Google Earth Engine

Earth Engine, Python and Jupyter Notebooks

GeoHackWeek 2016

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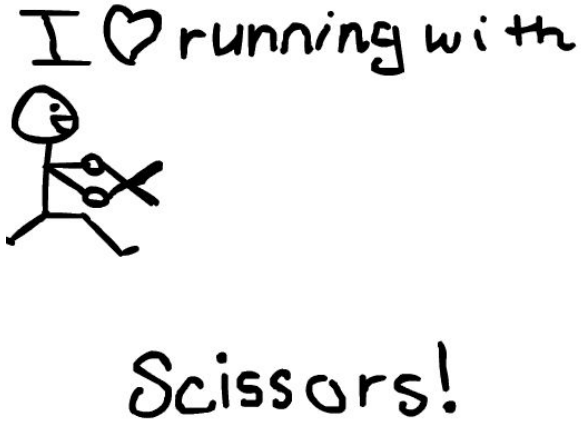
Senior Developer Advocate, Earth Engine

https://goo.gl/CbY9eI

Session Goals

- Learn the similarities and differences between the Javascript and Python APIs.
- Experience how to build a Docker environment for running Jupyter Notebooks enabled with the Python API.



source: http://www.lternet.edu/node/49495
photo: John Marr

A bit about me...

FOSS4G DENVER 2011

python™

search

» Package Index > pykml > 0.1.0

PACKAGE INDEX
- Browse packages
- Package submission
- List trove classifiers
- List packages
- RSS (latest 40 updates)
- RSS (newest 40 packages)
- Python 3 Packages
- PyPI Tutorial
- PyPI Security
- PyPI Support
- PyPI Bug Reports
- PyPI Discussion
- PyPI Developer Info

ABOUT
NEWS
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CORE DEVELOPMENT

pykml 0.1.0

Python KML library

Download
pykml-0.1.0.tar.gz

Package Documentation

PyKML is a Python package for parsing and authoring KML documents. It is based on the lxml.objectify API (http://codespeak.net/lxml/objectify.html) which provides Pythonic access to XML documents.

Not Logged In
- Login
- Register
- Lost Login?
- Use OpenID
- Login with Google

Status
- Nothing to report

See the Package Documentation for information on installation and usage.

File	Type	Py Version	Uploaded on	Size
pykml-0.1.0.tar.gz (md5)	Source		2011-08-30	33KB

Downloads (All Versions):
0 downloads in the last day
51 downloads in the last week
852 downloads in the last month

API choice: Javascript vs. Python

COMMENTARY:

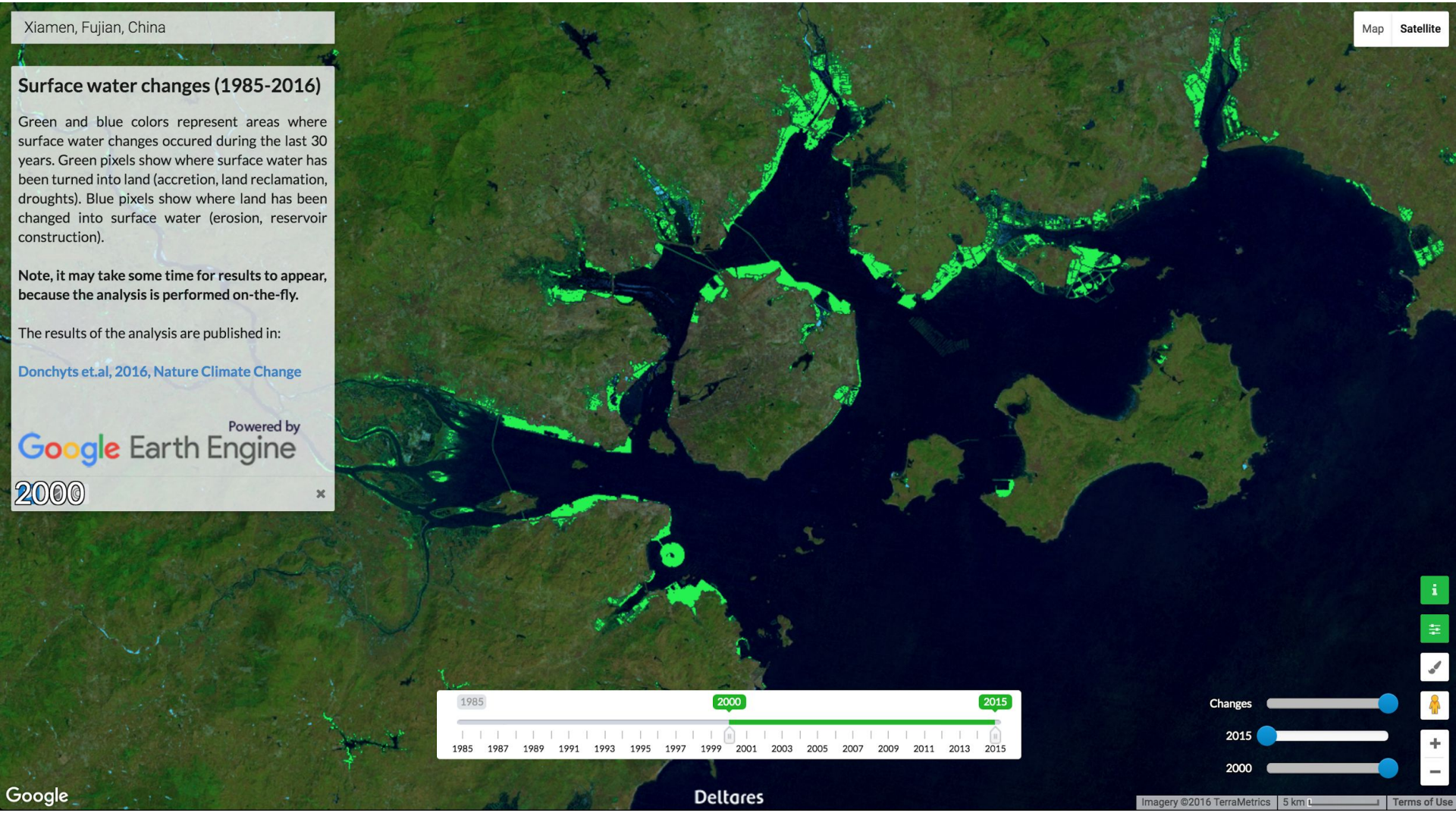
Earth's surface water change over the past 30 years

Gennadii Donchyts, Fedor Baart, Hessel Winsemius, Noel Gorelick, Jaap Kwadijk and Nick van de Giesen

Earth's surface gained 115,000 km^2 of water and 173,000 km^2 of land over the past 30 years, including 20,135 km^2 of water and 33,700 km^2 of land in coastal areas. Here, we analyse the gains and losses through the Deltares Aqua Monitor — an open tool that detects land and water changes around the globe.

NATURE CLIMATE CHANGE | VOL 6 | SEPTEMBER 2016 | www.nature.com/natureclimatechange

Application: http://aqua-monitor.appspot.com/
Code: https://github.com/gena/aqua-monitor


Xiamen, Fujian, China
Map
Satellite
Surface water changes (1985-2016)
Green and blue colors represent areas where surface water changes occured during the last 30 years. Green pixels show where surface water has been turned into land (accretion, land reclamation, droughts). Blue pixels show where land has been changed into surface water (erosion, reservoir construction).
Note, it may take some time for results to appear, because the analysis is performed on-the-fly.
The results of the analysis are published in:
Donchyts et.al, 2016, Nature Climate Change
Powered by
Google Earth Engine
2000
1985
2000
2015
1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
Changes
2015
2000
Google
Deltares
Imagery ©2016 TerraMetrics
5 km
Terms of Use

Objects and Methods are the Same!

- Both the Javascript and Python APIs provide access to the same set of Earth Engine objects and methods...
- … except… a few methods are capitalized differently
  - .and() vs. .And()
  - .or() vs. .Or()
  - etc.

The Docs Apply to Both!

Google Developers

Google Earth Engine API Search

tylere@google.com
Sign out

GUIDES REFERENCE TUTORIALS SEND FEEDBACK

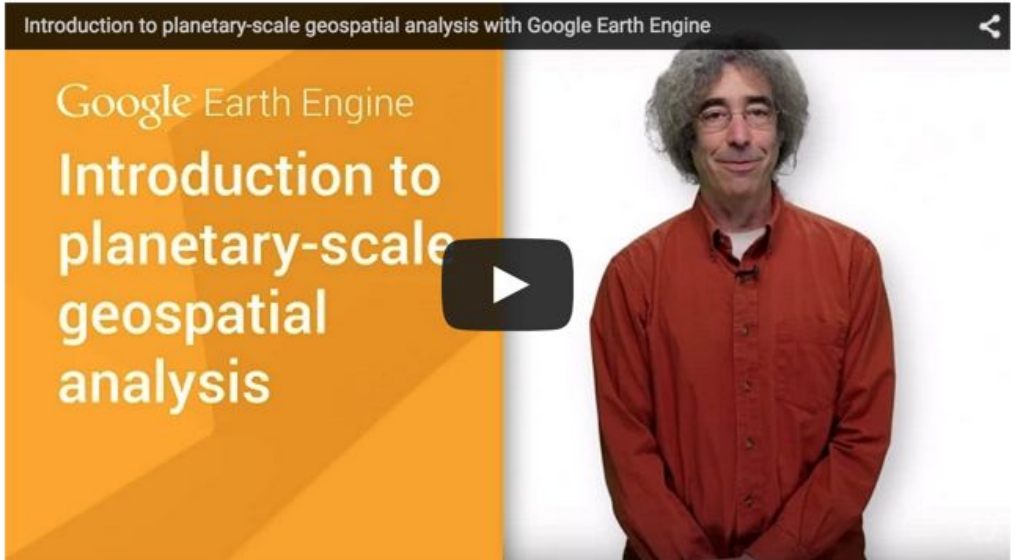
Developer's Guide

Introduction
Get Started
Earth Engine Playground
Python Installation

Image

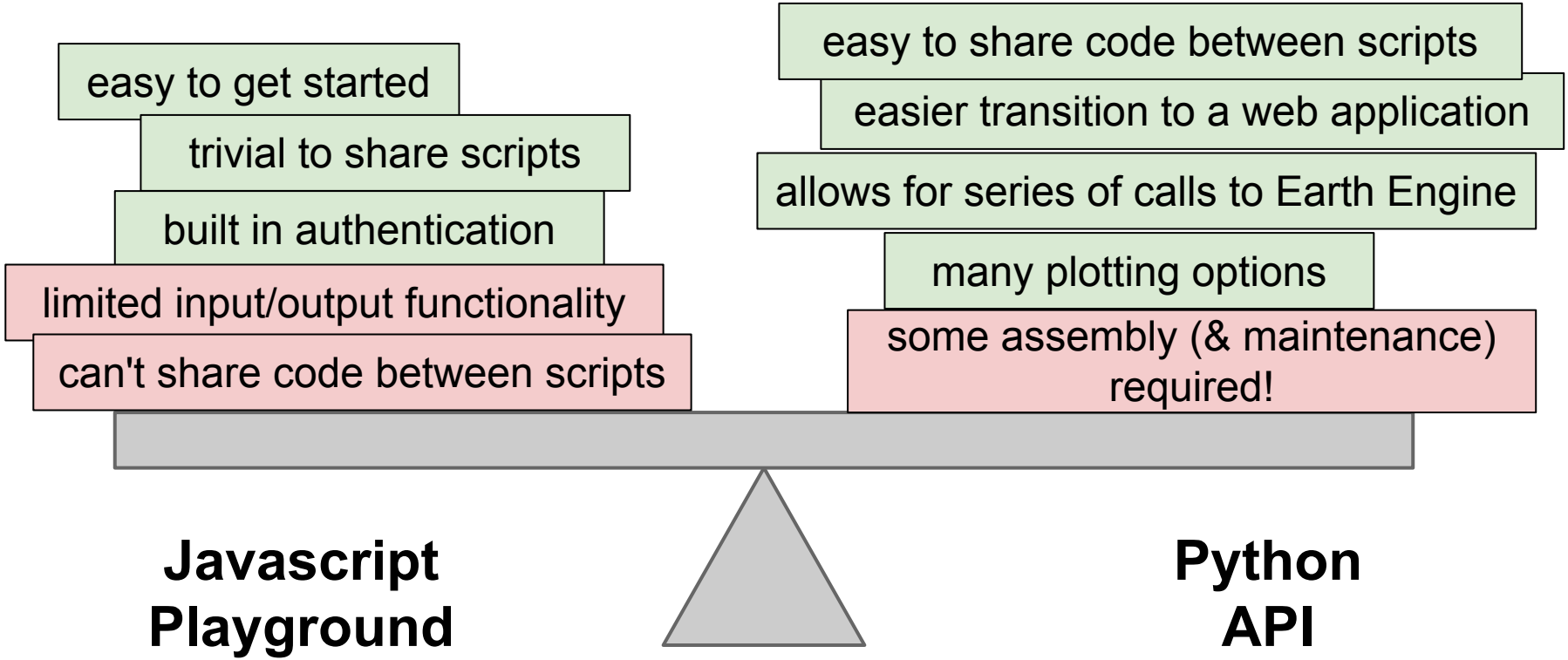
Image Overview
Image Visualization
Image Information and Metadata
Creating Images
Mathematical Operations
Relational, Conditional and Boolean Operations
Convolutions
Morphological Operations
Gradients
Edge Detection
Spectral Transformations

Explore the pages in this documentation to learn and explore the vast capabilities of Google Earth Engine. For a three-minute introduction to Earth Engine from developer advocate Dave Thau, check out the following video:

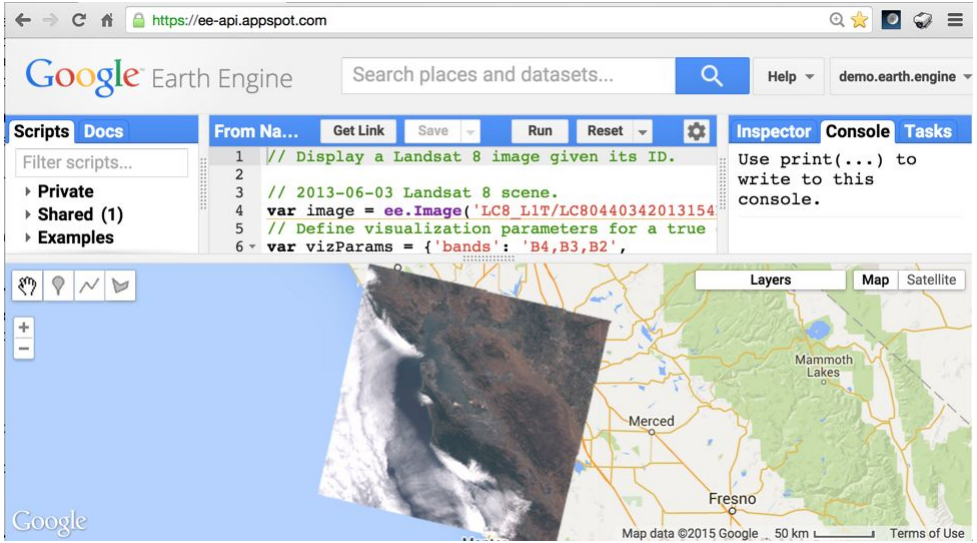


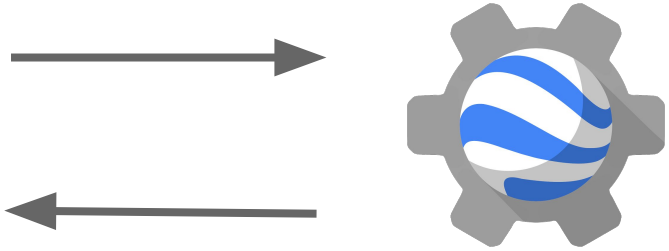
Contents

Earth Engine: Javascript vs. Python



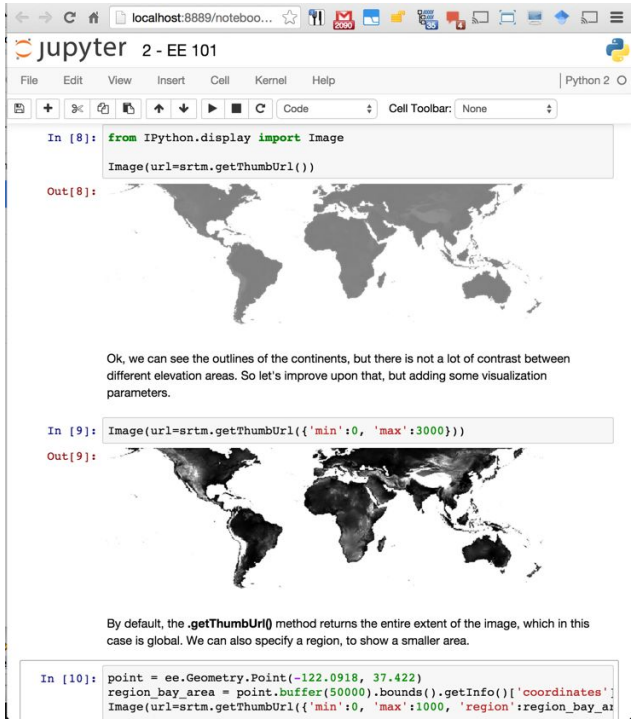
Interaction with the Javascript Playground





Earth Engine

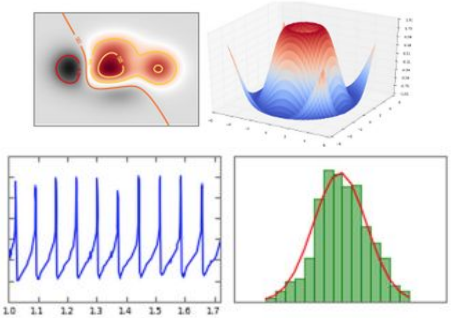
Interaction with Python



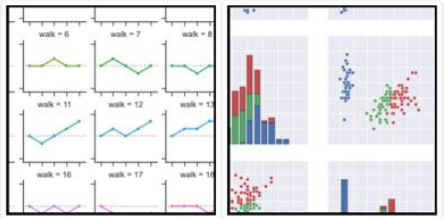
Python Script

Earth Engine

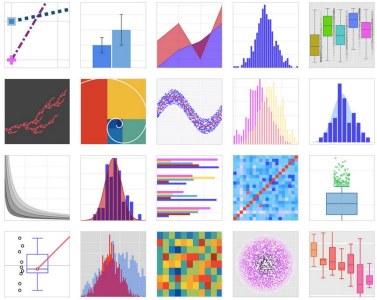
Python Plotting Packages



matplotlib



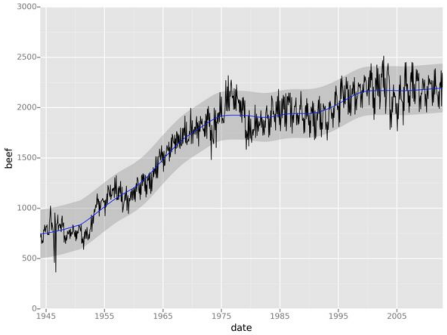
seaborn



plotly

bokeh

pygal



ggplot

Python Environment Setup

- Everyone's Python environment is different!
- Many Python libraries depend on non-Python code, that is different on each machine
- Multiple Python packaging solutions exist... there is no single community standard
  - easy_install
  - pip
  - wheel
  - conda

Python Environment Setup

- Manual Install
  - Currently used by EE Docs
  - Potentially separate install for every OS, Python package version

- Conda Install
  - Packages up Python code and dependencies
  - Separate packages for Linux, OSX, Windows

- Docker Containers
  - Packages up OS (Linux), Python code & dependencies
  - Standardized on Linux containers

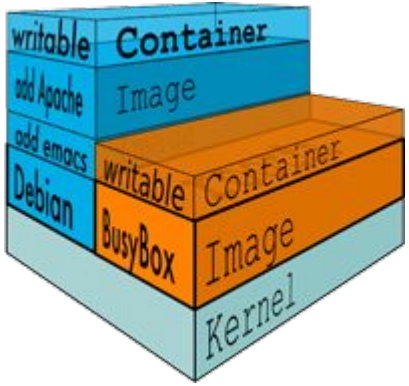
Civilization

Using Docker Containers for Setting up Your Environment

Google Earth Engine

Docker Containers

- Containers provide an isolated environment for Python and non-Python code.
- Allows for defining a consistent set of libraries needed to run the Earth Engine Python API



Docker Containers

Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Pulse | Graphs | Settings

Branch: master docker-ee-stacks / docker-ee-datascience-notebook / Dockerfile Find file Copy path

tylere Added GDAL and TensorFlow 89e0b71 on Sep 20

1 contributor

35 lines (26 sloc) | 987 Bytes Raw Blame History

```
FROM jupyter/datascience-notebook@sha256:eca7b98d0a26a026aedf1ded6b505e334855e2e8d80b13b28747795cddb928a9

MAINTAINER Tyler Erickson <tylere@google.com>

USER root

# Install Earth Engine non-Python dependencies
RUN apt-get update && apt-get install -y \
    libssl-dev \
    libffi-dev \
    git \
    && apt-get clean && \
    rm -rf /var/lib/apt/lists/*

# Add Conda-Forge as a recognized conda channel
RUN conda config --add channels conda-forge
```

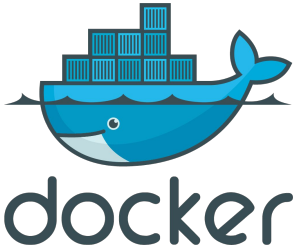
- Container definitions can be hosted on GitHub.

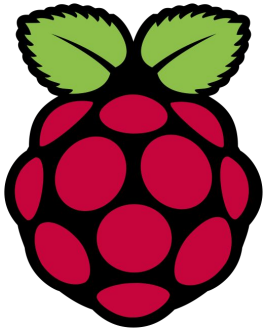
Containers Registries

- Publishing container definitions allows for easy access
- Container definitions can be published to:
  - Docker Hub and/or
  - Google Container Registry

Many Deployment Options

- Local (OSX, Windows, Linux)
- On a Virtual Machine
- Google Container Engine
- Amazon EC2 Container Service
- Microsoft Azure Container Service
- IBM Bluemix
- Raspberry Pi
- etc...





Hands on time!
(**locally** hosted Docker container)

Get Some Earth Engine Results

1. Pull a Docker container image

```
IMAGE = geohackweek2016/docker-ee-datascience-notebook
docker pull $image
```

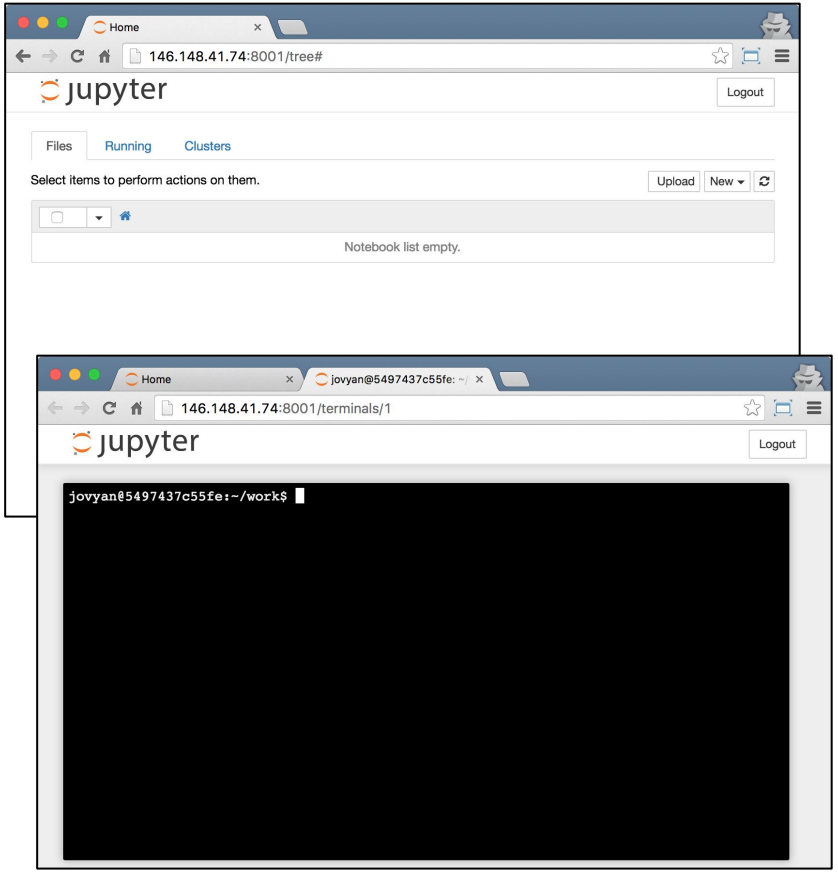
2. Start up the Docker container

```
LOCAL_WORKSPACE=~
docker run -d -p 8888:8888 \
    --name jupyter-ee \
    -v $LOCAL_WORKSPACE/work:/home/jovyan/work \
    -v $LOCAL_WORKSPACE/.config/earthengine:/home/jovyan/.config/earthengine \
    $IMAGE
```

3. Open up a browser and navigate to localhost:8888

Authenticating to Earth Engine

1. Select *New -> Terminal*
2. Type in:
   ```
   earthengine authenticate
   ```
3. Follow the instructions to complete authentication.
4. Try it out:
   ```
   python
   >>> import ee
   >>> ee.Initialize()
   ```



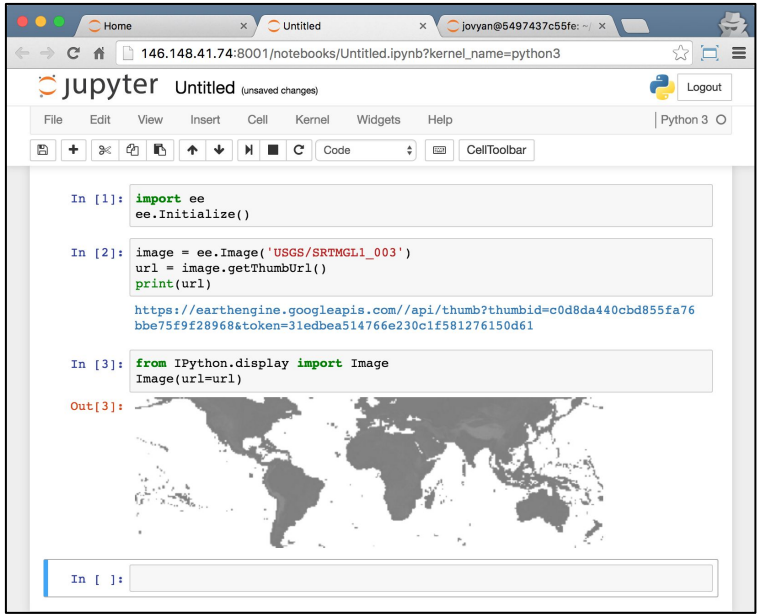
Get Some Earth Engine Results

1. Return to the Jupyter main window
2. Select *New -> Python 3*
3. Type in:

```
import ee
ee.Initialize()

image = ee.Image('USGS/SRTMGL1_003')
url = image.getThumbUrl()
print(url)

from IPython.display import Image
Image(url=url)
```



Get Some Earth Engine Results

1. Browse a GitHub repo
   https://github.com/tylere/ee-jupyter-examples
2. Get the GitHub URL
   https://github.com/tylere/ee-jupyter-examples.git
3. Open a Jupyter terminal window, and clone the repository
   `git clone https://github.com/tylere/ee-jupyter-examples.git`
4. Open up interesting notebooks

https://www.youtube.com/watch?v=8LZGBL4U3F4
https://github.com/tylere/jupyter_widget_gmaps
Needs updating for IPython 5 !!!

Resources

- Docker
  - https://www.docker.com/
  - https://hub.docker.com/
- Google Cloud Platform
  - https://cloud.google.com/compute/docs/containers/container_vms
- Jupyter
  - http://jupyter.org/
  - https://nbviewer.jupyter.org/

After the Workshop

- Please give us feedback on the course: https://goo.gl/yni9jE
- Review the workshop slides here: https://goo.gl/uFgLeU
- Read through the Earth Engine API Documentation, and work through tutorials.
- Join the Earth Engine Developers Group to learn about what others are doing with Earth Engine and to get your questions answered.

Google Earth Engine

Thank you