blueprints.
- **depth** (*int, optional*) – Depth of sub-dispatch blue. If negative all levels are bluprinted.

Returns

A Blueprint of the current object.

Return type

schedula.utils.blue.Blueprint

copy

SubDispatchFunction.**copy**()

form

SubDispatchFunction.**form**(*depth=1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *view=True*, *get_context=none*, *get_data=none*, *subsite_idle_timeout=600*, *basic_app_config=None*, *stripe_event_handler=<function Base.<lambda>>*)

Creates a dispatcher Form Flask app.

Parameters

- **depth** (*int*, *optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str]*, *optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str]*, *optional*) – Function node attributes produce API.
- **directory** (*str*, *optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site]*, *optional*) – A set of `Site` to maintain alive the backend server.
- **run** (*bool*, *optional*) – Run the backend server?
- **view** (*bool*, *optional*) – Open the url site with the sys default opener.
- **get_context** (*function | dict*, *optional*) – Function to pass extra data as form context.
- **get_data** (*function | dict*, *optional*) – Function to initialize the formdata.
- **subsite_idle_timeout** (*int*, *optional*) – Idle timeout of a debug subsite in seconds.
- **basic_app_config** (*object*, *optional*) – Flask app config object.
- **stripe_event_handler** (*function*, *optional*) – Stripe event handler function.

Returns

A FormMap or a Site if *sites is None* and *run or view is True*.

Return type

FormMap | Site

get_node

`SubDispatchFunction.get_node(*node_ids, node_attr=none)`

Returns a sub node of a dispatcher.

Parameters

- **node_ids** (*str*) – A sequence of node ids or a single node id. The id order identifies a dispatcher sub-level.
- **node_attr** (*str, None, optional*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  - for data node: its output, and if not exists, all its attributes.
  - for function and sub-dispatcher nodes: the 'function' attribute.

  When 'description', returns the "description" of the searched node, searching also in function or sub-dispatcher input/output description.

  When 'output', returns the data node output.

  When 'default_value', returns the data node default value.

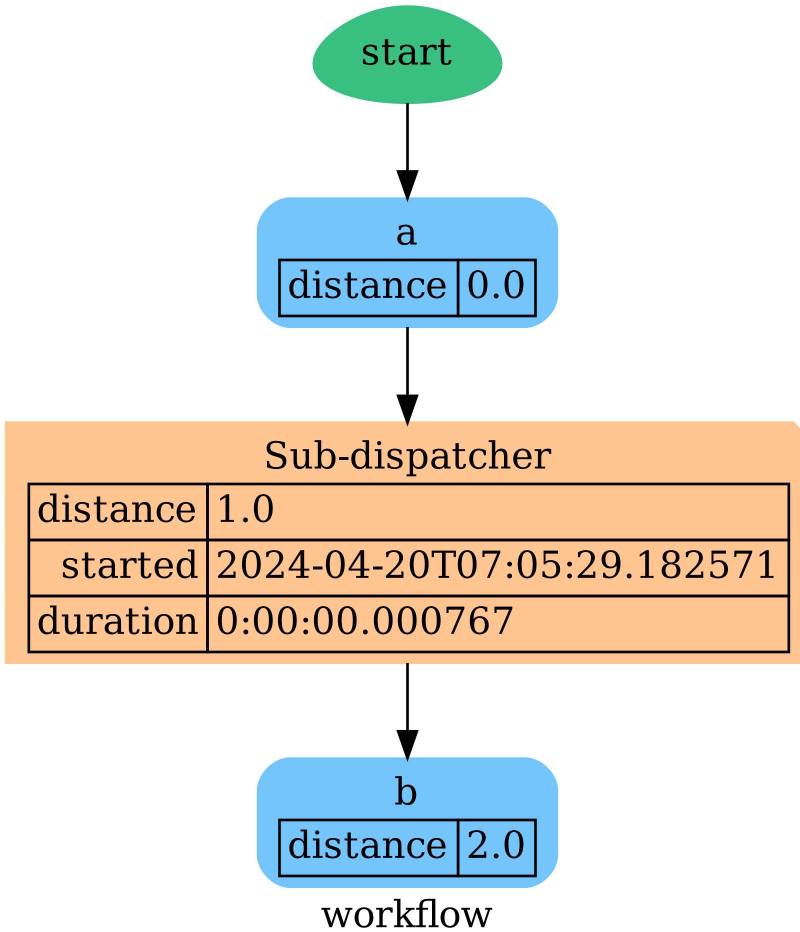
  When 'value_type', returns the data node value's type.

  When *None*, returns the node attributes.

Returns
Node attributes and its real path.

Return type
(T, (str, ...))

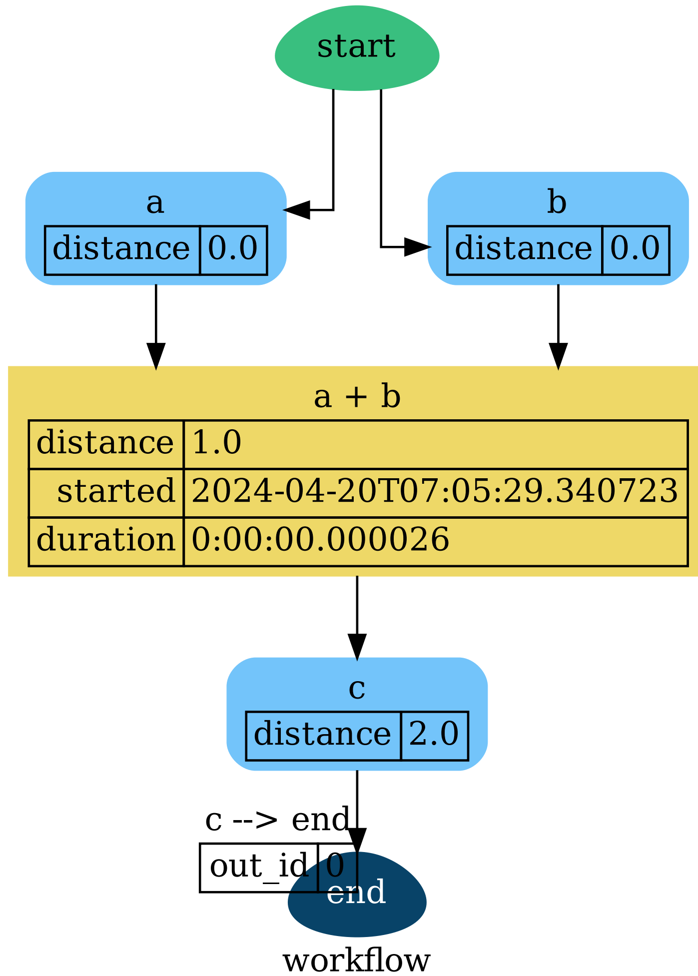
Example:



Get the sub node output:

```
>>> dsp.get_node('Sub-dispatcher', 'c')
(4, ('Sub-dispatcher', 'c'))
>>> dsp.get_node('Sub-dispatcher', 'c', node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

```
>>> sub_dsp, sub_dsp_id = dsp.get_node('Sub-dispatcher')
```



plot

`SubDispatchFunction.plot`(*workflow=None*, *view=True*, *depth=-1*, *name=none*, *comment=none*, *format=none*, *engine=none*, *encoding=none*, *graph_attr=none*, *node_attr=none*, *edge_attr=none*, *body=none*, *raw_body=none*, *node_styles=none*, *node_data=none*, *node_function=none*, *edge_data=none*, *max_lines=none*, *max_width=none*, *directory=None*, *sites=None*, *index=True*, *viz=False*, *short_name=None*, *executor='async'*, *render=False*, *run=False*)

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (*bool, optional*) – If True the latest solution will be plotted, otherwise the dmap.

- **view** (*bool*, *optional*) – Open the rendered directed graph in the DOT language with the sys default opener.
- **edge_data** (*tuple[str]*, *optional*) – Edge attributes to view.
- **node_data** (*tuple[str]*, *optional*) – Data node attributes to view.
- **node_function** (*tuple[str]*, *optional*) – Function node attributes to view.
- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int*, *optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.
- **name** (*str*) – Graph name used in the source code.
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str*, *optional*) – (Sub)directory for source saving and rendering.
- **format** (*str*, *optional*) – Rendering output format ('pdf', 'png', …).
- **engine** (*str*, *optional*) – Layout command used ('dot', 'neato', …).
- **encoding** (*str*, *optional*) – Encoding for saving the source.
- **graph_attr** (*dict*, *optional*) – Dict of (attribute, value) pairs for the graph.
- **node_attr** (*dict*, *optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict*, *optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict*, *optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list*, *optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site]*, *optional*) – A set of *Site* to maintain alive the backend server.
- **index** (*bool*, *optional*) – Add the site index as first page?
- **max_lines** (*int*, *optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int*, *optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool*, *optional*) – Render all pages statically?
- **viz** (*bool*, *optional*) – Use viz.js as back-end?
- **short_name** (*int*, *optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str*, *optional*) – Pool executor to render object.
- **run** (*bool*, *optional*) – Run the backend server?

Returns

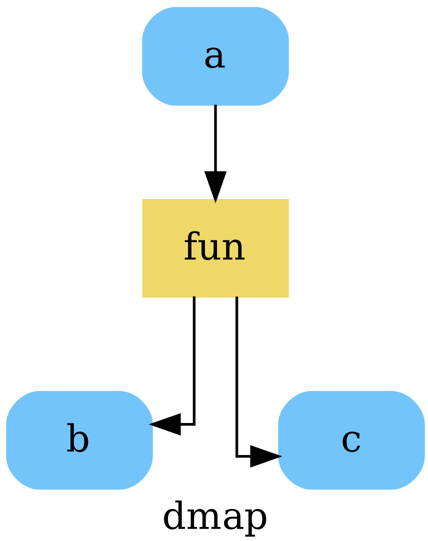
A SiteMap or a Site if .

Return type

schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



web

`SubDispatchFunction.`**`web`**(*depth=-1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *subsite_idle_timeout=600*)

Creates a dispatcher Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.

- **run** (*bool, optional*) – Run the backend server?
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.

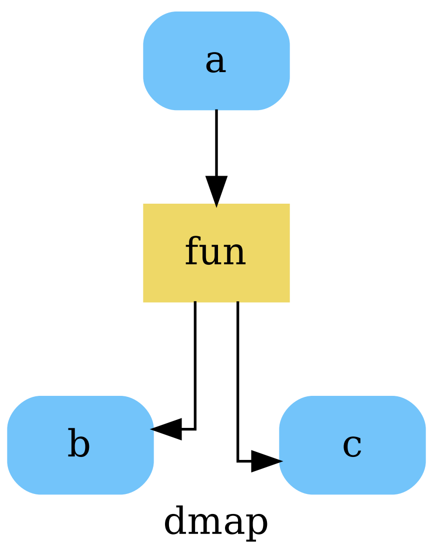
Returns
A WebMap.

Return type
WebMap

Example:

From a dispatcher like this:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
```



You can create a web server with the following steps:

```
>>> print("Starting...\n"); site = dsp.web(); site
Starting...
Site(WebMap([(Dispatcher, WebMap())]), host='localhost', ...)
>>> import requests
>>> url = '%s/%s/%s' % (site.url, dsp.name, fun.__name__)
>>> requests.post(url, json={'args': (0,)}).json()['return']
[1, -1]
```

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```
>>> site.shutdown()  # Remember to shutdown the server.
True
```

Note: When *Site* is garbage collected, the server is shutdown automatically.

__init__(*dsp*, *function_id=None*, *inputs=None*, *outputs=None*, *inputs_dist=None*, *shrink=True*, *wildcard=True*, *output_type=None*, *output_type_kw=None*, *first_arg_as_kw=False*)

Initializes the Sub-dispatch Function.

Parameters

- **dsp** (*schedula.Dispatcher | schedula.utils.blue.BlueDispatcher*) – A dispatcher that identifies the model adopted.
- **function_id** (*str, optional*) – Function name.
- **inputs** (*list[str], iterable, optional*) – Input data nodes.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **output_type** (*str, optional*) – Type of function output:
  - 'all': a dictionary with all dispatch outputs.
  - 'list': a list with all outputs listed in *outputs*.
  - 'dict': a dictionary with any outputs listed in *outputs*.
- **output_type_kw** (*bool*) – Extra kwargs to pass to the *selector* function.
- **first_arg_as_kw** – Uses the first argument of the __call__ method as *kwargs*.

Attributes

var_keyword

var_keyword

`SubDispatchFunction.var_keyword = 'kw'`

SubDispatchPipe

class SubDispatchPipe(*dsp=None*, **args*, ***kwargs*)

It converts a `Dispatcher` into a function.

This function takes a sequence of arguments as input of the dispatch.

Returns
A function that executes the pipe of the given *dsp*.

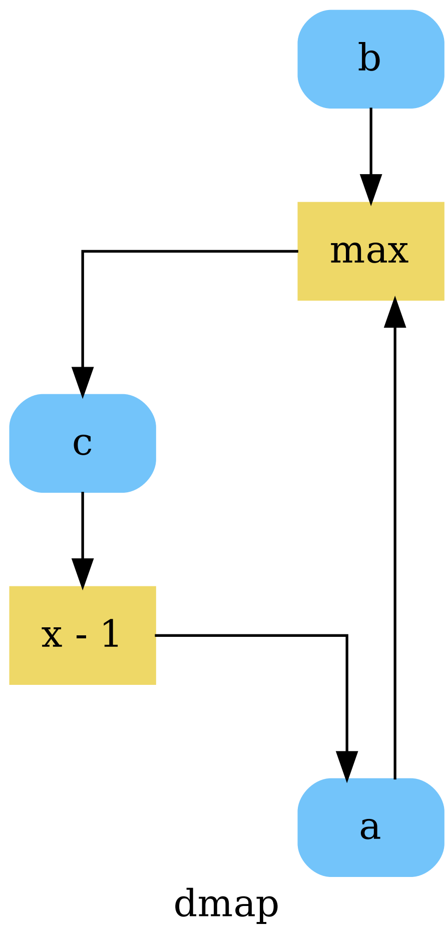
Return type
callable

See also:

`dispatch()`, `shrink_dsp()`

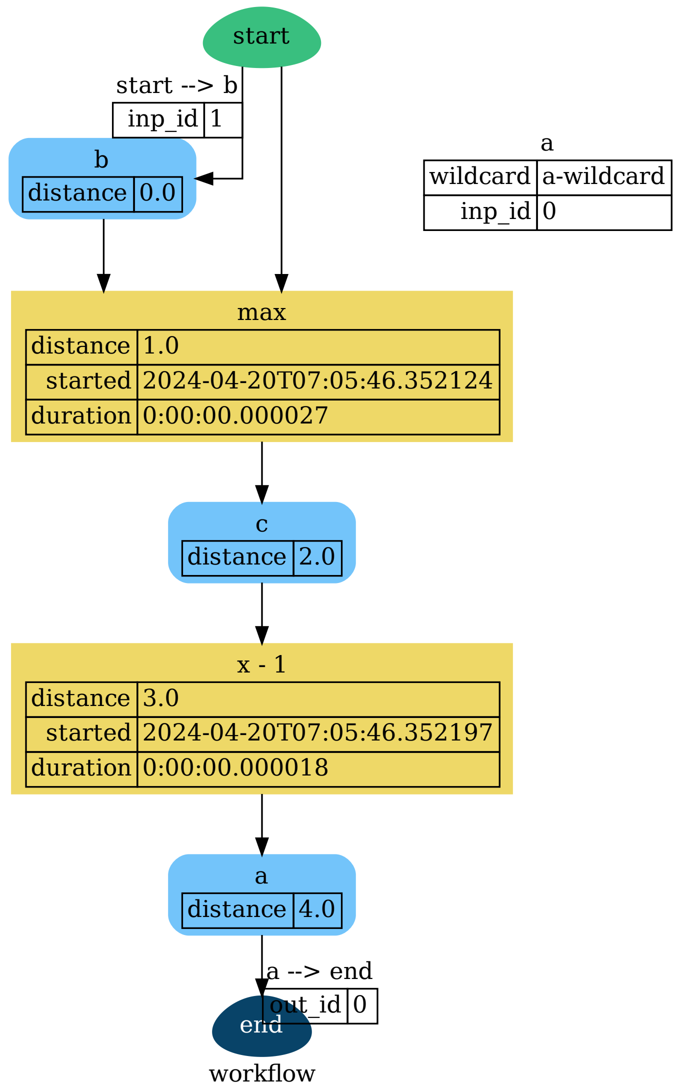
Example:

A dispatcher with two functions *max* and *min* and an unresolved cycle (i.e., *a* –> *max* –> *c* –> *min* –> *a*):



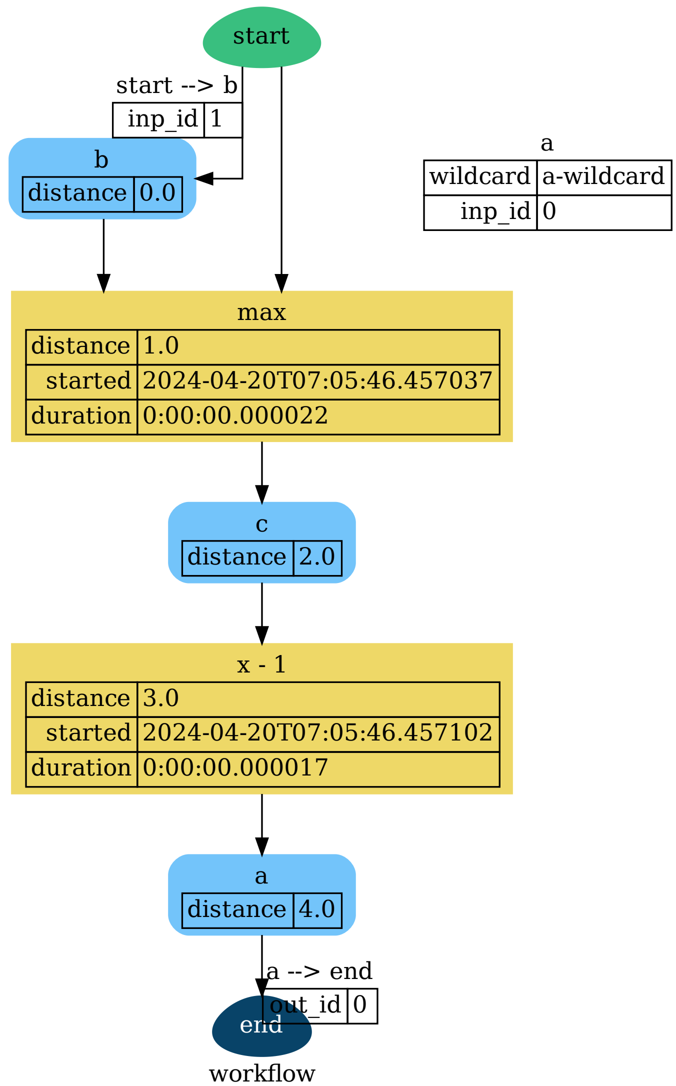
Extract a static function node, i.e. the inputs *a* and *b* and the output *a* are fixed:

```
>>> fun = SubDispatchPipe(dsp, 'myF', ['a', 'b'], ['a'])
>>> fun.__name__
'myF'
>>> fun(2, 1)
1
```



The created function raises a ValueError if un-valid inputs are provided:

```
>>> fun(1, 0)
0
```



Methods

__init__	Initializes the Sub-dispatch Function.
`blue`	Constructs a Blueprint out of the current object.
`copy`	
`form`	Creates a dispatcher Form Flask app.
`get_node`	Returns a sub node of a dispatcher.
`plot`	Plots the Dispatcher with a graph in the DOT language with Graphviz.
`web`	Creates a dispatcher Flask app.

__init__

SubDispatchPipe.**__init__**(*dsp*, *function_id=None*, *inputs=None*, *outputs=None*, *inputs_dist=None*, *no_domain=True*, *wildcard=True*, *shrink=True*, *output_type=None*, *output_type_kw=None*, *first_arg_as_kw=False*)

Initializes the Sub-dispatch Function.

Parameters

- **dsp** (*schedula.Dispatcher* | schedula.utils.blue.BlueDispatcher) – A dispatcher that identifies the model adopted.
- **function_id** (*str*) – Function name.
- **inputs** (*list[str], iterable*) – Input data nodes.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **no_domain** (*bool, optional*) – Skip the domain check.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **output_type** (*str, optional*) – Type of function output:
  - 'all': a dictionary with all dispatch outputs.
  - 'list': a list with all outputs listed in *outputs*.
  - 'dict': a dictionary with any outputs listed in *outputs*.
- **output_type_kw** (*bool*) – Extra kwargs to pass to the *selector* function.
- **first_arg_as_kw** – Converts first argument of the __call__ method as *kwargs*.

blue

SubDispatchPipe.**blue**(*memo=None*, *depth=-1*)

Constructs a Blueprint out of the current object.

Parameters

- **memo** (*dict[T,*schedula.utils.blue.Blueprint*]*) – A dictionary to cache Blueprints.
- **depth** (*int, optional*) – Depth of sub-dispatch blue. If negative all levels are bluprinted.

Returns

A Blueprint of the current object.

Return type

schedula.utils.blue.Blueprint

copy

SubDispatchPipe.**copy**()

form

SubDispatchPipe.**form**(*depth=1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *view=True*, *get_context=none*, *get_data=none*, *subsite_idle_timeout=600*, *basic_app_config=None*, *stripe_event_handler=<function Base.<lambda>>*)

Creates a dispatcher Form Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of Site to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?
- **view** (*bool, optional*) – Open the url site with the sys default opener.
- **get_context** (*function | dict, optional*) – Function to pass extra data as form context.
- **get_data** (*function | dict, optional*) – Function to initialize the formdata.
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.
- **basic_app_config** (*object, optional*) – Flask app config object.
- **stripe_event_handler** (*function, optional*) – Stripe event handler function.

Returns

A FormMap or a Site if *sites is None* and *run or view is True*.

Return type

FormMap | Site

get_node

`SubDispatchPipe.get_node(*node_ids, node_attr=none)`

Returns a sub node of a dispatcher.

Parameters

- **node_ids** (*str*) – A sequence of node ids or a single node id. The id order identifies a dispatcher sub-level.
- **node_attr** (*str, None, optional*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  - for data node: its output, and if not exists, all its attributes.
  - for function and sub-dispatcher nodes: the 'function' attribute.

  When 'description', returns the "description" of the searched node, searching also in function or sub-dispatcher input/output description.

  When 'output', returns the data node output.

  When 'default_value', returns the data node default value.

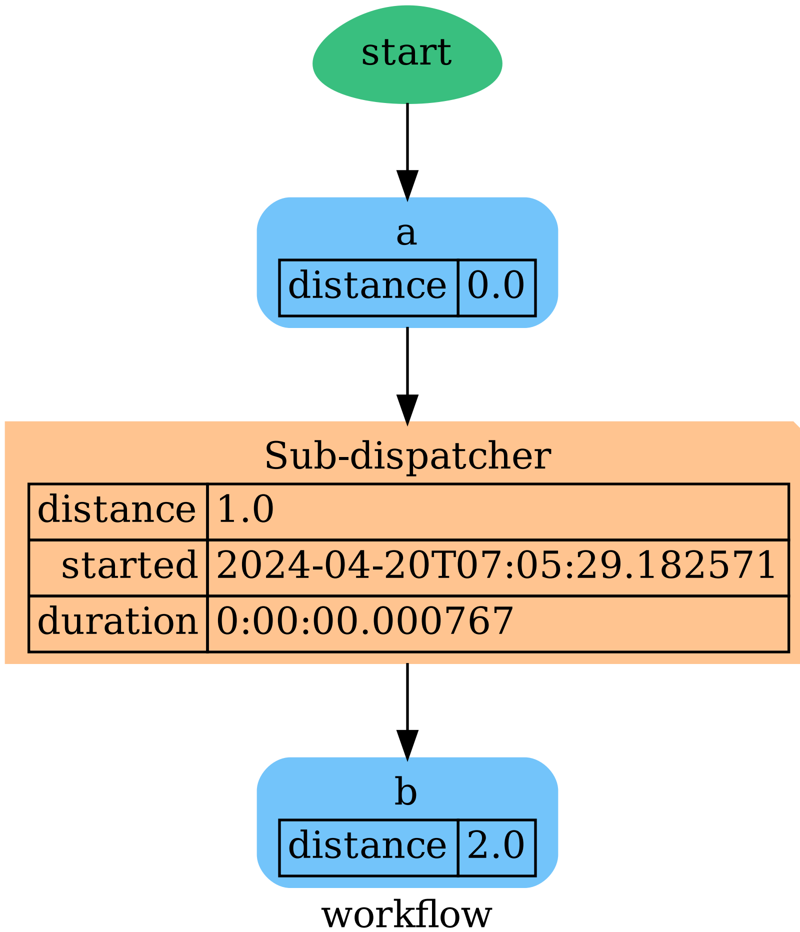
  When 'value_type', returns the data node value's type.

  When *None*, returns the node attributes.

Returns
Node attributes and its real path.

Return type
(T, (str, ...))

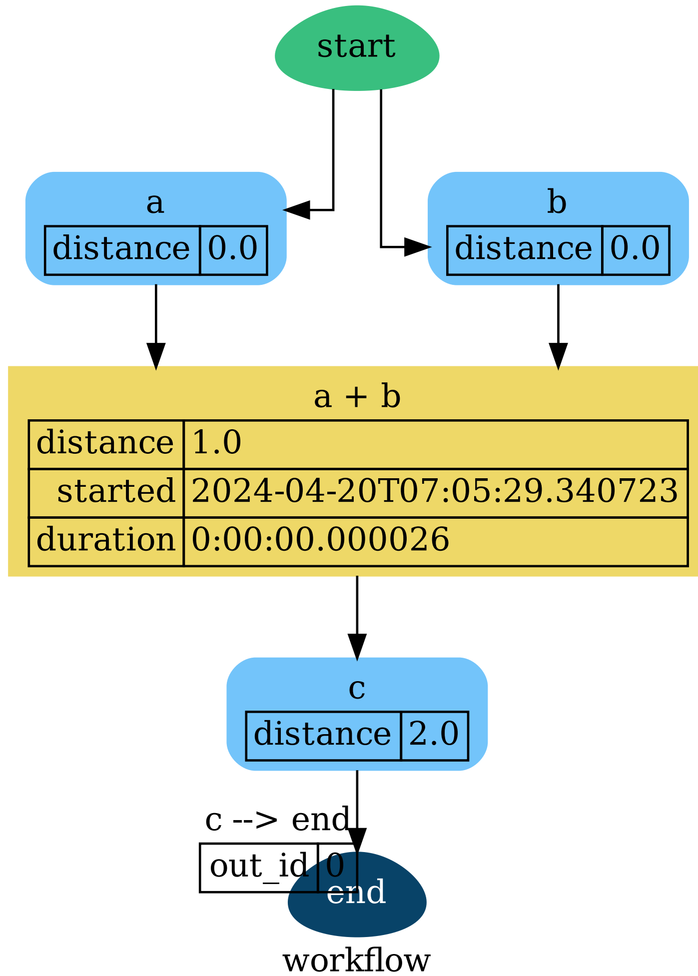
Example:



Get the sub node output:

```
>>> dsp.get_node('Sub-dispatcher', 'c')
(4, ('Sub-dispatcher', 'c'))
>>> dsp.get_node('Sub-dispatcher', 'c', node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

```
>>> sub_dsp, sub_dsp_id = dsp.get_node('Sub-dispatcher')
```



plot

SubDispatchPipe.**plot**(*workflow=None*, *view=True*, *depth=-1*, *name=none*, *comment=none*, *format=none*, *engine=none*, *encoding=none*, *graph_attr=none*, *node_attr=none*, *edge_attr=none*, *body=none*, *raw_body=none*, *node_styles=none*, *node_data=none*, *node_function=none*, *edge_data=none*, *max_lines=none*, *max_width=none*, *directory=None*, *sites=None*, *index=True*, *viz=False*, *short_name=None*, *executor='async'*, *render=False*, *run=False*)

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (*bool, optional*) – If True the latest solution will be plotted, otherwise the dmap.
- **view** (*bool, optional*) – Open the rendered directed graph in the DOT language

with the sys default opener.

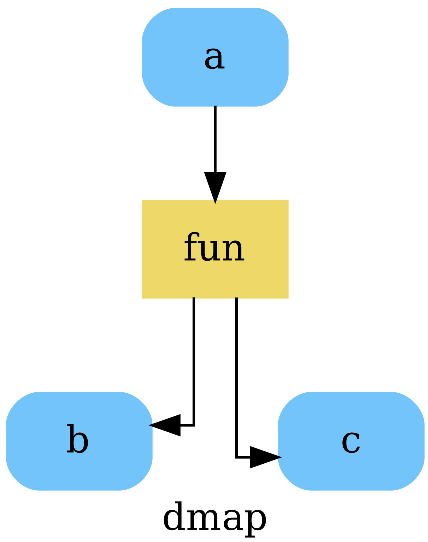
- **edge_data** (*tuple[str], optional*) – Edge attributes to view.
- **node_data** (*tuple[str], optional*) – Data node attributes to view.
- **node_function** (*tuple[str], optional*) – Function node attributes to view.
- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int, optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.
- **name** (*str*) – Graph name used in the source code.
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str, optional*) – (Sub)directory for source saving and rendering.
- **format** (*str, optional*) – Rendering output format ('pdf', 'png', …).
- **engine** (*str, optional*) – Layout command used ('dot', 'neato', …).
- **encoding** (*str, optional*) – Encoding for saving the source.
- **graph_attr** (*dict, optional*) – Dict of (attribute, value) pairs for the graph.
- **node_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict, optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list, optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.
- **index** (*bool, optional*) – Add the site index as first page?
- **max_lines** (*int, optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int, optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool, optional*) – Render all pages statically?
- **viz** (*bool, optional*) – Use viz.js as back-end?
- **short_name** (*int, optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str, optional*) – Pool executor to render object.
- **run** (*bool, optional*) – Run the backend server?

Returns
A SiteMap or a Site if .

Return type
schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



web

SubDispatchPipe.**web**(*depth=-1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *subsite_idle_timeout=600*)

Creates a dispatcher Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of *Site* to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?

- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.

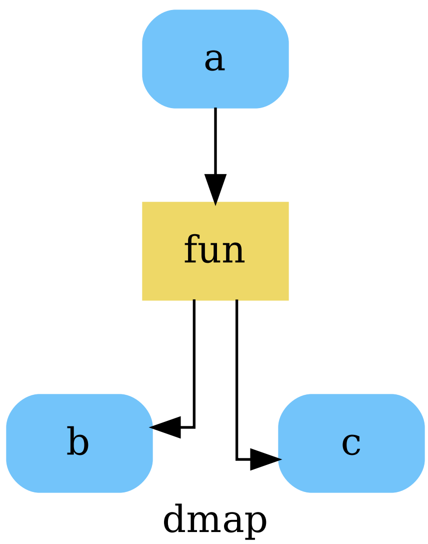
Returns
A WebMap.

Return type
WebMap

Example:

From a dispatcher like this:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
```



You can create a web server with the following steps:

```
>>> print("Starting...\n"); site = dsp.web(); site
Starting...
Site(WebMap([(Dispatcher, WebMap())]), host='localhost', ...)
>>> import requests
>>> url = '%s/%s/%s' % (site.url, dsp.name, fun.__name__)
>>> requests.post(url, json={'args': (0,)}).json()['return']
[1, -1]
>>> site.shutdown()  # Remember to shutdown the server.
True
```

Note: When `Site` is garbage collected, the server is shutdown automatically.

`__init__`(*dsp*, *function_id=None*, *inputs=None*, *outputs=None*, *inputs_dist=None*, *no_domain=True*, *wildcard=True*, *shrink=True*, *output_type=None*, *output_type_kw=None*, *first_arg_as_kw=False*)

Initializes the Sub-dispatch Function.

Parameters

- **dsp** (*schedula.Dispatcher | schedula.utils.blue.BlueDispatcher*) – A dispatcher that identifies the model adopted.
- **function_id** (*str*) – Function name.
- **inputs** (*list[str], iterable*) – Input data nodes.
- **outputs** (*list[str], iterable, optional*) – Ending data nodes.
- **inputs_dist** (*dict[str, int | float], optional*) – Initial distances of input data nodes.
- **no_domain** (*bool, optional*) – Skip the domain check.
- **shrink** (*bool, optional*) – If True the dispatcher is shrink before the dispatch.
- **wildcard** (*bool, optional*) – If True, when the data node is used as input and target in the ArciDispatch algorithm, the input value will be used as input for the connected functions, but not as output.
- **output_type** (*str, optional*) – Type of function output:
  - 'all': a dictionary with all dispatch outputs.
  - 'list': a list with all outputs listed in *outputs*.
  - 'dict': a dictionary with any outputs listed in *outputs*.
- **output_type_kw** (*bool*) – Extra kwargs to pass to the *selector* function.
- **first_arg_as_kw** – Converts first argument of the __call__ method as *kwargs*.

Attributes

var_keyword

var_keyword

SubDispatchPipe.**var_keyword = None**

var_keyword = None

add_args

class add_args(*func*, *n=1*, *callback=None*)

Methods

__init__	

__init__

add_args.**__init__**(*func*, *n=1*, *callback=None*)

__init__(*func*, *n=1*, *callback=None*)

inf

class inf(*_inf: float = 0*, *_num: float = 0*)

Class to model infinite numbers for workflow distance.

Methods

__init__	
format	

__init__

inf.**__init__**(*_inf: float = 0*, *_num: float = 0*) → None

format

static inf.**format**(*val*)

__init__(*_inf: float = 0*, *_num: float = 0*) → None

run_model

class run_model(*func*, **args*, *_init=None*, ***kwargs*)

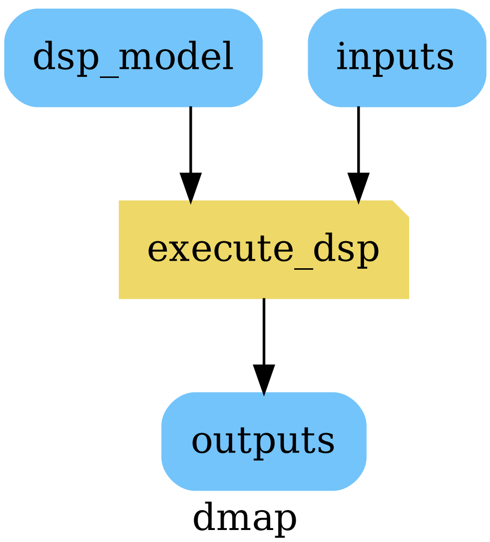
It is an utility function to execute dynamically generated function/models and - if Dispatcher based - add their workflows to the parent solution.

Returns
A function that executes the dispatch of the given *dsp*.

Return type
callable

Example:

Follows a simple example on how to use the `run_model()`:



Moreover, it can be used also with all `SubDispatcher()` like objects:

```
>>> sub_dsp = SubDispatch(dsp_model, outputs=['c'], output_type='list')
>>> sol = dsp({'dsp_model': sub_dsp, 'inputs': {'b': 1, 'a': 2}})
>>> sol['outputs']
[2]
>>> sol.workflow.nodes['execute_dsp']['solution']
Solution([('a', 2), ('b', 1), ('c', 2)])
```

Methods

__init__

__init__

run_model.**__init__**(*func*, **args*, *_init=None*, ***kwargs*)

__init__(*func*, **args*, *_init=None*, ***kwargs*)

7.2.9 exc

Defines the dispatcher exception.

Exceptions

DispatcherAbort
DispatcherError
ExecutorShutdown
SkipNode
WebResponse

DispatcherAbort

exception DispatcherAbort

DispatcherError

exception DispatcherError(**args*, *sol=None*, *ex=None*, ***kwargs*)

ExecutorShutdown

exception ExecutorShutdown

SkipNode

exception SkipNode(**args*, *ex=None*, ***kwargs*)

WebResponse

exception WebResponse(*response*)

7.2.10 form

It provides functions to build a form flask app from a dispatcher.

Sub-Modules:

cli	Define the command line interface for web forms.
config	It provides the default Flask App config file.
gapp	It provides the *gunicorn* BaseApplication to run the server in production.
json_secrets	It provides functions to dump and load secrets from flask session when dealing with JSON.
mail	It provides functions to send mails with Flask.
server	It provides functions to build the base form flask app.

cli

Define the command line interface for web forms.

config

It provides the default Flask App config file.

Classes

Config

Config

class Config

Methods

__init__

__init__

Config.**__init__**()

__init__()

Attributes

BABEL_DEFAULT_LOCALE
BABEL_LANGUAGES
DEBUG
MAIL_DEFAULT_SENDER
MAIL_PASSWORD
MAIL_PORT
MAIL_SERVER
MAIL_USERNAME
MAIL_USE_SSL
RECAPTCHA_PRIVATE_KEY
RECAPTCHA_PUBLIC_KEY
REMEMBER_COOKIE_SAMESITE
SCHEDULA_I18N_DIRNAME
SECRET_KEY
SECURITY_AUTO_LOGIN_AFTER_CONFIRM
SECURITY_BLUEPRINT_NAME
SECURITY_CONFIRMABLE
SECURITY_CONFIRM_ERROR_VIEW

continues on next page

Table 1 – continued from previous page

SECURITY_I18N_DIRNAME
SECURITY_PASSWORD_SALT
SECURITY_POST_CONFIRM_VIEW
SECURITY_RECOVERABLE
SECURITY_REDIRECT_BEHAVIOR
SECURITY_REGISTERABLE
SECURITY_RESET_ERROR_VIEW
SECURITY_RESET_VIEW
SECURITY_TRACKABLE
SECURITY_URL_PREFIX
SESSION_COOKIE_SAMESITE
SQLALCHEMY_DATABASE_URI
SQLALCHEMY_ENGINE_OPTIONS
SQLALCHEMY_TRACK_MODIFICATIONS
STRIPE_PUBLISHABLE_KEY
STRIPE_SECRET_KEY
STRIPE_WEBHOOK_SECRET_KEY
WTF_CSRF_CHECK_DEFAULT

BABEL_DEFAULT_LOCALE

Config.**BABEL_DEFAULT_LOCALE = 'en_US'**

BABEL_LANGUAGES

```
Config.BABEL_LANGUAGES = {'af_ZA': {'icon': '', 'label': 'Afrikaans'}, 'ca_ES':
{'icon': '', 'label': 'Català'}, 'da_DK': {'icon': '', 'label': 'Dansk'},
'de_DE': {'icon': '', 'label': 'Deutsch'}, 'en_US': {'icon': '', 'label':
'English'}, 'es_ES': {'icon': '', 'label': 'Español'}, 'eu_ES': {'icon': '',
'label': 'Euskara'}, 'fr_FR': {'icon': '', 'label': 'Français'}, 'hu_HU':
{'icon': '', 'label': 'Magyar'}, 'hy_AM': {'icon': '', 'label': ''}, 'is_IS':
{'icon': '', 'label': 'Íslenska'}, 'it_IT': {'icon': '', 'label': 'Italiano'},
'ja_JP': {'icon': '', 'label': ''}, 'nl_NL': {'icon': '', 'label':
'Nederlands'}, 'pl_PL': {'icon': '', 'label': 'Polski'}, 'pt_BR': {'icon': '',
'label': 'Português (Brasil)'}, 'pt_PT': {'icon': '', 'label': 'Português
(Portugal)'}, 'ru_RU': {'icon': '', 'label': ''}, 'tr_TR': {'icon': '',
'label': 'Türkçe'}, 'zh_Hans_CN': {'icon': '', 'label': ''}}
```

DEBUG

```
Config.DEBUG = True
```

MAIL_DEFAULT_SENDER

```
Config.MAIL_DEFAULT_SENDER = 'ProsaWeb <info@prosaweb.it>'
```

MAIL_PASSWORD

```
Config.MAIL_PASSWORD = 'prosaweb@123'
```

MAIL_PORT

```
Config.MAIL_PORT = 465
```

MAIL_SERVER

```
Config.MAIL_SERVER = 'smtps.aruba.it'
```

MAIL_USERNAME

```
Config.MAIL_USERNAME = 'info@prosaweb.it'
```

MAIL_USE_SSL

`Config.MAIL_USE_SSL = True`

RECAPTCHA_PRIVATE_KEY

`Config.RECAPTCHA_PRIVATE_KEY = '6LcsgJglAAAAAAbR3aHm2qJS_c3XsGqmC90816eH'`

RECAPTCHA_PUBLIC_KEY

`Config.RECAPTCHA_PUBLIC_KEY = '6LcsgJglAAAAAMm7ilxkhBRevaCAuxlpefYZmxHU'`

REMEMBER_COOKIE_SAMESITE

`Config.REMEMBER_COOKIE_SAMESITE = 'strict'`

SCHEDULA_I18N_DIRNAME

`Config.SCHEDULA_I18N_DIRNAME = ['translations', 'translations', '/home/docs/checkouts/readthedocs.org/user_builds/schedula/envs/v1.5.9/lib/python3.11/site-packages/schedula/utils/form/translations']`

SECRET_KEY

`Config.SECRET_KEY = 'WSZWMLxkasrg272a538Jg58O0TTDg09NFiPJ42O-mh0'`

SECURITY_AUTO_LOGIN_AFTER_CONFIRM

`Config.SECURITY_AUTO_LOGIN_AFTER_CONFIRM = False`

SECURITY_BLUEPRINT_NAME

`Config.SECURITY_BLUEPRINT_NAME = 'security'`

SECURITY_CONFIRMABLE

`Config.SECURITY_CONFIRMABLE = True`

SECURITY_CONFIRM_ERROR_VIEW

Config.SECURITY_CONFIRM_ERROR_VIEW = '/#login'

SECURITY_I18N_DIRNAME

Config.SECURITY_I18N_DIRNAME = ['translations', 'translations', '/home/docs/checkouts/readthedocs.org/user_builds/schedula/envs/v1.5.9/lib/python3.11/site-packages/schedula/utils/translations', '/home/docs/checkouts/readthedocs.org/user_builds/schedula/envs/v1.5.9/lib/python3.11/site-packages/flask_security/translations']

SECURITY_PASSWORD_SALT

Config.SECURITY_PASSWORD_SALT = 121815299565884518877356025784761042912

SECURITY_POST_CONFIRM_VIEW

Config.SECURITY_POST_CONFIRM_VIEW = '/#login'

SECURITY_RECOVERABLE

Config.SECURITY_RECOVERABLE = True

SECURITY_REDIRECT_BEHAVIOR

Config.SECURITY_REDIRECT_BEHAVIOR = 'spa'

SECURITY_REGISTERABLE

Config.SECURITY_REGISTERABLE = True

SECURITY_RESET_ERROR_VIEW

Config.SECURITY_RESET_ERROR_VIEW = '/#login'

SECURITY_RESET_VIEW

`Config.SECURITY_RESET_VIEW = '/#reset'`

SECURITY_TRACKABLE

`Config.SECURITY_TRACKABLE = True`

SECURITY_URL_PREFIX

`Config.SECURITY_URL_PREFIX = '/user'`

SESSION_COOKIE_SAMESITE

`Config.SESSION_COOKIE_SAMESITE = 'strict'`

SQLALCHEMY_DATABASE_URI

`Config.SQLALCHEMY_DATABASE_URI = 'sqlite://'`

SQLALCHEMY_ENGINE_OPTIONS

`Config.SQLALCHEMY_ENGINE_OPTIONS = {'pool_pre_ping': True}`

SQLALCHEMY_TRACK_MODIFICATIONS

`Config.SQLALCHEMY_TRACK_MODIFICATIONS = False`

STRIPE_PUBLISHABLE_KEY

`Config.STRIPE_PUBLISHABLE_KEY = None`

STRIPE_SECRET_KEY

`Config.STRIPE_SECRET_KEY = None`

STRIPE_WEBHOOK_SECRET_KEY

Config.**STRIPE_WEBHOOK_SECRET_KEY = None**

WTF_CSRF_CHECK_DEFAULT

Config.**WTF_CSRF_CHECK_DEFAULT = False**

gapp

It provides the *gunicorn* BaseApplication to run the server in production.

Functions

get_module

get_module

get_module(*module=None*, *extra_sys_paths=()*)

Classes

Application

Application

class Application(*app*, *workers=None*, *timeout=0*, *threads=10*, *accesslog='-'*, ***options*)

Methods

__init__	
do_load_config	Loads the configuration
init	
load	
load_config	This method is used to load the configuration from one or several input(s).
load_default_config	
reload	
run	
wsgi	

__init__

Application.**__init__**(*app*, *workers=None*, *timeout=0*, *threads=10*, *accesslog='-'*, ***options*)

do_load_config

Application.**do_load_config**()

Loads the configuration

init

Application.**init**(*parser*, *opts*, *args*)

load

Application.**load**()

load_config

Application.**load_config**()

This method is used to load the configuration from one or several input(s). Custom Command line, configuration file. You have to override this method in your class.

load_default_config

`Application.load_default_config()`

reload

`Application.reload()`

run

`Application.run()`

wsgi

`Application.wsgi()`

`__init__`(*app*, *workers=None*, *timeout=0*, *threads=10*, *accesslog='-'*, ***options*)

`load_config()`

This method is used to load the configuration from one or several input(s). Custom Command line, configuration file. You have to override this method in your class.

json_secrets

It provides functions to dump and load secrets from flask session when dealing with JSON.

Functions

dumps
dumps_secret
loads
loads_secret
secrets

dumps

dumps(*obj*, ***kwargs*)

dumps_secret

dumps_secret(*o*)

loads

loads(*s*, ***kwargs*)

loads_secret

loads_secret(*key*)

secrets

secrets(*obj*, *dumps=True*)

mail

It provides functions to send mails with Flask.

Functions

prepare_message

prepare_message

prepare_message(*boby*, *subject*, *recipients*, *reply_to=None*, ***kwargs*)

Classes

Mail

Mail

class Mail(*app=None*)

Methods

__init__	
connect	Opens a connection to the mail host.
init_app	Initializes your mail settings from the application settings.
init_mail	
record_messages	Records all messages. Use in unit tests for example::.
send	Sends a single message instance.
send_message	Shortcut for send(msg).
send_rst	

__init__

Mail.**__init__**(*app=None*)

connect

Mail.**connect**()

Opens a connection to the mail host.

init_app

Mail.**init_app**(*app*)

Initializes your mail settings from the application settings.

You can use this if you want to set up your Mail instance at configuration time.

Parameters
app – Flask application instance

init_mail

Mail.**init_mail**(*config*, *debug=False*, *testing=False*)

record_messages

Mail.**record_messages**()

Records all messages. Use in unit tests for example:

```
with mail.record_messages() as outbox:
    response = app.test_client.get("/email-sending-view/")
    assert len(outbox) == 1
    assert outbox[0].subject == "testing"
```

You must have blinker installed in order to use this feature. :versionadded: 0.4

send

Mail.**send**(*message*)

Sends a single message instance. If TESTING is True the message will not actually be sent.

Parameters
message – a Message instance.

send_message

Mail.**send_message**(**args*, ***kwargs*)

Shortcut for send(msg).

Takes same arguments as Message constructor.

Versionadded
0.3.5

send_rst

Mail.**send_rst**(*to*, *rst=None*, *reply_to=None*, *body=None*, *subject=None*, ***data*)

__init__(*app=None*)

server

It provides functions to build the base form flask app.

Functions

basic_app	
default_get_form_context	

basic_app

basic_app(*sitemap*, *app*)

default_get_form_context

default_get_form_context()

Classes

FormMap

FormMap

class FormMap

Methods

__init__	
add2csrf_protected	
add_headers	
add_items	
after_request	
app	
basic_app	
before_request	
clear	
copy	
fromkeys	Create a new ordered dictionary with keys from iterable and values set to value.
generate_csrf	
get	Return the value for key if key is in the dictionary, else default.

continues on next page

Table 2 – continued from previous page

get_directory	
get_dsp_from	
get_form_context	
get_sol_from	
init_debug_subsite	
items	
keys	
move_to_end	Move an existing element to the end (or beginning if last is false).
pop	If the key is not found, return the default if given; otherwise, raise a KeyError.
popitem	Remove and return a (key, value) pair from the dictionary.
render	
render_form	
rules	
send_static_file	
setdefault	Insert key with a value of default if key is not in the dictionary.
site	
site_index	
update	If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]
validate_csrf	
values	

__init__

`FormMap.__init__()`

add2csrf_protected

`FormMap.add2csrf_protected(app=None, item=None)`

add_headers

`FormMap.add_headers(resp)`

add_items

`FormMap.add_items(item, workflow=False, depth=-1, folder=None, memo=None, **options)`

after_request

`static FormMap.after_request(response)`

app

`FormMap.app(root_path=None, depth=1, mute=False, blueprint_name=None, **kwargs)`

basic_app

`FormMap.basic_app(root_path, mute=True, blueprint_name=None, **kwargs)`

before_request

`static FormMap.before_request()`

clear

`FormMap.clear()` → None. Remove all items from od.

copy

`FormMap.copy()` → a shallow copy of od

fromkeys

`FormMap.fromkeys(value=None)`

Create a new ordered dictionary with keys from iterable and values set to value.

generate_csrf

`FormMap.generate_csrf()`

get

`FormMap.get(key, default=None, /)`

Return the value for key if key is in the dictionary, else default.

get_directory

`FormMap.get_directory(directory)`

get_dsp_from

`static FormMap.get_dsp_from(item)`

get_form_context

`FormMap.get_form_context()`

get_sol_from

`static FormMap.get_sol_from(item)`

init_debug_subsite

`FormMap.init_debug_subsite(func)`

items

FormMap.**items**() → a set-like object providing a view on D's items

keys

FormMap.**keys**() → a set-like object providing a view on D's keys

move_to_end

FormMap.**move_to_end**(*key*, *last=True*)

Move an existing element to the end (or beginning if last is false).

Raise KeyError if the element does not exist.

pop

FormMap.**pop**(*key*[, *default*]) → v, remove specified key and return the corresponding value.

If the key is not found, return the default if given; otherwise, raise a KeyError.

popitem

FormMap.**popitem**(*last=True*)

Remove and return a (key, value) pair from the dictionary.

Pairs are returned in LIFO order if last is true or FIFO order if false.

render

FormMap.**render**(**args*, ***kwargs*)

render_form

FormMap.**render_form**(*form='index'*)

rules

FormMap.**rules**(*depth=-1*, *index=True*, *viz_js=False*)

send_static_file

static FormMap.**send_static_file**(*filename*)

setdefault

FormMap.**setdefault**(*key*, *default=None*)

Insert key with a value of default if key is not in the dictionary.

Return the value for key if key is in the dictionary, else default.

site

FormMap.**site**(*root_path=None*, *depth=-1*, *index=True*, *view=False*, *run=False*, ***kw*)

site_index

FormMap.**site_index**(***kwargs*)

update

FormMap.**update**([*E*,]***F*) → None. Update D from dict/iterable E and F.

If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]

validate_csrf

FormMap.**validate_csrf**()

values

FormMap.**values**() → an object providing a view on D's values

__init__()

Attributes

blueprint_name
csrf_defaults
csrf_required
directory
idle_timeout
include_folders_as_filenames
methods
nodes
options
short_name
subsite_methods

blueprint_name

`FormMap.blueprint_name = None`

csrf_defaults

`FormMap.csrf_defaults = {'CSRF_AUTO_REFRESH_HEADER': 'N-CSRF-Token', 'CSRF_ENABLED': True, 'CSRF_FIELD_NAME': 'CSRF_token', 'CSRF_HEADERS': {'X-CSRF-Token', 'X-CSRFToken'}, 'CSRF_METHODS': {'DELETE', 'PATCH', 'POST', 'PUT'}, 'CSRF_SECRET_KEY': <function FormMap.<lambda>>, 'CSRF_SSL_STRICT': True, 'CSRF_TIME_LIMIT': 3600}`

csrf_required

`FormMap.csrf_required = {'CSRF_FIELD_NAME': 'A field name is required to use CSRF.', 'CSRF_HEADERS': 'A valid headers is required to use CSRF.', 'CSRF_METHODS': 'A valid request methods is required to use CSRF.', 'CSRF_SECRET_KEY': 'A secret key is required to use CSRF.'}`

directory

FormMap.**directory** = None

idle_timeout

FormMap.**idle_timeout** = 600

include_folders_as_filenames

FormMap.**include_folders_as_filenames** = False

methods

FormMap.**methods** = ['POST']

nodes

property FormMap.**nodes**

options

FormMap.**options** = {'digraph', 'edge_data', 'max_lines', 'max_width', 'node_data', 'node_function', 'node_styles'}

short_name

FormMap.**short_name** = None

subsite_methods

FormMap.**subsite_methods** = ['GET', 'POST']

7.2.11 gen

It contains classes and functions of general utility.

These are python-specific utilities and hacks - general data-processing or numerical operations.

Functions

counter	Return a object whose .__call__() method returns consecutive values.

counter

counter(*start=0*, *step=1*)

Return a object whose .__call__() method returns consecutive values.

Parameters

- **start** (*int*, *float*, *optional*) – Start value.
- **step** (*int*, *float*, *optional*) – Step value.

Classes

Token	It constructs a unique constant that behaves like a string.

Token

class Token(**args*)

It constructs a unique constant that behaves like a string.

Example:

```
>>> s = Token('string')
>>> s
string
>>> s == 'string'
False
>>> s == Token('string')
False
>>> {s: 1, Token('string'): 1}
{string: 1, string: 1}
>>> s.capitalize()
'String'
```

Methods

__init__	
capitalize	Return a capitalized version of the string.
casefold	Return a version of the string suitable for caseless comparisons.
center	Return a centered string of length width.

continues on next page

Table 3 – continued from previous page

count	Return the number of non-overlapping occurrences of substring sub in string S[start:end].
encode	Encode the string using the codec registered for encoding.
endswith	Return True if S ends with the specified suffix, False otherwise.
expandtabs	Return a copy where all tab characters are expanded using spaces.
find	Return the lowest index in S where substring sub is found, such that sub is contained within S[start:end].
format	Return a formatted version of S, using substitutions from args and kwargs.
format_map	Return a formatted version of S, using substitutions from mapping.
index	Return the lowest index in S where substring sub is found, such that sub is contained within S[start:end].
isalnum	Return True if the string is an alpha-numeric string, False otherwise.
isalpha	Return True if the string is an alphabetic string, False otherwise.
isascii	Return True if all characters in the string are ASCII, False otherwise.
isdecimal	Return True if the string is a decimal string, False otherwise.
isdigit	Return True if the string is a digit string, False otherwise.
isidentifier	Return True if the string is a valid Python identifier, False otherwise.
islower	Return True if the string is a lowercase string, False otherwise.
isnumeric	Return True if the string is a numeric string, False otherwise.
isprintable	Return True if the string is printable, False otherwise.
isspace	Return True if the string is a whitespace string, False otherwise.
istitle	Return True if the string is a title-cased string, False otherwise.
isupper	Return True if the string is an uppercase string, False otherwise.
join	Concatenate any number of strings.
ljust	Return a left-justified string of length width.
lower	Return a copy of the string converted to lowercase.
lstrip	Return a copy of the string with leading whitespace removed.
maketrans	Return a translation table usable for str.translate().
partition	Partition the string into three parts using the given separator.
removeprefix	Return a str with the given prefix string removed if present.
removesuffix	Return a str with the given suffix string removed if present.

continues on next page

Table 3 – continued from previous page

`replace`	Return a copy with all occurrences of substring old replaced by new.
`rfind`	Return the highest index in S where substring sub is found, such that sub is contained within S[start:end].
`rindex`	Return the highest index in S where substring sub is found, such that sub is contained within S[start:end].
`rjust`	Return a right-justified string of length width.
`rpartition`	Partition the string into three parts using the given separator.
`rsplit`	Return a list of the substrings in the string, using sep as the separator string.
`rstrip`	Return a copy of the string with trailing whitespace removed.
`split`	Return a list of the substrings in the string, using sep as the separator string.
`splitlines`	Return a list of the lines in the string, breaking at line boundaries.
`startswith`	Return True if S starts with the specified prefix, False otherwise.
`strip`	Return a copy of the string with leading and trailing whitespace removed.
`swapcase`	Convert uppercase characters to lowercase and lowercase characters to uppercase.
`title`	Return a version of the string where each word is titlecased.
`translate`	Replace each character in the string using the given translation table.
`upper`	Return a copy of the string converted to uppercase.
`zfill`	Pad a numeric string with zeros on the left, to fill a field of the given width.

__init__

`Token.__init__(*args)`

capitalize

`Token.capitalize()`

Return a capitalized version of the string.

More specifically, make the first character have upper case and the rest lower case.

casefold

`Token.casefold()`

Return a version of the string suitable for caseless comparisons.

center

`Token.center(width, fillchar=' ', /)`

Return a centered string of length width.

Padding is done using the specified fill character (default is a space).

count

`Token.count(sub[, start[, end]])` → int

Return the number of non-overlapping occurrences of substring sub in string S[start:end]. Optional arguments start and end are interpreted as in slice notation.

encode

`Token.encode(encoding='utf-8', errors='strict')`

Encode the string using the codec registered for encoding.

encoding
The encoding in which to encode the string.

errors
The error handling scheme to use for encoding errors. The default is 'strict' meaning that encoding errors raise a UnicodeEncodeError. Other possible values are 'ignore', 'replace' and 'xmlcharrefreplace' as well as any other name registered with codecs.register_error that can handle UnicodeEncodeErrors.

endswith

`Token.endswith(suffix[, start[, end]])` → bool

Return True if S ends with the specified suffix, False otherwise. With optional start, test S beginning at that position. With optional end, stop comparing S at that position. suffix can also be a tuple of strings to try.

expandtabs

`Token.expandtabs(tabsize=8)`

Return a copy where all tab characters are expanded using spaces.

If tabsize is not given, a tab size of 8 characters is assumed.

find

Token.**find**(*sub*[, *start*[, *end*]]) → int

Return the lowest index in S where substring sub is found, such that sub is contained within S[start:end]. Optional arguments start and end are interpreted as in slice notation.

Return -1 on failure.

format

Token.**format**(**args*, ***kwargs*) → str

Return a formatted version of S, using substitutions from args and kwargs. The substitutions are identified by braces ('{' and '}').

format_map

Token.**format_map**(*mapping*) → str

Return a formatted version of S, using substitutions from mapping. The substitutions are identified by braces ('{' and '}').

index

Token.**index**(*sub*[, *start*[, *end*]]) → int

Return the lowest index in S where substring sub is found, such that sub is contained within S[start:end]. Optional arguments start and end are interpreted as in slice notation.

Raises ValueError when the substring is not found.

isalnum

Token.**isalnum**()

Return True if the string is an alpha-numeric string, False otherwise.

A string is alpha-numeric if all characters in the string are alpha-numeric and there is at least one character in the string.

isalpha

Token.**isalpha**()

Return True if the string is an alphabetic string, False otherwise.

A string is alphabetic if all characters in the string are alphabetic and there is at least one character in the string.

isascii

`Token.isascii()`

Return True if all characters in the string are ASCII, False otherwise.

ASCII characters have code points in the range U+0000-U+007F. Empty string is ASCII too.

isdecimal

`Token.isdecimal()`

Return True if the string is a decimal string, False otherwise.

A string is a decimal string if all characters in the string are decimal and there is at least one character in the string.

isdigit

`Token.isdigit()`

Return True if the string is a digit string, False otherwise.

A string is a digit string if all characters in the string are digits and there is at least one character in the string.

isidentifier

`Token.isidentifier()`

Return True if the string is a valid Python identifier, False otherwise.

Call keyword.iskeyword(s) to test whether string s is a reserved identifier, such as "def" or "class".

islower

`Token.islower()`

Return True if the string is a lowercase string, False otherwise.

A string is lowercase if all cased characters in the string are lowercase and there is at least one cased character in the string.

isnumeric

`Token.isnumeric()`

Return True if the string is a numeric string, False otherwise.

A string is numeric if all characters in the string are numeric and there is at least one character in the string.

isprintable

`Token.isprintable()`

Return True if the string is printable, False otherwise.

A string is printable if all of its characters are considered printable in repr() or if it is empty.

isspace

`Token.isspace()`

Return True if the string is a whitespace string, False otherwise.

A string is whitespace if all characters in the string are whitespace and there is at least one character in the string.

istitle

`Token.istitle()`

Return True if the string is a title-cased string, False otherwise.

In a title-cased string, upper- and title-case characters may only follow uncased characters and lowercase characters only cased ones.

isupper

`Token.isupper()`

Return True if the string is an uppercase string, False otherwise.

A string is uppercase if all cased characters in the string are uppercase and there is at least one cased character in the string.

join

`Token.join(iterable, /)`

Concatenate any number of strings.

The string whose method is called is inserted in between each given string. The result is returned as a new string.

Example: '.'.join(['ab', 'pq', 'rs']) -> 'ab.pq.rs'

ljust

`Token.ljust(width, fillchar=' ', /)`

Return a left-justified string of length width.

Padding is done using the specified fill character (default is a space).

lower

`Token.lower()`

Return a copy of the string converted to lowercase.

lstrip

`Token.lstrip(chars=None, /)`

Return a copy of the string with leading whitespace removed.

If chars is given and not None, remove characters in chars instead.

maketrans

`static Token.maketrans()`

Return a translation table usable for str.translate().

If there is only one argument, it must be a dictionary mapping Unicode ordinals (integers) or characters to Unicode ordinals, strings or None. Character keys will be then converted to ordinals. If there are two arguments, they must be strings of equal length, and in the resulting dictionary, each character in x will be mapped to the character at the same position in y. If there is a third argument, it must be a string, whose characters will be mapped to None in the result.

partition

`Token.partition(sep, /)`

Partition the string into three parts using the given separator.

This will search for the separator in the string. If the separator is found, returns a 3-tuple containing the part before the separator, the separator itself, and the part after it.

If the separator is not found, returns a 3-tuple containing the original string and two empty strings.

removeprefix

`Token.removeprefix(prefix, /)`

Return a str with the given prefix string removed if present.

If the string starts with the prefix string, return string[len(prefix):]. Otherwise, return a copy of the original string.

removesuffix

`Token.removesuffix(suffix, /)`

Return a str with the given suffix string removed if present.

If the string ends with the suffix string and that suffix is not empty, return string[:-len(suffix)]. Otherwise, return a copy of the original string.

replace

`Token.replace(old, new, count=-1, /)`

Return a copy with all occurrences of substring old replaced by new.

count
Maximum number of occurrences to replace. -1 (the default value) means replace all occurrences.

If the optional argument count is given, only the first count occurrences are replaced.

rfind

`Token.rfind(sub[, start[, end]]) → int`

Return the highest index in S where substring sub is found, such that sub is contained within S[start:end]. Optional arguments start and end are interpreted as in slice notation.

Return -1 on failure.

rindex

`Token.rindex(sub[, start[, end]]) → int`

Return the highest index in S where substring sub is found, such that sub is contained within S[start:end]. Optional arguments start and end are interpreted as in slice notation.

Raises ValueError when the substring is not found.

rjust

`Token.rjust(width, fillchar=' ', /)`

Return a right-justified string of length width.

Padding is done using the specified fill character (default is a space).

rpartition

`Token.rpartition(sep, /)`

Partition the string into three parts using the given separator.

This will search for the separator in the string, starting at the end. If the separator is found, returns a 3-tuple containing the part before the separator, the separator itself, and the part after it.

If the separator is not found, returns a 3-tuple containing two empty strings and the original string.

rsplit

`Token.rsplit(sep=None, maxsplit=-1)`

Return a list of the substrings in the string, using sep as the separator string.

sep
The separator used to split the string.

When set to None (the default value), will split on any whitespace character (including n r t f and spaces) and will discard empty strings from the result.

maxsplit
Maximum number of splits (starting from the left). -1 (the default value) means no limit.

Splitting starts at the end of the string and works to the front.

rstrip

`Token.rstrip(chars=None, /)`

Return a copy of the string with trailing whitespace removed.

If chars is given and not None, remove characters in chars instead.

split

`Token.split(sep=None, maxsplit=-1)`

Return a list of the substrings in the string, using sep as the separator string.

sep
The separator used to split the string.

When set to None (the default value), will split on any whitespace character (including n r t f and spaces) and will discard empty strings from the result.

maxsplit
Maximum number of splits (starting from the left). -1 (the default value) means no limit.

Note, str.split() is mainly useful for data that has been intentionally delimited. With natural text that includes punctuation, consider using the regular expression module.

splitlines

`Token.splitlines(keepends=False)`

Return a list of the lines in the string, breaking at line boundaries.

Line breaks are not included in the resulting list unless keepends is given and true.

startswith

`Token.startswith(prefix[, start[, end]]) → bool`

Return True if S starts with the specified prefix, False otherwise. With optional start, test S beginning at that position. With optional end, stop comparing S at that position. prefix can also be a tuple of strings to try.

strip

`Token.strip(chars=None, /)`

Return a copy of the string with leading and trailing whitespace removed.

If chars is given and not None, remove characters in chars instead.

swapcase

`Token.swapcase()`

Convert uppercase characters to lowercase and lowercase characters to uppercase.

title

`Token.title()`

Return a version of the string where each word is titlecased.

More specifically, words start with uppercased characters and all remaining cased characters have lower case.

translate

`Token.translate(table, /)`

Replace each character in the string using the given translation table.

table
: Translation table, which must be a mapping of Unicode ordinals to Unicode ordinals, strings, or None.

The table must implement lookup/indexing via __getitem__, for instance a dictionary or list. If this operation raises LookupError, the character is left untouched. Characters mapped to None are deleted.

upper

Token.**upper**()

Return a copy of the string converted to uppercase.

zfill

Token.**zfill**(*width*, */*)

Pad a numeric string with zeros on the left, to fill a field of the given width.

The string is never truncated.

__init__(**args*)

7.2.12 graph

It contains the *DiGraph* class.

Classes

DiGraph

DiGraph

class DiGraph(*nodes=None*, *adj=None*)

Methods

__init__
add_edge
add_edge_fw
add_edges_from
add_node
add_nodes_from
copy
has_edge
remove_edge
remove_edges_from
remove_node
remove_nodes_from
subgraph

__init__

DiGraph.**__init__**(*nodes=None*, *adj=None*)

add_edge

DiGraph.**add_edge**(*u*, *v*, ***attr*)

add_edge_fw

DiGraph.**add_edge_fw**(*u*, *v*, ***attr*)

add_edges_from

DiGraph.**add_edges_from**(*ebunch_to_add*)

add_node

DiGraph.**add_node**(*n*, ***attr*)

add_nodes_from

DiGraph.**add_nodes_from**(*nodes_for_adding*)

copy

DiGraph.**copy**()

has_edge

DiGraph.**has_edge**(*u*, *v*)

remove_edge

DiGraph.**remove_edge**(*u*, *v*)

remove_edges_from

DiGraph.**remove_edges_from**(*ebunch*)

remove_node

DiGraph.**remove_node**(*n*)

remove_nodes_from

DiGraph.**remove_nodes_from**(*nodes*)

subgraph

DiGraph.**subgraph**(*nodes*)

__init__(*nodes=None*, *adj=None*)

Attributes

nodes	
succ	
pred	
adj	
edges	

nodes

DiGraph.**nodes**

succ

DiGraph.**succ**

pred

DiGraph.**pred**

adj

property DiGraph.**adj**

edges

property DiGraph.**edges**

7.2.13 imp

Fixes ImportError for MicroPython.

7.2.14 io

It provides functions to read and save a dispatcher from/to files.

Functions

load_default_values	Load Dispatcher default values in Python pickle format.
load_dispatcher	Load Dispatcher object in Python pickle format.
load_map	Load Dispatcher map in Python pickle format.
save_default_values	Write Dispatcher default values in Python pickle format.
save_dispatcher	Write Dispatcher object in Python pickle format.
save_map	Write Dispatcher graph object in Python pickle format.

load_default_values

load_default_values(*dsp*, *path*)

Load Dispatcher default values in Python pickle format.

Pickles are a serialized byte stream of a Python object. This format will preserve Python objects used as nodes or edges.

Parameters

- **dsp** (*schedula.Dispatcher*) – A dispatcher that identifies the model adopted.
- **path** (*str, file*) – File or filename to write. File names ending in .gz or .bz2 will be uncompressed.

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher()
>>> dsp.add_data('a', default_value=1)
'a'
>>> dsp.add_function(function=max, inputs=['a', 'b'], outputs=['c'])
'max'
>>> save_default_values(dsp, file_name)

>>> dsp = Dispatcher(dmap=dsp.dmap)
>>> load_default_values(dsp, file_name)
>>> dsp.dispatch(inputs={'b': 3})['c']
3
```

load_dispatcher

load_dispatcher(*path*)

Load Dispatcher object in Python pickle format.

Pickles are a serialized byte stream of a Python object. This format will preserve Python objects used as nodes or edges.

Parameters

path (*str, file*) – File or filename to write. File names ending in .gz or .bz2 will be uncompressed.

Returns

A dispatcher that identifies the model adopted.

Return type

schedula.Dispatcher

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher()
>>> dsp.add_data('a', default_value=1)
'a'
>>> dsp.add_function(function=max, inputs=['a', 'b'], outputs=['c'])
'max'
>>> save_dispatcher(dsp, file_name)

>>> dsp = load_dispatcher(file_name)
>>> dsp.dispatch(inputs={'b': 3})['c']
3
```

load_map

load_map(*dsp*, *path*)

Load Dispatcher map in Python pickle format.

Parameters

- **dsp** (*schedula.schedula.Dispatcher*) – A dispatcher that identifies the model to be upgraded.
- **path** (*str, file*) – File or filename to write. File names ending in .gz or .bz2 will be uncompressed.

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher()
>>> dsp.add_function(function=max, inputs=['a', 'b'], outputs=['c'])
'max'
>>> save_map(dsp, file_name)

>>> dsp = Dispatcher()
>>> load_map(dsp, file_name)
>>> dsp.dispatch(inputs={'a': 1, 'b': 3})['c']
3
```

save_default_values

save_default_values(*dsp*, *path*)

Write Dispatcher default values in Python pickle format.

Pickles are a serialized byte stream of a Python object. This format will preserve Python objects used as nodes or edges.

Parameters

- **dsp** (*schedula.Dispatcher*) – A dispatcher that identifies the model adopted.
- **path** (*str, file*) – File or filename to write. File names ending in .gz or .bz2 will be compressed.

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher()
>>> dsp.add_data('a', default_value=1)
'a'
>>> dsp.add_function(function=max, inputs=['a', 'b'], outputs=['c'])
'max'
>>> save_default_values(dsp, file_name)
```

save_dispatcher

save_dispatcher(*dsp*, *path*)

Write Dispatcher object in Python pickle format.

Pickles are a serialized byte stream of a Python object. This format will preserve Python objects used as nodes or edges.

Parameters

- **dsp** (*schedula.Dispatcher*) – A dispatcher that identifies the model adopted.
- **path** (*str, file*) – File or filename to write. File names ending in .gz or .bz2 will be compressed.

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher()
>>> dsp.add_data('a', default_value=1)
'a'
>>> dsp.add_function(function=max, inputs=['a', 'b'], outputs=['c'])
'max'
>>> save_dispatcher(dsp, file_name)
```

save_map

save_map(*dsp*, *path*)

Write Dispatcher graph object in Python pickle format.

Pickles are a serialized byte stream of a Python object. This format will preserve Python objects used as nodes or edges.

Parameters

- **dsp** (*schedula.Dispatcher*) – A dispatcher that identifies the model adopted.
- **path** (*str, file*) – File or filename to write. File names ending in .gz or .bz2 will be compressed.

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher()
>>> dsp.add_function(function=max, inputs=['a', 'b'], outputs=['c'])
'max'
>>> save_map(dsp, file_name)
```

7.2.15 sol

It provides a solution class for dispatch result.

Classes

Solution	Solution class for dispatch result.

Solution

class Solution(**args*, ***kwargs*)

Solution class for dispatch result.

Methods

__init__	
check_targets	Terminates ArciDispatch algorithm when all targets have been visited.
check_wait_in	Stops the search of the investigated node of the ArciDispatch algorithm, until all inputs are satisfied.
clear	
copy	
form	Creates a dispatcher Form Flask app.
fromkeys	Create a new ordered dictionary with keys from iterable and values set to value.
get	Return the value for key if key is in the dictionary, else default.
get_node	Returns a sub node of a dispatcher.
get_sub_dsp_from_workflow	Returns the sub-dispatcher induced by the workflow from sources.
items	
keys	
move_to_end	Move an existing element to the end (or beginning if last is false).
plot	Plots the Dispatcher with a graph in the DOT language with Graphviz.
pop	If the key is not found, return the default if given; otherwise, raise a KeyError.
popitem	Remove and return a (key, value) pair from the dictionary.
result	Set all asynchronous results.
setdefault	Insert key with a value of default if key is not in the dictionary.
update	If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]
values	
web	Creates a dispatcher Flask app.

__init__

Solution.**__init__**(*dsp=None*, *inputs=None*, *outputs=None*, *wildcard=False*, *inputs_dist=None*, *no_call=False*, *rm_unused_nds=False*, *wait_in=None*, *no_domain=False*, *_empty=False*, *index=(-1,)*, *full_name=()*, *verbose=False*, *excluded_defaults=()*)

check_targets

Solution.**check_targets**(*node_id*)

Terminates ArciDispatch algorithm when all targets have been visited.

Parameters
node_id (*str*) – Data or function node id.

Returns
True if all targets have been visited, otherwise False.

Return type
bool

check_wait_in

Solution.**check_wait_in**(*wait_in*, *n_id*)

Stops the search of the investigated node of the ArciDispatch algorithm, until all inputs are satisfied.

Parameters

- **wait_in** (*bool*) – If True the node is waiting input estimations.
- **n_id** (*str*) – Data or function node id.

Returns
True if all node inputs are satisfied, otherwise False.

Return type
bool

clear

Solution.**clear**() → None. Remove all items from od.

copy

Solution.**copy**() → a shallow copy of od

form

Solution.**form**(*depth=1*, *node_data=none*, *node_function=none*, *directory=None*, *sites=None*, *run=True*, *view=True*, *get_context=none*, *get_data=none*, *subsite_idle_timeout=600*, *basic_app_config=None*, *stripe_event_handler=<function Base.<lambda>>*)

Creates a dispatcher Form Flask app.

Parameters

- **depth** (*int*, *optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str]*, *optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str]*, *optional*) – Function node attributes produce API.
- **directory** (*str*, *optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site]*, *optional*) – A set of Site to maintain alive the backend server.
- **run** (*bool*, *optional*) – Run the backend server?
- **view** (*bool*, *optional*) – Open the url site with the sys default opener.
- **get_context** (*function | dict*, *optional*) – Function to pass extra data as form context.
- **get_data** (*function | dict*, *optional*) – Function to initialize the formdata.
- **subsite_idle_timeout** (*int*, *optional*) – Idle timeout of a debug subsite in seconds.
- **basic_app_config** (*object*, *optional*) – Flask app config object.
- **stripe_event_handler** (*function*, *optional*) – Stripe event handler function.

Returns

A FormMap or a Site if *sites is None* and *run or view is True*.

Return type

FormMap | Site

fromkeys

Solution.**fromkeys**(*value=None*)

Create a new ordered dictionary with keys from iterable and values set to value.

get

`Solution.get(key, default=None, /)`

Return the value for key if key is in the dictionary, else default.

get_node

`Solution.get_node(*node_ids, node_attr=none)`

Returns a sub node of a dispatcher.

Parameters

- **node_ids** (*str*) – A sequence of node ids or a single node id. The id order identifies a dispatcher sub-level.
- **node_attr** (*str, None, optional*) – Output node attr.

  If the searched node does not have this attribute, all its attributes are returned.

  When 'auto', returns the "default" attributes of the searched node, which are:

  – for data node: its output, and if not exists, all its attributes.

  – for function and sub-dispatcher nodes: the 'function' attribute.

  When 'description', returns the "description" of the searched node, searching also in function or sub-dispatcher input/output description.

  When 'output', returns the data node output.

  When 'default_value', returns the data node default value.

  When 'value_type', returns the data node value's type.

  When *None*, returns the node attributes.

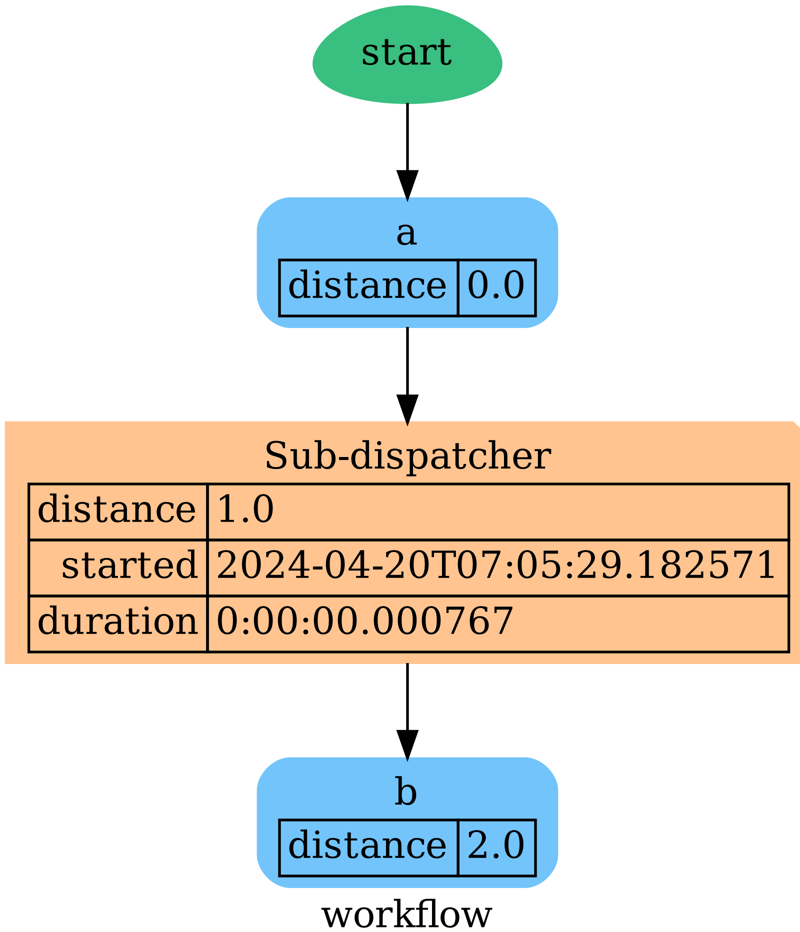
Returns

Node attributes and its real path.

Return type

(T, (str, ...))

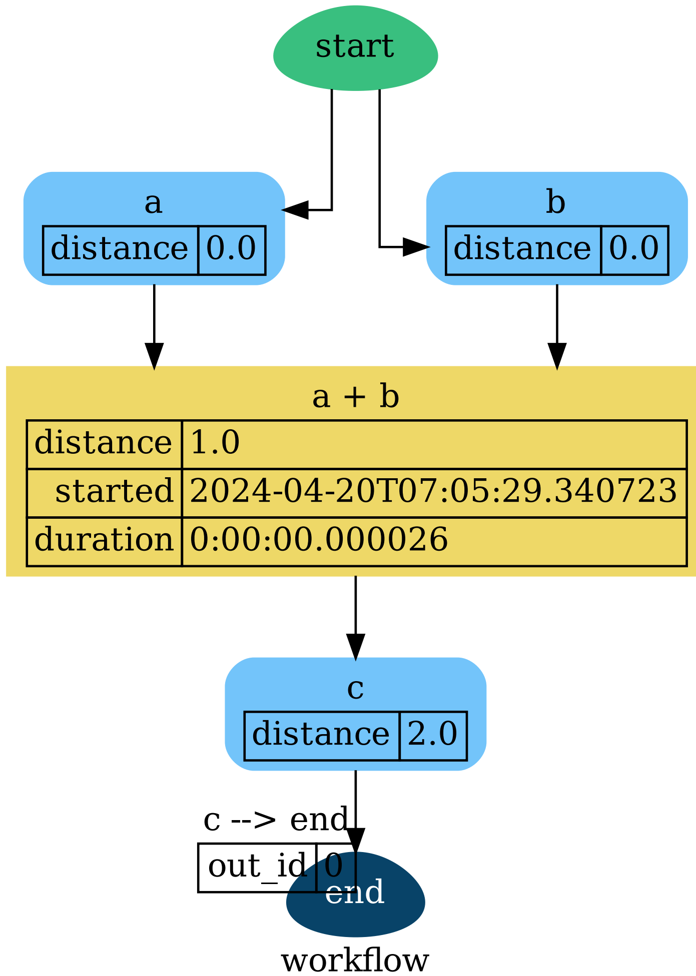
Example:



Get the sub node output:

```
>>> dsp.get_node('Sub-dispatcher', 'c')
(4, ('Sub-dispatcher', 'c'))
>>> dsp.get_node('Sub-dispatcher', 'c', node_attr='type')
('data', ('Sub-dispatcher', 'c'))
```

```
>>> sub_dsp, sub_dsp_id = dsp.get_node('Sub-dispatcher')
```



get_sub_dsp_from_workflow

Solution.**get_sub_dsp_from_workflow**(*sources*, *reverse=False*, *add_missing=False*, *check_inputs=True*)

Returns the sub-dispatcher induced by the workflow from sources.

The induced sub-dispatcher of the dsp contains the reachable nodes and edges evaluated with breadth-first-search on the workflow graph from source nodes.

Parameters

- **sources** (*list[str], iterable*) – Source nodes for the breadth-first-search. A container of nodes which will be iterated through once.
- **reverse** (*bool, optional*) – If True the workflow graph is assumed as reversed.
- **add_missing** (*bool, optional*) – If True, missing function' inputs are added to

the sub-dispatcher.

- **check_inputs** (*bool, optional*) – If True the missing function' inputs are not checked.

Returns
A sub-dispatcher.

Return type
schedula.dispatcher.Dispatcher

items

`Solution.items()` → a set-like object providing a view on D's items

keys

`Solution.keys()` → a set-like object providing a view on D's keys

move_to_end

`Solution.move_to_end(key, last=True)`

Move an existing element to the end (or beginning if last is false).

Raise KeyError if the element does not exist.

plot

`Solution.plot(workflow=None, view=True, depth=-1, name=none, comment=none, format=none, engine=none, encoding=none, graph_attr=none, node_attr=none, edge_attr=none, body=none, raw_body=none, node_styles=none, node_data=none, node_function=none, edge_data=none, max_lines=none, max_width=none, directory=None, sites=None, index=True, viz=False, short_name=None, executor='async', render=False, run=False)`

Plots the Dispatcher with a graph in the DOT language with Graphviz.

Parameters

- **workflow** (*bool, optional*) – If True the latest solution will be plotted, otherwise the dmap.
- **view** (*bool, optional*) – Open the rendered directed graph in the DOT language with the sys default opener.
- **edge_data** (*tuple[str], optional*) – Edge attributes to view.
- **node_data** (*tuple[str], optional*) – Data node attributes to view.
- **node_function** (*tuple[str], optional*) – Function node attributes to view.
- **node_styles** (*dict[str|Token, dict[str, str]]*) – Default node styles according to graphviz node attributes.
- **depth** (*int, optional*) – Depth of sub-dispatch plots. If negative all levels are plotted.

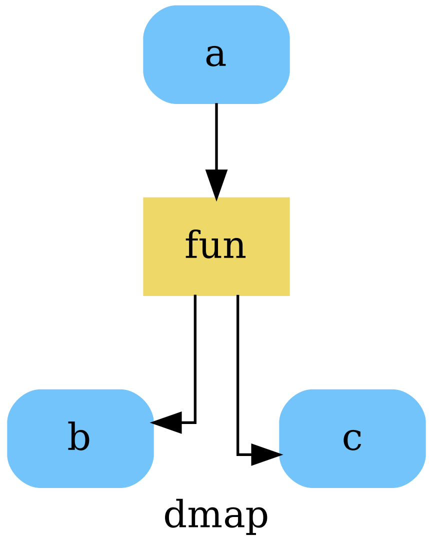
- **name** (*str*) – Graph name used in the source code.
- **comment** (*str*) – Comment added to the first line of the source.
- **directory** (*str, optional*) – (Sub)directory for source saving and rendering.
- **format** (*str, optional*) – Rendering output format ('pdf', 'png', …).
- **engine** (*str, optional*) – Layout command used ('dot', 'neato', …).
- **encoding** (*str, optional*) – Encoding for saving the source.
- **graph_attr** (*dict, optional*) – Dict of (attribute, value) pairs for the graph.
- **node_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all nodes.
- **edge_attr** (*dict, optional*) – Dict of (attribute, value) pairs set for all edges.
- **body** (*dict, optional*) – Dict of (attribute, value) pairs to add to the graph body.
- **raw_body** (*list, optional*) – List of command to add to the graph body.
- **directory** – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of Site to maintain alive the backend server.
- **index** (*bool, optional*) – Add the site index as first page?
- **max_lines** (*int, optional*) – Maximum number of lines for rendering node attributes.
- **max_width** (*int, optional*) – Maximum number of characters in a line to render node attributes.
- **view** – Open the main page of the site?
- **render** (*bool, optional*) – Render all pages statically?
- **viz** (*bool, optional*) – Use viz.js as back-end?
- **short_name** (*int, optional*) – Maximum length of the filename, if set name is hashed and reduced.
- **executor** (*str, optional*) – Pool executor to render object.
- **run** (*bool, optional*) – Run the backend server?

Returns
A SiteMap or a Site if .

Return type
schedula.utils.drw.SiteMap

Example:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
>>> dsp.plot(view=False, graph_attr={'ratio': '1'})
SiteMap([(Dispatcher, SiteMap())])
```



pop

Solution.**pop**(*key*[, *default*]) → v, remove specified key and return the corresponding value.

If the key is not found, return the default if given; otherwise, raise a KeyError.

popitem

Solution.**popitem**(*last=True*)

Remove and return a (key, value) pair from the dictionary.

Pairs are returned in LIFO order if last is true or FIFO order if false.

result

Solution.**result**(*timeout=None*)

Set all asynchronous results.

Parameters

timeout (*float*) – The number of seconds to wait for the result if the futures aren't done. If None, then there is no limit on the wait time.

Returns

Update Solution.

Return type

Solution

setdefault

`Solution.setdefault(key, default=None)`

Insert key with a value of default if key is not in the dictionary.

Return the value for key if key is in the dictionary, else default.

update

`Solution.update([E, ]**F)` → None. Update D from dict/iterable E and F.

If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]

values

`Solution.values()` → an object providing a view on D's values

web

`Solution.web(depth=-1, node_data=none, node_function=none, directory=None, sites=None, run=True, subsite_idle_timeout=600)`

Creates a dispatcher Flask app.

Parameters

- **depth** (*int, optional*) – Depth of sub-dispatch API. If negative all levels are configured.
- **node_data** (*tuple[str], optional*) – Data node attributes to produce API.
- **node_function** (*tuple[str], optional*) – Function node attributes produce API.
- **directory** (*str, optional*) – Where is the generated Flask app root located?
- **sites** (*set[Site], optional*) – A set of `Site` to maintain alive the backend server.
- **run** (*bool, optional*) – Run the backend server?
- **subsite_idle_timeout** (*int, optional*) – Idle timeout of a debug subsite in seconds.

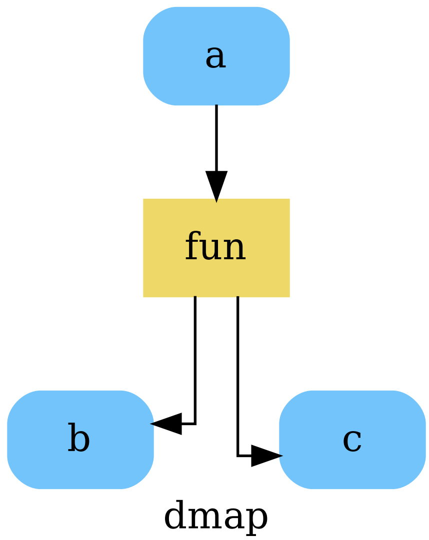
Returns
A WebMap.

Return type
WebMap

Example:

From a dispatcher like this:

```
>>> from schedula import Dispatcher
>>> dsp = Dispatcher(name='Dispatcher')
>>> def fun(a):
...     return a + 1, a - 1
>>> dsp.add_function('fun', fun, ['a'], ['b', 'c'])
'fun'
```



You can create a web server with the following steps:

```
>>> print("Starting...\n"); site = dsp.web(); site
Starting...
Site(WebMap([(Dispatcher, WebMap())]), host='localhost', ...)
>>> import requests
>>> url = '%s/%s/%s' % (site.url, dsp.name, fun.__name__)
>>> requests.post(url, json={'args': (0,)}).json()['return']
[1, -1]
>>> site.shutdown()  # Remember to shutdown the server.
True
```

Note: When *Site* is garbage collected, the server is shutdown automatically.

__init__(*dsp=None*, *inputs=None*, *outputs=None*, *wildcard=False*, *inputs_dist=None*, *no_call=False*, *rm_unused_nds=False*, *wait_in=None*, *no_domain=False*, *_empty=False*, *index=(-1,)*, *full_name=()*, *verbose=False*, *excluded_defaults=()*)

Attributes

pipe	Returns the full pipe of a dispatch run.

pipe

property Solution.**pipe**

Returns the full pipe of a dispatch run.

check_wait_in(*wait_in*, *n_id*)

Stops the search of the investigated node of the ArciDispatch algorithm, until all inputs are satisfied.

Parameters

- **wait_in** (*bool*) – If True the node is waiting input estimations.
- **n_id** (*str*) – Data or function node id.

Returns
True if all node inputs are satisfied, otherwise False.

Return type
bool

result(*timeout=None*)

Set all asynchronous results.

Parameters
timeout (*float*) – The number of seconds to wait for the result if the futures aren't done. If None, then there is no limit on the wait time.

Returns
Update Solution.

Return type
Solution

get_sub_dsp_from_workflow(*sources*, *reverse=False*, *add_missing=False*, *check_inputs=True*)

Returns the sub-dispatcher induced by the workflow from sources.

The induced sub-dispatcher of the dsp contains the reachable nodes and edges evaluated with breadth-first-search on the workflow graph from source nodes.

Parameters

- **sources** (*list[str], iterable*) – Source nodes for the breadth-first-search. A container of nodes which will be iterated through once.
- **reverse** (*bool, optional*) – If True the workflow graph is assumed as reversed.
- **add_missing** (*bool, optional*) – If True, missing function' inputs are added to the sub-dispatcher.
- **check_inputs** (*bool, optional*) – If True the missing function' inputs are not checked.

Returns
A sub-dispatcher.

Return type
schedula.dispatcher.Dispatcher

property pipe
Returns the full pipe of a dispatch run.

check_targets(*node_id*)
Terminates ArciDispatch algorithm when all targets have been visited.

Parameters
node_id (*str*) – Data or function node id.

Returns
True if all targets have been visited, otherwise False.

Return type
bool

7.2.16 utl

It provides some utility functions.

Functions

dict_diff	
get_unused_node_id	Finds an unused node id in *graph*.
select_diff	

dict_diff

dict_diff(*adict: dict*, *excluded: set*) → dict

get_unused_node_id

get_unused_node_id(*graph*, *initial_guess='unknown'*, *_format='{}<%d>'*)
Finds an unused node id in *graph*.

Parameters

- **graph** (schedula.utils.graph.DiGraph) – A directed graph.
- **initial_guess** (*str, optional*) – Initial node id guess.
- **_format** (*str, optional*) – Format to generate the new node id if the given is already used.

Returns
An unused node id.

Return type
str

select_diff

select_diff(*adict: dict*, *excluded: set*, *key: str*) → dict

7.2.17 web

It provides functions to build a flask app from a dispatcher.

Classes

FolderNodeWeb
WebFolder
WebMap
WebNode

FolderNodeWeb

class FolderNodeWeb(*folder*, *node_id*, *attr*, ***options*)

Methods

__init__	
counter	Implement next(self).
dot	
href	
items	
parent_ref	
render_funcs	
render_size	
style	
yield_attr	

__init__

FolderNodeWeb.**__init__**(*folder*, *node_id*, *attr*, ***options*)

counter

FolderNodeWeb.**counter**()

Implement next(self).

dot

FolderNodeWeb.**dot**(*context=None*)

href

FolderNodeWeb.**href**(*context*, *link_id*)

items

FolderNodeWeb.**items**()

parent_ref

FolderNodeWeb.**parent_ref**(*context*, *node_id*, *attr=None*)

render_funcs

FolderNodeWeb.**render_funcs**()

render_size

FolderNodeWeb.**render_size**(*out*)

style

FolderNodeWeb.**style**()

yield_attr

FolderNodeWeb.**yield_attr**(*name*)

__init__(*folder*, *node_id*, *attr*, ***options*)

Attributes

edge_data
max_lines
max_width
node_data
node_function
node_map
node_styles
pprint
re_node
title
type

edge_data

FolderNodeWeb.**edge_data** = ()

max_lines

FolderNodeWeb.**max_lines** = 5

max_width

`FolderNodeWeb.max_width = 200`

node_data

`FolderNodeWeb.node_data = ()`

node_function

`FolderNodeWeb.node_function = ('+function',)`

node_map

`FolderNodeWeb.node_map = {'': ('dot', 'table'), '!': ('dot', 'table'), '*': ('link',), '+': ('dot', 'table'), '-': (), '.': ('dot',), '?': ()}`

node_styles

FolderNodeWeb.node_styles = {'error': {empty: {'fillcolor': '#FFFFFF', 'label': 'empty', 'shape': 'egg'}, end: {'color': '#084368', 'fillcolor': '#084368', 'fontcolor': '#FFFFFF', 'label': 'end', 'ordering': 'in', 'shape': 'egg'}, none: {'data': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'penwidth': 2, 'shape': 'box', 'style': 'rounded,filled'}, 'dispatcher': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'dispatchpipe': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'edge': {None: None}, 'function': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'box'}, 'function-dispatcher': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note'}, 'mapdispatch': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'run_model': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note'}, 'subdispatch': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'subdispatchfunction': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'subdispatchpipe': {'color': '#5E1F00', 'fillcolor': '#FF3536', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}}, plot: {'color': '#fcf3dd', 'fillcolor': '#fcf3dd', 'label': 'plot', 'shape': 'egg'}, self: {'color': '#C1A4FE', 'fillcolor': '#C1A4FE', 'label': 'self', 'shape': 'egg'}, sink: {'color': '#303030', 'fillcolor': '#303030', 'fontcolor': '#FFFFFF', 'label': 'sink', 'shape': 'egg'}, start: {'color': '#39bf7f', 'fillcolor': '#39bf7f', 'label': 'start', 'ordering': 'out', 'shape': 'egg'}}, 'info': {empty: {'fillcolor': '#FFFFFF', 'label': 'empty', 'shape': 'egg'}, end: {'color': '#084368', 'fillcolor': '#084368', 'fontcolor': '#FFFFFF', 'label': 'end', 'ordering': 'in', 'shape': 'egg'}, none: {'data': {'color': '#73c4fa', 'fillcolor': '#73c4fa', 'shape': 'box', 'style': 'rounded,filled'}, 'dispatcher': {'color': '#c6c6c6', 'fillcolor': '#c6c6c6', 'shape': 'note', 'style': 'filled'}, 'dispatchpipe': {'color': '#e8c268', 'fillcolor': '#e8c268', 'ordering': 'in', 'shape': 'note', 'style': 'filled'}, 'edge': {None: None}, 'function': {'color': '#eed867', 'fillcolor': '#eed867', 'ordering': 'in', 'shape': 'box'}, 'function-dispatcher': {'color': '#eed867', 'fillcolor': '#eed867', 'ordering': 'in', 'shape': 'note'}, 'mapdispatch': {'color': '#f4bd6a', 'fillcolor': '#f4bd6a', 'ordering': 'in', 'shape': 'note', 'style': 'filled'}, 'run_model': {'color': '#eed867', 'fillcolor': '#eed867', 'ordering': 'in', 'shape': 'note'}, 'subdispatch': {'color': '#ffc490', 'fillcolor': '#ffc490', 'shape': 'note', 'style': 'filled'}, 'subdispatchfunction': {'color': '#f9d951', 'fillcolor': '#f9d951', 'ordering': 'in', 'shape': 'note', 'style': 'filled'}, 'subdispatchpipe': {'color': '#f1cd5d', 'fillcolor': '#f1cd5d', 'ordering': 'in', 'shape': 'note', 'style': 'filled'}}, plot: {'color': '#fcf3dd', 'fillcolor': '#fcf3dd', 'label': 'plot', 'shape': 'egg'}, self: {'color': '#C1A4FE', 'fillcolor': '#C1A4FE', 'label': 'self', 'shape': 'egg'}, sink: {'color': '#303030', 'fillcolor': '#303030', 'fontcolor': '#FFFFFF', 'label': 'sink', 'shape': 'egg'}, start: {'color': '#39bf7f', 'fillcolor': '#39bf7f', 'label': 'start', 'ordering': 'out', 'shape': 'egg'}}, 'warning': {empty: {'fillcolor': '#FFFFFF', 'label': 'empty', 'shape': 'egg'}, end: {'color': '#084368', 'fillcolor': '#084368', 'fontcolor': '#FFFFFF', 'label': 'end', 'ordering': 'in', 'shape': 'egg'}, none: {'data': {'color': '#C9340A', 'fillcolor': '#fea22b', 'penwidth': 2, 'shape': 'box', 'style': 'rounded,filled'}, 'dispatcher': {'color': '#C9340A', 'fillcolor': '#fea22b', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'dispatchpipe': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'edge': {None: None}, 'function': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'box'}, 'function-dispatcher': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'note'}, 'mapdispatch': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'note', 'style': 'filled'}, 'run_model': {'color': '#C9340A', 'fillcolor': '#fea22b', 'ordering': 'in', 'penwidth': 2, 'shape': 'note'},

pprint

FolderNodeWeb.**pprint** = <pprint.PrettyPrinter object>

re_node

FolderNodeWeb.**re_node** = '^([.*+!]?)([\\w]+)(?>\\|([\\w]+))?$'

title

property FolderNodeWeb.**title**

type

property FolderNodeWeb.**type**

WebFolder

class WebFolder(*item*, *dsp*, *graph*, *obj*, *name=''*, *workflow=False*, *digraph=None*, *parent=None*, *short_name=None*, ***options*)

Methods

__init__	
counter	Implement next(self).
dot	
view	

__init__

WebFolder.**__init__**(*item*, *dsp*, *graph*, *obj*, *name=''*, *workflow=False*, *digraph=None*, *parent=None*, *short_name=None*, ***options*)

counter

`WebFolder.counter()`

Implement next(self).

dot

`WebFolder.dot(context=None)`

view

`WebFolder.view(filepath, context=None, viz=False, **kwargs)`

`__init__(item, dsp, graph, obj, name='', workflow=False, digraph=None, parent=None, short_name=None, **options)`

Attributes

digraph
ext
filename
inputs
label_name
name
outputs
title
view_id

digraph

`WebFolder.digraph = {'body': {'splines': 'ortho', 'style': 'filled'}, 'edge_attr': {}, 'format': 'svg', 'graph_attr': {'bgcolor': 'transparent', 'nslimit': '1', 'nslimit1': '1'}, 'node_attr': {'style': 'filled'}}`

ext

`WebFolder.ext = ''`

filename

`property WebFolder.filename`

inputs

`property WebFolder.inputs`

label_name

`property WebFolder.label_name`

name

`property WebFolder.name`

outputs

`property WebFolder.outputs`

title

`property WebFolder.title`

view_id

`property WebFolder.view_id`

WebMap

`class WebMap`

Methods

`__init__`	
`add_items`	
`after_request`	
`app`	
`basic_app`	
`before_request`	
`clear`	
`copy`	
`fromkeys`	Create a new ordered dictionary with keys from iterable and values set to value.
`get`	Return the value for key if key is in the dictionary, else default.
`get_directory`	
`get_dsp_from`	
`get_sol_from`	
`init_debug_subsite`	
`items`	
`keys`	
`move_to_end`	Move an existing element to the end (or beginning if last is false).
`pop`	If the key is not found, return the default if given; otherwise, raise a KeyError.
`popitem`	Remove and return a (key, value) pair from the dictionary.
`render`	
`rules`	
`setdefault`	Insert key with a value of default if key is not in the dictionary.
`site`	
`site_index`	
`update`	If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]
`values`	

__init__

`WebMap.__init__()`

add_items

`WebMap.add_items(item, workflow=False, depth=-1, folder=None, memo=None, **options)`

after_request

`static WebMap.after_request(response)`

app

`WebMap.app(root_path=None, depth=-1, mute=False, blueprint_name=None, **kwargs)`

basic_app

`WebMap.basic_app(root_path, mute=True, blueprint_name=None, **kwargs)`

before_request

`static WebMap.before_request()`

clear

`WebMap.clear()` → None. Remove all items from od.

copy

`WebMap.copy()` → a shallow copy of od

fromkeys

`WebMap.fromkeys(value=None)`

Create a new ordered dictionary with keys from iterable and values set to value.

get

`WebMap.get(key, default=None, /)`

Return the value for key if key is in the dictionary, else default.

get_directory

`WebMap.get_directory(directory)`

get_dsp_from

`static WebMap.get_dsp_from(item)`

get_sol_from

`static WebMap.get_sol_from(item)`

init_debug_subsite

`WebMap.init_debug_subsite(func)`

items

`WebMap.items()` → a set-like object providing a view on D's items

keys

`WebMap.keys()` → a set-like object providing a view on D's keys

move_to_end

`WebMap.move_to_end(key, last=True)`

Move an existing element to the end (or beginning if last is false).

Raise KeyError if the element does not exist.

pop

WebMap.**pop**(*key*[, *default*]) → v, remove specified key and return the corresponding value.

If the key is not found, return the default if given; otherwise, raise a KeyError.

popitem

WebMap.**popitem**(*last=True*)

Remove and return a (key, value) pair from the dictionary.

Pairs are returned in LIFO order if last is true or FIFO order if false.

render

WebMap.**render**(**args*, ***kwargs*)

rules

WebMap.**rules**(*depth=-1*, *index=True*, *viz_js=False*)

setdefault

WebMap.**setdefault**(*key*, *default=None*)

Insert key with a value of default if key is not in the dictionary.

Return the value for key if key is in the dictionary, else default.

site

WebMap.**site**(*root_path=None*, *depth=-1*, *index=True*, *view=False*, *run=False*, ***kw*)

site_index

WebMap.**site_index**(***kwargs*)

update

WebMap.**update**([*E*,]***F*) → None. Update D from dict/iterable E and F.

If E is present and has a .keys() method, then does: for k in E: D[k] = E[k] If E is present and lacks a .keys() method, then does: for k, v in E: D[k] = v In either case, this is followed by: for k in F: D[k] = F[k]

values

`WebMap.values()` → an object providing a view on D's values

`__init__()`

Attributes

blueprint_name
directory
idle_timeout
include_folders_as_filenames
methods
nodes
options
short_name
subsite_methods

blueprint_name

`WebMap.blueprint_name = None`

directory

`WebMap.directory = None`

idle_timeout

`WebMap.idle_timeout = 600`

include_folders_as_filenames

`WebMap.include_folders_as_filenames = False`

methods

`WebMap.methods = ['POST']`

nodes

`property WebMap.nodes`

options

`WebMap.options = {'digraph', 'edge_data', 'max_lines', 'max_width', 'node_data', 'node_function', 'node_styles'}`

short_name

`WebMap.short_name = None`

subsite_methods

`WebMap.subsite_methods = ['GET', 'POST']`

WebNode

class WebNode(*folder*, *node_id*, *item*, *obj*, *dsp_node_id*, *short_name=None*)

Methods

__init__	
counter	Implement next(self).
render	
view	

__init__

WebNode.**__init__**(*folder*, *node_id*, *item*, *obj*, *dsp_node_id*, *short_name=None*)

counter

WebNode.**counter**()

Implement next(self).

render

WebNode.**render**(**args*, ***kwargs*)

view

WebNode.**view**(*filepath*, **args*, ***kwargs*)

__init__(*folder*, *node_id*, *item*, *obj*, *dsp_node_id*, *short_name=None*)

Attributes

ext
filename
name
pprint
title
view_id

ext

WebNode.**ext** = ''

filename

`property WebNode.filename`

name

`property WebNode.name`

pprint

`WebNode.pprint = <pprint.PrettyPrinter object>`

title

`property WebNode.title`

view_id

`property WebNode.view_id`

7.3 ext

It provides sphinx extensions.

Extensions:

autosummary	It is a patch to sphinx.ext.autosummary.
dispatcher	It provides dispatcher sphinx documenter and directive.

7.3.1 autosummary

It is a patch to sphinx.ext.autosummary.

Functions

generate_autosummary_content
generate_autosummary_docs
process_generate_options
setup

generate_autosummary_content

generate_autosummary_content(*name*, *obj*, *parent*, *template*, *template_name*, *imported_members*, *app*, *recursive*, *context*, *modname=None*, *qualname=None*)

generate_autosummary_docs

generate_autosummary_docs(*sources*, *output_dir=None*, *suffix='.rst'*, *base_path=None*, *imported_members=False*, *app=None*, *overwrite=True*, *encoding='utf-8'*)

process_generate_options

process_generate_options(*app*)

setup

setup(*app*)

7.3.2 dispatcher

It provides dispatcher sphinx documenter and directive.

Extensions:

documenter	Dispatcher documenter.
graphviz	Dispatcher directive.

documenter

Dispatcher documenter.

Functions

add_autodocumenter	
contains_doctest	
get_grandfather_content	
setup	Setup *dispatcher* Sphinx extension module.

add_autodocumenter

add_autodocumenter(*app*, *cls*)

contains_doctest

contains_doctest(*text*)

get_grandfather_content

get_grandfather_content(*content*, *level=2*, *offset=None*)

setup

setup(*app*)

Setup *dispatcher* Sphinx extension module.

Classes

DispatcherDirective	
DispatcherDocumenter	Specialized Documenter subclass for dispatchers.

DispatcherDirective

class DispatcherDirective(*name*, *arguments*, *options*, *content*, *lineno*, *content_offset*, **args*, ***kwargs*)

Methods

`__init__`	
`add_name`	Append self.options['name'] to node['names'] if it exists.
`assert_has_content`	Throw an ERROR-level DirectiveError if the directive doesn't have contents.
`debug`	
`directive_error`	Return a DirectiveError suitable for being thrown as an exception.
`error`	
`get_location`	Get current location info for logging.
`get_source_info`	Get source and line number.
`info`	
`run`	
`set_source_info`	Set source and line number to the node.
`severe`	
`warning`	

__init__

DispatcherDirective.**__init__**(*name*, *arguments*, *options*, *content*, *lineno*, *content_offset*, **args*, ***kwargs*)

add_name

DispatcherDirective.**add_name**(*node*)

Append self.options['name'] to node['names'] if it exists.

Also normalize the name string and register it as explicit target.

assert_has_content

DispatcherDirective.**assert_has_content**()

Throw an ERROR-level DirectiveError if the directive doesn't have contents.

debug

DispatcherDirective.**debug**(*message*)

directive_error

DispatcherDirective.**directive_error**(*level*, *message*)

Return a DirectiveError suitable for being thrown as an exception.

Call "raise self.directive_error(level, message)" from within a directive implementation to return one single system message at level *level*, which automatically gets the directive block and the line number added.

Preferably use the *debug*, *info*, *warning*, *error*, or *severe* wrapper methods, e.g. `self.error(message)` to generate an ERROR-level directive error.

error

DispatcherDirective.**error**(*message*)

get_location

DispatcherDirective.**get_location**() → str

Get current location info for logging.

get_source_info

DispatcherDirective.**get_source_info**() → tuple[str, int]

Get source and line number.

info

DispatcherDirective.**info**(*message*)

run

DispatcherDirective.**run**() → list[Node]

set_source_info

DispatcherDirective.**set_source_info**(*node: Node*) → None

Set source and line number to the node.

severe

DispatcherDirective.**severe**(*message*)

warning

DispatcherDirective.**warning**(*message*)

__init__(*name*, *arguments*, *options*, *content*, *lineno*, *content_offset*, **args*, ***kwargs*)

Attributes

config	Reference to the Config object.
env	Reference to the BuildEnvironment object.
final_argument_whitespace	May the final argument contain whitespace?
has_content	May the directive have content?
option_spec	Mapping of option names to validator functions.
optional_arguments	Number of optional arguments after the required arguments.
required_arguments	Number of required directive arguments.

config

property DispatcherDirective.**config**: *Config*

Reference to the *Config* object.

env

property DispatcherDirective.**env**: **BuildEnvironment**

Reference to the BuildEnvironment object.

final_argument_whitespace

DispatcherDirective.**final_argument_whitespace = True**

May the final argument contain whitespace?

has_content

DispatcherDirective.**has_content = True**

May the directive have content?

option_spec

`DispatcherDirective.option_spec = {}`

Mapping of option names to validator functions.

optional_arguments

`DispatcherDirective.optional_arguments = 0`

Number of optional arguments after the required arguments.

required_arguments

`DispatcherDirective.required_arguments = 1`

Number of required directive arguments.

DispatcherDocumenter

class DispatcherDocumenter(*directive: DocumenterBridge*, *name: str*, *indent: str = ''*)

Specialized Documenter subclass for dispatchers.

Methods

__init__	
add_content	Add content from docstrings, attribute documentation and user.
add_directive_header	Add the directive header and options to the generated content.
add_line	Append one line of generated reST to the output.
can_document_member	Called to see if a member can be documented by this Documenter.
check_module	Check if *self.object* is really defined in the module given by *self.modname*.
document_members	Generate reST for member documentation.
filter_members	Filter the given member list.
format_args	Format the argument signature of *self.object*.
format_name	Format the name of *self.object*.
format_signature	Format the signature (arguments and return annotation) of the object.
generate	Generate reST for the object given by *self.name*, and possibly for its members.
get_attr	getattr() override for types such as Zope interfaces.
get_doc	Decode and return lines of the docstring(s) for the object.
get_module_comment	
get_object_members	Return *(members_check_module, members)* where *members* is a list of *(membername, member)* pairs of the members of *self.object*.
get_real_modname	Get the real module name of an object to document.
get_sourcename	
import_object	Import the object given by *self.modname* and *self.objpath* and set it as *self.object*.
parse_name	Determine what module to import and what attribute to document.
process_doc	Let the user process the docstrings before adding them.
resolve_name	Resolve the module and name of the object to document given by the arguments and the current module/class.
should_suppress_directive_header	Check directive header should be suppressed.
should_suppress_value_header	Check :value: header should be suppressed.
sort_members	Sort the given member list.
update_annotations	Update __annotations__ to support type_comment and so on.
update_content	Update docstring, for example with TypeVar variance.

__init__

DispatcherDocumenter.**__init__**(*directive: DocumenterBridge*, *name: str*, *indent: str = ''*) → None

add_content

DispatcherDocumenter.**add_content**(*more_content*, *no_docstring=False*)

Add content from docstrings, attribute documentation and user.

add_directive_header

DispatcherDocumenter.**add_directive_header**(*sig*)

Add the directive header and options to the generated content.

add_line

DispatcherDocumenter.**add_line**(*line: str*, *source: str*, **lineno: int*) → None

Append one line of generated reST to the output.

can_document_member

classmethod DispatcherDocumenter.**can_document_member**(*member*, **args*, ***kwargs*)

Called to see if a member can be documented by this Documenter.

check_module

DispatcherDocumenter.**check_module**() → bool

Check if *self.object* is really defined in the module given by *self.modname*.

document_members

DispatcherDocumenter.**document_members**(*all_members: bool = False*) → None

Generate reST for member documentation.

If *all_members* is True, document all members, else those given by *self.options.members*.

filter_members

DispatcherDocumenter.**filter_members**(*members: list[ObjectMember]*, *want_all: bool*) → list[tuple[str, Any, bool]]

Filter the given member list.

Members are skipped if

- they are private (except if given explicitly or the private-members option is set)
- they are special methods (except if given explicitly or the special-members option is set)

- they are undocumented (except if the undoc-members option is set)

The user can override the skipping decision by connecting to the `autodoc-skip-member` event.

format_args

`DispatcherDocumenter.format_args(**kwargs: Any) → str`

Format the argument signature of *self.object*.

Should return None if the object does not have a signature.

format_name

`DispatcherDocumenter.format_name() → str`

Format the name of *self.object*.

This normally should be something that can be parsed by the generated directive, but doesn't need to be (Sphinx will display it unparsed then).

format_signature

`DispatcherDocumenter.format_signature()`

Format the signature (arguments and return annotation) of the object.

Let the user process it via the `autodoc-process-signature` event.

generate

`DispatcherDocumenter.generate(more_content=None, **kw)`

Generate reST for the object given by *self.name*, and possibly for its members.

If *more_content* is given, include that content. If *real_modname* is given, use that module name to find attribute docs. If *check_module* is True, only generate if the object is defined in the module name it is imported from. If *all_members* is True, document all members.

get_attr

`DispatcherDocumenter.get_attr(obj: Any, name: str, *defargs: Any) → Any`

getattr() override for types such as Zope interfaces.

get_doc

`DispatcherDocumenter.get_doc() → list[list[str]] | None`

Decode and return lines of the docstring(s) for the object.

When it returns None, autodoc-process-docstring will not be called for this object.

get_module_comment

DispatcherDocumenter.**get_module_comment**(*attrname: str*) → list[str] | None

get_object_members

DispatcherDocumenter.**get_object_members**(*want_all: bool*) → tuple[bool, list[ObjectMember]]

Return *(members_check_module, members)* where *members* is a list of *(membername, member)* pairs of the members of *self.object*.

If *want_all* is True, return all members. Else, only return those members given by *self.options.members* (which may also be None).

get_real_modname

DispatcherDocumenter.**get_real_modname**()

Get the real module name of an object to document.

It can differ from the name of the module through which the object was imported.

get_sourcename

DispatcherDocumenter.**get_sourcename**() → str

import_object

DispatcherDocumenter.**import_object**(**args*, ***kwargs*)

Import the object given by *self.modname* and *self.objpath* and set it as *self.object*.

Returns True if successful, False if an error occurred.

parse_name

DispatcherDocumenter.**parse_name**()

Determine what module to import and what attribute to document.

Returns True and sets *self.modname*, *self.objpath*, *self.fullname*, *self.args* and *self.retann* if parsing and resolving was successful.

process_doc

DispatcherDocumenter.**process_doc**(*docstrings: list[list[str]]*) → Iterator[str]

Let the user process the docstrings before adding them.

resolve_name

DispatcherDocumenter.**resolve_name**(*modname: str | None*, *parents: Any*, *path: str*, *base: str*) → tuple[str | None, list[str]]

Resolve the module and name of the object to document given by the arguments and the current module/class.

Must return a pair of the module name and a chain of attributes; for example, it would return `('zipfile', ['ZipFile', 'open'])` for the `zipfile.ZipFile.open` method.

should_suppress_directive_header

DispatcherDocumenter.**should_suppress_directive_header**() → bool

Check directive header should be suppressed.

should_suppress_value_header

DispatcherDocumenter.**should_suppress_value_header**() → bool

Check :value: header should be suppressed.

sort_members

DispatcherDocumenter.**sort_members**(*documenters: list[tuple[Documenter, bool]]*, *order: str*) → list[tuple[Documenter, bool]]

Sort the given member list.

update_annotations

DispatcherDocumenter.**update_annotations**(*parent: Any*) → None

Update __annotations__ to support type_comment and so on.

update_content

DispatcherDocumenter.**update_content**(*more_content: StringList*) → None

Update docstring, for example with TypeVar variance.

__init__(*directive: DocumenterBridge*, *name: str*, *indent: str = ''*) → None

Attributes

blue_cache	
code	
content_indent	indentation by which to indent the directive content
default_opt	
directivetype	
documenters	Returns registered Documenter classes
is_doctest	
member_order	order if autodoc_member_order is set to 'groupwise'
objtype	name by which the directive is called (auto...) and the default generated directive name
option_spec	
priority	priority if multiple documenters return True from can_document_member
titles_allowed	true if the generated content may contain titles
config	
env	
modname	
parent	
object	
objpath	

blue_cache

DispatcherDocumenter.**blue_cache** = {}

code

`DispatcherDocumenter.code = None`

content_indent

`DispatcherDocumenter.content_indent = ''`

indentation by which to indent the directive content

default_opt

`DispatcherDocumenter.default_opt = {'depth': 0, 'view': False}`

directivetype

`DispatcherDocumenter.directivetype = 'data'`

documenters

`property DispatcherDocumenter.documenters: dict[str, type[Documenter]]`

Returns registered Documenter classes

is_doctest

`DispatcherDocumenter.is_doctest = False`

member_order

`DispatcherDocumenter.member_order = 40`

order if autodoc_member_order is set to 'groupwise'

objtype

`DispatcherDocumenter.objtype = 'dispatcher'`

name by which the directive is called (auto...) and the default generated directive name

option_spec

DispatcherDocumenter.**option_spec: ClassVar[OptionSpec] = {'annotation': <function annotation_option>, 'code': <function bool_option>, 'data': <function bool_option>, 'description': <function bool_option>, 'dsp': <function bool_option>, 'func': <function bool_option>, 'height': <function length_or_unitless>, 'no-index': <function bool_option>, 'no-value': <function bool_option>, 'noindex': <function bool_option>, 'opt': <function _dsp2dot_option>, 'width': <function length_or_percentage_or_unitless>}**

priority

DispatcherDocumenter.**priority = -10**

priority if multiple documenters return True from can_document_member

titles_allowed

DispatcherDocumenter.**titles_allowed = True**

true if the generated content may contain titles

config

DispatcherDocumenter.**config:** *Config*

env

DispatcherDocumenter.**env: BuildEnvironment**

modname

DispatcherDocumenter.**modname:** str

parent

DispatcherDocumenter.**parent: Any**

object

`DispatcherDocumenter.object: Any`

objpath

`DispatcherDocumenter.objpath: list[str]`

content_indent = ''

indentation by which to indent the directive content

objtype = 'dispatcher'

name by which the directive is called (auto…) and the default generated directive name

get_real_modname()

Get the real module name of an object to document.

It can differ from the name of the module through which the object was imported.

classmethod can_document_member(*member*, **args*, ***kwargs*)

Called to see if a member can be documented by this Documenter.

add_directive_header(*sig*)

Add the directive header and options to the generated content.

parse_name()

Determine what module to import and what attribute to document.

Returns True and sets *self.modname*, *self.objpath*, *self.fullname*, *self.args* and *self.retann* if parsing and resolving was successful.

generate(*more_content=None*, ***kw*)

Generate reST for the object given by *self.name*, and possibly for its members.

If *more_content* is given, include that content. If *real_modname* is given, use that module name to find attribute docs. If *check_module* is True, only generate if the object is defined in the module name it is imported from. If *all_members* is True, document all members.

import_object(args*, ***kwargs*)**

Import the object given by *self.modname* and *self.objpath* and set it as *self.object*.

Returns True if successful, False if an error occurred.

format_signature()

Format the signature (arguments and return annotation) of the object.

Let the user process it via the `autodoc-process-signature` event.

add_content(*more_content*, *no_docstring=False*)

Add content from docstrings, attribute documentation and user.

graphviz

Dispatcher directive.

Functions

html_visit_dispatcher	
setup	Setup *dsp* Sphinx extension module.

html_visit_dispatcher

html_visit_dispatcher(*self*, *node*)

setup

setup(*app*)

Setup *dsp* Sphinx extension module.

Classes

DispatcherSphinxDirective
dsp

DispatcherSphinxDirective

class **DispatcherSphinxDirective**(*name*, *arguments*, *options*, *content*, *lineno*, *content_offset*, *block_text*, *state*, *state_machine*)

Methods

__init__	
add_name	Append self.options['name'] to node['names'] if it exists.
assert_has_content	Throw an ERROR-level DirectiveError if the directive doesn't have contents.
debug	
directive_error	Return a DirectiveError suitable for being thrown as an exception.
error	
get_location	Get current location info for logging.
get_source_info	Get source and line number.
info	
run	
set_source_info	Set source and line number to the node.
severe	
warning	

__init__

DispatcherSphinxDirective.**__init__**(*name*, *arguments*, *options*, *content*, *lineno*, *content_offset*, *block_text*, *state*, *state_machine*)

add_name

DispatcherSphinxDirective.**add_name**(*node*)

Append self.options['name'] to node['names'] if it exists.

Also normalize the name string and register it as explicit target.

assert_has_content

DispatcherSphinxDirective.**assert_has_content**()

Throw an ERROR-level DirectiveError if the directive doesn't have contents.

debug

`DispatcherSphinxDirective.debug(message)`

directive_error

`DispatcherSphinxDirective.directive_error(level, message)`

Return a DirectiveError suitable for being thrown as an exception.

Call "raise self.directive_error(level, message)" from within a directive implementation to return one single system message at level *level*, which automatically gets the directive block and the line number added.

Preferably use the *debug*, *info*, *warning*, *error*, or *severe* wrapper methods, e.g. `self.error(message)` to generate an ERROR-level directive error.

error

`DispatcherSphinxDirective.error(message)`

get_location

`DispatcherSphinxDirective.get_location()` → str

Get current location info for logging.

get_source_info

`DispatcherSphinxDirective.get_source_info()` → tuple[str, int]

Get source and line number.

info

`DispatcherSphinxDirective.info(message)`

run

`DispatcherSphinxDirective.run()`

set_source_info

`DispatcherSphinxDirective.set_source_info(node: Node)` → None

Set source and line number to the node.

severe

DispatcherSphinxDirective.**severe**(*message*)

warning

DispatcherSphinxDirective.**warning**(*message*)

__init__(*name*, *arguments*, *options*, *content*, *lineno*, *content_offset*, *block_text*, *state*, *state_machine*)

Attributes

config	Reference to the *Config* object.
env	Reference to the BuildEnvironment object.
final_argument_whitespace	May the final argument contain whitespace?
has_content	May the directive have content?
img_opt	
option_spec	Mapping of option names to validator functions.
optional_arguments	Number of optional arguments after the required arguments.
required_arguments	Number of required directive arguments.

config

property DispatcherSphinxDirective.**config**: *Config*

Reference to the *Config* object.

env

property DispatcherSphinxDirective.**env**: **BuildEnvironment**

Reference to the BuildEnvironment object.

final_argument_whitespace

DispatcherSphinxDirective.**final_argument_whitespace = False**

May the final argument contain whitespace?

has_content

DispatcherSphinxDirective.**has_content = True**

May the directive have content?

img_opt

DispatcherSphinxDirective.**img_opt = {'height': <function length_or_unitless>, 'width': <function length_or_percentage_or_unitless>}**

option_spec

DispatcherSphinxDirective.**option_spec: ClassVar[OptionSpec] = {'align': <function align_spec>, 'alt': <function unchanged>, 'caption': <function unchanged>, 'class': <function class_option>, 'graphviz_dot': <function unchanged>, 'height': <function length_or_unitless>, 'index': <function bool_option>, 'layout': <function unchanged>, 'name': <function unchanged>, 'viz': <function bool_option>, 'width': <function length_or_percentage_or_unitless>}**

Mapping of option names to validator functions.

optional_arguments

DispatcherSphinxDirective.**optional_arguments = 1**

Number of optional arguments after the required arguments.

required_arguments

DispatcherSphinxDirective.**required_arguments = 1**

Number of required directive arguments.

required_arguments = 1

Number of required directive arguments.

option_spec: ClassVar[OptionSpec] = {'align': <function align_spec>, 'alt': <function unchanged>, 'caption': <function unchanged>, 'class': <function class_option>, 'graphviz_dot': <function unchanged>, 'height': <function length_or_unitless>, 'index': <function bool_option>, 'layout': <function unchanged>, 'name': <function unchanged>, 'viz': <function bool_option>, 'width': <function length_or_percentage_or_unitless>}

Mapping of option names to validator functions.

dsp

class dsp(*rawsource=''*, **children*, ***attributes*)

Methods

__init__	
append	
append_attr_list	For each element in values, if it does not exist in self[attr], append it.
asdom	Return a DOM **fragment** representation of this Node.
astext	Return a string representation of this Node.
attlist	
clear	
coerce_append_attr_list	First, convert both self[attr] and value to a non-string sequence type; if either is not already a sequence, convert it to a list of one element.
copy	Monkey-patch \``nodes.Element.copy`\` to not copy the `_document` attribute.
copy_attr_coerce	If attr is an attribute of self and either self[attr] or value is a list, convert all non-sequence values to a sequence of 1 element and then concatenate the two sequence, setting the result to self[attr].
copy_attr_concatenate	If attr is an attribute of self and both self[attr] and value are lists, concatenate the two sequences, setting the result to self[attr].
copy_attr_consistent	If replace is True or self[attr] is None, replace self[attr] with value.
copy_attr_convert	If attr is an attribute of self, set self[attr] to [self[attr], value], otherwise set self[attr] to value.
deepcopy	Monkey-patch \``nodes.Element.deepcopy`\` for speed.
delattr	
emptytag	
endtag	
extend	
findall	Return an iterator yielding nodes following *self*:
first_child_matching_class	Return the index of the first child whose class exactly matches.
first_child_not_matching_class	Return the index of the first child whose class does *not* match.
get	

continues on next page

Table 4 – continued from previous page

`get_language_code`	Return node's language tag.
`has_key`	
`hasattr`	
`index`	
`insert`	
`is_not_default`	
`is_not_known_attribute`	Returns True if and only if the given attribute is NOT recognized by this class.
`is_not_list_attribute`	Returns True if and only if the given attribute is NOT one of the basic list attributes defined for all Elements.
`next_node`	Return the first node in the iterator returned by findall(), or None if the iterable is empty.
`non_default_attributes`	
`note_referenced_by`	Note that this Element has been referenced by its name *name* or id *id*.
`pformat`	Return an indented pseudo-XML representation, for test purposes.
`pop`	
`previous_sibling`	Return preceding sibling node or `None`.
`remove`	
`replace`	Replace one child *Node* with another child or children.
`replace_attr`	If self[attr] does not exist or force is True or omitted, set self[attr] to value, otherwise do nothing.
`replace_self`	Replace *self* node with *new*, where *new* is a node or a list of nodes.
`set_class`	Add a new class to the "classes" attribute.
`setdefault`	
`setup_child`	
`shortrepr`	
`starttag`	
`traverse`	Return list of nodes following *self*.
`update_all_atts`	Updates all attributes from node or dictionary *dict_*.
`update_all_atts_coercion`	Updates all attributes from node or dictionary *dict_*.
`update_all_atts_concatenating`	Updates all attributes from node or dictionary *dict_*.
`update_all_atts_consistantly`	Updates all attributes from node or dictionary *dict_*.
`update_all_atts_convert`	Updates all attributes from node or dictionary *dict_*.

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Table 4 – continued from previous page

`update_basic_atts`	Update basic attributes ('ids', 'names', 'classes', 'dupnames', but not 'source') from node or dictionary *dict_*.
`walk`	Traverse a tree of *Node* objects, calling the *dispatch_visit()* method of *visitor* when entering each node.
`walkabout`	Perform a tree traversal similarly to *Node.walk()* (which see), except also call the *dispatch_departure()* method before exiting each node.

__init__

`dsp.__init__(rawsource='', *children, **attributes)`

append

`dsp.append(item)`

append_attr_list

`dsp.append_attr_list(attr, values)`

For each element in values, if it does not exist in self[attr], append it.

NOTE: Requires self[attr] and values to be sequence type and the former should specifically be a list.

asdom

`dsp.asdom(dom=None)`

Return a DOM **fragment** representation of this Node.

astext

`dsp.astext()`

Return a string representation of this Node.

attlist

`dsp.attlist()`

clear

dsp.**clear**()

coerce_append_attr_list

dsp.**coerce_append_attr_list**(*attr*, *value*)

First, convert both self[attr] and value to a non-string sequence type; if either is not already a sequence, convert it to a list of one element. Then call append_attr_list.

NOTE: self[attr] and value both must not be None.

copy

dsp.**copy**() → Element

Monkey-patch `` `nodes.Element.copy` `` to not copy the `_document` attribute.

xref: https://github.com/sphinx-doc/sphinx/issues/11116#issuecomment-1376767086

copy_attr_coerce

dsp.**copy_attr_coerce**(*attr*, *value*, *replace*)

If attr is an attribute of self and either self[attr] or value is a list, convert all non-sequence values to a sequence of 1 element and then concatenate the two sequence, setting the result to self[attr]. If both self[attr] and value are non-sequences and replace is True or self[attr] is None, replace self[attr] with value. Otherwise, do nothing.

copy_attr_concatenate

dsp.**copy_attr_concatenate**(*attr*, *value*, *replace*)

If attr is an attribute of self and both self[attr] and value are lists, concatenate the two sequences, setting the result to self[attr]. If either self[attr] or value are non-sequences and replace is True or self[attr] is None, replace self[attr] with value. Otherwise, do nothing.

copy_attr_consistent

dsp.**copy_attr_consistent**(*attr*, *value*, *replace*)

If replace is True or self[attr] is None, replace self[attr] with value. Otherwise, do nothing.

copy_attr_convert

dsp.**copy_attr_convert**(*attr*, *value*, *replace=True*)

If attr is an attribute of self, set self[attr] to [self[attr], value], otherwise set self[attr] to value.

NOTE: replace is not used by this function and is kept only for
compatibility with the other copy functions.

deepcopy

dsp.**deepcopy**() → Element

Monkey-patch `` `nodes.Element.deepcopy` `` for speed.

delattr

dsp.**delattr**(*attr*)

emptytag

dsp.**emptytag**()

endtag

dsp.**endtag**()

extend

dsp.**extend**(*item*)

findall

dsp.**findall**(*condition=None*, *include_self=True*, *descend=True*, *siblings=False*, *ascend=False*)

Return an iterator yielding nodes following *self*:

- self (if *include_self* is true)
- all descendants in tree traversal order (if *descend* is true)
- the following siblings (if *siblings* is true) and their descendants (if also *descend* is true)
- the following siblings of the parent (if *ascend* is true) and their descendants (if also *descend* is true), and so on.

If *condition* is not None, the iterator yields only nodes for which `condition(node)` is true. If *condition* is a node class `cls`, it is equivalent to a function consisting of `return isinstance(node, cls)`.

If *ascend* is true, assume *siblings* to be true as well.

If the tree structure is modified during iteration, the result is undefined.

For example, given the following tree:

```
<paragraph>
    <emphasis>      <--- emphasis.traverse() and
        <strong>    <--- strong.traverse() are called.
            Foo
        Bar
    <reference name="Baz" refid="baz">
        Baz
```

Then tuple(emphasis.traverse()) equals

```
(<emphasis>, <strong>, <#text: Foo>, <#text: Bar>)
```

and list(strong.traverse(ascend=True) equals

```
[<strong>, <#text: Foo>, <#text: Bar>, <reference>, <#text: Baz>]
```

first_child_matching_class

`dsp.`**`first_child_matching_class`**(*childclass*, *start=0*, *end=9223372036854775807*)

Return the index of the first child whose class exactly matches.

Parameters:

- *childclass*: A *Node* subclass to search for, or a tuple of *Node* classes. If a tuple, any of the classes may match.
- *start*: Initial index to check.
- *end*: Initial index to *not* check.

first_child_not_matching_class

`dsp.`**`first_child_not_matching_class`**(*childclass*, *start=0*, *end=9223372036854775807*)

Return the index of the first child whose class does *not* match.

Parameters:

- *childclass*: A *Node* subclass to skip, or a tuple of *Node* classes. If a tuple, none of the classes may match.
- *start*: Initial index to check.
- *end*: Initial index to *not* check.

get

`dsp.`**`get`**(*key*, *failobj=None*)

get_language_code

dsp.**get_language_code**(*fallback=''*)

Return node's language tag.

Look iteratively in self and parents for a class argument starting with `language-` and return the remainder of it (which should be a *BCP49* language tag) or the *fallback*.

has_key

dsp.**has_key**(*attr*)

hasattr

dsp.**hasattr**(*attr*)

index

dsp.**index**(*item*, *start=0*, *stop=9223372036854775807*)

insert

dsp.**insert**(*index*, *item*)

is_not_default

dsp.**is_not_default**(*key*)

is_not_known_attribute

classmethod dsp.**is_not_known_attribute**(*attr*)

Returns True if and only if the given attribute is NOT recognized by this class.

is_not_list_attribute

classmethod dsp.**is_not_list_attribute**(*attr*)

Returns True if and only if the given attribute is NOT one of the basic list attributes defined for all Elements.

next_node

dsp.**next_node**(*condition=None*, *include_self=False*, *descend=True*, *siblings=False*, *ascend=False*)

Return the first node in the iterator returned by findall(), or None if the iterable is empty.

Parameter list is the same as of *findall()*. Note that *include_self* defaults to False, though.

non_default_attributes

dsp.**non_default_attributes**()

note_referenced_by

dsp.**note_referenced_by**(*name=None*, *id=None*)

Note that this Element has been referenced by its name *name* or id *id*.

pformat

dsp.**pformat**(*indent=' '*, *level=0*)

Return an indented pseudo-XML representation, for test purposes.

Override in subclasses.

pop

dsp.**pop**(*i=-1*)

previous_sibling

dsp.**previous_sibling**()

Return preceding sibling node or `None`.

remove

dsp.**remove**(*item*)

replace

dsp.**replace**(*old*, *new*)

Replace one child *Node* with another child or children.

replace_attr

dsp.**replace_attr**(*attr*, *value*, *force=True*)

If self[attr] does not exist or force is True or omitted, set self[attr] to value, otherwise do nothing.

replace_self

dsp.**replace_self**(*new*)

Replace *self* node with *new*, where *new* is a node or a list of nodes.

set_class

dsp.**set_class**(*name*)

Add a new class to the "classes" attribute.

setdefault

dsp.**setdefault**(*key*, *failobj=None*)

setup_child

dsp.**setup_child**(*child*)

shortrepr

dsp.**shortrepr**()

starttag

dsp.**starttag**(*quoteattr=None*)

traverse

dsp.**traverse**(*condition=None*, *include_self=True*, *descend=True*, *siblings=False*, *ascend=False*)

Return list of nodes following *self*.

For looping, Node.findall() is faster and more memory efficient.

update_all_atts

dsp.**update_all_atts**(*dict_*, *update_fun=<function Element.copy_attr_consistent>*, *replace=True*, *and_source=False*)

Updates all attributes from node or dictionary *dict_*.

Appends the basic attributes ('ids', 'names', 'classes', 'dupnames', but not 'source') and then, for all other attributes in **dict_**, updates the same attribute in self. When attributes with the same identifier appear in both self and **dict_**, the two values are merged based on the value of update_fun. Generally, when replace is True, the values in self are replaced or merged with the values in **dict_**; otherwise, the values in self may be preserved or merged. When and_source is True, the 'source' attribute is included in the copy.

NOTE: When replace is False, and self contains a 'source' attribute,
'source' is not replaced even when **dict_** has a 'source' attribute, though it may still be merged into a list depending on the value of update_fun.

NOTE: It is easier to call the update-specific methods then to pass
the update_fun method to this function.

update_all_atts_coercion

dsp.**update_all_atts_coercion**(*dict_*, *replace=True*, *and_source=False*)

Updates all attributes from node or dictionary *dict_*.

Appends the basic attributes ('ids', 'names', 'classes', 'dupnames', but not 'source') and then, for all other attributes in **dict_**, updates the same attribute in self. When attributes with the same identifier appear in both self and **dict_** whose values are both not lists and replace is True, the values in self are replaced with the values in **dict_**; if either of the values from self and **dict_** for the given identifier are of list type, then first any non-lists are converted to 1-element lists and then the two lists are concatenated and the result stored in self; otherwise, the values in self are preserved. When and_source is True, the 'source' attribute is included in the copy.

NOTE: When replace is False, and self contains a 'source' attribute,
'source' is not replaced even when **dict_** has a 'source' attribute, though it may still be merged into a list depending on the value of update_fun.

update_all_atts_concatenating

dsp.**update_all_atts_concatenating**(*dict_*, *replace=True*, *and_source=False*)

Updates all attributes from node or dictionary *dict_*.

Appends the basic attributes ('ids', 'names', 'classes', 'dupnames', but not 'source') and then, for all other attributes in **dict_**, updates the same attribute in self. When attributes with the same identifier appear in both self and **dict_** whose values aren't each lists and replace is True, the values in self are replaced with the values in **dict_**; if the values from self and **dict_** for the given identifier are both of list type, then the two lists are concatenated and the result stored in self; otherwise, the values in self are preserved. When and_source is True, the 'source' attribute is included in the copy.

NOTE: When replace is False, and self contains a 'source' attribute,
'source' is not replaced even when **dict_** has a 'source' attribute, though it may still be merged into a list depending on the value of update_fun.

update_all_atts_consistantly

`dsp.update_all_atts_consistantly(dict_, replace=True, and_source=False)`

Updates all attributes from node or dictionary *dict_*.

Appends the basic attributes ('ids', 'names', 'classes', 'dupnames', but not 'source') and then, for all other attributes in **dict_**, updates the same attribute in self. When attributes with the same identifier appear in both self and **dict_** and replace is True, the values in self are replaced with the values in **dict_**; otherwise, the values in self are preserved. When and_source is True, the 'source' attribute is included in the copy.

NOTE: When replace is False, and self contains a 'source' attribute,
'source' is not replaced even when **dict_** has a 'source' attribute, though it may still be merged into a list depending on the value of update_fun.

update_all_atts_convert

`dsp.update_all_atts_convert(dict_, and_source=False)`

Updates all attributes from node or dictionary *dict_*.

Appends the basic attributes ('ids', 'names', 'classes', 'dupnames', but not 'source') and then, for all other attributes in **dict_**, updates the same attribute in self. When attributes with the same identifier appear in both self and **dict_** then first any non-lists are converted to 1-element lists and then the two lists are concatenated and the result stored in self; otherwise, the values in self are preserved. When and_source is True, the 'source' attribute is included in the copy.

NOTE: When replace is False, and self contains a 'source' attribute,
'source' is not replaced even when **dict_** has a 'source' attribute, though it may still be merged into a list depending on the value of update_fun.

update_basic_atts

`dsp.update_basic_atts(dict_)`

Update basic attributes ('ids', 'names', 'classes', 'dupnames', but not 'source') from node or dictionary *dict_*.

walk

`dsp.walk(visitor)`

Traverse a tree of *Node* objects, calling the *dispatch_visit()* method of *visitor* when entering each node. (The *walkabout()* method is similar, except it also calls the *dispatch_departure()* method before exiting each node.)

This tree traversal supports limited in-place tree modifications. Replacing one node with one or more nodes is OK, as is removing an element. However, if the node removed or replaced occurs after the current node, the old node will still be traversed, and any new nodes will not.

Within `visit` methods (and `depart` methods for *walkabout()*), *TreePruningException* subclasses may be raised (*SkipChildren*, *SkipSiblings*, *SkipNode*, *SkipDeparture*).

Parameter *visitor*: A *NodeVisitor* object, containing a `visit` implementation for each *Node* subclass encountered.

Return true if we should stop the traversal.

walkabout

dsp.**walkabout**(*visitor*)

Perform a tree traversal similarly to *Node.walk()* (which see), except also call the *dispatch_departure()* method before exiting each node.

Parameter *visitor*: A *NodeVisitor* object, containing a `visit` and `depart` implementation for each *Node* subclass encountered.

Return true if we should stop the traversal.

__init__(*rawsource=''*, **children*, ***attributes*)

Attributes

`basic_attributes`	Tuple of attributes which are defined for every Element-derived class instance and can be safely transferred to a different node.
`child_text_separator`	Separator for child nodes, used by *astext()* method.
`document`	Return the *document* root node of the tree containing this Node.
`known_attributes`	Tuple of attributes that are known to the Element base class.
`line`	The line number (1-based) of the beginning of this Node in *source*.
`list_attributes`	Tuple of attributes that are automatically initialized to empty lists for all nodes.
`local_attributes`	Tuple of class-specific attributes that should not be copied with the standard attributes when replacing a node.
`parent`	Back-reference to the Node immediately containing this Node.
`source`	Path or description of the input source which generated this Node.
`tagname`	The element generic identifier.
`rawsource`	The raw text from which this element was constructed.
`children`	List of child nodes (elements and/or *Text*).
`attributes`	Dictionary of attribute {name: value}.

basic_attributes

dsp.**basic_attributes = ('ids', 'classes', 'names', 'dupnames')**

Tuple of attributes which are defined for every Element-derived class instance and can be safely transferred to a different node.

child_text_separator

```
dsp.child_text_separator = '\n\n'
```

Separator for child nodes, used by *astext()* method.

document

```
property dsp.document
```

Return the *document* root node of the tree containing this Node.

known_attributes

```
dsp.known_attributes = ('ids', 'classes', 'names', 'dupnames', 'backrefs', 'source')
```

Tuple of attributes that are known to the Element base class.

line

```
dsp.line = None
```

The line number (1-based) of the beginning of this Node in *source*.

list_attributes

```
dsp.list_attributes = ('ids', 'classes', 'names', 'dupnames', 'backrefs')
```

Tuple of attributes that are automatically initialized to empty lists for all nodes.

local_attributes

```
dsp.local_attributes = ('backrefs',)
```

Tuple of class-specific attributes that should not be copied with the standard attributes when replacing a node.

NOTE: Derived classes should override this value to prevent any of its attributes being copied by adding to the value in its parent class.

parent

```
dsp.parent = None
```

Back-reference to the Node immediately containing this Node.

source

`dsp.source = None`

Path or description of the input source which generated this Node.

tagname

`dsp.tagname = None`

The element generic identifier. If None, it is set as an instance attribute to the name of the class.

rawsource

`dsp.rawsource`

The raw text from which this element was constructed.

NOTE: some elements do not set this value (default '').

children

`dsp.children`

List of child nodes (elements and/or *Text*).

attributes

`dsp.attributes`

Dictionary of attribute {name: value}.

Functions

setup	Setup *dispatcher* Sphinx extension module.

setup

`setup(app)`

Setup *dispatcher* Sphinx extension module.

7.4 cli

Define the command line interface.

CHAPTER

EIGHT

CHANGELOG

8.1 v1.5.9 (2024-04-21)

8.1.1 Fix

- (form): Correct bug when copying files in cmd line.

8.2 v1.5.8 (2024-04-20)

8.2.1 Fix

- (setup): Add missing *package_data*.

8.3 v1.5.7 (2024-04-19)

8.3.1 Feat

- (form): Update resources.
- (form): Add cmd to generate a sample project and update the mode of passing *edit_on_change*, *pre_submit*, and *post_submit* options.
- (form): Remove *ExcelPreview* component and widget.
- (form): Add cmd to generate a sample project and update the mode of passing *edit_on_change*, *pre_submit*, and *post_submit* options.
- (form): Add Icon component.
- (form): Replace *xlsx-preview* with *univerjs*.

8.3.2 Fix

- (bin): Correct default option of *publish.sh*.
- (test): Correct order of selenium execution.

8.4 v1.5.6 (2024-04-03)

8.4.1 Feat

- (form): Update resources.
- (form): Add *ExcelPreviewWidget* and *ExcelPreview* components.
- (form): Change behaviour of *edit_on_change*, *pre_submit* and *post_submit* optional paths.
- (dsp): Add option to avoid cycles when extracting dsp from reverse graph.
- (form): Add *ResponsiveGridLayout* component.
- (form): Update *ant-design-draggable-modal* for antd v5.
- (form): Secure secrets data of payments.
- (form): Change icons of TableField and App component.
- (form): Improve rendering of tables.

8.4.2 Fix

- (test): Ensure timing for testcases.
- (form): Correct Cascader properties in omit.
- (form): Correct FileWidgets behaviours.
- (form): Correct CascaderField layout.

8.5 v1.5.5 (2024-03-19)

8.5.1 Feat

- (form): Update resources.

8.5.2 Fix

- (form): Enable caching of files on browser.
- (form): Correct toPathSchema for cascader.
- (form): Harmonize the extraInputProps of InputTemplate.
- (form): Correct Table reordering.
- (form): Improve performance of Form rendering.
- (form): Improve performances of retrieve schema.

- (form): Correct default language selection.
- (form): Correct Cascader Layout.
- (form): Correct emptyValue behaviour of *BaseInputTemplate*.

8.6 v1.5.4 (2024-03-17)

8.6.1 Feat

- (form): Update resources.
- (form): Add *ImageFileWidget*.
- (form): Make table field orderable.
- (form): Add Base template to cascader.
- (form): Add flexlayout to *App*.

8.6.2 Fix

- (form): Improve widget aspect.
- (form): Improve behaviour of InputTemplate.
- (form): Improve behaviour of Flex layout.

8.7 v1.5.3 (2024-03-14)

8.7.1 Feat

- (doc): Update copyright.
- (form): Update resources.
- (form): Update dependencies.
- (form): Add stripe component.
- (react): Add layout to function rendering.
- (form): Add auto loader for js files.
- (form,antd): Add option to edit when row is close.
- (form, antd): Add *DraggerFileWidget*.
- (form): Correct PDF rendering.
- (form,antd): Add *Mentions* widget.
- (form,antd): Add *Flex* component.
- (react): Add Static component to add html content using also dompurify.
- (form): Make pre-compiling validator dynamically.
- (doc): Add download badges.

8.7.2 Fix

- (requirements): Add missing *stripe* requirement.
- (form): Correct error for missing *blueprint_name* for *Flask- Security-Too*.
- (form): Correct typo in auto loader for js files.
- (react): Correct handling of preSubmit input.
- (form): Correct DateRangeWidget.
- (form, antd): Correct mentions.
- (form): Correct PDF paragraph rendering.

8.8 v1.5.2 (2023-11-19)

8.8.1 Feat

- (form): Update static code.
- (form): Add *antd* translations.
- (test): Update coverage python version.

8.8.2 Fix

- (drw): Correct broken link when same object is rendered twice.
- (asy): Ensure all processes are well closed.
- (form): Correct language selector bugs and uniform translation handling.

8.9 v1.5.1 (2023-11-11)

8.9.1 Fix

- (doc): Correct docs errors.
- (doc): Add missing API links.
- (doc): Add readthedocs config file.

8.10 v1.5.0 (2023-11-10)

8.10.1 Feat

- (react): Split bundle.
- (react): Add pricing component.
- (setup): Add python 3.11.
- (form): Update static code.

- (form): Compress all static files.
- (form): Update default ui schema.
- (react): Update dev requirements.
- (react): Extend base ObjectField.
- (react): Extend base form.
- (form): Update static code.
- (example): Add output table title.
- (form): Remove unuseful log.
- (example): Update length converter form example.
- (form): Re-enable form tests.
- (form): Update requirements.
- (form): Update App component.
- (form): Correct behaviour of *get_form_context*.
- (form): Update App component.
- (form): Add automatic column table name form schema.
- (form): Add new requirements for server.
- (form): Update state only when errors change.
- (form)Simplify layout definition.
- (drw): Add option to run site when plotting.
- (drw): Add option to run site when plotting.
- (form)Simplify layout definition.

8.10.2 Fix

- (sphinx): Correct sphinx requirement *sphinx>=7.2*.
- (setup): Update form requirements.
- (test): Remove unwanted libs.
- (sphinx): Correct sphinx requirement.
- (core): Fix compatibility with python 3.8.
- (react): Correct layout.
- (react): Remove warning about *selectedKeys*.
- (react): Define validator before rendering.
- (react): Use *debounceValidate* instead *liveValidate*.
- (react): Correct uiSchema and schemaUtils errors.
- (react): Avoid the overwrite of rootSchema.
- (react): Speed up validator definition.
- (react): Correct *getFirstMatchingOption* parameters.

- (react): Update *rjsf* to version 5.13.6.
- (react): Remove unused import.
- (form): Correct requirements.
- (web): Correct blueprint_name.
- (form): Remove dependency from *pkg_resources*.
- (form): Correct filename for windows.
- (ext): Update autosummary according to new Sphinx.
- (web): Improve gzip encoding handler.

8.11 v1.4.9 (2023-01-23)

8.11.1 Feat

- (form): Update bundle.
- (dsp): Use *dataclass* for inf instance.

8.11.2 Fix

- (ext): Correct parent content getter.
- (form): Correct fullscreen behaviour.
- (form): Clean wrong error states.

8.12 v1.4.8 (2023-01-06)

8.12.1 Feat

- (form): Update bundle.
- (form): Make modal unmount.

8.12.2 Fix

- (form): Correct *useEffect* loop.
- (form): Add missing invocation of *editOnChange*.

8.13 v1.4.7 (2023-01-05)

8.13.1 Feat

- (form): Update bundle.
- (form): Request gzip schemas.
- (form): Enforce correct defaults.
- (form): Resolve schema.

8.13.2 Fix

- (test): Test only one python version for windows.
- (form): Invoke form validation after submit.
- (form): Use *retrieveSchema* function to retrieve field schema.
- (web): Correct debug url.

8.14 v1.4.6 (2023-01-04)

8.14.1 Feat

- (site): Drop gevent dependence.
- (form): Update bundle.
- (form): Add error handling on file widget.
- (form): Move *ReactModal* in a custom component.
- (form): Add *savingData* option to nav component.
- (form): Add download buttons to file widget.
- (form): Group all states to a single state + debounce live validation.
- (site): Enable async routes.
- (form): Reduce bundle size.
- (form): Add new method *path* for *ui:layout*.
- (form): Use gzip to POST requests.
- (form): Add download buttons to file widget.

8.14.2 Fix

- (form): Correct modal css.
- (form): Ensure datagrid string or bool format.

8.15 v1.4.5 (2022-12-27)

8.15.1 Feat

- (form): Add FileWidget + Improve Autosaving and enforce code splitting.

8.15.2 Fix

- (site): Correct *gevent* error when watcher is *None*.

8.16 v1.4.4 (2022-12-22)

8.16.1 Feat

- (test): Add more form test cases.
- (test): Disable logging for test cases.
- (site): Add option *url_prefix*.

8.16.2 Fix

- (form): Use modal instead popup to show the debug view.
- (web): Remove custom methods *PING* and *DEBUG* for standards *GET* and *POST*.

8.17 v1.4.3 (2022-12-21)

8.17.1 Feat

- (web): Add *DEBUG* method as *API* service.

8.17.2 Fix

- (test): Correct test cases to generate autodispatcher.
- (form): Correct bug when plot is empty.

8.18 v1.4.2 (2022-12-15)

8.18.1 Feat

- (form): Add options to edit/pre- post-process within the form dynamically.

8.19 v1.4.1 (2022-12-12)

8.19.1 Feat

- (base): Update default behaviour when invoking *plot*, *web* and *form*.
- (sol): Remove unused code.
- (core): Create a new module *utl*.

8.19.2 Fix

- (form): Correct form *url* API.
- (doc): Remove *requires.io*.

8.20 v1.4.0 (2022-12-12)

8.20.1 Feat

- (form): Add extension for forms with test cases.
- (drw): Add option to add raw body to dot graphviz file.
- (dsp): Improve readability of *MapDispatch* results.
- (core): Drop cutoff functionality.
- (dsp): Add options to use *SubDispatchFunction* like *SubDispatch*.
- (setup) #19: Add option to publish schedula-core.
- (form): Add delete all button on datagrid.
- (parallel): Make sync the default executor.
- (setup) #19: Add feature to install only core functionalities.

8.20.2 Fix

- (binder): Correct installation of binder.
- (form): Correct *CSRF* error handling.
- (jinja)Disable HTML AutoEscape.
- (asy): Avoid adding solution when *NoSub*.

8.21 v1.3.6 (2022-11-21)

8.21.1 Feat

- (form): Add data saver and restore options + fix fullscreen + improve *ScrollTop*.

8.21.2 Fix

- (form): Fix layout *isEmpty*.

8.22 v1.3.5 (2022-11-08)

8.22.1 Fix

- (form): Correct data import in nav.

8.23 v1.3.4 (2022-11-07)

8.23.1 Feat

- (form): Add fullscreen support.
- (form): Add nunjucks support.
- (form): Add react-reflex component.
- (web): Add option to rise a WebResponse from a dispatch.
- (form): Add CSRF protection.

8.24 v1.3.3 (2022-11-03)

8.24.1 Feat

- (form): Add markdown.
- (form): Avoid rendering elements with empty children.
- (form): Add more option to accordion and stepper.

- (form): Change position of error messages.

8.24.2 Fix

- (rtd): Correct doc rendering.
- (form): Correct plotting behaviour.

8.25 v1.3.2 (2022-10-24)

8.25.1 Feat

- (drw, web, form): Add option to return a blueprint.
- (form): Update bundle.

8.25.2 Fix

- (form): Add extra missing package data.

8.26 v1.3.1 (2022-10-20)

8.26.1 Fix

- (form): Add missing package data.
- (ext): Correct documenter doctest import.

8.27 v1.3.0 (2022-10-19)

8.27.1 Feat

- (form): Add new method form to create jsonschema react forms automatically.
- (blue): Add option to limit the depth of sub-dispatch blue.

8.27.2 Fix

- (sol): Correct default initialization for sub-dispatchers.
- (setup): Ensure correct size of distribution pkg.

8.28 v1.2.19 (2022-07-06)

8.28.1 Feat

- (dsp): Add new utility function *run_model*.
- (dsp): Add *output_type_kw* option to *SubDispatch* utility.
- (core): Add workflow when function is a dsp.

8.28.2 Fix

- (blue): Add memo when call register by default.

8.29 v1.2.18 (2022-07-02)

8.29.1 Feat

- (micropython): Update build for *micropython==v1.19.1*.
- (sol): Improve speed performance.
- (dsp): Make *shrink* optional for *SubDispatchPipe*.
- (core): Improve performance dropping *set* instances.

8.30 v1.2.17 (2022-06-29)

8.30.1 Feat

- (sol): Improve speed performances.

8.30.2 Fix

- (sol): Correct missing reference due to sphinx update.
- (dsp): Correct wrong workflow.pred reference.

8.31 v1.2.16 (2022-05-10)

8.31.1 Fix

- (drw): Correct recursive plots.
- (doc): Correct *requirements.io* link.

8.32 v1.2.15 (2022-04-12)

8.32.1 Feat

- (sol): Improve performances of *_see_remote_link_node*.
- (drw): Improve performances of site rendering.

8.33 v1.2.14 (2022-01-21)

8.33.1 Fix

- (drw): Correct plot of *DispatchPipe*.

8.34 v1.2.13 (2022-01-13)

8.34.1 Feat

- (doc): Update copyright.
- (actions): Add *fail-fast: false*.
- (setup): Add missing dev requirement.

8.34.2 Fix

- (drw): Skip permission error in server cleanup.
- (core): Correct import dependencies.
- (doc): Correct link target.

8.35 v1.2.12 (2021-12-03)

8.35.1 Feat

- (test): Add test cases improving coverage.

8.35.2 Fix

- (drw): Correct graphviz *_view* attribute call.
- (drw): Correct cleanup function.

8.36 v1.2.11 (2021-12-02)

8.36.1 Feat

- (actions): Add test cases.
- (test): Update test cases.
- (drw): Make plot rendering parallel.
- (asy): Add *sync* executor.
- (dispatcher): Add auto inputs and outputs + prefix tags for *add_dispatcher* method.
- (setup): Pin sphinx version.

8.36.2 Fix

- (test): Remove windows long path test.
- (test): Correct test cases for parallel.
- (drw): Correct optional imports.
- (doc): Remove sphinx warning.
- (drw): Correct body format.
- (asy): Correct *atexit_register* function.
- (bin): Correct script.

8.37 v1.2.10 (2021-11-11)

8.37.1 Feat

- (drw): Add custom style per node.
- (drw): Make clean-up site optional.
- (drw): Add *force_plot* option to data node to plot Solution results.
- (drw): Update graphs colors.

8.37.2 Fix

- (setup): Pin graphviz version <0.18.
- (alg): Ensure *str* type of *node_id*.
- (drw): Remove empty node if some node is available.
- (drw): Add missing node type on js script.
- (drw): Extend short name to sub-graphs.

8.38 v1.2.9 (2021-10-05)

8.38.1 Feat

- (drw): Add option to reduce length of file names.

8.38.2 Fix

- (setup): Correct supported python versions.
- (doc): Correct typos.

8.39 v1.2.8 (2021-05-31)

8.39.1 Fix

- (doc): Skip KeyError when searching descriptions.

8.40 v1.2.7 (2021-05-19)

8.40.1 Feat

- (travis): Remove python 3.6 and add python 3.9 from text matrix.

8.40.2 Fix

- (sphinx): Add missing attribute.
- (sphinx): Update option parser.
- (doc): Update some documentation.
- (test): Correct test case missing library.

8.41 v1.2.6 (2021-02-09)

8.41.1 Feat

- (sol): Improve performances.

8.41.2 Fix

- (des): Correct description error due to *MapDispatch*.
- (drw): Correct *index* plotting.

8.42 v1.2.5 (2021-01-17)

8.42.1 Fix

- (core): Update copyright.
- (drw): Correct viz rendering.

8.43 v1.2.4 (2020-12-12)

8.43.1 Fix

- (drw): Correct plot auto-opening.

8.44 v1.2.3 (2020-12-11)

8.44.1 Feat

- (drw): Add plot option to use viz.js as back-end.

8.44.2 Fix

- (setup): Add missing requirement *requests*.

8.45 v1.2.2 (2020-11-30)

8.45.1 Feat

- (dsp): Add custom formatters for *MapDispatch* class.

8.46 v1.2.1 (2020-11-04)

8.46.1 Feat

- (dsp): Add *MapDispatch* class.
- (core): Add execution function log.

8.46.2 Fix

- (rtd): Correct documentation rendering in *rtd*.
- (autosumary): Correct bug for *AutosummaryEntry*.

8.47 v1.2.0 (2020-04-08)

8.47.1 Feat

- (dispatcher): Avoid failure when functions does not have the name.
- (ubuild): Add compiled and not compiled code.
- (sol): Improve speed importing functions directly for *heappop* and *heappush*.
- (dispatcher): Avoid failure when functions does not have the name.
- (dsp): Simplify repr of inf numbers.
- (micropython): Pin specific MicroPython version *v1.12*.
- (micropython): Add test using *.mpy* files.
- (setup): Add *MicroPython* support.
- (setup): Drop *dill* dependency and add *io* extra.
- (github): Add pull request templates.

8.47.2 Fix

- (test): Skip micropython tests.
- (ext): Update code for sphinx 3.0.0.
- (sphinx): Remove documentation warnings.
- (utils): Drop unused *pairwise* function.
- (dsp): Avoid fringe increment in *SubDispatchPipe*.

8.48 v1.1.1 (2020-03-12)

8.48.1 Feat

- (github): Add issue templates.
- (exc): Add base exception to *DispatcherError*.
- (build): Update build script.

8.49 v1.1.0 (2020-03-05)

8.49.1 Feat

- (core): Drop *networkx* dependency.
- (core): Add *ProcessPoolExecutor*.
- (asy): Add *ExecutorFactory* class.
- (asy): Split *asy* module.
- (core): Add support for python 3.8 and drop python 3.5.
- (asy): Check if *stopper* is set when getting executor.
- (asy): Add *mp_context* option in *ProcessExecutor* and *ProcessPoolExecutor*.

8.49.2 Fix

- (alg): Correct pipe generation when *NoSub* found.
- (asy): Remove un-useful and dangerous states before serialization.
- (asy): Ensure wait of all executor futures.
- (asy): Correct bug when future is set.
- (asy): Correct init and shutdown of executors.
- (sol): Correct raise exception order in *sol.result*.
- (travis): Correct tests collector.
- (test): Correct test for multiple async.

8.50 v1.0.0 (2020-01-02)

8.50.1 Feat

- (doc): Add code of conduct.
- (examples): Add new example + formatting.
- (sol): New *raises* option, if raises=" no warning logs.
- (web): Add query param *data* to include/exclude data into the server JSON response.

- (sphinx): Update dispatcher documenter and directive.
- (drw): Add wildcard rendering.

8.50.2 Fix

- (test): Update test cases.
- (dsp): Correct pipe extraction for wildcards.
- (setup): Add missing *drw* files.

8.51 v0.3.7 (2019-12-06)

8.51.1 Feat

- (drw): Update the *index* GUI of the plot.
- (appveyor): Drop *appveyor* in favor of *travis*.
- (travis): Update travis configuration file.
- (plot): Add node link and id in graph plot.

8.51.2 Fix

- (drw): Render dot in temp folder.
- (plot): Add *quiet* arg to *_view* method.
- (doc): Correct missing gh links.
- (core) #17: Correct deprecated Graph attribute.

8.52 v0.3.6 (2019-10-18)

8.52.1 Fix

- (setup) #17: Update version networkx.
- (setup) #13: Build universal wheel.
- (alg) #15: Escape % in node id.
- (setup) #14: Update tests requirements.
- (setup): Add env *ENABLE_SETUP_LONG_DESCRIPTION*.

8.53 v0.3.4 (2019-07-15)

8.53.1 Feat

- (binder): Add *@jupyterlab/plotly-extension*.
- (binder): Customize *Site._repr_html_* with env *SCHEDULA_SITE_REPR_HTML*.
- (binder): Add *jupyter-server-proxy*.
- (doc): Add binder examples.
- (gen): Create super-class of *Token*.
- (dsp): Improve error message.

8.53.2 Fix

- (binder): Simplify *processing_chain* example.
- (setup): Exclude *binder* and *examples* folders as packages.
- (doc): Correct binder data.
- (doc): Update examples for binder.
- (doc): Add missing requirements binder.
- (test): Add *state* to fake directive.
- (import): Remove stub file to enable autocomplete.
- Update to canonical pypi name of beautifulsoup4.

8.54 v0.3.3 (2019-04-02)

8.54.1 Feat

- (dispatcher): Improve error message.

8.54.2 Fix

- (doc): Correct bug for sphinx AutoDirective.
- (dsp): Add dsp as kwargs for a new Blueprint.
- (doc): Update PEP and copyright.

8.55 v0.3.2 (2019-02-23)

8.55.1 Feat

- (core): Add stub file.
- (sphinx): Add Blueprint in Dispatcher documenter.
- (sphinx): Add BlueDispatcher in documenter.
- (doc): Add examples.
- (blue): Customizable memo registration of blueprints.

8.55.2 Fix

- (sphinx): Correct bug when “ is in csv-table directive.
- (core): Set module attribute when *__getattr__* is invoked.
- (doc): Correct utils description.
- (setup): Improve keywords.
- (drw): Correct tooltip string format.
- (version): Correct import.

8.56 v0.3.1 (2018-12-10)

8.56.1 Fix

- (setup): Correct long description for pypi.
- (dsp): Correct bug *DispatchPipe* when dill.

8.57 v0.3.0 (2018-12-08)

8.57.1 Feat

- (blue, dispatcher): Add method *extend* to extend Dispatcher or Blueprint with Dispatchers or Blueprints.
- (blue, dsp): Add *BlueDispatcher* class + remove *DFun* util.
- (core): Remove *weight* attribute from *Dispatcher* struc.
- (dispatcher): Add method *add_func* to *Dispatcher*.
- (core): Remove *remote_links* attribute from dispatcher data nodes.
- (core): Implement callable raise option in *Dispatcher*.
- (core): Add feature to dispatch asynchronously and in parallel.
- (setup): Add python 3.7.
- (dsp): Use the same *dsp.solution* class in *SubDispatch* functions.

8.57.2 Fix

- (dsp): Do not copy solution when call *DispatchPipe*, but reset solution when copying the obj.
- (alg): Correct and clean *get_sub_dsp_from_workflow* algorithm.
- (sol): Ensure *bool* output from *input_domain* call.
- (dsp): Parse arg and kw using *SubDispatchFunction.__signature__*.
- (core): Do not support python 3.4.
- (asy): Do not dill the Dispatcher solution.
- (dispatcher): Correct bug in removing remote links.
- (core): Simplify and correct Exception handling.
- (dsp): Postpone *__signature__* evaluation in *add_args*.
- (gen): Make Token constant when pickled.
- (sol): Move callback invocation in *_evaluate_node*.
- (core) #11: Lazy import of modules.
- (sphinx): Remove warnings.
- (dsp): Add missing *code* option in *add_function* decorator.

8.57.3 Other

- Refact: Update documentation.

8.58 v0.2.8 (2018-10-09)

8.58.1 Feat

- (dsp): Add inf class to model infinite numbers.

8.59 v0.2.7 (2018-09-13)

8.59.1 Fix

- (setup): Correct bug when *long_description* fails.

8.60 v0.2.6 (2018-09-13)

8.60.1 Feat

- (setup): Patch to use *sphinxcontrib.restbuilder* in setup *long_description*.

8.61 v0.2.5 (2018-09-13)

8.61.1 Fix

- (doc): Correct link docs_status.
- (setup): Use text instead rst to compile *long_description* + add logging.

8.62 v0.2.4 (2018-09-13)

8.62.1 Fix

- (sphinx): Correct bug sphinx==1.8.0.
- (sphinx): Remove all sphinx warnings.

8.63 v0.2.3 (2018-08-02)

8.63.1 Fix

- (des): Correct bug when SubDispatchFunction have no *outputs*.

8.64 v0.2.2 (2018-08-02)

8.64.1 Fix

- (des): Correct bug of get_id when tuple ids nodes are given as input or outputs of a sub_dsp.
- (des): Correct bug when tuple ids are given as *inputs* or *outputs* of *add_dispatcher* method.

8.65 v0.2.1 (2018-07-24)

8.65.1 Feat

- (setup): Update *Development Status* to *5 - Production/Stable*.
- (setup): Add additional project_urls.
- (doc): Add changelog to rtd.

8.65.2 Fix

- (doc): Correct link docs_status.
- (des): Correct bugs get_des.

8.66 v0.2.0 (2018-07-19)

8.66.1 Feat

- (doc): Add changelog.
- (travis): Test extras.
- (des): Avoid using sphinx for *getargspec*.
- (setup): Add extras_require to setup file.

8.66.2 Fix

- (setup): Correct bug in *get_long_description*.

8.67 v0.1.19 (2018-06-05)

8.67.1 Fix

- (dsp): Add missing content block in note directive.
- (drw): Make sure to plot same sol as function and as node.
- (drw): Correct format of started attribute.

8.68 v0.1.18 (2018-05-28)

8.68.1 Feat

- (dsp): Add *DispatchPipe* class (faster pipe execution, it overwrite the existing solution).
- (core): Improve performances replacing *datetime.today()* with *time.time()*.

8.69 v0.1.17 (2018-05-18)

8.69.1 Feat

- (travis): Run coveralls in python 3.6.

8.69.2 Fix

- (web): Skip Flask logging for the doctest.
- (ext.dispatcher): Update to the latest Sphinx 1.7.4.
- (des): Use the proper dependency (i.e., *sphinx.util.inspect*) for *getargspec*.
- (drw): Set socket option to reuse the address (host:port).
- (setup): Correct dill requirements *dill>=0.2.7.1 –> dill!=0.2.7*.

8.70 v0.1.16 (2017-09-26)

8.70.1 Fix

- (requirements): Update dill requirements.

8.71 v0.1.15 (2017-09-26)

8.71.1 Fix

- (networkx): Update according to networkx 2.0.

8.72 v0.1.14 (2017-07-11)

8.72.1 Fix

- (io): pin dill version <=0.2.6.
- (abort): abort was setting Exception.args instead of *sol* attribute.

8.72.2 Other

- Merge pull request #9 from ankostis/fixabortex.

8.73 v0.1.13 (2017-06-26)

8.73.1 Feat

- (appveyor): Add python 3.6.

8.73.2 Fix

- (install): Force update setuptools>=36.0.1.
- (exc): Do not catch KeyboardInterrupt exception.
- (doc) #7: Catch exception for sphinx 1.6.2 (listeners are moved in EventManager).
- (test): Skip empty error message.

8.74 v0.1.12 (2017-05-04)

8.74.1 Fix

- (drw): Catch dot error and log it.

8.75 v0.1.11 (2017-05-04)

8.75.1 Feat

- (dsp): Add *add_function* decorator to add a function to a dsp.
- (dispatcher) #4: Use *kk_dict* function to parse inputs and outputs of *add_dispatcher* method.
- (dsp) #4: Add *kk_dict* function.

8.75.2 Fix

- (doc): Replace type function with callable.
- (drw): Folder name without ext.
- (test): Avoid Documentation of DspPlot.
- (doc): fix docstrings types.

8.76 v0.1.10 (2017-04-03)

8.76.1 Feat

- (sol): Close sub-dispatcher solution when all outputs are satisfied.

8.76.2 Fix

- (drw): Log error when dot is not able to render a graph.

8.77 v0.1.9 (2017-02-09)

8.77.1 Fix

- (appveyor): Setup of lmxl.
- (drw): Update plot index.

8.78 v0.1.8 (2017-02-09)

8.78.1 Feat

- (drw): Update plot index + function code highlight + correct plot outputs.

8.79 v0.1.7 (2017-02-08)

8.79.1 Fix

- (setup): Add missing package_data.

8.80 v0.1.6 (2017-02-08)

8.80.1 Fix

- (setup): Avoid setup failure due to get_long_description.
- (drw): Avoid to plot unneeded weight edges.
- (dispatcher): get_sub_dsp_from_workflow set correctly the remote links.

8.81 v0.1.5 (2017-02-06)

8.81.1 Feat

- (exl): Drop exl module because of formulas.
- (sol): Add input value of filters in solution.

8.81.2 Fix

- (drw): Plot just one time the filer attribute in workflow +*filers|solution_filters* .

8.82 v0.1.4 (2017-01-31)

8.82.1 Feat

- (drw): Save autoplot output.
- (sol): Add filters and function solutions to the workflow nodes.
- (drw): Add filters to the plot node.

8.82.2 Fix

- (dispatcher): Add missing function data inputs edge representation.
- (sol): Correct value when apply filters on setting the node output.
- (core): get_sub_dsp_from_workflow blockers can be applied to the sources.

8.83 v0.1.3 (2017-01-29)

8.83.1 Fix

- (dsp): Raise a DispatcherError when the pipe workflow is not respected instead KeyError.
- (dsp): Unresolved references.

8.84 v0.1.2 (2017-01-28)

8.84.1 Feat

- (dsp): add_args _set_doc.
- (dsp): Remove parse_args class.
- (readme): Appveyor badge status == master.
- (dsp): Add _format option to *get_unused_node_id*.
- (dsp): Add wildcard option to *SubDispatchFunction* and *SubDispatchPipe*.
- (drw): Create sub-package drw.

8.84.2 Fix

- (dsp): combine nested dicts with different length.
- (dsp): are_in_nested_dicts return false if nested_dict is not a dict.
- (sol): Remove defaults when setting wildcards.
- (drw): Misspelling *outpus* –> *outputs*.
- (directive): Add exception on graphviz patch for sphinx 1.3.5.

8.85 v0.1.1 (2017-01-21)

8.85.1 Fix

- (site): Fix ResourceWarning: unclosed socket.
- (setup): Not log sphinx warnings for long_description.
- (travis): Wait util the server is up.
- (rtd): Missing requirement dill.
- (travis): Install first - pip install -r dev-requirements.txt.
- (directive): Tagname from _img to img.
- (directive): Update minimum sphinx version.
- (readme): Badge svg links.

8.85.2 Other

- Add project descriptions.
- (directive): Rename schedula.ext.dsp_directive –> schedula.ext.dispatcher.
- Update minimum sphinx version and requests.

CHAPTER NINE

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