Using Deep Learning Models with ArcGIS to Extract Information From Imagery

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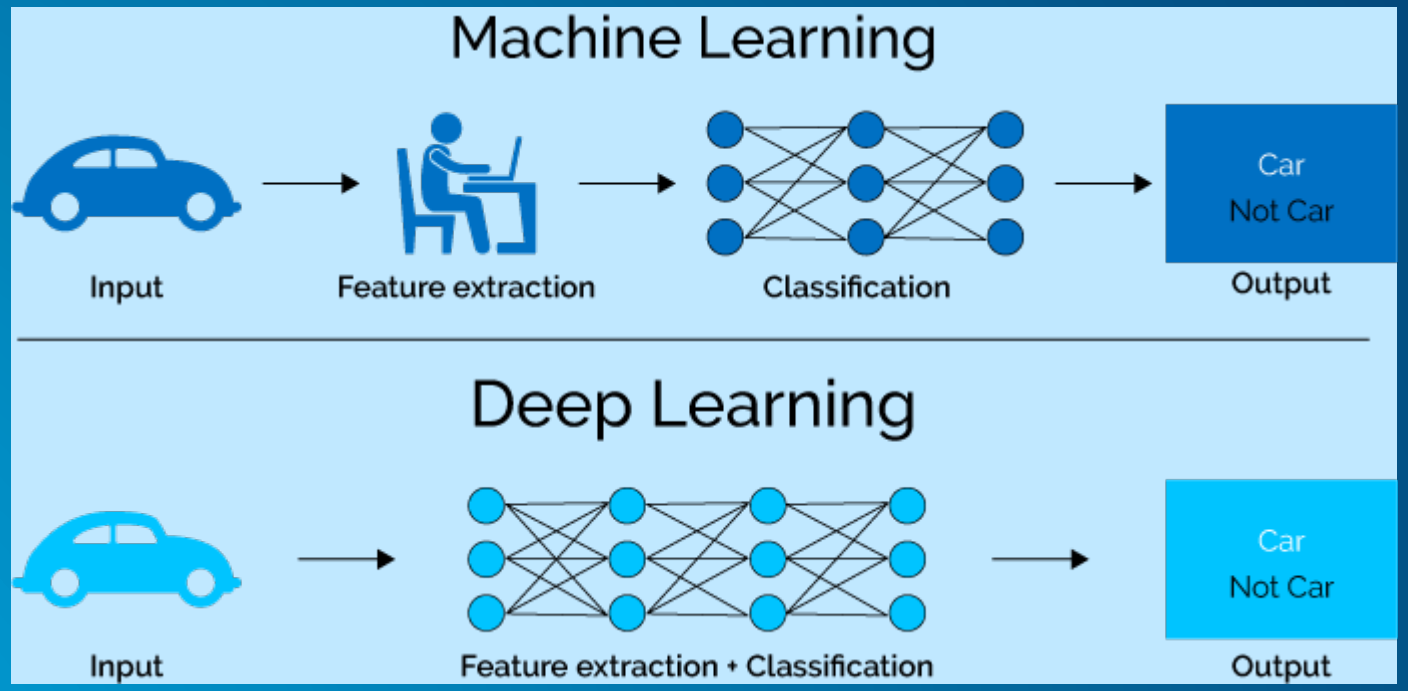
2019 ESRI DEVELOPER SUMMIT
Palm Springs, CA

Overview

- ArcGIS and Deep Learning integration for imagery information extraction
- Deep Learning tools in ArcGIS
  - Demo: create training samples
- Deep learning package
  - Demo: write python raster function for deep learning
  - Esri model definition
- Deep Learning Inference in ArcGIS
  - Demo: perform deep learning inference
- Resources
- Q & A

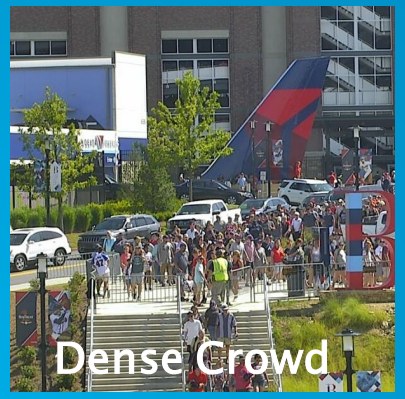
What is deep learning?



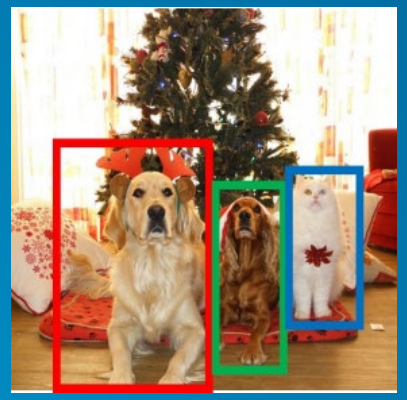
Deep Learning broadly refers to algorithms that break down complex problems using layered algorithm architectures known as “neural networks”, leveraging vast quantities of training data and compute power

Deep Learning: Use Cases

Image Classification



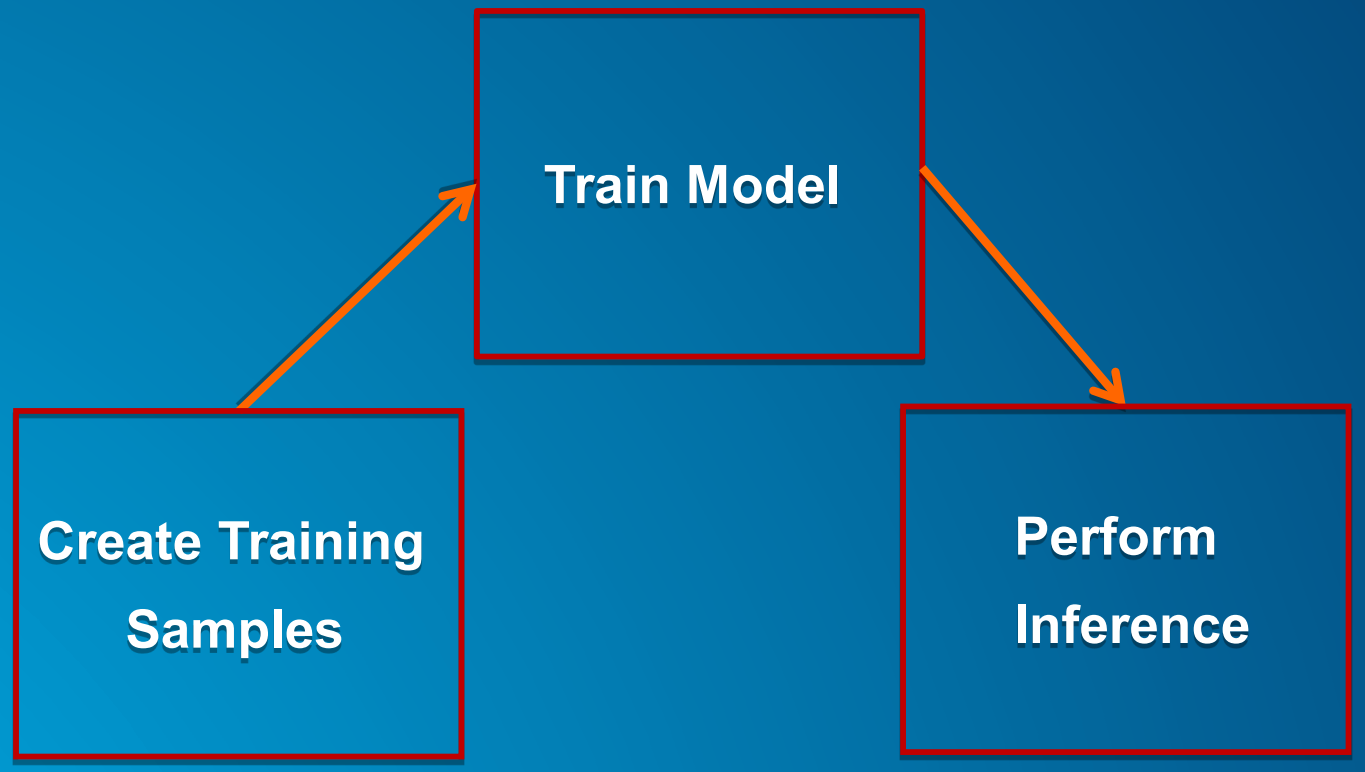
Object Detection



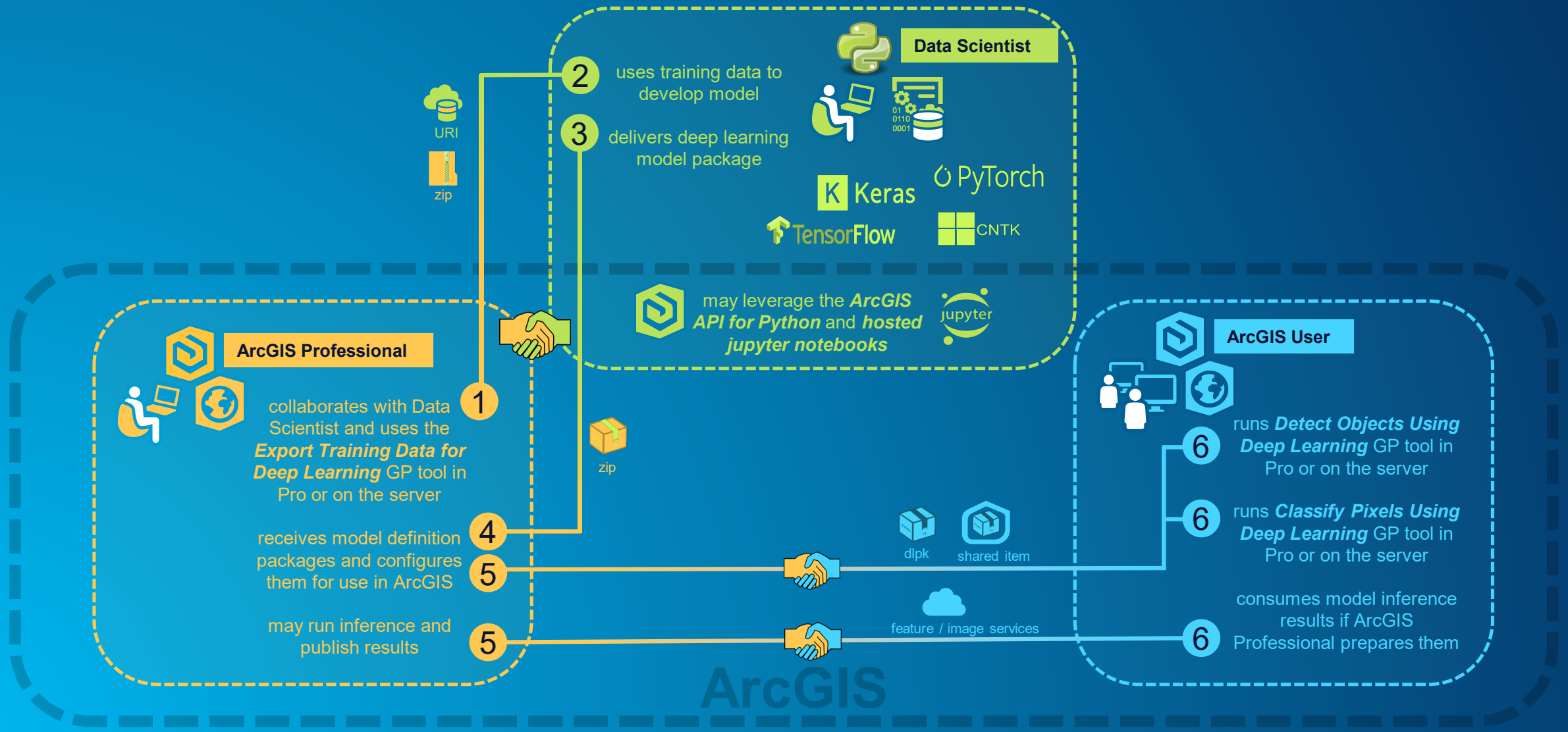
Semantic Segmentation

Instance Segmentation

Deep learning workflow

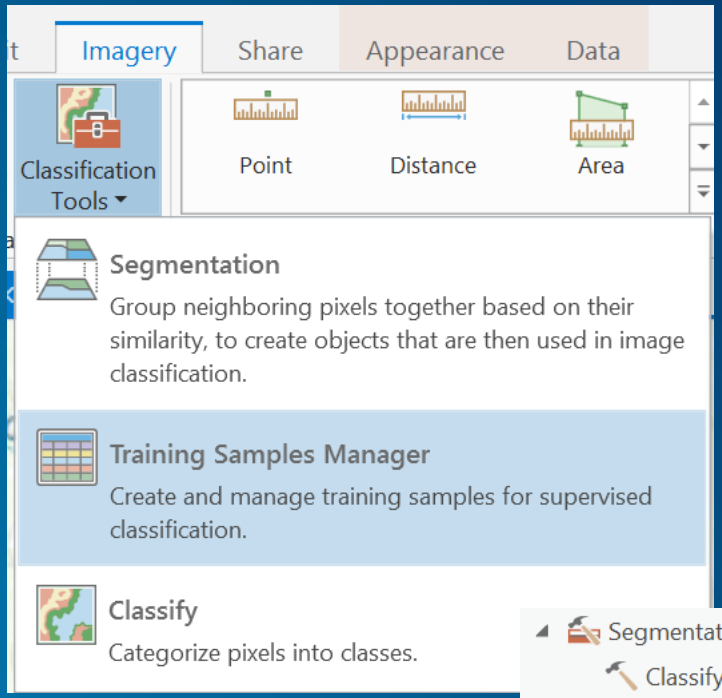


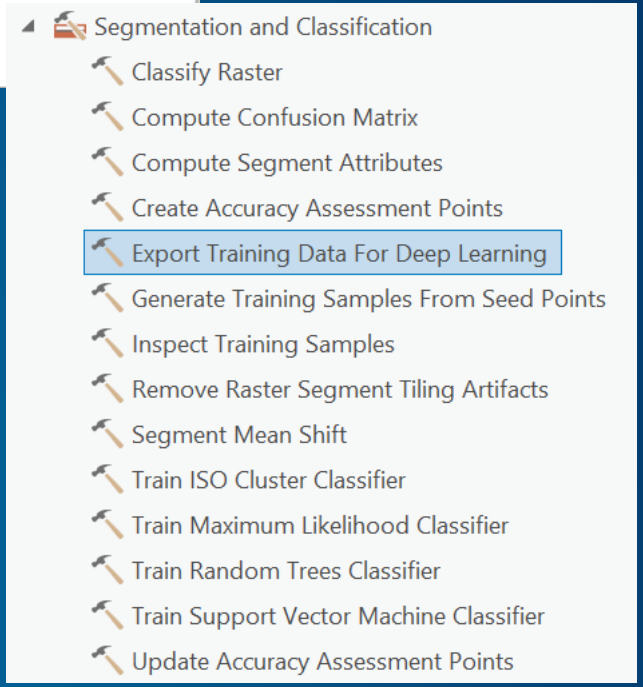
ArcGIS Enterprise and ArcGIS Pro Deep Learning Integration

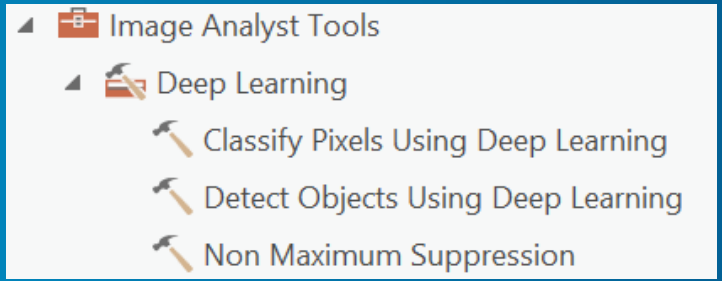


Deep Learning in ArcGIS Pro

- Create Training Samples
  - Training Sample Manager
  - Export Training Data For Deep Learning
- Perform Inference
  - Detect Objects Using Deep Learning
  - Classify Pixels Using Deep Learning
- Post processing
  - Non Maximum Suppression







Deep Learning in ArcGIS Raster Analytics

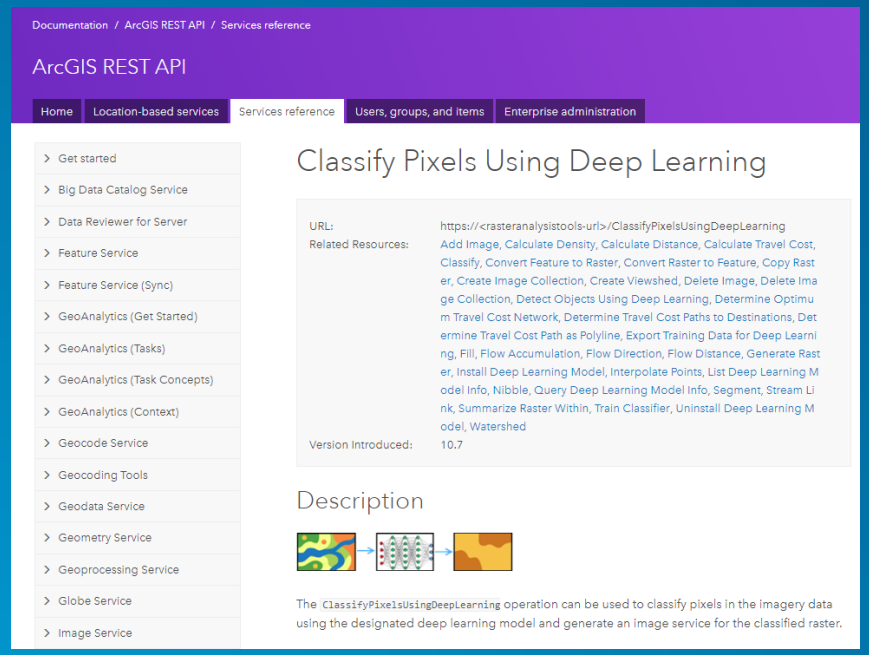
System/RasterAnalysisTools (GPServer)

Service Description: The RasterAnalysisTools service is used by ArcGIS Server to provide distributed raster analysis.

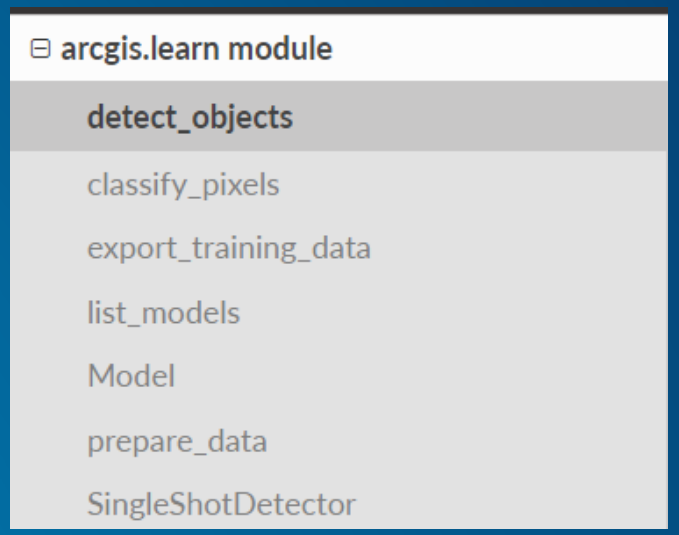
Tasks:

- DetectObjectsUsingDeepLearning
- ClassifyPixelsUsingDeepLearning
- ExportTrainingDataforDeepLearning
- QueryDeepLearningModelInfo
- InstallDeepLearningModel
- UninstallDeepLearningModel
- ListDeepLearningModels

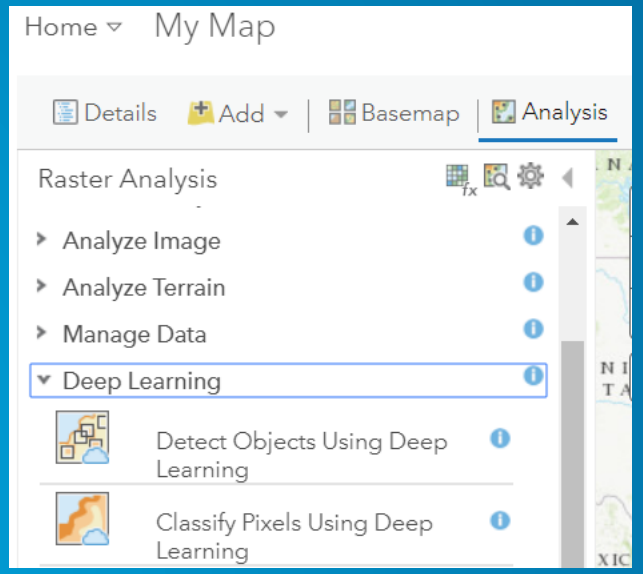
ArcGIS REST API



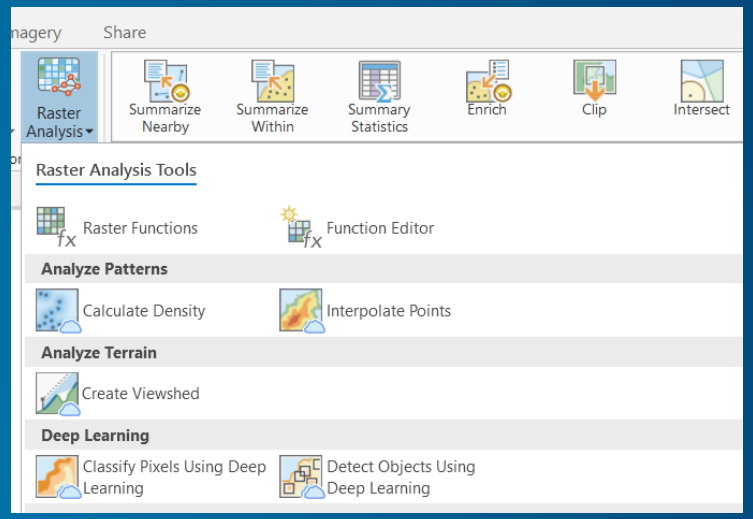
ArcGIS API for Python

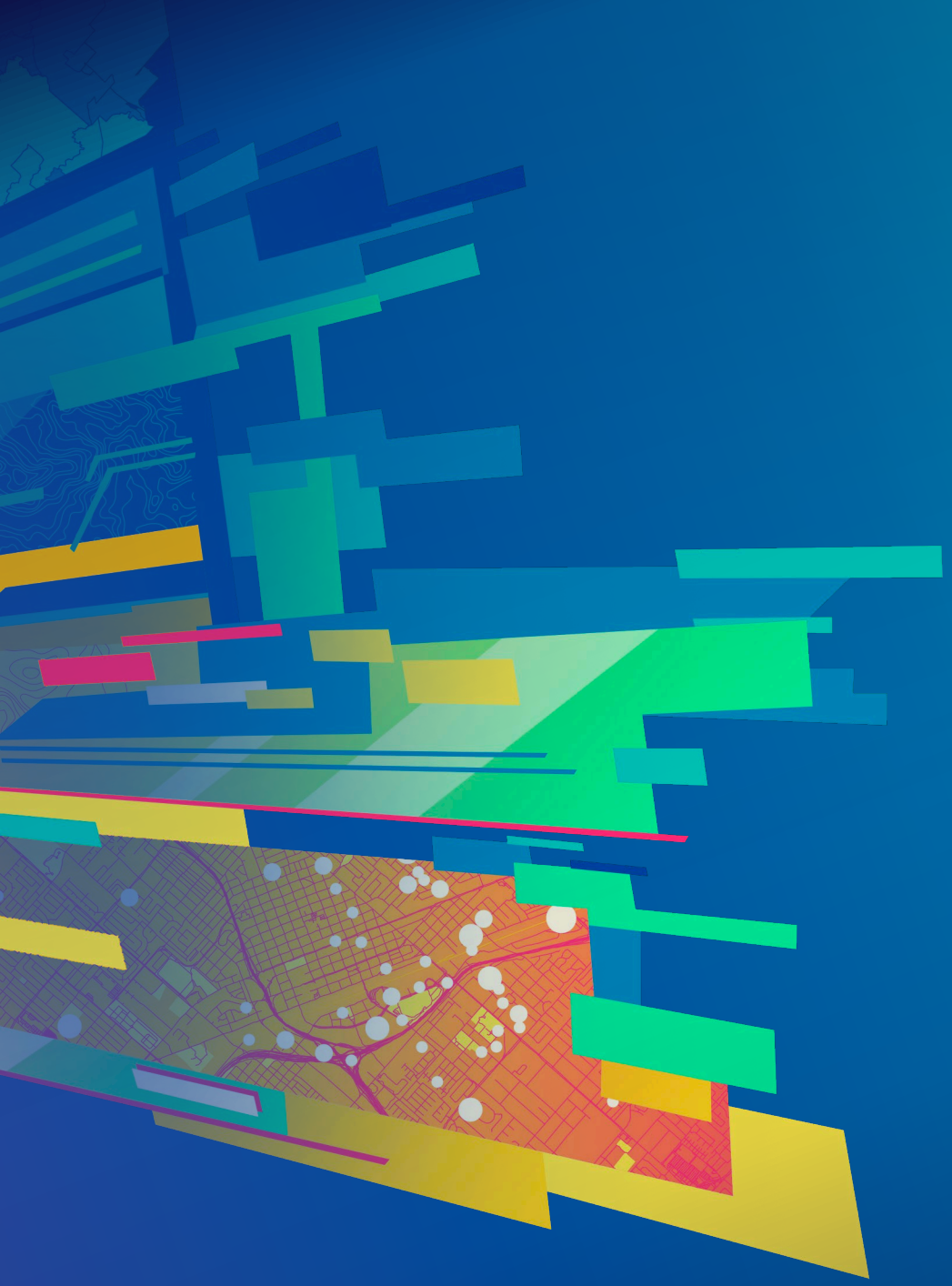


ArcGIS Portal Map Viewer



ArcGIS Pro





Demo

Export Training Data For Deep Learning

Deep learning model package

What's a *Python* Raster Function?

- Transforming rasters—image processing and analytic algorithms—in Python.
- Implement a raster function from the comfort of your *Python module*.
- *Architecture:* Module loaded by an adapter—Python-aware *and* a first-class participant in the function chain.
- Your Python module—assisted by ArcGIS—is a raster function.

Hello, World!

```python
import numpy as np

class HelloWorld():
    def __init__(self):
        self.name = "Hello World Function"

    def getParameterInfo(self):
        return [{
            'name': 'r',
            'dataType': 'raster'
        }]

    def updatePixels(self, tlc, shape, props, **pixelBlocks):
        r = pixelBlocks['r_pixels'] + 10
        pixelBlocks['output_pixels'] = r.astype(props['pixelType'])
        return pixelBlocks
```

The API

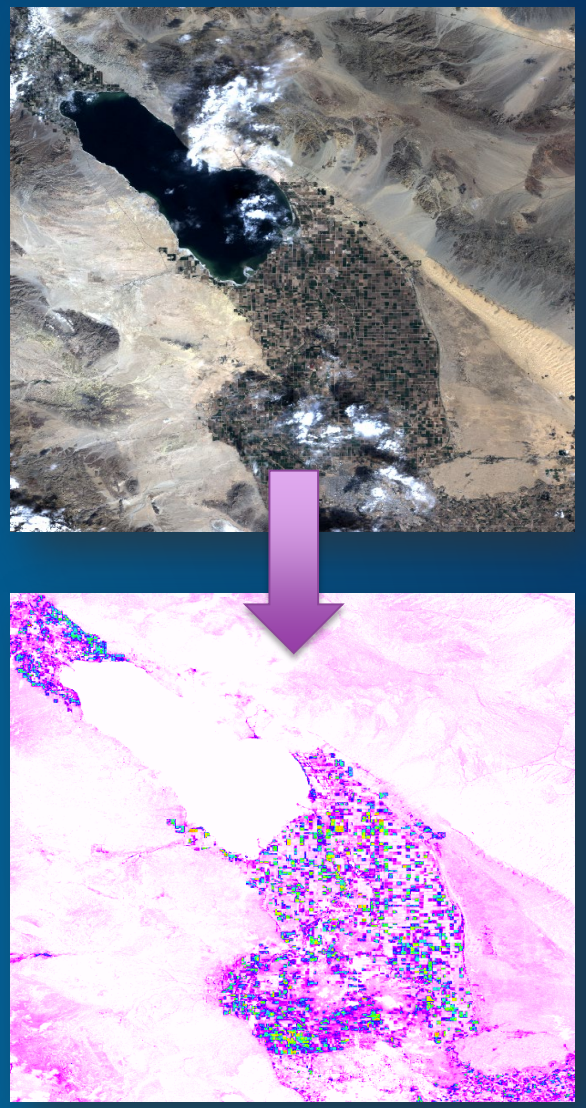
- initialize
  - global initialization
- getParameterInfo
  - define all input parameters to the function
- getConfiguration
  - how the input rasters are read
- updateRasterInfo
  - implement if used in classify pixels, define the output raster properties
- getFields
  - implement if used in detect objects, define the fields of the output feature class
- getGeometryType
  - implement if used in detect objects, define the geometry type of the output feature class

The API

- `updatePixels()`

- **Workhorse of the raster function. Process Pixels.**
- ***Given:***
  - **Expected pixel-block size+location**
  - **output raster properties (map space)**
  - **pixels+mask of selected input rasters**

- ***Returns:*** **Pixels+mask of requested pixel block.**

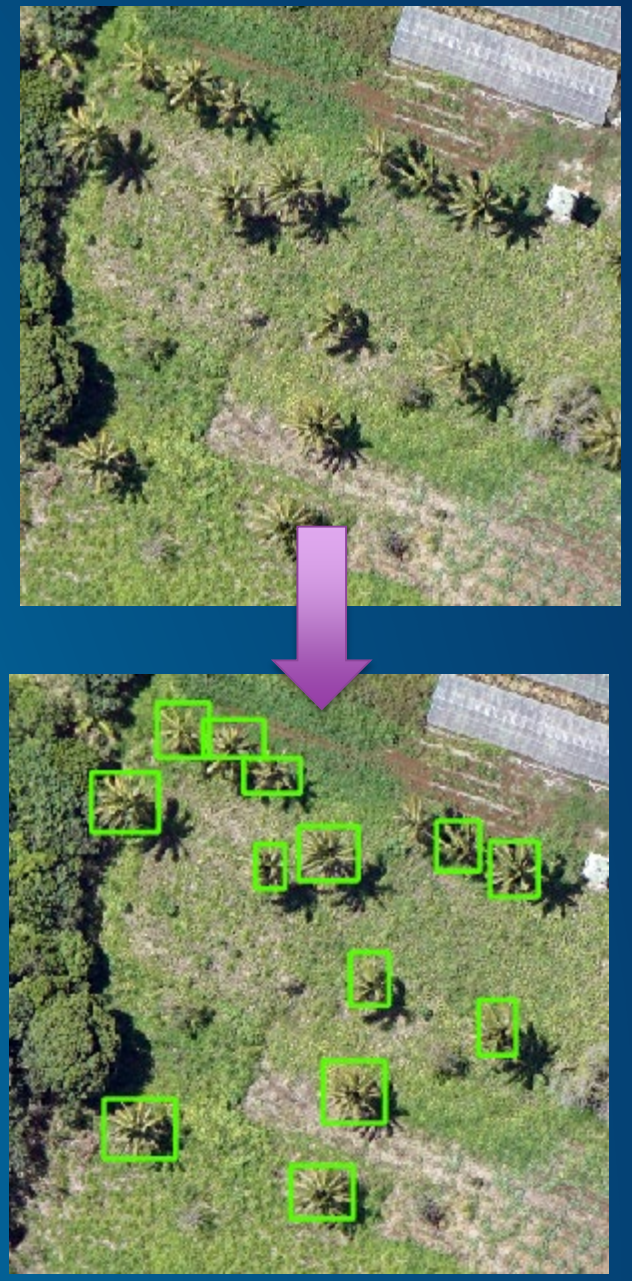


The API

- `vectorize()`

- **Workhorse of the raster function. Process Pixels.**
- ***Given:***
  - **Expected pixel-block.**

- ***Returns:*** **String of GeoJSON object.**



Demo

Supported Models and Frameworks

	Detect Objects (Bounding Box)	Detect Objects (Instance Segmentation)	Classify Pixels
TensorFlow	Google Implementation		DeepLab Implemented by Google
CNTK	Faster-RCNN Implemented by Microsoft		U-Net Implemented by Microsoft
PyTorch	FastAI – SSD		
Keras		Mask-RCNN Implemented by Matterport	
Other			

out of the box Python Raster Function

custom Python Raster Function*

** Image Scientist implements the raster function using Esri provided Python code utilities and samples*

Deep learning inference in ArcGIS

Demo

Upload and query deep learning model

Perform deep learning inference

Resources

- ArcGIS/raster-deep-learning repo
  - https://github.com/Esri/raster-deep-learning
- Esri/raster-functions repo
  - https://github.com/Esri/raster-functions
- ArcGIS API for Python
  - https://developers.arcgis.com/python/
- Story Map and Articles
  - http://ivt.maps.arcgis.com/apps/MapSeries/index.html?appid=9766dba97c954fcaa175da83b72ccf06
  - https://medium.com/geoai/high-resolution-land-cover-mapping-using-deep-learning-7126fee571dd
- Webinar
  - Integrating Deep Learning with ArcGIS using Python https://www.youtube.com/watch?v=osnMPbKJxsE

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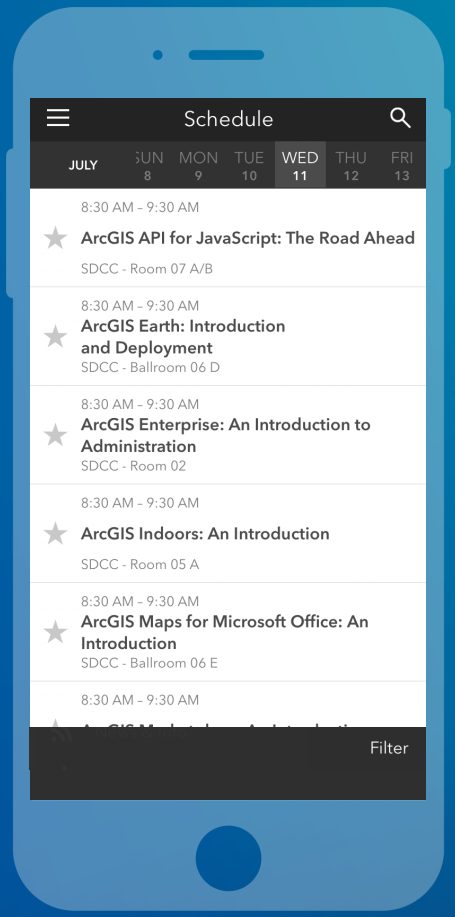
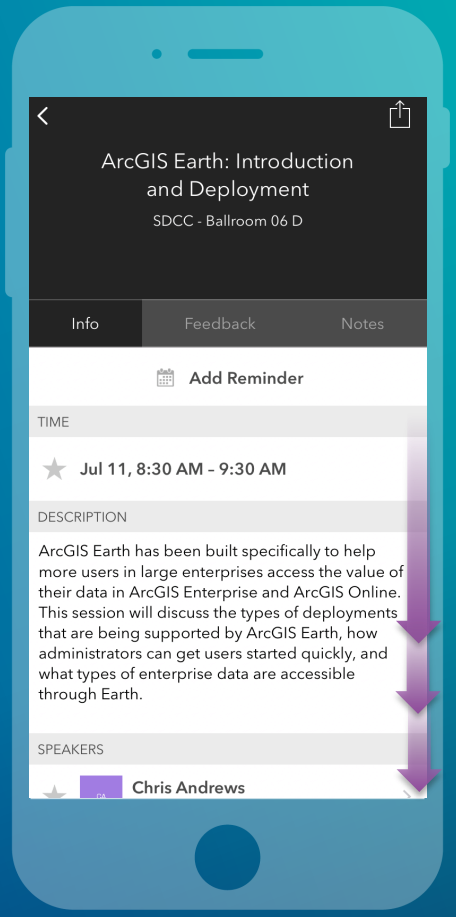
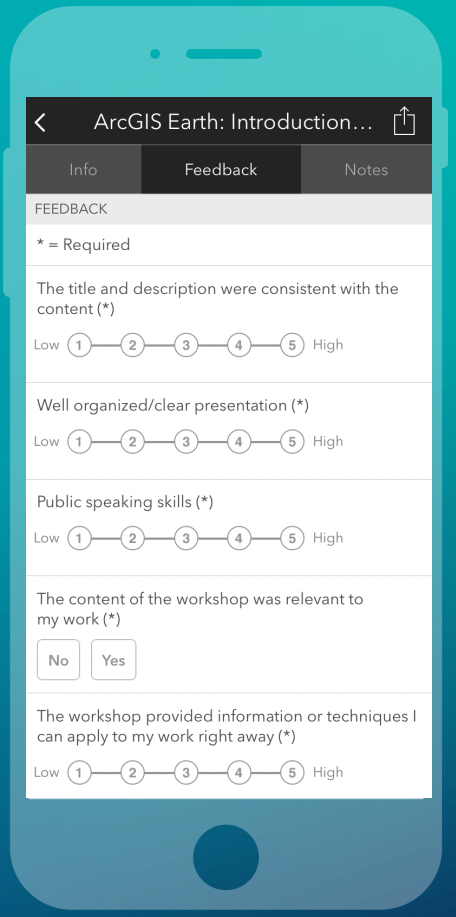


Scroll down to find the feedback section



Complete answers and select “Submit”



Questions & Comments?

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