# Digital Transformation: Possibilities for a Geo-Enabled Campus

Geri Miller
Esri, Education Outreach
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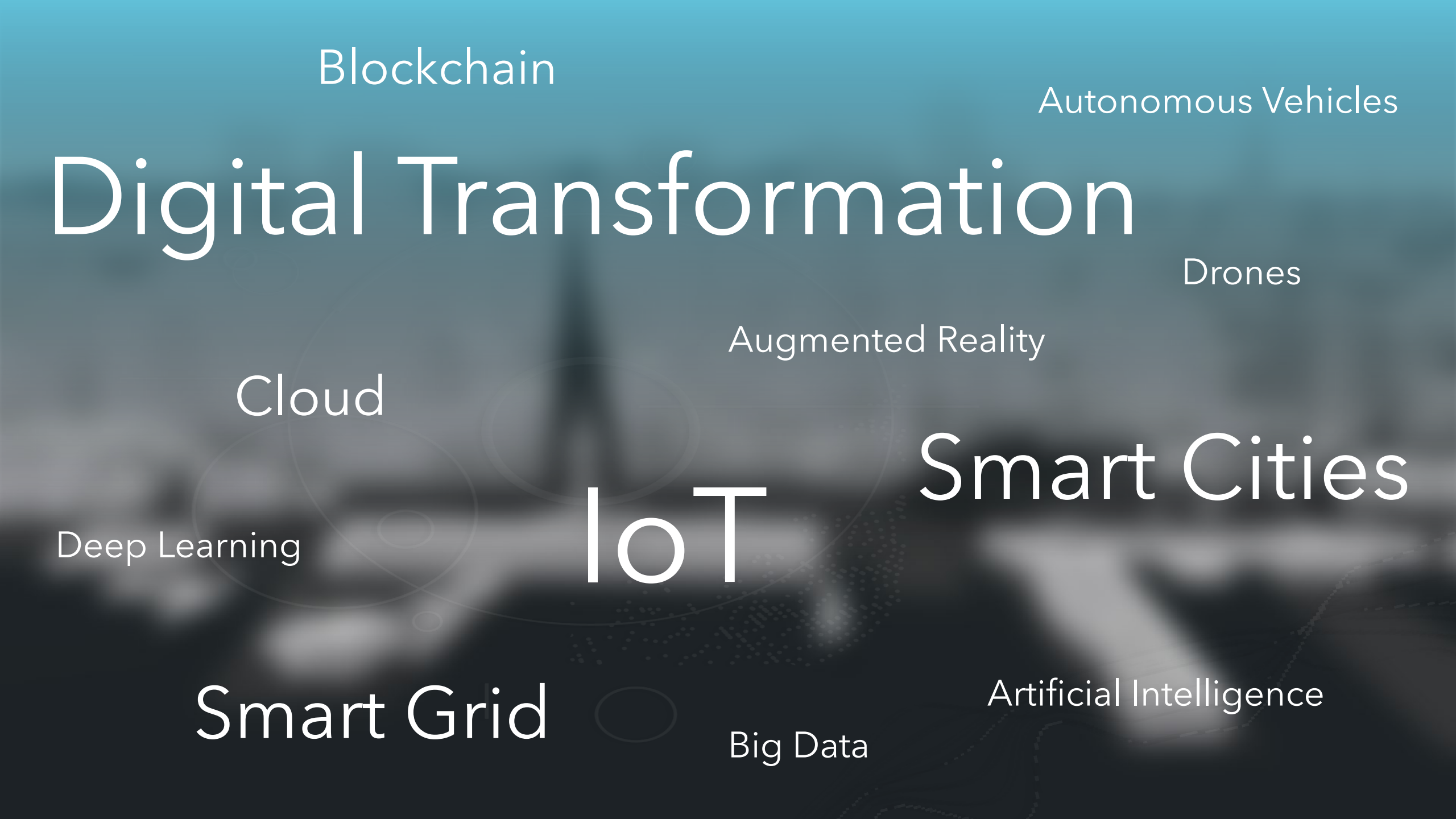
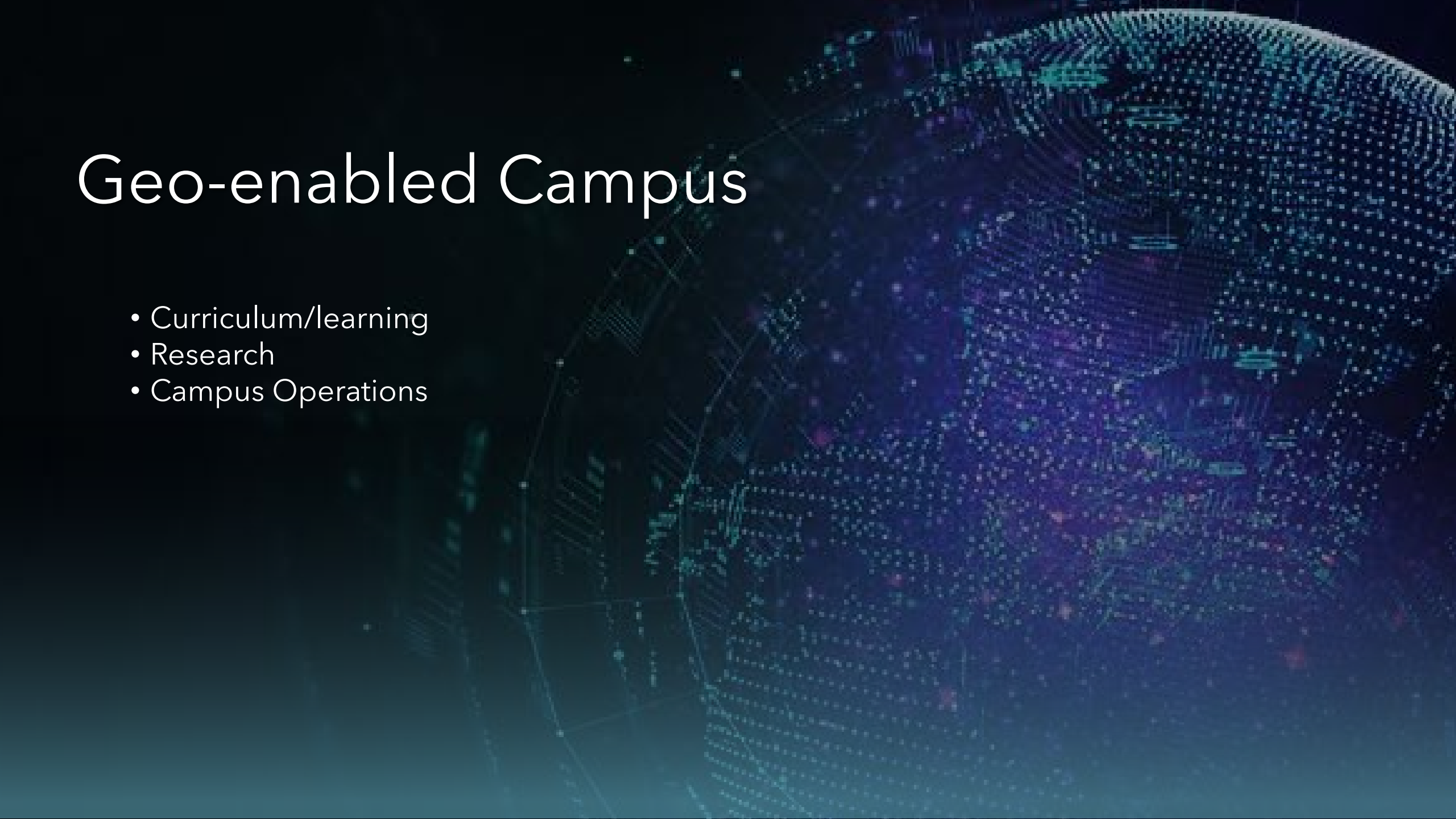

Blockchain
Autonomous Vehicles
Digital Transformation
Drones
Augmented Reality
Cloud
Smart Cities
IoT
Deep Learning
Smart Grid
Artificial Intelligence
Big Data

# Geo-enabled Campus

- Curriculum/learning
- Research
- Campus Operations



# Esri Development Centers (EDC)

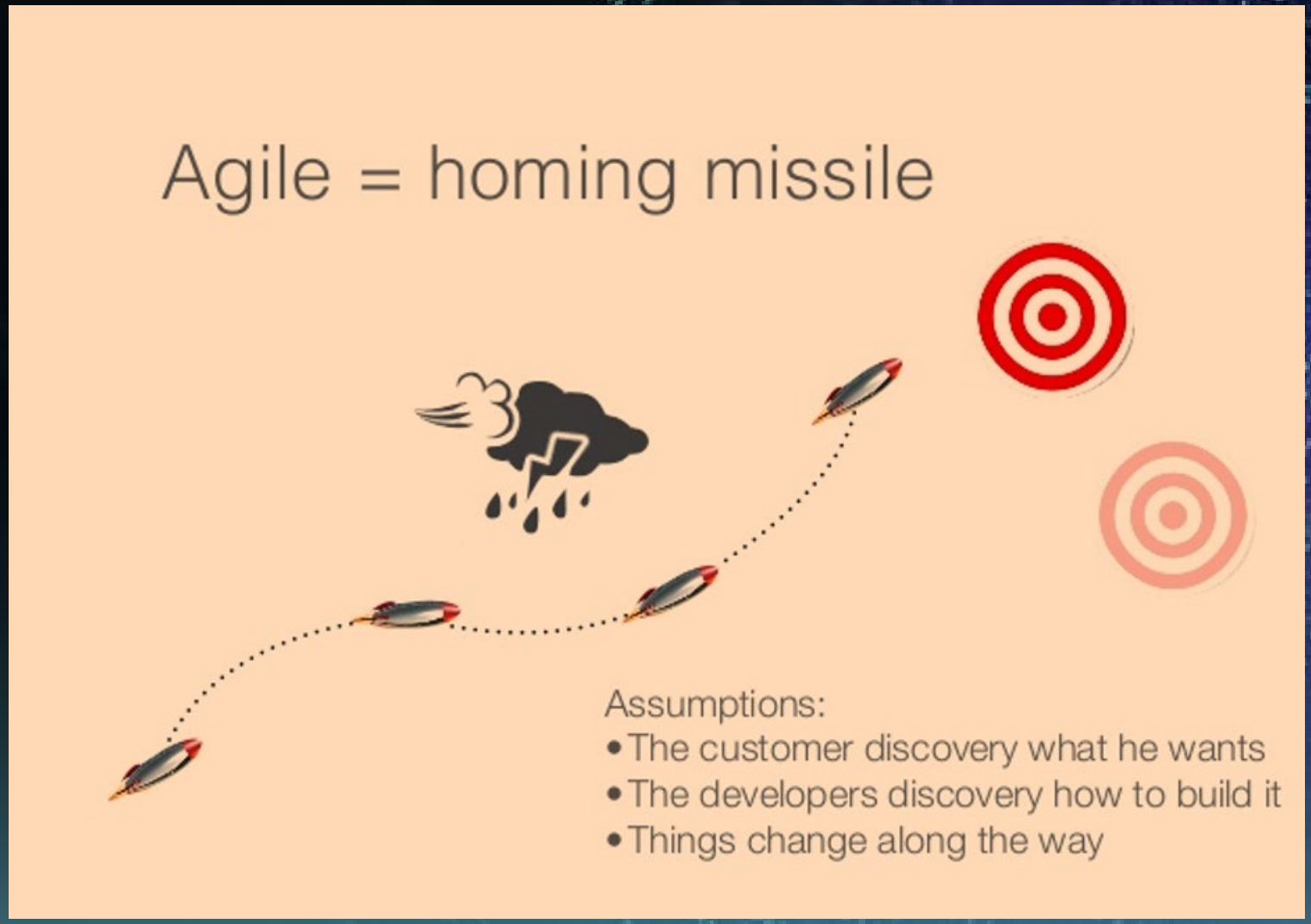
- Student of the Year

Esri Development Center (EDC)

Program for Higher Education

ArcGIS is an enabling technology—a foundation upon which geospatial professionals implement solutions that meet their organizations' needs. Graduates of higher education programs who can build apps, code, administer systems, and who are current in their GI systems and science skills are highly sought after by employers. The Esri Development Center (EDC) program confers special status and benefits upon a select few leading university departments that challenge their students to implement innovative solutions based upon the ArcGIS platform. This can include programs that help students advance and extend Esri's core technology, utilizing Esri solutions in technology trends or that provide training in system integration, enterprise implementation, and application development within a particular domain. EDCs may be degree-granting academic departments or GIS research and development centers within higher education institutions.

# Agile curriculum



# What is modern GIS?

GIS that is interactive, accessible, that helps you explore questions, solve problems, find answers, and that works with many kinds of data.

It is GIS you can share.

….

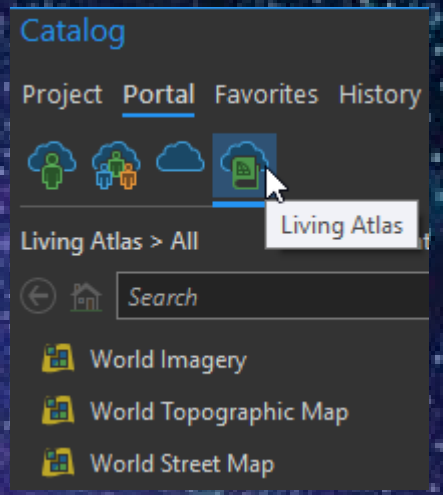
# Apps

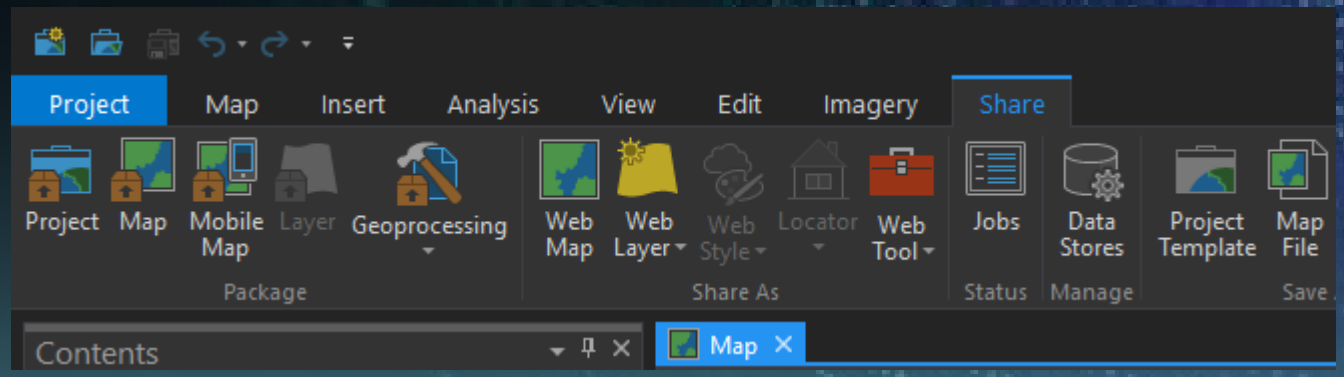
- Simple, focused apps
- Access anywhere, anytime, any device
- Integrating GIS with other business systems
- Ready to use solutions
- Configuration of apps (native and web-based)

# Services – based

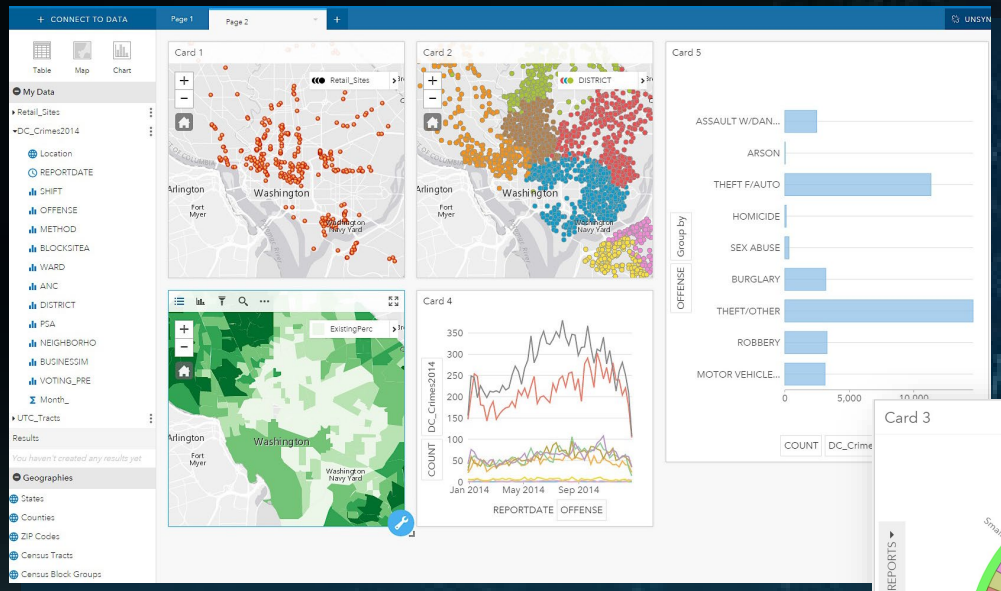
- Many types of services (maps, data, analysis, image, geocode)
- Ready to use services/content
- Hosting services/content
- Interoperability

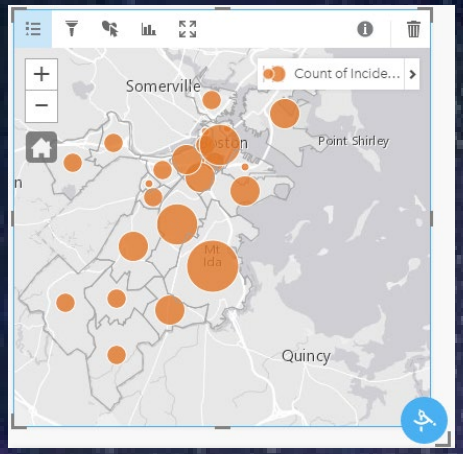
- Cloud/On Premises

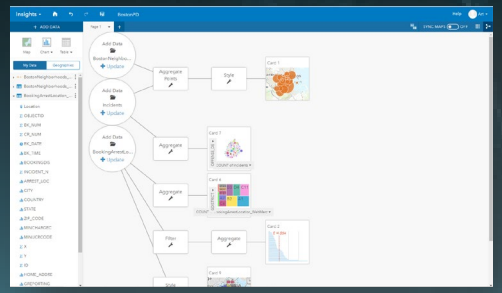


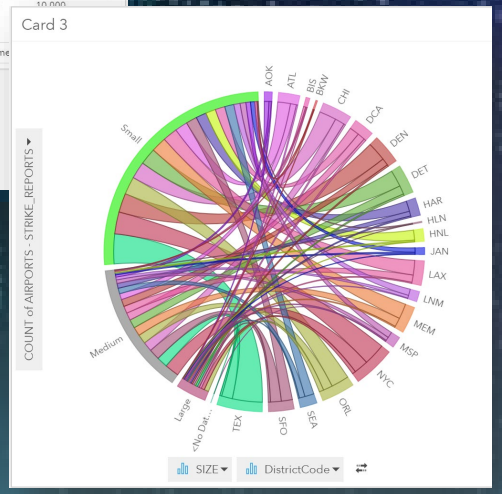



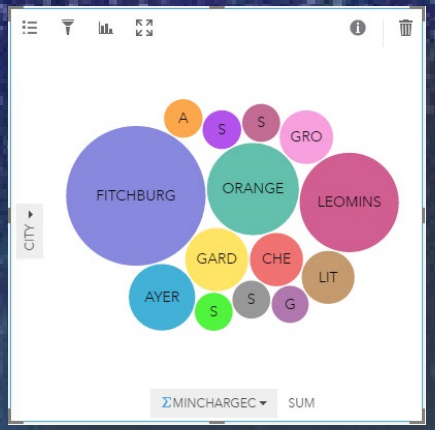
# Analytics as a Service





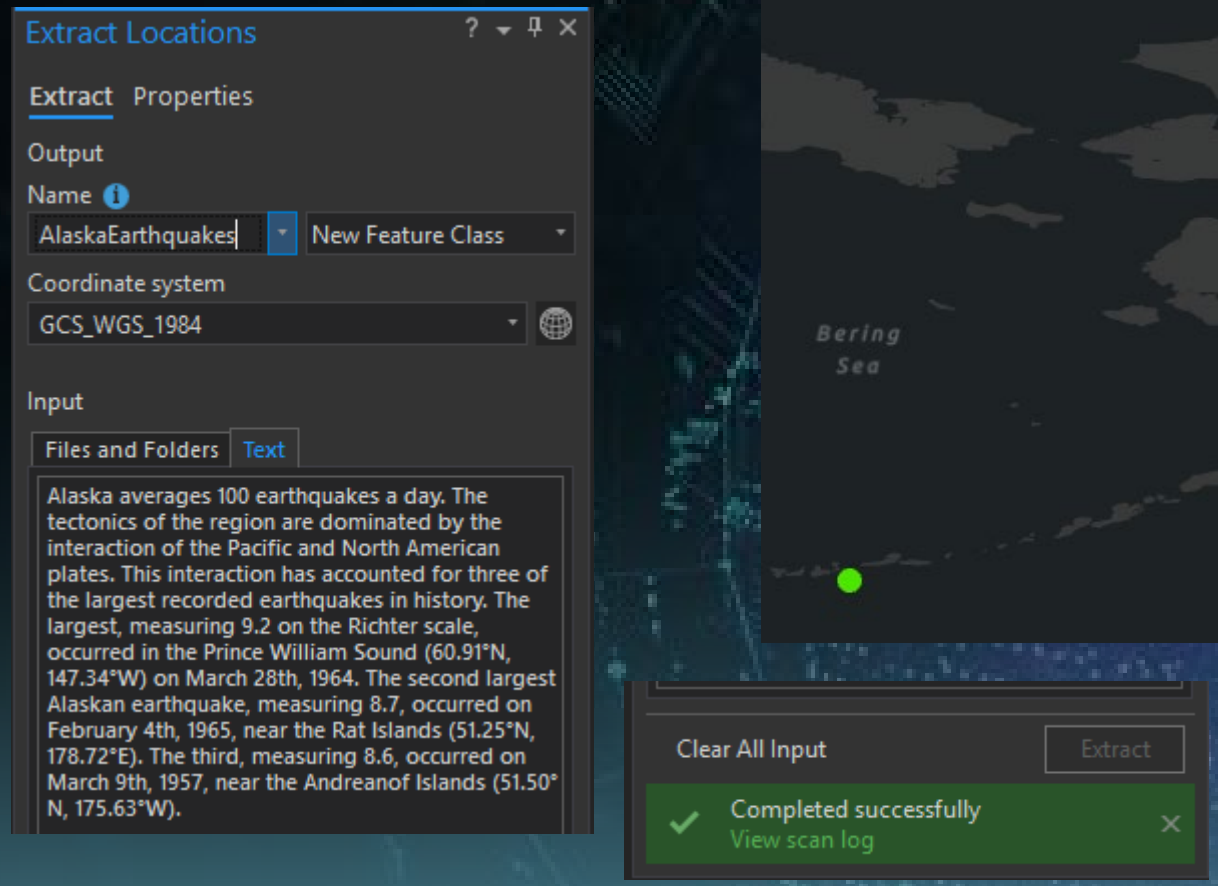
# Data wrangling: Unstructured data

- LocateXT

Alaska averages 100 earthquakes a day. The tectonics of the region are dominated by the interaction of the Pacific and North American plates. This interaction has accounted for three of the largest recorded earthquakes in history. The largest, measuring 9.2 on the Richter scale, occurred in the Prince William Sound (60.91°N, 147.34°W) on March 28th, 1964. The second largest Alaskan earthquake, measuring 8.7, occurred on February 4th, 1965, near the Rat Islands (51.25°N, 178.72°E). The third, measuring 8.6, occurred on March 9th, 1957, near the Andreanof Islands (51.50°N, 175.63°W).

# Data wrangling: Unstructured data

- LocateXT



# Internet of Everywhere

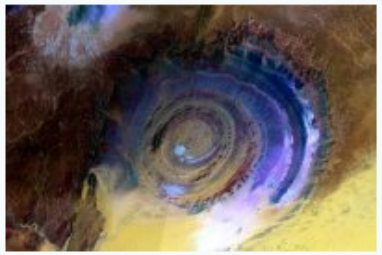
- Tracker for ArcGIS
  - Know where everyone is

# GeoAI

- Predictive analytics
- Spatial machine learning

```
In [2]: l8 = agol_gis.content.search('Landsat Multispectral', 'Imagery Layer')[2]
        l8
```

Out[2]:



Multispectral Landsat

Landsat 8 OLI, 30m multispectral and multitemporal 8-band imagery.

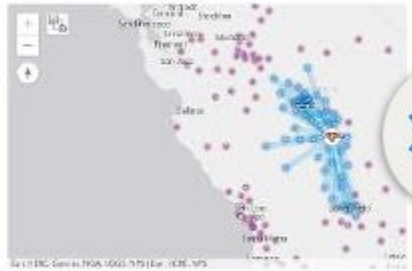
Imagery Layer by esri
Last Modified: May 03, 2018
0 comments, 109,072 views

## Featured Notebooks

Deep Learning: Downscale climate models

Raster Analytics: Calculate wildfire landslide risk

Raster Analytics: Count features in satellite images



Site Selection: Health clinics

Home Gallery Map Scene Notebook Groups Content Organization

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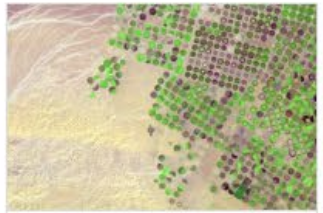
gmiller

## Raster Analytics: Count features in satellite images

Overview Preview



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Count the number of center pivots farms using scikit-image.

Notebook by esri_notebook

Created: Jan 28, 2019 Updated: Jan 28, 2019 View Count: 15

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ArcGIS | Raster Analytics: Count features in satellite images last checkpoint: a few seconds ago (unsaved changes)

Geri Miller
gmiller

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# Raster Analytics: Count features in satellite images

- Data Science
- Raster Analysis
- Ready To Run!

## Table of Contents


- Connect to your GIS
- Set the extent
- Preprocess the image
- Blob detection using scikit-image


The example below uses scikit-image library to detect circular features in farms using center pivot irrigation in Saudi Arabia. It then counts and reports the number of farms. This is one of the ways in which libraries from the scientific Python ecosystem can be integrated with the ArcGIS platform.

## Connect to your GIS

In [1]:

```
# Import ArcGIS libraries
from arcgis.gis import GIS
agol_gis = GIS()
from arcgis.raster.functions import stretch, ndvi

# Import Python image processing libraries
import numpy as np
from scipy.signal import convolve2d
from skimage import feature, color

# Import plotting libraries
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
```

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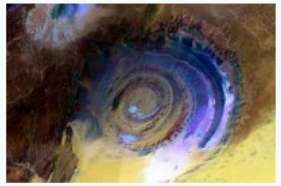
In [2]:
```
l8 = agol_gis.content.search('Landsat Multispectral', 'Imagery Layer')[2]
l8
```

Out[2]:



**Multispectral Landsat**

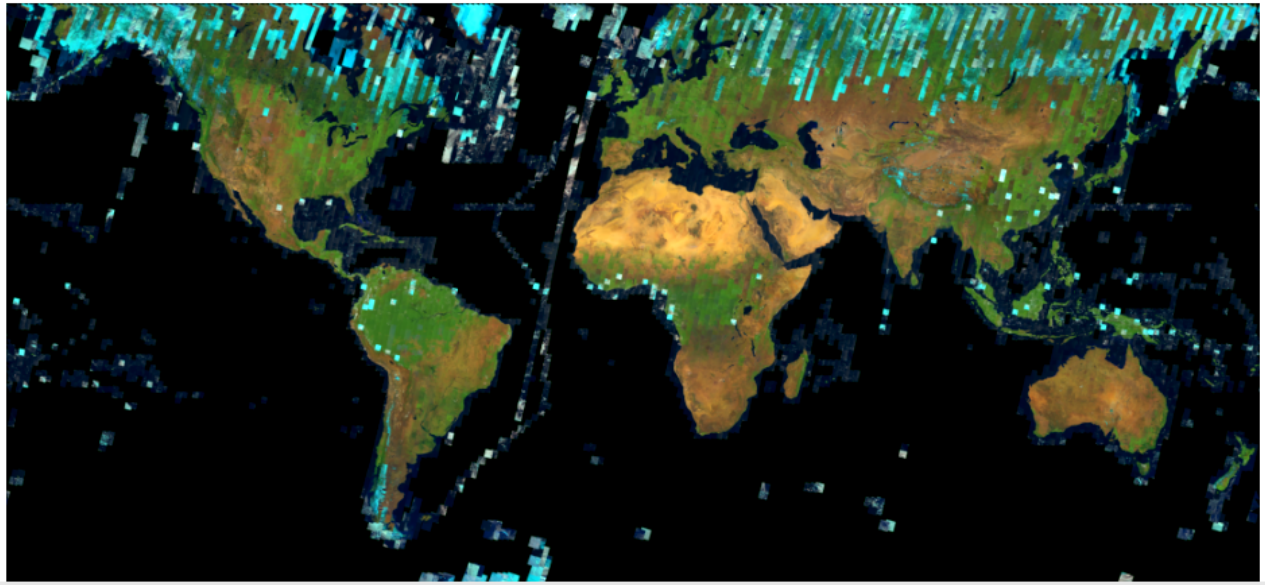
Landsat 8 OLI, 30m multispectral and multitemporal 8-band imagery, with on-the-fly renderings and indices. This imagery layer is sourced from the Landsat on AWS collections and is updated daily with new imagery.

Imagery Layer by esri
Last Modified: May 03, 2018
0 comments, 109,072 views

We query the first layer from this item and use that for this sample. Here, the RGB composite of the image is made up of Short Wave Infrared (SWIR), Near-Infrared (NIR), and blue bands.

In [3]:
```
l8lyr = l8.layers[0]
l8lyr
```

Out[3]:



ArcGIS | Raster Analytics: Count features in satellite images last checkpoint: a few seconds ago (unsaved changes)

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## Set the extent

The code below sets the extent of the layer, to a known extent of farms in Saudi Arabia and then visualizes the landsat layer:

In [4]:
```
l8lyr.extent = {'spatialReference': {'latestWkid': 3857, 'wkid': 102100},
                'type': 'extent',
                'xmax': 4296559.143733407,
                'xmin': 4219969.241391764,
                'ymax': 3522726.823081019,
                'ymin': 3492152.0117669892}
l8lyr
```

Out[4]:

## Preprocess the image

We can preprocess the imagery using raster functions. The code below uses the NDVI raster function to identify areas that have healthy vegetation. This preprocessing step makes the scikit-image blob detection algorithm work better.

In [5]:
```
stretched_ndvi = stretch(ndvi(l8lyr), # construct NDVI and pass that to stretch function
                         stretch_type='PercentClip', # applies a linear stretch between min and max
                         min_percent=30, # the low values to exclude from the stretch
                         max_percent=70, # the high values to exclude from the stretch
                         dra=True) # turn on the Dynamic Range Adjustment

stretched_ndvi
```

Out[5]:

ArcGIS | Raster Analytics: Count features in satellite images last checkpoint: a few seconds ago (unsaved changes)

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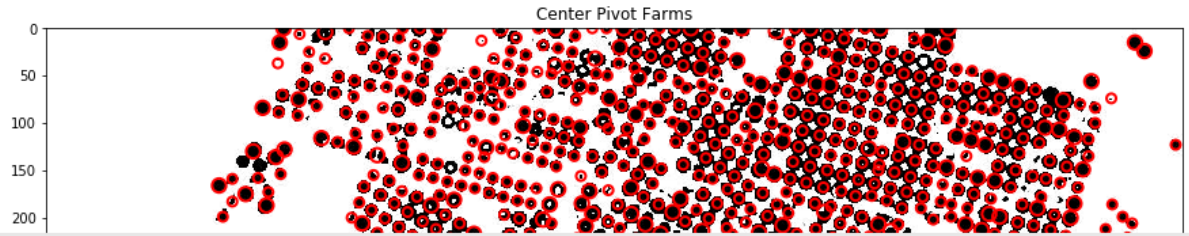
## Blob detection using `scikit-image`

The code below uses `scikit-image` library to find blobs in the given grayscale image, and reports the number of farms thus detected. It also plots as **red** circles superimposed on the wells for visualization using matplotlib.

Blobs are found using the Difference of Gaussian (DoG) method.

In [8]:

```
bw = img.mean(axis=2) # compute the arithmetic mean along the third axis

fig=plt.figure(figsize = (15,15))
ax=fig.add_subplot(1,1,1)

blobs_dog = [(x[0],x[1],x[2]) for x in feature.blob_dog(-bw,
                                                        min_sigma=4, # The min std for Gaussian Kernel
                                                        max_sigma=8, # The max std for Gaussian Kernel
                                                        threshold=0.1, # Ignore local maxima smaller
                                                        overlap=0.6)] # Ignore blob with lower fraction


#remove duplicates
blobs_dog = set(blobs_dog)

img_blobs = color.gray2rgb(img)

for blob in blobs_dog:
    y, x, r = blob
    c = plt.Circle((x, y), r+1, color='red', linewidth=2, fill=False)
    ax.add_patch(c)

plt.imshow(img_blobs)
plt.title('Center Pivot Farms')

plt.show()
print('Number of center pivot farms detected: ' + str(len(blobs_dog)))
```



# Student Quote

**Thread:** API Sandbox
**Post:** API Sandbox
**Author:** JOSEPH T[redacted]

**Posted Date:** April 24, 2019 9:32 PM
**Status:** Published

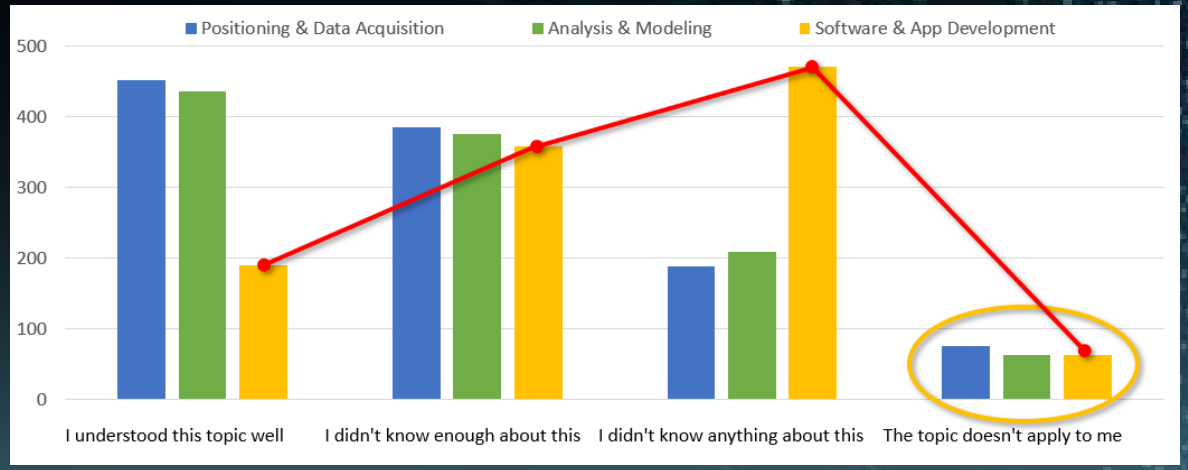
Hey Class,

After using the API Sandbox, I was impressed with it's ease of use.  I have to admit, I was slightly intimidated by this week's content; however, was relieved after using the Sandbox.

Thanks!

# Programming

Programming for data science: Visualization and Analytics
Programming for web application development
Programming for your IT
Programming for native apps: Mobile
Programming for native apps: Desktop




Goal: Identify gaps in our curricula. The below relate to geospatial technology (not any other development).

- What kind of programming tasks do you do (multiple choice)?
  - Develop Web applications using out of the box solutions
  - Develop Widgets
  - Develop Mobile Applications
  - Develop Desktop Applications
  - Develop Desktop extensions/add-ins
  - Automate Workflows
  - Data Analysis
  - Integration with other non-GIS systems
  - System Architecture/Administration
  - Other

  (rank them)

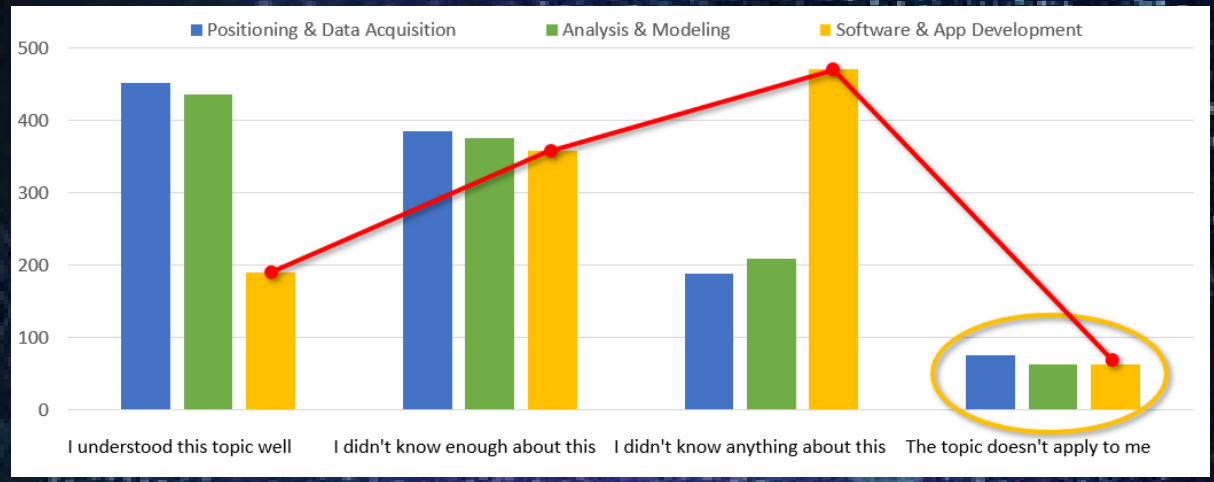
- For each of the above, what programming languages do you use (rank them)?
  - Python
  - JavaScript
  - R
  - SQL
  - Mobile development Android
  - Mobile development iOS
  - Qt
  - Java
  - C#
  - C++
  - Other

  (rank them)

# IT

- Why GIS in organization's infrastructure
- Web Servers, Map Servers, Database Servers
- Configuration of portal environments
- Management of networks
- Understanding Security

- Enterprise GIS



# How…Resources?

# Geo-enabled Campus

# Geo-enable campus

Administer GIS as an institution-wide, enterprise-class system

- Access for everyone
- Access to everything
- More doing GIS…
- ...Less administrating GIS

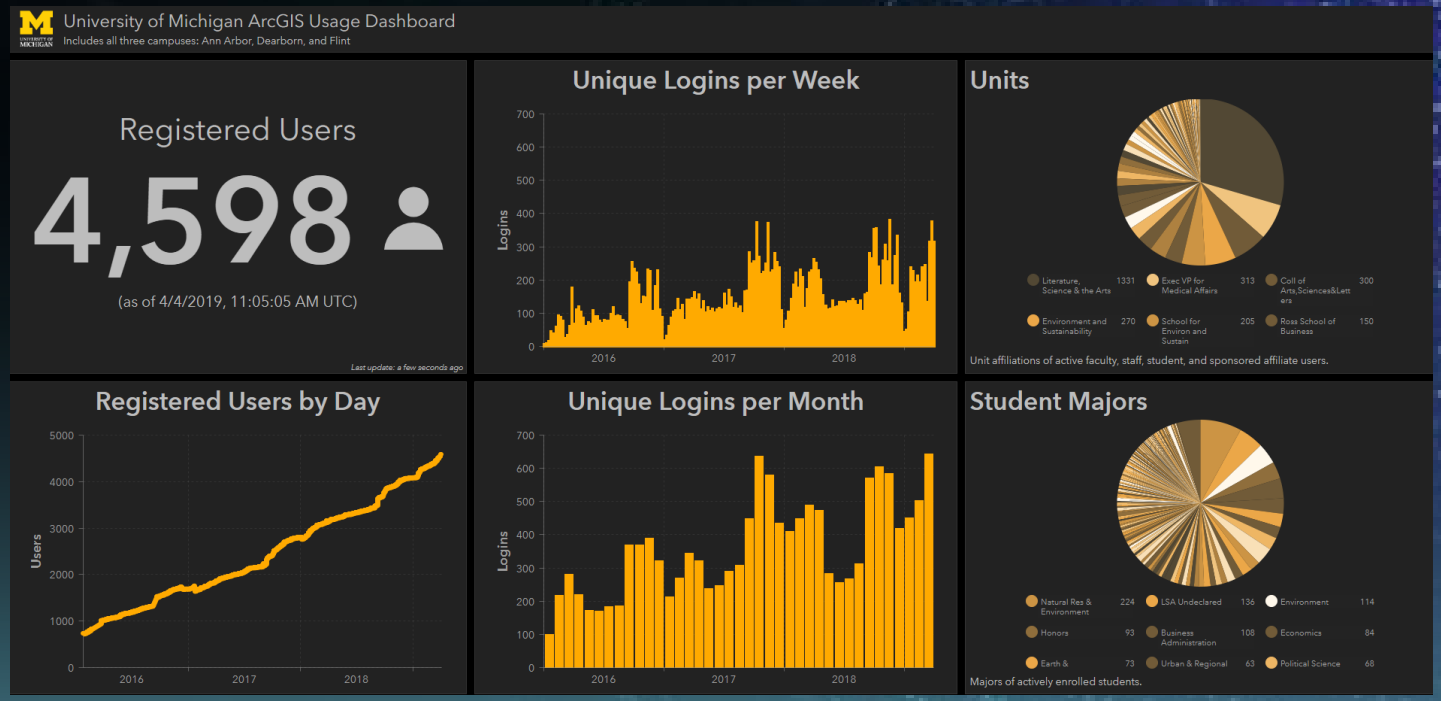
# Integration with campus business systems

Implement SSO using Enterprise Logins
LMS integration

- → Enable everyone at your institution to have access to GIS

# Usage Data to Support Justification

- How broad is the impact of GIS? (Total Users)
- How deep is the impact of GIS? (Unique Logins per time period)



# Geo-enabled campus = A Smart Campus

esri | THE SCIENCE OF WHERE

# A Smart Campus Platform

GIS leverages your existing data and infrastructure to help create an optimal campus experience for operations staff, faculty, and students

# ArcGIS – a platform for campus management and safety

## Locate People and Assets

Faculty and Students
Classrooms
Work Order Requests

## Monitor Campus Operations in Real-Time

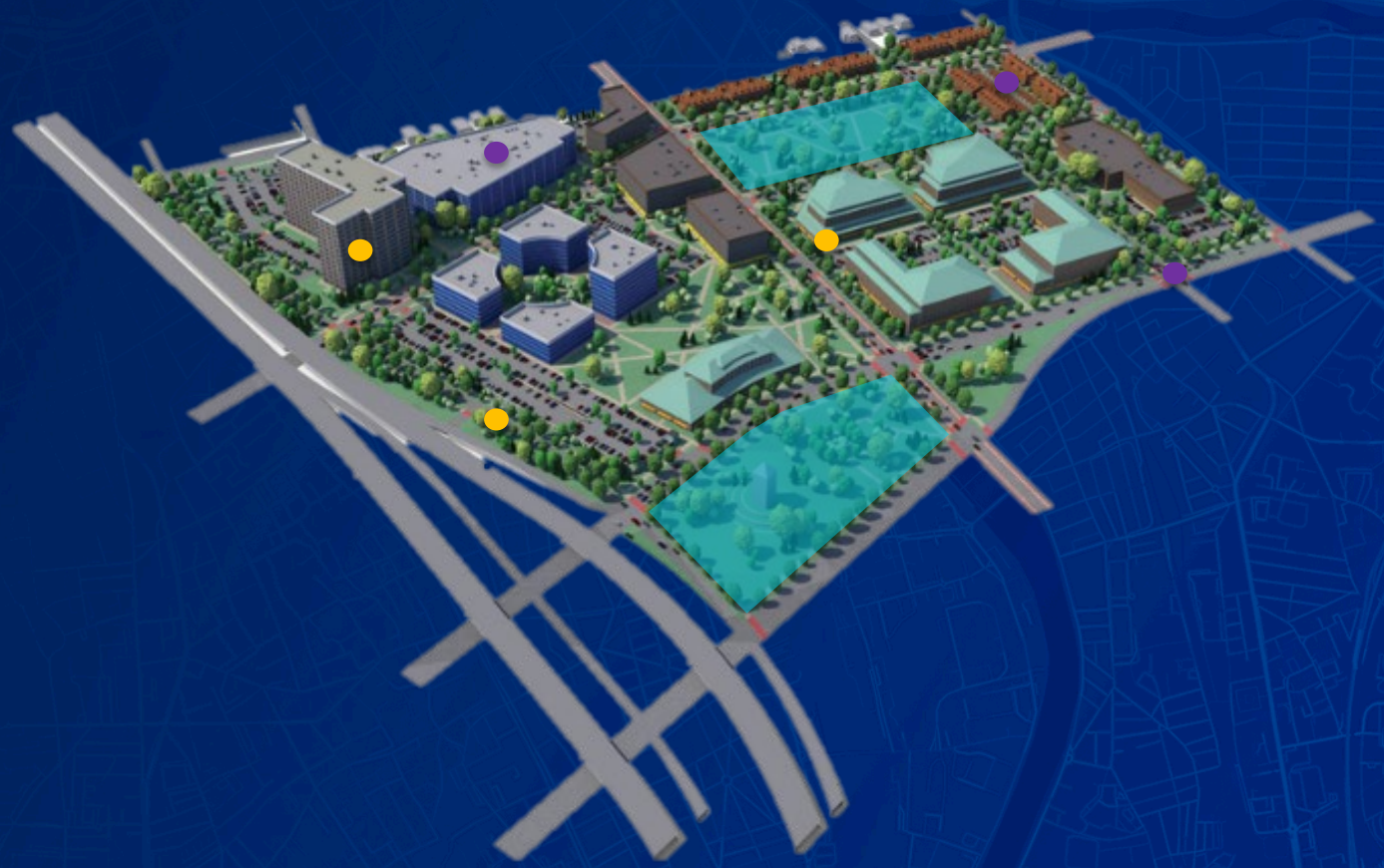
Space Utilization
Energy Consumption
Facility Condition

## Plan + Optimize

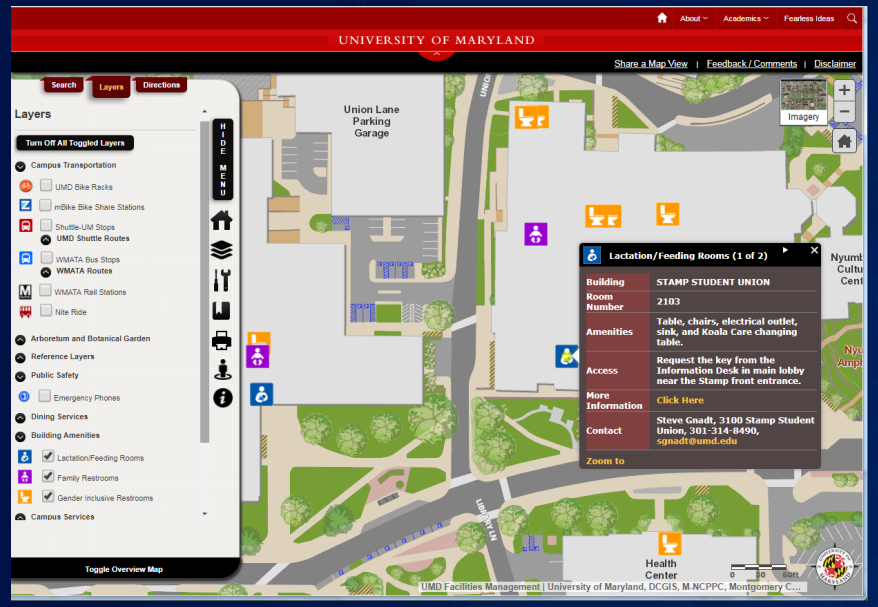
Maintenance Workflows
Campus Safety & Security
Faculty/Student Experience

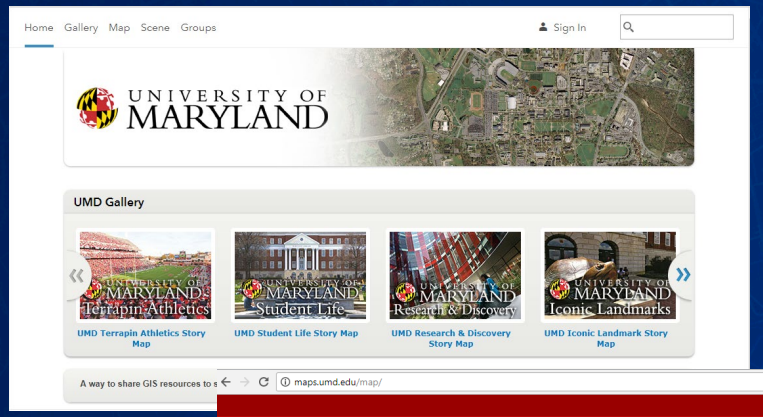
## Create and Deliver Maps Quickly

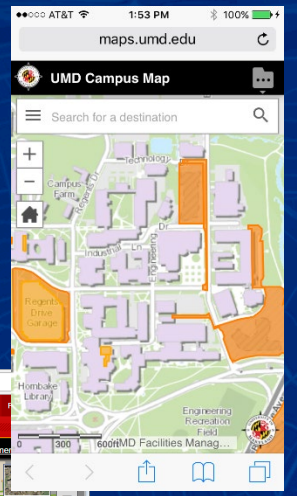
Students
Faculty
Visitors

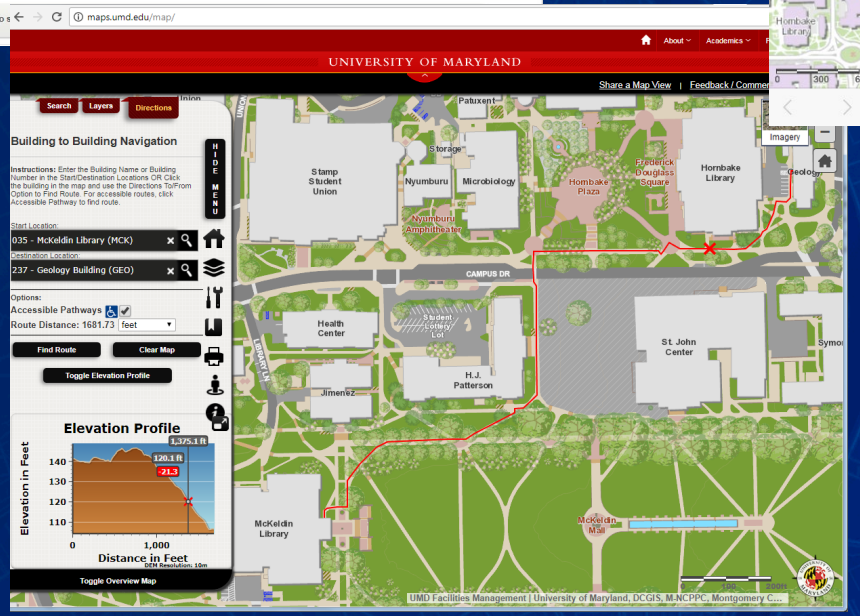


# University of Maryland: Curated geodata, interdepartmental collaboration, campus routing




**UMD campus map**
https://maps.umd.edu

**UMD story map gallery**
http://uofmd.maps.arcgis.com

**UMD enterprise GIS story**
http://www.esri.com/esri-news/arcnews

# Campus Viewer

Quickly locate people, assets, and spaces across campus

# 3D Campus Viewer

Communicate and plan using real-world context

# Campus Dashboard

Monitor conditions across campus such as occupancy, energy usage, and facility/utility conditions

# Safety & Security

Generate dynamic line of site and viewsheds for fixed assets across campus

# Thank You

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Esri

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