
Getting Started with
Cloud Foundry
Ian Huston, Data Scientist
Pivotal
PyData London 2015

Who am I?

- Ian Huston
- @ianhuston
- www.ianhuston.net
- Talk resources: https://github.com/ihuston/python-cf-examples

- Data Scientist
- Use PyData stack for predictive analytics and machine learning
- Previously a theoretical physicist using Python for numerical simulations & HPC

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Who are Pivotal?

Apache Tomcat

CLOUD FOUNDRY™

OPEN DATA PLATFORM

Pivotal
Big Data Suite

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Aims for this tutorial

Goals:

- Understand how to use CF as a developer/data scientist
- Understand how to push PyData apps and bind to services

Anti-goals:

- Understand CF from an operations viewpoint
- Install & run a full Cloud Foundry installation

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Plan

- What is Cloud Foundry?
- Getting started with a hosted CF instance
- Pushing your first app
- What are buildpacks?
- Using PyData packages
- Using data services like Redis
- Putting it all together

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Important Resources

Clone this repo:

https://github.com/ihuston/python-cf-examples

OR download and unpack this file:

http://tinyurl.com/cf-pydata

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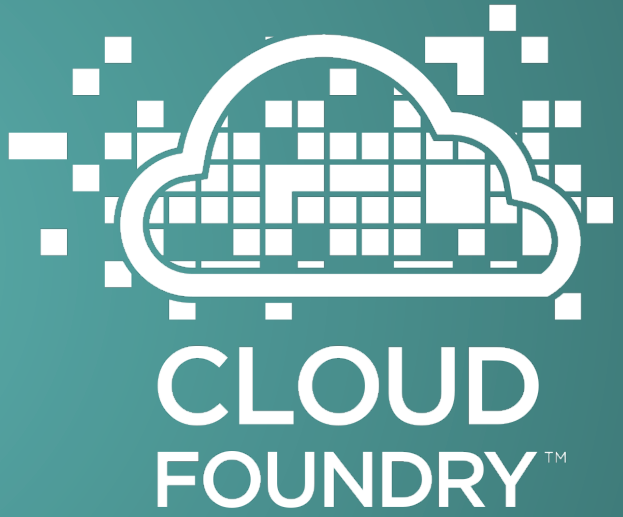
What is Cloud Foundry?

http://cloudfoundry.org

Open Source
Multi-Cloud Platform

Simple App Deployment,
Scaling & Availability



Cloud Applications Haiku

Here is my source code
Run it on the cloud for me
I do not care how.

- Onsi Fakhouri
@onsijoe

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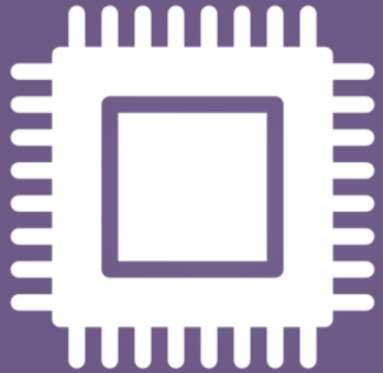
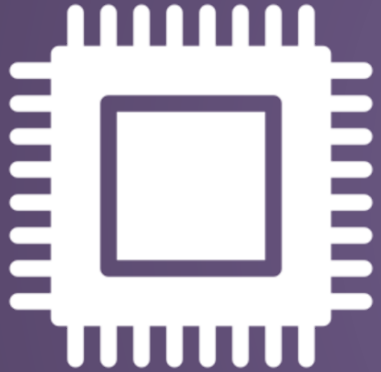
How can data scientists use CF?



Data Services

Easy control of incoming data

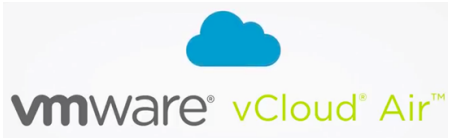


Distributed computation

Data Driven Applications

Multi-cloud

- Same applications running across different cloud providers:



Private

Public

Hosted

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Cloud Foundry Foundation

See relative contributions at http://dashboard.cloudfoundry.org/

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Hosted options

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Web Services

- IBM Bluemix
- Anynines
- HP Helion Development Platform
- Activestate Stackato
- CenturyLink AppFog

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Getting Started on Pivotal Web Services

- Go to http://run.pivotal.io
- **Trial lasts for 60 days, no credit card required**
- Click ‘Sign Up’ and enter your email
- Open confirmation email and verify registration
- Complete SMS verification check
- Choose an organisation name (your name/handle is fine)

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Downloading the Command Line Interface

- Register at http://run.pivotal.io
- In the CF management website click ‘Tools’ and download appropriate package
- Or go to https://github.com/cloudfoundry/cli
- Or use homebrew on OSX:

```
$ brew tap pivotal/tap
$ brew install cloudfoundry-cli
```

- Provides the `cf` command, your interface to Cloud Foundry

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cf push

Challenge 1: Pushing your first app

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Logging in to PWS

- Choose PWS API endpoint:

```
$ cf api https://api.run.pivotal.io
```

- Login:

```
$ cf login
```

- Enter your email address and password
- You should see output like:

```
API endpoint: https://api.run.pivotal.io (API version:2.28.0)
User:           YOUR_USER_NAME
Org:            YOUR_ORG_NAME
Space:          development
```

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Challenge 1: Pushing your first application

- Choose PWS API endpoint: `$ cf api https://api.run.pivotal.io`
- Login: `$ cf login`
- Code directory: `01-simple-python-app`
- Deploy with

```
$ cf push
```

- Check it worked at http://myapp-RANDOM-WORDS.cfapps.io
- Turn off your app when finished with `cf stop myapp` (but not yet!)

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Simple Flask App Demo

- Simple one page “Hello World” web app
- Video: https://www.youtube.com/watch?v=QOfD6tnoAB8
- Demonstrates:
  - Installation of requirements
  - Scaling properties
- Need to Provide:
  - App files
  - Dependencies listed in requirements.txt file
  - Optional manifest.yml file with configuration for deployment

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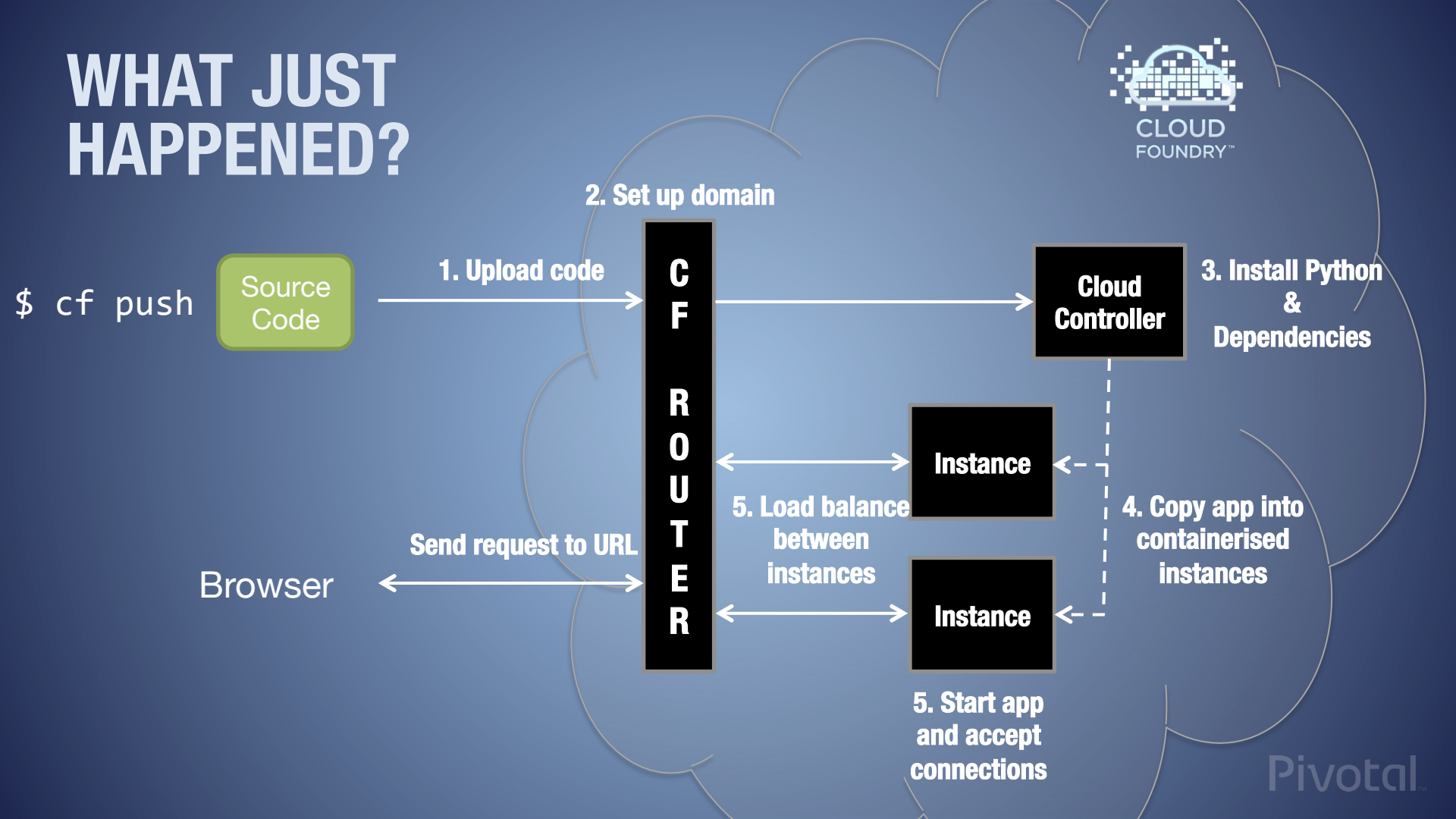
WHAT JUST HAPPENED?



What just happened?

1. Application code is uploaded to CF
2. Domain URL is set up ready for routing
3. Cloud controller builds application in container:
   - Python interpreter selected
   - Dependencies installed with pip
4. Container is replicated to provide instances
5. App starts and Router load balances requests

- See what's happening using logs: `$ cf logs myapp --recent`

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Python on Cloud Foundry

- First class language (with Go, Java, Ruby, Node.js, PHP)
- Automatic app type detection
  - Looks for requirements.txt or setup.py
- **Buildpack** takes care of
  - Detecting that a Python app is being pushed
  - Installing Python interpreter
  - Installing packages in requirements.txt using pip
  - Starting web app as requested (e.g. python myapp.py)

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Scaling memory and instances

- We can scale our application as needed in terms of memory and number of instances:

```
$ cf scale myapp -i 5
$ cf scale myapp -m 256M
```

- Check app in browser to see different ports being used.
- Scale back down with `$ cf scale myapp -i 1`

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How does this work?

- Containerised application is cached and ready to be deployed.
- Scaling number of instances replicates container and load balances requests across all instances.
- Scaling memory requires restarting app.
- Auto-scaling is also possible.

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Buildpacks

Challenge 2: Pushing PyData apps

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What are buildpacks?

- Idea and format from Heroku
- Responsible for doing whatever is necessary to get your app running.
- Buildpacks take care of
  - Detecting which type of application is being pushed
  - Installing the appropriate run-time
  - Installing required dependencies or other artifacts
  - Starting the application as requested
- Official buildpacks for Python, Java, Node.js, Go, Ruby, PHP & for static websites and running binaries

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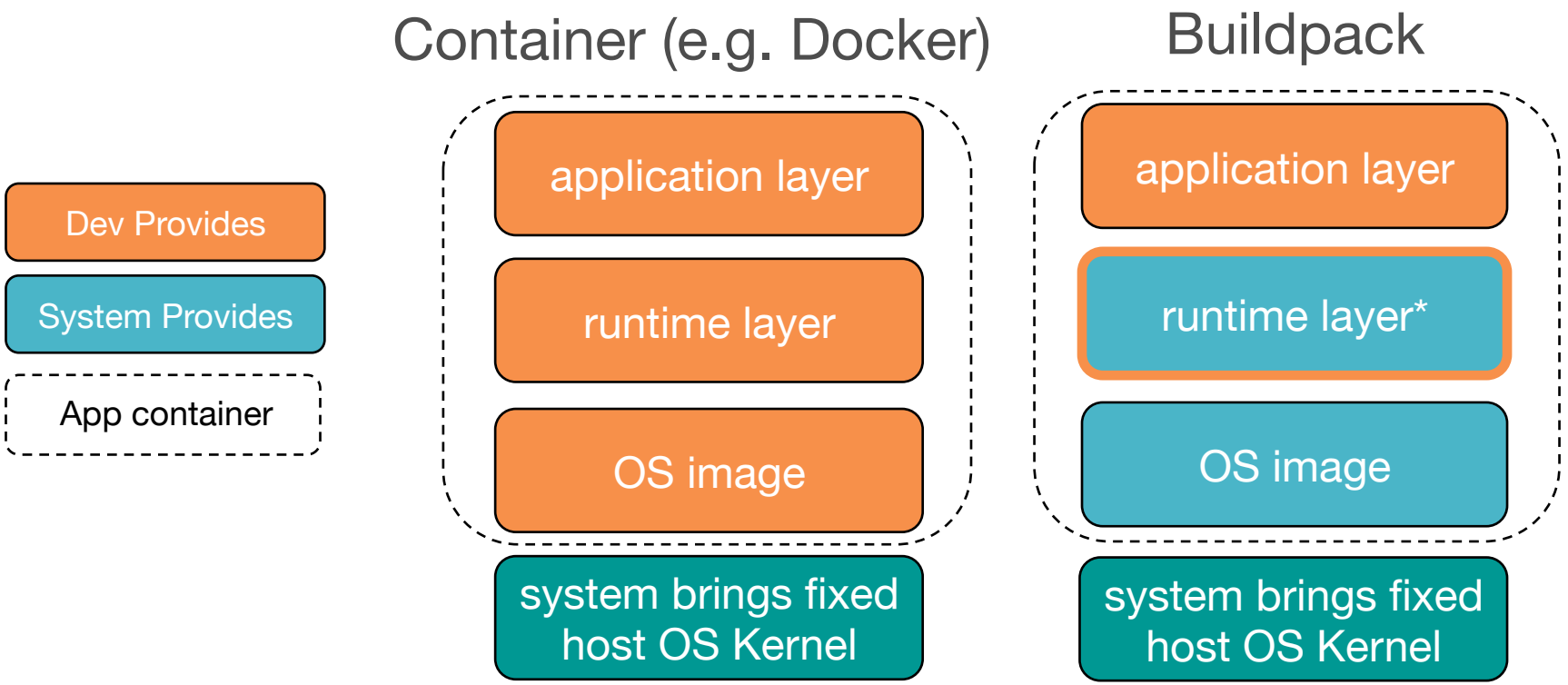
Containers vs Buildpacks



* Devs may bring a custom buildpack

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Custom buildpacks

- Instead of using an official buildpack you can use any custom buildpack installed on your CF or available on Github.
- Only 3 shell scripts needed:
  - detect
  - compile
  - release
- Specify buildpack with `-b` or in manifest.yml

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Community Buildpacks

https://github.com/cloudfoundry-community/cf-docs-contrib/wiki/Buildpacks

- Lots of languages:
  Clojure, Haskell, .NET, Erlang, Elixir, etc.
- RShiny app buildpack:
  https://github.com/alexkago/cf-buildpack-r
- Can also use some Heroku buildpacks without modification.

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Official Python buildpack

- ✓ Great for simple pip based requirements
- ✓ Well tested and officially maintained
- ✓ Covers both Python 2 and 3
- ✗ Suffers from the Python Packaging Problem:
  - Hard to build packages with C, C++ or Fortran extensions
  - Complicated local configuration of libraries and paths needed
  - Takes a long time to build main PyData packages from source

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Using conda for package management

CONTINUUM
ANALYTICS

- http://conda.pydata.org
- Benefits:
  - Uses precompiled binary packages
  - No fiddling with Fortran or C compilers and library paths
  - Known good combinations of main package versions
  - Really simple environment management (better than virtualenv)
  - Easy to run Python 2 and 3 side-by-side

Go try it out if you haven't already!

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How to use the conda buildpack

https://github.com/ihuston/python-conda-buildpack

- Specify as a custom buildpack when pushing app with manifest or `-b` command line option.
- Export your current environment to a environment.yml file
- Or write requirements.txt (pip) and conda_requirements.txt
- Send me feedback & pull requests!

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Challenge 2: Pushing a PyData app

- Code directory: `02-pydata-spyre-app`
- Spyre – Adam Hajari https://github.com/adamhajari/spyre
- This app uses the Pydata buildpack to install Matplotlib, NumPy and more.
- Spyre provides a simple way to build interactive web based visualisations similar to Rshiny.

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Using Services

Challenge 3: Using Redis in an app

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Services

These are available on Pivotal CF (Pivotal's packaged Cloud Foundry offering).

See http://run.pivotal.io for the services available on Pivotal Web Services.

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Cloud Native Applications

- Suitable for deployment on cloud platforms
- Can scale up easily without changes
- Follow these rules: http://12factor.net
- In a nutshell:
  - Apps are stateless processes
  - Easy to create and destroy apps with no side-effects
  - Persistent state handled through backing services
  - Interact with services through port binding

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Challenge 3: Binding a service to an app

- Create a free Redis service:

```
$ cf cs rediscloud 30mb myredis
```

- Bind to our earlier app:

```
$ cf bind-service myapp myredis
```

- See how apps find credentials in environmental variables:

```
$ cf env myapp
```

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Challenge 3: Using Services in an app

- Code directory: `03-services-redis`
- This app binds to a Redis service if available and counts the number of hits on the app homepage.
- Add keys and values by adding /keyname/value to URL.
- Data is persisted in Redis, will survive deleting and restarting the app.
- Multiple instances all access the same service.

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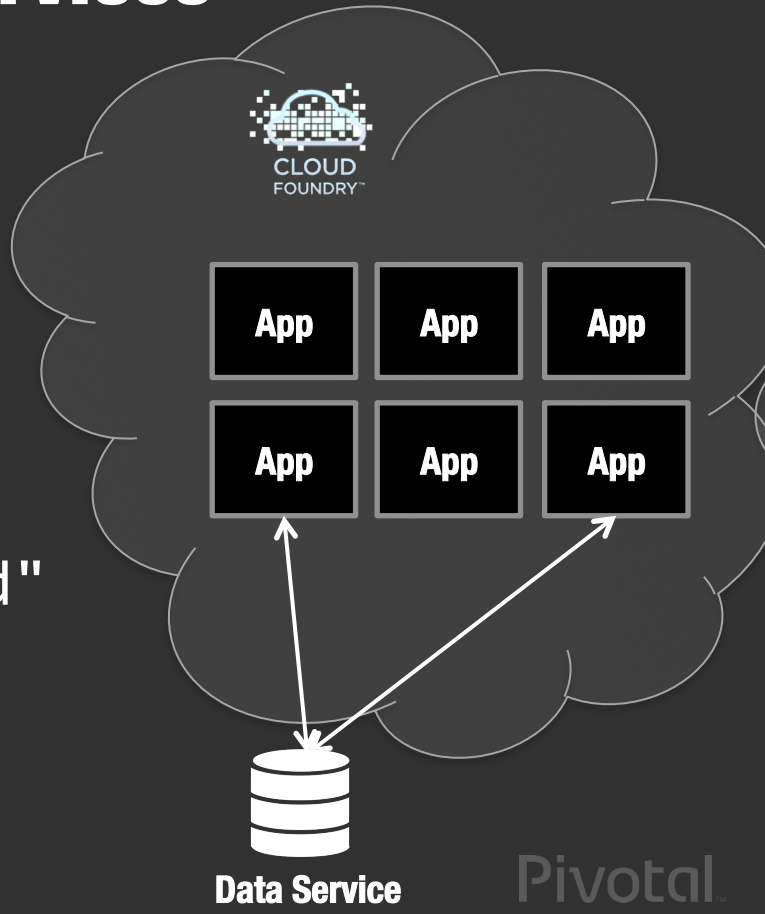
User Provided Services

How to add User Provided Services:

Standalone Hadoop or Apache Spark cluster, Big Data System, RDBMS etc.

```
$ cf cups SERVICE_INSTANCE -p
"host, port, username, password"
```



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Putting it all together

Challenge 4: Build your own prediction API

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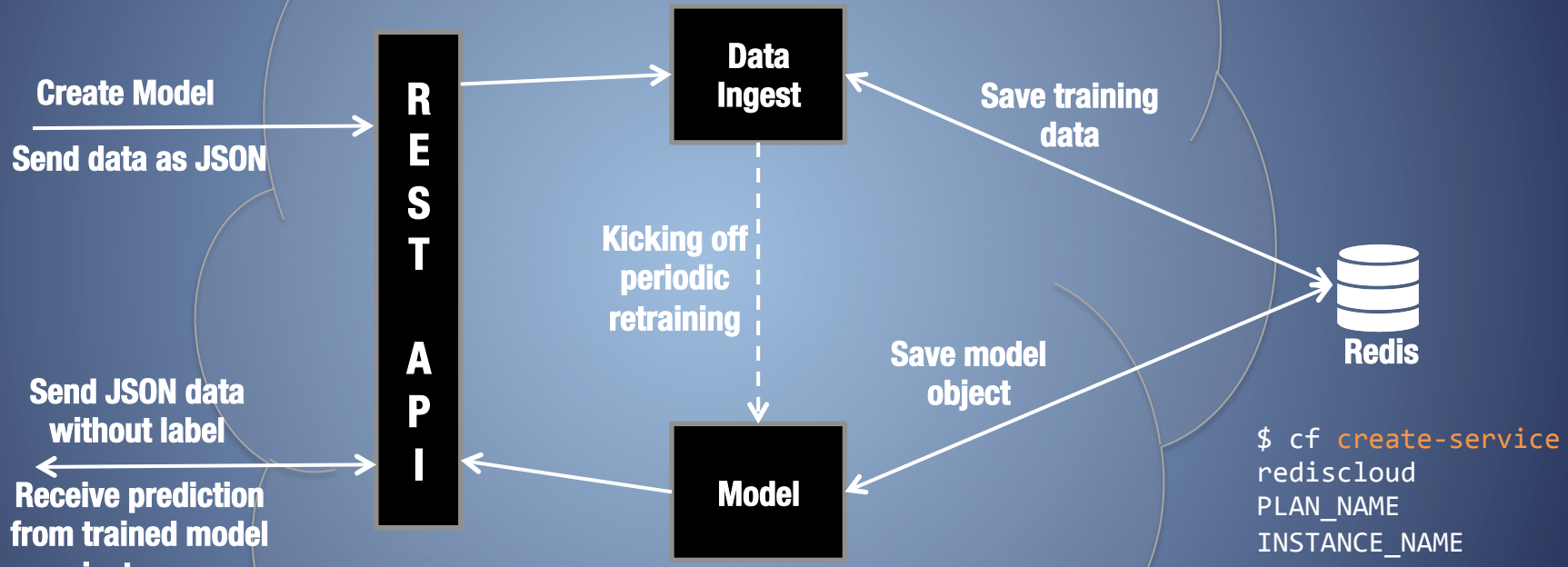
PREDICTION API ARCHITECTURE

Deployed at:
http://dsoncf.cfapps.io



Code:
https://github.com/alexkago/ds-cfpylearning

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Final challenge: Build your own predictive API

- Code directory: `04-learning-api`
- Simple Flask + scikit-learn based machine learning API
- Push the application and go to the app URL to see instructions on how to use.
- Model is built in scikit-learn and persisted in Redis
- Simplified version of this project by Alex Kagoshima: https://github.com/alexkago/ds-cfpylearning

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Resources

- Docs: http://docs.cloudfoundry.org
- CF Summit videos: http://cfsummit.com
- Join the CF community: http://cloudfoundry.org
- CF meetups: http://cloud-foundry.meetup.com
- Don’t forget to stop your apps with `cf stop myapp`.

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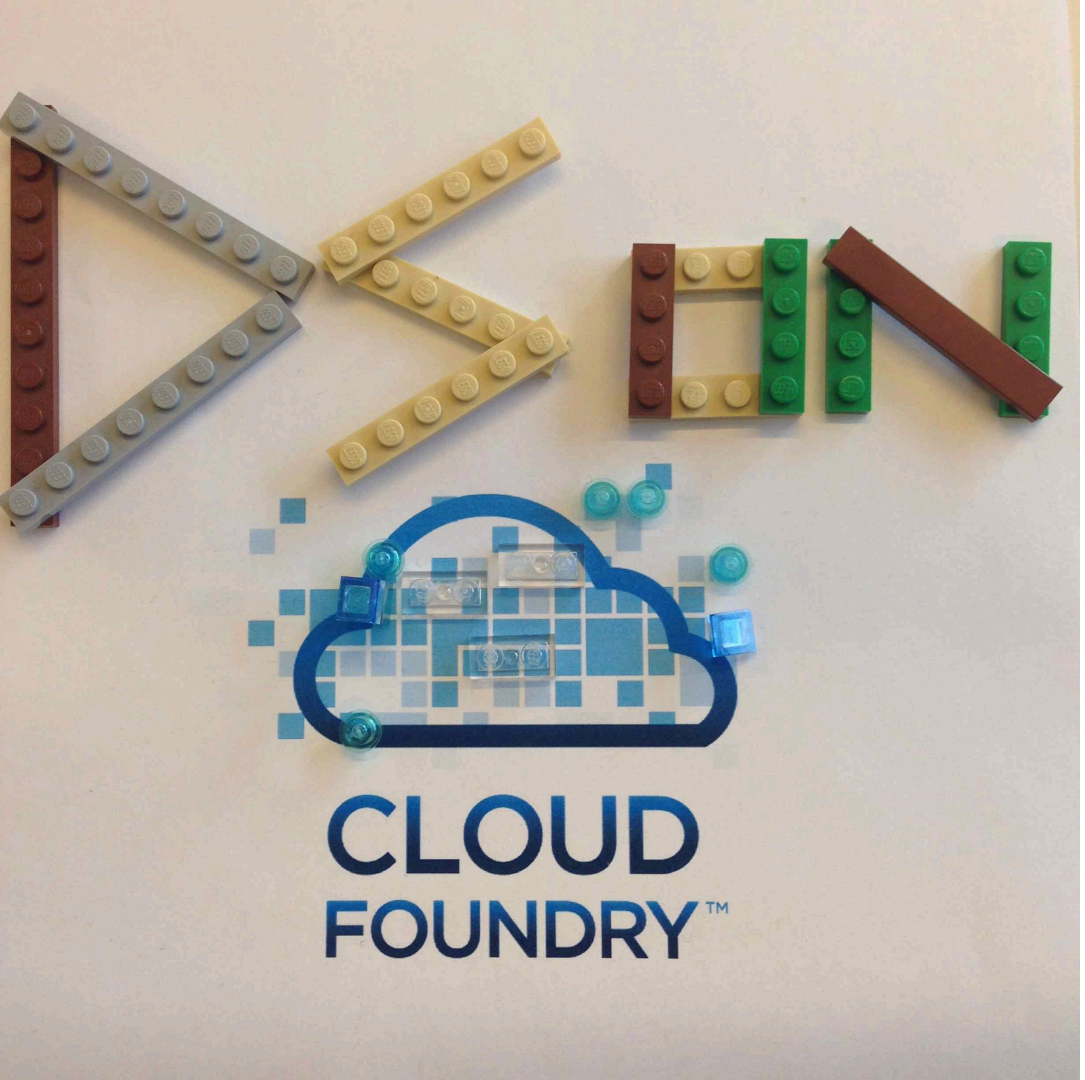

Show off your data science related Cloud Foundry apps:

Twitter: @dsoncf

http://dsoncf.com

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@ianhuston

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