jupyter

# Deploying JupyterHub for students and researchers

JupyterCon 2017

**Min Ragan-Kelley, Simula**
**Carol Willing, Cal Poly**
**Yuvi Panda, UC Berkeley**
**Ryan Lovett, UC Berkeley**

# Set Up

```
git clone \
    https://github.com/jupyterhub/jupyterhub-tutorial \
    /srv/jupyterhub
```

# Tutorial logistics

| | |
|---|---|
| 9:00 - 9:15 | Welcome |
| 9:15 - 10:30 | JupyterHub |
| 10:30 - 11:00 | Morning break |
| 11:00 - 12:20 | JupyterHub and Kubernetes |
| 12:20 - 12:30 | Wrap up |

# Tutorial logistics

- Gitter channel for this tutorial

  https://gitter.im/jupyterhub-tutorial/Lobby

- Post-its

  questions and assistance

  done with task and doing well

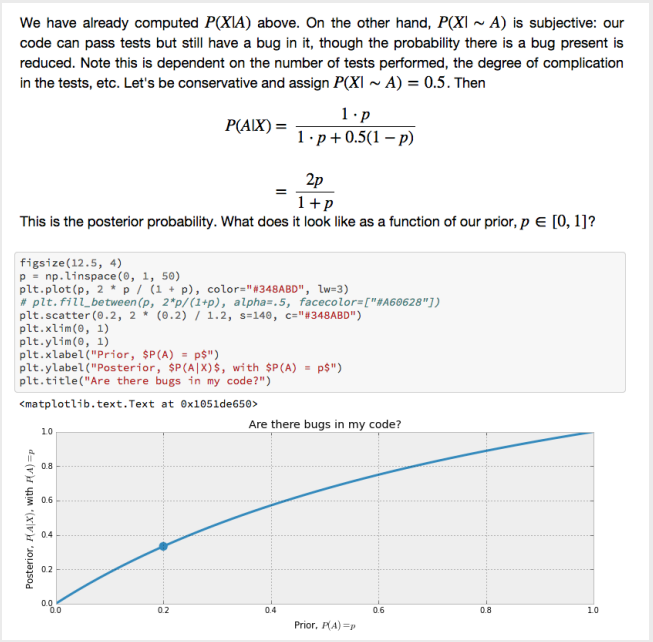
- Tutorial materials

  https://github.com/jupyterhub/jupyterhub-tutorial

# What are Jupyter and JupyterHub?

# What is a Notebook?

- Document
- Environment
- **Web app**



We have already computed $P(X|A)$ above. On the other hand, $P(X| \sim A)$ is subjective: our code can pass tests but still have a bug in it, though the probability there is a bug present is reduced. Note this is dependent on the number of tests performed, the degree of complication in the tests, etc. Let's be conservative and assign $P(X| \sim A) = 0.5$. Then

$$P(A|X) = \frac{1 \cdot p}{1 \cdot p + 0.5(1-p)}$$

$$= \frac{2p}{1+p}$$

This is the posterior probability. What does it look like as a function of our prior, $p \in [0, 1]$?

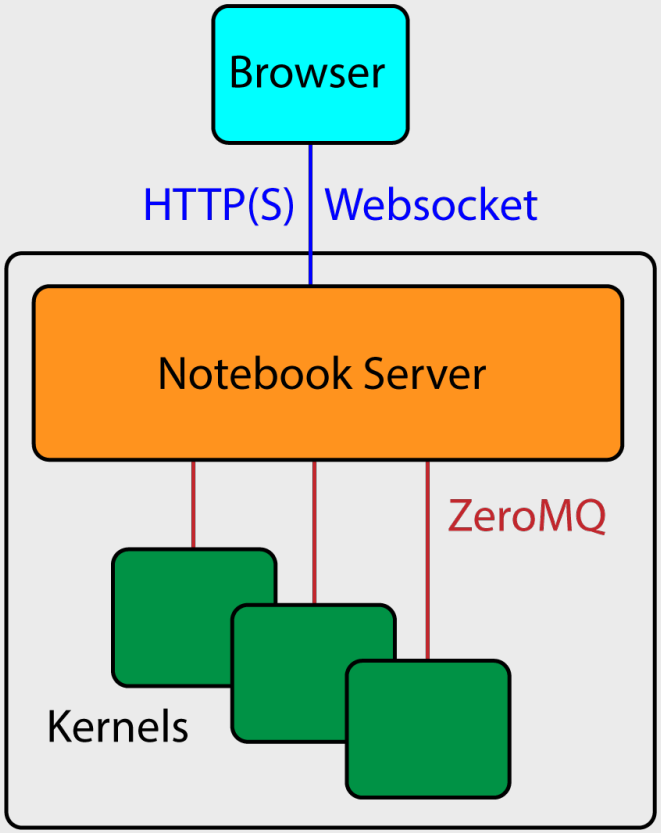
```
figsize(12.5, 4)
p = np.linspace(0, 1, 50)
plt.plot(p, 2 * p / (1 + p), color="#348ABD", lw=3)
# plt.fill_between(p, 2*p/(1+p), alpha=.5, facecolor=["#A60628"])
plt.scatter(0.2, 2 * (0.2) / 1.2, s=140, c="#348ABD")
plt.xlim(0, 1)
plt.ylim(0, 1)
plt.xlabel("Prior, $P(A) = p$")
plt.ylabel("Posterior, $P(A|X)$, with $P(A) = p$")
plt.title("Are there bugs in my code?")
```

```
<matplotlib.text.Text at 0x1051de650>
```



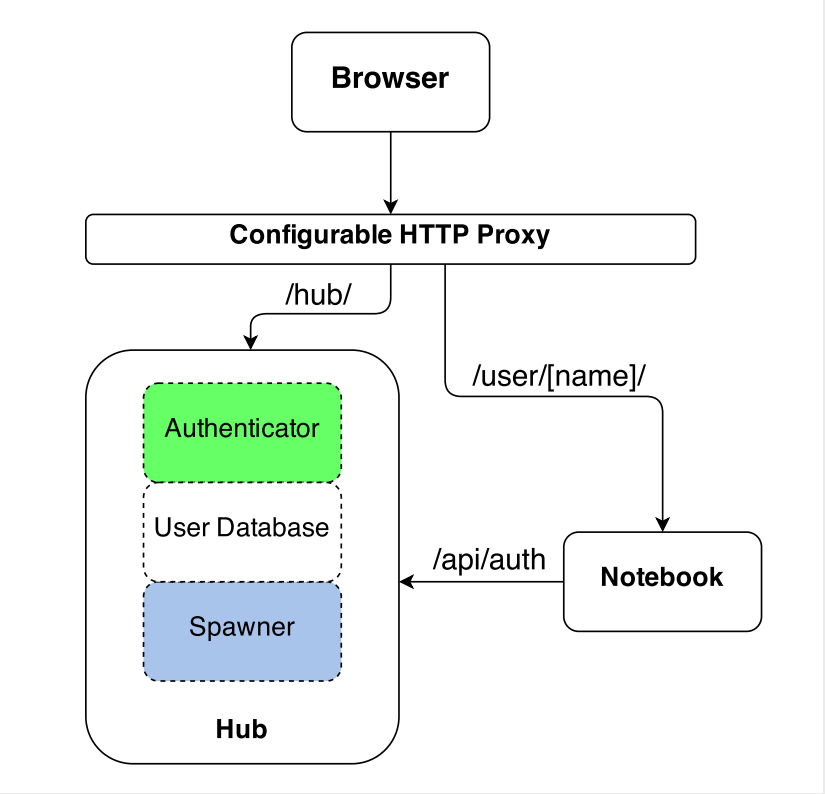
https://github.com/CamDavidsonPilon/Probabilistic-Programming-and-Bayesian-Methods-for-Hackers

# What is a Notebook Server?



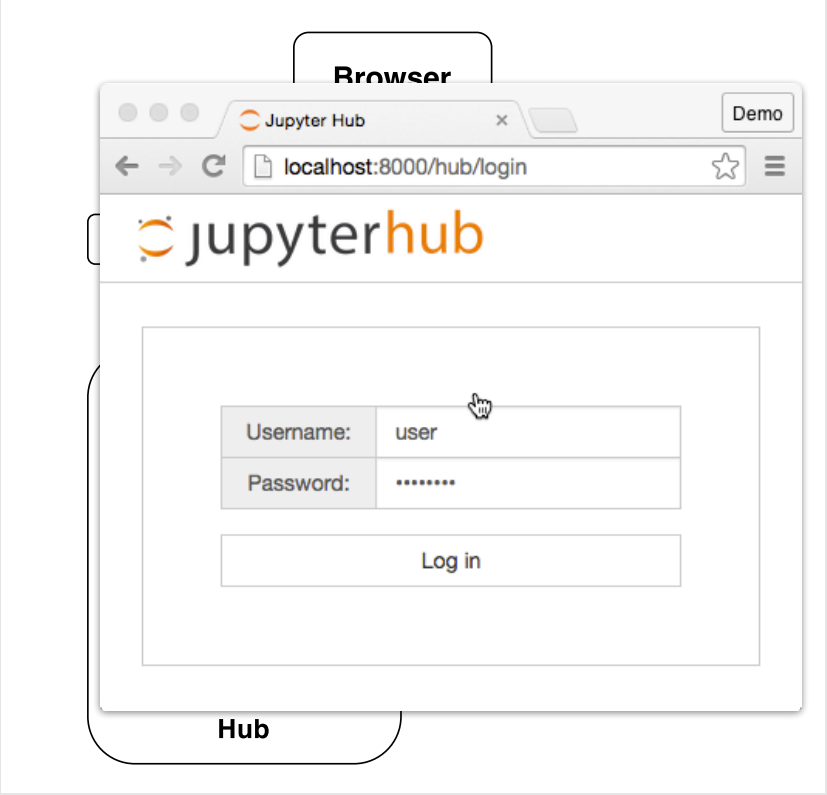
# jupyterhub

- Manages authentication
- Spawns single-user servers on-demand
- Each user gets a complete notebook server



# jupyterhub

- Initial request is handled by Hub
- User authenticates via form / OAuth
- Spawner starts single-user server
- Hub notifies Proxy
- Redirects user to `/user/[name]`
- Single-user Server verifies auth with Hub



# Installation

*Photo taken by Matthew Bowers*

# Installation (as administrator)

conda:

```
conda install -c conda-forge jupyterhub
conda install notebook
```

pip, npm:

```
python3 -m pip install jupyterhub
npm install -g configurable-http-proxy
```

test:

```
jupyterhub -h
configurable-http-proxy -h
```

# Installation (this repo)

```
conda env create -f environment.yml
source activate jupyterhub-tutorial
```

# Installation Caveats

JupyterHub installation must be **readable+executable** by all users*

This is often not the case for envs, so be careful

*when using local users

# Plug: conda-forge

Community-managed conda packages.

https://conda-forge.github.io

```
conda config --add channels conda-forge
```

# Installation: Spawner and Single User

https://docs.docker.com/engine/installation

```
pip install dockerspawner
docker pull jupyterhub/singleuser
```

# JupyterHub Defaults

- Authentication: PAM (local users, passwords)
- Spawning: Local users
- Hub must run as root

# Aside: SSL

- JupyterHub is an authenticated service - users login. That should **never** happen over plain HTTP.
- For testing, we can generate self-signed certificates:

```
openssl req -x509 -nodes -days 365 -newkey rsa:1024 \
  -keyout jupyterhub.key -out jupyterhub.crt
```

Note: Safari will not connect websockets to untrusted (self-signed) certs

# SSL: Let's Encrypt

- https://letsencrypt.org/getting-started/
- Free SSL for any domain

```
wget https://dl.eff.org/certbot-auto
chmod a+x certbot-auto
./certbot-auto certonly --standalone -d mydomain.tld

key:  /etc/letsencrypt/live/mydomain.tld/privkey.pem
cert: /etc/letsencrypt/live/mydomain.tld/fullchain.pem
```

# Configuration

*Photo taken by Matthew Bowers*

# Start configuring JupyterHub

```
jupyterhub --generate-config
```

```
c.JupyterHub.ssl_key = 'jupyterhub.key'
c.JupyterHub.ssl_cert = 'jupyterhub.crt'
c.JupyterHub.port = 443
```

jupyterhub_config.py

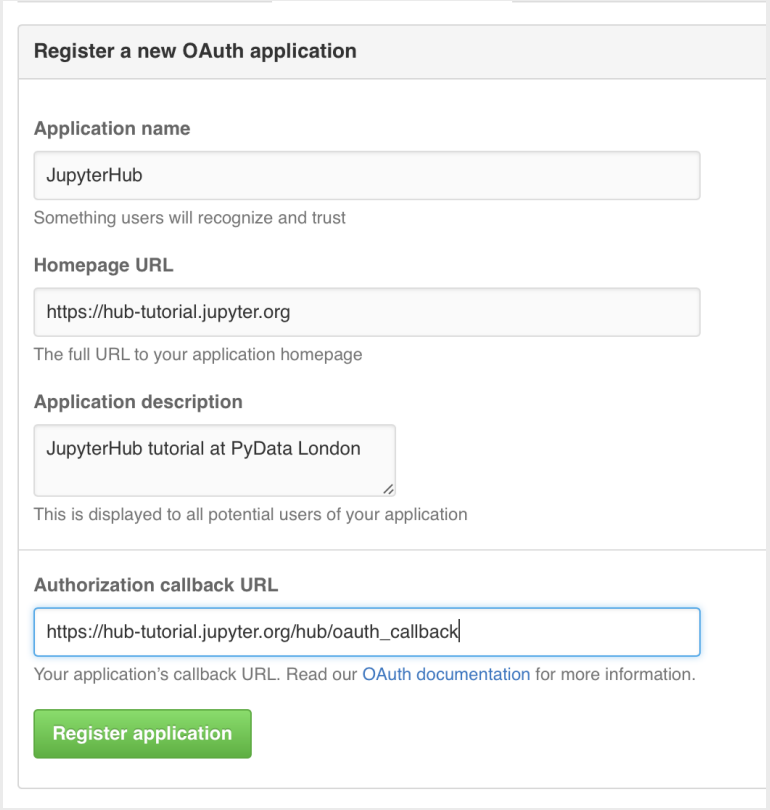
# Installing language kernels for all users

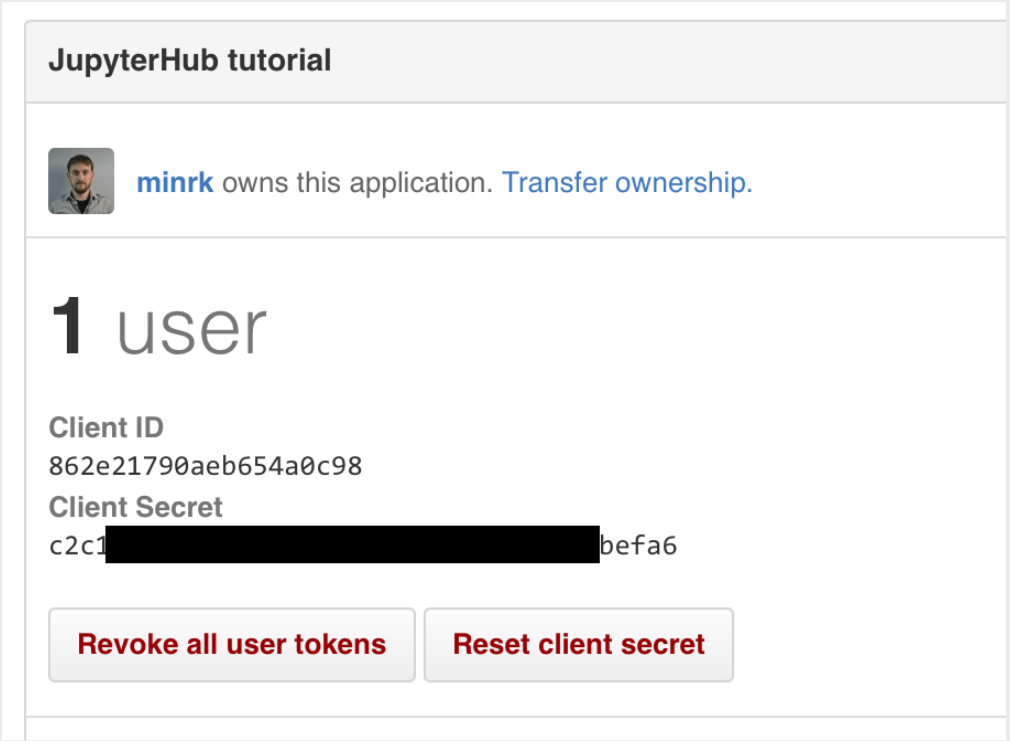
```
conda create -n py2 python=2 ipykernel
conda run -n py2 -- ipython kernel install

jupyter kernelspec list
```

# Using GitHub OAuth

https://github.com/settings/applications/new



# Using GitHub OAuth

File: ./env

```
export GITHUB_CLIENT_ID=from_github
export GITHUB_CLIENT_SECRET=from_github
export OAUTH_CALLBACK_URL=https://YOURDOMAIN/hub/oauth_callback
```

```
source ./env
```

# Using GitHub OAuth

We need to install: OAuthenticator

```
python3 -m pip install oauthenticator
```

Config file: `jupyterhub_config.py`

```
from oauthenticator.github import LocalGitHubOAuthenticator
c.JupyterHub.authenticator_class = LocalGitHubOAuthenticator
c.LocalGitHubOAuthenticator.create_system_users = True
```

# Specifying Users

By default, any user that successfully authenticates is allowed to use the Hub.

This is appropriate for shared workstations with PAM Auth, but probably not GitHub:

```
# set of users allowed to use the Hub
c.Authenticator.whitelist = {'minrk', 'takluyver'}

# set of users who can administer the Hub itself
c.Authenticator.admin_users = {'minrk'}
```

# Custom Authenticators

*Photo taken by Matthew Bowers*

# Using DockerSpawner

We need DockerSpawner:

```
python3 -m pip install dockerspawner netifaces
docker pull jupyterhub/singleuser
```

In jupyterhub_config.py:

```
from oauthenticator.github import GitHubOAuthenticator
c.JupyterHub.authenticator_class = GitHubOAuthenticator

from dockerspawner import DockerSpawner
c.JupyterHub.spawner_class = DockerSpawner
```

# Using DockerSpawner

```
from dockerspawner import DockerSpawner
c.JupyterHub.spawner_class = DockerSpawner

# The Hub's API listens on localhost by default,
# but docker containers can't see that.
# Tell the Hub to listen on its docker network:
import netifaces
docker0 = netifaces.ifaddresses('docker0')
docker0_ipv4 = docker0[netifaces.AF_INET][0]
c.JupyterHub.hub_ip = docker0_ipv4['addr']
```

# Using DockerSpawner

- There is *loads* to configure with Docker
- Networking configuration
- Data volumes
- `DockerSpawner.image = 'jupyter/scipy-notebook:8f56e3c47fec'`

# Customizing Spawners

*Photo taken by Matthew Bowers*

# JupyterHub with supervisor

apt-get install supervisor

```
#!/usr/bin/env bash
# /srv/jupyterhub/launch.sh
set -e
source ./env
exec jupyterhub $@
```

```
# /etc/supervisor/conf.d/jupyterhub.conf
[program:jupyterhub]
command=bash launch.sh
directory=/srv/jupyterhub
autostart=true
autorestart=true
startretries=3
exitcodes=0,2
stopsignal=TERM
redirect_stderr=true
stdout_logfile=/var/log/jupyterhub.log
stdout_logfile_maxbytes=1MB
stdout_logfile_backups=10
user=root
```

# Reference Deployments

https://github.com/jupyterhub/helm-chart

Helm, KubeSpawner, Hub in container

https://github.com/jupyterhub/jupyterhub-deploy-docker

docker-compose, DockerSpawner, Hub in Docker

https://github.com/jupyterhub/jupyterhub-deploy-teaching

ansible, no docker, nbgrader

# Docker Deployment

- Docker Compose: https://docs.docker.com/compose/install/
- git clone https://github.com/jupyterhub/jupyterhub-deploy-docker
- Setup the basics (creates volumes, network, pulls images):
  `make build`

# Docker Deployment

- `mkdir secrets`
- Copy SSL key, cert to:
  - secrets/jupyterhub.cert (cert)
  - secrets/jupyterhub.key (key)

# Docker Deployment

Make userlist:

```
minrk admin
willingc admin
yuvipanda
ryanlovett
```

# Docker Deployment

Launch: 🚀

```
docker-compose up
```

# Optimizations and Best Practices

*Photo taken by Matthew Bowers*

# Optimizations and best practices

- **Always use SSL!**
- Use postgres for the Hub database
- Put nginx in front of the proxy
- Run cull-idle-servers service to prune resources
- Global configuration in `/etc/jupyter` and `/etc/ipython`
- **Back up your user data!!!**

# When to use JupyterHub

- A class where students can do homework (nbgrader)
- A short-lived workshop, especially if installation is hard
- A research group with a shared workstation or small cluster
- On-site computing resources for researchers and analysts at an institution

# When ***not*** to use JupyterHub

- JupyterHub is Authenticated and Persistent
- It takes work to keep it going
- SageMathCloud is *hosted* and provides realtime-collaboration
- A growing number of cloud providers support notebook services (Google, Microsoft, etc.)

# JupyterHub API

*Photo taken by Matthew Bowers*

# End of JupyterHub Fundamentals

Break - 30 min

See you back here at 11:00 am.

## Up next: JupyterHub and Kubernetes

# Attributions and recognition

A huge thank you to the Project Jupyter team and community.
Your hard work and passion makes this all possible.



Thank you

# Thank you

*try.jupyter.org*

*www.jupyter.org*

*ipython.org*

*numfocus.org*