PyCon Taiwan 2019 talk

asynccontextmanager for Python 3.7

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About Me

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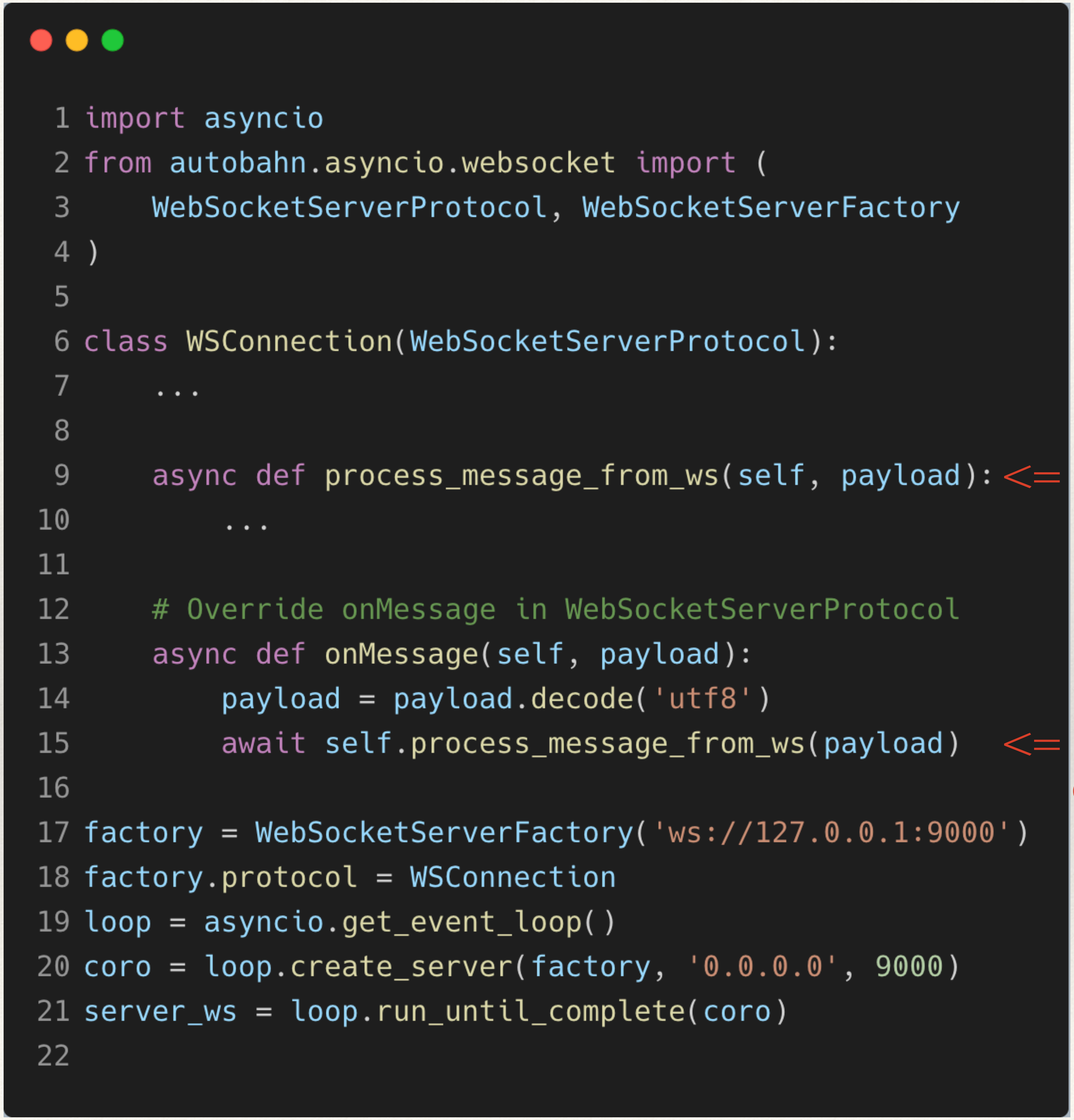
- Use Flask and Autobahn-python to create chatbot platform.

asyncio

- Assumption:
    - 24 opponents
    - Player makes each chess move in 5 seconds
    - Opponents each take 55 seconds to make a move
    - All games have 30 pair-moves.
- Synchronous
    - One game at a time
    - Each game takes (5 + 55) * 30 = 1800 seconds => 30 minutes
    - Playing with 24 opponents cost 30 * 24 minutes => 12 hours
- Asynchronous
    - Move from table to table
    - 1 pair-moves for 24 opponents cost 24 * 5 seconds => 2 minutes
    - 30 pair-moves (a full game) for 24 opponents cost 30 * 2 minutes => 1 hour

asyncio:
- Concurrency in a Single Thread
- Run Tasks (wrapped coroutines) in an event loop

# [Asynchronous Python for the Complete Beginner]



```
import asyncio
from autobahn.asyncio.websocket import (
    WebSocketServerProtocol, WebSocketServerFactory
)

class WSConnection(WebSocketServerProtocol):
    ...

    async def process_message_from_ws(self, payload): <= coroutine
        ...

    # Override onMessage in WebSocketServerProtocol
    async def onMessage(self, payload):
        payload = payload.decode('utf8')
        await self.process_message_from_ws(payload)    <= run a
                                                          coroutine
factory = WebSocketServerFactory('ws://127.0.0.1:9000')
factory.protocol = WSConnection
loop = asyncio.get_event_loop()
coro = loop.create_server(factory, '0.0.0.0', 9000)
server_ws = loop.run_until_complete(coro)

```

Context Manager

- Allow you to allocate and release resources precisely when you want to.

```python
from sqlalchemy import create_engine

db_settings = {...}
DB = create_engine(db_url, **db_settings)

with DB.connect() as conn:
    conn.execute('SELECT ...')
```

Access database

```python
import requests

with requests.Session() as s:
    r = s.get('https://www.google.com/')
    print(r.text)
```

Request a webpage

Open and write on a file

```python
with File('demo.txt', 'w') as opened_file:
    opened_file.write('Hola!')
```

Handle WebSocket connection

```python
import websockets

uri = 'ws://127.0.0.1:9000'
with websockets.connect(uri) as ws:
    while True:
        message = yield from ws.recv()
        yield from ws.send(message)
```

PEP 343 -- The "with" Statement

Context Manager

- Allow you to allocate and release resources precisely when you want to.
- Could implement it into 2 types:
    - Class
        - Implement __enter__ method and __exit__ method.
    - Generator
        - Add the decorator @contextlib.contextmanager onto the generator's definition.

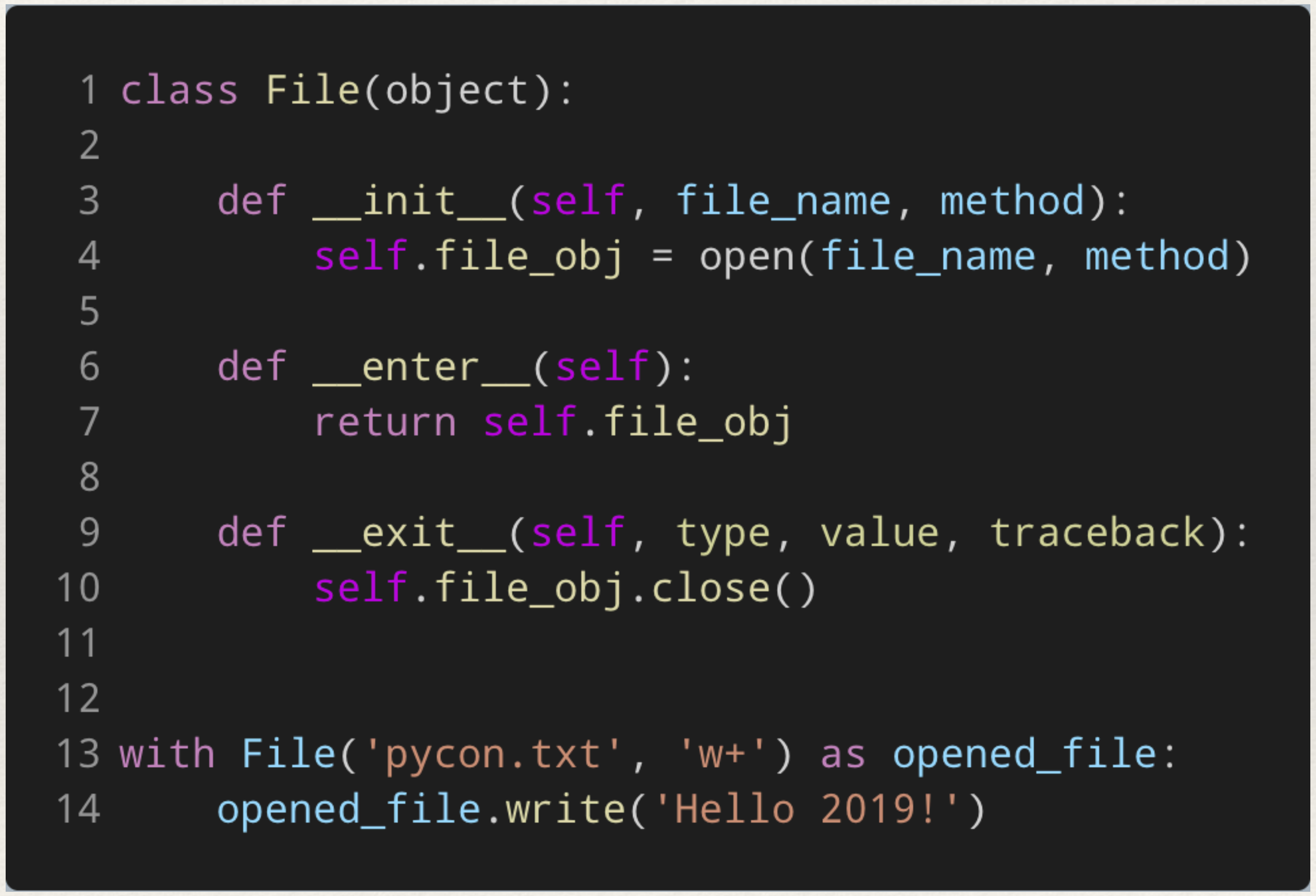
asynccontextmanager?

- Asyncio + ContextManager as a Generator
- Asyncio + ContextManager as a Class

Context Manager as a Class

1. Create class instance
2. Call __init__ method, and the file is opened
3. with statement stores the __exit__ method
4. Call __enter__ method
5. self.file_obj is assigned to \`opened_file\`
6. Do .write()
7. Call the stored __exit__ method, and the file is closed
    - If the error happens, the exception should be dealt here.
      (The reason why there are 3 arguments on __exit__)

Just by defining __enter__ and __exit__ methods we can use our new class in a with statement.



```python
class File(object):

    def __init__(self, file_name, method):
        self.file_obj = open(file_name, method)

    def __enter__(self):
        return self.file_obj

    def __exit__(self, type, value, traceback):
        self.file_obj.close()


with File('pycon.txt', 'w+') as opened_file:
    opened_file.write('Hello 2019!')
```

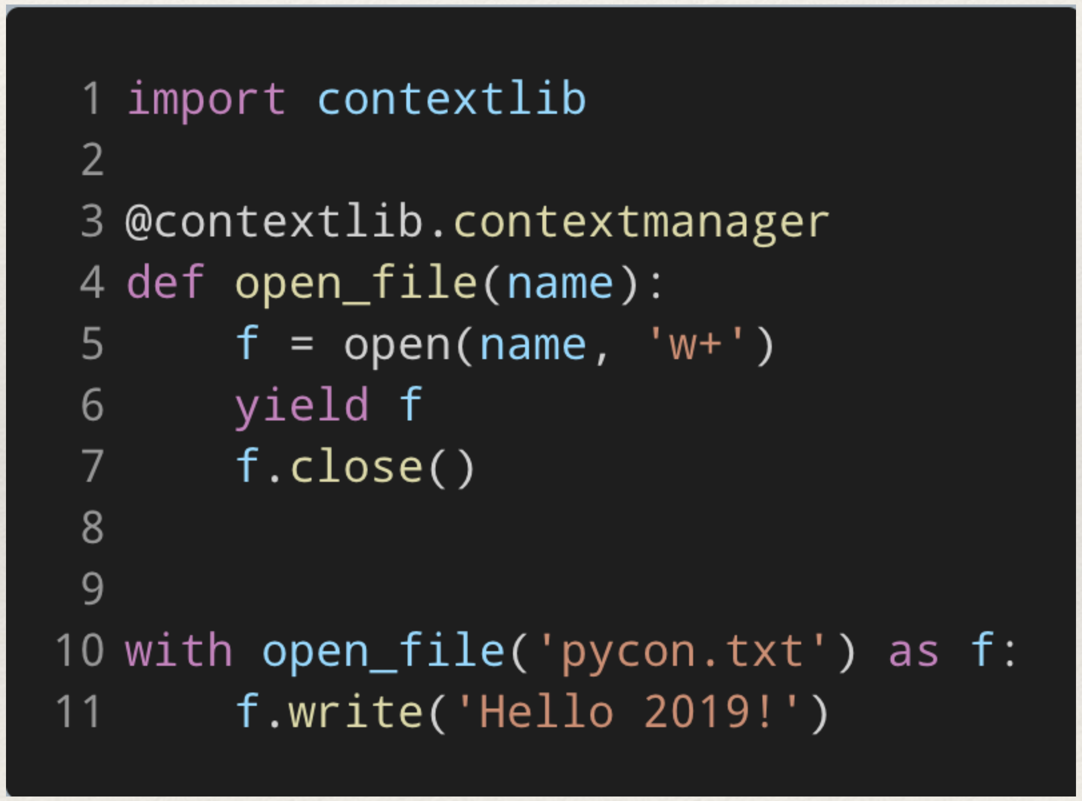
Context Manager as a Generator

1. Call `open_file` function
2. The @contextmanager decorator returns the generator wrapped by the _GeneratorContextManager object
3. The _GeneratorContextManager is assigned to the `open_file` function

=> open_file function have related __enter__ method and __exit__ method

4. Call __enter__ method
5. The file object `f` is yielded
6. Do .write()
7. Call __exit__ method

@contextmanager is called with the function name “open_file” as it’s argument



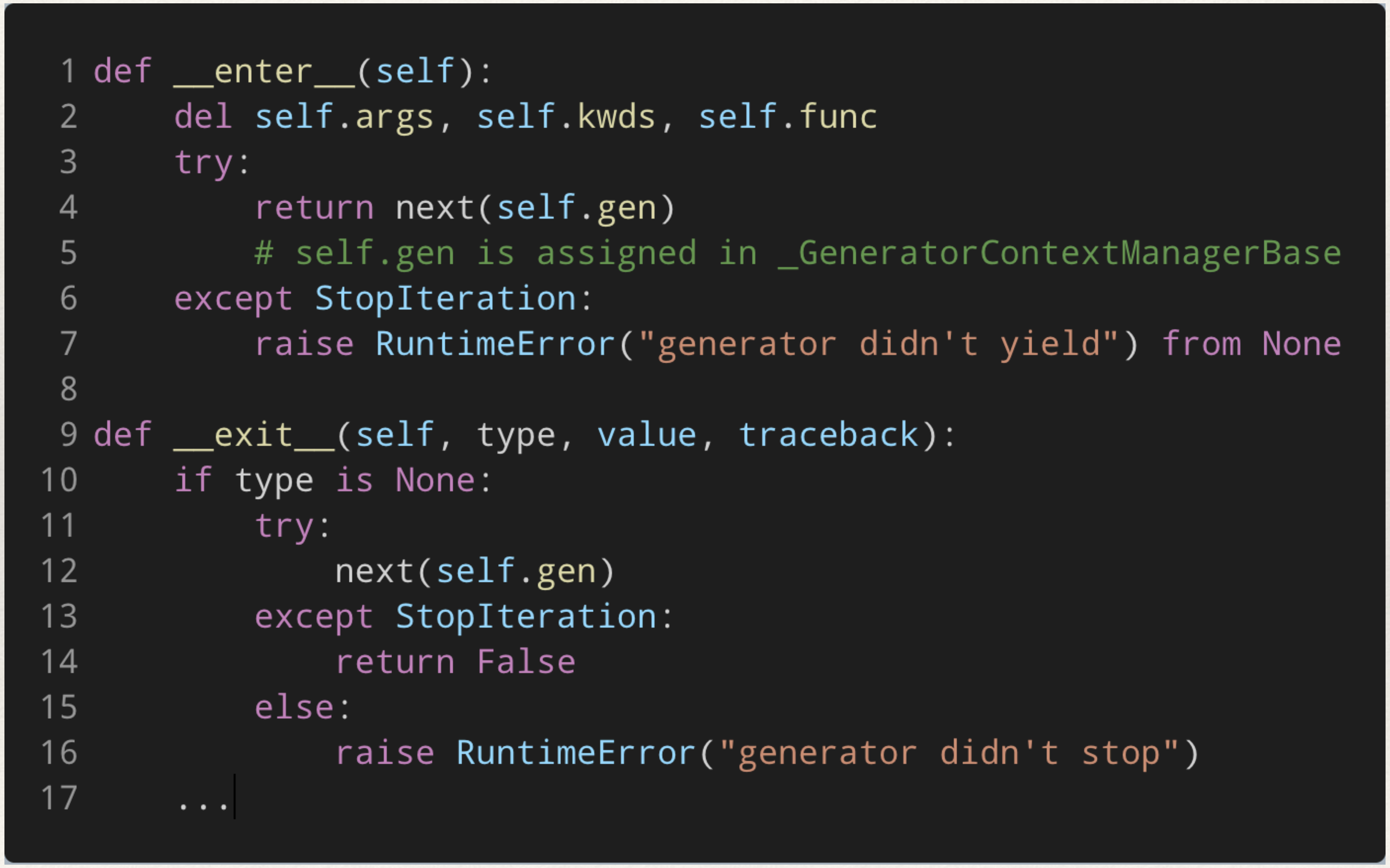
```python
import contextlib

@contextlib.contextmanager
def open_file(name):
    f = open(name, 'w+')
    yield f
    f.close()


with open_file('pycon.txt') as f:
    f.write('Hello 2019!')
```

Context Manager as a Generator (Cont.)

In _GeneratorContextManager class:



```python
def __enter__(self):
    del self.args, self.kwds, self.func
    try:
        return next(self.gen)
        # self.gen is assigned in _GeneratorContextManagerBase
    except StopIteration:
        raise RuntimeError("generator didn't yield") from None

def __exit__(self, type, value, traceback):
    if type is None:
        try:
            next(self.gen)
        except StopIteration:
            return False
        else:
            raise RuntimeError("generator didn't stop")
    ...
```

asynccontextmanager

=> Run/Use multiple resources with contextmanager simultaneously

- Decorator @asynccontextmanager
  - Asyncio + ContextManager as a Generator
- Class with __aenter__ and __aexit__ method
  - Asyncio + ContextManager as a Class

asynccontextmanager as a Generator

1. Call `open_session`

2. The @asynccontextmanager decorator returns the generator wrapped by the _AsyncGeneratorContextManager object

=> open_file function have related __aenter__ method and __aexit__ method

3. Call __aenter__ method, which iterates `open_session` generator

4. The session object `s` is yielded

5. Await .session.get() and Await .text()

6. Call __aexit__ method, which finish the rest part of `open_session` generator

```python
import aiohttp
from contextlib import asynccontextmanager

url = 'https://tw.pycon.org/2019/'

@asynccontextmanager
async def open_session():
    s = aiohttp.ClientSession()
    yield s
    await s.close()

async def main():
    async with open_session() as session:
        response = await session.obj.get(url)
        text = await response.text()


import asyncio
asyncio.run(main())
```

asynccontextmanager as a Class

1. Create class instance
2. Call __init__ method, and the session opened
3. async with statement stores the __aexit__ method
4. Call __aenter__ method
5. self.obj is assigned to \`session\`
6. Await .session.get() and Await .text()
7. Call the stored __aexit__ method, and the session is closed
    - If the error happens, the exception should be dealt here. (The reason why there are 3 arguments on __aexit__)

```python
from aiohttp import ClientSession

the_url = 'https://tw.pycon.org/2019/'

class TheSession:
    def __init__(self):
        self.obj = None
    async def __aenter__(self):
        self.obj = ClientSession()
        return self.obj
    async def __aexit__(self, typ, value, tb):
        await self.obj.close()

async def main():
    async with TheSession() as session:
        response = await session.obj.get(the_url)
        text = await response.text


import asyncio
asyncio.run(main())
```

Live Demo

Learn More

- **contextlib**
  - ExitStack & AsyncExitStack(new in 3.7)
    - ✦ https://www.rath.org/on-the-beauty-of-pythons-exitstack.html
  - nullcontext (new in 3.7)
- **other new features on asyncio in 3.7**
  - async and await become keywords
  - asyncio.run()
  - Support for Context Variable (PEP-567, new in 3.7)
  - Support for loop.call_soon()/loop.call_later()/loop.call_at()
  - Shortcuts (asyncio.create_task(), asyncio.current_task(), asyncio.all_task(), etc.)
  - Network/Socket/Streaming (improvement in BufferedProtocol, asyncio.Server, etc.)

Commercial

SINITIC™

- Hiring Full-stack Engineer (Python Flask + Vue.js)
- JD Link: https://secure.collage.co/jobs/sinitic/10484

References

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- https://docs.python.org/3/library/contextlib.html
- https://docs.python.org/3/library/asyncio-task.html
- https://docs.python.org/3/whatsnew/3.7.html#whatsnew37-asyncio
- http://book.pythontips.com/en/latest/context_managers.html
- https://stackoverflow.com/questions/37433157/asynchronous-context-manager