Mastering Advanced Remote Sensing using ArcGIS Pro

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THE SOUTHERN AFRICA ESRI USER CONFERENCE 2023

Agenda

- **Introduction**
- **Imagery Management** *(30 Minutes)*
- **Web-Based Imagery Services** *(10 Minutes)*
- **Deep Learning** *(35 Minutes)*
- **Summary** *(25 Minutes)*
  - Questions

Agenda

Time	Section	Subject	Min	Presenter
10:30 – 10:40	**Introduction**		10	Stuart
10:40 – 10:55	**Imagery Management**	**Raster Functions**	15	Sean
10:55 – 11:10		**Mosaic Datasets**	15	Stuart
11:10 – 11:20		**Publishing Mosaic Datasets**	10	Sean
11:20 – 11:25	**Web-based Imagery Services**	**Consuming Public Services in ArcGIS Pro**	5	Stuart
11:25 – 11:30		**Consuming Web-Based Public Services**	5	

Agenda

Time	Section	Subject	Min	Presenter
11:30 – 11:35	**Deep Learning**	**Workflows**	5	Stuart
11:35 – 11:45		**Pretrained Models**	10	
11:45 – 11:50		**Labelling an Image**	5	Sean
11:50 – 11:55		**Training a Model**	5	
11:55 – 12:05		**Inferencing**	10	
12:05 – 12:30	**Closing and Questions**		25	Stuart

Introduction

Background

Introduction

- **This is an Advanced Workshop**
- **Experience required**
  - ArcGIS Pro
  - Basic Image processing
    - *Background and some experience*
- **What are you going to learn from this session?**

Introduction

- **Housekeeping**
  - Open to questions as we go along
  - Presentation will be made available after the Conference
- **Feel free to contribute**

Imagery Management

Raster Functions

Raster Functions

Software to be Demonstrated

- *ArcGIS Pro*
  - *Raster Functions*

Application

- *In Memory raster analysis and processing*
- *Build up a processing chain*

Raster Functions

Licensing Considerations

ArcGIS Pro

- Multiband Math
- Indices
- Appearance
- Correction
- Data Management
- Interpolation
- Surface Generation

Image Analyst

- Segmentation
- Classification
- Weighted Overlay
- Statistics
- Math's

Spatial Analyst

- Distance & Density
- Hydrology
- Overlay Analysis
- Viewshed Analysis

Take home message

- **Can be used to create results on basic workflows**
  - In-memory
  - Easy to use
- **Derive information from imagery data**
  - Create complex function chains
- **Save workflows to be used again**
  - Different imagery

Imagery Management

Mosaic Datasets

Mosaic Datasets

Software to be Demonstrated

- *ArcGIS Pro Standard*

Application

- *Create collections of imagery*
- *Analysis ready across all platforms*
- *Easy to share*

Take Home message

- Easy to manage and use a large collections of imagery
- Can Create a time enabled mosaic
- Apply analysis across all items simultaneously
  - Visualisation, Enhancement, Indices
- Create a Reference Mosaic (Subset) of your master data
- Mosaic referencing central repository
  - Cloud and Enterprise

Imagery Management

Publishing Mosaics

Publishing Mosaic Datasets

Software to be Demonstrated

- *ArcGIS Pro Standard*
  - *Cloud or Server Hosted Imagery*
- *Publish to ArcGIS Enterprise*
  - *Image Server*

Application

- *Creating access to analysis ready imagery*

Take Home message

- **Easy way to disseminate imagery**
  - Easy to Publish to ArcGIS Enterprise
    - *Image Server*
    - *Single source of imagery*
  - Service can be continuously updated
    - *Can be automated*
  - Predefined function chains attached
    - *Visual Analysis*
    - *Indices*

Web-Based Services

Consuming Services In ArcGIS Pro

Consuming Imagery Services

Software to be Demonstrated

- *ArcGIS Pro*
  - *Internet Access & Named User*

Application

- *Leveraging cloud hosted imagery*
- *Filtering a global service to your requirements*

Take home message

- Access to curated cloud-based imagery
- Standard processing chains
  - Typical imagery analysis workflows
- Custom filters
- Up to date medium resolution imagery

Web-Based Services

Web-Based Public Services

Web-based Imagery Services

- **Software to be Demonstrated**
  - *Browser (Internet Access)*
    - *Named User*

- **Application**
  - *Web based access to imagery*
  - *Web based processing*

Take Home message

- **Extensive catalog of analysis ready imagery**
  - Landsat 8/9
  - Sentinel 2
- **Updated daily**
- **Simplified analysis workflows**

Deep Learning

Workflows

Deep Learning Workflows

Software to be Demonstrated

- *ArcGIS Pro*
  - *Image Analyst*
- *ArcGIS Enterprise*
  - *Image Server*

Application

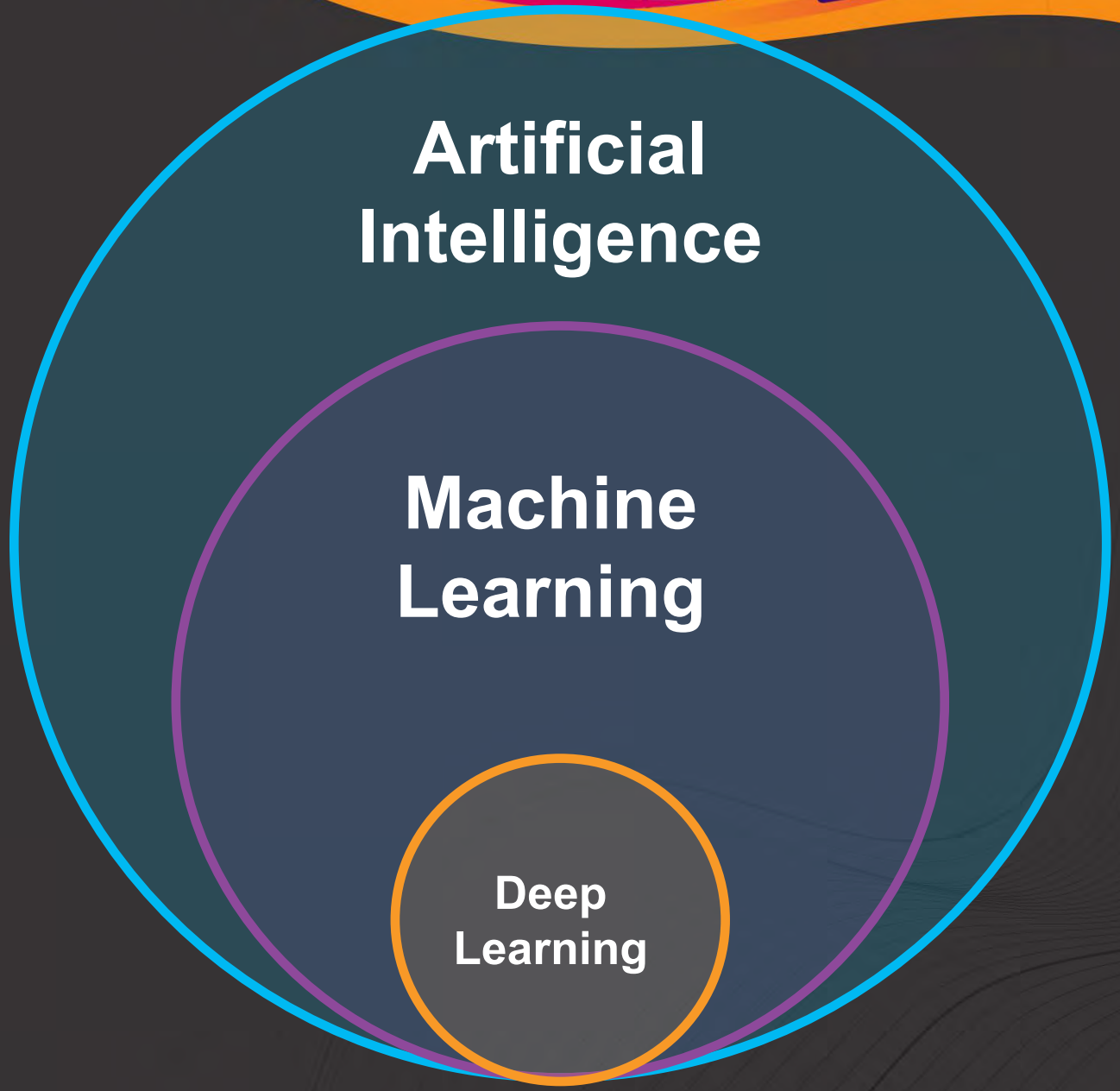
- *Feature Extraction using Artificial Intelligence – Deep Learning*

Artificial Intelligence

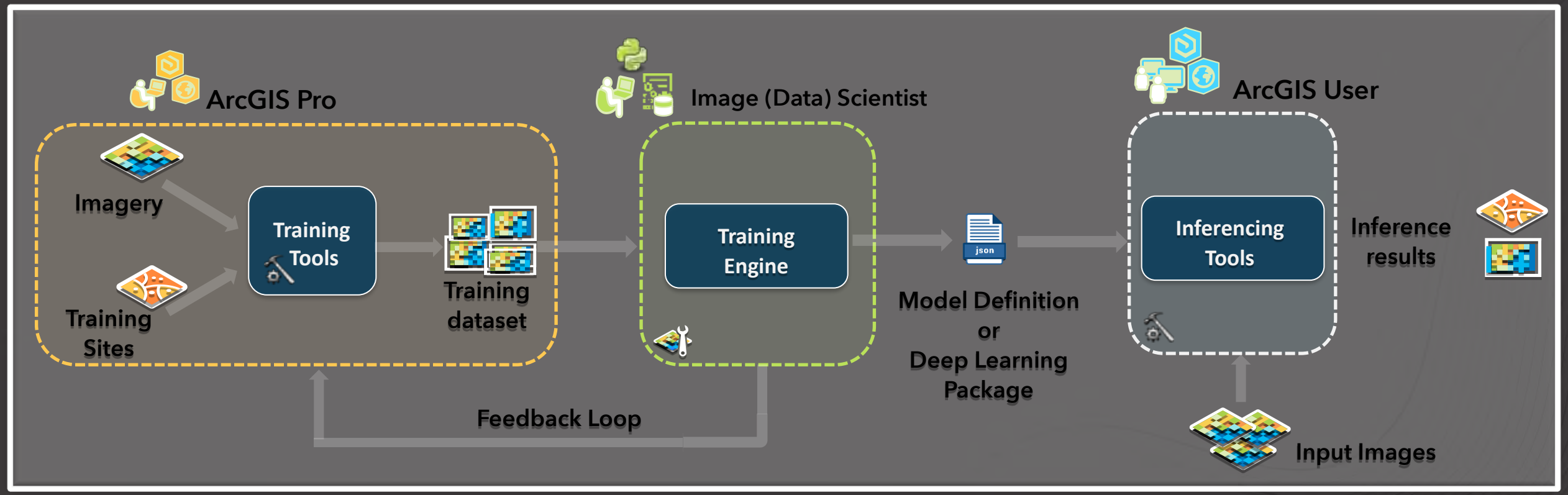
Programs with the ability to learn and reason like humans.

Algorithms with the ability to learn, without being explicitly programmed

A subset of machine learning in which artificial neural networks adapt and learn from vast amounts of data



Deep Learning Workflow



Take Home message

- **Automate Repetitive Tasks**
  - Artificial Intelligence

- **Improvements**
  - Speed
  - Repeatability
  - “Accuracy” (?)

- **Five year old within 3 seconds….**

Deep Learning

Pretrained Models

Pre-Trained Models

Software to be Demonstrated

- *ArcGIS Pro*
  - *Image Analyst*
- *ArcGIS Enterprise*
  - *Image Server*

Application

- *Use Pre-trained models (DLPK) to extract features*
- *These can be enhanced, improved*

Take Home message

- **You have access to Esri Pre-Trained Model**
  - Deep Learning Packages (DLPK)
  - These can be improved through additional training

- **Used as a Geoprocessing Tool**
  - As is…..

Deep Learning

Labelling Images

Labelling Images

Software to be Demonstrated

- *ArcGIS Pro*
  - *Image Analyst*
- *Image Server*
  - *Deep Learning Studio*

Application

- *Label an Image to train the model*
- *Label positives and negatives*
- *Export Training Data*

Take Home message

- **The are some basic rules to follow when labelling an image**
  - Label the features you want to extract
    - *Label what you do not want to extract*
  - Label features in context
    - *Swimming Pools are standalone*
    - *Trees in a compartments need to be labelled together*
  - Take time to capture a representative sample
    - *Improve sample over time*

Deep Learning

Training Models

Training a Model

Software to be Demonstrated

- *ArcGIS Pro*
  - *Image Analyst*

Application

- *Train a Deep Learning Model using pre-labelled samples*
- *Multiple Models Included (20+)*
  - *RCNN, FastRCNN, FasterRCNN, YOLO, SingleShot Detection, etc.*
  - *Run AutoDL*

Take Home message

- **Multiple Options are Available to build the model**
  - Choose the right one
  - Understand the differences between the models
  - Consider AutoDL (Remove the Guesswork)
- **It takes time….**
  - The Training and the Model Building Process takes the most time
  - Rerun the process until you are happy with the results

Deep Learning

Inferencing

Deep Learning - Inferencing

Software to be Demonstrated

- *ArcGIS Pro*
  - *Image Analyst*
- *ArcGIS Enterprise*
  - *Image Server*

Application

- *Detect Objects with Deep Learning*
- *Test results against training samples and other test data*

Take Home message

- **It is simple to build your own Deep Learning Model**
  - Sufficient Training Samples
  - Appropriate Model
  - You can also reuse a Pre-Trained model
- **Inferencing is relatively fast**
  - Note Confidence Scores
  - Be aware of Model Accuracy
- **Models are portable**
  - You need the same imagery inputs

Summary

Summary

- **Imagery is a powerful source of data**
  - Multi Spectral
  - Temporal (Change)
  - Basemaps
  - Foundational Source of Content
    - *Vector, 3D, Imagery*

Summary

- **ArcGIS has a suit of tools to leverage your imagery**
  - System of Record
    - *Manage your Imagery*
  - System of Insight
    - *Extract Features from Imagery*
  - System of Engagement
    - *Using product (datasets) derived from Imagery*

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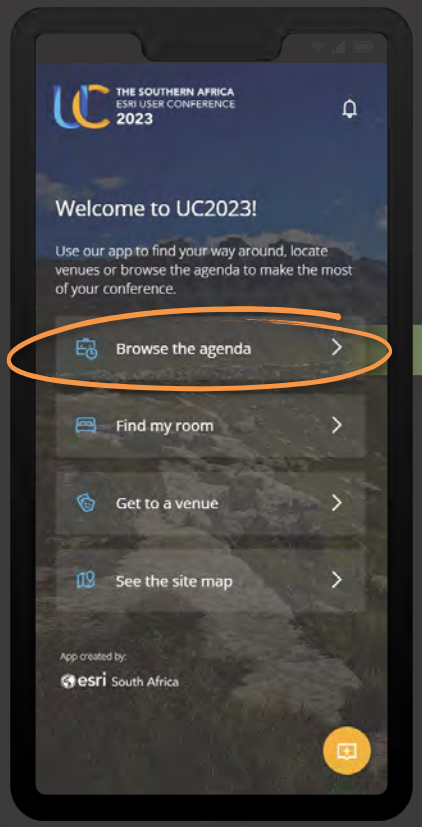
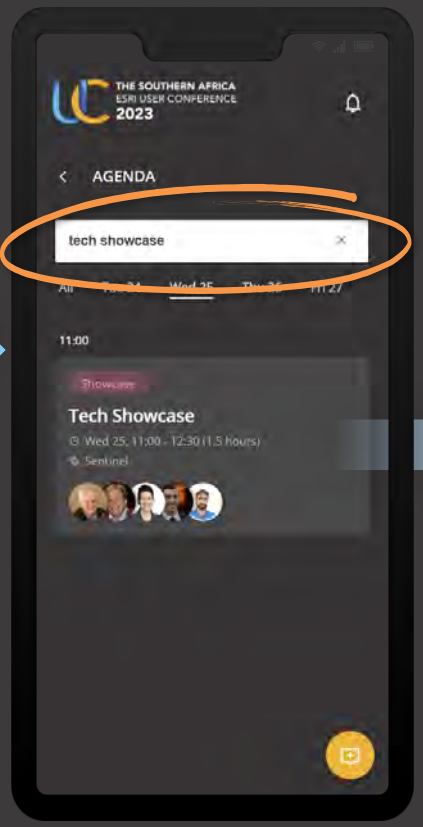


Search and select the session you attended



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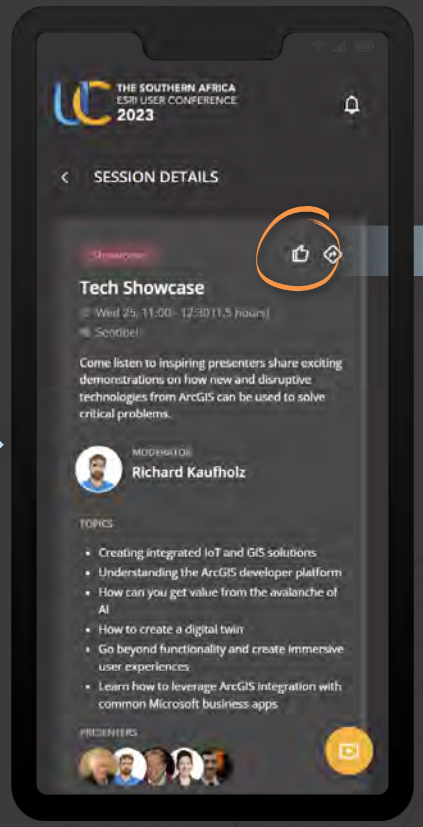
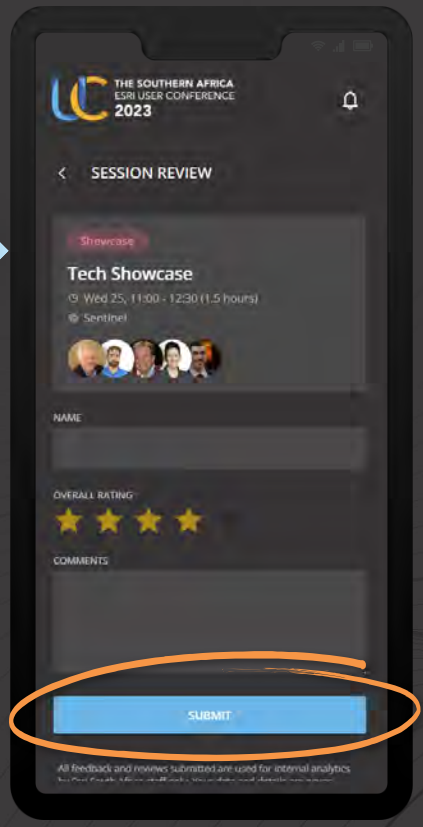


Complete and submit your review



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