



# Deep Learning and GeoAI starting guide

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What is the purpose of this presentation?

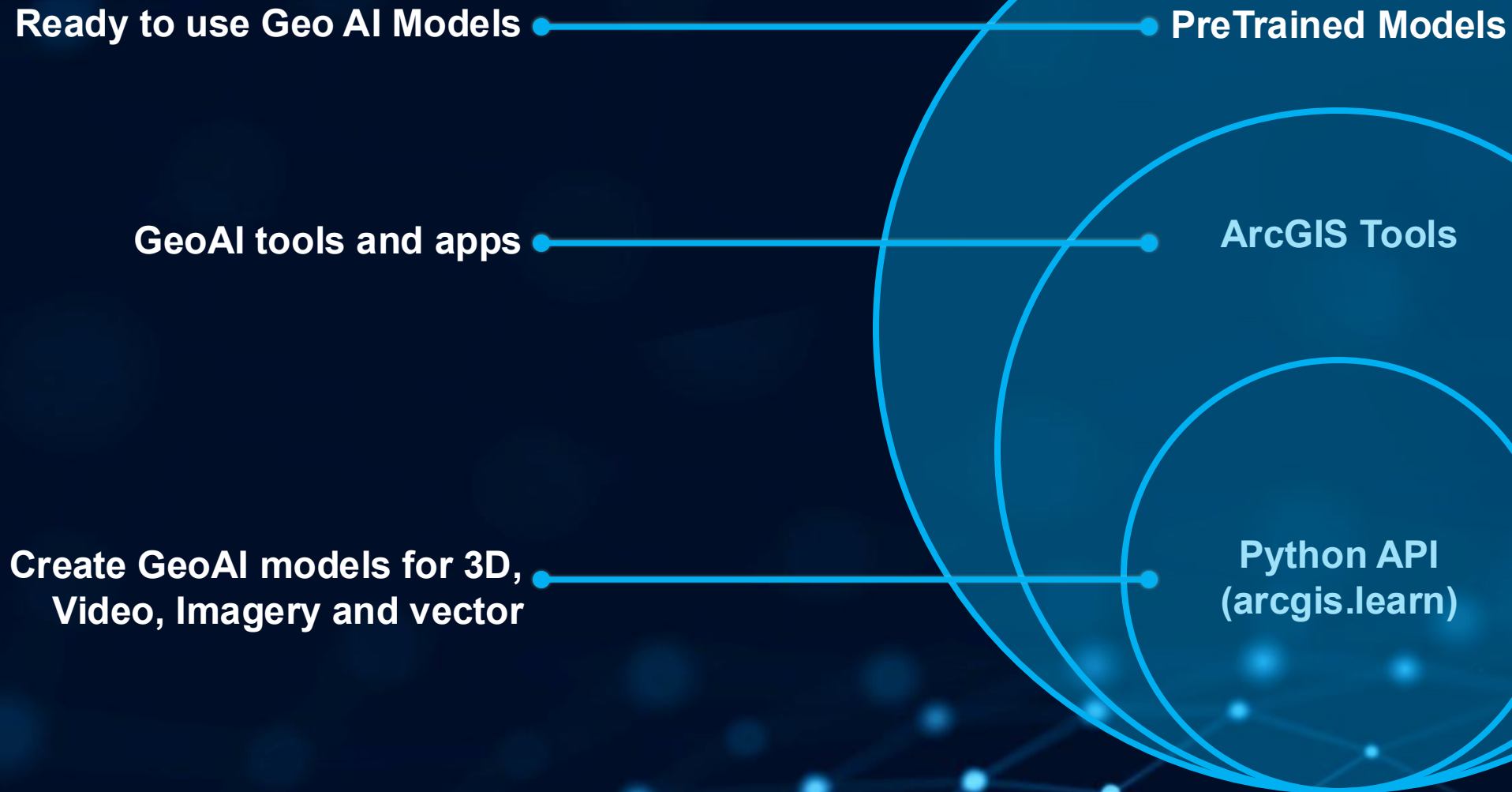
# What is the purpose of this presentation?

- **Demystify Spatial AI:** A beginner-friendly intro to AI in ArcGIS.
- **Concrete Use Cases:** Learn feature extraction, object detection, and prediction in ArcGIS.
- **Target Audience:** Beginners who wants to start with Geo AI...

# Introduction

Click to add text

# Deep Learning in ArcGIS



# Esri PreTrained Models

- ✓ **Ready-to-use**
- ✓ **Eliminate** the need to **develop** and **train model**
- ✓ **Instantly extract** features from a stream of data
- ✓ **Seamless integration** with ArcGIS Pro, Online, and Enterprise
- ✓ **Lowers technical barrier** for non-experts
- ✓ **Retrainable** to your geography and imagery
- ✓ Supported with **documentation** and technical help
- ✓ **New models added** regularly for emerging use cases



**PreTrained Models**

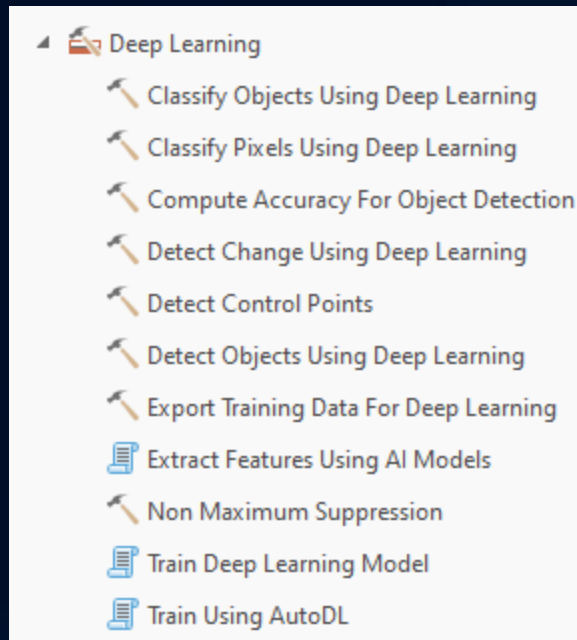
# Demo

- ✓ **Pretrained models**
- ✓ **Documentation**
- ✓ **Download `.dlpk`**



# ArcGIS Tools

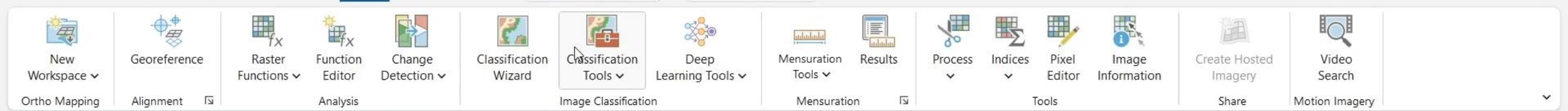
- ✓ Train your model
- ✓ Define your settings / parameters
- ✓ Retrained a pretrained model
- ✓ “No coding” interface





# Demo

- ✓ **Image classification**
- ✓ **Geo AI Toolbox**
- ✓ **Configure your parameters**



**Contents**

Search

**Drawing Order**

- Map
  - validation\_sunlit\_shadow\_2class
  - samples\_imper\_per
  - ☒ RGB.tif
    - RGB
      - Red: Red
      - Green: Green
      - Blue: Blue



**Image Classification Wizard**

Configure

Classification Method: Supervised

Classification Type: Object based

Classification Schema: [Empty]

Output Location: C:\Users\XZ\Arcgis\_Academy\Classification\Image

**Optional**

Segmented Image: [Empty]

Training Samples: [Empty]

Reference Dataset: [Empty]

Next >



Project Map Insert Analysis View Edit Imagery Share Studio Toolkit Studio Printing Studio Workflow Help Feature Layer Labeling Data Linear Referencing

Paste Cut Copy Copy Path Clipboard

Explore Navigate

Basemap Add Data Add Data From Path XY Table To Point Add Graphics Layer Layer

Select Select By Attributes Select By Location Selection

Attributes Clear Measure Locate Infographics Coordinate Conversion Inquiry

Pause Lock View Unplaced More Labeling

Convert Download Map Offline

Map X

Contents

Catalog

Project Portal Computer Favorites

Search Project

- Maps
- Toolboxes
- Databases
- Styles
- Folders
- Locators

1:1,368 172.649,21E 5.645,842,20N Selected Features: 0

Catalog Modify F... Raster Fu... History Geoproc...



The main map area displays an aerial photograph of a city street intersection. A circular roundabout is visible on the left side of the map. Several red rectangular overlays are placed along the streets, likely indicating specific features or areas of interest. A mouse cursor is visible over the map.



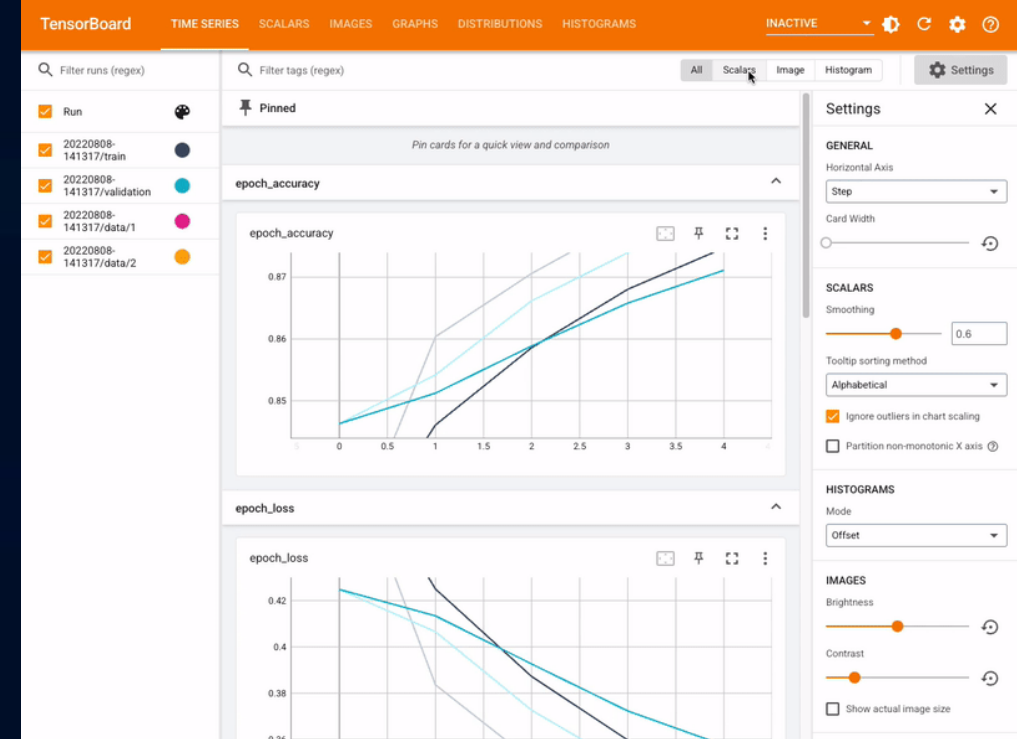
# Python API

- Python = Programming
- Try & Error – Fix the parameters of your models
- Connection with tensorBoard
- Mass Production “mode”
- Use best practices
  - ✓ learning rate finder
  - ✓ Transfer learning
  - ✓ Early stopping
  - ✓ ...

```
from arcgis.learn import prepare_data, Model

data = prepare_data('path/to/data')
model = Model(data)
model.fit(10)
model.show_results()
model.save()
```

## Python API (arcgis.learn)



TensorBoard

```
C:\Windows\system32\cmd.exe
Fri Feb 19 16:26:50 2021

+-----+
| NVIDIA-SMI 451.82                Driver Version: 451.82                CUDA Version: 11.0                |
+-----+-----+-----+-----+-----+-----+
| GPU   Name      TCC/WDDM  | Bus-Id      Disp.A    Volatile Uncorr. ECC  |
| Fan  Temp  Perf  Pwr:Usage/Cap|      Memory-Usage | GPU-Util  Compute M. |
+-----+-----+-----+-----+-----+-----+
|  0   Quadro RTX 5000      WDDM  | 00000000:01:00:0 Off |          N/A         |
|N/A   51C    P8      27W /  N/A | 214MiB / 16384MiB |    0%      Default   |
+-----+-----+-----+-----+-----+-----+

+-----+
| Processes: |
| GPU   GI   CI        PID   Type   Process name                      GPU Memory |
|  ID   ID   ID                                 Usage     |
+-----+-----+-----+-----+-----+
| No running processes found |
+-----+
```

CUDA | nvidia-smi



# Set up your configuration...

Click to add text

# A working environment ...



## What license do I need for the deep learning tools?

All deep learning geoprocessing tools and the **Label Objects for Deep Learning** pane, used for deep learning with imagery in 2D, require the ArcGIS Image Analyst extension (+ ArcGIS Pro Advanced)

## Install deep learning frameworks for ArcGIS

ArcGIS Pro 3.5 | [Other versions](#) | [Help archive](#)

All deep learning geoprocessing tools in ArcGIS Pro require that the supported deep learning frameworks libraries be installed.

For instructions on how to install deep learning packages, see the [Deep Learning Libraries Installer](#) for ArcGIS Pro.

### Note:

Each version of ArcGIS Pro requires specific versions of deep learning libraries. When you upgrade ArcGIS Pro, you need to install the deep learning libraries that correspond to that version of ArcGIS Pro. For the list of libraries required at each version along with other information, see [Deep learning frequently asked questions](#).

You can also use deep learning tools in your ArcGIS Enterprise environment. For instructions on how to install deep learning frameworks for ArcGIS Enterprise, see [Configure ArcGIS Enterprise for deep learning](#).

### Related topics

- [Introduction to deep learning](#)
- [Deep learning in ArcGIS Pro](#)

[Link](#)

# IT Infrastructure

- On premise/ Cloud (!! Security)
  - Volume of data / Frequency?
  - Scalable solution
  - Budget
- GPU is a key element
    - Recommended: 16 GB VRAM or more
  - The training phase is the most resource-intensive VS Inferencing

| Computer   | Performance   |
|--|---|
| <ul style="list-style-type: none"><li>• NVIDIA RTX A6000 48 Gb</li><li>• SSD Hard disk – 2 To</li><li>• CPU – AMD Ryzen 9 3900X</li><li>• 128 Gb RAM process</li></ul> | <p>Satellite image (30cm GSD)</p> <ul style="list-style-type: none"><li>• <b>Training:</b> 2h – 40 000 buildings - 30km<sup>2</sup></li><li>• <b>Inferencing:</b> 6min/km<sup>2</sup></li></ul> |





# Conclusions

# If you want to start...

1. Check your licenses and computer resources
2. Install the python librairies
3. Try with pretrained models on your own data...
4. Train your 1<sup>st</sup> model
  - Collect data and labelling
  - Train your model
  - Apply the trained model on new data
5. Dive into the results/ statistics and try to improve your trained model
6. Move to the Python API +Improve technical skills

# Useful links

- Deep learning frequently asked questions: <https://pro.arcgis.com/en/pro-app/latest/help/analysis/deep-learning/deep-learning-faq.htm#anchor4>
- Pretrained models: <https://www.esri.com/en-us/arcgis/deep-learning-models>
- Install deep learning frameworks for ArcGIS: <https://pro.arcgis.com/en/pro-app/latest/help/analysis/deep-learning/install-deep-learning-frameworks.htm>
- Tensorboard: <https://developers.arcgis.com/python/latest/guide/monitor-model-training-with-tensorboard/>

# Questions

# Where to next

|               | Track ArcGIS Enterprise       | Track ArcGIS Pro      | Track ArcGIS Web & Mobile Apps |
|---------------|-------------------------------|-----------------------|--------------------------------|
| 16:20 - 17:00 | ArcGIS Online: what's New     | ArcGIS Data Pipelines | PowerBI and GIS Integration    |
| 17:05 - 17:30 | Wrap up presentation & awards |                       |                                |
|               | Reception                     |                       |                                |



# Satisfaction Survey





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