TORNADO
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TORNADO

what is it?

Non-blocking web server

Based on epoll / kqueue

Handles 1000s of connections

Powers FriendFeed

paylogic

why do you even care?

Know what you use

I can't trust

what I don't know

Learning and sharing: fun!

what *do you use it for?*

We built a

Scalable

Distributed

Fault tolerant

High load

...thing

[CITATION NEEDED]

paylogic

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TORNADO

what *is it made of?*

IOLoop

Callbacks, Tasks, Timeouts

TCPServer

Application

RequestHandler

Generators

can I extend it?

Sure!

It's easy

How would we make

a simple TCPServer?

show me the source!

0b_tcpserver.py

GETTING STARTED

how do I make the simplest app?

Define a RequestHandler

Implement get

Define an Application

Tell the application to listen

Start the IOLoop

show me the source!

`01_getting_started.py`

what is an Application?

Collection of RequestHandlers

Implements listen:

Starts an HTTPServer

Sets the Application as request callback

Implements __call__:

Handles the user requests

show me the source!

t1_application_listen.py

what does Application.__call__ do?

Parses the URL

Decides which handler to use

and creates an instance of it

(each connection gets one)

_executes it

(passing any defined transforms to it -e.g. Gzip compression)

show me the source!

`t2_application_call.py`

what
does RequestHandler._execute do?

Calls the handler method

Checks XSRF cookie

Maybe closes the connection

show me the source!

`t3_request_handler__execute.py`

IOLOOP

CALLBACK TIMEOUT EVENT

what is the IOLoop?

Core of Tornado

Usable standalone or with WSGI

Used for server and client

Single instance per process

Small!

what does the IOLoop do?

Loops forever

Executes:

Callbacks (asap)

Timeouts (when due)

Events (when occoured)

what is an Event?

Something that **happened** on a socket (fd)

(e.g. a user opened a conneciton)

Applications define **handlers** for Events

how do I wait for an Event?

add_handler(fd, handler, events)

update_handler(fd, handler, events)

remove_handler(fd, handler)

"Notify me when I can READ or WRITE,
or when there is an ERROR"

IOLOOP

THE LOOP

IN FOUR STEPS

first process the Callbacks

Process Callbacks

They were scheduled by previous:

Callbacks

Event handlers

second process the Timeouts

For each Timeout:

Is it due now?

Run its callback

Calculate the time till next Timeout

third poll for Events

Poll timeout:

Callbacks? Then 0

Timeouts? Then time until the next Timeout

Neither? 1 hour

Here the IOLoop blocks

and fourth process the Events

For each (file descriptor, Event):

Call its handler

...and repeat the loop

THE EXAMPLE

WHAT IT REALLY DOES

show me the source!

`01_getting_started.py`

what does the example do?

Application.listen

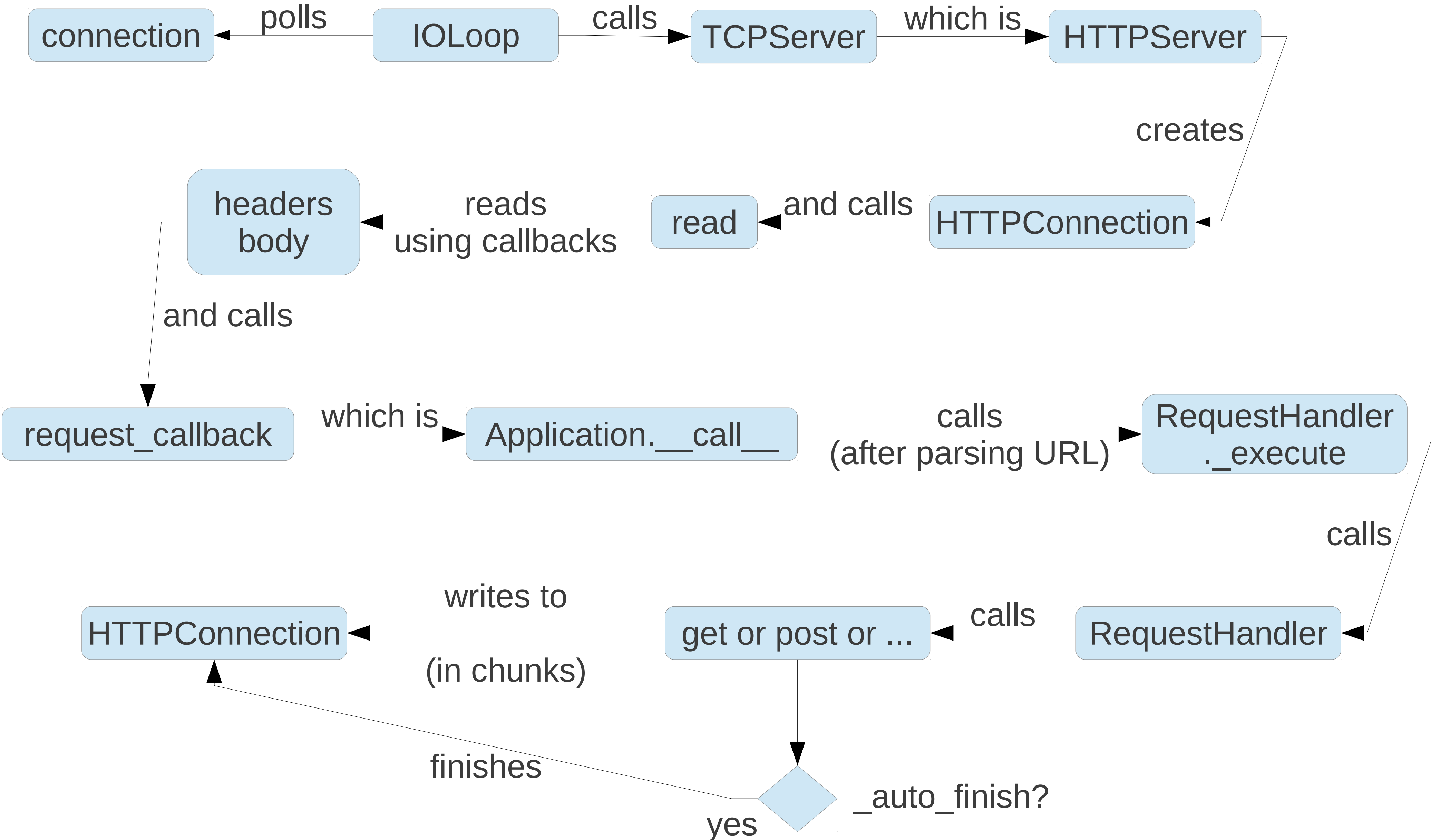
starts HTTPServer

calls IOLoop.add_accept_handler

(Application.__call__ will handle the ACCEPT event)

and when a client connects...

what ***does the example do?***



show me the source!

`t4_simple_ioloop.py`

SCHEDULED TASKS

how do we schedule a task?

Call me back **asap**

Ioloop.**add_callback**

Call me back **later**

Ioloop.**add_timeout**

Call me **often**

PeriodicCallback

show me the source!

02_scheduled_tasks.py

how does add_callback work?

Adds the callback to the list of callbacks.

(and wraps it in a threadlocal-like stack context)

what do you mean, threadlocal-like?

StackContext

Keeps track of the socket connection

Handles association between socket and Application classes

show me the source!

`t6_add_callback.py`

how does add_timeout work?

Pushes the timeout to the **heap** of timeouts.

(and wraps it in a threadlocal-like stack context too)

show me the source!

`t7_add_timeout.py`

how *do PeriodicCallbacks work?*

start

Schedules the next **timeout** to call **_run**

Marks the PeriodicCallback as **running**

stop

Removes the next **timeout**

Marks the PeriodicCallback as **stopped**

_run

Calls the **callback**

(unless **stop** was called)

show me the source!

`t8_periodic_callback.py`

what about Callback?

Indeed.

ASYNC HANDLERS

@ASYNCHRONOUS & _AUTO_FINISH

how does @asynchronous work?

Sets _auto_finish to False

(and does some Exception wrapping)

The connection remains open

after get, post...

Close it yourself

(whenever you want)

show me the source!

`03_fetch_async.py`

I put a callback on your callback

Nested callbacks
make ugly code.

what about Callback?

Indeed.

GENERATORS

how do I avoid callbacks?

Use Callback

(finally!)

and yield

Or Task

show me the source!

04_fetch_gen.py

YIELD POINTS

what is a YieldPoint?

Something you **yield**

Then **stuff** happens

what ***is a YieldPoint?***

Callback

Sends a **result** for a key

Wait

Waits till a **result** for a key arrives

WaitMany

Same as **Wait**, for many keys

what is a YieldPoint?

Task

Wait + Callback

(with an auto-generated key)

Multi

List of YeldPoints

how do we do async processing?

```
callback=(yield Callback(“key”))
```

When a result arrives, send it for the key "key"

how do we do async processing?

```
response=yield Wait(“key”)
```

When the result is sent, read it into `response`.

show me the source!

`04_fetch_gen.py`

show me the source!

`05_task.py`

show me the source!

`t9_yield_points.py`

WEBSOCKETS

how do we use websockets?

Extend WebSocketHandler

(instead of RequestHandler)

Implement on_message

show me the source!

`06_websocket.py`

how *do websockets work?*

Similar to **@asynchronous**

(the connection is kept open)

After writing, read for more

(asynchronously- see IOStream)

To Application, it looks like a RequestHandler

how does WebSocket work?

_execute

Accepts the connection

Decides the version of the protocol.

Instantiates a WebSocketProtocol class

how does WebSocketProtocol work?

accept_connection

Sends the required initial message

Reads the next message (asynchronously)

_write_response

Writes a response on the socket

Reads the next message (asynchronously)

show me the source!

`ta_websocket.py`

IOSTREAM

what does IOStream do?

Communicates with the socket

Asynchronous

Uses IOLoop Callbacks

how does IOStream work?

_add_io_state

“Notify me when I can READ or WRITE, or when ERROR”

schedules Callback for an event (READ, WRITE, …)

_handle_events

Can I read? Call _handle_read

Can I write? Call _handle_write

Handles errors

how does IOStream work?

_handle_read

Store data in read buffer

Call the read callback (_read_from_buffer)

_handle_write

Write data from the buffer into the socket (handling funny circumstances)

Call the write callback (if it exists)

how does IOStream work?

connect

socket.connect

_add_io_state(WRITE)

read

Set callback

Data in read buffer? Return it

Read buffer empty? _add_io_state(READ)

write

Add data to write buffer

_add_io_state(WRITE)

how *do I use IOStream directly?*

read_until_regex

read_until

read_bytes

read_until_close

All take a callback

how do I use streaming callbacks?

read_bytes

read_until_close

Param: streaming_callback

Data is sent to callback as it arrives

show me the source!

`0a_async_callback.py`

DATABASE

how do I talk to a database?

database.connection

query("SQL")

Returns an iterable

Very simple

show me the source!

`07_db.py`

NOT ASYNC!

ASYNCMONGO

what is asyncmongo?

Asynchronous MongoDB client

Uses Tornado's IOLoop

how do I use asyncmongo?

asyncmongo.Client

db.**find**

takes a **callback** parameter

show me the source!

`08_mongo.py`

how *does asyncmongo work?*

Implements a Connection

Many: ConnectionPool

Sends data via Tornado's IOStream

Commands send via Cursor

Cursor.send_message

Uses Connection to communicate asynchronously

can we write our own asyncmysql?

Difficult

C driver has **blocking** calls

mysql_query

mysql_store_result

mysql_use_result

Alternative

Use Twisted's **txMySQL** with tornado.platform.twisted

Slower

Q&A

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source: uncertain (sorry!)