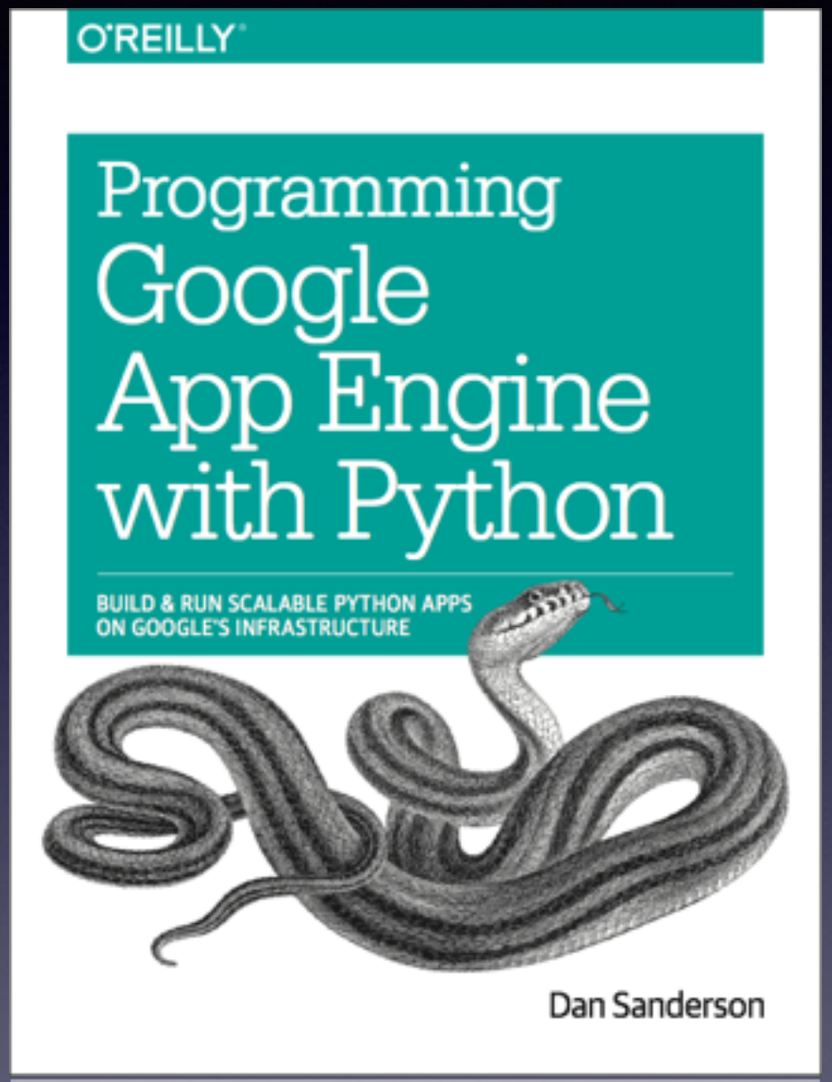
# Building Scalable Web Apps with Python and Google Cloud Platform

Dan Sanderson, April 2015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Google
App Engine
with Python
BUILD & RUN SCALABLE PYTHON APPS
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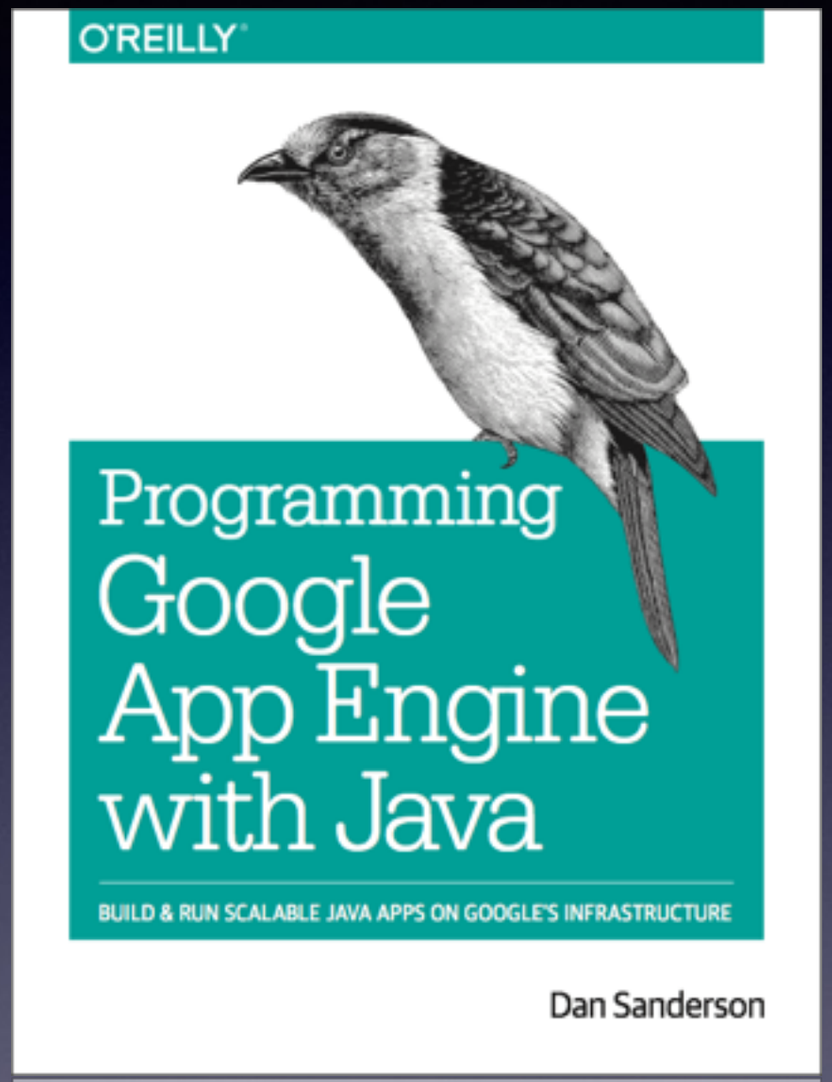
Dan Sanderson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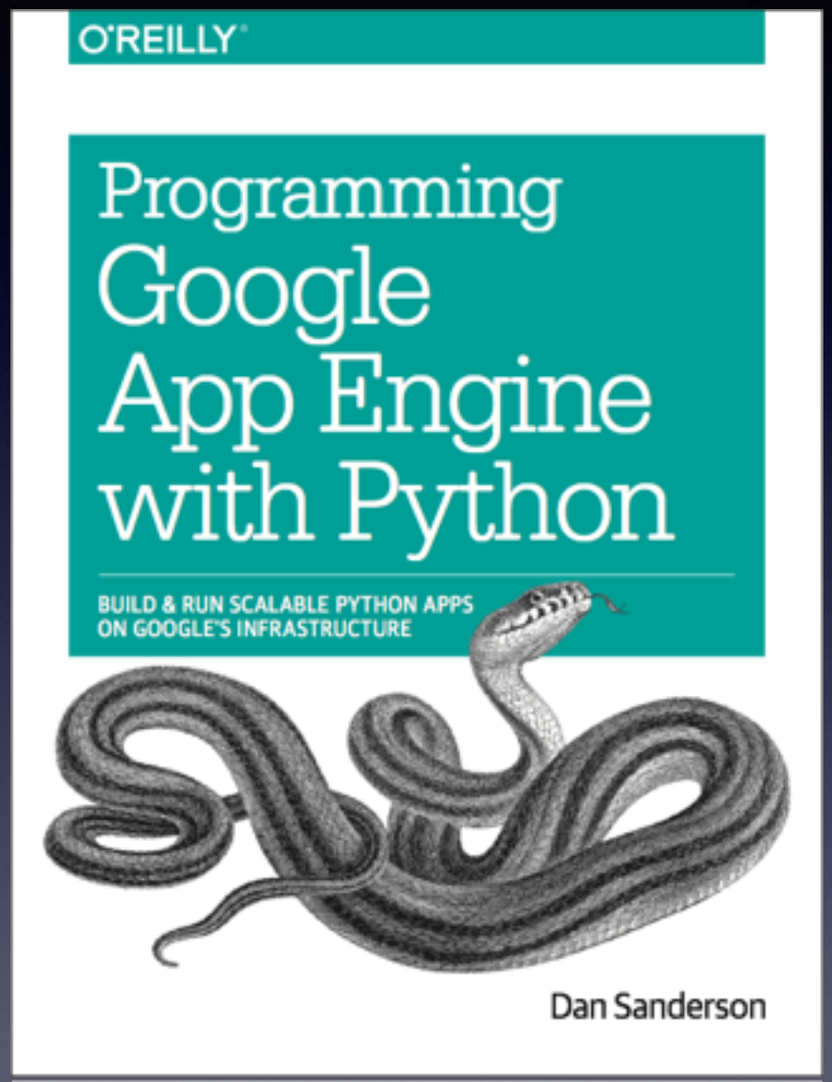


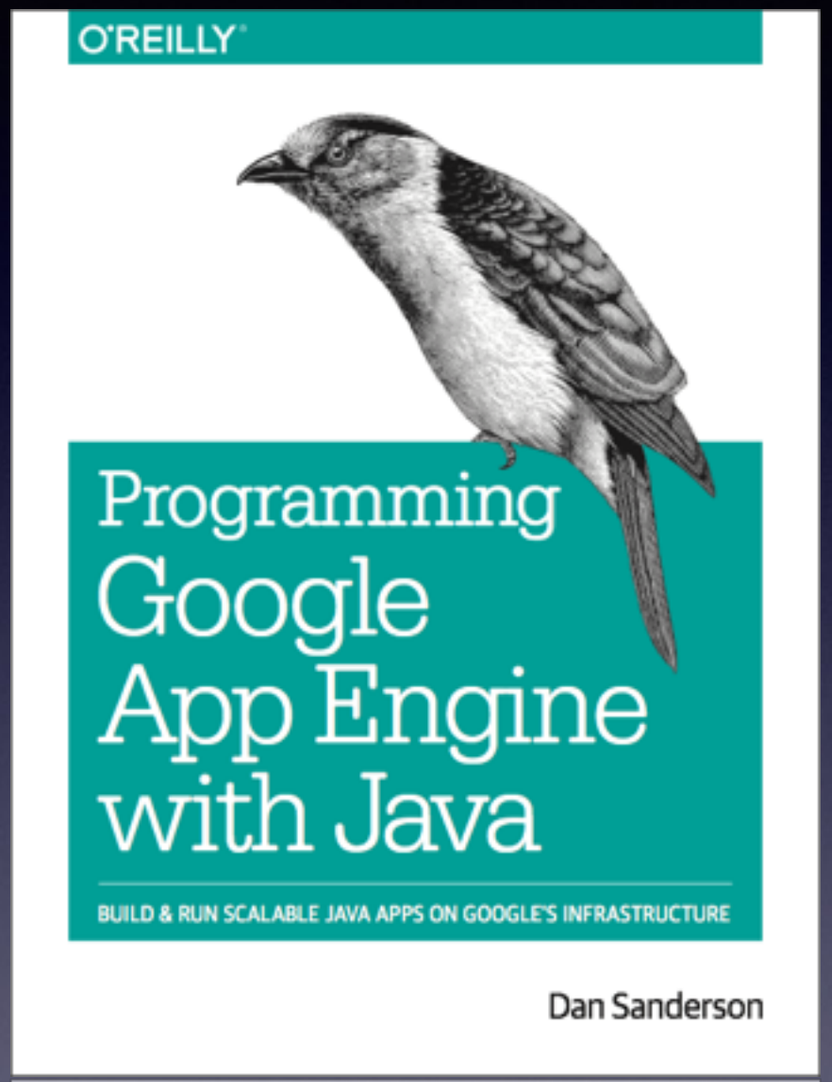


**June 2015**

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# Agenda

- Introducing GCP & GAE
- Starting a project with gcloud and Cloud Console
- Understanding request handlers and instances
- Using Python libraries and frameworks
- Using Flask
- Testing
- Deploying, monitoring, debugging

# Google Cloud Platform

- Computation
- Networking
- Data storage
- Data analysis
- Deployment, monitoring, source control, access control, services…
- Scaling infrastructure

# Google Cloud Platform

- Web applications and services
- Gaming and mobile backends
- Scientific computing
- Video and graphics rendering

# Google Cloud Platform

*Computation and networking*

Google App Engine (GAE)

Google Container Engine (GKE)

Google Compute Engine (GCE)

# Google Cloud Platform

*Computation and networking*

Managed VMs *(beta)*

# Google Cloud Platform

*Data storage and analysis*

Google
Cloud
Datastore

Google
Cloud
SQL

Google
Cloud
Storage

# Google App Engine

- Scalable serving infrastructure optimized for web apps
- High level of abstraction
- Streamlined, sandboxed, language-specific
- Scalable services
  - (Some services specific to App Engine)

# Google App Engine

- Easy to deploy, easy to manage
- Pay only for what you use
  - Free tier, daily allocation
- Preview launched in 2008 as Python-only; Java, Go, PHP added later

# Setting up a development environment

- Cloud SDK: http://cloud.google.com/sdk/
  - The gcloud command
  - Python 2.7
  - git
  - pip, virtualenv

# gcloud

- Authentication
- Project set-up
- Component installation and management
- Service-specific tools

# gcloud

- App Engine SDK, Python libraries
- App Engine development server
  - Development server console
- App Engine deployment

# Cloud Console

https://console.developers.google.com/

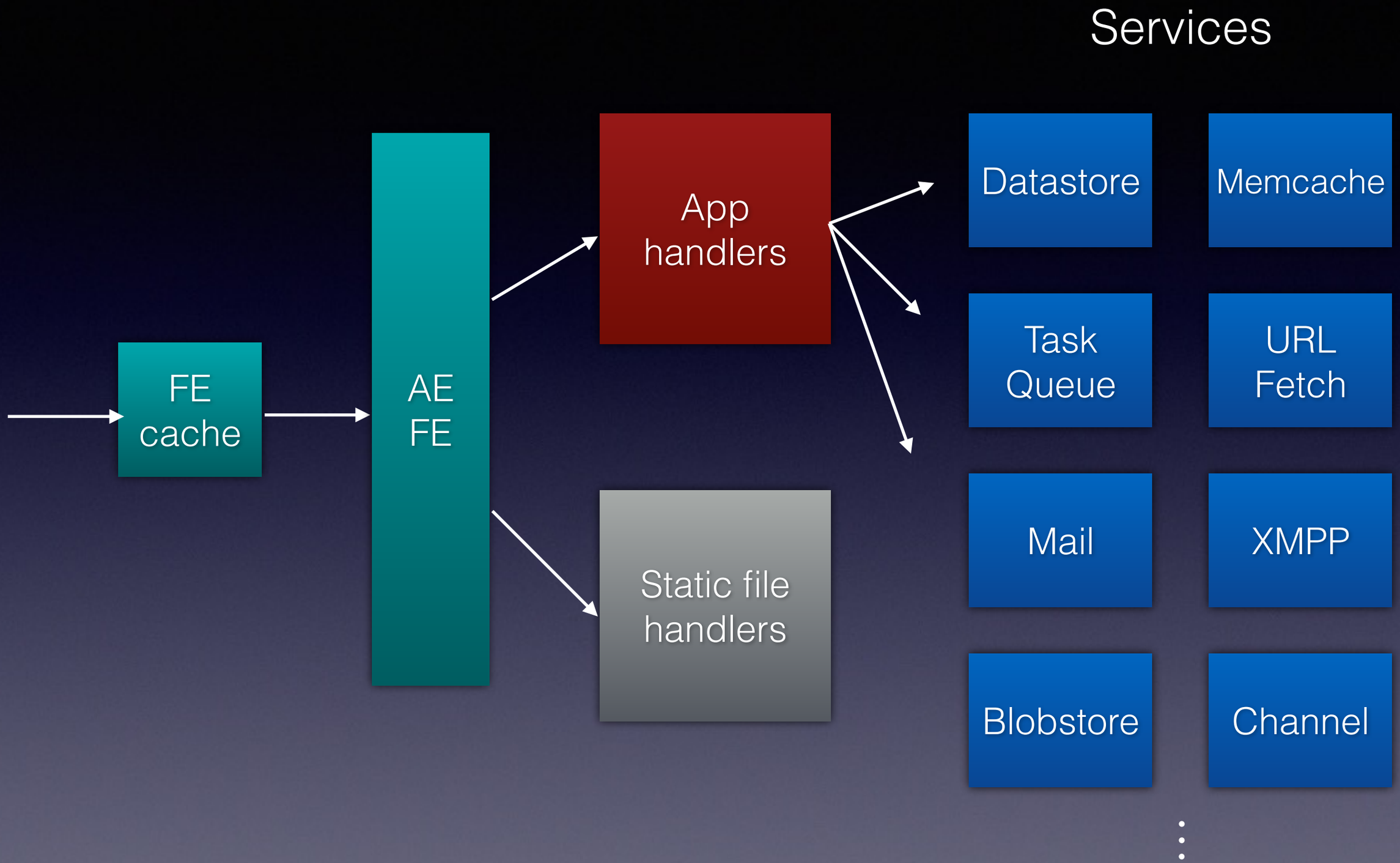
# *Demo*

# gcloud

- gcloud auth login
- gcloud init <project>
  - creates .gcloud file, clones git repo
- gcloud app run app.yaml

  *(gcloud preview app …)*
- gcloud app deploy app.yaml

# Instances and Request Handlers


Services
FE cache
AE FE
App handlers
Static file handlers
Datastore
Memcache
Task Queue
URL Fetch
Mail
XMPP
Blobstore
Channel

# Instances and Request Handlers

- Request handlers are ephemeral:
  now you see them, now you don’t
- Can’t rely on data persistence between requests
- Use storage services to persist data

Request handler

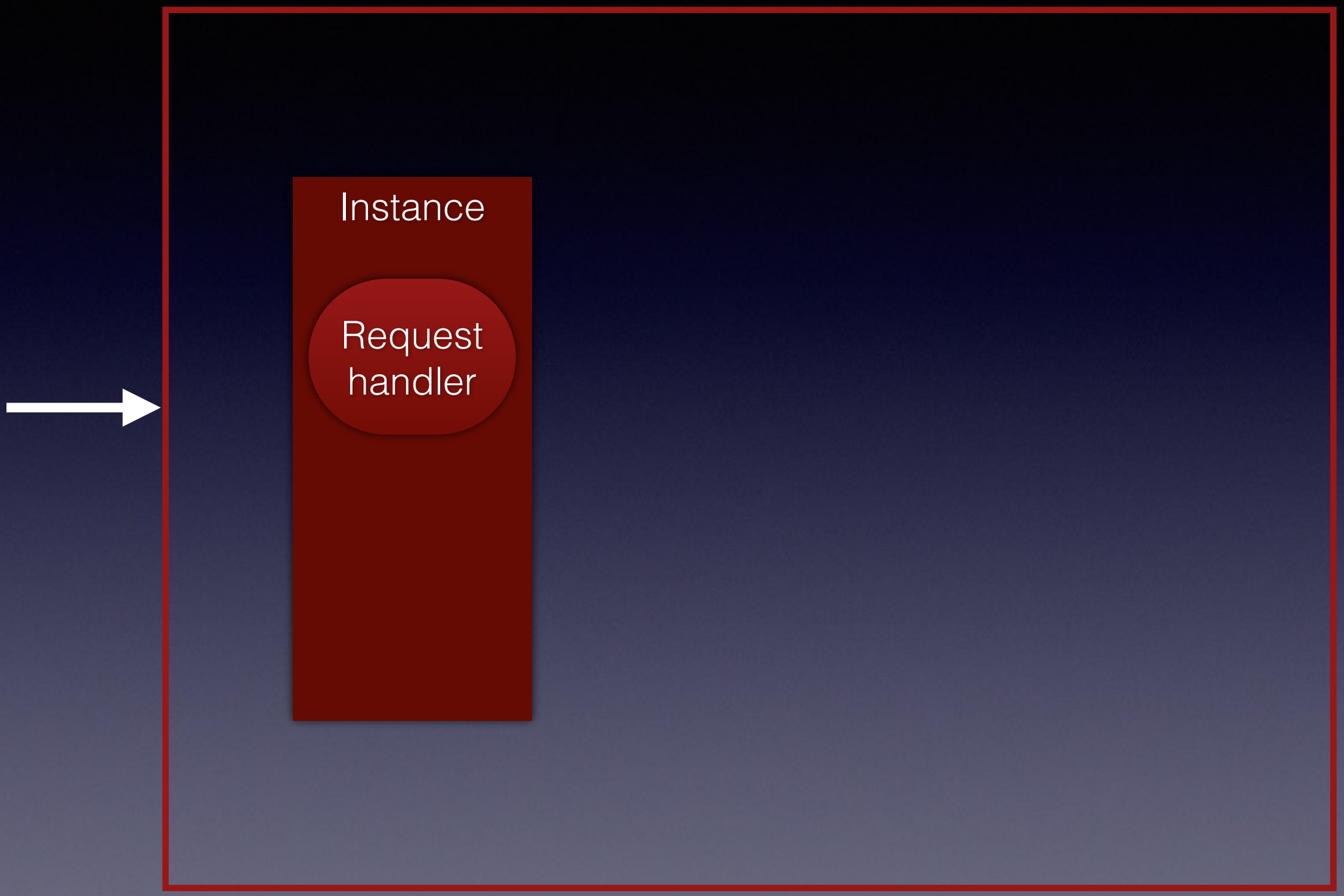
Request handler

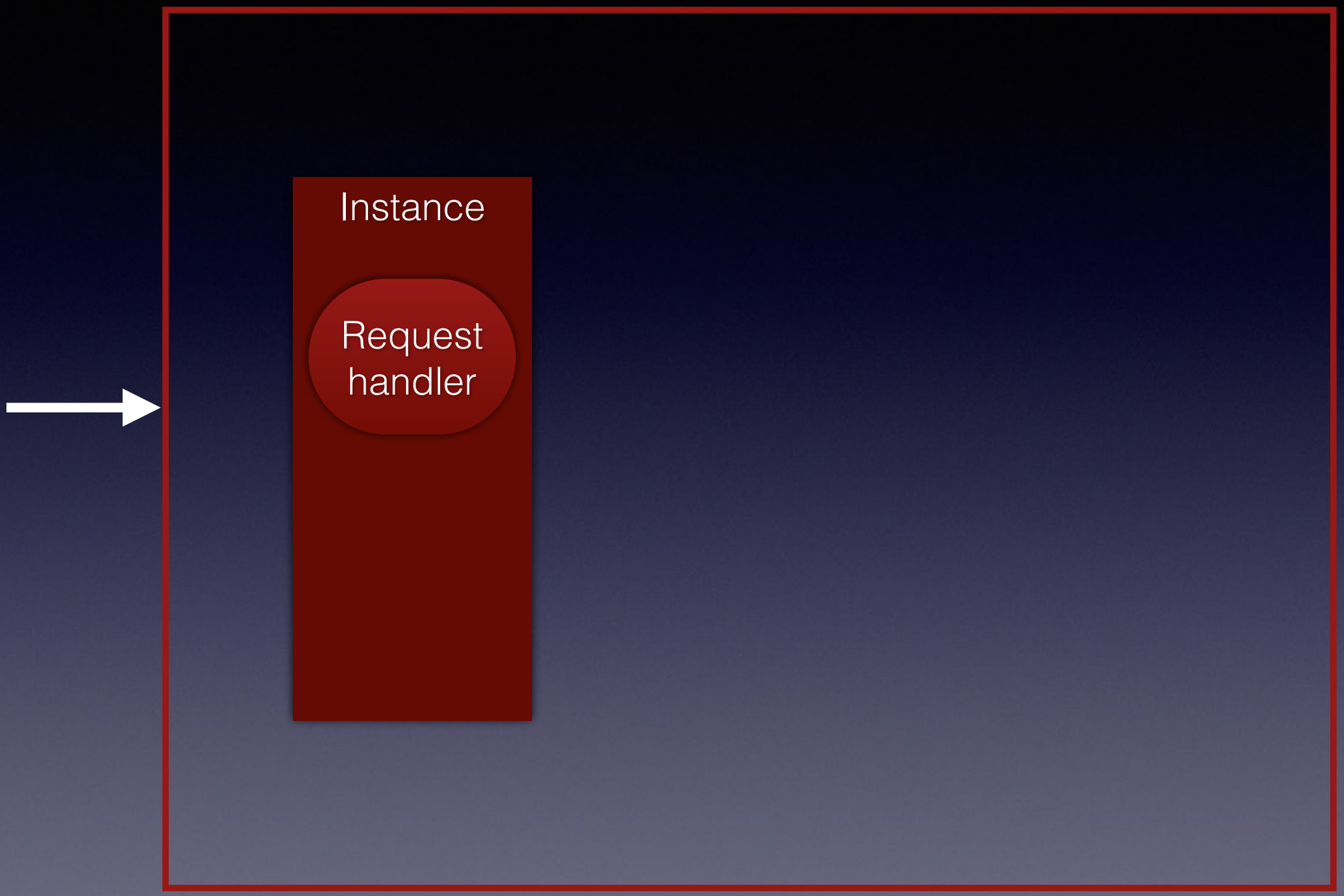
Request handler

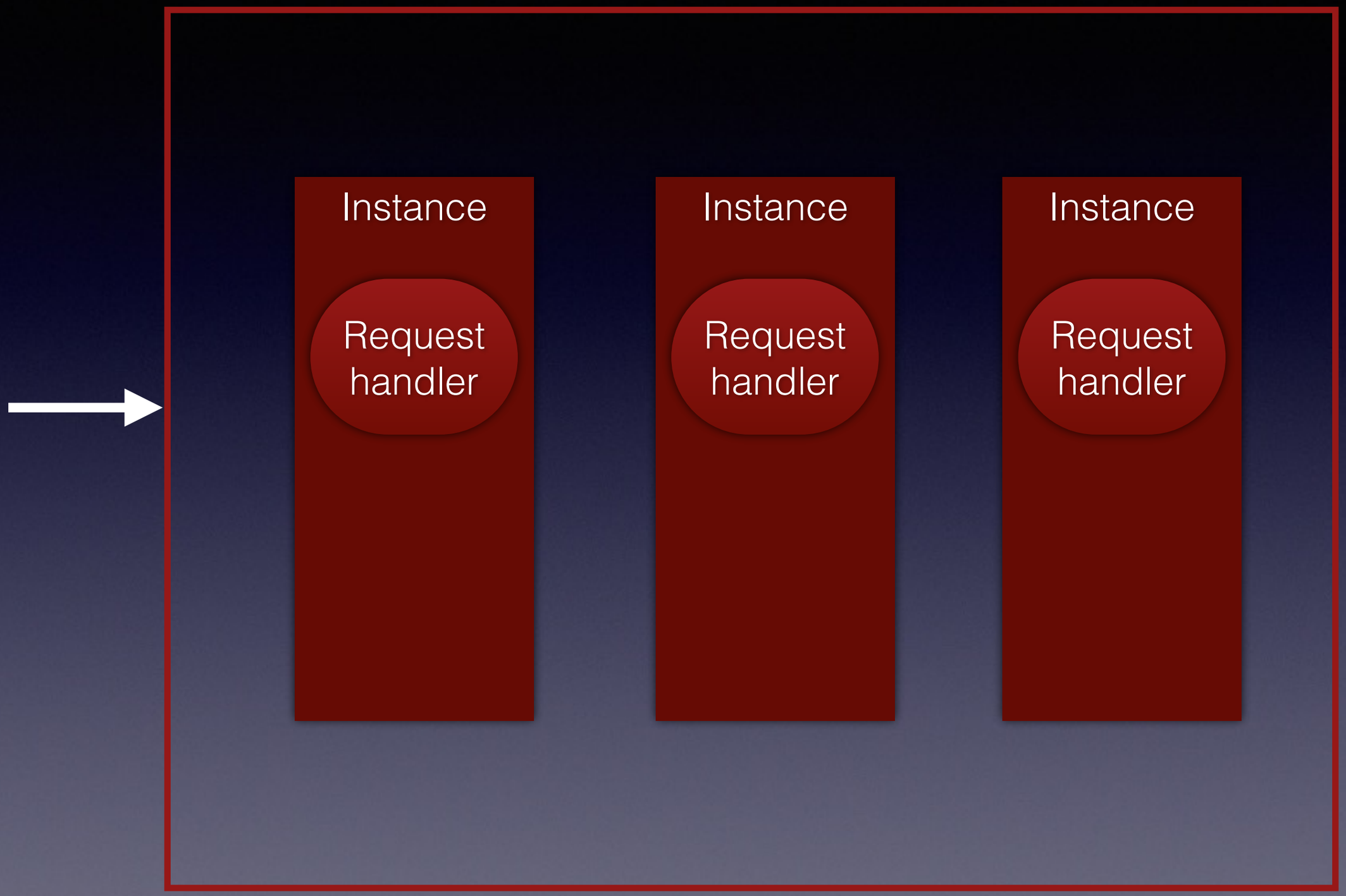
Request handler

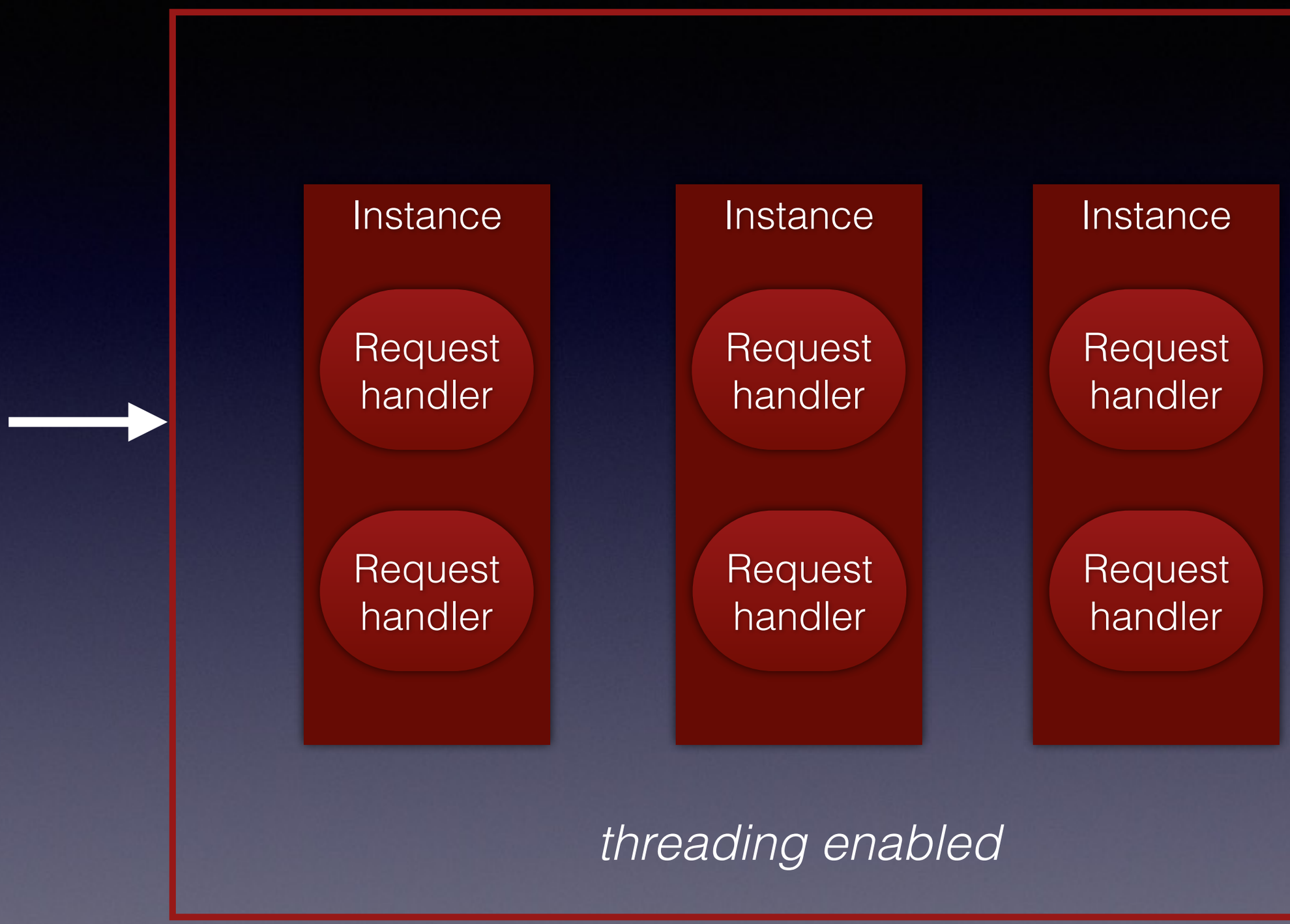
# Instances and Request Handlers

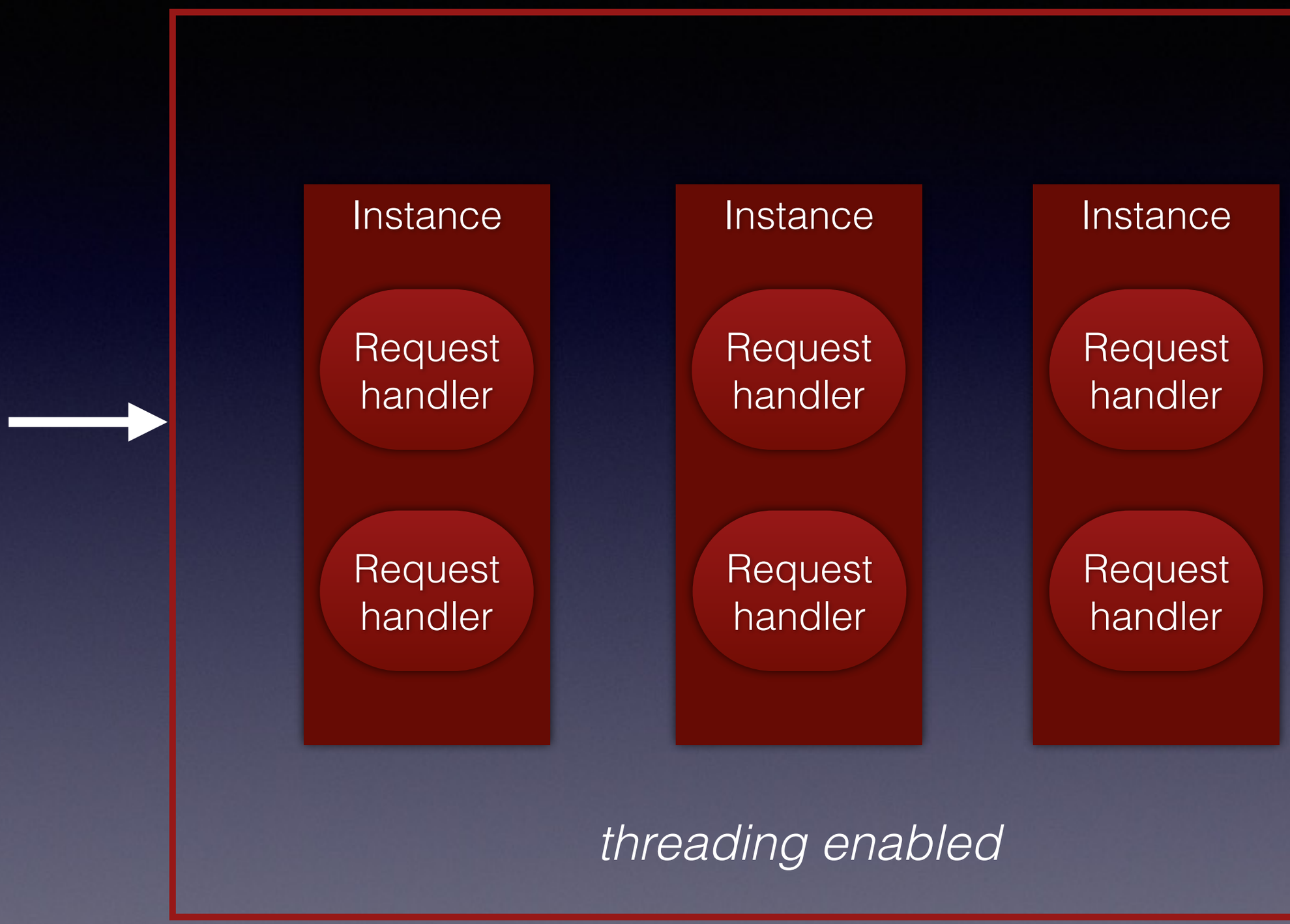
- In practice, app initialization is expensive
- An app instance is long running, can handle multiple requests in its lifetime
- Environment initialized; instance memory loaded
- Started and stopped as needed
- Can’t rely on a single user’s session to go to the same instance


Instance
Request handler


Instance
Request handler


Instance
Request handler
Instance
Request handler
Instance
Request handler
...


Instance
Request handler
Request handler
Instance
Request handler
Request handler
Instance
Request handler
Request handler
...
threading enabled


Instance
Request handler
Request handler
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Request handler
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Request handler
Request handler
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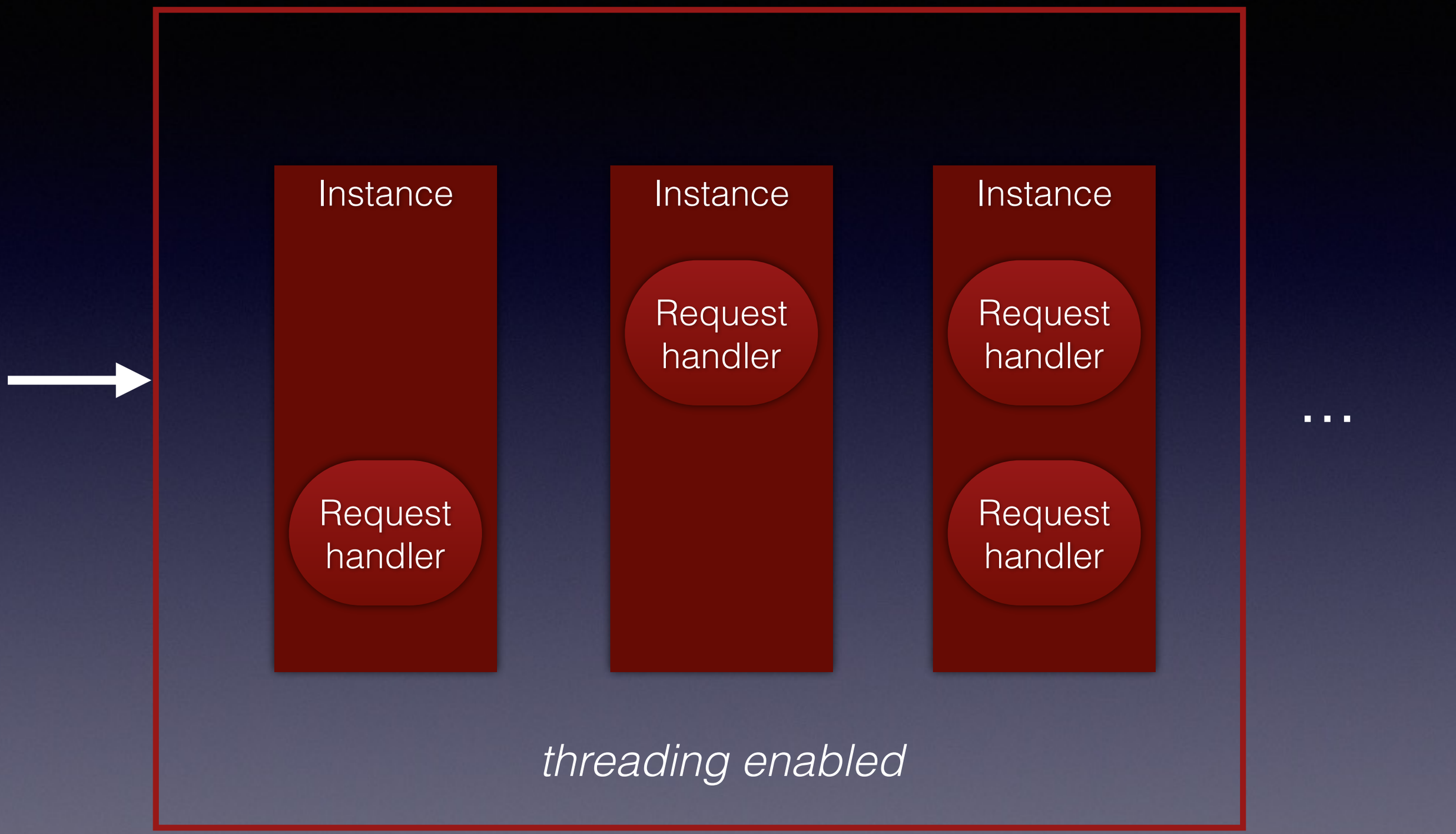
threading enabled


Instance
Request handler
Instance
Request handler
Instance
Request handler
Request handler
...
threading enabled

# The Python Runtime Environment

# Runtime Environment

- Sandboxing
  - Data isolation
  - Performance isolation
  - Python 2.7: app code must be Python only
- Sandboxing → scalability

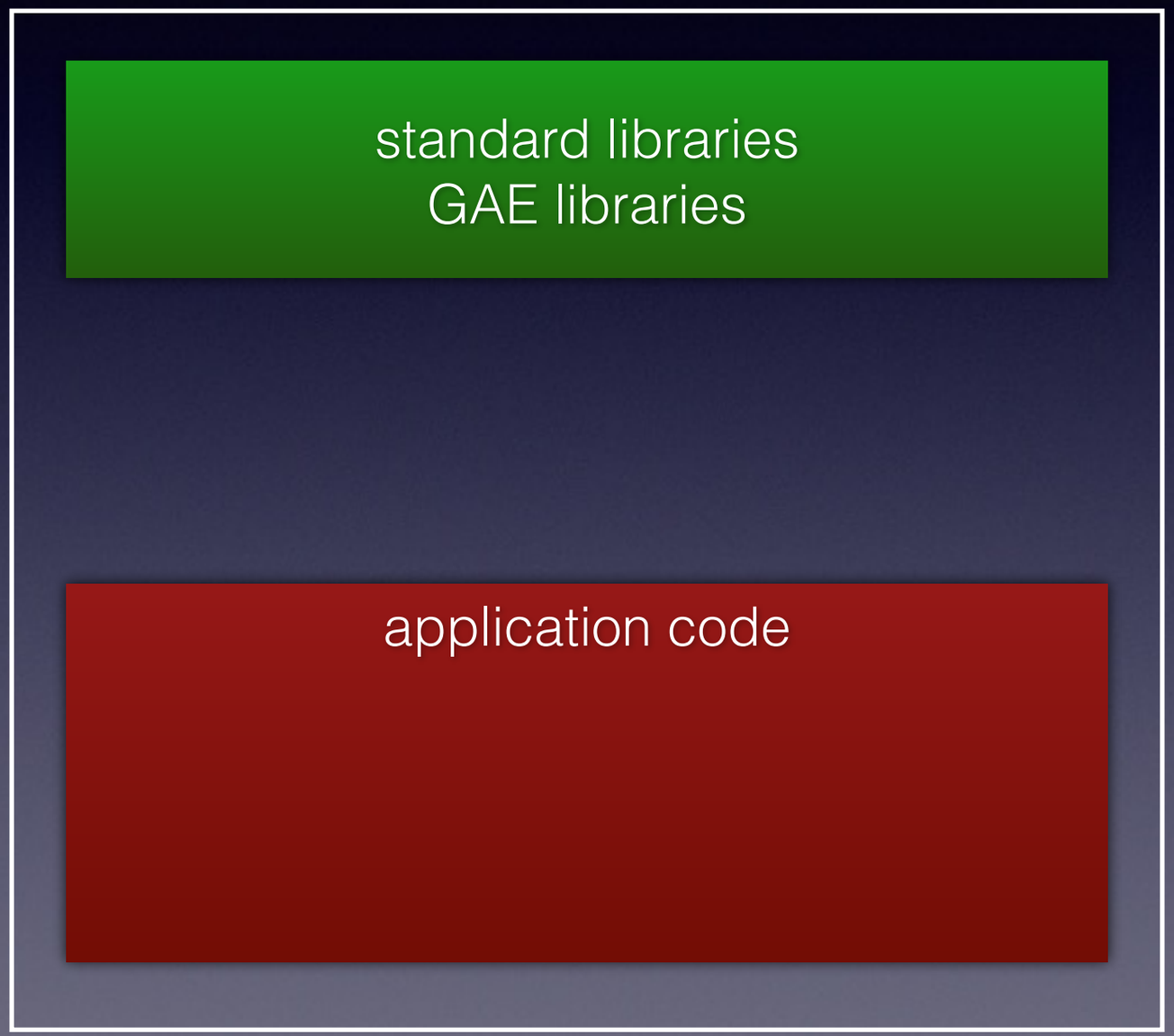
# Runtime Environment

- Limits
  - Request timer
  - Restricted access to filesystem, sockets
  - More performance isolation: RAM, CPU
  - Data sizes: requests, responses, API calls, storage objects
- Limits → scalability

# Python Libraries

- Runtime includes standard lib and GAE libs automatically
- App code must be “pure Python”
  - Can add “pure Python” libs to your app code
- App config can request specific libs be added

# Python Libraries

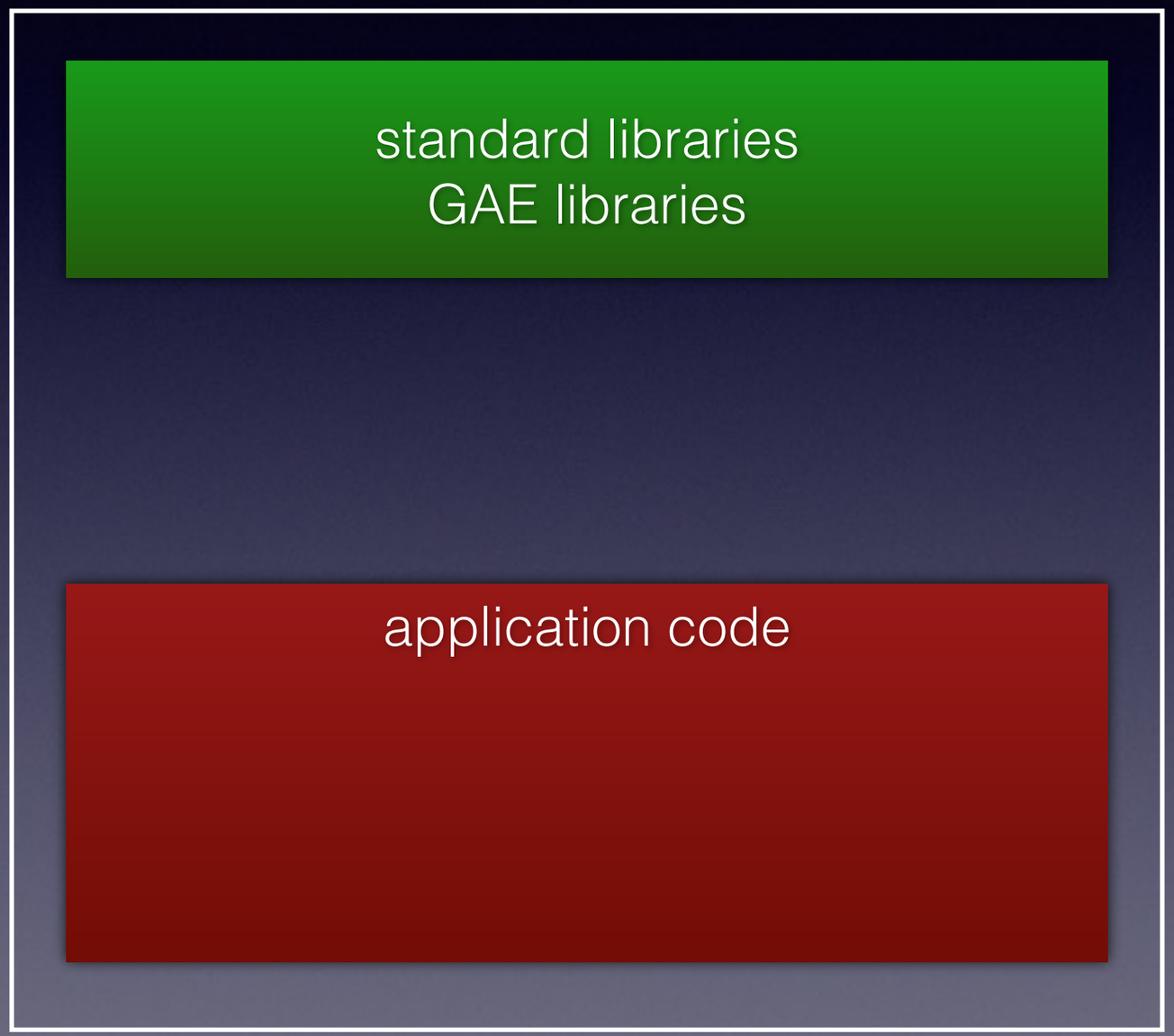


# Python Libraries

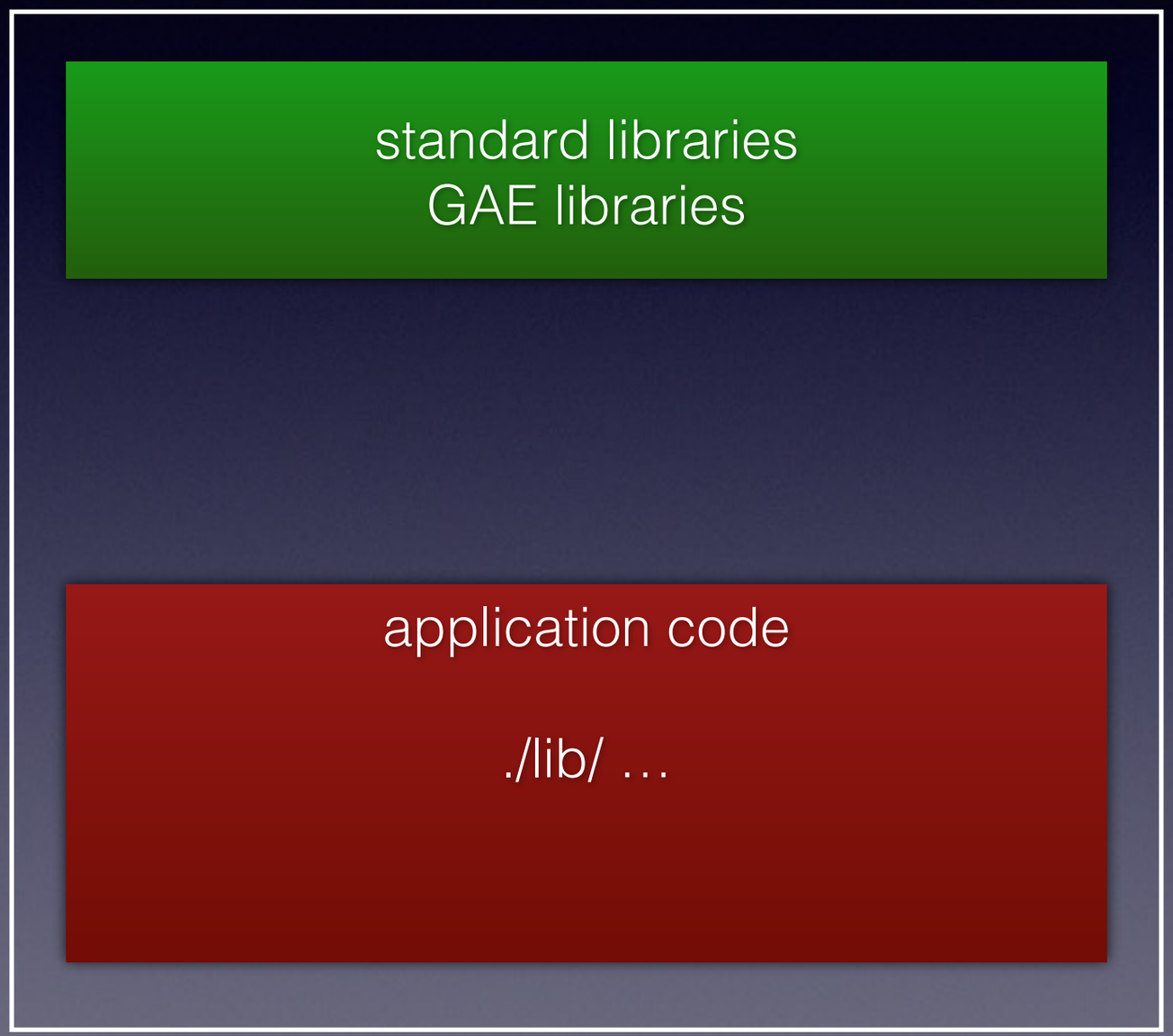
- Python 2.7 standard library
- GAE libraries (`google.appengine…`)
- Runtime / dev server has GAE libs on path already
- For other scripts, like test runners:

```
import sys
sys.path.insert(0,
  ‘…/google-cloud-sdk/platform/
   google_appengine/‘)
```

# Python Libraries



# Python Libraries



# Python Libraries

```
% mkdir ./lib
% pip install -t lib Flask==0.10
```

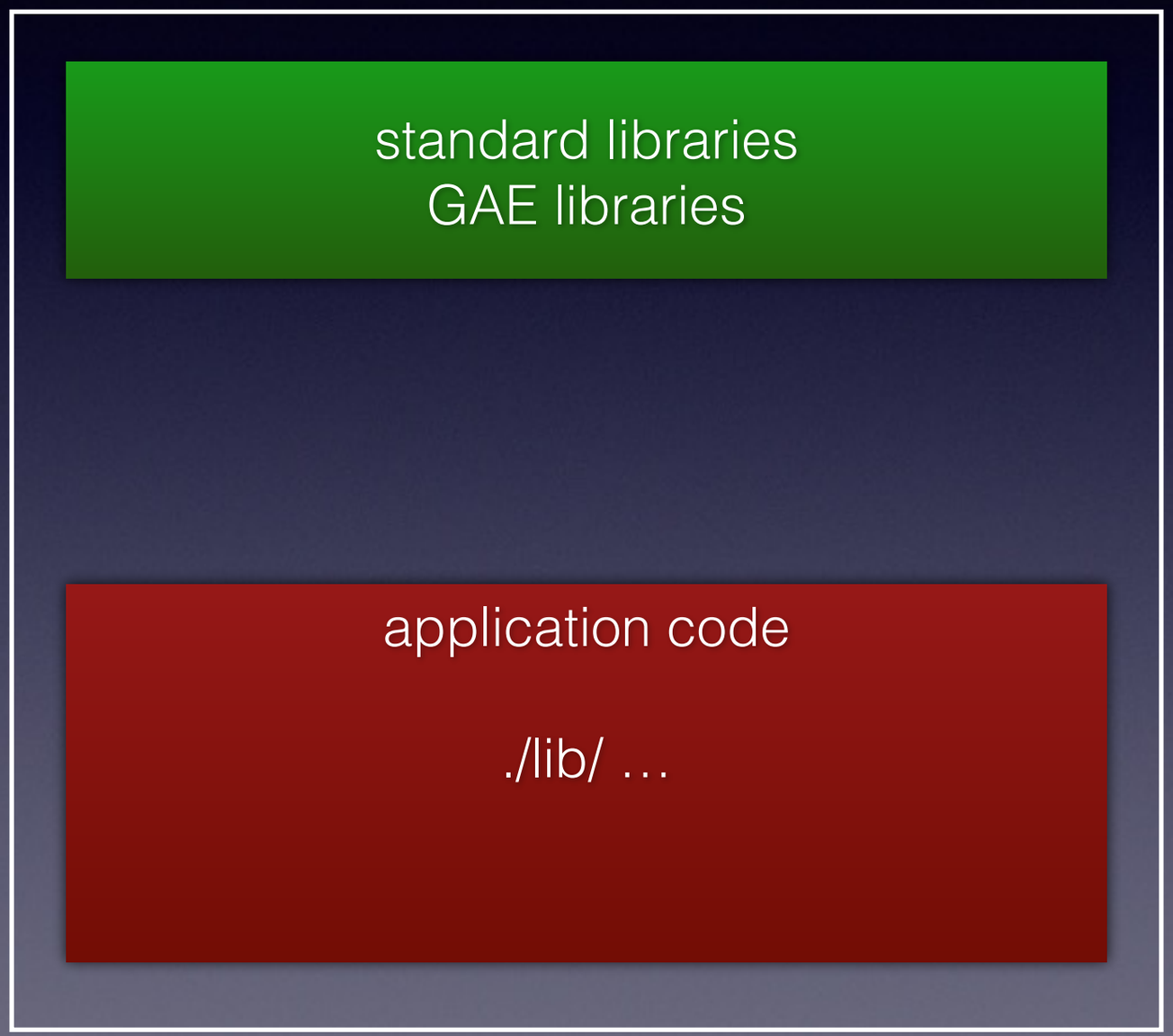
# Python Libraries

```
% mkdir ./lib
% pip install -t lib Flask==0.10

# appengine_config.py
from google.appengine.ext import vendor
vendor.add('lib')
```

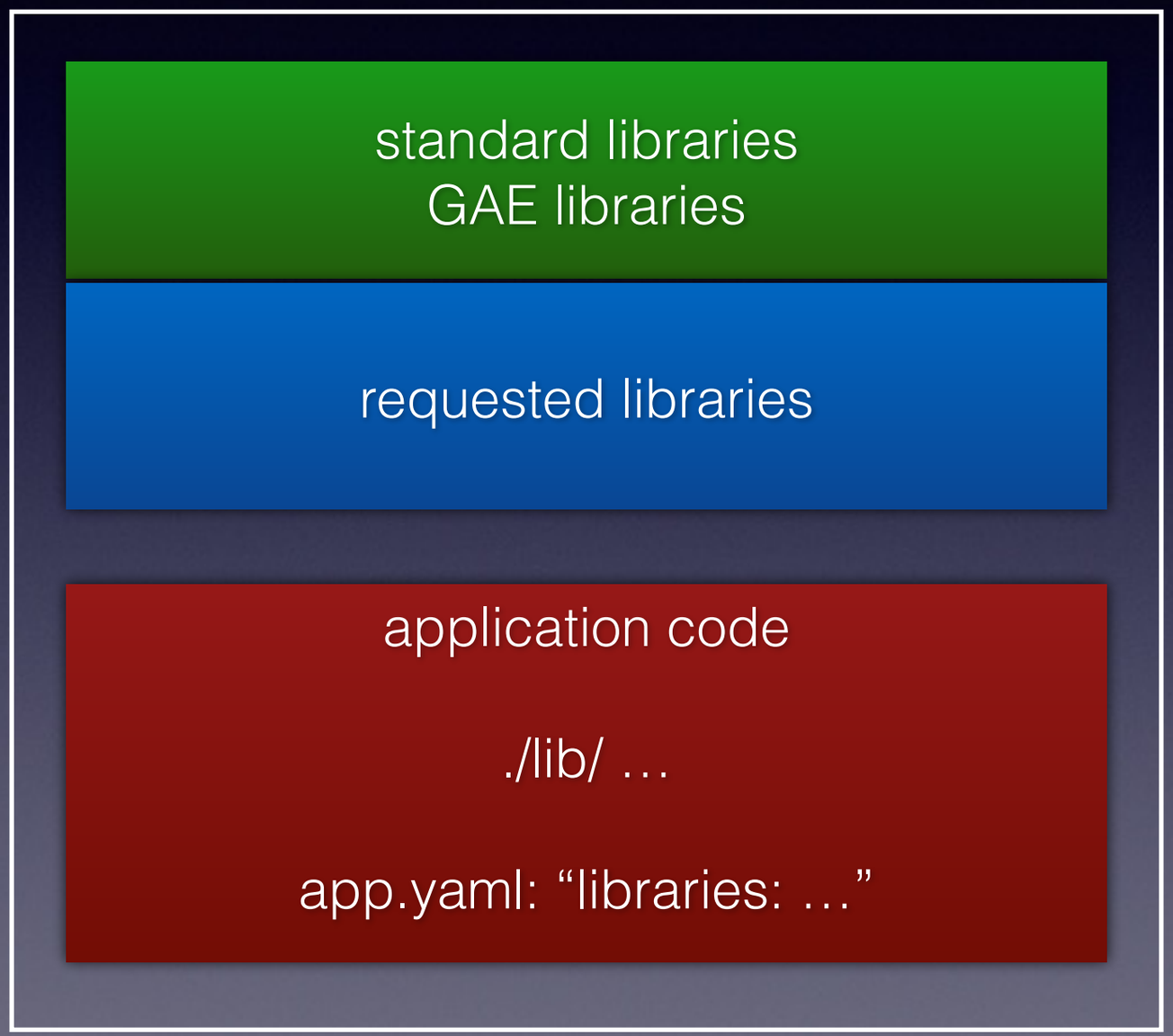
# Python Libraries

```
% mkdir ./lib
% pip install -t lib Flask==0.10

# appengine_config.py
from google.appengine.ext import vendor
vendor.add('lib')

# .gitignore
lib/*
```

# Python Libraries



# Python Libraries



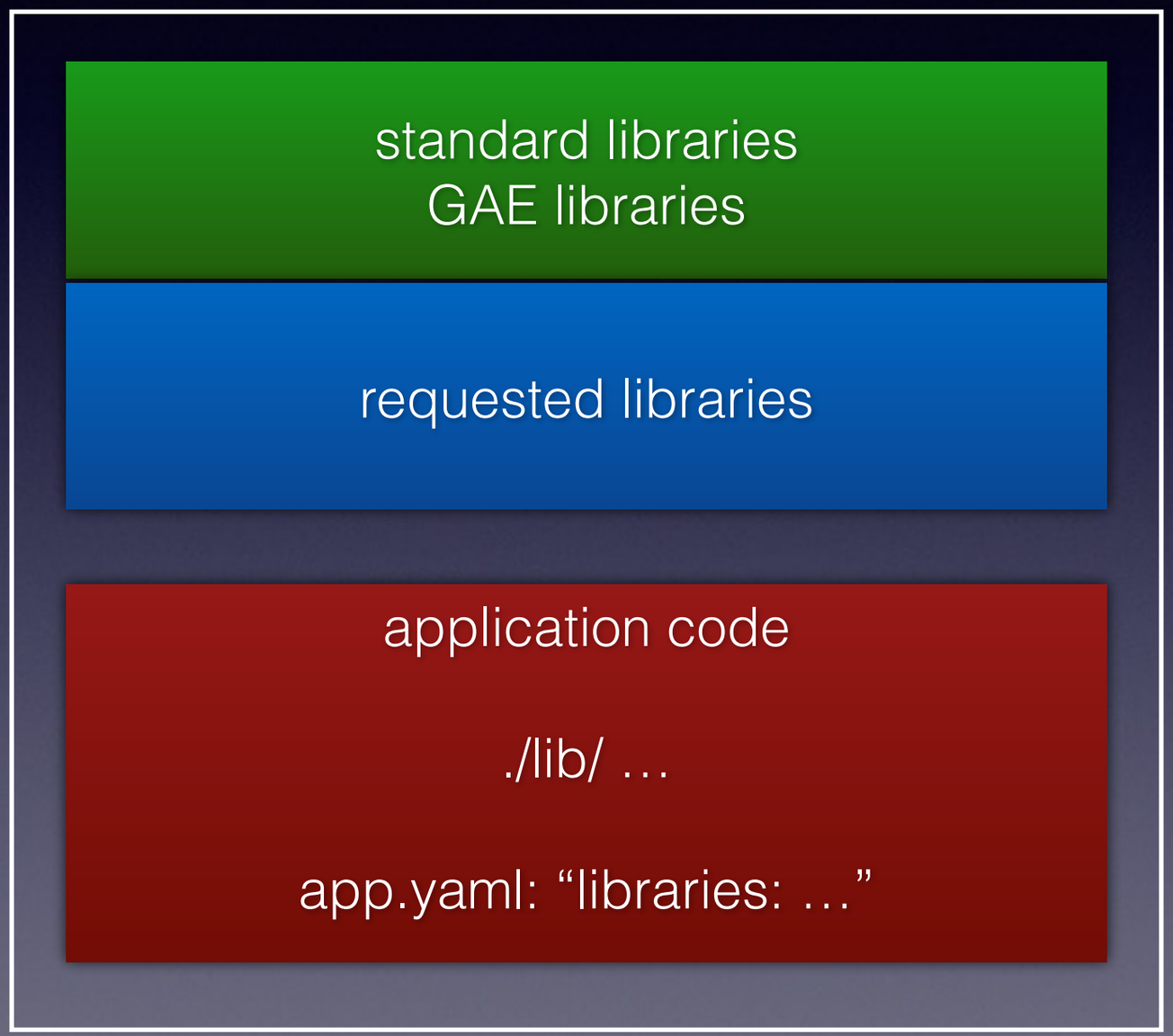
# Python Libraries

```
django
endpoints
jinja2
lxml
markupsafe
matplotlib
MySQLdb
numpy
PIL
protorpc
PyAMF
pycrypto
setuptools
ssl
webapp2
webob
yaml
```

# Python Libraries

```
# app.yaml

libraries:
  - name: jinja2
    version: “2.6”
  - name: markupsafe
    version: “0.15”
```

# Python Libraries



# Python Libraries

*Use* `virtualenv`
*to contain requested libraries*
*in your development environment.*

```
% virtualenv venv
% source venv/bin/activate
(venv)% pip install jinja2==2.6
```

# Python Libraries

*Use* `pip` *requirements files*
*to install and document dependencies.*

```
# requirements_cfg.txt
jinja2==2.6
markupsafe==0.15

(venv)% pip install -r requirements_cfg.txt
```

# Python Libraries

*Use* `pip` *requirements files*
*to install and document dependencies.*

```
# requirements_vnd.txt
Flask==0.10
google-api-python-client

(venv)% pip install -t lib \
             —r requirements_vnd.txt
```

# Using Flask

# Using Flask

- Install Flask in ./lib
- Request jinja2 and markup safe in app.yaml; install in virtualenv
    - lib/markupsafe's C-based speed-up is not usable but app.yaml will override with built-in
- app = Flask()
- No need to call app.run(); GAE dev server will take care of it

# Cloud Datastore and ndb

```
from google.appengine.ext import ndb

class Entry(ndb.Model):
  title = ndb.StringProperty(required=True)
  text = ndb.TextProperty(required=True)
  last_updated_date = ndb.DateTimeProperty(
    auto_now=True)
```

# Cloud Datastore and ndb

```
entry = Entry(
    title=flask.request.form['title'],
    text=flask.request.form['text'])
entry.put()
```

```
entries = Entry.query().order(
    -Entry.last_updated_date)
for entry in entries:
  # ...
```

# Google Accounts

```
from google.appengine.api import users

user = users.get_current_user()
if user:
  # user.nickname...

login_url = users.create_login_url(‘/‘)
logout_url = users.create_logout_url(‘/‘)
```

# Google Accounts

```
# app.yaml

handlers:
- url: /add
  script: main.app
  login: required

- url: .*
  script: main.app
```

# *Demo*

# Testing

# Testing

- It’s just Python, right?
- Activate your virtualenv
- Make sure google_appengine, the app root, and ./lib are in PYTHONPATH
  - (also yaml)
- Use your favorite test framework (e.g. unittest)

# testbed

- Service API stubs for a clean test environment, including Cloud Datastore
- Provided by the GAE SDK
  - google.appengine.ext.testbed
- Datastore: can fuzz test consistency guarantees
- Users: can set signed-in status, address, is-admin status

# testbed

```
import unittest
from google.appengine.ext import testbed

import main
import models

class MyBlogTestCase(unittest.TestCase):
  def setUp(self):
    # ...
  def tearDown(self):
    # ...
```

# testbed

```
class MyBlogTestCase(unittest.TestCase):
  def setUp(self):
    self.tb = testbed.Testbed()
    self.tb.activate()
    self.tb.init_datastore_v3_stub()
    self.tb.init_memcache_stub()
    self.tb.init_user_stub()

    main.app.config['TESTING'] = True
    self.app = main.app.test_client()
```

# testbed

```
class MyBlogTestCase(unittest.TestCase):
  def tearDown(self):
    self.tb.deactivate()
```

# testbed

```
class TestEntry(MyBlogTestCase):
  def test_entry(self):
    m = models.Entry(
      title='Test',
      text='Test entry text')
    m.put()
    self.assertIsNotNone(m.last_updated_date)
```

# testbed

```
class MyBlogInteractions(MyBlogTestCase):
  def test_no_entries(self):
    rv = self.app.get('/')
    assert 'No entries here so far' in rv.data

  def test_one_entry(self):
    e = models.Entry(title='Test', text='Test text')
    e.put()

    rv = self.app.get('/')
    assert 'No entries here so far' not in rv.data
```

# testbed

```
tb.init_all_stubs()
tb.init_blobstore_stub()
tb.init_datastore_v3_stub()
tb.init_memcache_stub()
tb.init_images_stub()
tb.init_mail_stub()
tb.init_taskqueue_stub()
tb.init_urlfetch_stub()
tb.init_user_stub()
tb.init_xmpp_stub()
```

*cloud.google.com/appengine/docs/python/tools/localunittesting*

# Flask Testing

*flask.pocoo.org/docs/0.10/testing/*

# *Demo*

# Deploying, Monitoring, Debugging

# *Demo*

# Where to go from here…

- Modules
- Task Queues
- Advanced Cloud Datastore: ndb, transactions, memcache
- Cloud SQL
- Cloud Storage
- Compute / Container Engine
- Managed VMs (beta)

Thank you!

*cloud.google.com*

*ae-book.appspot.com*

*Programming Google App Engine with Python, … with Java*
Early Access / pre-order now
Fully available June 2015

Dan Sanderson
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