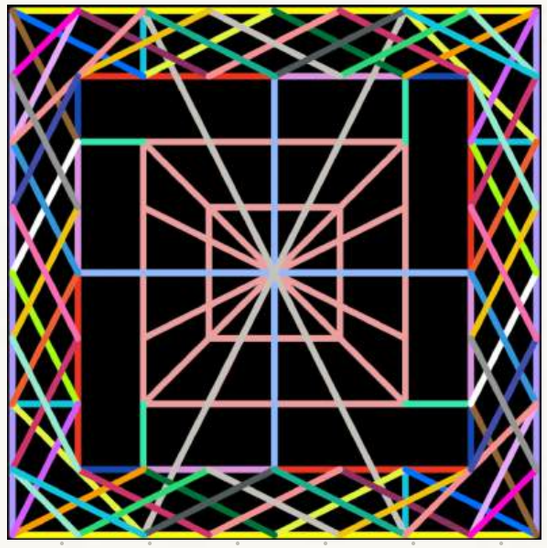
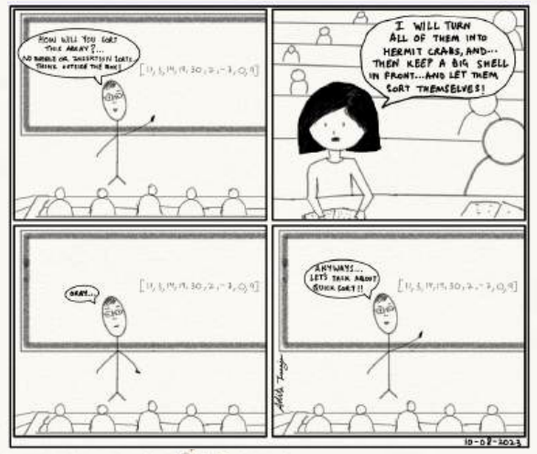
Understanding API Dispatching in NetworkX

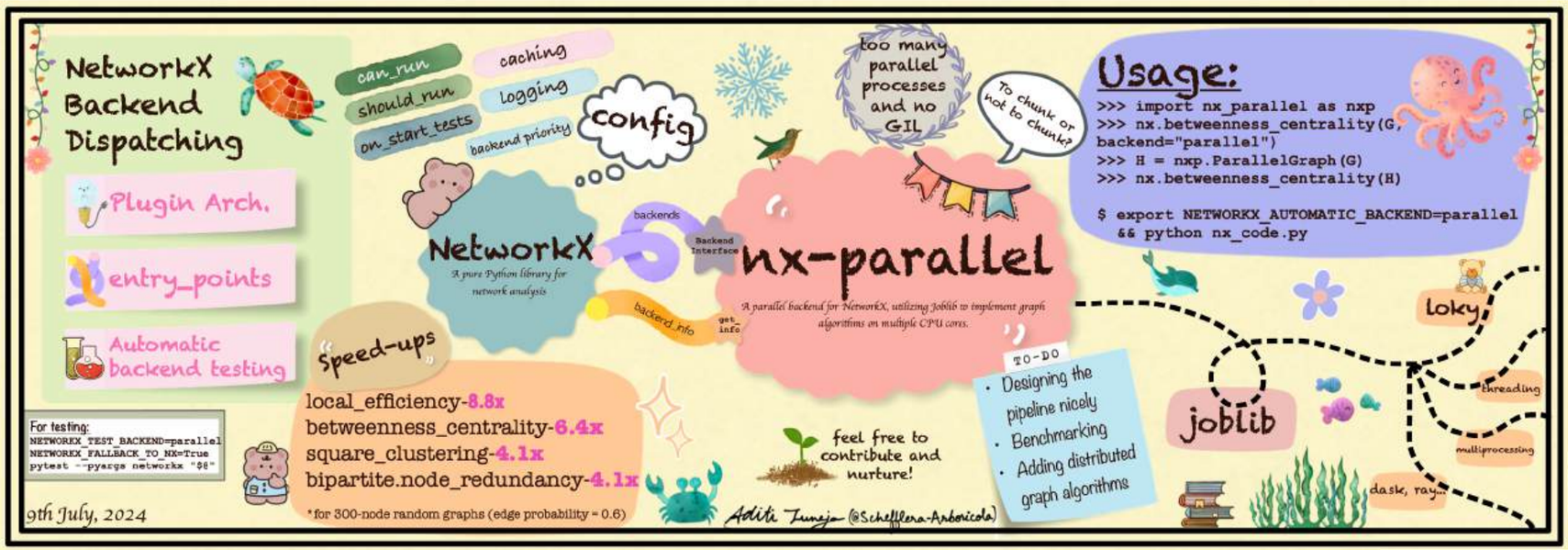
About Me

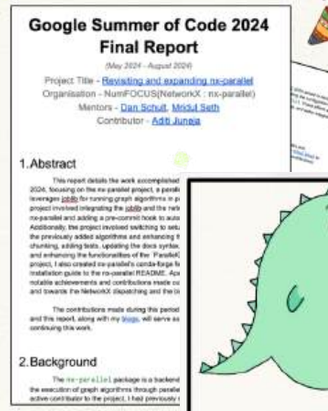
- Aditi Juneja (@Schefflera-Arboricola)
- Worked mostly around API Dispatching stuff and the nx-parallel backend
- NetworkX's core developer

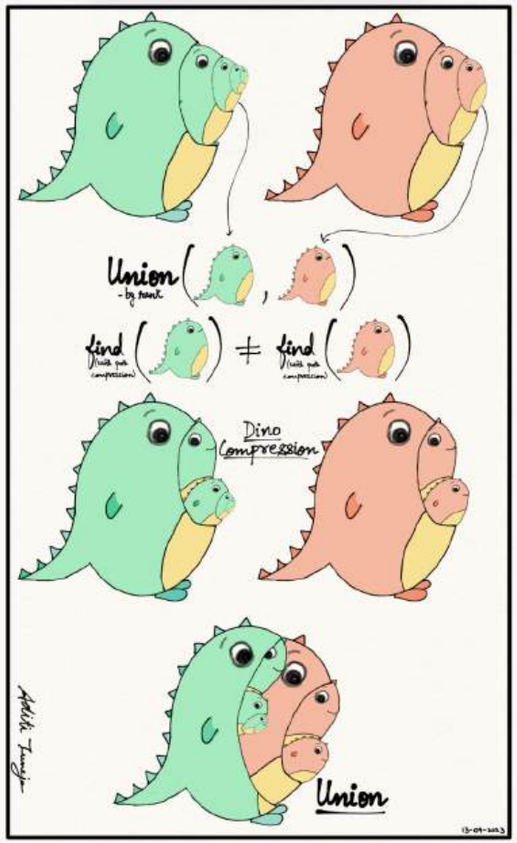


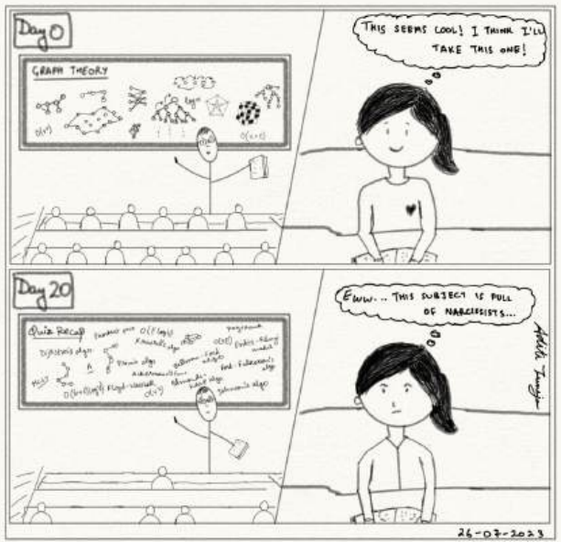
And...here is some of my stuff...

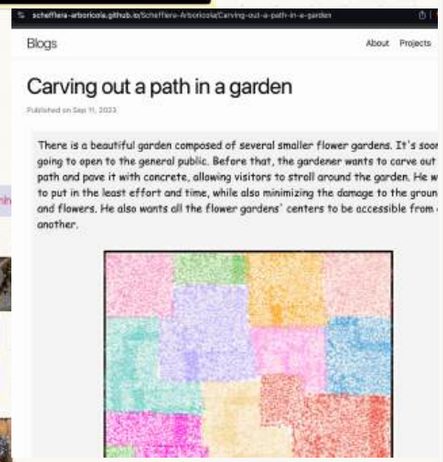












Understanding API Dispatching in NetworkX

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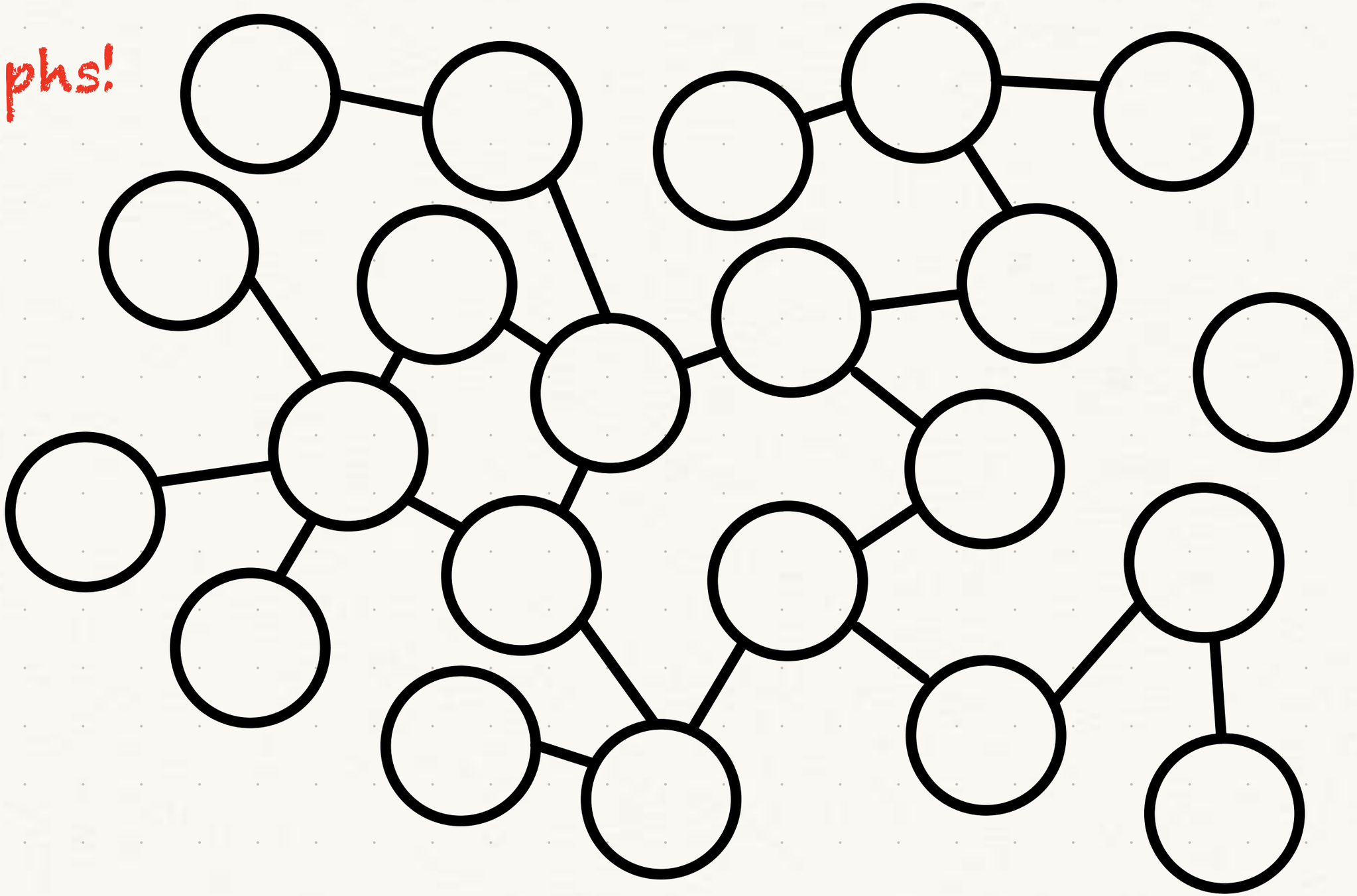
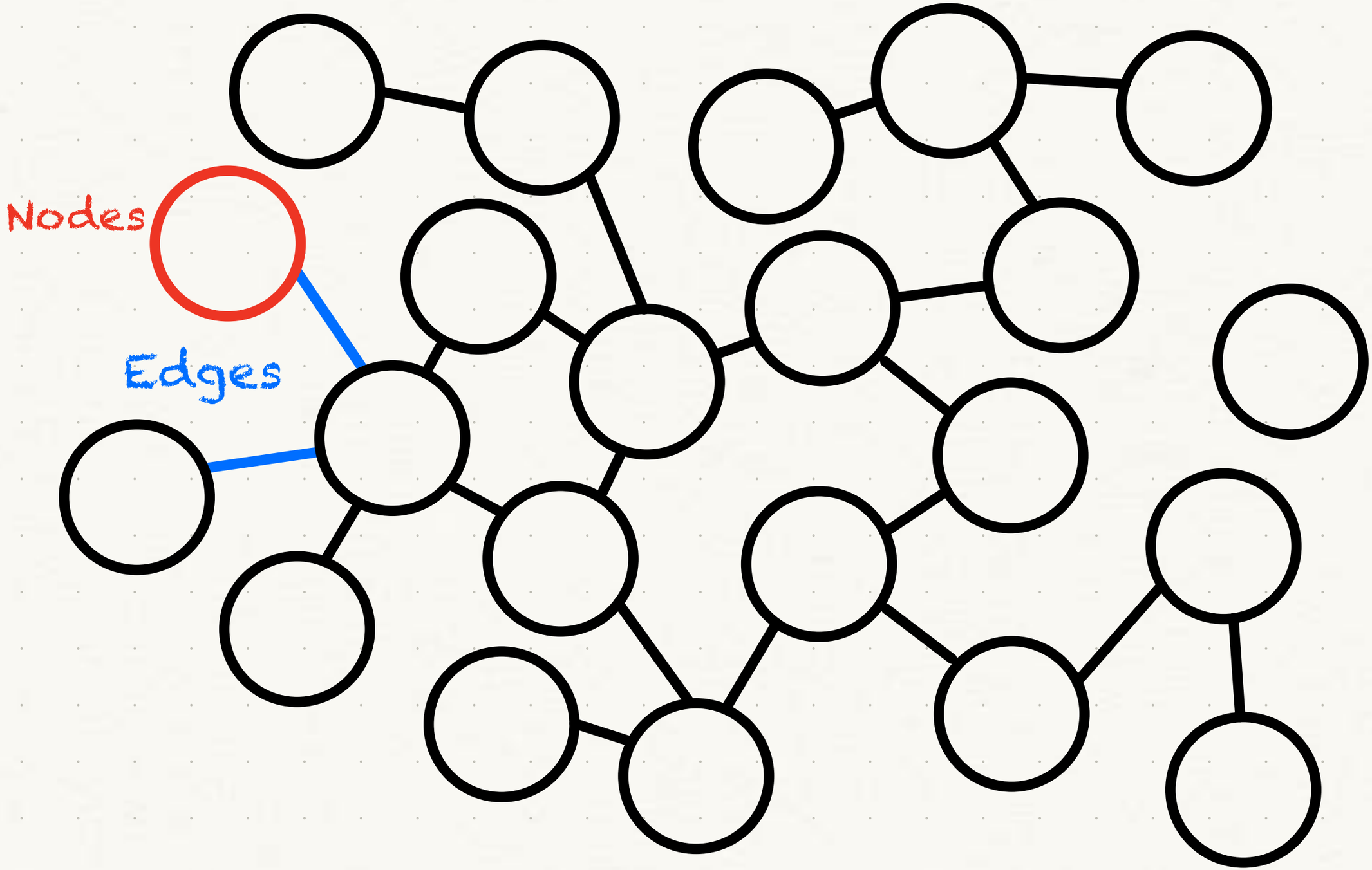
NetworkX is a **graph** (aka network) analysis Python library

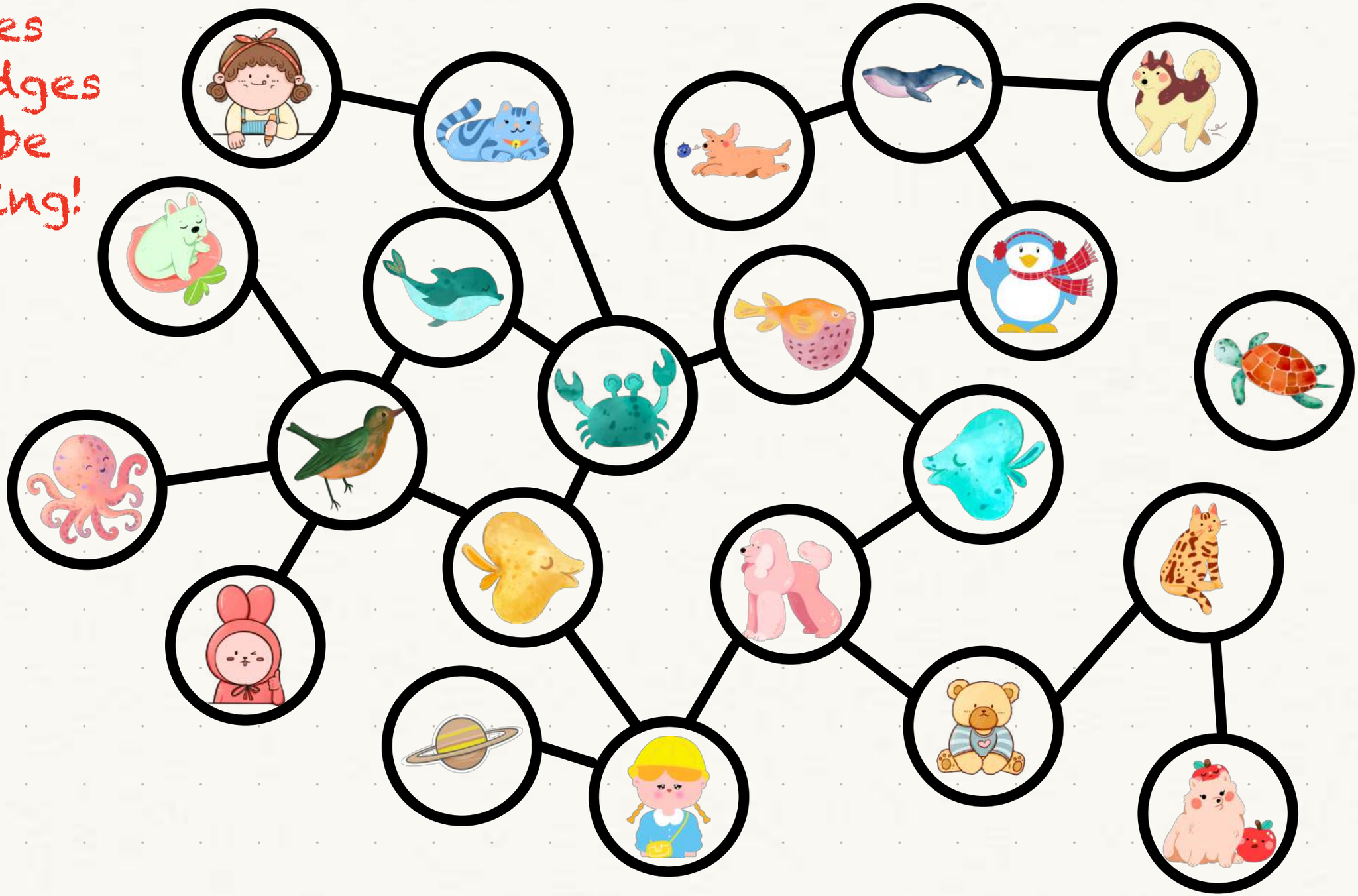
NOT these kind of graphs!

Graphs!

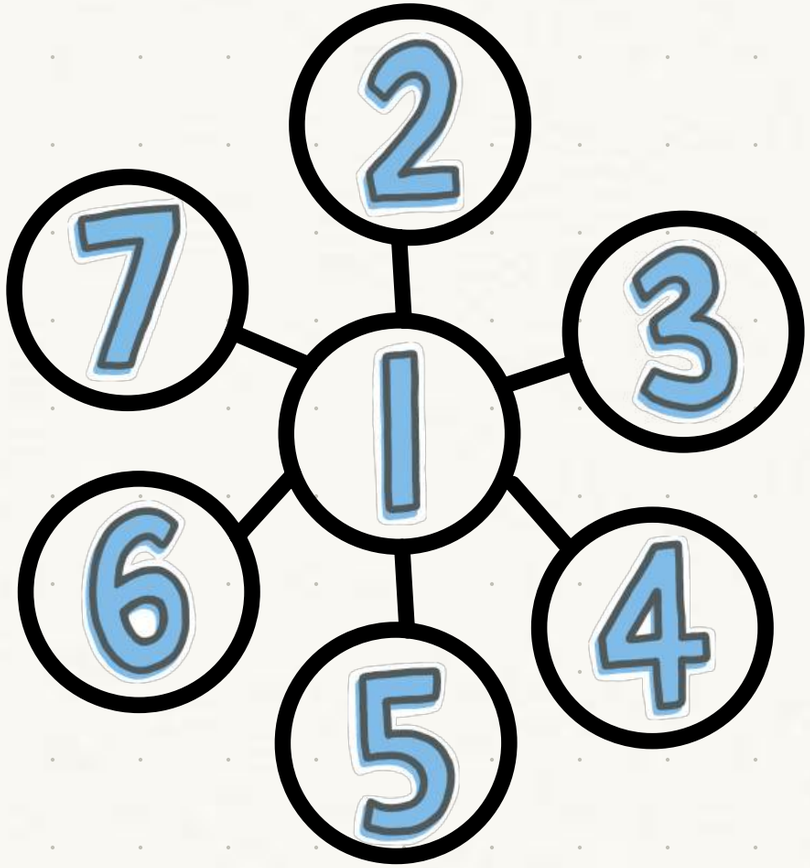



Nodes
Edges

Nodes and edges can be anything!



Which is the most important node?



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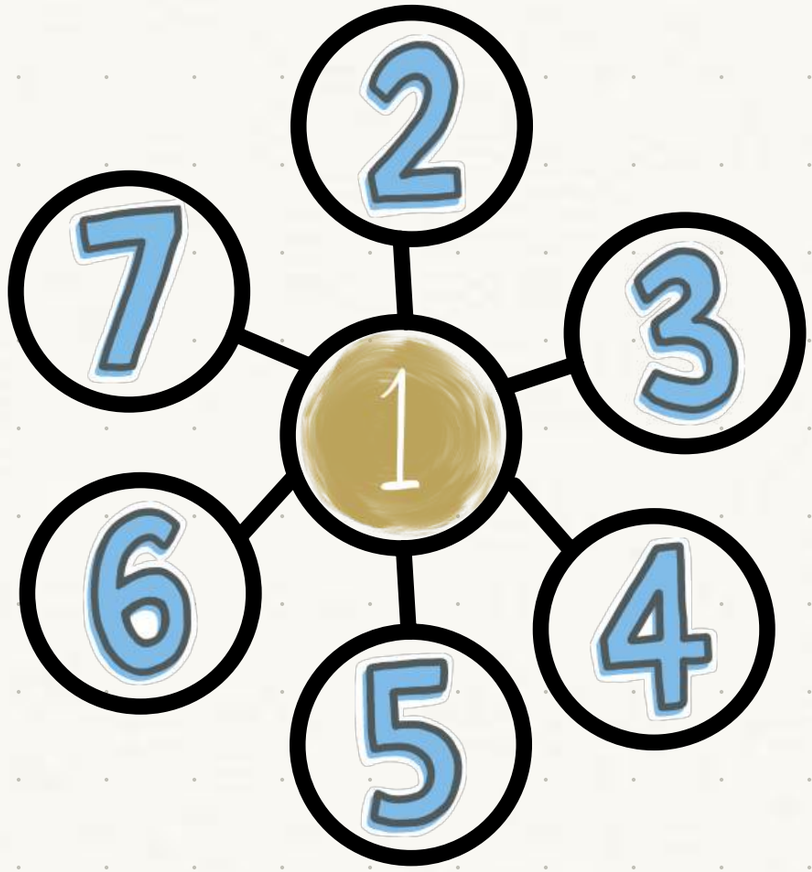

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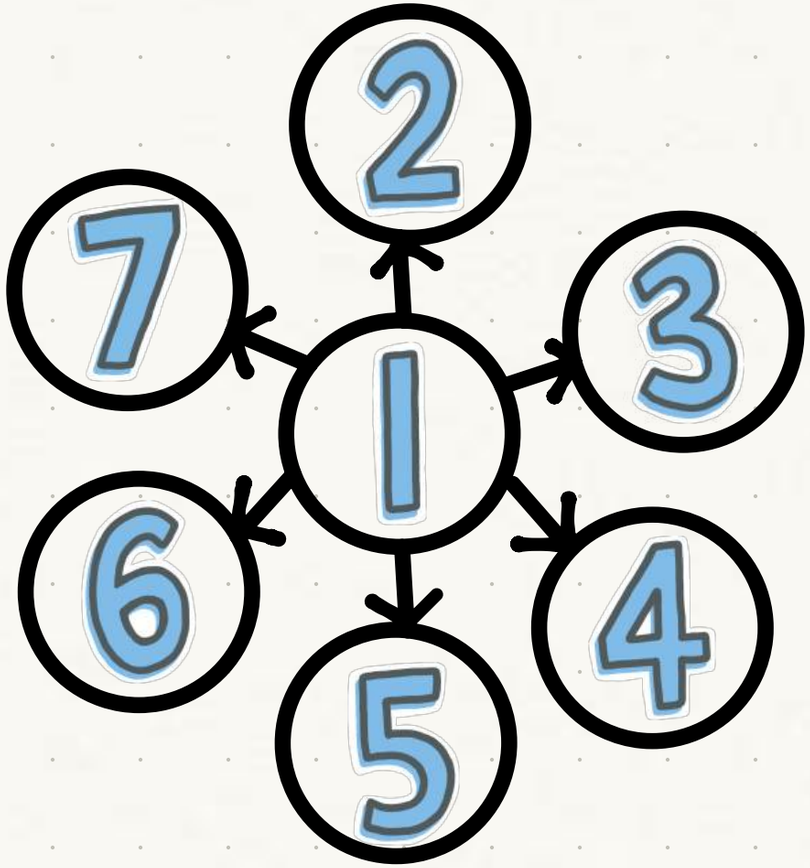

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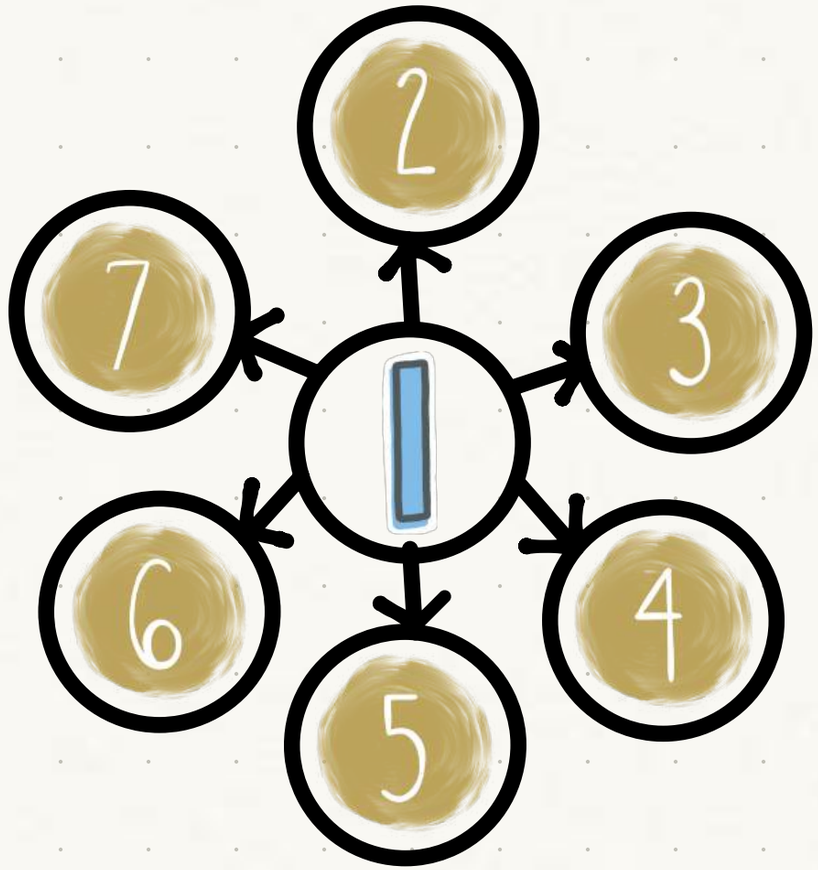

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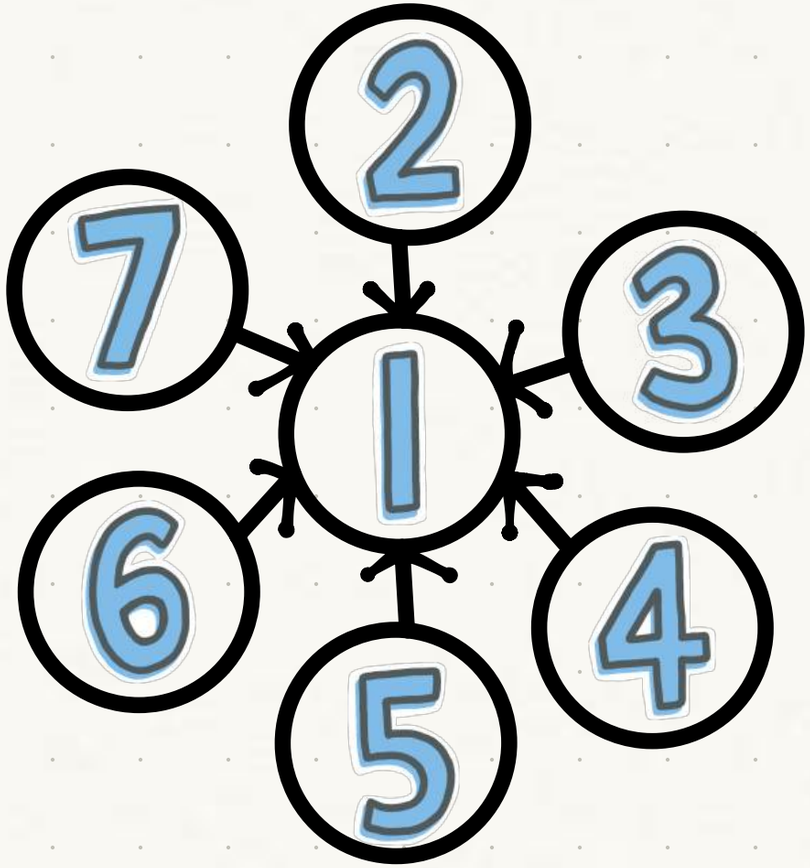

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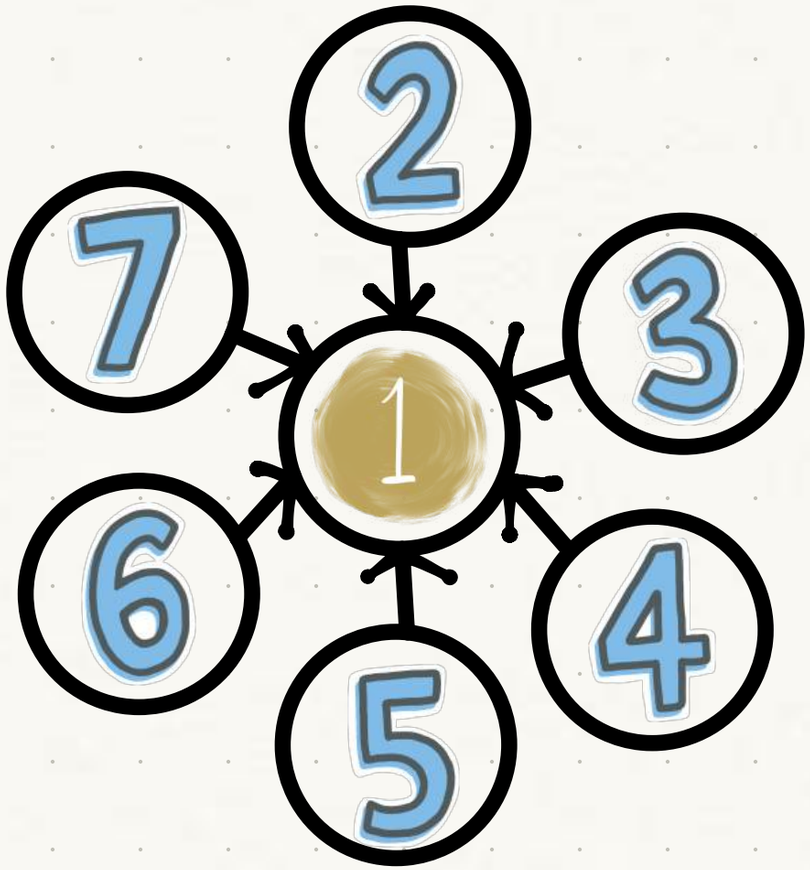


But, what is this "importance"?

betweenness_centrality

pagerank

degree

closeness_centrality

eigenvector_centrality

square_clustering

But, graph analysis is more than this...

connectivity

traversals

triads

isomorphism

flow

communities

trees

cycles

density

shortest paths

matching

dependency

efficiency

link prediction

temporal graphs

NetworkX API

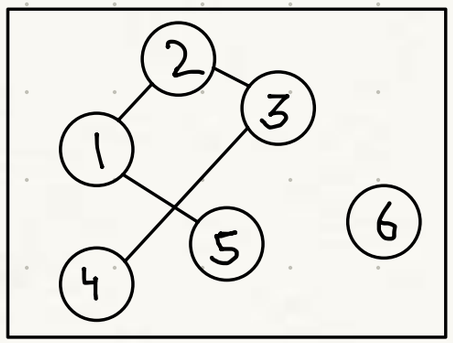
```
>>> import networkx as nx

>>> G = nx.Graph()

>>> G.add_edges_from([(1,2), (3,4), (2,3),
(5,1)])

>>> G.add_node(6)

>>> nx.betweenness_centrality(G)
```



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{1: 0.30000000000000004, 2: 0.4, 3:
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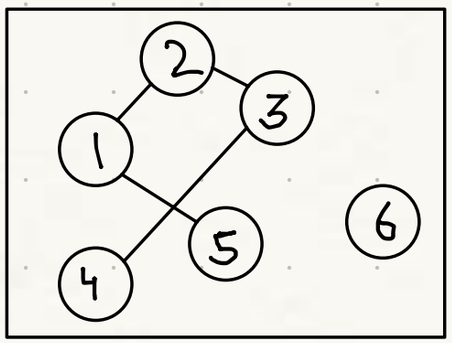
```



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Lets try this...

NetworkX API

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...takes forever 😫😫😫😭😭
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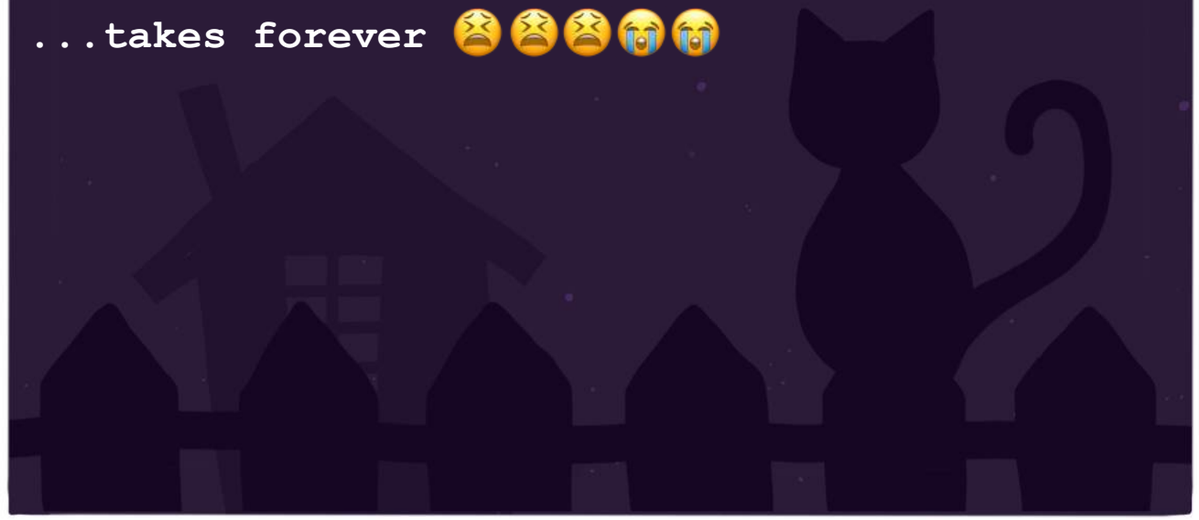

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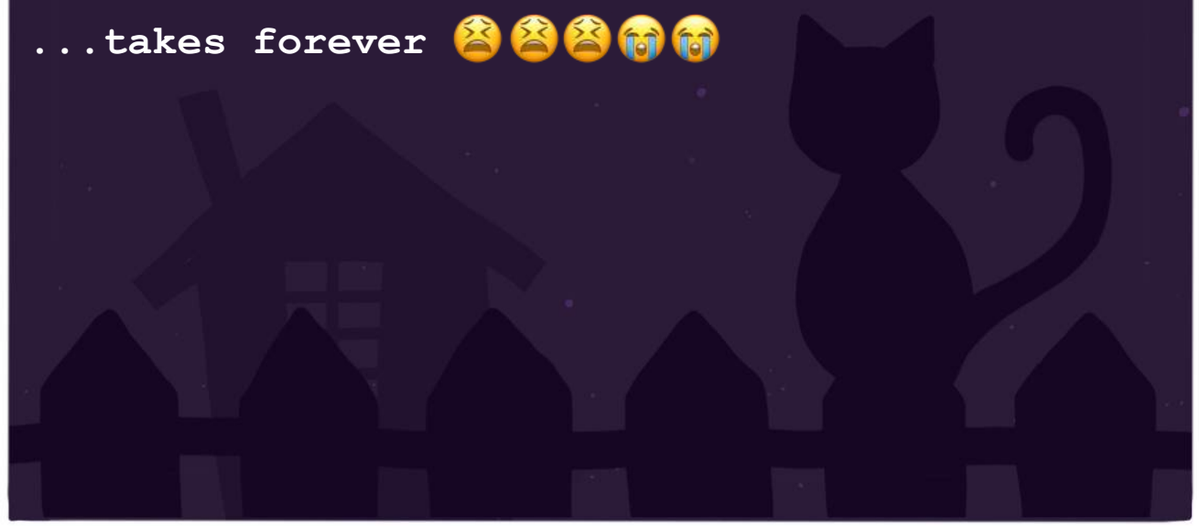

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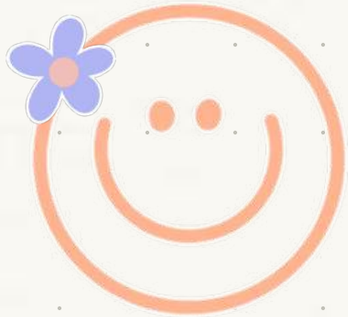
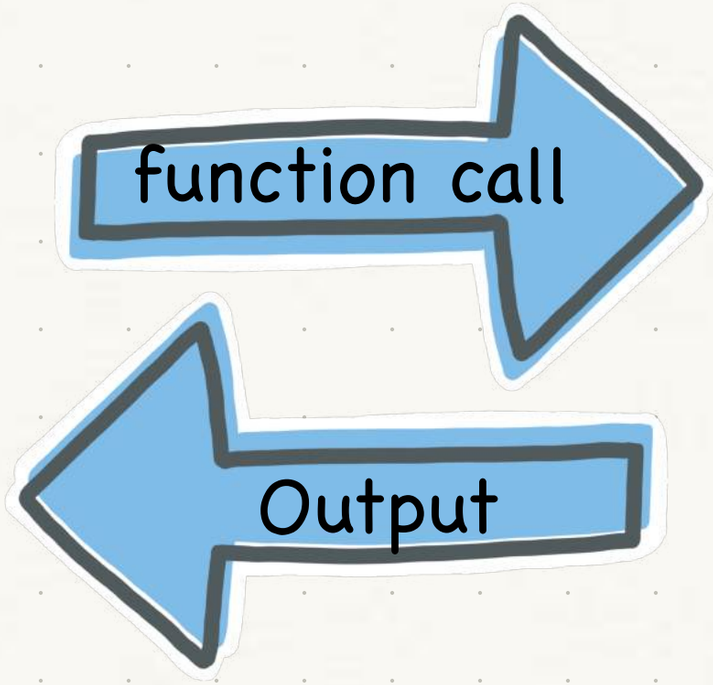
"What is Dispatching?"

Usually...



User



The main library

Usually...

User

nx.betweenness_centrality(G)

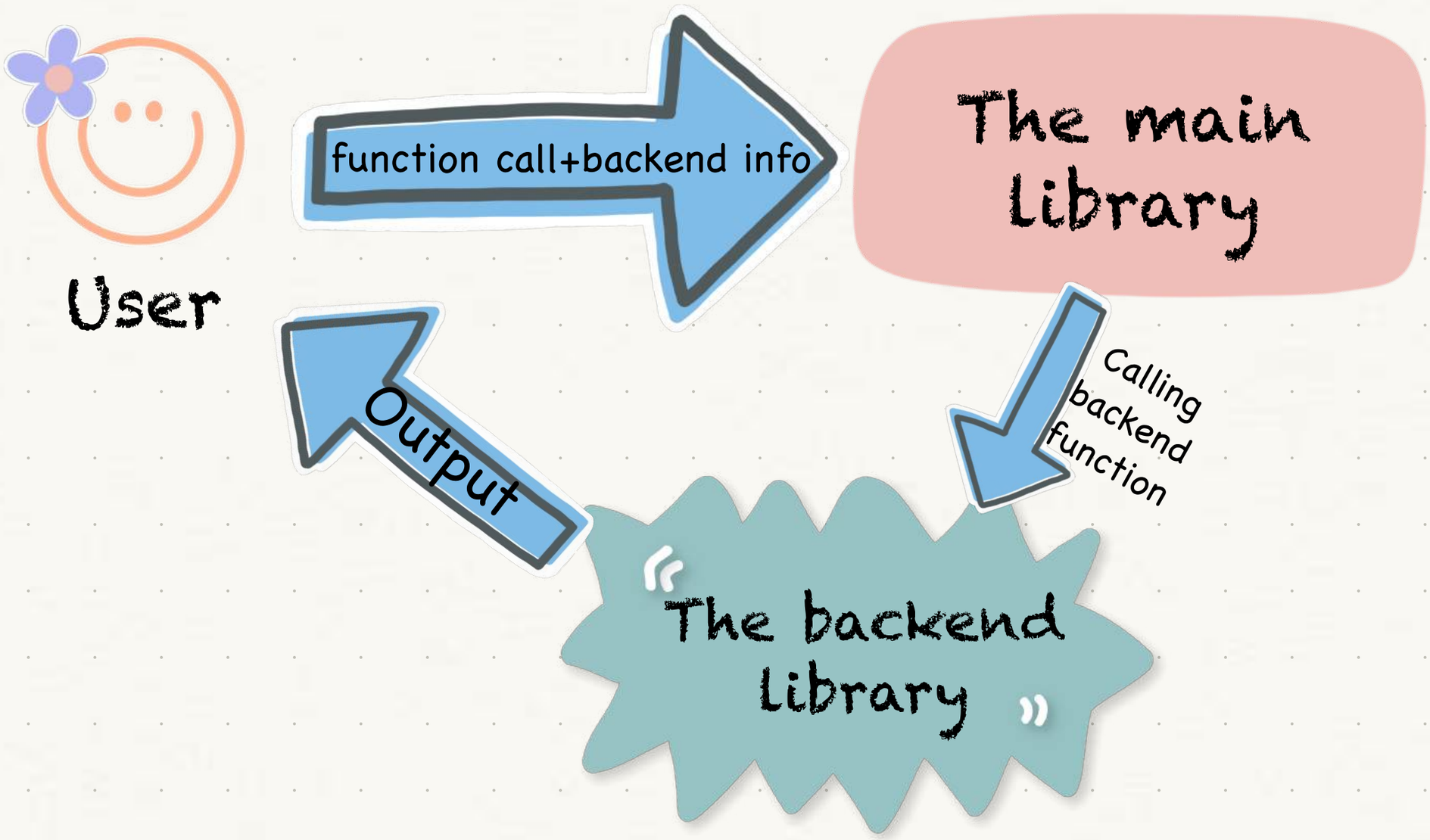
function call

Output

The main library

{1: 0.30000000000000004, 2: 0.4, 3: 0.30000000000000004, 4: 0.0, 5: 0.0, 6: 0.0}

Dispatching



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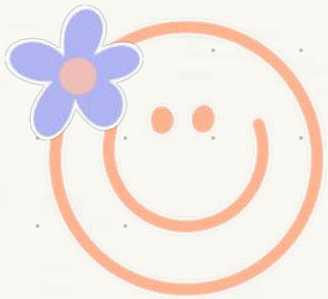


User

function call+backend info

The main library

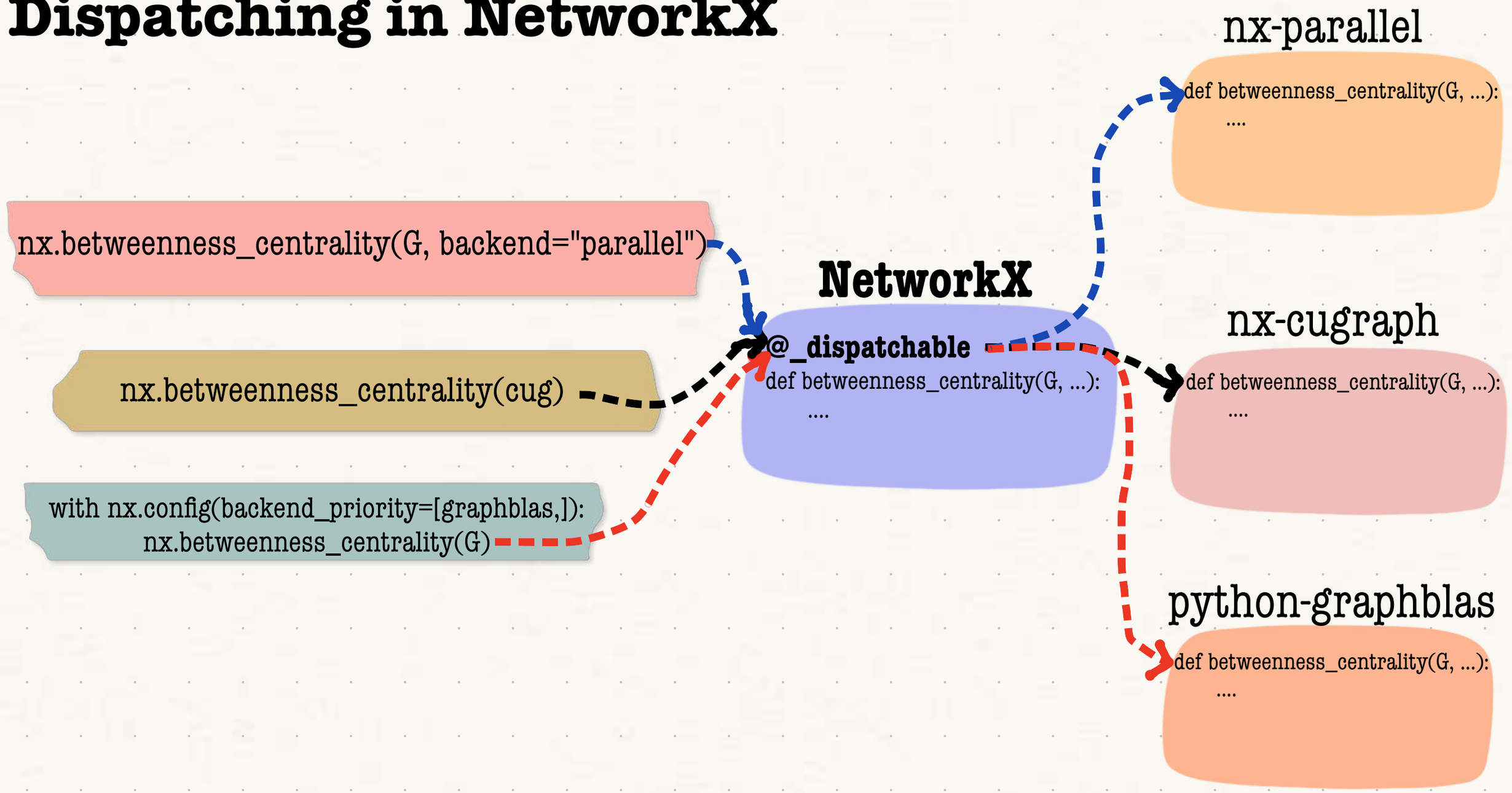
Calling backend function

Output

"The backend library"

Here, backend info can be inside the function call or stored globally as an environment variable, or in the Graph object itself.

Dispatching in NetworkX



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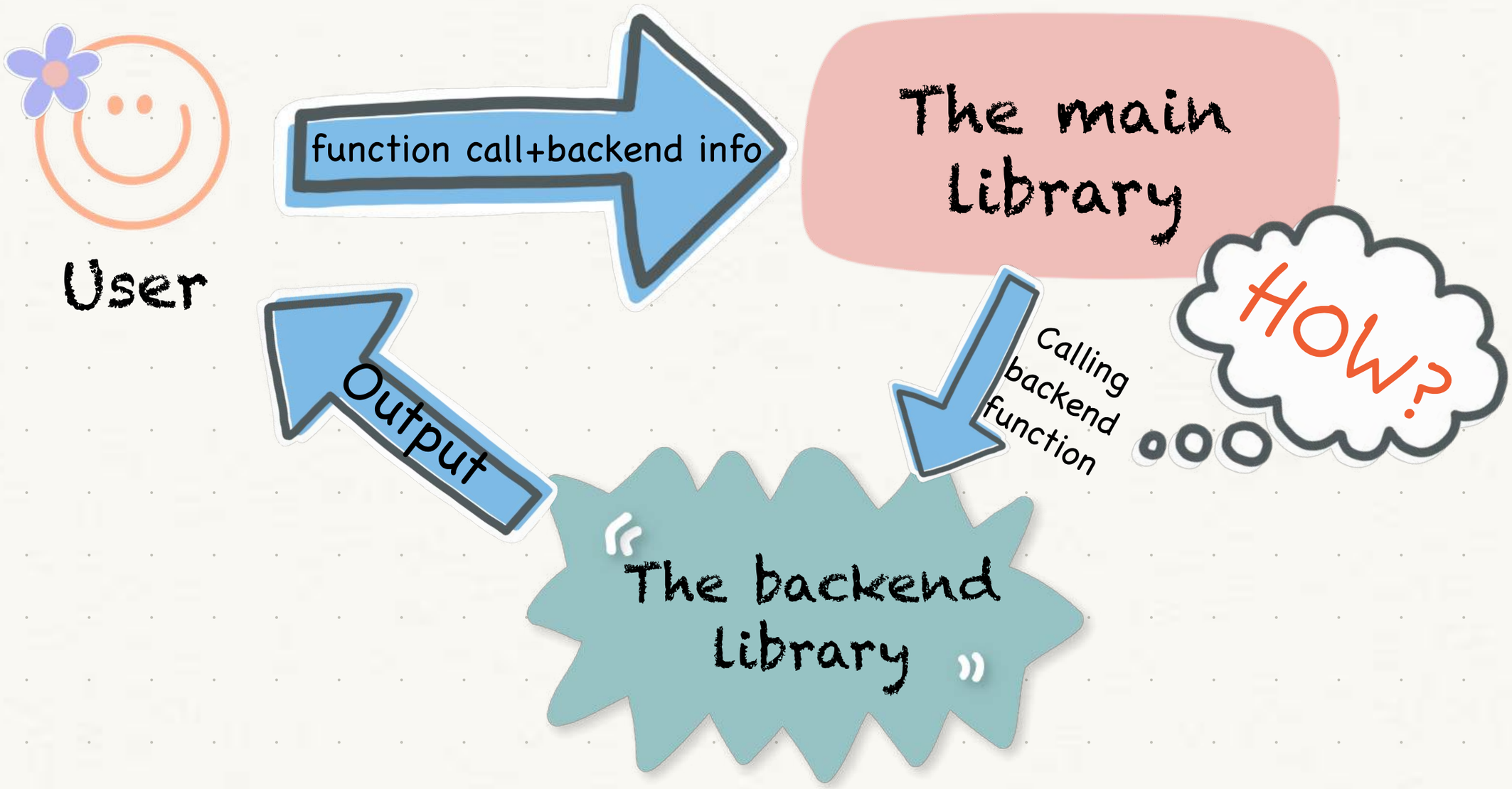
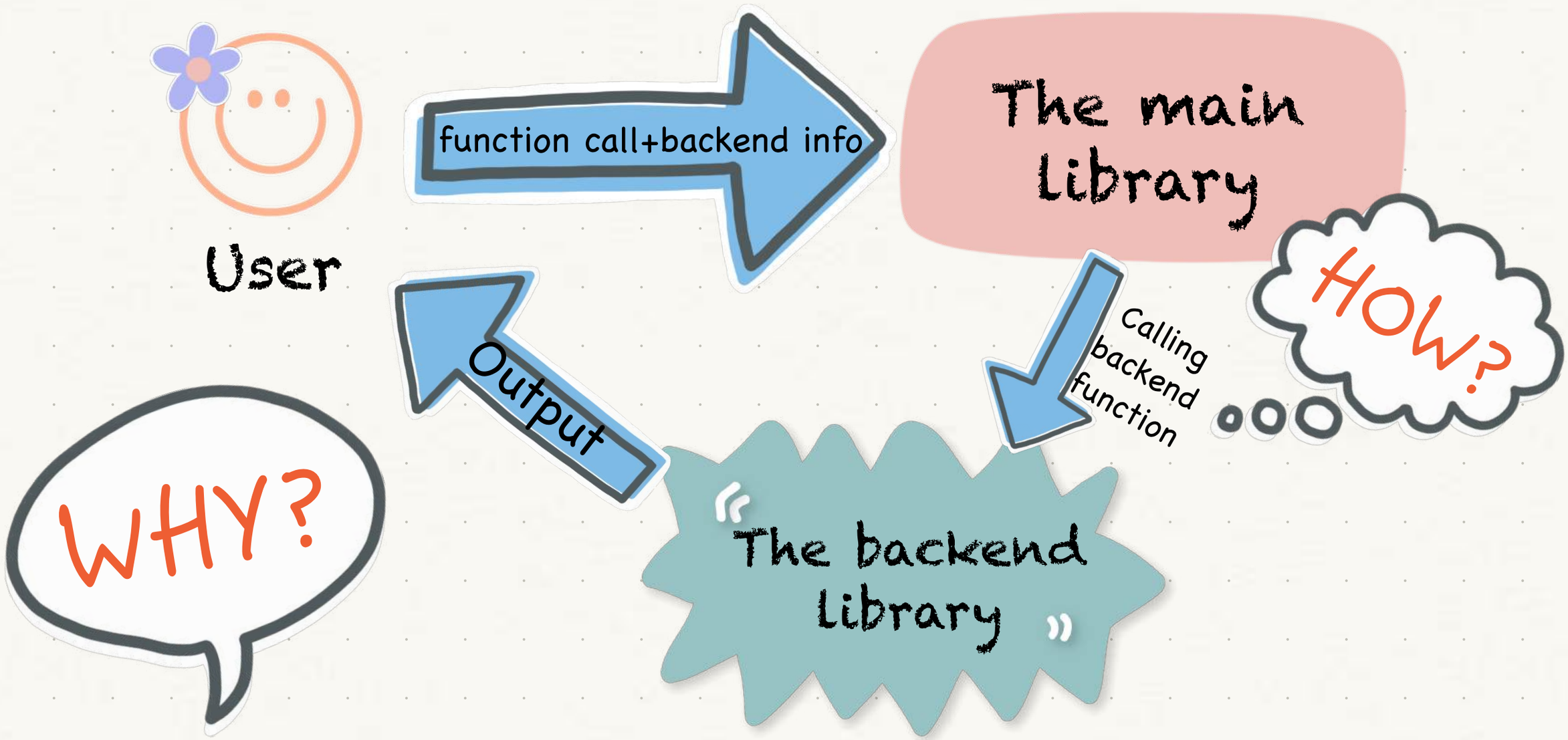


Dispatching



dispatching?

dispatching?

- NetworkX is a big and old project...
  - Consistency
  - Maintenance
- The User-API remains the same!
- Will this API dispatching be good for your project? - IDK...

does the main library calls the function in the backend library?

does the main library calls the function in the backend library?

1. find the backend library
2. find the function in the backend
3. call the function and return the output

There may be more or less steps depending on the nature of the library!!

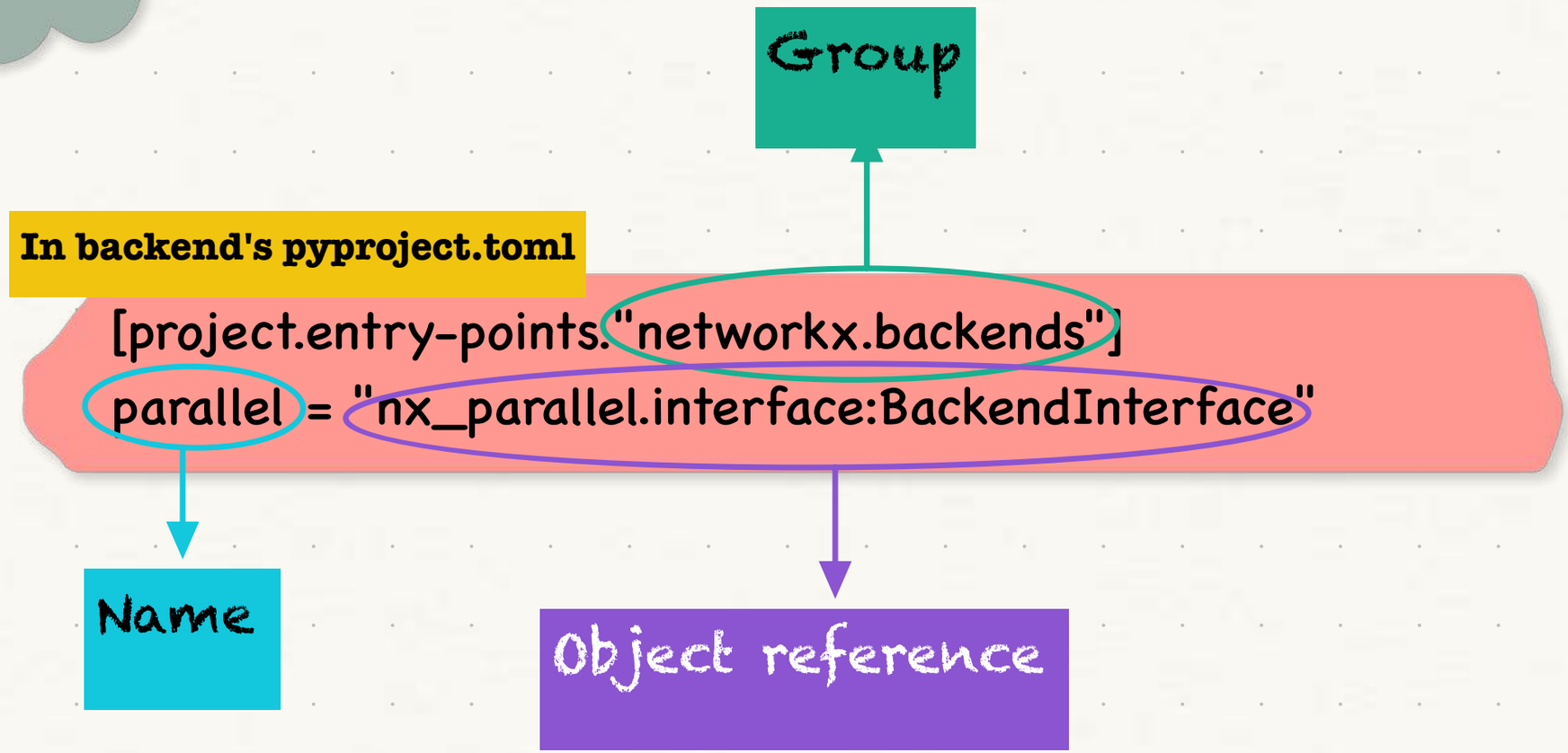
does NetworkX calls the function in the backend library?

1. find the backend library
2. convert the args to backend apt. arg type
3. find the function in the backend
4. call the function and return the output

ref. https://networkx.org/documentation/latest/reference/backends.html

"find the backend library"

Defining a Python entry_point:



ref. https://packaging.python.org/en/latest/specifications/entry-points/

Defining a Python entry_point:

Group

In backend's pyproject.toml

```
[project.entry-points."networkx.backends"]
parallel = "nx_parallel.interface:BackendInterface"
```

Name

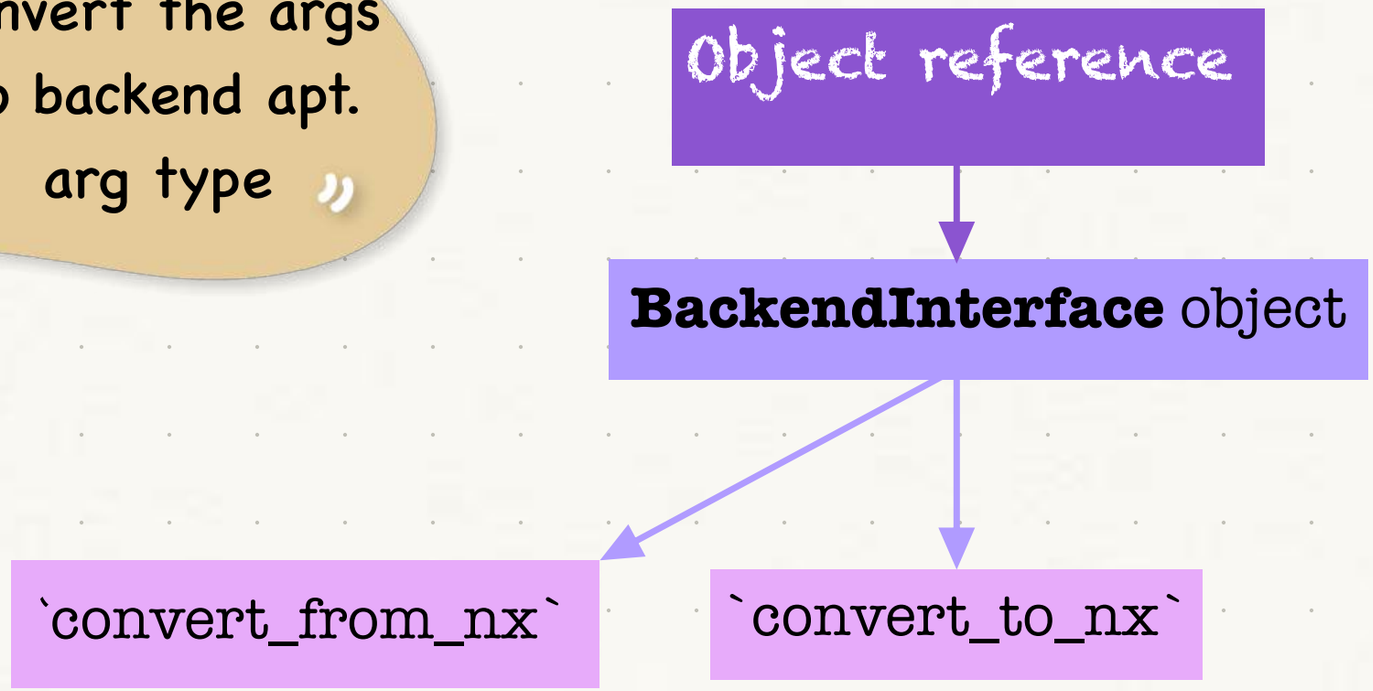
Object reference

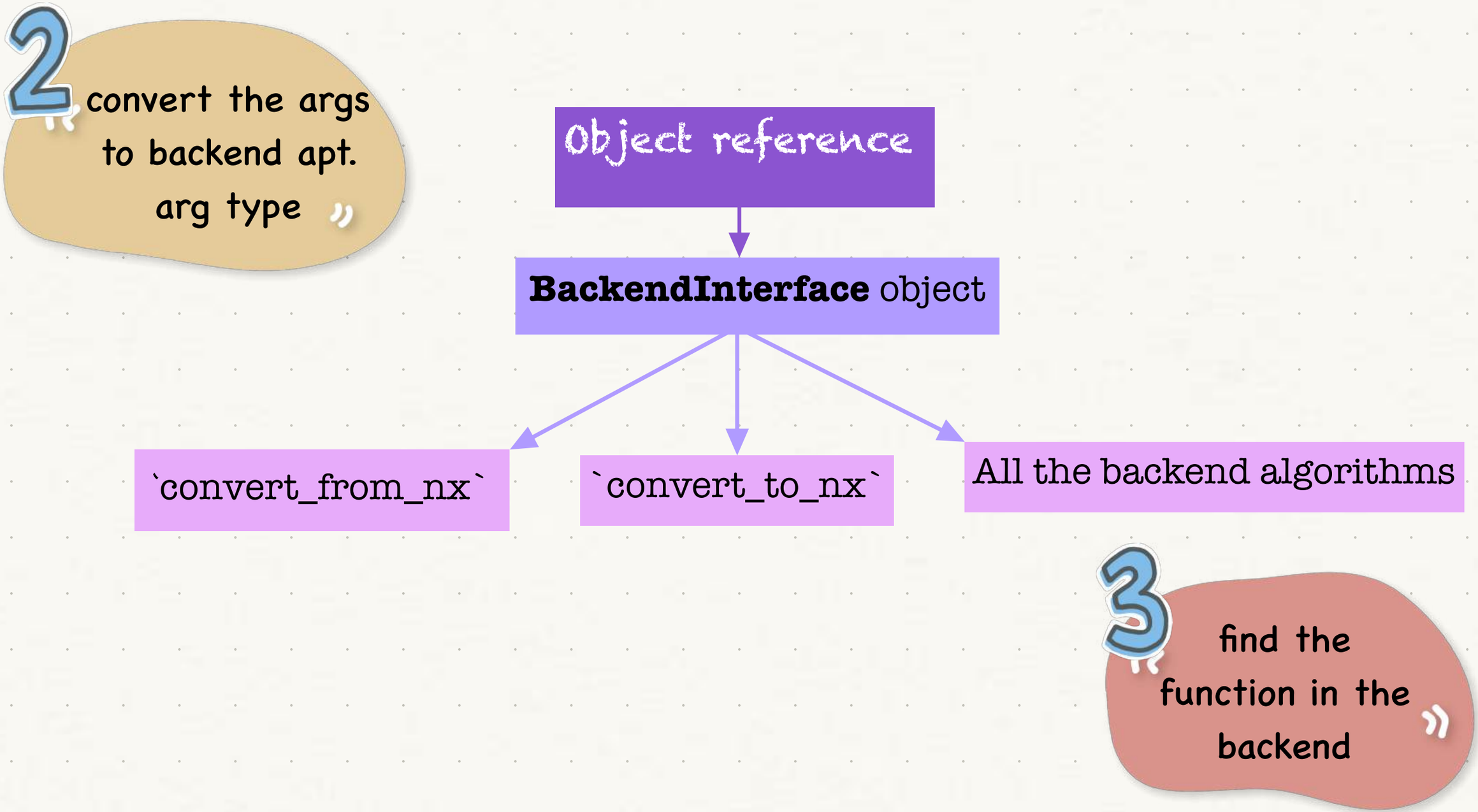
```
>>> from importlib.metadata import entry_points
>>> entry_points(group="networkx.backends")
(EntryPoint(name='parallel',
value='nx_parallel.interface:BackendInterface',
group='networkx.backends'),
EntryPoint(name='nx_loopback',
value='networkx.classes.tests.dispatch_interface:b
ackend_interface', group='networkx.backends'))
```

ref. https://packaging.python.org/en/latest/specifications/entry-points/

2

convert the args to backend apt. arg type




2
convert the args to backend apt. arg type
Object reference
BackendInterface object
`convert_from_nx`
`convert_to_nx`
All the backend algorithms
3
find the function in the backend

What makes up a NetworkX backend?

`networkx.backends` entry_point referring to a `BackendInterface` object with attributes - `convert_from_nx`, `convert_to_nx`, and all the algorithms implemented in the backend. And a backend graph object with `__networkx_backend__` attribute.

Some more dispatching-related stuff:

logging

Automatic testing

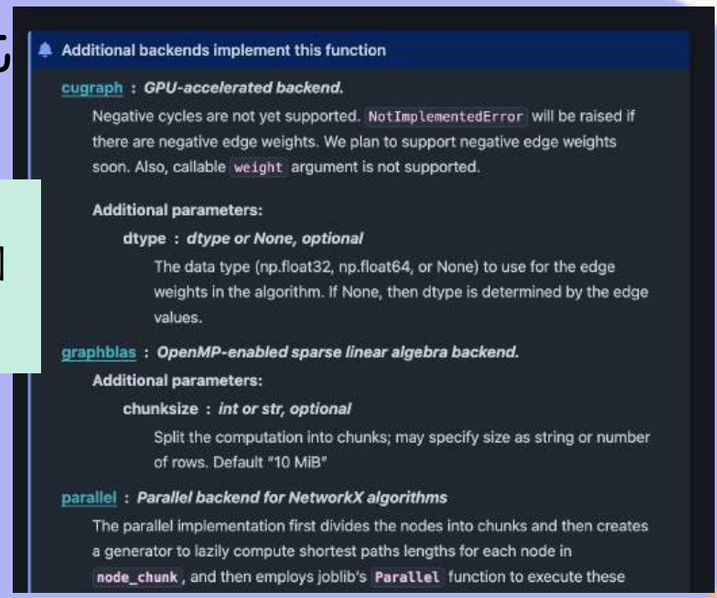
```
NETWORKX_TEST_BACKEND=parallel
NETWORKX_FALLBACK_TO_NX=True
pytest --pyargs networkx
```

Additional backend args

```
>>> nx.betweenness_centrality(G,
backend="parallel",
get_chunks=get_chunks)
```

2nd entry point

```
[project.entry-
points."networkx.backend_info"]
parallel = "_nx_parallel:get_info"
```



Configurations

```
nx.config.backends.parallel.n_jobs = 8
nx.config.backends.parallel.verbose = 10
```

fallback option

Caching conversion

Is dispatching just to run algorithms faster?

Is dispatching just to run algorithms faster?

No...

- database backend: nx-arangodb
- visualisation backend: ??
- more to come...

Dispatching and other projects

- scikit-image
- sklearn
- numpy
- ...?

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- scikit-image
- sklearn
- numpy
- ...?

what are your challenges?

Dispatching discussions:

- **Weekly dispatch meetings**: https://scientific-python.org/calendars/networkx.ics
- **Dispatching channel in Scientific Python discord**: https://discord.com/invite/vur45CbwMz
- **`spatch` repository**: https://github.com/scientific-python/spatch
- **SPEC-2 (API Dispatching) document**: https://scientific-python.org/specs/spec-0002/
- **Scientific Python discuss**: https://discuss.scientific-python.org/t/spec-2-api-dispatch/173


“
Thank you :)
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