Tornado

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01. OVERVIEW

ORIGINES

- ❏ Created in 2009 by FriendFeed
  - ❏ Open Source (Licence Apache 2), written in Python
  - ❏ Acquired by Facebook

WHICH COMPANIES USE TORNADO?

uploadcare

02.

CONCEPTS

CONCEPTS

Tornado is based on the following major components:

❏ A Web Framework

❏ Asynchronous library

❏ Client / Server HTTP

❏ Coroutine library

❏ DIY Framework (Do It Yourself)

- ❑ Many simultaneous connections
- ❑ Performances
- ❑ Lightweight
- ❑ Ideal for app needing long time connection

- ❑ Tornado store upload files in memory
- ❑ Smaller community than Django
- ❑ Create all by yourself

PYTHON ALTERNATIVE TO TORNADO ?

Flask

- ❑ DIY Framework
- ❑ Back end Framework
- ❑ Lightweight

Tornado

- ❑ DIY Framework
- ❑ Full Stack Framework
- ❑ Long polling and async app

django

- ❑ Complete Framework
- ❑ Full Stack Framework
- ❑ Big project

SIMILAR FRAMEWORK?

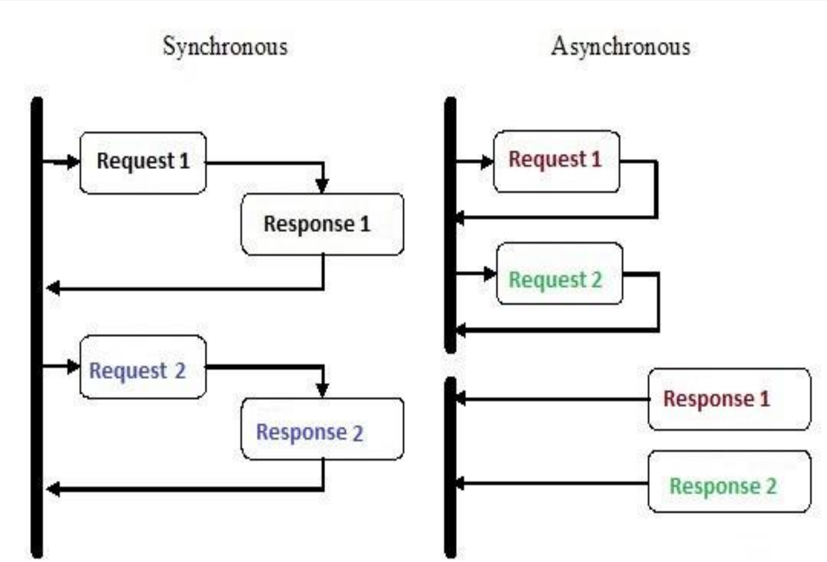
Tornado
node
JS
TM

- ❏ Asynchronous Framework
- ❏ Non-blocking I/O
- ❏ Real-time Web app

ONE KEY POINT : ASYNCHRONOUS IN TORNADO

- ❑ Python is natively single-threaded language
  - ❑ All resources for One thing at a time

- ❑ In Web, Requests come at any time
  - ❑ How to handle all this !?

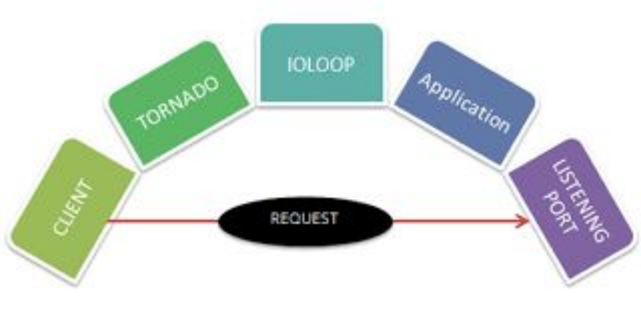


- ❑ Tornado has a built-in library << *tornado.httpclient.AsyncHTTPClient* >> for handling multiple requests in async way

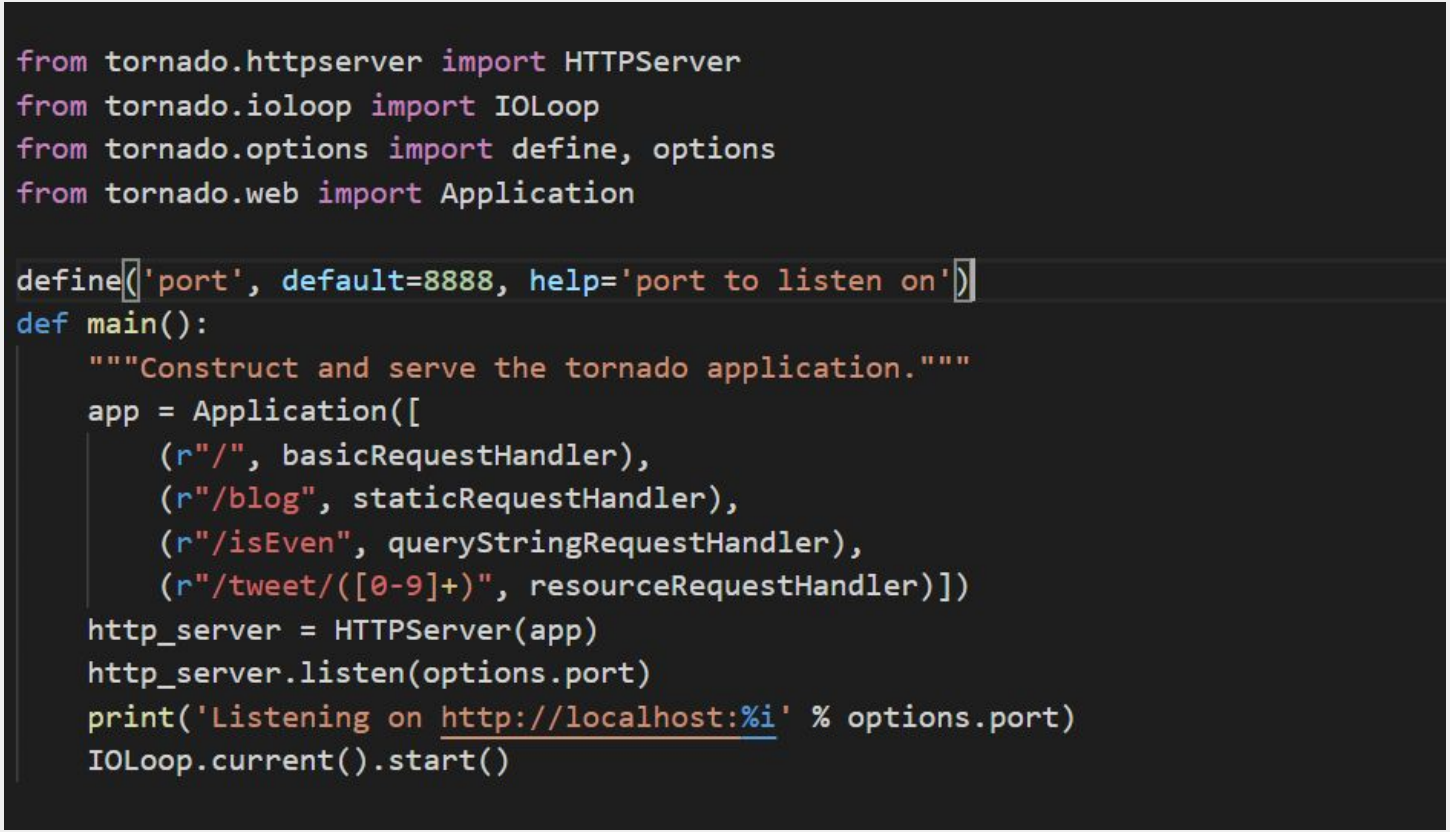
03. CODE WITH TORNADO

BASIC IMPLEMENTATION

- ❑ Application
  - ❑ Defines routes
  - ❑ Configures initial state (e.g: connexion to a database, others web services)
- ❑ HTTP Server
  - ❑ enables HTTP access to the application
- ❑ IO Loop
  - ❑ Needs to be started so that the web server remains listening
- ❑ Request Handlers

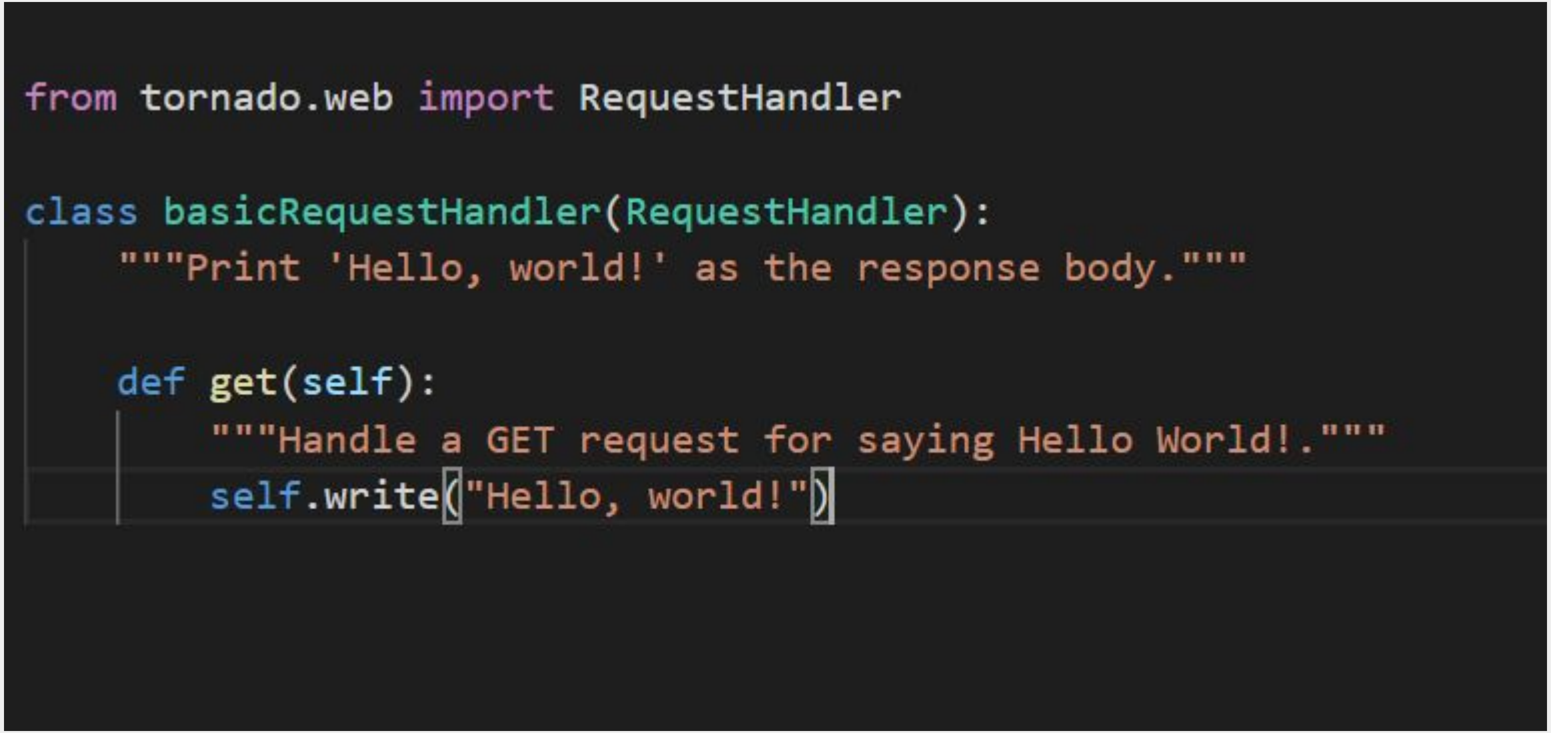


APPLICATION



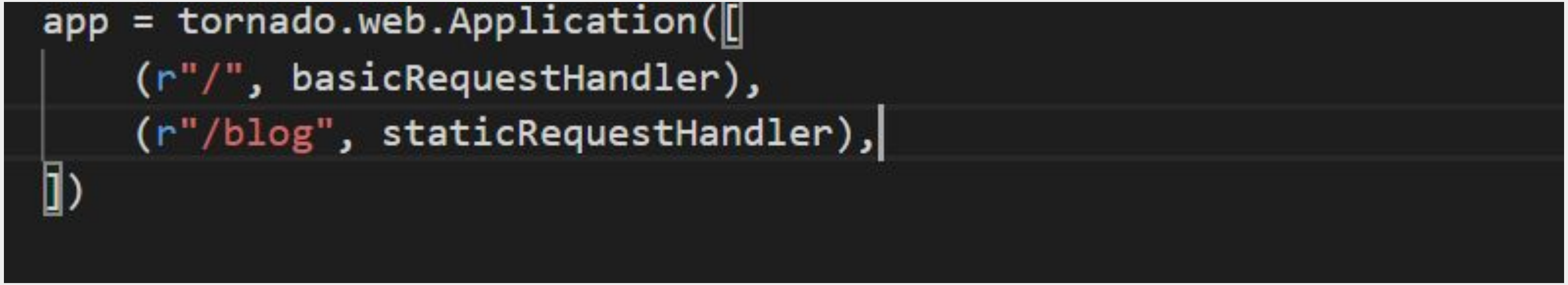
```
from tornado.httpserver import HTTPServer
from tornado.ioloop import IOLoop
from tornado.options import define, options
from tornado.web import Application

define('port', default=8888, help='port to listen on')
def main():
    """Construct and serve the tornado application."""
    app = Application([
        (r"/", basicRequestHandler),
        (r"/blog", staticRequestHandler),
        (r"/isEven", queryStringRequestHandler),
        (r"/tweet/([0-9]+)", resourceRequestHandler)])
    http_server = HTTPServer(app)
    http_server.listen(options.port)
    print('Listening on http://localhost:%i' % options.port)
    IOLoop.current().start()
```

REQUEST HANDLER

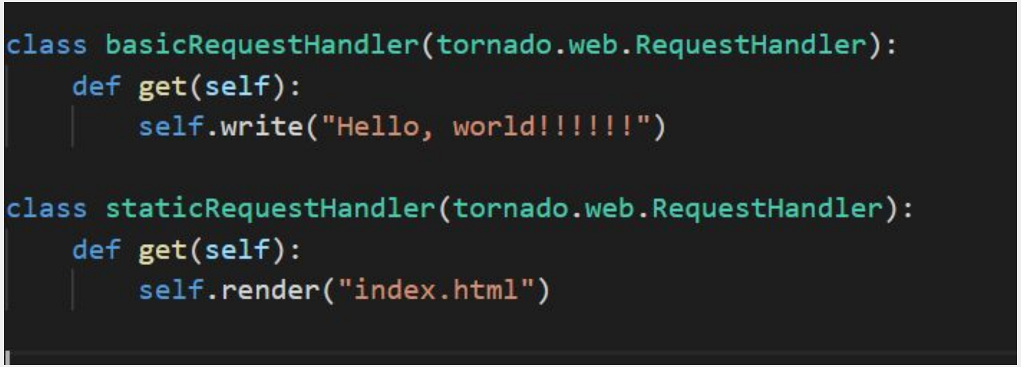


```python
from tornado.web import RequestHandler

class basicRequestHandler(RequestHandler):
    """Print 'Hello, world!' as the response body."""

    def get(self):
        """Handle a GET request for saying Hello World!."""
        self.write("Hello, world!")
```

DEFINES ROUTES

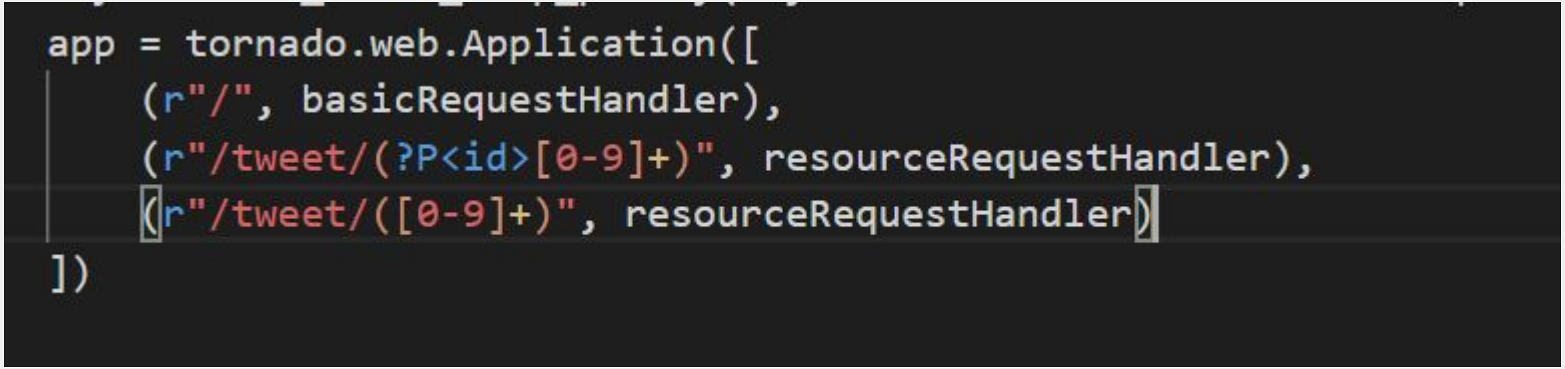


```
app = tornado.web.Application([
    (r"/", basicRequestHandler),
    (r"/blog", staticRequestHandler),
])
```

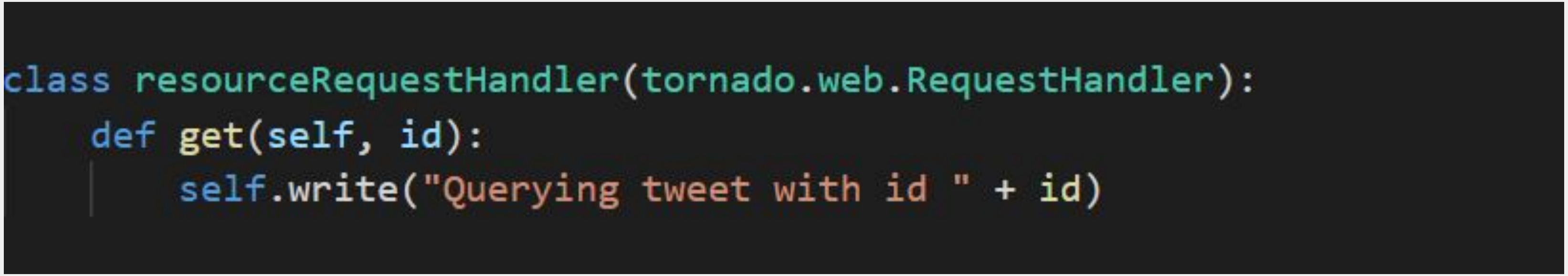


```
class basicRequestHandler(tornado.web.RequestHandler):
    def get(self):
        self.write("Hello, world!!!!!!")

class staticRequestHandler(tornado.web.RequestHandler):
    def get(self):
        self.render("index.html")
```

DEFINES ROUTES



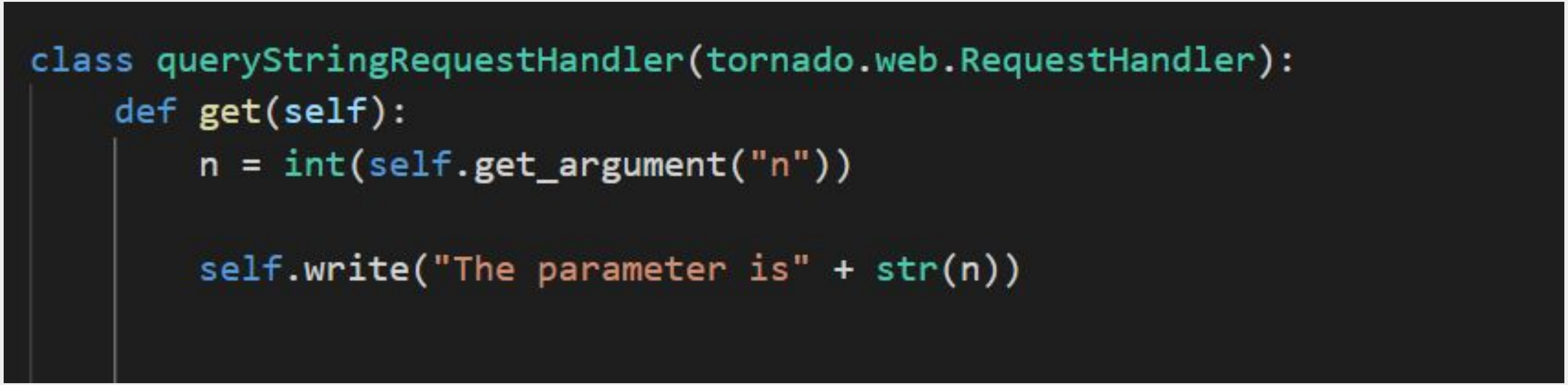
```
app = tornado.web.Application([
        (r"/", basicRequestHandler),
        (r"/tweet/(?P<id>[0-9]+)", resourceRequestHandler),
        (r"/tweet/([0-9]+)", resourceRequestHandler)
])
```



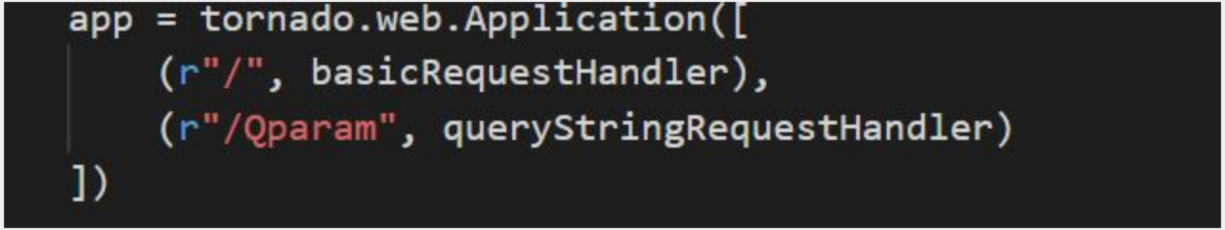
```
class resourceRequestHandler(tornado.web.RequestHandler):
    def get(self, id):
        self.write("Querying tweet with id " + id)
```

DEFINES ROUTES

- ❑ Query parameter -> http://localhost:8881/**Qparam?n=1**



```python
class queryStringRequestHandler(tornado.web.RequestHandler):
    def get(self):
        n = int(self.get_argument("n"))

        self.write("The parameter is" + str(n))

```

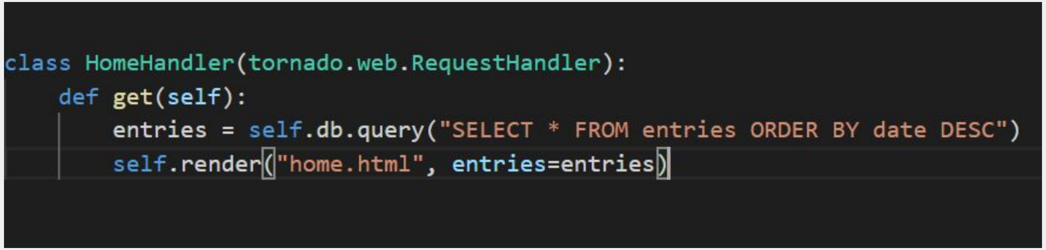


```python
app = tornado.web.Application([
    (r"/", basicRequestHandler),
    (r"/Qparam", queryStringRequestHandler)
])
```

HOW TO MANAGE VIEWS ?

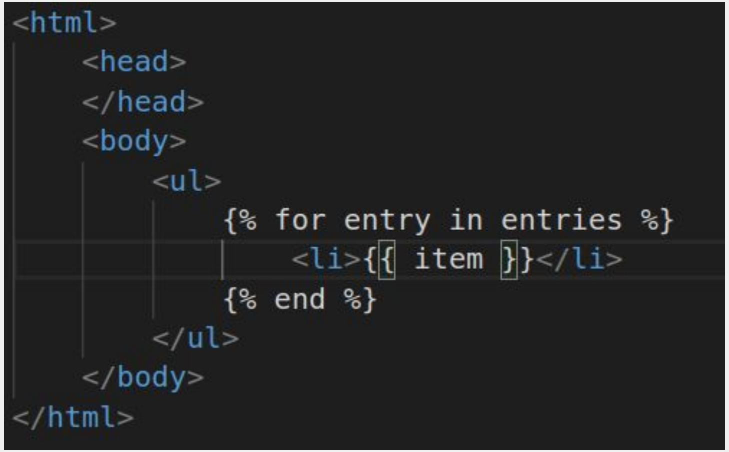
❑ Templates are managed in the same way as in Django and Flask

Render Integration :



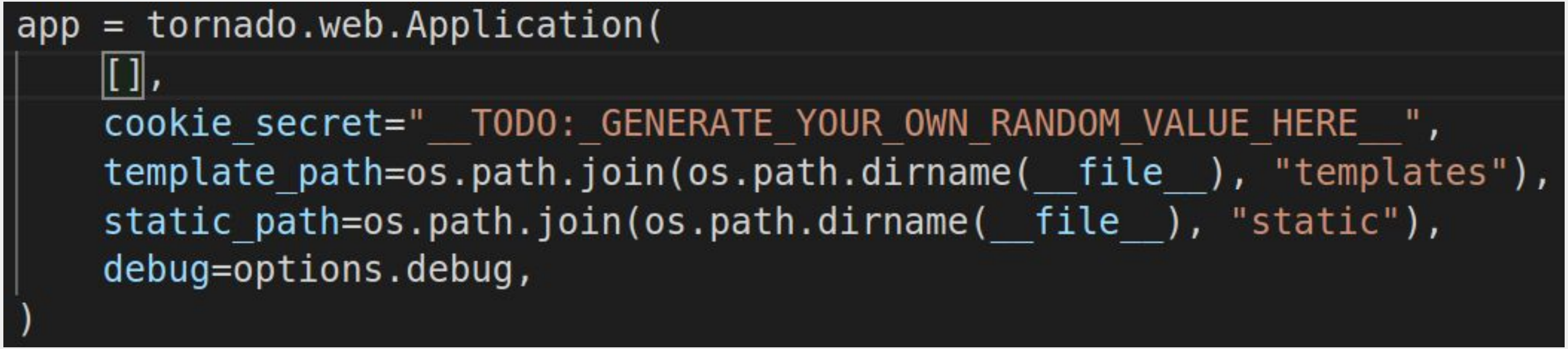
```python
class HomeHandler(tornado.web.RequestHandler):
    def get(self):
        entries = self.db.query("SELECT * FROM entries ORDER BY date DESC")
        self.render("home.html", entries=entries)
```

Template view :



```html
<html>
    <head>
    </head>
    <body>
        <ul>
            {% for entry in entries %}
                <li>{{ item }}</li>
            {% end %}
        </ul>
    </body>
</html>
```

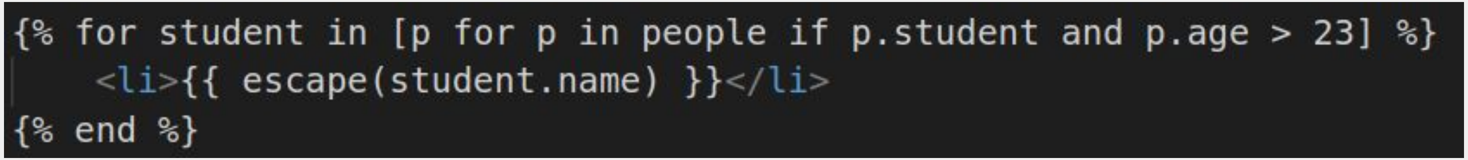
SPECIFY TEMPLATES PATHS



```
app = tornado.web.Application(
    [],
    cookie_secret="__TODO:_GENERATE_YOUR_OWN_RANDOM_VALUE_HERE__",
    template_path=os.path.join(os.path.dirname(__file__), "templates"),
    static_path=os.path.join(os.path.dirname(__file__), "static"),
    debug=options.debug,
)
```

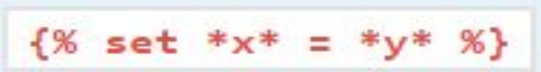
TEMPLATES POSSIBILITIES

Complex expression translated to Python :

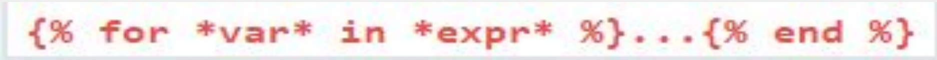


```
{% for student in [p for p in people if p.student and p.age > 23] %}
    <li>{{ escape(student.name) }}</li>
{% end %}
```

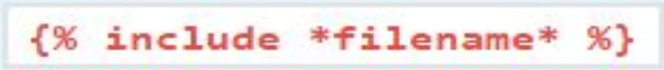
Useful Syntax :



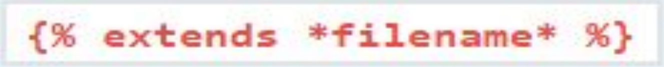
```
{% set *x* = *y* %}
```



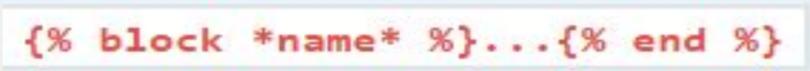
```
{% for *var* in *expr* %}...{% end %}
```



```
{% include *filename* %}
```



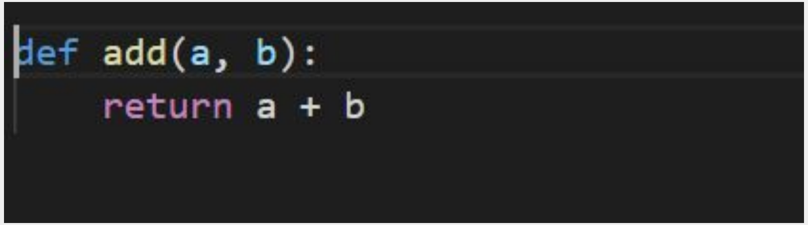
```
{% extends *filename* %}
```



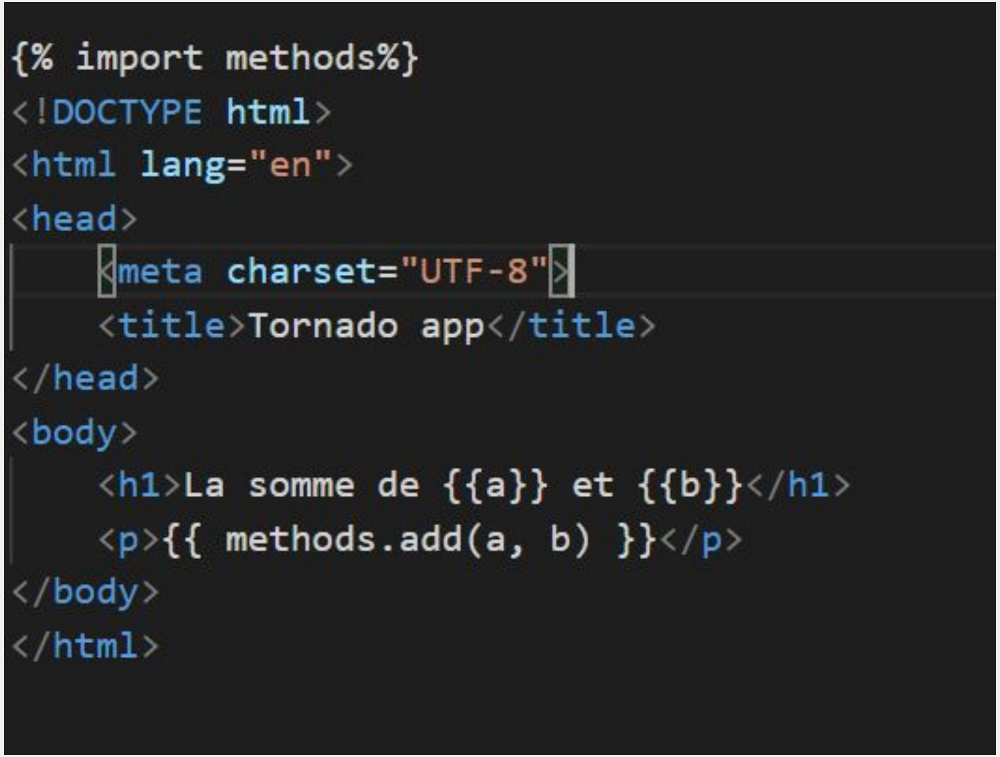
```
{% block *name* %}...{% end %}
```

TEMPLATES POSSIBILITIES

- Use Methods



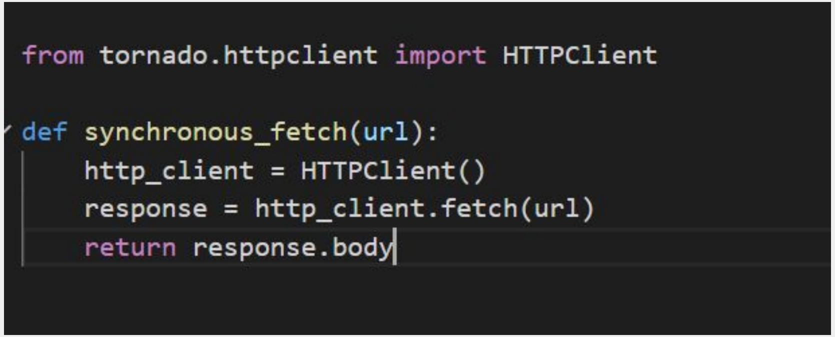
```python
def add(a, b):
    return a + b
```



```html
{% import methods%}
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <title>Tornado app</title>
</head>
<body>
    <h1>La somme de {{a}} et {{b}}</h1>
    <p>{{ methods.add(a, b) }}</p>
</body>
</html>
```

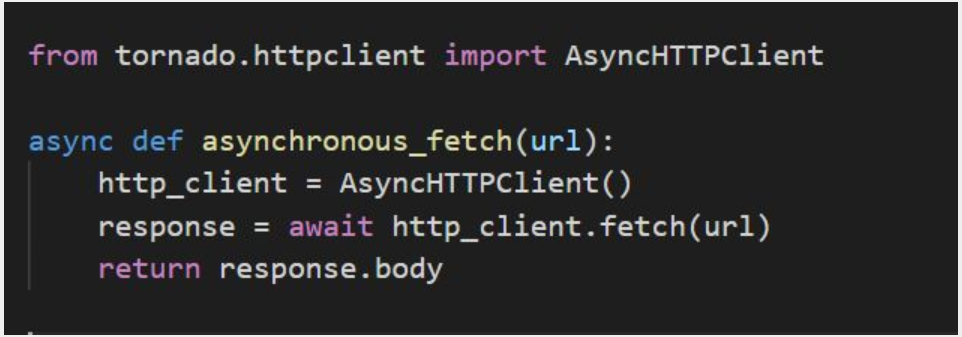
SYNC & ASYNC WITH TORNADO

Synchronous method :



```python
from tornado.httpclient import HTTPClient

def synchronous_fetch(url):
    http_client = HTTPClient()
    response = http_client.fetch(url)
    return response.body
```

ASynchronous method :



```python
from tornado.httpclient import AsyncHTTPClient

async def asynchronous_fetch(url):
    http_client = AsyncHTTPClient()
    response = await http_client.fetch(url)
    return response.body
```

COROUTINES

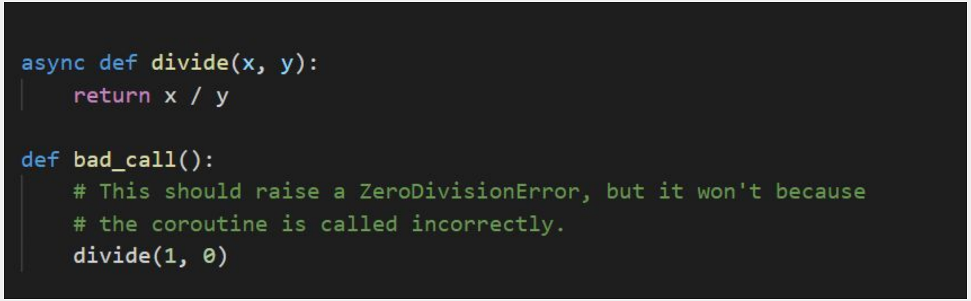
- Recommended for asynchronous code in tornado
- use the keywords : “await” or “yield”
- as simple as synchronous code
- easier concurrency : reduce the number of places where a context can switch

```
Decorated:

# Normal function declaration
# with decorator
@gen.coroutine
def a():
    # "yield" all async funcs
funcs
    b = yield c()
    # "return" and "yield"
    # cannot be mixed in
    # Python 2, so raise a
    # special exception.
     raise gen.Return(b)
```

```
Native:


 # "async def" keywords

 async def a():
     # "await" all async

     b = await c()




     # Return normally
      return b
```

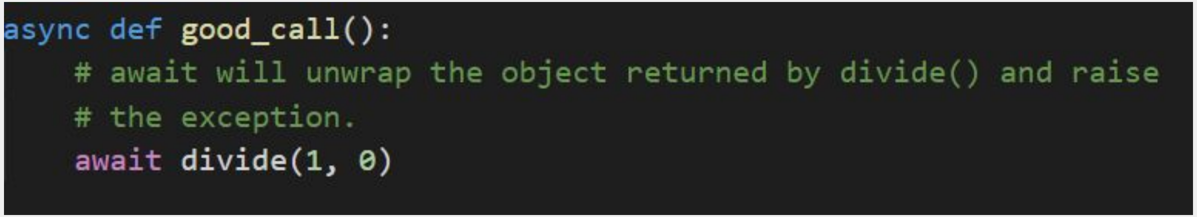
HOW TO CALL COROUTINE

Bad way :



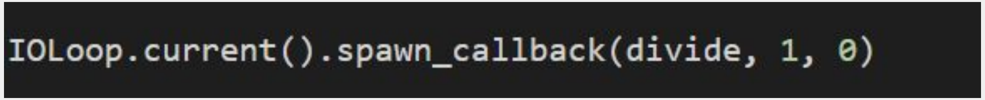
```python
async def divide(x, y):
    return x / y

def bad_call():
    # This should raise a ZeroDivisionError, but it won't because
    # the coroutine is called incorrectly.
    divide(1, 0)
```

Good Way :



```python
async def good_call():
    # await will unwrap the object returned by divide() and raise
    # the exception.
    await divide(1, 0)
```

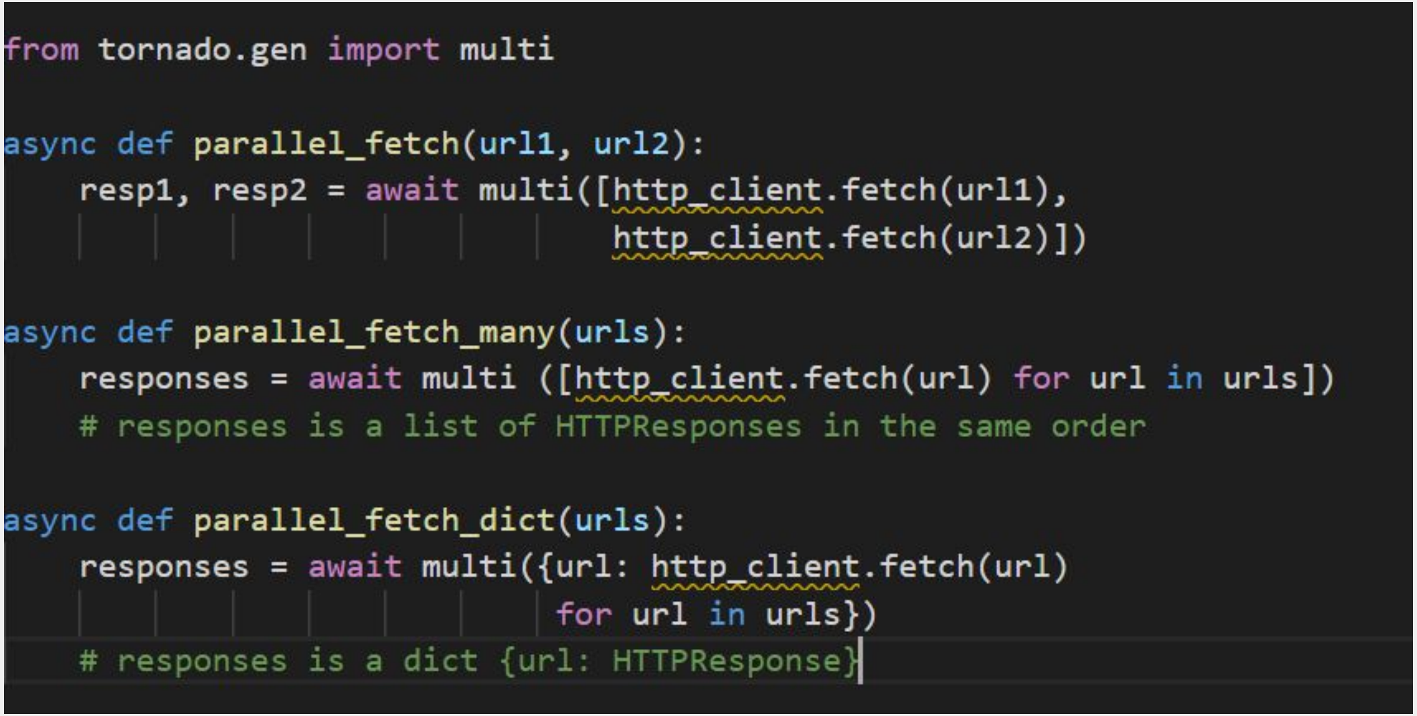
Fire and forget method :



```python
IOLoop.current().spawn_callback(divide, 1, 0)
```

COROUTINE PATTERNS

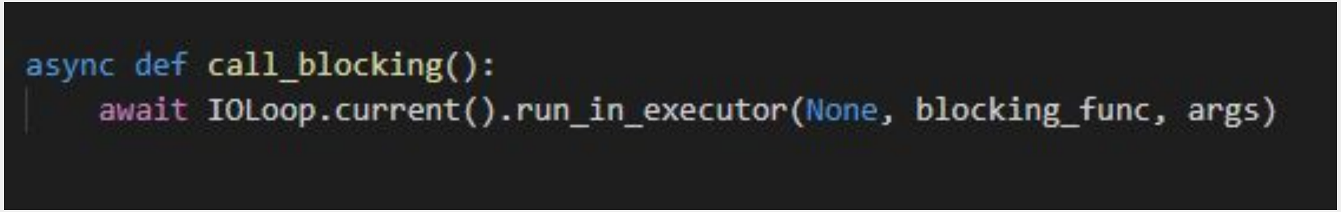
Parallelism :



```python
from tornado.gen import multi

async def parallel_fetch(url1, url2):
    resp1, resp2 = await multi([http_client.fetch(url1),
                                http_client.fetch(url2)])

async def parallel_fetch_many(urls):
    responses = await multi ([http_client.fetch(url) for url in urls])
    # responses is a list of HTTPResponses in the same order

async def parallel_fetch_dict(urls):
    responses = await multi({url: http_client.fetch(url)
                             for url in urls})
    # responses is a dict {url: HTTPResponse}
```

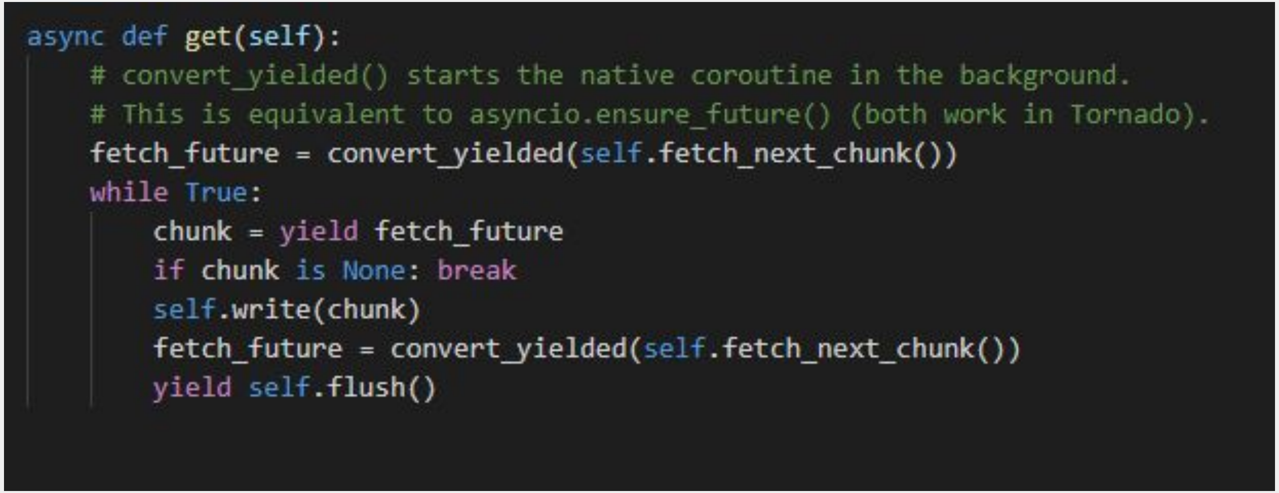
COROUTINE PATTERNS

CALL BLOCKING METHOD :



```
async def call_blocking():
    await IOLoop.current().run_in_executor(None, blocking_func, args)
```

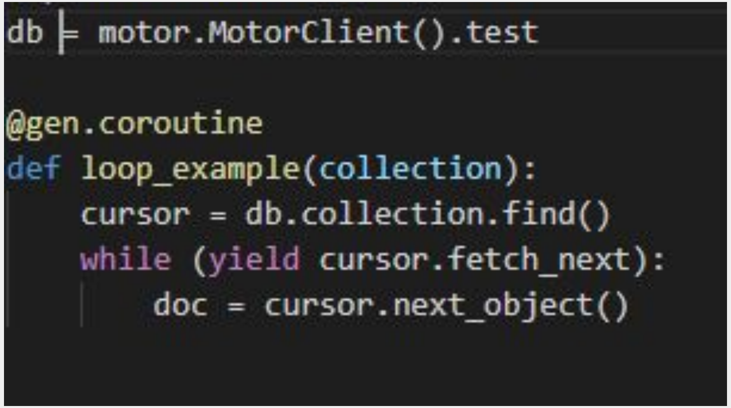
INTERLEAVING



```
async def get(self):
    # convert_yielded() starts the native coroutine in the background.
    # This is equivalent to asyncio.ensure_future() (both work in Tornado).
    fetch_future = convert_yielded(self.fetch_next_chunk())
    while True:
        chunk = yield fetch_future
        if chunk is None: break
        self.write(chunk)
        fetch_future = convert_yielded(self.fetch_next_chunk())
        yield self.flush()
```

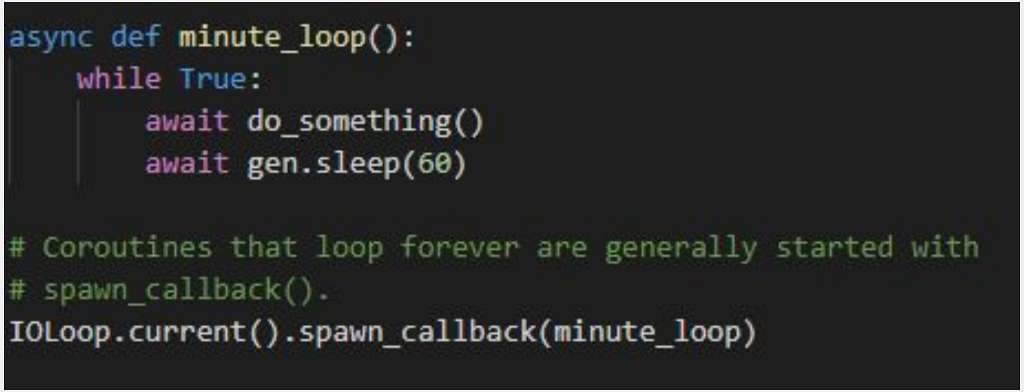
COROUTINE PATTERNS

LOOPING :



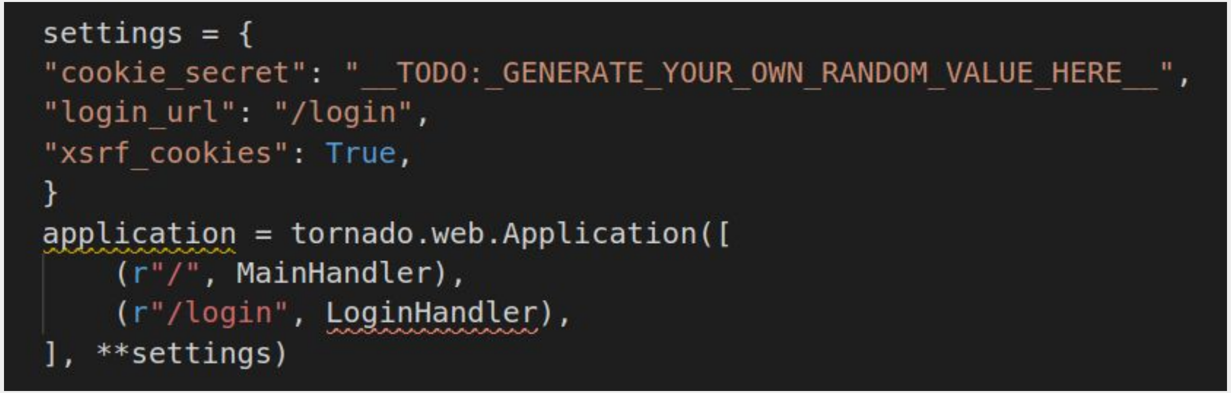
```
db = motor.MotorClient().test

@gen.coroutine
def loop_example(collection):
    cursor = db.collection.find()
    while (yield cursor.fetch_next):
        doc = cursor.next_object()
```

RUNNING IN THE BACKGROUND :

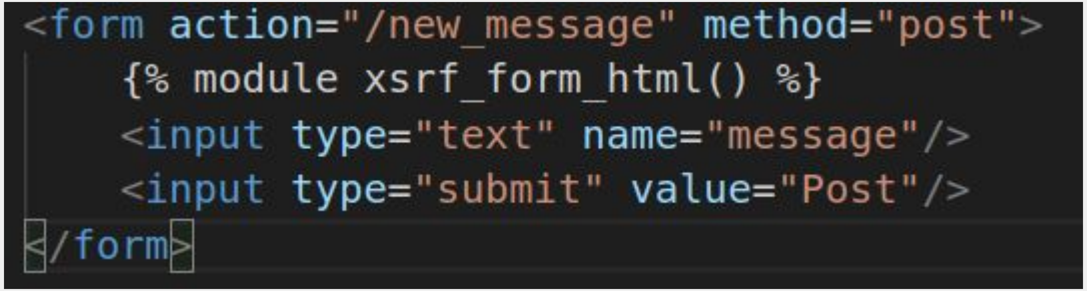


```
async def minute_loop():
    while True:
        await do_something()
        await gen.sleep(60)

# Coroutines that loop forever are generally started with
# spawn_callback().
IOLoop.current().spawn_callback(minute_loop)
```

SOME SECURITY ISSUES



```
settings = {
"cookie_secret": "__TODO:_GENERATE_YOUR_OWN_RANDOM_VALUE_HERE__",
"login_url": "/login",
"xsrf_cookies": True,
}
application = tornado.web.Application([
    (r"/", MainHandler),
    (r"/login", LoginHandler),
], **settings)
```



```
<form action="/new_message" method="post">
    {% module xsrf_form_html() %}
    <input type="text" name="message"/>
    <input type="submit" value="Post"/>
</form>
```

04. TP

https://gitlab.univ-lille.fr/francodavy.irakoze.etu/tp-tornado

Framework
Tornado
Client
HTTP
Asynchronous
Server
Non
Web
Blocking