



ArcGIS Enterprise Raster Analytics in Image Server

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An abstract graphic on the right side of the slide consists of various overlapping geometric shapes in shades of blue, teal, orange, and red. Some shapes contain patterns like topographic contour lines or a grid of dots. In the bottom right corner of this graphic, there is a red rectangular box containing the text "GIS INSPIRING WHAT'S NEXT" in white, uppercase, sans-serif font.

GIS
INSPIRING
WHAT'S
NEXT

Introduction and Context

The ArcGIS Platform and ArcGIS Image Server

THE ARCGIS PLATFORM

Any device, anywhere

SYSTEM OF INSIGHT



derive actionable information from imagery and rasters by performing analytics on massive volumes of data available from multiple sources



Content from all sources

SYSTEM OF ENGAGEMENT



enable access to imagery and analysis through a wide range of integrated desktop, mobile, and web applications that are interactive, informative, and engaging

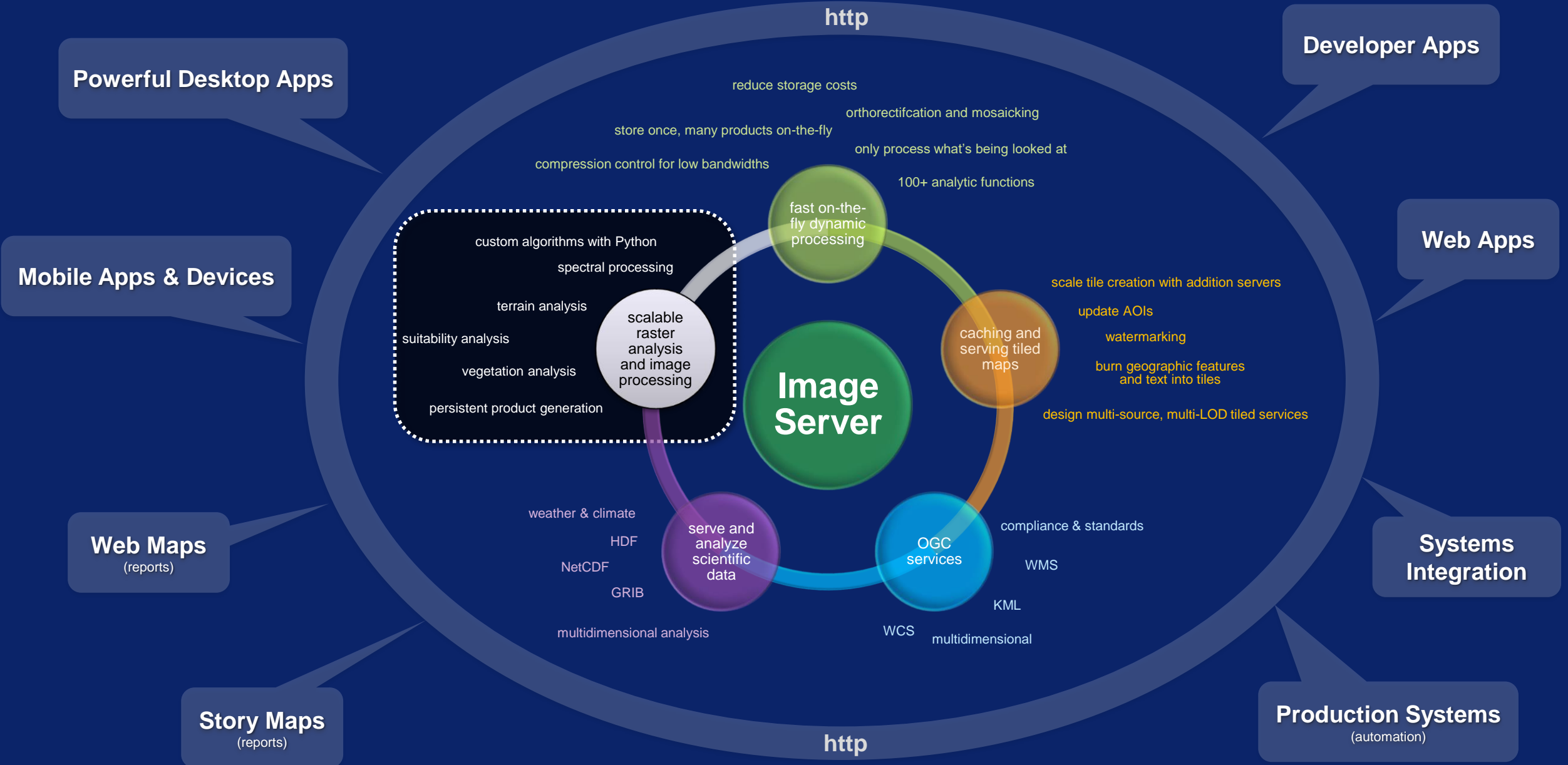
SYSTEM OF RECORD



manage and process imagery into authoritative data sources that are appropriately and efficiently disseminated to those that need access



ArcGIS Image Server 10.6.1



Raster Analytics

ArcGIS Enterprise and ArcGIS Image Server 10.6.1

What is Raster Analytics?

- ***The ArcGIS way to create and execute spatial analysis models and image processing chains which leverage distributed storage and analytics***
 - Raster Analytics works with your existing GIS data and imagery
 - Raster Analytics can optimize your data for distributed analytics
 - Raster Analytics is designed to scale with your organization's demands

The Foundation of Raster Analytics

Dynamic Raster Models



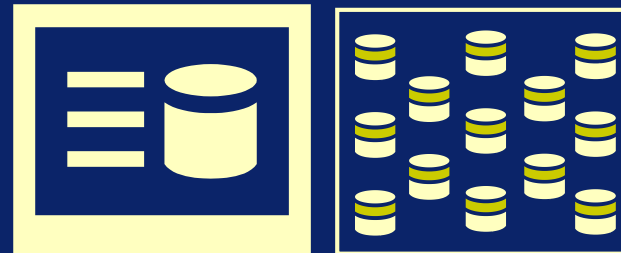
on-the-fly processing

Geoprocessing Models



powerful analytics

Server-based Distributed Raster Analytics with Distributed Raster Data Storage



(persistent) distributed analytics with optional distributed storage for even greater scalability

Web GIS Layers



rich geoinformation model

Problem Solving with Raster Analytics

- **run models against data that is too big for single desktop**
 - small and medium scale global rasters (big geography)
 - large scale local or regional rasters (high resolution)
- **run models against massive collections and scale it**
- **run models and meet time constraints**



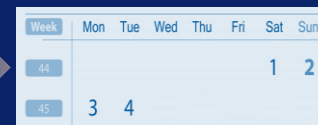
January	February	March	April
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

months



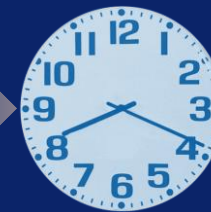
November							
Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
42						1	2
43	3	4	5	6	7	8	9
44	10	11	12	13	14	15	16
45	17	18	19	20	21	22	23
46	24	25	26	27	28	29	30

weeks



Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
44						1	2
45	3	4					

days

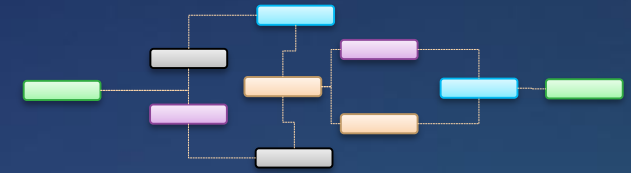


hours



minutes

Single Functions and Modeling



Multiband Math

Arithmetic
Band Arithmetic

Math

Calculator	ACos	Bitwise
Abs	ACosH	And
Divide	ASin	Left Shift
Exp	ASinH	Not
Exp10	ATan	Or
Exp2	ATan2	Right Shift
Float	ATanH	Xor
Int	Cos	Boolean
Ln, Log10	CosH	And
Log2	Sin	Not
Minus	SinH	Or
Mod	Tan	Xor
Negate	TanH	Equal To
Plus	Con	Greater Than
Power	Set Null	Greater Than
Round Down		Equal
Round Up		Is Null
Square		Less Than
Square Root		Less Than
Times		Equal
		Not Equal

Correction

Apparent Reflectance
Geometric Correction
Speckle Filtering (Lee,Frost,Kuan)
Thermal Noise
Radiometric Calibration

Data Management & Conversion

Raster to Vector
Vector to Raster
Colormap
Colormap To RGB
Complex
Grayscale
Remap / Reclass
Spectral Conversion
Unit Conversion
Vector Field
LAS to Raster
LAS Dataset to Raster
Clip
Composite
Extract Bands
Mask
Mosaic Rasters
Rasterize Features
Reproject
Nibble

Visualization & Appearance

Contrast and Brightness
Convolution
Pansharpening
Resample
Statistics and Histogram
Stretch

Interpolation

Interpolate Irregular Data
Nearest Neighbor
IDW
EBK
Swath

Surface Generation & Analysis

Aspect
Curvature
Elevation Void Fill
Hillshade
Shaded Relief
Slope
Viewshed
Contour

Analysis: Distance & Density

Euclidean Distance
Cost Distance
Least Cost Path
Kernel Density

Analysis: Band Math & Indices

NDVI / NDVI Colorized
SAVI / MSAVI / TSAVI
GEMI
GVI (Landsat TM)
PVI
Tasseled Cap (Kauth-Thomas)
Binary Thresholding

Analysis: Image Segmentation & Classification

Segmentation (Mean Shift)
Training (ISO, SVM, ML)
Supervised Classification

Analysis: Hydrology

Fill
Flow Accumulation
Flow Direction
Flow Distance
Stream Link
Watershed

Analysis: Overlay

Weighted Overlay
Weighted Sum

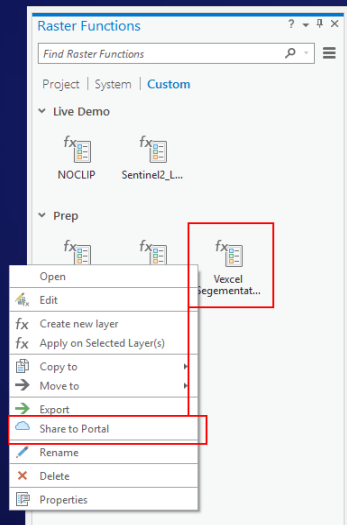
Statistics:

Zonal Statistics
Cell Statistics
ArgStatistics

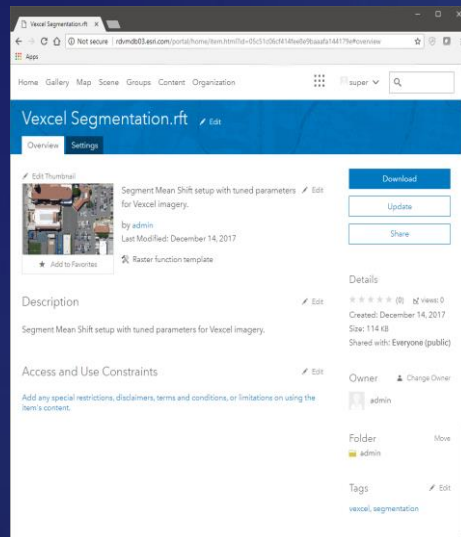
Python

Custom Algorithms

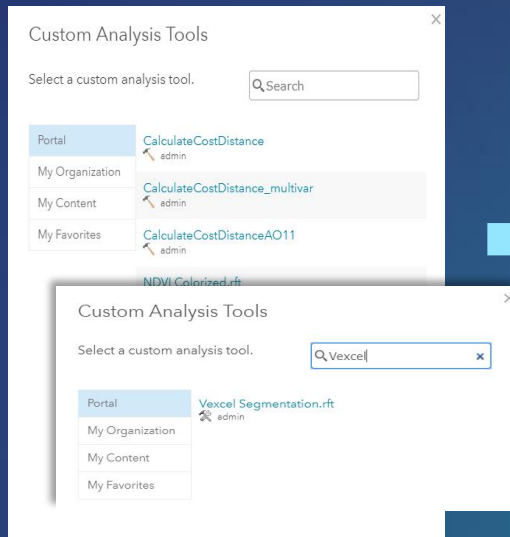
Raster Analytics Models Can Be Shared



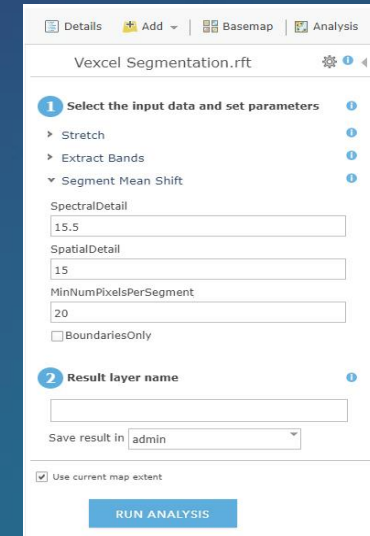
develop custom processing models and share to Portal from Pro



Raster Function Template item



browse and search for Raster Function Template items



form generated, user supplies parameters and runs the custom analysis

Raster Analytics User Experiences

ArcGIS Pro

The screenshot displays the ArcGIS Pro Geoprocessing environment. On the left, a 'Raster Analysis Tools' pane lists categories such as 'Raster Functions', 'Analyze Patterns', 'Analyze Terrain', 'Create Viewshed', 'Generalize', 'Hydrology', 'Manage Data', 'Summarize Data', 'Use Proximity', and 'Conversion'. The 'Raster Functions' pane is open, showing a grid of tools including Binary Thresholding, Heat Index, Kernel Density, NDVI, NDVI Colorized, Tasseled Cap, Weighted Overlay, Weighted Sum, and Wind Chill. The 'Raster Analysis Tools' pane is also visible, showing 'Analyze Patterns' and 'Analyze Terrain' sub-categories.

Web

The screenshot shows the ArcGIS Web interface for 'My Map'. The 'Raster Analysis' pane is active, displaying a list of tools: 'Summarize Data' (Summarize Raster Within), 'Analyze Patterns' (Calculate Density, Interpolate Points), 'Analyze Image' (Monitor Vegetation), 'Analyze Terrain' (Calculate Slope, Derive Aspect, Create Viewshed), and 'Manage Data' (Extract Raster, Remap Values, Convert Feature to Raster, Convert Raster to Feature). A configuration panel for 'Raster Analysis / Create Viewshed' is open on the right, showing steps for 'Elevation surface', 'Point features that represent observer locations', 'Optimize for' (Speed/Accuracy), 'Output height to become visible (optional)', and 'Result layer name'. A 'RUN ANALYSIS' button is at the bottom.

ArcGIS API for Python

The screenshot shows a Jupyter notebook in a browser window titled 'calculating_cost_surfaces'. The notebook contains two code cells. The first cell, labeled 'In [36]:', contains Python code for generating a final analysis output using intermediate datasets. The second cell, labeled 'Out[36]:', displays a map of a region with a color-coded overlay representing travel cost. The third cell, labeled 'In [38]:', contains Python code for displaying the result on a map.

```
In [36]: # Generate a final result using the intermediate datasets
# generated above:
# - Apply weights to the reclassified datasets
# - the sum of the weights must equal 1.0
# - assign higher weight values to datasets that are
#   considered to have more importance to the result
# - Calculate the sum of the weighted, reclassified datasets
#   (i.e. the weighted overlay)
# - Display the result with a colormap, where red = high
#   travel cost, and green = low travel cost

# In this example, each variable, elevation, slope, and HMI
# and given equal weight.
weighted_overlay = colormap(0.34 * elev_remap + 0.33 *
                             slope_remap + 0.33 * hmi_remap,
                             colormap=clrmap)
weighted_overlay

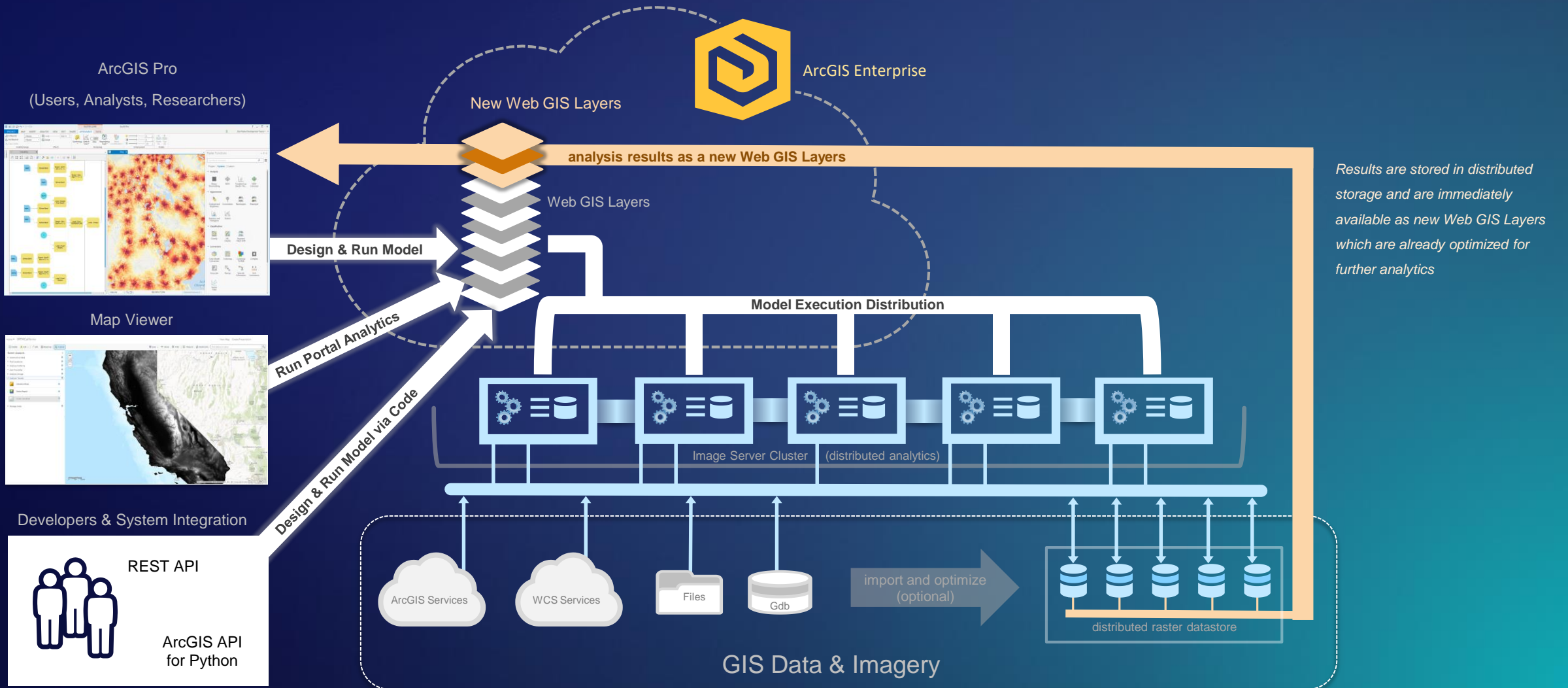
Out[36]:
```

Display the results on a map

```
In [38]: # Display the result in a map
m = gis.map('Ventura County, USA')
m.add_layer(weighted_overlay)
m
```

Raster Analytics Conceptual Overview

Raster Analytics can power systems that need to execute spatial analysis and image processing models in a distributed and scalable environment. It is designed for users, developers, and system integrators.



Raster Analytics Deployment

- **deployed as ArcGIS Enterprise + ArcGIS Image Server**

- Web GIS on-premise

- **your infrastructure can be...**

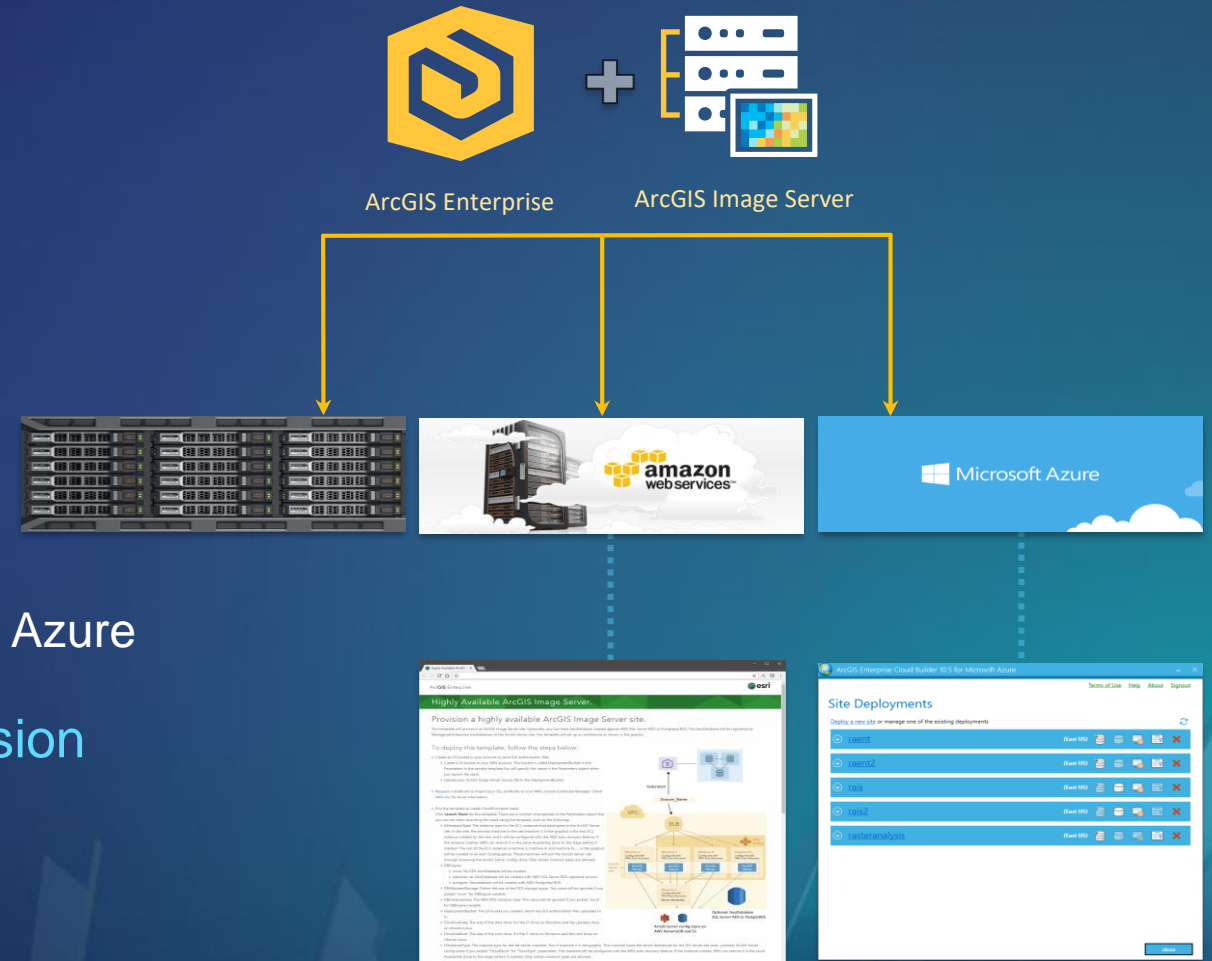
- your hardware
- your Amazon
- your Azure

- **deployment tools**

- Amazon CloudFormation Templates
- ArcGIS Enterprise Cloud Builder for Microsoft Azure

- **Deploying Distributed Raster Analytics Session**

- Session ID 1684, SDCC Room 30 E
- Thursday 07/12 @ 13:00



Raster Analytics

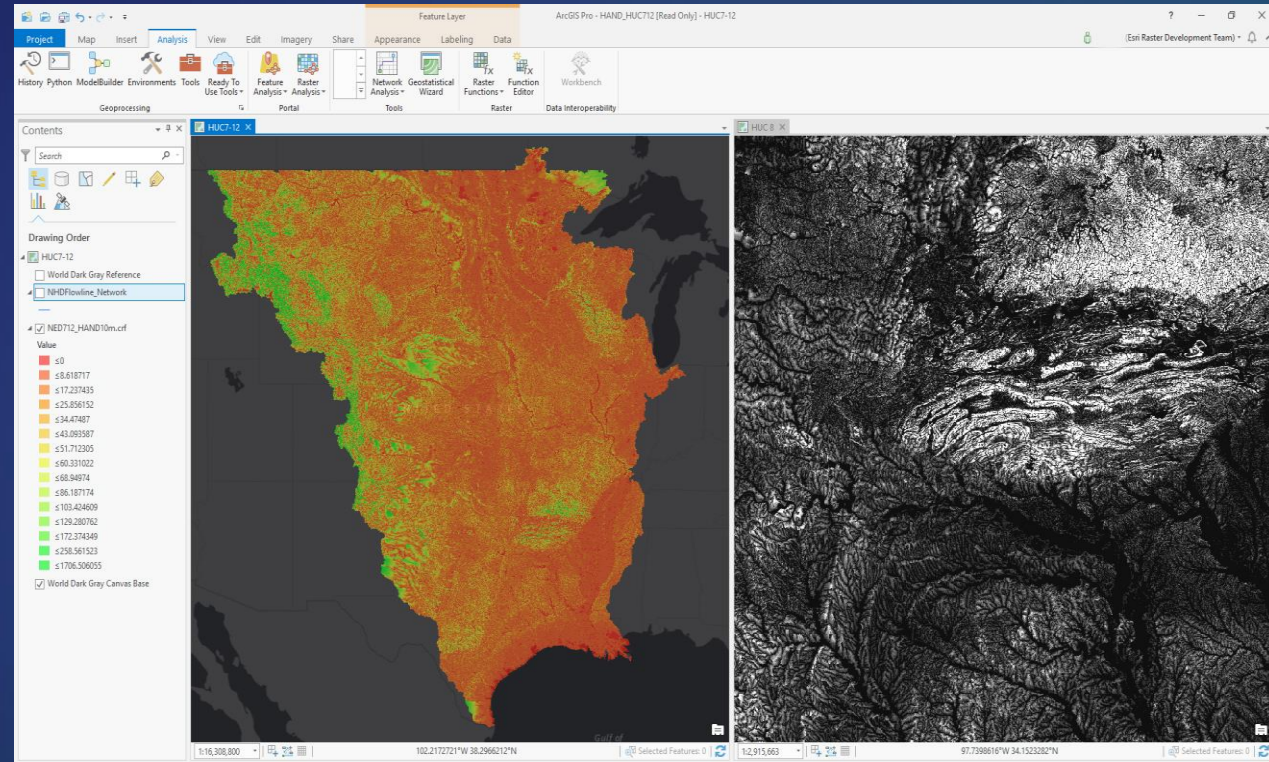
Examples

Enterprise Raster Analytics Hydro Tools

Mississippi (HUC2 Regions 7-12 @ 10m) ~105 billion cells

- **Distributed as of 10.6**

- Fill
- Flow Distance
- Flow Direction
- Flow Accumulation
- Watershed
- Stream Link
- Nibble

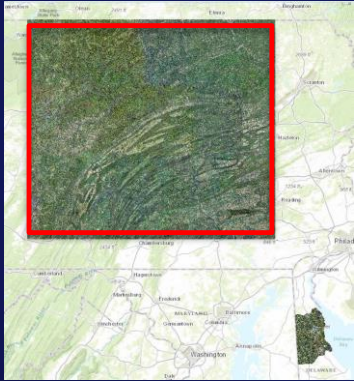


- **Fill:** 18h 39m 23s
- **Flow Direction D8:** 4h 46m 22s
- **Flow Accumulation:** 23h 40m 24s
- **Flow Direction D ∞ :** 13h 5m 21s

4 in-house commodity servers (desktops) running 8 RA processors each

Raster Analytics: Penn State Watershed Processing

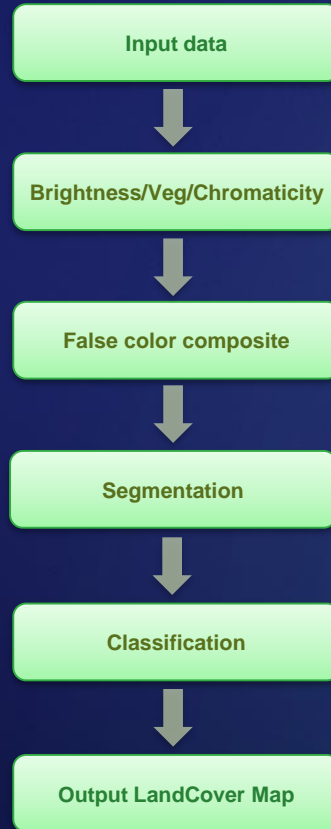
Input data



Penn State Watershed

- 397 GB
- distributed datastore

Processing



Output



100 billion pixels!

1 hour 13 minutes

10 – 20 core Azure instances

Infrastructure



ArcGIS Enterprise on Azure



Image Server Cluster

10 Azure instances – 20 cores each

Esri
Sponsor/
Exhibitor
Services

ESRI DEMO
THEATERS 1-2

ESRI
DEMO
THEATER
3

ESRI DEMO
THEATERS 4-5

INTEROPERABILITY
AND
STANDARDS

INTELLIGENT
ANALYTICALS
& LANGUAGE
SUPPORT

ESRI
DEMO
THEATER
6

TECHNICAL
SUPPORT

MEETING ROOMS
G1-G3

MEETING ROOMS
G4-G7

531 630
529 628

CAREERS
IN GIS

REAL-TIME
GIS

SPATIAL DATA
MANAGEMENT

ARCGIS ENTERPRISE

139 238

339 438

239

137 236
135 234

335 434
333

437 534
435

DESIGN &
PLANNING
ARCGIS
INSIGHTS

IMAGERY

MAPPING &
VISUALIZATION

ARCGIS PRO

IMPLEMENTING
ArcGIS

MOBILE TESTING
& USABILITY LAB

127

231 238A
229 326
227

331 428
329

431 530
429 528
427 526

527

627 730

731 830

827

927 1030

1031 1130

1127

See Cool Stuff!

ESRI
DESIGN
RESEARCH
STATION

219

319

419

519

619

719

819

919

1019

1119

LIFELONG
LEARNING

ESRI INFO

ArcGIS
SOLUTIONS

1619 A
1619 B

115 214
111 212
210
105 208
204

215 314
213 312
211 308
209

COMMERCIAL
UTILITIES

615 714
613 712
611 710
609 708

601

AEC
NATURAL
RESOURCES
EARTH SCIENCES
ENVISIONING
CENTER 1

1015 1114
1013 1112
1011 1108
1007
1104

1001

HEALTH &
HUMAN
SERVICES
COMMUNITY
DEVELOPMENT
EDUCATION
PUBLIC
POLICY

LAND RECORDS
& CADASTRE
PUBLIC
WORKS
TRANSPORTATION
MAPPING &
STATISTICS
ENVISIONING
CENTER 2

MEETING
ROOMS F1-F5

ENTRANCE

MEETING ROOMS E1-E6

ENTRANCE

MEETING ROOMS D1-D5

ENTRANCE

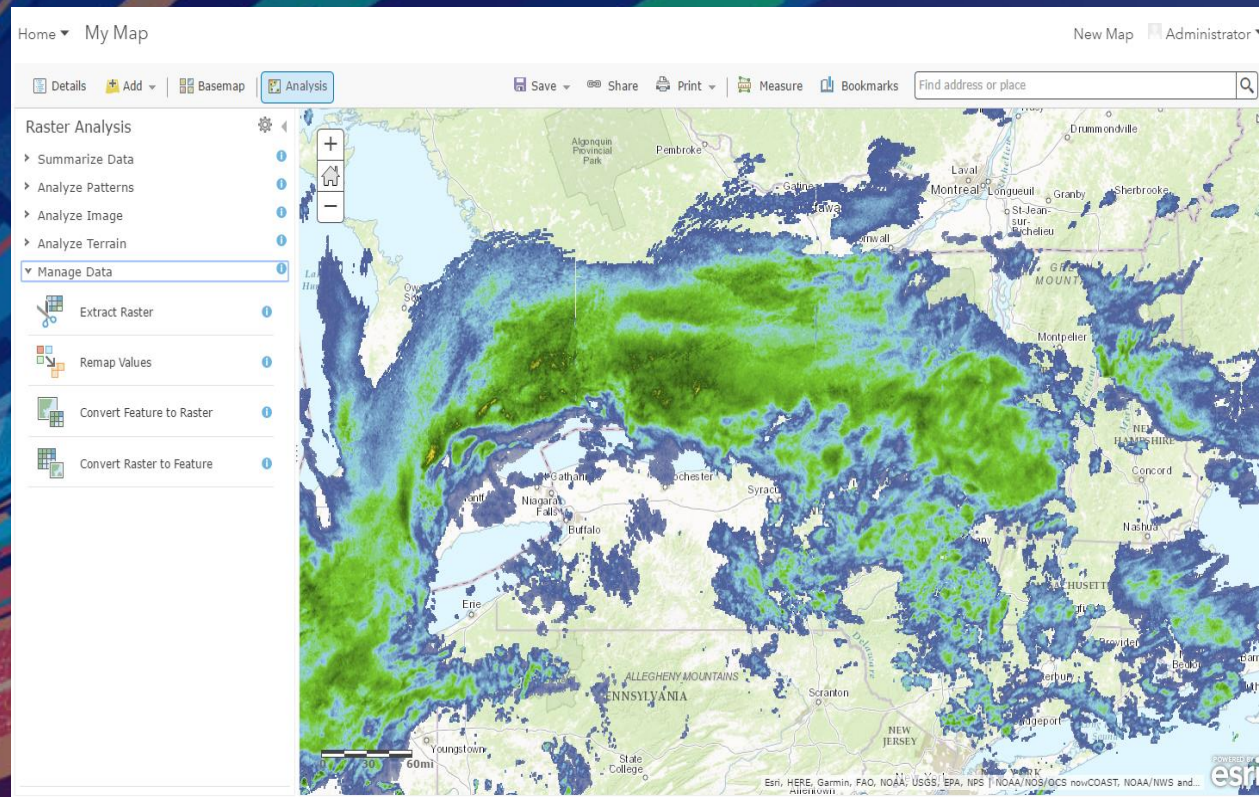
MEETING ROOMS C1-C5

ENTRANCE

MEETING ROOMS B1-B5

HALL C

HALL B



Demos

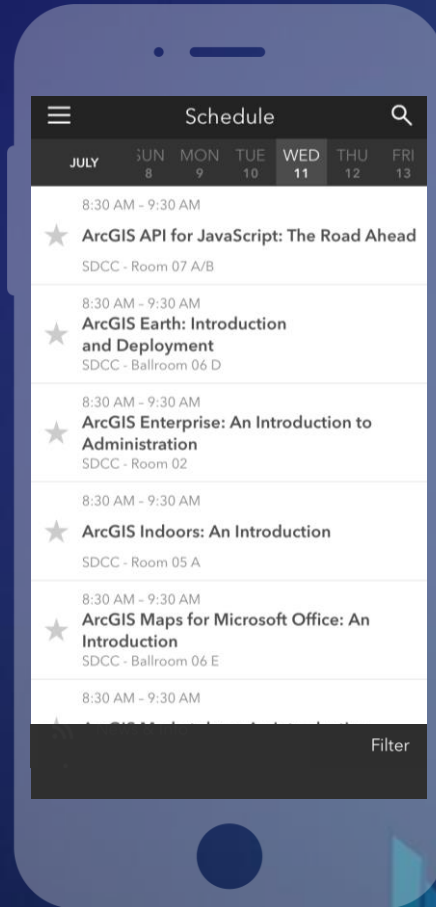
Vinay Viswambharan

Please Take Our Survey on the App

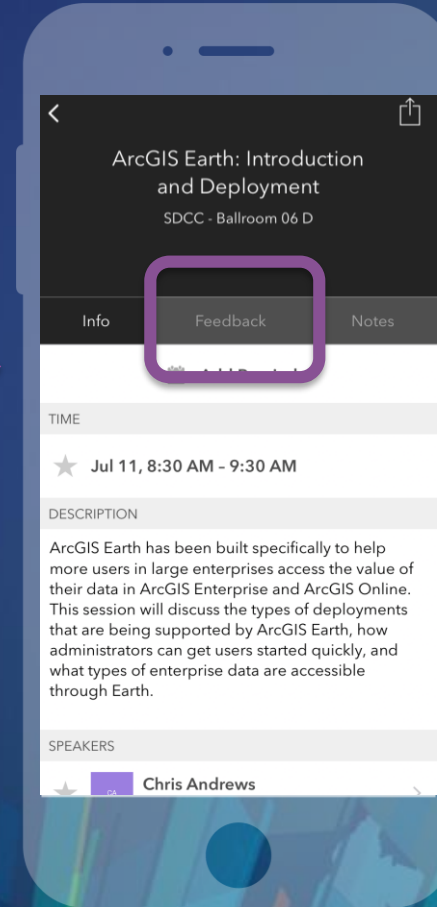
Download the Esri Events app and find your event



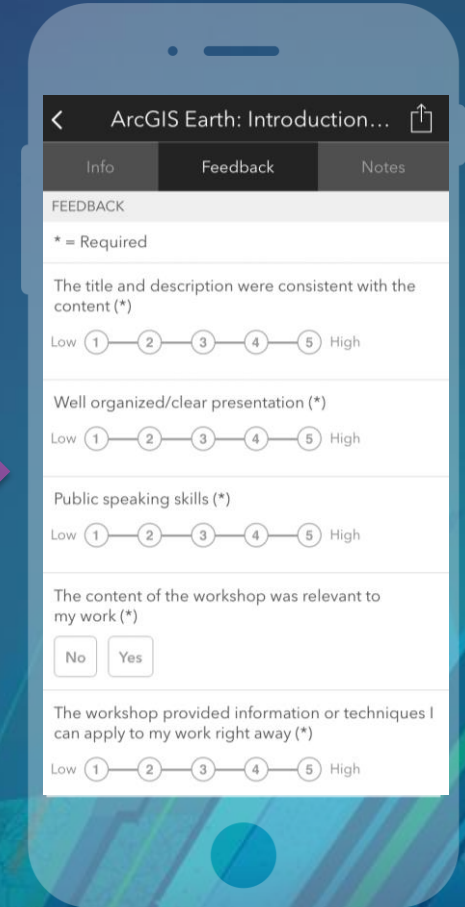
Select the session you attended



Select the Feedback tab



Complete answers and select "Submit"





esri

THE
SCIENCE
OF
WHERE