



ESRI MID-ATLANTIC USER CONFERENCE

Using Python Across the Platform

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Esri-NYC @JimBarry



So, what is Python?

- Free scripting language
- Syntax that is easy to learn and understand



Benefits:

1. Scalability
2. Integrated packages
3. Open source and community development

How do I get Python?

- Get Python - <https://www.anaconda.com/distribution/>
- Install Python - <https://docs.anaconda.com/anaconda/install/>
- Verify install - <https://docs.anaconda.com/anaconda/install/verify-install/>

Where do I write my Python Scripts?

- Terminal, **Notepad++**, Sublime, Idle, Visual Studio, PyCharm, Python window in Pro, **Jupyter notebooks**
- **Notepad / Sublime / Idle** – Stand alone script
- **Visual Studio / PyCharm** – Projects in Python
- **Jupyter Notebooks** – Stand alone scripts, Projects, Tutorials

Python is Everywhere



arcpy

Python package, provides scripting interface for desktop GIS:

ArcMap

ArcGIS Pro

Use, automate, and extend Desktop GIS

arcgis

Python package, provides scripting interface for Web GIS:

ArcGIS Online

ArcGIS Enterprise (Portal)

Use, automate, and extend Web GIS

arcpy

- Automatic geoprocessing tasks
- Create, edit, and manage data, vector and raster
- Integrate other Python packages into your work
- Work with ArcGIS Pro interactively
- Author Geoprocessing Services
- Map automation
- Write add-ins

› Data Access module

› Image Analyst module

› Mapping module

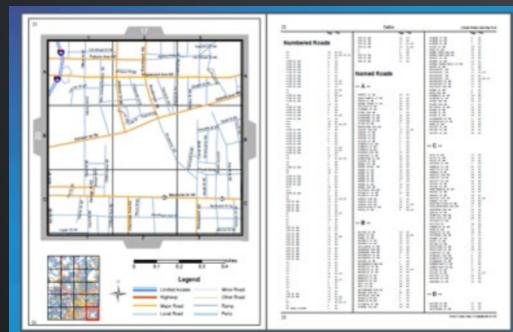
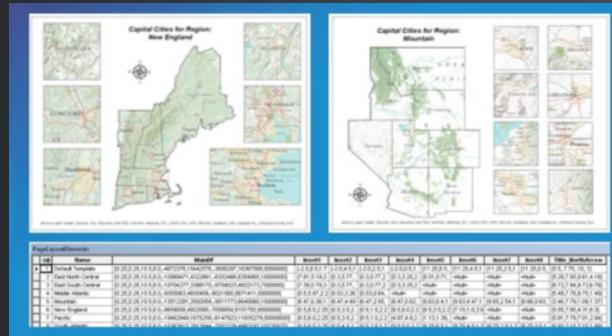
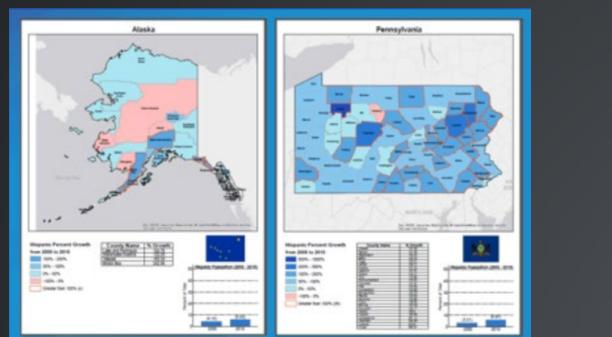
› Network Analyst module

› Sharing module

› Spatial Analyst module

› Workflow Manager module

Map automation samples - esriurl.com/8899



ArcGIS Pricing Map Scene Help Sign In

Python Map Automation / arcpy.m(a)p(ping)

Overview Content Members

Search group content

1 - 10 of 10

Filters

Item Type

- Maps
- Layers
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Location

Date Modified

Tags

MapSeries_LayoutManager_Pro24

Code Sample by MapAutomationTeam

Manage layout elements (inset maps, text, north arrows) on different pages in a map series using a single layout that has map series enabled.

Created: Oct 24, 2019 Updated: Oct 24, 2019 Number of Downloads: 151

GenerateMapBookWithIndexPages_10_v2

Code Sample by MapAutomationTeam

This sample combines the use of Data Driven Pages, arcpy.mapping, and a 3rd party PDF design toolkit called ReportLab all together to create a final map book product with index pages.

Created: Jun 26, 2012 Updated: Apr 27, 2016 Number of Downloads: 4,392

Local Government Basemaps for Basic Web Map Printing/Exporting Using arcpy.mapping Tutorial (v 10.1+)

Map Template by MapAutomationTeam

This data is used for the basic web map printing/exporting using arcpy.mapping tutorial.

Created: Mar 19, 2015 Updated: Mar 19, 2015 Number of Downloads: 317

MapBooksInPro_Pro1.0_v1

Code Sample by MapAutomationTeam

Uses arcpy.mp in ArcGIS Pro to simulate many of the Data Driven Pages capabilities in ArcMap to produce a mapbook.

Created: Mar 6, 2015 Updated: Mar 9, 2015 Number of Downloads: 659

DDPwithDynamicTablesAndGraphs_10.1_v1

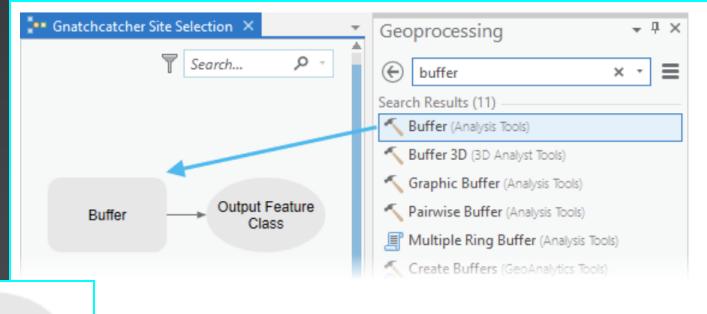
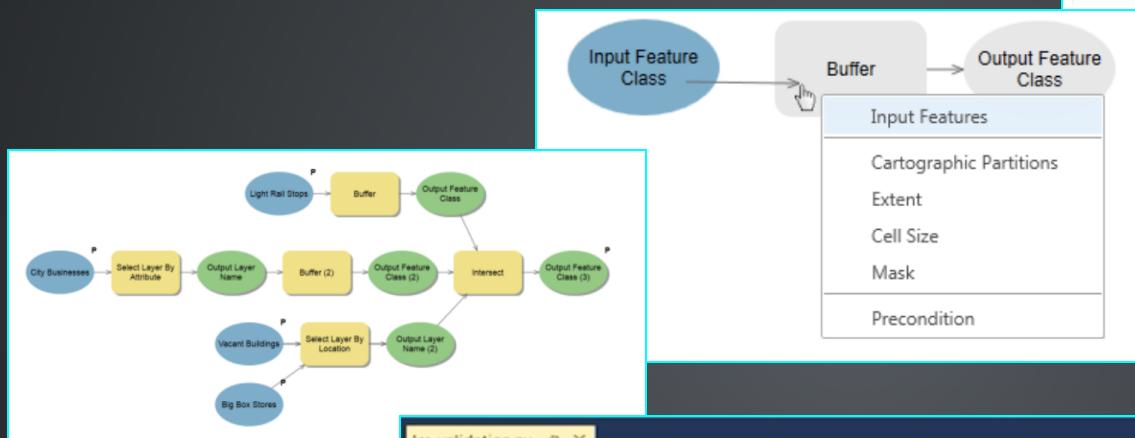
Code Sample by MapAutomationTeam

Use the new arcpy.mapping cloning capabilities to build dynamic tables in a layout

Created: Jul 9, 2012 Updated: Apr 16, 2013 Number of Downloads: 5,307

MultipleElementLayoutManager_10.0_v1

Model Builder - export to Python



```
if self.params[0].valueAsText and self.params[1].valueAsText:

    input_boundary = arcpy.Describe(self.params[0]).extent.polygon
    clip_boundary = arcpy.Describe(self.params[1]).extent.polygon

    disjoint = input_boundary.disjoint(clip_boundary)

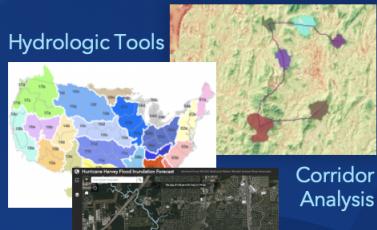
    #if disjoint: # right
    if not disjoint: # wrong
        self.params[1].setErrorMessage('Clip area outside raster boundary')

return
```

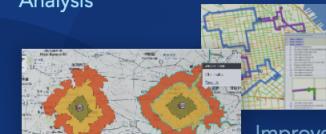
Spatial Analysis & Data Science in ArcGIS Pro

Spatial Analysis

Hydrologic Tools



Corridor Analysis



Flood Modeling

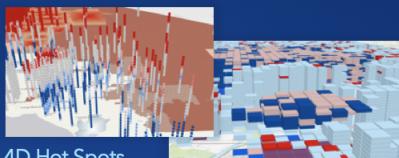


Data Clock

Data Understanding



4D Hot Spots



Outlier Analysis



Out-of-the-box Machine Learning and AI

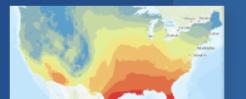
Training Data Preparation



Empirical Bayesian Kriging Regression Prediction



Density-Based Clustering



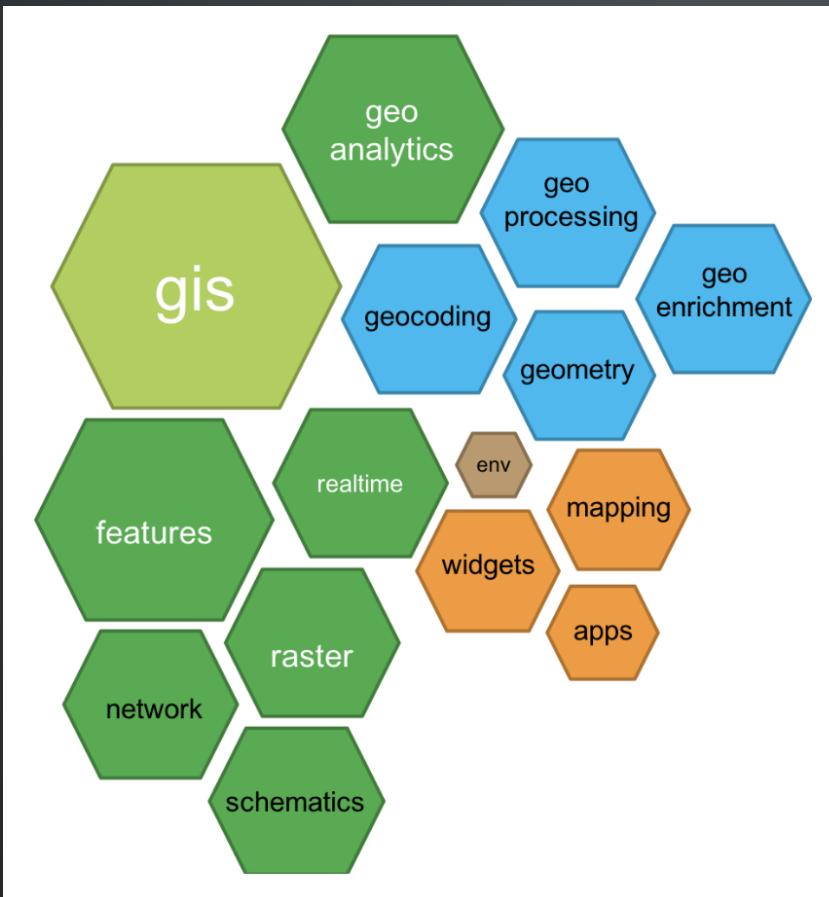
Forest-Based Classification and Regression



Open Libraries & Frameworks

arcgis *[python module]*

ArcGIS API for Python



- Feature data and analysis
- Working with the Spatially Enabled DataFrame
- Imagery and raster analysis
- Working with big data
- Using geoprocessing tools
- Finding places with geocoding
- Performing network analyses
- Enriching GIS data with thematic information
- Mapping and visualization
- Managing ArcGIS applications
- Deep Learning with ArcGIS



ArcGIS API for Python

A powerful Python library for spatial analysis, mapping, and GIS.

[Get Started](#)

Version 1.7.0 · Oct 31, 2019

[Install the API](#)[Get started](#)[View Sample Notebooks](#)

Get started

Use tutorials to add the ArcGIS API for Python to your Jupyter notebook.

Guide

Learn how to do mapping, geocoding, routing, and spatial analysis.

Sample Notebooks

Get Jupyter notebooks for mapping, visualization, and spatial analysis (Available on GitHub).

API Reference

Documentation for all ArcGIS API for Python classes, methods, and properties.



Understand your GIS

This "hello world" style notebook shows how to get started with the GIS and visualize its contents.

[Get started with the GIS class](#)

Manage your GIS

The ArcGIS API for Python provides APIs and samples for ArcGIS Online administrators to manage their online organization.

[Clone a portal](#)

Perform Spatial Analysis

Call sophisticated spatial analysis tools that work with online content, using a few lines of code.

[Chennai floods analysis](#)

ArcGIS API for Python

What can it do for you?

Platform API
**Power Users
Developers**

Enterprise Integration

Users, Roles & Group management



**Administrators
DevOps**

Your Web GIS

A Pythonic representation of GIS

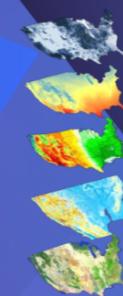
Spatial Analysis

Imagery

Location Analytics

Analysts

Big Data



Raster Analytics

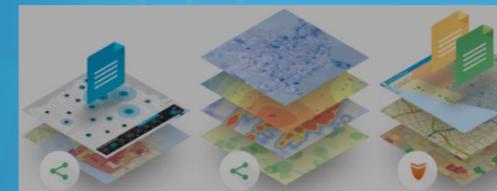


Feature Analytics



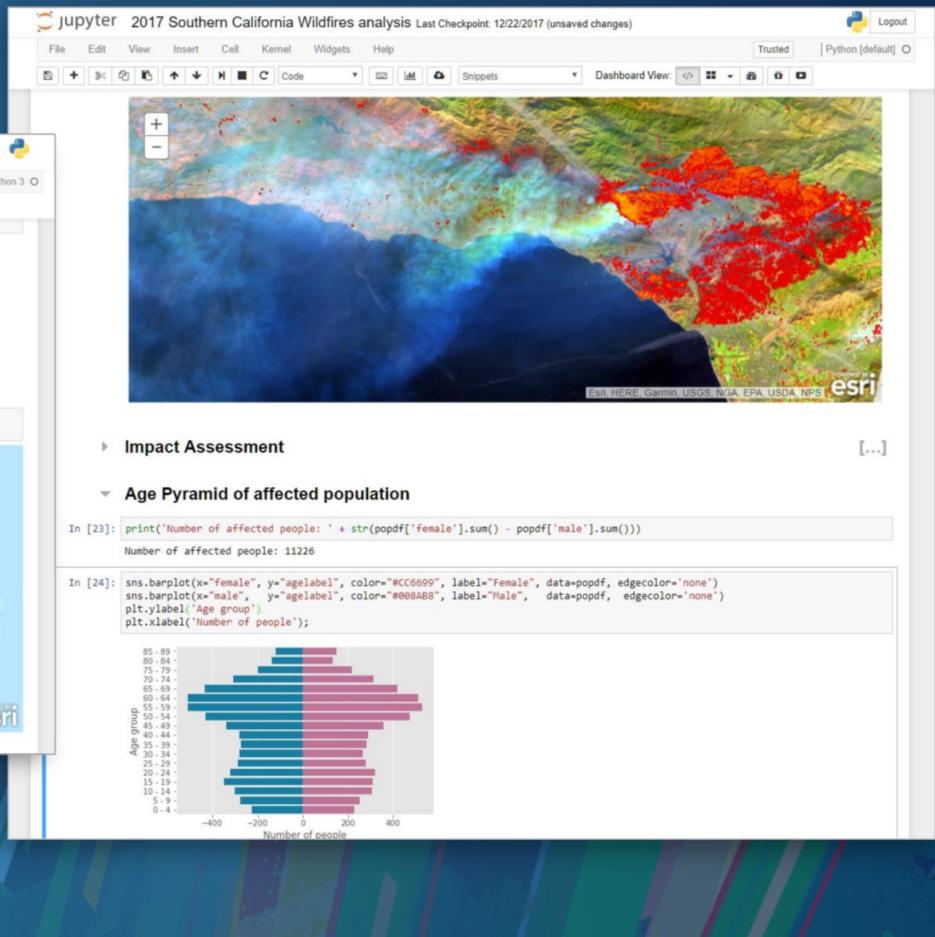
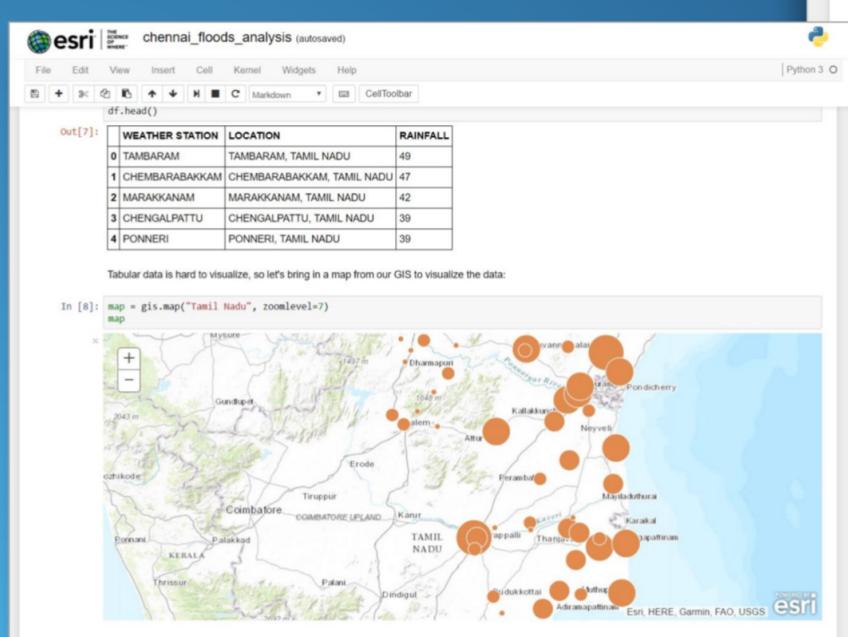
Data Scientists

Content Publishers



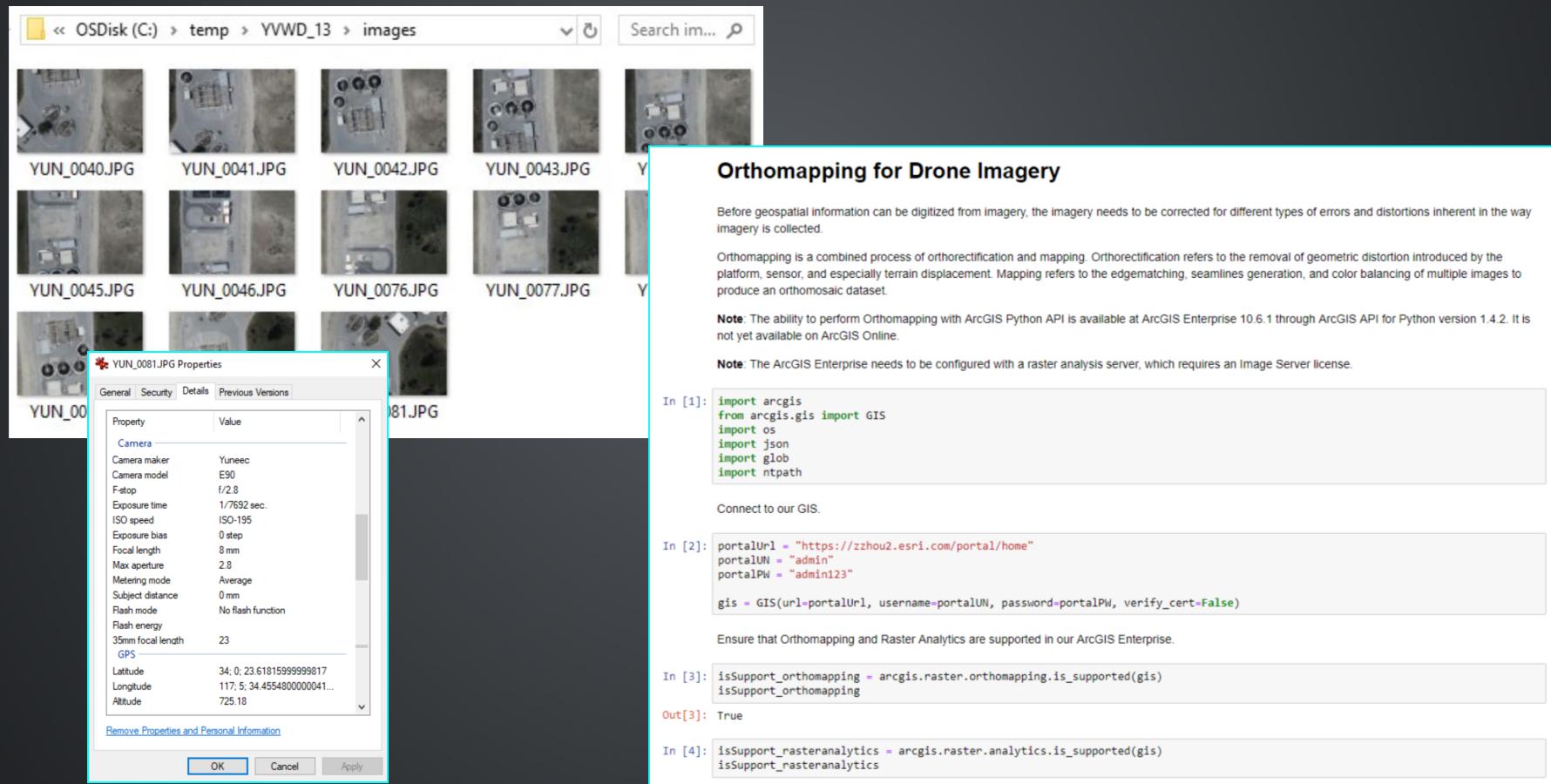
Data Management

ArcGIS + Jupyter = ❤



Drone2Map for ArcGIS

arcgis.raster.orthomapping module



The image shows a file explorer window and a Jupyter Notebook interface. The file explorer displays a folder structure: 'OSDisk (C:) > temp > YVWD_13 > images'. Inside the 'images' folder, there are several JPEG files: YUN_0040.JPG, YUN_0041.JPG, YUN_0042.JPG, YUN_0043.JPG, YUN_0045.JPG, YUN_0046.JPG, YUN_0076.JPG, YUN_0077.JPG, and YUN_0081.JPG. A 'Properties' dialog box is open for 'YUN_0081.JPG', showing camera metadata such as Camera maker (Yuneec), Camera model (E90), F-stop (f/2.8), and Exposure time (1/7692 sec.). The Jupyter Notebook cell contains Python code for orthomapping:

```
In [1]: import arcgis
from arcgis.gis import GIS
import os
import json
import glob
import ntpath
```

Connect to our GIS.

```
In [2]: portalUrl = "https://zzhou2.esri.com/portal/home"
portalUN = "admin"
portalPW = "admin123"

gis = GIS(url=portalUrl, username=portalUN, password=portalPW, verify_cert=False)
```

Ensure that Orthomapping and Raster Analytics are supported in our ArcGIS Enterprise.

```
In [3]: isSupport_orthomapping = arcgis.raster.orthomapping.is_supported(gis)
isSupport_orthomapping
```

```
Out[3]: True
```

```
In [4]: isSupport_rasteranalytics = arcgis.raster.analytics.is_supported(gis)
isSupport_rasteranalytics
```

```
Out[4]: True
```

What is Ortho Mapping?

A technology used to process remote sensing images and produce ortho imagery products

Satellite, Drone, and aerial photograph



Raw images

Ortho Mapping

Mapping and analysis with imagery in GIS



Ortho Mosaic/DSM/DTM

arcgis.raster.orthomapping module

Jupyter Demo_DevSummit Part 1 Last Checkpoint: 2 hours ago (autosaved)

File Edit View Insert Cell Kernel Widgets Help

Notebook saved Trusted Python 3

1.1.2 Upload images into the project folder

```
In [10]: imageFolderPath = r"c:\temp\YvWD_13\images"
imageList = glob.glob(os.path.join(imageFolderPath, '*.JPG'))
imageItemList = []
itemPropTemplate = {"type": "Image"}

for imageFullPath in imageList:
    imageName = ntpath.split(imageFullPath)[1]
    itemPropTemplate["title"] = imageName
    itemPropTemplate["tags"] = imageName
    itemPropTemplate["description"] = imageName

    imageItem = gis.content.add(item_properties=itemPropTemplate, data=imageFullPath, owner=portalUN,
    imageItemList.append(imageItem)
```

Construct the GPS array structure - [[imageName1, gpsLatitude1, gpsLongitude1, gpsAltitude1]...]

```
In [15]: gps = [[ntpath.split(image)[1],
    find_lat_long_alt(image, 'GPS GPSLatitude'),
    find_lat_long_alt(image, 'GPS GPSLongitude'),
    find_lat_long_alt(image, 'GPS GPSAltitude')] for image in imageList]
```

Construct the camera properties dictionary structure - {"maker", "model", "focalLength", "columns", "rows", "pixelSize"}. We can query camera database with `arcgis.raster.orthomapping.query_camera_info()`

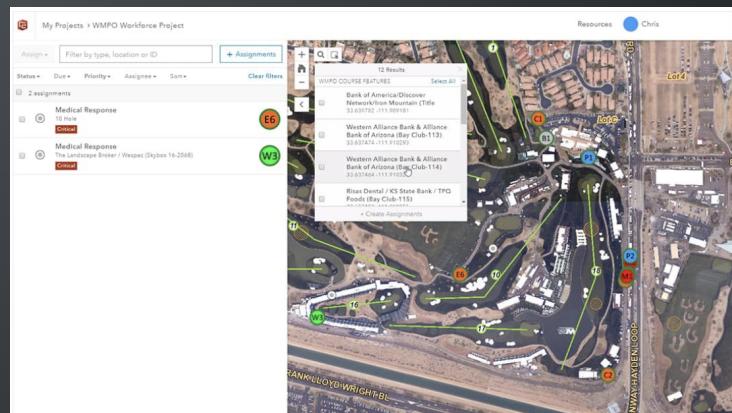
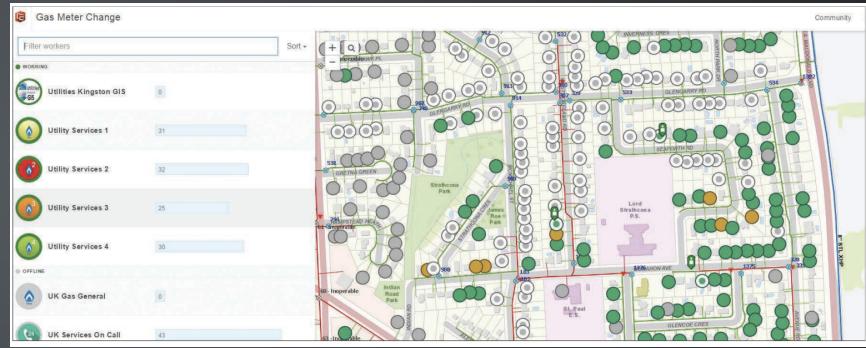
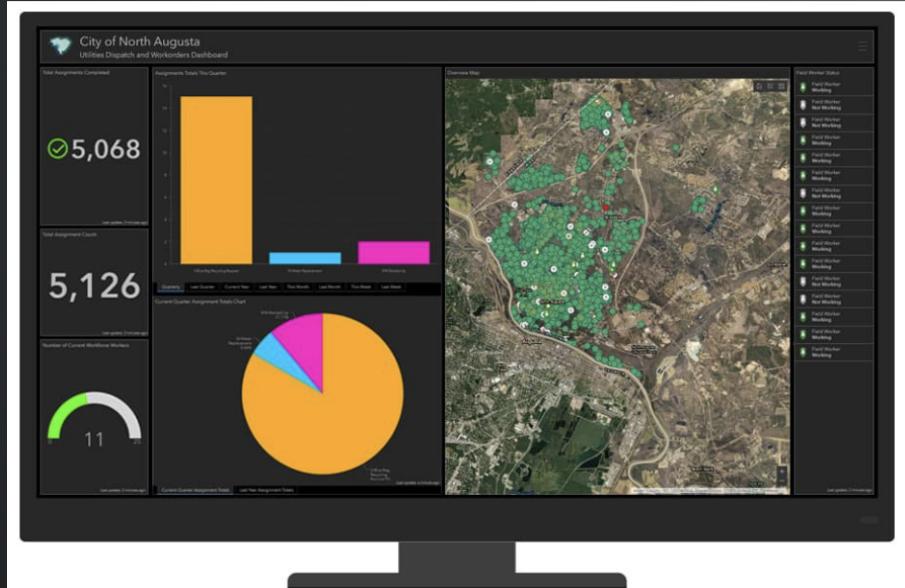
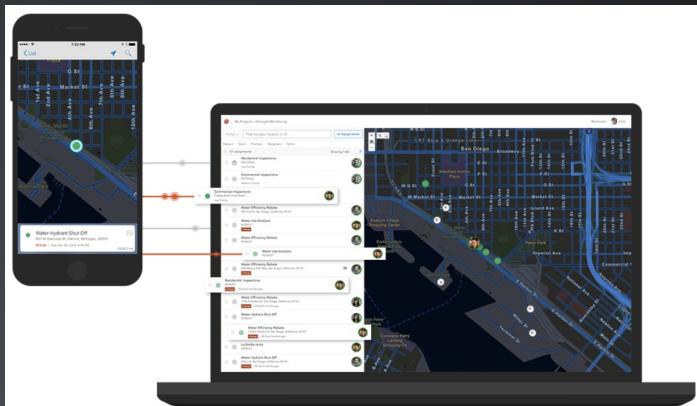
```
In [13]: arcgis.raster.orthomapping.query_camera_info(camera_query="Make='Yuneec'")
cameraProperties = {"maker": "Yuneec", "model": "E90", "focalLength": 8, "columns": 5472, "rows": 3648, "pixelSize": 0.0024}
```

Marker	Model	Focal Length	Columns	Rows	Pixel Size	
0	Yuneec	E90	8.0	5472	3648	0.0024



Workforce for ArcGIS

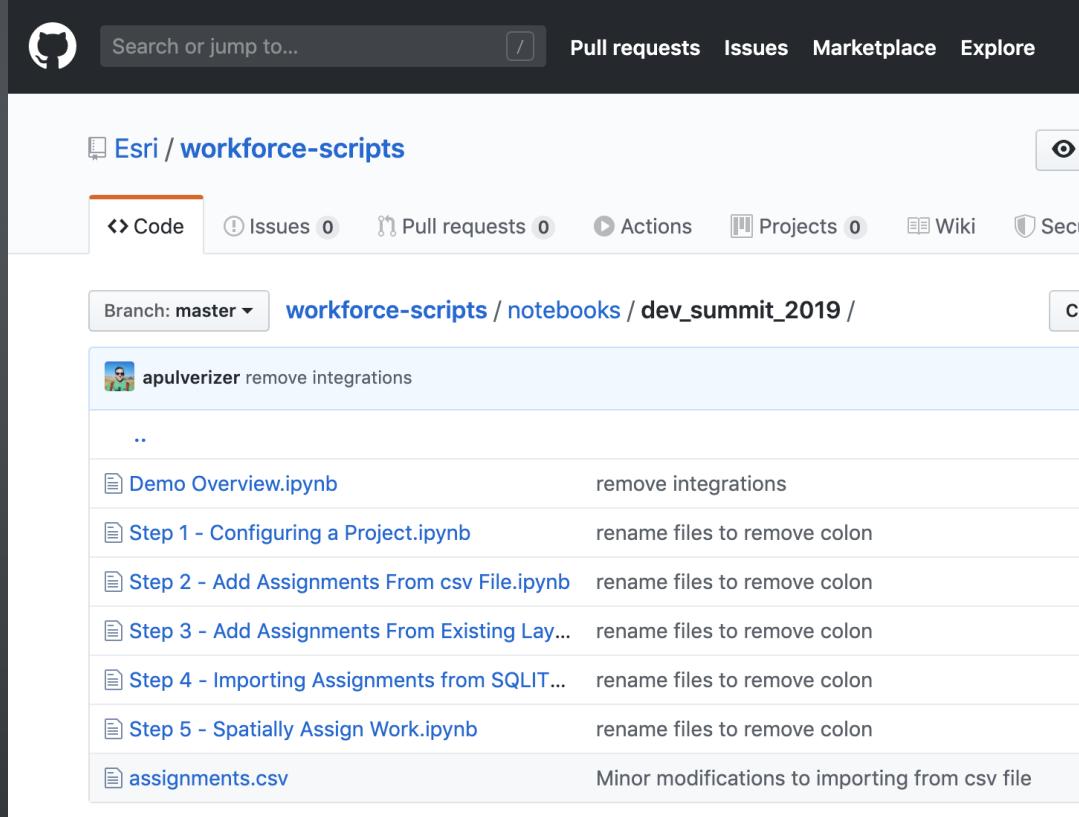
Field workforce coordination



Import ArcGIS API for Python

Import the `arcgis` library and some modules within it.

```
In [ ]: import arcgis
         from arcgis.apps import workforce
         from arcgis.gis import GIS
```



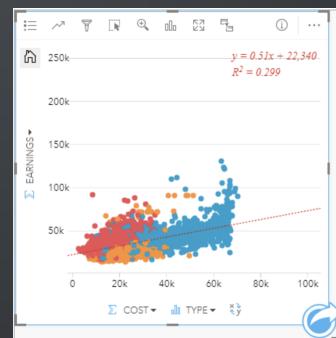
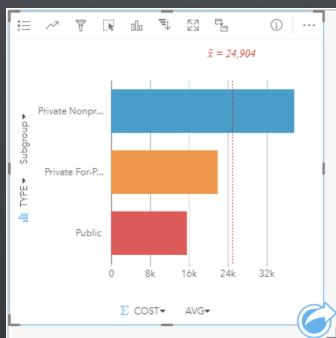
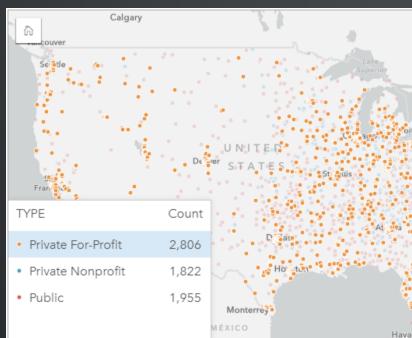
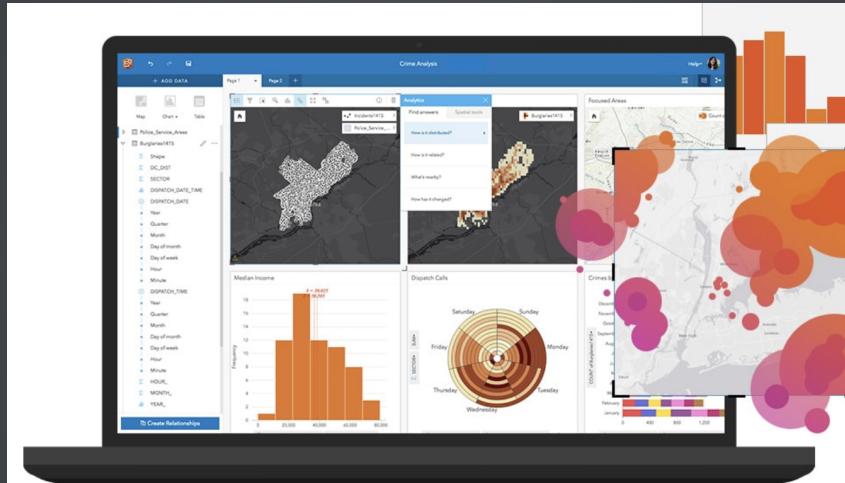
The screenshot shows a GitHub repository page for the 'Esri / workforce-scripts' repository. The repository has 0 issues, 0 pull requests, 0 actions, 0 projects, and 0 wiki pages. The current branch is 'master'. The page lists several notebooks and their descriptions:

File	Description
remove integrations	apulverizer
Demo Overview.ipynb	remove integrations
Step 1 - Configuring a Project.ipynb	rename files to remove colon
Step 2 - Add Assignments From csv File.ipynb	rename files to remove colon
Step 3 - Add Assignments From Existing Lay...	rename files to remove colon
Step 4 - Importing Assignments from SQLIT...	rename files to remove colon
Step 5 - Spatially Assign Work.ipynb	rename files to remove colon
assignments.csv	Minor modifications to importing from csv file

ArcGIS Insights

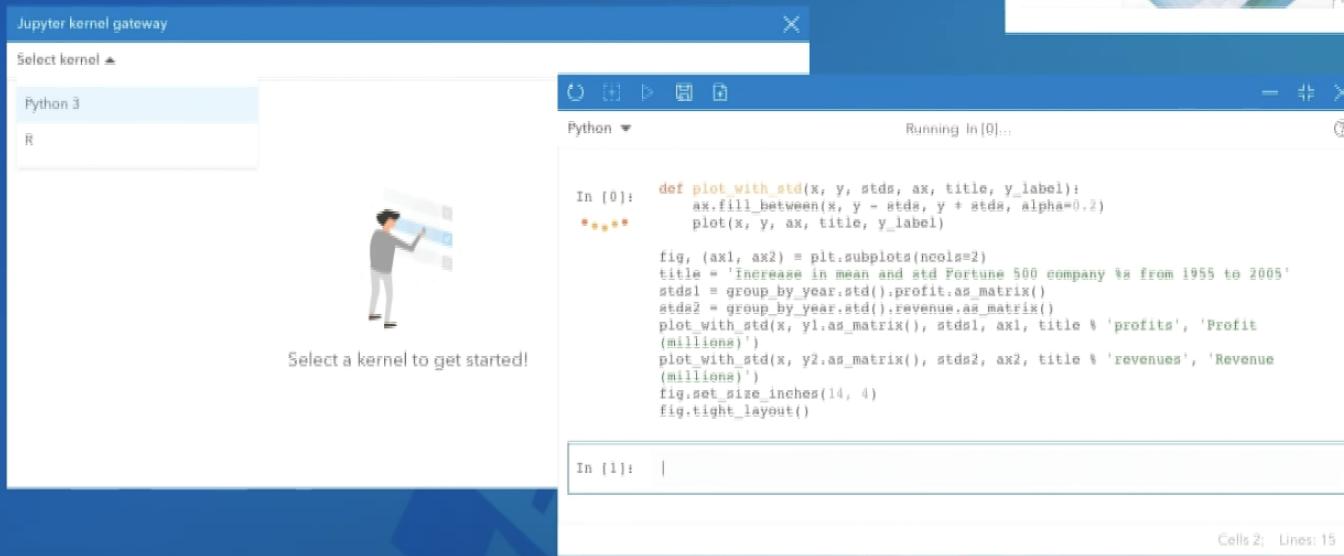
analysis software:

fuses location analytics with open data science and business intelligence workflows



Python and R with Insights

- Extend your analysis using Python and/or R
- Incorporate visualizations as cards
- Manage data



Jupyter kernel gateway

Select kernel ▾

Python 3

R

Select a kernel to get started!

Python

In [0]:

```
def plot_with_std(x, y, stds, ax, title, y_label):
    ax.fill_between(x, y - stds, y + stds, alpha=0.2)
    plot(x, y, ax, title, y_label)

fig, (ax1, ax2) = plt.subplots(ncols=2)
title = 'Increase in mean and std Fortune 500 company is from 1955 to 2005'
stds1 = group_by_year.std().profit.as_matrix()
stds2 = group_by_year.std().revenue.as_matrix()
plot_with_std(x, y1.as_matrix(), stds1, ax1, title + 'profits', 'Profit (millions)')
plot_with_std(x, y2.as_matrix(), stds2, ax2, title + 'revenues', 'Revenue (millions)')
fig.set_size_inches(14, 4)
fig.tight_layout()
```

Out [0]:



Running In [0]...

In [1]:

```
def plot_with_std(x, y, stds, ax, title, y_label):
    ax.fill_between(x, y - stds, y + stds, alpha=0.2)
    plot(x, y, ax, title, y_label)

fig, (ax1, ax2) = plt.subplots(ncols=2)
title = 'Increase in mean and std Fortune 500 company is from 1955 to 2005'
stds1 = group_by_year.std().profit.as_matrix()
stds2 = group_by_year.std().revenue.as_matrix()
plot_with_std(x, y1.as_matrix(), stds1, ax1, title + 'profits', 'Profit (millions)')
plot_with_std(x, y2.as_matrix(), stds2, ax2, title + 'revenues', 'Revenue (millions)')
fig.set_size_inches(14, 4)
fig.tight_layout()
```

Cells 2/ Lines: 15

Cells 2/ Lines: 15



+ ADD

Introduction

Regional Overview

State Patterns

Python

R

Sharing results

+



% years of data

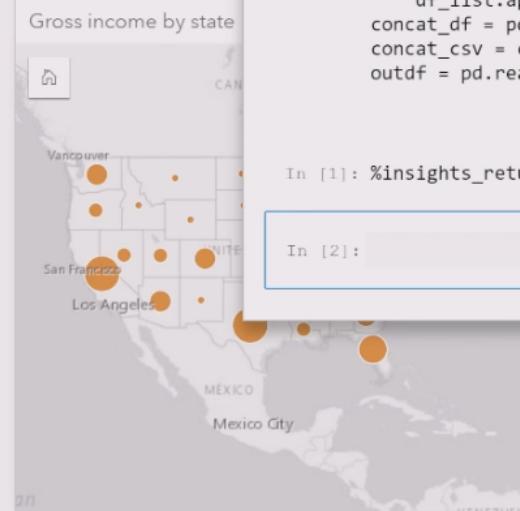
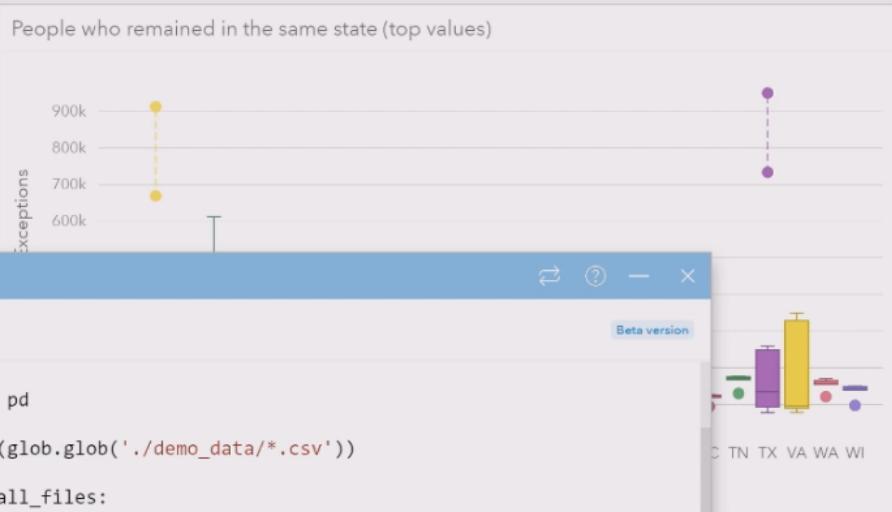
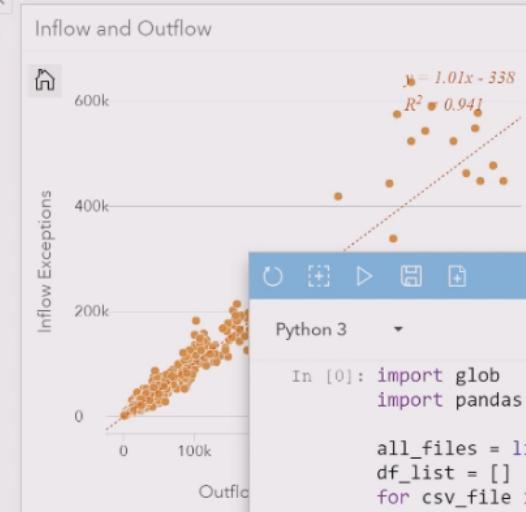
- State FIPS
- State Abbr
- State Name
- Years
- Adjusted gross income
- Total Returns
- Total Exceptions
- Total Returns Adj Gross Incom...
- Total Returns Adj Gross Incom...
- Non Migrant Returns
- Non Migrant Exceptions
- Outflow Returns
- Outflow Exceptions
- Inflow Returns
- Inflow Exceptions
- Same State Returns
- Same State Exceptions

Migration5yrs

Map 2

Box Plot 1

Create Relationships



Python 3

Beta version

```
In [0]: import glob
import pandas as pd

all_files = list(glob.glob('./demo_data/*.csv'))
df_list = []
for csv_file in all_files:
    df = pd.read_csv(csv_file)
    df_list.append(df)
concat_df = pd.concat(df_list, ignore_index=True, sort=False)
concat_csv = concat_df.to_csv('./allfiles.csv', index=False)
outdf = pd.read_csv('./allfiles.csv')

In [1]: %insights_return(df)

In [2]:
```



ArcGIS Runtime Local Server

- ArcGIS Runtime SDKs
 - Create native apps, mobile, desktop
- Desktop apps
 - Leverage Local Server for running offline GP tasks
- Perform analysis and geoprocessing that's not natively supported in the Runtime core.
- Requires a GP Package (.gpkx or .gpk file), authored in ArcMap or Pro, with Model Builder or Python.

Learning Resources

- **W3Schools** - <https://www.w3schools.com/python/>
- **Python Tutorial** - <https://docs.python.org/3/tutorial/>
- **Books**
 - **Head First Python (O'Reilly)**
 - **Think Python: How to think like a Computer Scientist (O'Reilly)**
- **Arcpy**
 - <https://www.esri.com/training/>
 - **Python Scripting for ArcGIS (Esri Press)**
- **ArcGIS Python API** - <https://developers.arcgis.com/python/>
- **Exercises for practice** - <https://www.practicepython.org/>

developers.arcgis.com/labs

ArcGIS Tutorials

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 Manage Data	Download data Automate downloading data from the cloud using ArcGIS API for Python. Python	⌚ 10 minutes	 Manage Data	Import data Automate loading data into the ArcGIS Online cloud using ArcGIS API for Python. Python ArcGIS Online	⌚ 10 minutes
 Manage Data	Create data Add features to your own service using the ArcGIS API for Python. Python	⌚ 15 minutes	 Maps & Layers	Add a layer from an item Build an app that loads and displays a layer from ArcGIS Online. JavaScript Android iOS Java .NET Qt Python AppStudio	⌚ 10 minutes
 Maps & Layers	Display a web map Build an app to load and display a web map from ArcGIS Online. JavaScript Android iOS Java .NET Qt Python AppStudio	⌚ 10 minutes	 Maps & Layers	Display a web scene Build an app to load and display a 3D web scene from ArcGIS Online. JavaScript Android iOS .NET Python	⌚ 10 minutes
 Manage Data	Share maps and layers Automate sharing your layers or keeping them private. Python ArcGIS Online	⌚ 10 minutes	 Geocoding	Search for an address Build an app to find addresses and places with the ArcGIS World Geocoding Service. JavaScript Android iOS Java .NET Qt Python REST API	⌚ 10 minutes
 Geocoding	Find places Build an app to search for coffee shops, gas stations, restaurants, and other nearby places. JavaScript Android iOS Python REST API	⌚ 5 minutes	 Manage Data	Load Spatial Data Frame Load a spatial data frame from a feature layer for analytic workflows. Python	⌚ 10 minutes

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- ✓ Learn all the coding fundamentals in Python!
- ✓ Learn about all of the latest features in Python 3.6
- ✓ Make complex HTTP requests to APIs using Python
- ✓ Really Really Understand Object Oriented programming in Python
- ✓ Write your own Decorators and higher order functions
- ✓ Confidently work with Lambdas!
- ✓ Build games with Python
- ✓ Work with all the Python data structures: lists, dictionaries, sets, tuples, and more!
- ✓ Master built-in python functions like zip and filter
- ✓ Write your own custom modules
- ✓ Work through nearly 200 exercises and quizzes!
- ✓ Use Python to create an automated web crawler and scraper
- ✓ Master the quirks of Python style and conventions
- ✓ Learn testing and TDD (Test Driven Development) with Python
- ✓ Write your own Generators and other Iterators
- ✓ Master tricky topics like Multiple Inheritance and Polymorphism
- ✓ Build larger projects that span across multiple files
- ✓ Become an expert at list and dictionary comprehensions
- ✓ Handle errors and debug code
- ✓ Work with files, including CSV

GeoNet forums community.esri.com

The image shows a screenshot of the GeoNet forums interface, specifically the 'Community' section of the Esri website. The top navigation bar includes 'All Places', a search bar, and links for 'Follow', 'Actions', and 'Help'.

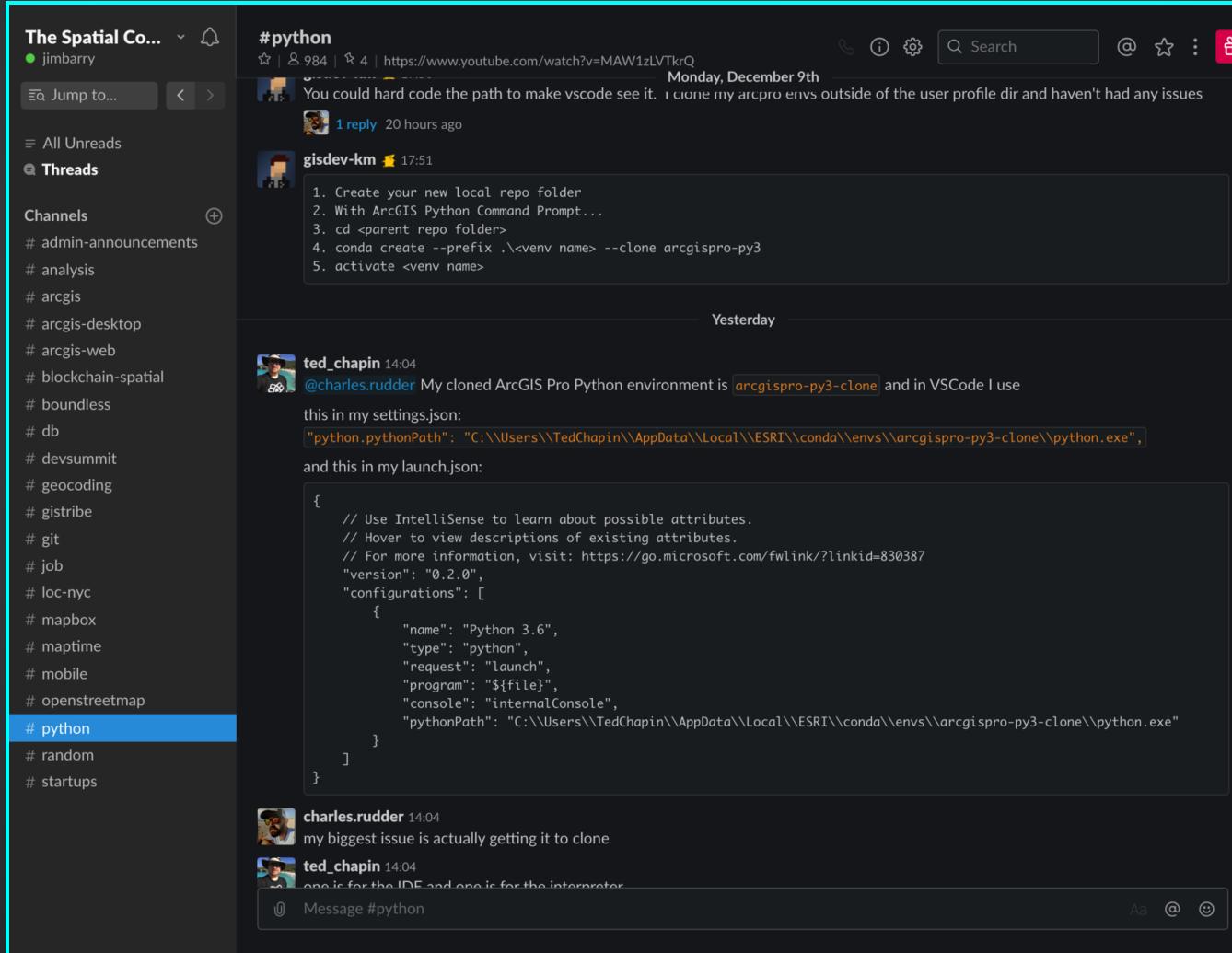
ArcGIS API for Python Forum:

- Header:** All Places > ArcGIS API for Python
- Actions:** Ask a Question, Start a discussion, Upload a file, Write a document, Write a blog post, Create a poll, Create a video, Create an event.
- Content:** Overview, Activity, Content (selected), People, Calendar.
- Header Buttons:** Follow, Actions, Help.
- Content Area:** All Content (1025) table with columns: Title, Author, Latest activity, Views, Likes, Comments, and a gear icon. The first item is 'PermissionError' by Lino Sun.
- Bottom Buttons:** Facebook, Twitter, Plus, 0.
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Python AddIns Forum:

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- Content Area:** All Content (52) table with columns: Title, Author, Latest activity, Views, Likes, Comments, and a gear icon. The first item is 'Created Feature Class temporary by default, need to save the mxd to keep it from being gone...' by Pier-Philippe Labrie.
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#python theSpatialCommunity.slack.com



The Spatial Co... Jump to... Threads

python

984 | https://www.youtube.com/watch?v=MAW1zLVTkrQ

Monday, December 9th

You could hard code the path to make vscode see it. I clone my arcpro envs outside of the user profile dir and haven't had any issues

1 reply 20 hours ago

gisdev-km 17:51

```
1. Create your new local repo folder
2. With ArcGIS Python Command Prompt...
3. cd <parent repo folder>
4. conda create --prefix .\<venv name> --clone arcgispro-py3
5. activate <venv name>
```

Yesterday

ted_chapin 14:04

@charles.rudder My cloned ArcGIS Pro Python environment is `arcgispro-py3-clone` and in VSCode I use this in my `settings.json`:

```
"python.pythonPath": "C:\\\\Users\\\\TedChapin\\\\AppData\\\\Local\\\\ESRI\\\\conda\\\\envs\\\\arcgispro-py3-clone\\\\python.exe",
```

and this in my `launch.json`:

```
{
  // Use IntelliSense to learn about possible attributes.
  // Hover to view descriptions of existing attributes.
  // For more information, visit: https://go.microsoft.com/fwlink/?linkid=830387
  "version": "0.2.0",
  "configurations": [
    {
      "name": "Python 3.6",
      "type": "python",
      "request": "Launch",
      "program": "${file}",
      "console": "internalConsole",
      "pythonPath": "C:\\\\Users\\\\TedChapin\\\\AppData\\\\Local\\\\ESRI\\\\conda\\\\envs\\\\arcgispro-py3-clone\\\\python.exe"
    }
  ]
}
```

charles.rudder 14:04

my biggest issue is actually getting it to clone

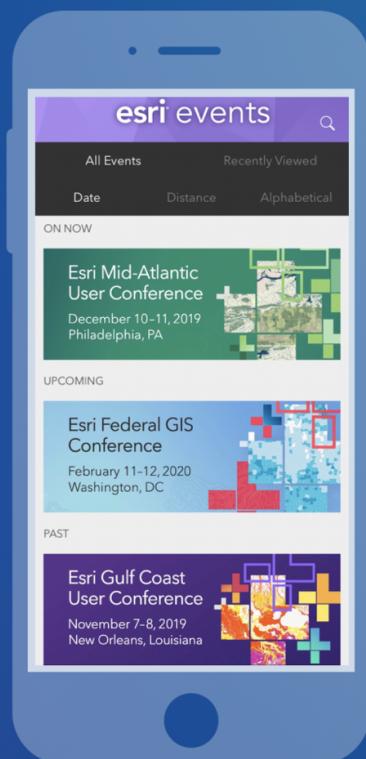
ted_chapin 14:04

`one` is for the IDE and `one` is for the interpreter

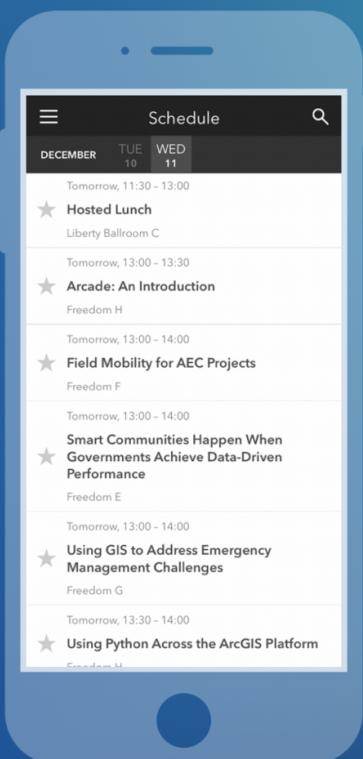
Message #python

Please Take Our Survey on the App

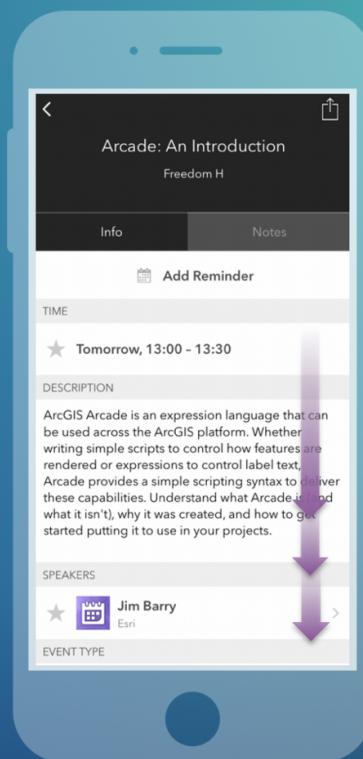
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