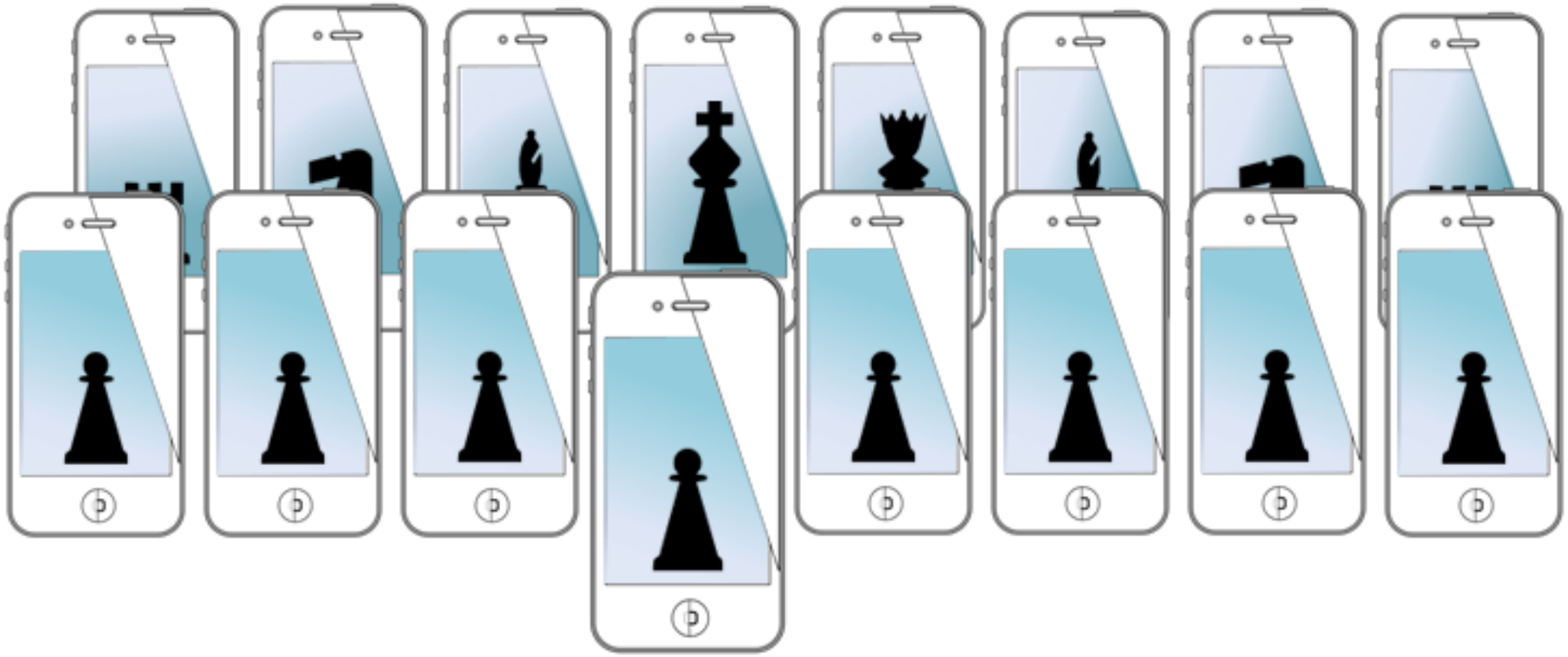
MOBILE SENSING LEARNING



CS5323 & 7323

Mobile Sensing and Learning

tornado, pymongo, and http requests

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course logistics/agenda

- start to think about the final project you want to propose
- agenda:
  - continue tornado
  - pymongo

review: tornado example

- a very simple web server
- what is a get request?
  - a request for data from the server!
  - URL contains any na

```
import tornado.ioloop
import tornado.web

class MainHandler(tornado.web.RequestHandler):
    def get(self):
        self.write("Hello, MSLC World")

application = tornado.web.Application([
    (r"/", MainHandler),
])

if __name__ == "__main__":
    application.listen(8888)
    tornado.ioloop.IOLoop.instance().start()
```

new class, inherit from RequestHandler

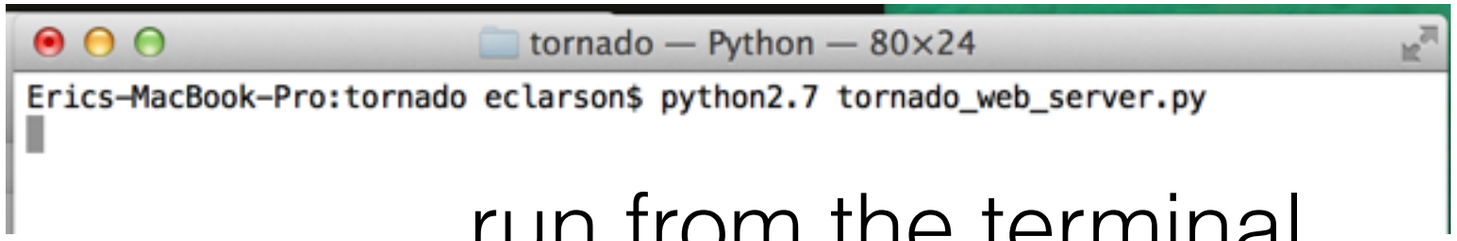
override get request handling

tuple with URL and handler

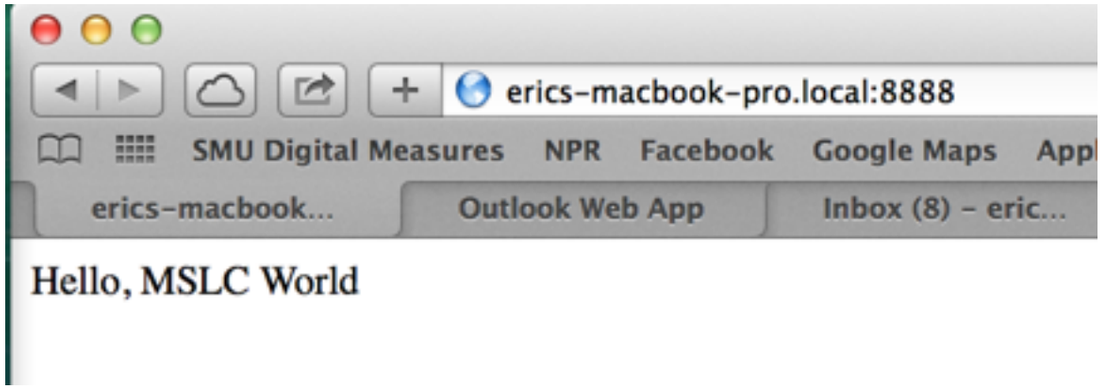
listen on 8888

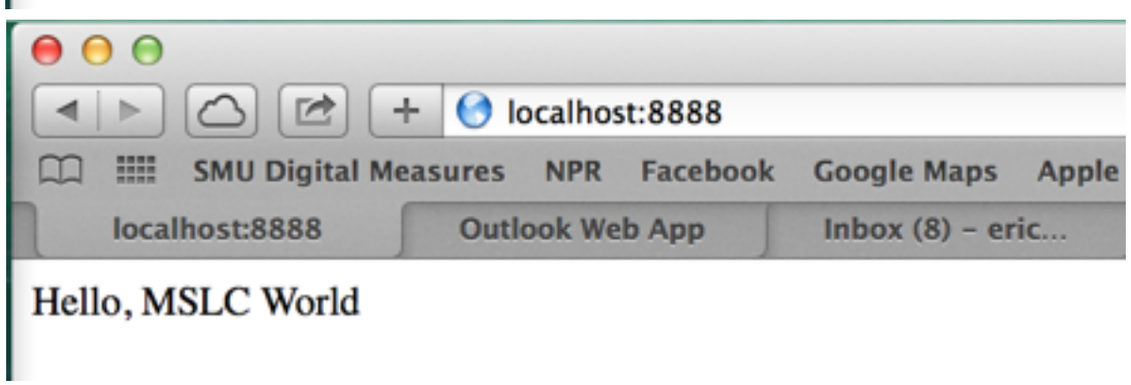
start the IO loop

review: tornado example



run from the terminal





tornado: get request

- get requests with arguments

```
class GetExampleHandler(tornado.web.RequestHandler):
    def get(self):
        arg = self.get_argument("arg", None, True) # get arg
        if arg is None:
            self.write("No 'arg' in query")
        else:
            self.write(str(arg)) # spit back out the argument
```

- how many connections?
  - one front end of Tornado~3,000 concurrent
  - with nginx and four instances of tornado
    - anywhere from 9,000-17,000
  - caveat: as long as you do not block the thread!

blocking example

```
import tornado.ioloop
import tornado.web
import tornado.httpclient

flickrSearch = ‘https://www.flickr.com/services/rest/?
method=flickr.photos.getRecent&api_key=API_KEY'

class SearchHandler(tornado.web.RequestHandler):
   def get(self):
    self.write("Searching on Flickr!”)

    http_client = tornado.httpclient.HTTPClient()
    response = http_client.fetch(flickrSearch)

    self.write(" and we got a response! \n\n")
    self.write(response.body.replace("<", " "))
```

http://www.slideshare.net/moret1979/nginx-tornado-17k-reqs?next_slideshow=1

non-blocking example

```
import tornado.ioloop
import tornado.web
import tornado.httpclient
```

Run the blocking code on another thread. When asynchronous libraries are not available, `concurrent.futures.ThreadPoolExecutor` can be used to run any blocking code on another thread. This is a universal solution that can be used for any blocking function whether an asynchronous counterpart exists or not:

```
class ThreadPoolHandler(RequestHandler):
    async def get(self):
        for i in range(5):
            print(i)
            await IOLoop.current().run_in_executor(None, time.sleep, 1)
```

allow return to IOLoop **if supported** by function

https://www.tornadoweb.org/en/stable/faq.html

sub-classing application

```
# tornado imports
import tornado.web
from tornado.web import HTTPError
from tornado.httpserver import HTTPServer
from tornado.ioloop import IOLoop
from tornado.options import define, options

# Setup information for tornado class
define("port", default=8000,
       help="run on the given port", type=int)

CUSTOM CLASSES AND DEFINITIONS

def main():
    '''Create server, begin IOLoop
    '''
    tornado.options.parse_command_line()
    http_server = HTTPServer(Application(), xheaders=True)
    http_server.listen(options.port)
    IOLoop.instance().start()

if __name__ == "__main__":
    main()
```

We need to write the Application class to meet desired functionality

sub-classing application

```
# Utility to be used when creating the Tornado server
# Contains the handlers and the database connection
class Application(tornado.web.Application):
    def __init__(self):
        '''Store necessary handlers,
           connect to database
        '''

        handlers = [(r"/[/]?",
                     BaseHandler),
                    (r"/Test[/]?",
                     examplehandlers.TestHandler),
                    (r"/DoPost[/]?",
                    MORE HANDLERS AND URL PATHS
                    ]

        settings = {'debug':True}
        tornado.web.Application.__init__(self, handlers, **settings)

        SETUP DATABASE

    def __exit__(self):
        self.client.close()
```

I wrote the base handler for you

handlers should subclass it

more to come in a moment

post versus get

Compare GET vs. POST

The following table compares the two HTTP methods: GET and POST.

	GET	POST
BACK button/Reload	Harmless	Data will be re-submitted (the browser should alert the user that the data are about to be re-submitted)
Bookmarked	Can be bookmarked	Cannot be bookmarked
Cached	Can be cached	Not cached
Encoding type	application/x-www-form-urlencoded	application/x-www-form-urlencoded or multipart/form-data. Use multipart encoding for binary data
History	Parameters remain in browser history	Parameters are not saved in browser history
Restrictions on data length	Yes, when sending data, the GET method adds the data to the URL; and the length of a URL is limited (maximum URL length is 2048 characters)	No restrictions
Restrictions on data type	Only ASCII characters allowed	No restrictions. Binary data is also allowed
Security	GET is less secure compared to POST because data sent is part of the URL Never use GET when sending passwords or other sensitive information!	POST is a little safer than GET because the parameters are not stored in browser history or in web server logs
Visibility	Data is visible to everyone in the URL	Data is not displayed in the URL

credit: w3schools.com

BaseHandler Demo

- check out what it does
  - built for analyzing and writing back json
  - implements both get and post requests
  - put this in the main python file to access these:

```
# custom imports
from basehandler import BaseHandler
import examplehandlers
```

post versus get

- if we are sending data to a server for processing
  - of unknown length
  - of many different formats
  - possibly in a multi-part file
- should we use post or get requests?
- why?

post requests

- identical handling code in python
- in our implementation, return json

convenience function written for you!

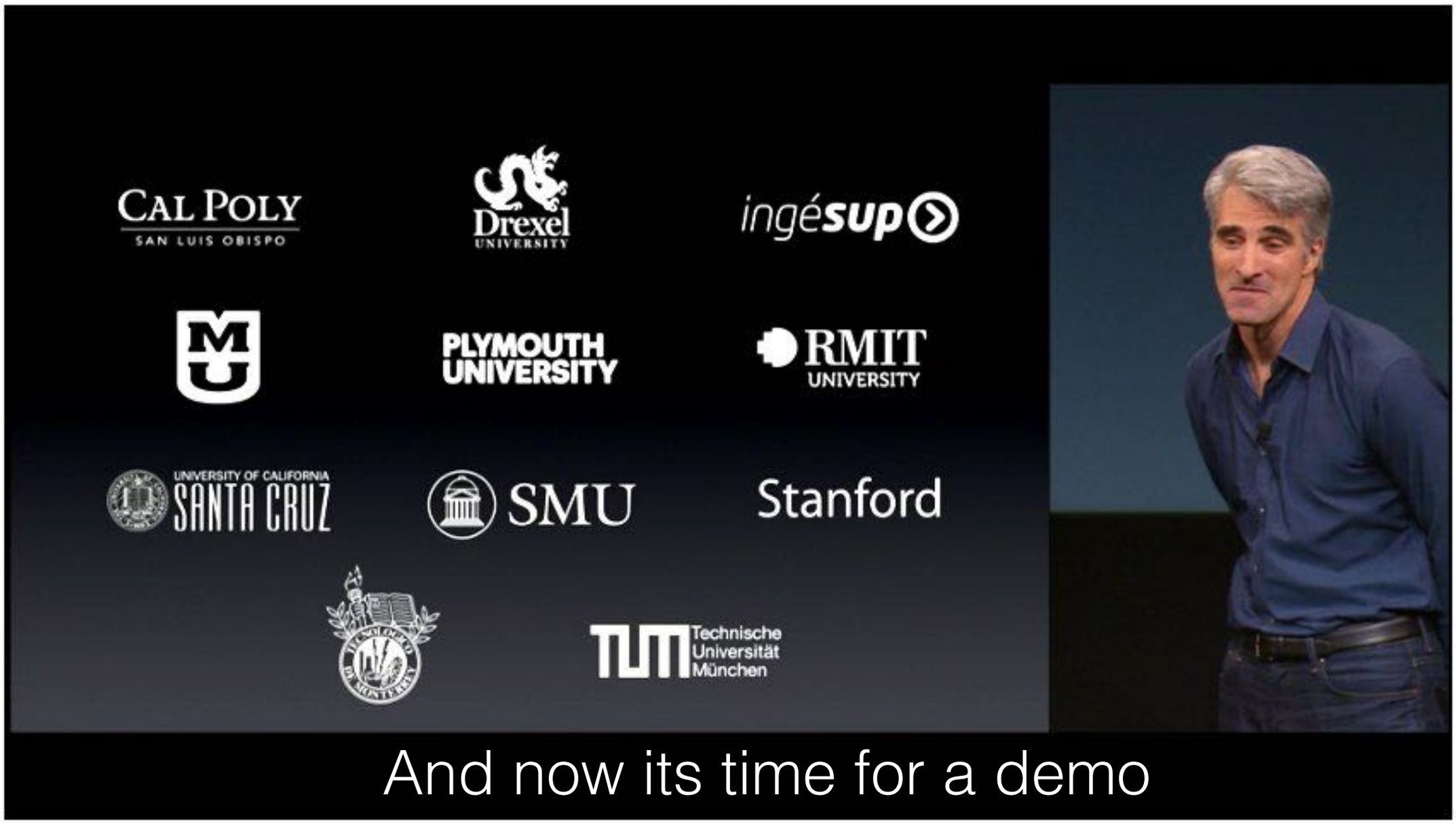
```
class PostHandler(BaseHandler):
  def get(self):
   '''respond with arg1*2
   '''
   arg1 = self.get_float_arg("arg1",default="none");
   self.write("Get from Post Handler? " + str(arg1*2));

  def post(self):
   '''Respond with arg1 and arg1*4
   '''
   arg1 = self.get_float_arg("arg1",default=1.0);
   self.write_json({"arg1":arg1,"arg2":4*arg1});
```

convenience function written for you!

tornado examples

ifconfig | grep "inet "

- with everything, except the database
- note that quick database queries are “okay” to block on



mongodb

- hu**mongo**us data
- NoSQL database (vs relational database)
  - its a document database
- everything stored as a document
  - more or less json
  - key: value/array
- schema is dynamic
  - the key advantage of NoSQL

mongodb install

- install it
- http://www.mongodb.org/downloads
- to run single server database:
  - make a directory for the db
    - like `data/db`
  - run mongodb
    - `./mongod --dbpath "<path to db>"`
  - its running! localhost
- you can also **run as a service** (`./mongo`)

make sure this exists!

mongodb

- a document, as stated by mongodb

Document Database

A record in MongoDB is a document, which is a data structure composed of field and value pairs. MongoDB documents are similar to JSON objects. The values of fields may include other documents, arrays, and arrays of documents.

```
{
  name:  "sue",                          ← field: value
  age: 26,                               ← field: value
  status: "A",                           ← field: value
  groups: [ "news", "sports" ]           ← field: value
}
```

A MongoDB document.

The advantages of using documents are:

- Documents (i.e. objects) correspond to native data types in many programming languages.
- Embedded documents and arrays reduce need for expensive joins.
- Dynamic schema supports fluent polymorphism.

docs and collections

Database: MSLC_creations

limit on size of each document:
16MB

apps_collection

```
{
  app: "mongoApp",
  users: 100005,
}

{
  app: “StepCount",
  users: 45,
  rating: 2.6,
}
....

{
  app: “Trench",
  users: 4050000,
  rating: 5,
}
```

teams_collection

```
{
  team: "mongo",
  members: [ "Eric", “Ringo”, “Paul” ],
  numApps: 21,
  website: “teammongo.org",
}
{
  team: “ran off",
  members: [ "John", “Yoko” ],
  website: “flewthecoop.org",
}
....
{
  team: “21 Pilots",
  members: [ "Tyler", “Nick” ],
  numApps: 4,
  website: “RollingStone.com”,
}
```

pymongo

- python wrapper for using mongo db

```
client  = MongoClient() # localhost, default port
db = client.some_database # access database
```

create this database, if it does not exist

```
collect = client.some_database.some_collection # access a collection
```

relational equivalent of a table

create this database, if it does not exist

nothing is **created** until the first insert!!!

```
db.collection_names()
[u'system.indexes', u'some_collection']
```

get collections

pymongo (add data)

- insertion

```
dbid = db.some_collect.insert(
        {“key1”:values,"key2":more_values,
         “coolkey”:with_cool_values}
);
```

unique key, _id

- update

```
db.some_collect.update({"thiskey":keyValue},
        {  "$set": {"keyToSet":valueToSet}  },
        upsert=True)
```

where ever this key is…

equal to this

set

this key to this value

insert if it does not exist

pymongo (get data)

- find one datum in database

```
a = db.some_collect.find_one(sort=[("sortOnThisKey", -1)])
newData = float( a['sortOnThisKey'] );
```

its a list!

access the result

sort with this key

last element

- loop through all results

```
f=[];
for a in db.some_collect.find({"keyIWant":valueOfKeyIWant}):
    f.append( str(a['keyToGrabDataWith']) )
```

- lots of advanced queries are possible

https://api.mongodb.org/python/current/

teams example

```
>>> from pymongo import MongoClient
>>> client = MongoClient()

>>> db = client.some_database
>>> collect1 = db.some_collection
>>> collect1.insert({"team":"TeamFit","members":["Matt","Mark","Rita","Gavin"]})
ObjectId('53396a80291ebb9a796a8af1')

>>> db.collection_names()
[u'system.indexes', u'some_collection']

>>> db.some_collection.find_one()
{u'_id': ObjectId('53396a80291ebb9a796a8af1'), u'members': [u'Matt', u'Mark', u'Rita', u'Gavin'],
u'team': u'TeamFit'}

>>> collect1.insert({"team":"Underscore","members":["Carly","Lauryn","Cameron"]})
ObjectId('53396c80291ebb9a796a8af2')

>>> db.some_collection.find_one()
{u'_id': ObjectId('53396a80291ebb9a796a8af1'), u'members': [u'Matt', u'Mark', u'Rita', u'Gavin'],
u'team': u'TeamFit'}

>>> db.some_collection.find_one({"team":"Underscore"})
{u'_id': ObjectId('53396c80291ebb9a796a8af2'), u'members': [u'Carly', u'Lauryn', u'Cameron'],
u'team': u'Underscore'}
```

bulk operations

```
from pymongo import MongoClient

client = MongoClient()
db=client.some_database
collect1 = db.some_collection

insert_list = [{"team":"MCVW","members":["Matt","Rowdy","Jason"]},
               {“team":"CHC", "members":["Hunter","Chelsea","Conner"]}]

obj_ids=collect1.insert(insert_list)
```

```
for document in collect1.find({"members":"Matt"}):
  print(document)
```

```
{u'_id': ObjectId('53396a80291ebb9a796a8af1'), u'members': [u'Matt', u'Mark', u'Rita', u'Gavin'], u'team': u'TeamFit'}
{u'_id': ObjectId('53397331291ebb9afdd3cd2f'), u'members': [u'Matt', u'Rowdy', u'Jason'], u'team': u'MCVW'}
```

```
document = collect1.find_one({"members":"Matt","team":"MCVW"})
print (document)
```

```
{u'_id': ObjectId('53397331291ebb9afdd3cd2f'), u'members': [u'Matt', u'Rowdy', u'Jason'], u'team': u'MCVW'}
```

mongodb and binary data

- want to store binary data more than 16MB?
- use `gridfs`, its real simple
- use `put()` and `get()` instead of

can also add metadata for easier search

wrap db in GridFS object

```
> from pymongo import MongoClient
> import gridfs
> db = MongoClient().gridfs_ex
> fs = gridfs.GridFS(db)

> a = fs.put("hello world”)
> fs.get(a).read()
'hello world'
```

```
> b = fs.put("hello world”,
      filename="foo", bar="baz")
> out = fs.get(b)
> out.read()          'hello world'
> out.filename          u'foo'
> out.bar               u'baz'
> out.upload_date
datetime.datetime(...)
```

put/read used like file object id, “a” is like file pointer

/current/examples/gridfs.html

mongodb and binary data

- want to store binary data more than 16MB?
- use `gridfs`, its real simple
- use `put()` and `get()` instead of `insert()` and `find()`
  - `get()` returns a "file- ... d in chunks

search using metadata

```
for grid_out in fs.find({"filename": "foo.txt"},
                        no_cursor_timeout=True):
    data = grid_out.read()

most_recent_three = fs.find().sort(
                    "uploadDate", -1).limit(3)
```

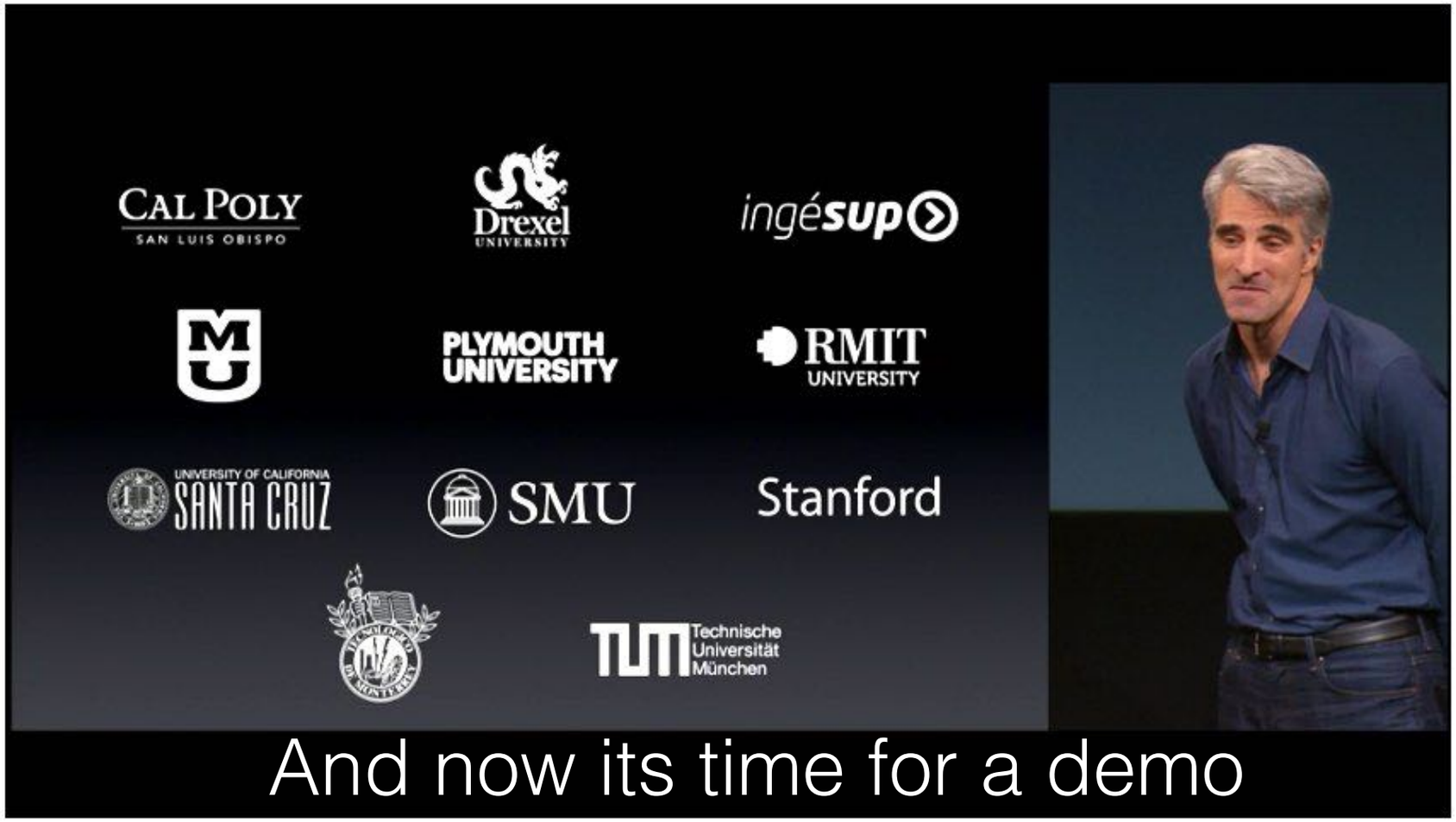
get three most recent files

http://api.mongodb.com/python/current/examples/gridfs.html

mongodb + tornado

ifconfig | grep "inet "

- demo:
  - store data inside mongodb with each http request



and add ***something*** to it