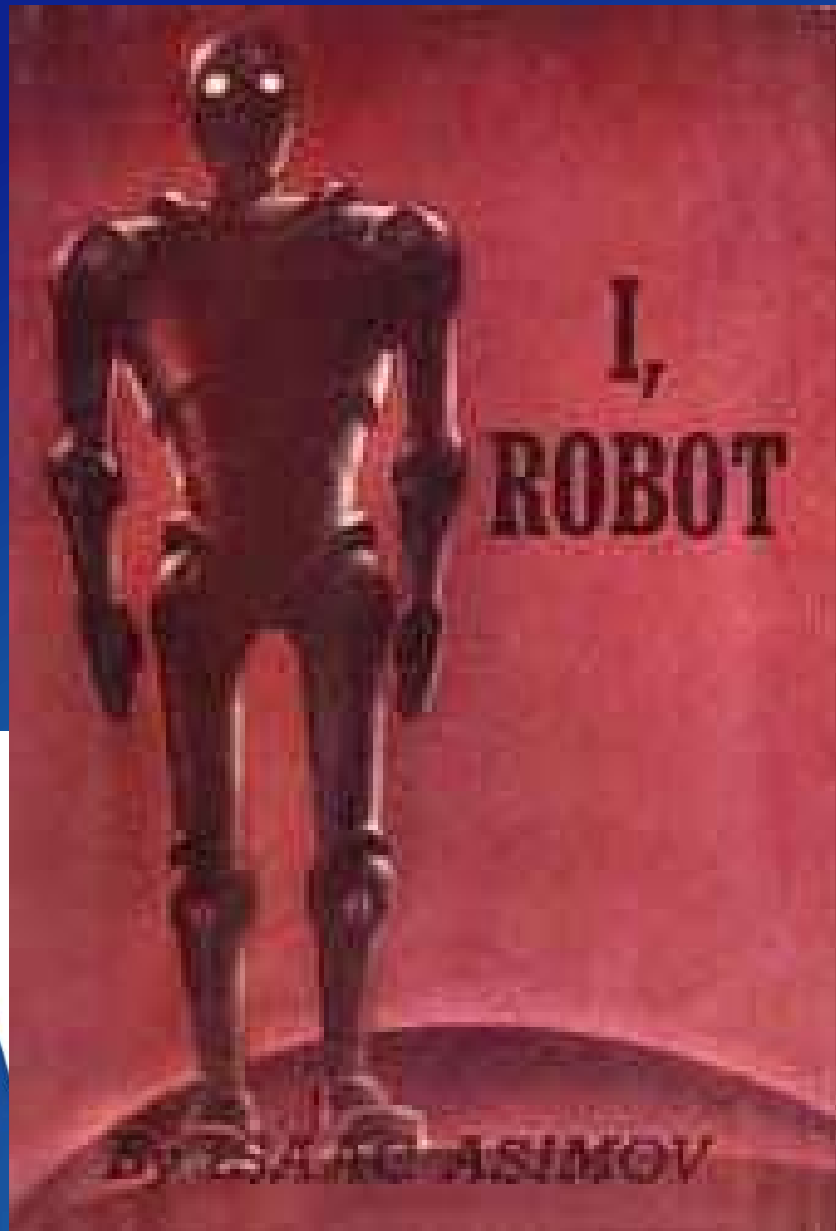


A futuristic landscape with a person on a path, overlaid with a hexagonal grid pattern. The scene is set against a dark, starry sky with a large, glowing red and white celestial body. The ground is a mix of green, yellow, and blue, suggesting a diverse environment. A person in a red suit is walking along a path that leads towards the horizon. The overall atmosphere is one of exploration and discovery.

The Changing Landscape of Land Administration

Brent Jones PE, PLS

Esri



World's Largest Media Company



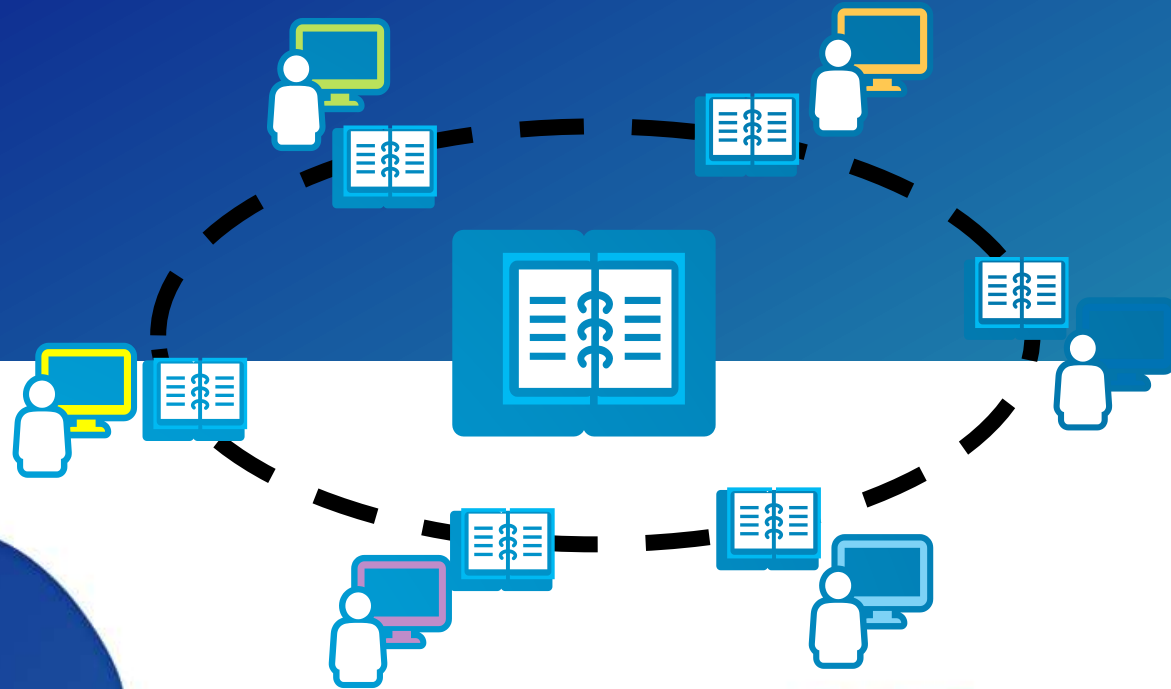
- No Journalists
- No Content Producers
- No Publishers

World's Largest Hospitality Company



- No Rooms
- No Receptionists
- No Front Desk

World's Largest Database - Blockchain



- No Operating System
- No Infrastructure
-

World's Largest Currency



- No Vault
- No Tellers

• No Physical Withdrawal

World's Largest Transportation Company

- No Cars
- No Manufacturing
- No Retail Facilities

Industrial Revolutions.....

- **First** ~ 1760 - 1820
- **Second** ~ 1840 - 1914
- **Third** ~ 1945 - 2000



*aaS





www.nationalparks.nsw.gov.au/google-trekker



www.limely.co.uk/google-street-view-cameras-upgrade



<https://pbs.twimg.com/media/DOld6AxWkAAVPKx.jpg>



<http://www.ros.org/news/2014/03/why-here-mapping-cars-are-basically-cyborgs.html>

WILL ROBOTS TAKE MY JOB?

willrobotstakemyjob.com/

90%

Appraisers and Assessors of
Real Estate

SOC CODE: 13-2021 01

Appraise real property and estimate its fair value. May assess taxes in accordance with
prescribed laws.

AUTOMATION RISK LEVEL

You are doomed

at 90% probability of automation

PROJECTED GROWTH

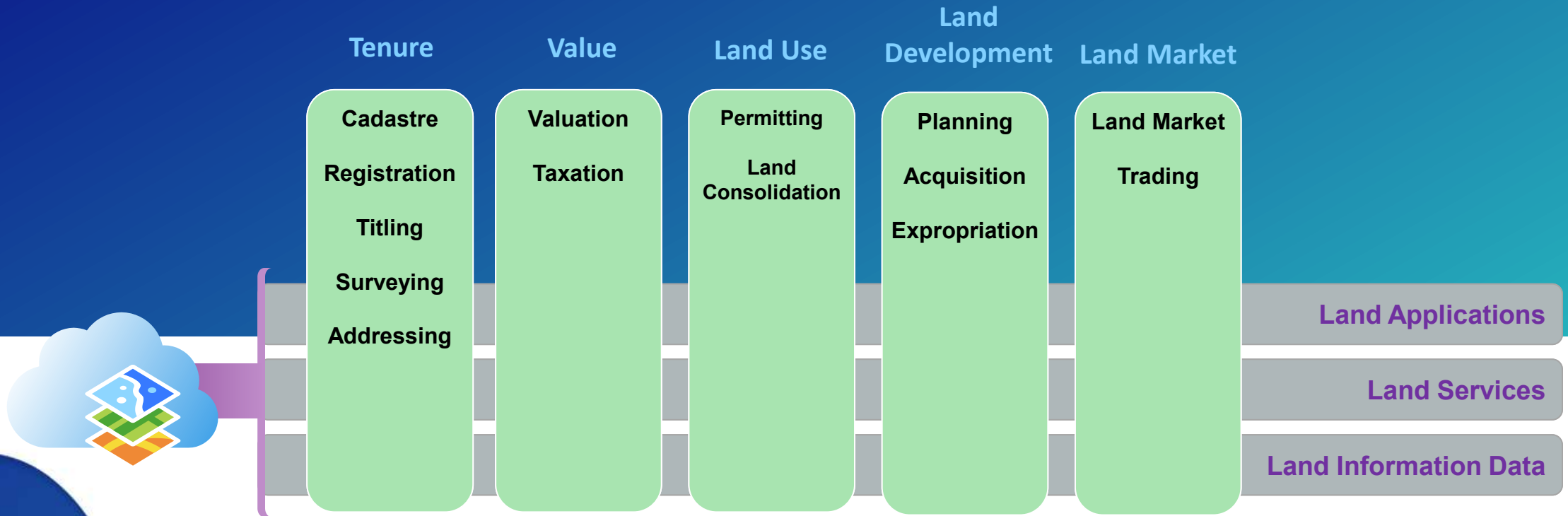
8%

by 2024





Land Administration



Artificial Intelligence

Video game
behavioral AI

Natural
Language
Processing

Computer
Vision

Robotics

Machine Learning

Theano

Keras

CNTK

TensorFlow

IBM
Watson

scikit-learn

Deep Learning

It's applied everywhere..

Autonomous Cars



Sentiment Analysis



Chatbots



War Robots



Advanced Video Analytics



Predictive Maintenance



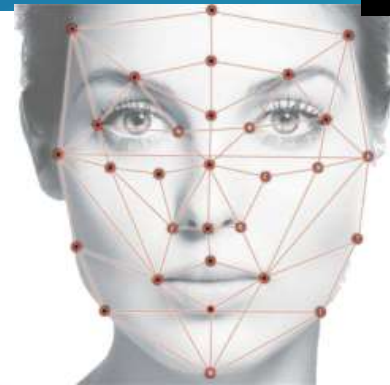
Crime Prediction



Cancer Detection



Facial Recognition



Machine Learning



Cloud ML

On-premise ML

New Products

	Microsoft	IBM	amazon	Google	SAP	ORACLE
Cloud ML	Azure ML Cognitive Services Azure Bot Service	Watson ML Service Data Science Experience	Amazon ML	Cloud AI Cloud ML (TF)	Leonardo SAP Analytics Cloud	Advanced Analytics
On-premise ML	ML Server	SPSS ML for z/OS	--	--	Leonardo SAP Predictive Analytics	Advanced Analytics R Enterprise Data Mining R Advanced Analytics for Hadoop
	Office 365 PowerPoint Outlook ..	Predictive Maintenance Targeted Marketing ..	Demand Forecasting, Recommendations, Search, Merchandising Placement, Fraud..	Search, Ads, Gmail, Translation, YouTube, Maps..	Fraud Mgmt, SAPHIRE, S/4HANA, Fieldglass, Total Workforce Insight	Predictive Maintenance Targeted Marketing ..
New Products	Cortana Assistant	--	Alexa, Prime Air Delivery Drones, Grocery Stores	Google Assistant	--	--

The Machine Learning Race

Top Active Companies & Categories

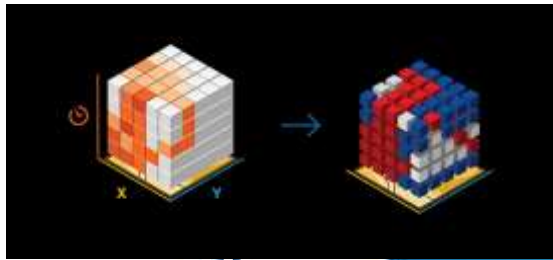
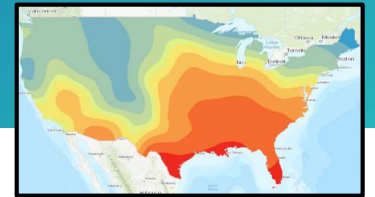
TOP COMPANIES INVESTING IN AI, BY INDUSTRY

SOFTWARE AND IT	FINANCIAL SERVICES	MANUFACTURING	AUTOMOTIVE	INDUSTRIAL AUTOMATION
Google Microsoft Amazon Facebook Mitre IBM Deloitte	Bloomberg American Express TD Ameritrade Deutsche Bank Goldman Sachs BNP Paribas	Abb National Instruments Toshiba GE	Tesla Ford GM Toyota	Bosch Siemens Rockwell Automation Honeywell
HEALTHCARE	TELECOMMUNICATIONS	RETAIL	SEMICONDUCTORS	INTERNET
GE Healthcare Nuance Mayo Clinic Siemens Healthcare McKesson Massachusetts General Hospital	Huawei Nokia BT Group Orange S.A. Nippon Verizon	Walmart Gamestop Target Rakuten Best Buy Barnes & Noble	Intel Texas instruments Microchip Technology Altera Imagination Technologies ARM Mellanox Qualcomm	Google Facebook LinkedIn Amazon

GIS Machine Learning Tools



Classification

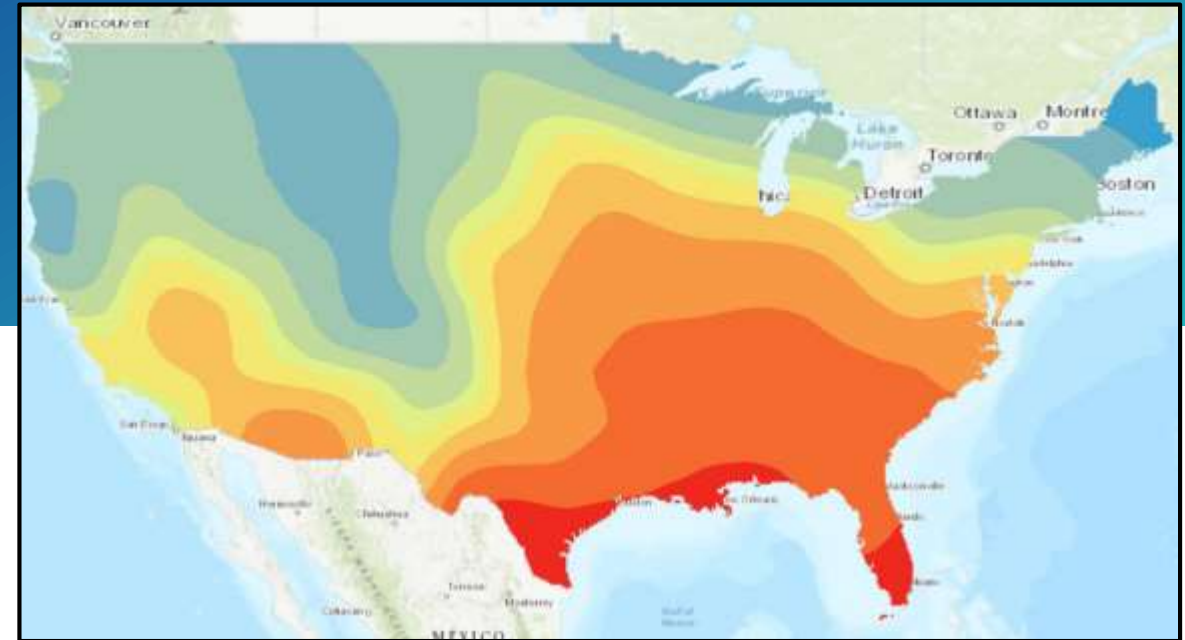
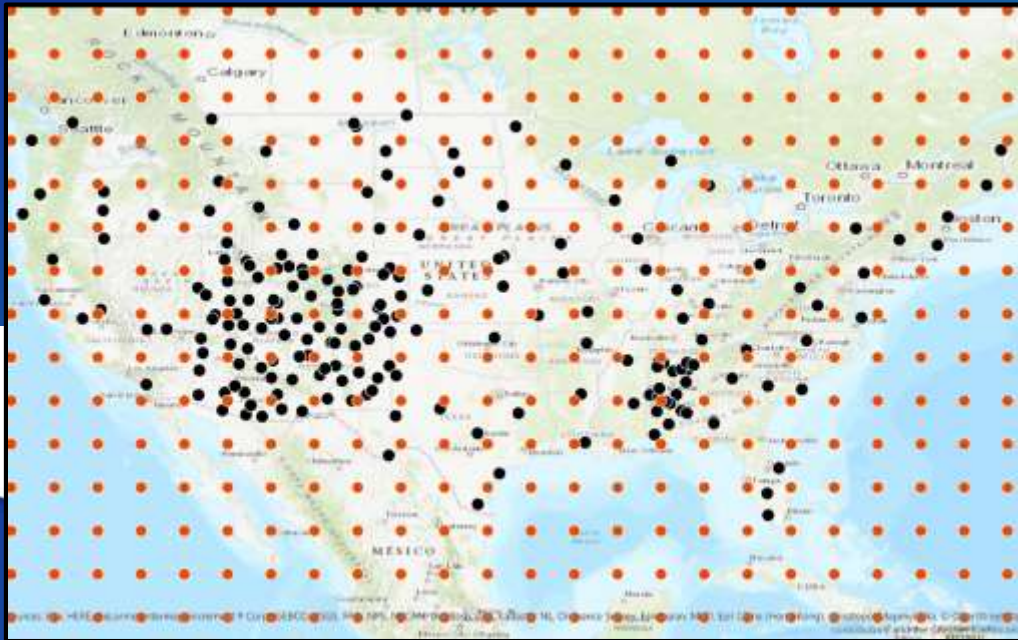


ml

Prediction

Using the known to estimate the unknown

Use Case: Accurately predict impacts of climate change on local temperature using global climate model data

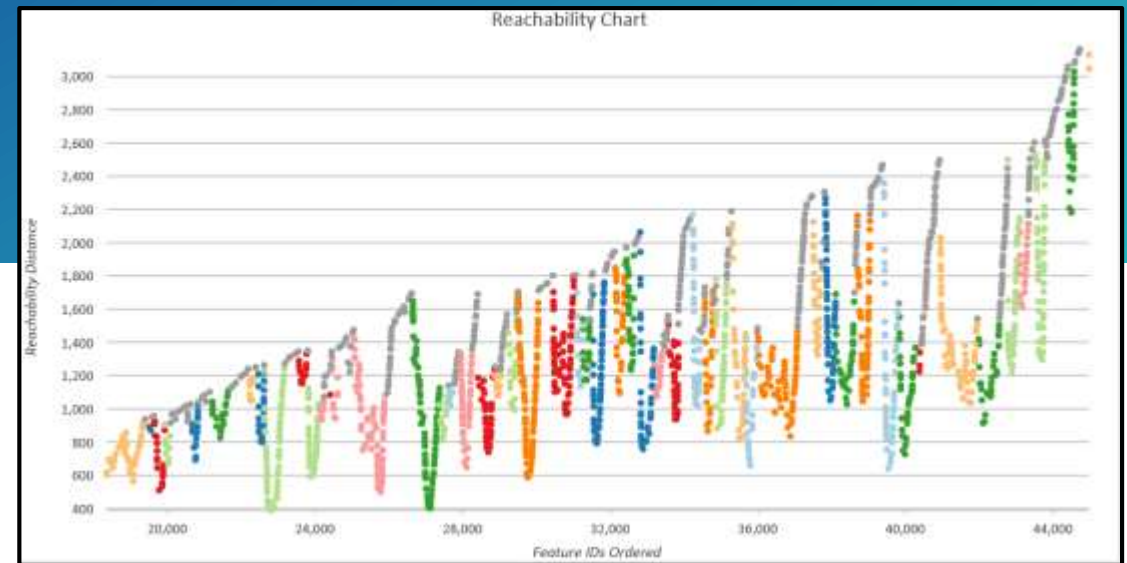
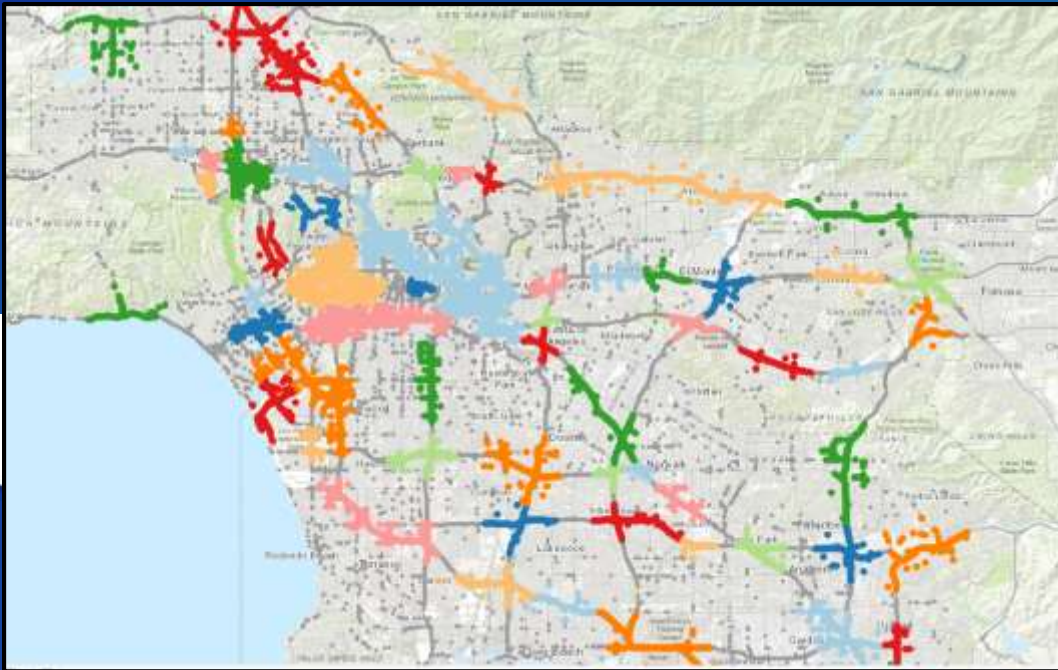


In ArcGIS: **Geographical Bayesian Kriging, Areal Interpolation, Regression Prediction, and Exploratory Regression, Geographical Regression**

Clustering

The grouping of observations based on similarities of values or locations

Use Case: Given the nearly 50,000 reports of traffic between 5pm and 6pm in Los Angeles (from Traffic Alerts by Waze), where are traffic zones that can be used to elicit feedback from current drivers in the area?

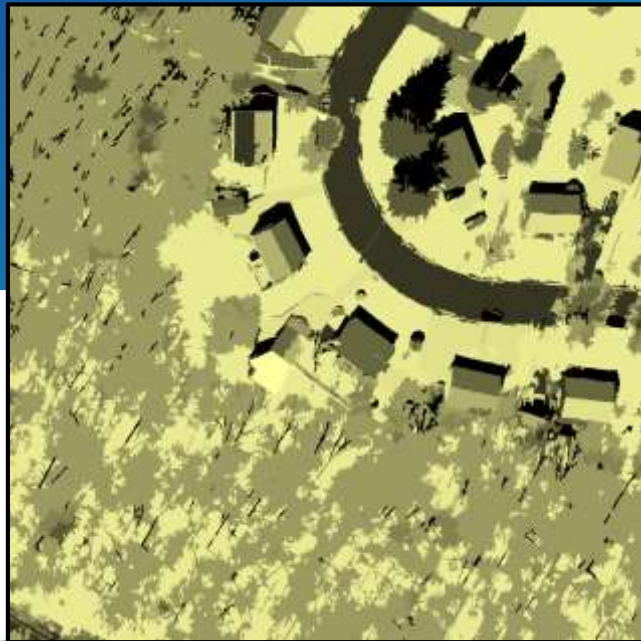


In ArcGIS, Spatially Constrained Multivariate Clustering, Density Clustering, Density-Based Clustering, DBSCAN, Image Segmentation, Hot Spot Analysis, Cluster and Outlier Analysis, Space Time Pattern Analysis

Classification

The process of deciding to which category an object should be assigned based on a training dataset

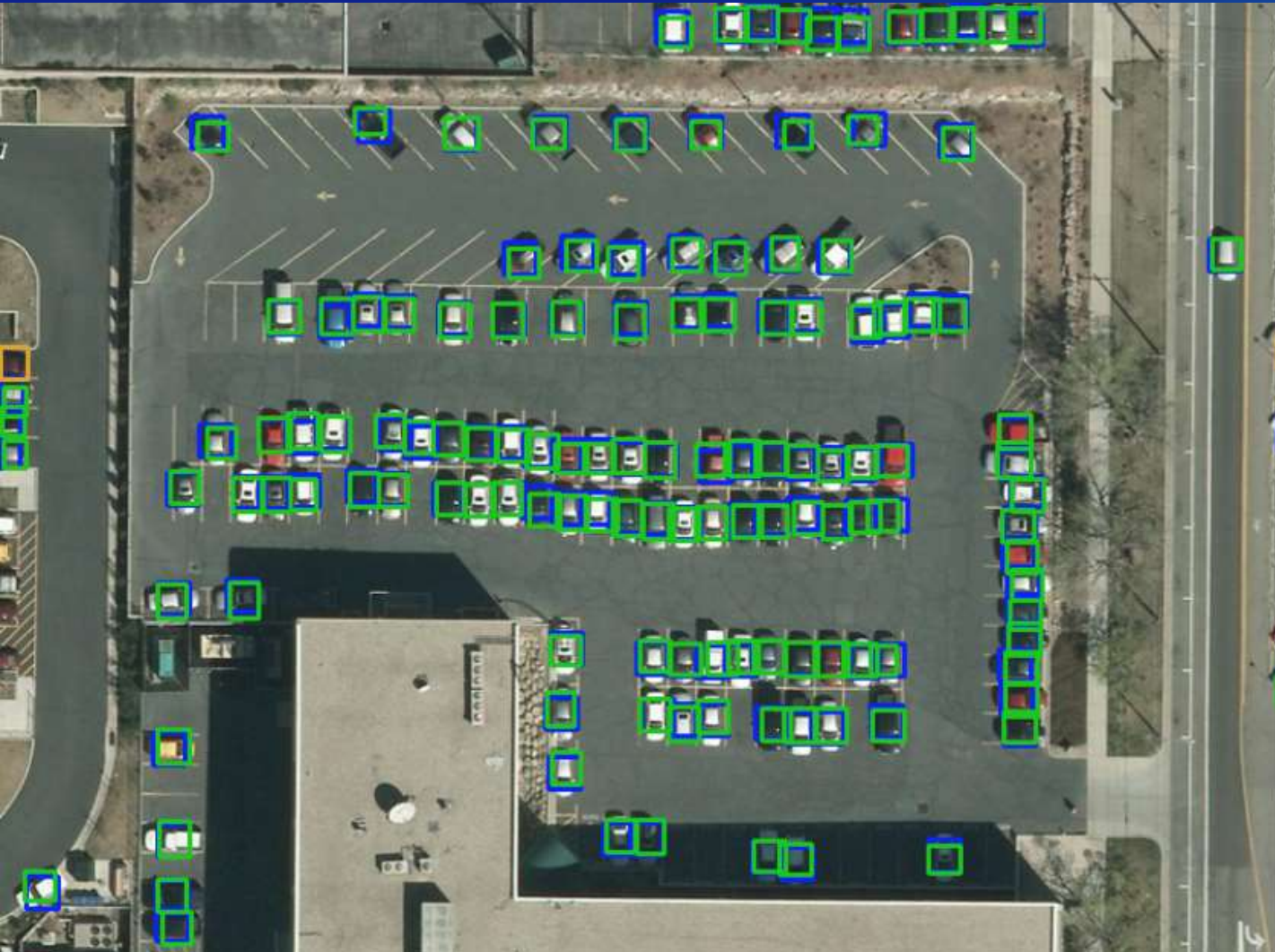
Use Case: Classify impervious surfaces to help effectively prepare for storm and flood events based on the latest high-resolution imagery



In ArcGIS, Maximum Likelihood Classification, Random Forest, and Support Vector Machine

Integration with External Frameworks





Advanced Object Detection from Imagery

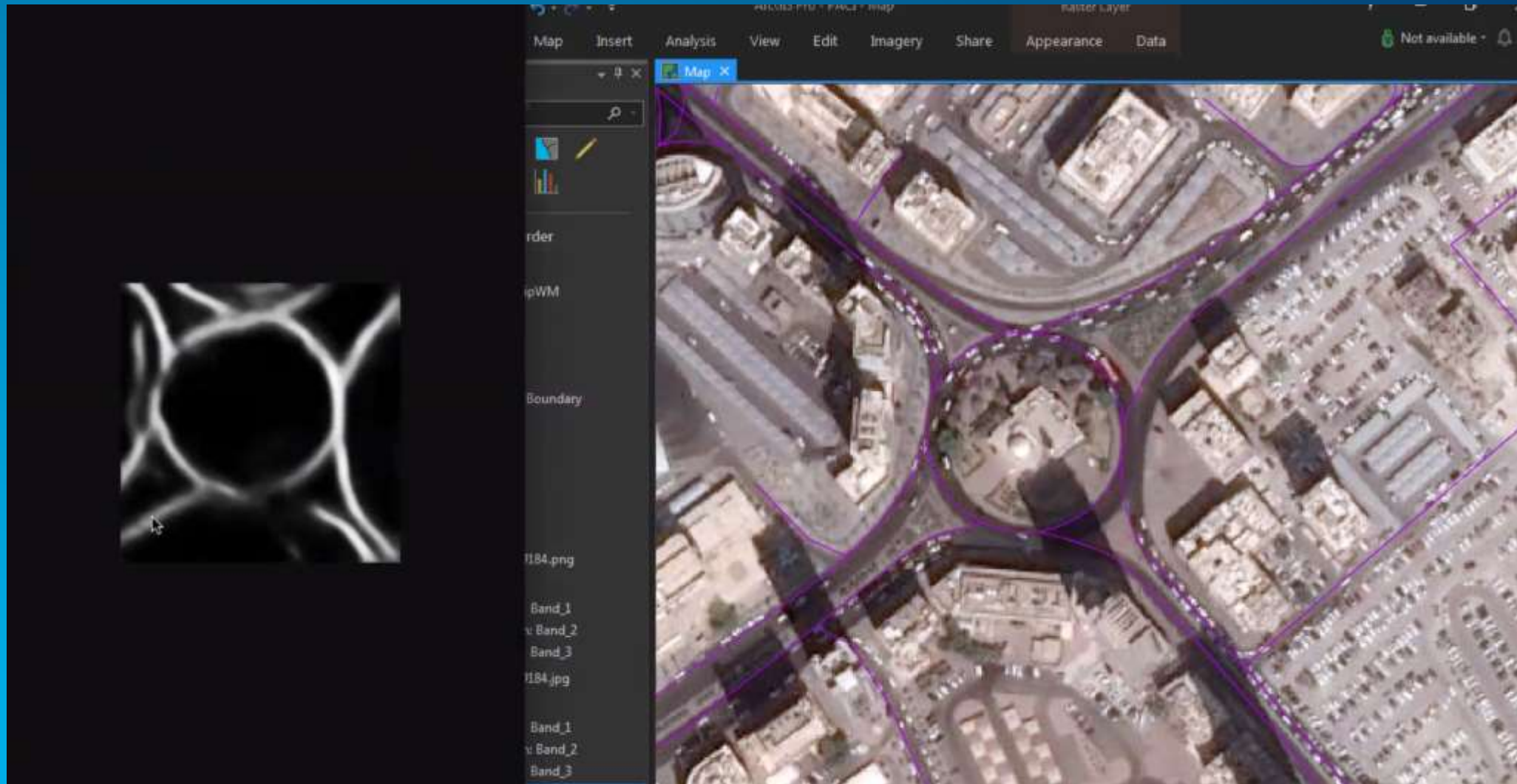
Discover Deep Hidden Insights from Imagery Data



Smart Road Snapping



Road Detection from Satellite Imagery



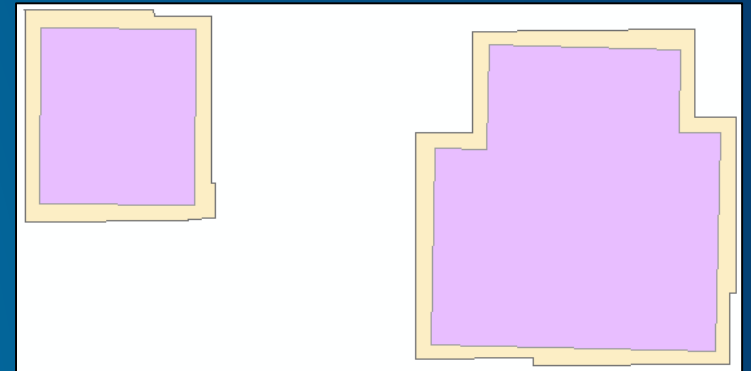
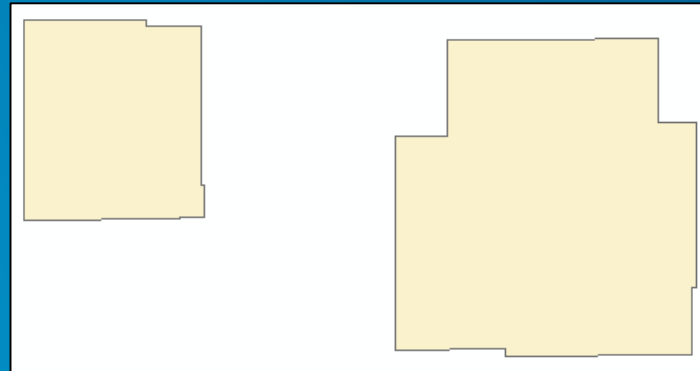
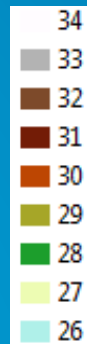
Real-Time Activity Detection

Using Deep Learning with ArcGIS API for Python and Operations Dashboard

The dashboard displays real-time activity detection results for a street scene in Jackson, Wyoming. It consists of four main components:

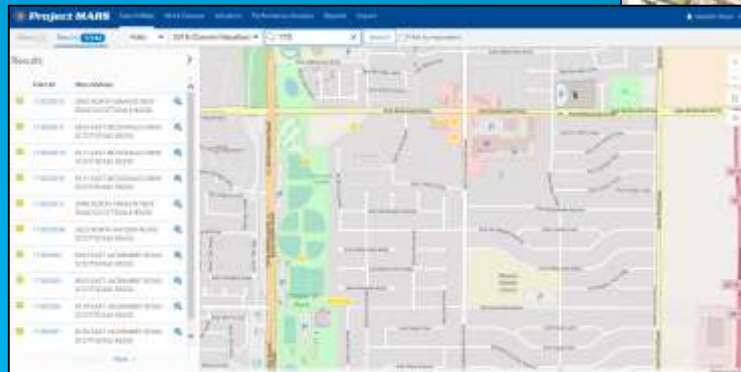
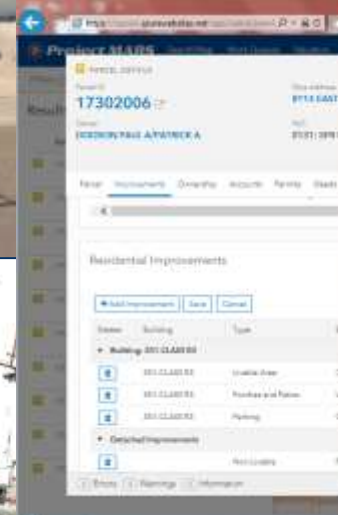
- Video Feed:** A live camera view of a street intersection. The bottom portion of the video shows yellow bounding boxes around detected vehicles with labels such as "car: 43%", "car: 56%", "car: 30%", "car: 58%", and "car: 25%".
- Vehicle Count at Observation (Six Second Intervals):** A gauge chart showing a count of 8 vehicles. The scale ranges from 0 to 15. The gauge is partially filled with orange, and the text "Last update: a few seconds ago" is visible below it.
- Observation Object Counts (Six Second Intervals):** A bar chart showing the distribution of detected objects. The y-axis represents the count (0 to 8). The x-axis categories are Cars, Large Trucks, Buses, Motorcycles, Pedestrians, and Bicycles. The "Cars" bar is the highest, reaching a count of 8.
- Map:** A map view showing the location of the observation point in Jackson, Wyoming. A red dot on the map indicates the specific location, and a street grid is overlaid.

Automated Mapping with Lidar



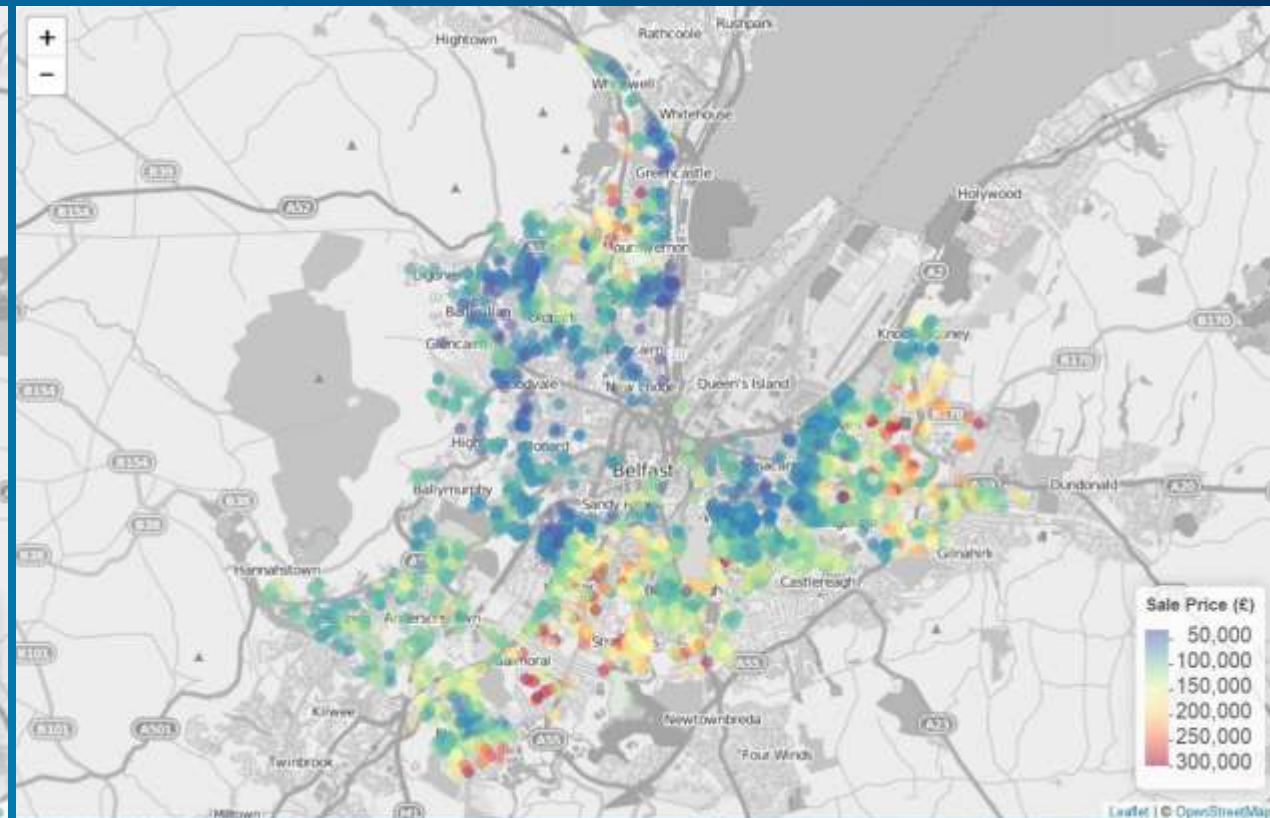
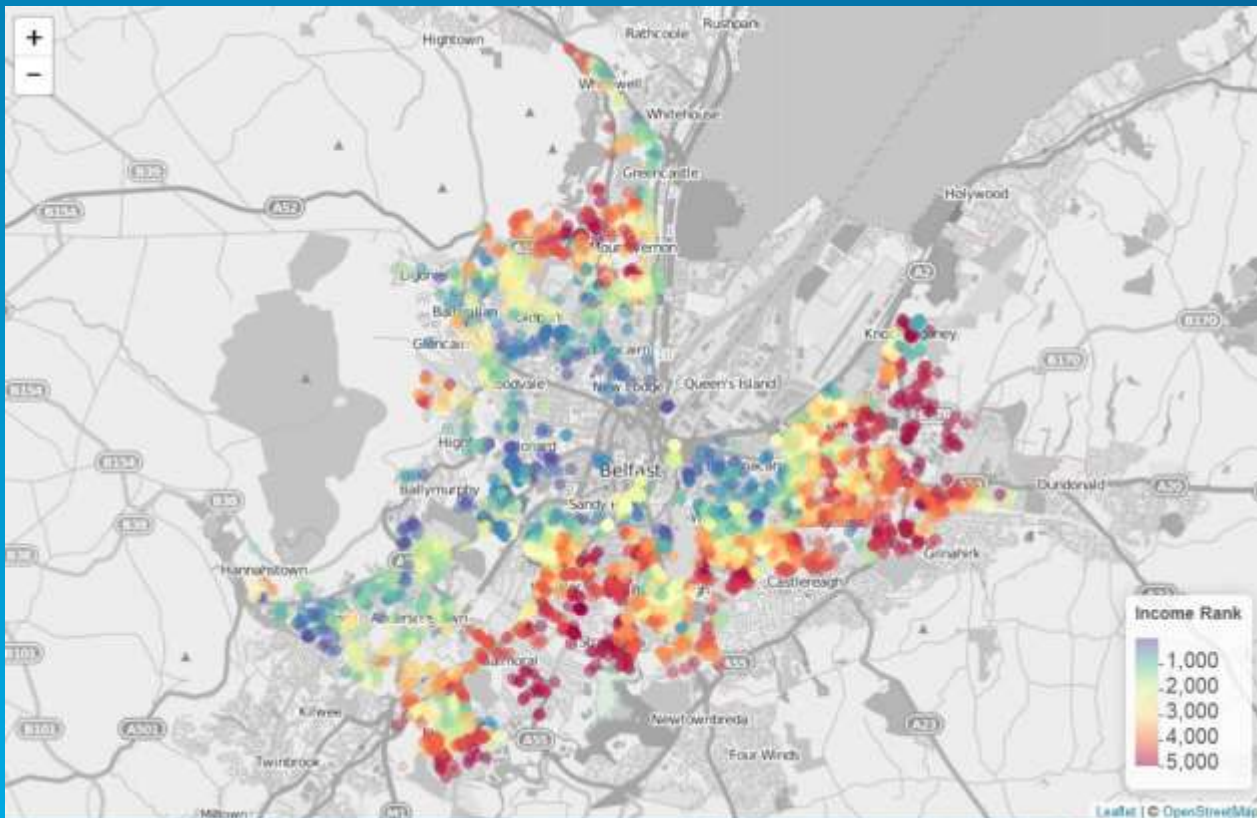
Courtesy: Esri Canada

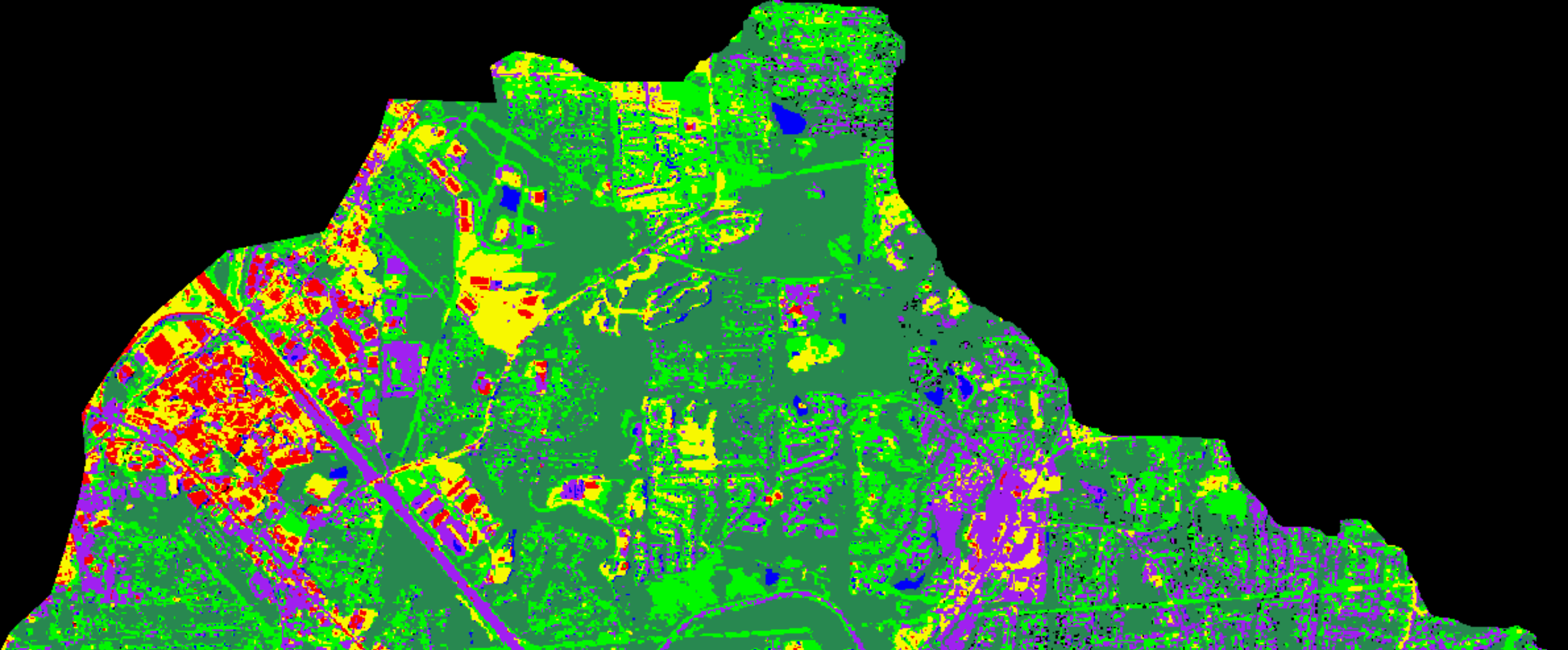
Combining Capabilities



Courtesy: Esri Canada

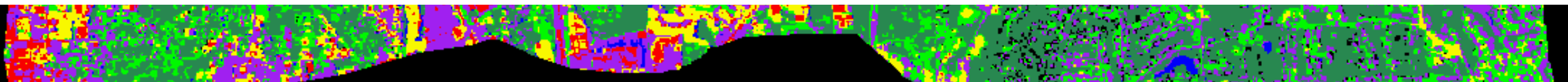
Vertical and Horizontal Equity

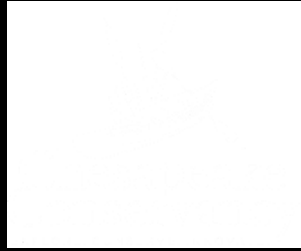




High Resolution Land Cover

Using Deep Learning to achieve 1-meter resolution land cover at scale





Manually created a high-resolution land cover map for precision conservation of the Chesapeake watershed

100k mi²

Area of watershed to map

2TB

File size of imagery to classify

18 months

Time to create map

By the time the land cover map was completed in December 2016, it was already out of date, and an update would be time-intensive and costly.

Land Classification Model

Working Platform: GeoAI Virtual Machine

Dataset: 120k mi² of imagery at 1-meter resolution, split in half geographically into train and test sets

Labeled Training Images

Chesapeake Conservancy Dataset



Convolutional Network Architecture
23 layer U-Net

Test Images



Land Classification Model



Land Cover Map



Algorithm Results

91%

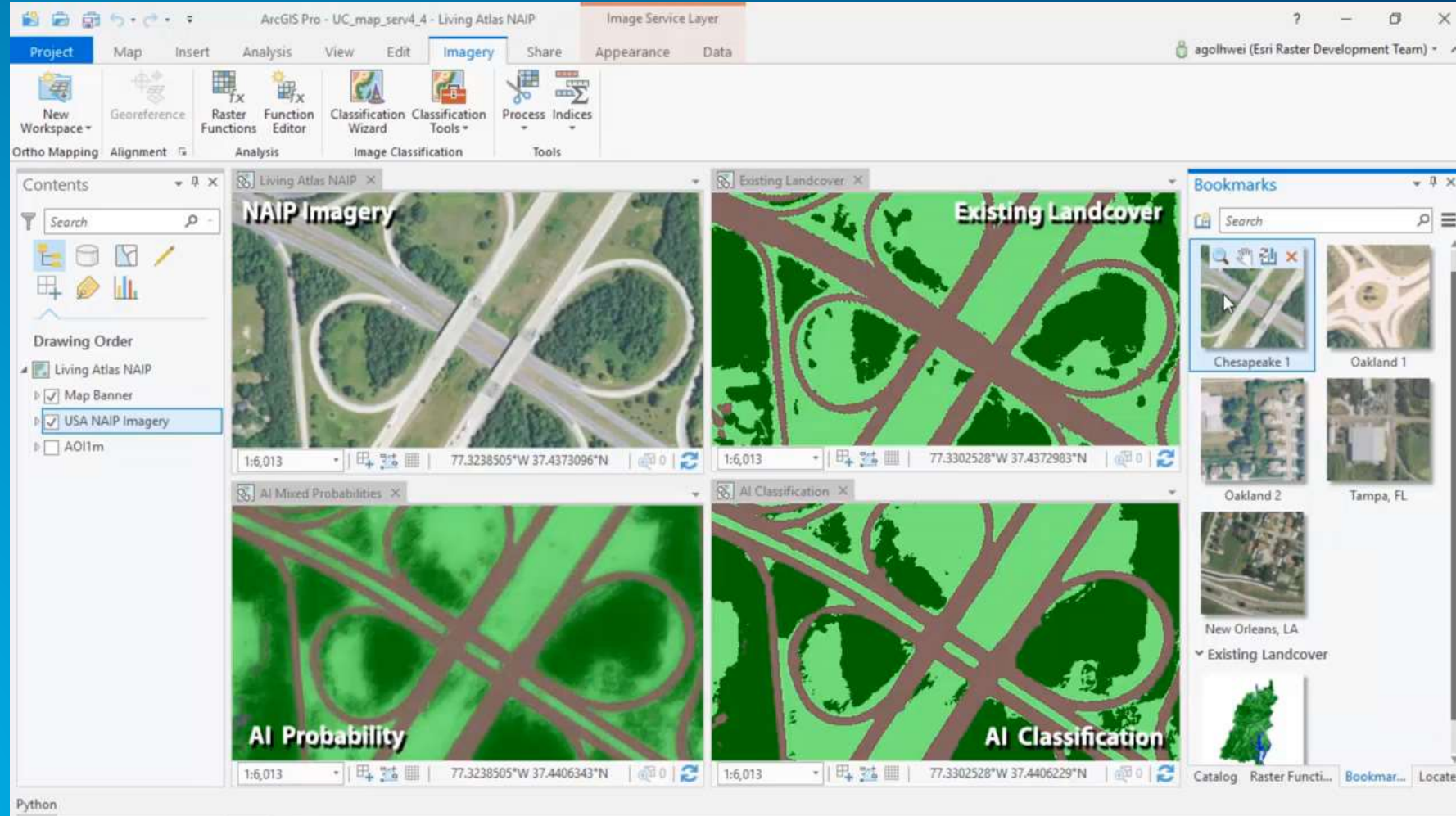
Average land classification accuracy

16x

Faster than Chesapeake Conservancy's previous methods

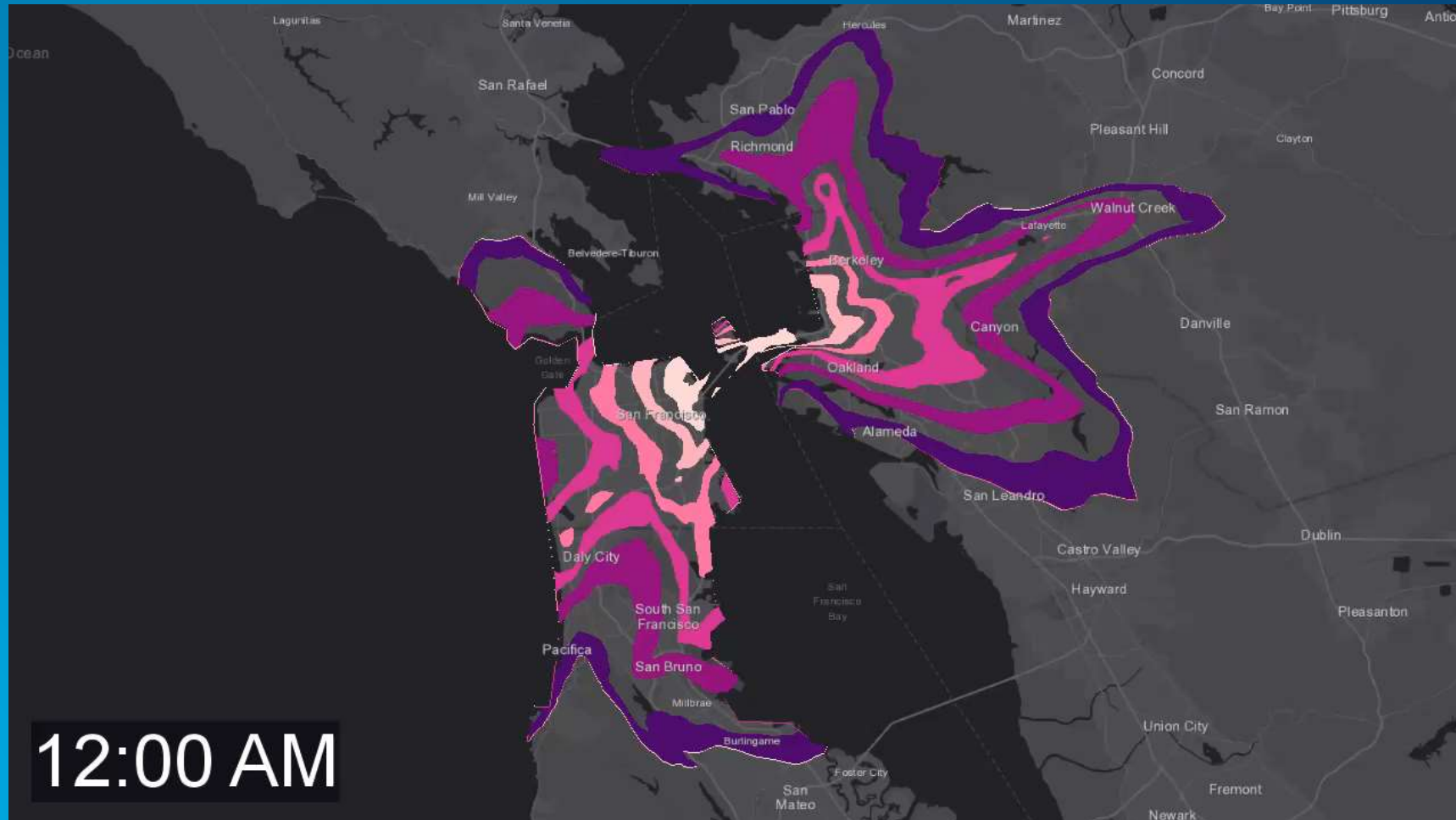
High Resolution Land Classification

Using CNTK Convolutional Neural Networks - Microsoft Cognitive Toolkit (<https://cntk.ai>)



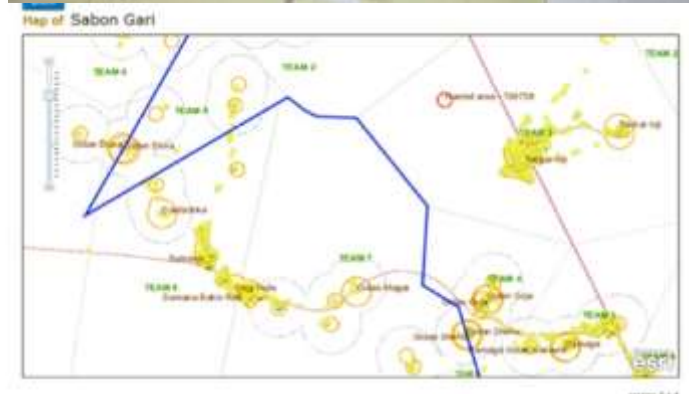
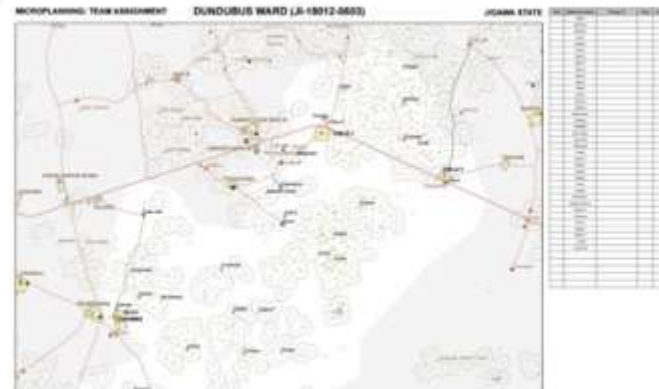
ETA Prediction

Using Deep Learning with Network Analyst
to Predict ETA from Downtown San Francisco to different areas under 25 Minutes

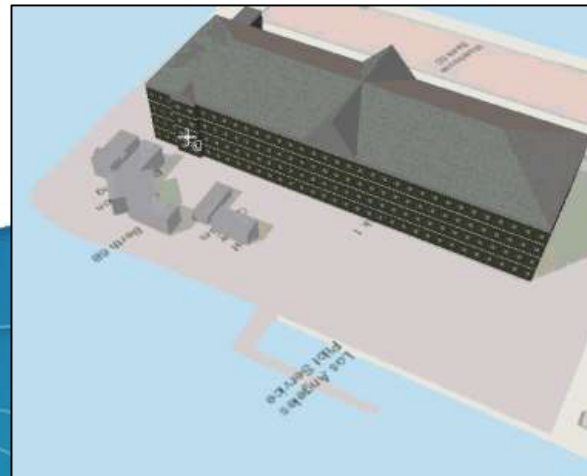
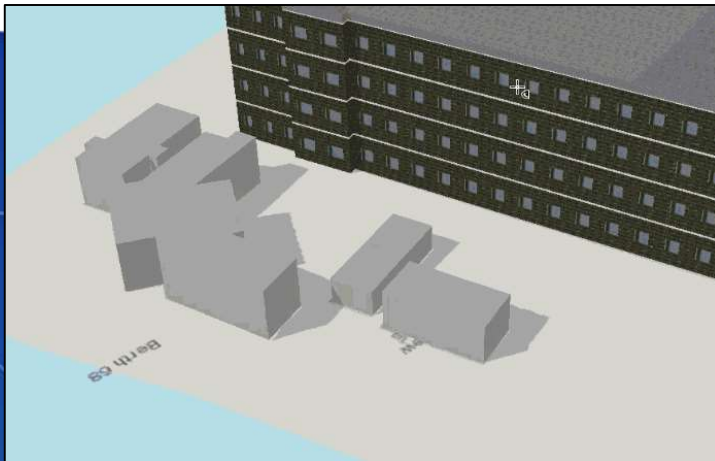
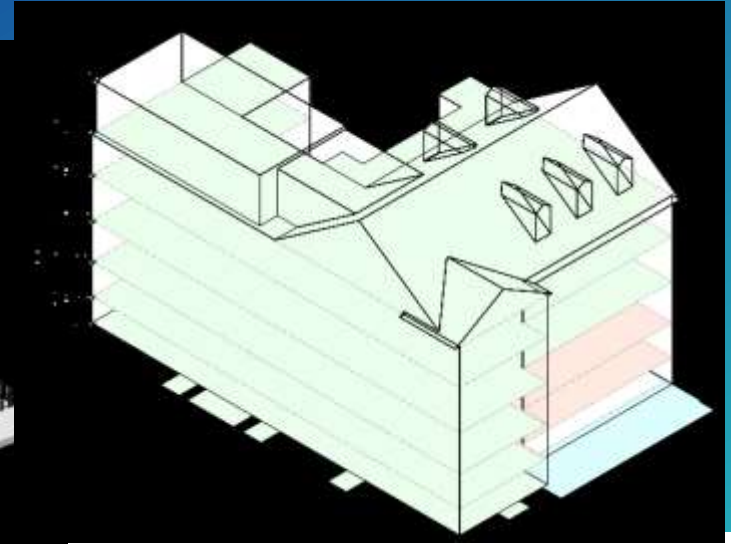
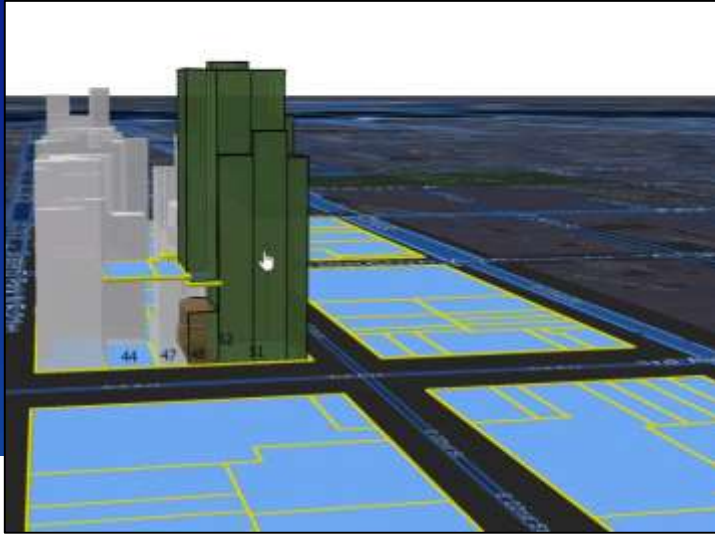


Nigeria - Polio

<https://www.gatesnotes.com/>



3D Cadastre



So what do we do now?

How do we stay relevant?



Brent's Seven Rules for Success



1. Think Big and Spatial

Mapping & Visualization



Understand locations and relationships with maps and visual representations

Data Management



Collect, organize, and maintain accurate locations and details about assets and resources

Field Mobility



Manage and enable a mobile workforce to collect and access information in the field

Monitoring



Track, manage, and monitor assets and resources in real-time

Analytics



Discover, quantify, and predict trends and patterns to improve outcomes

Design & Planning



Evaluate alternative solutions and create optimal designs

Decision Support



Gain situational awareness, and enable information-driven decision making

Constituent Engagement



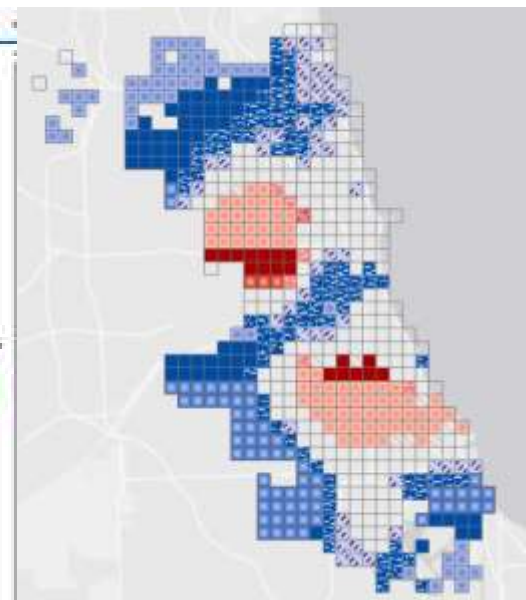
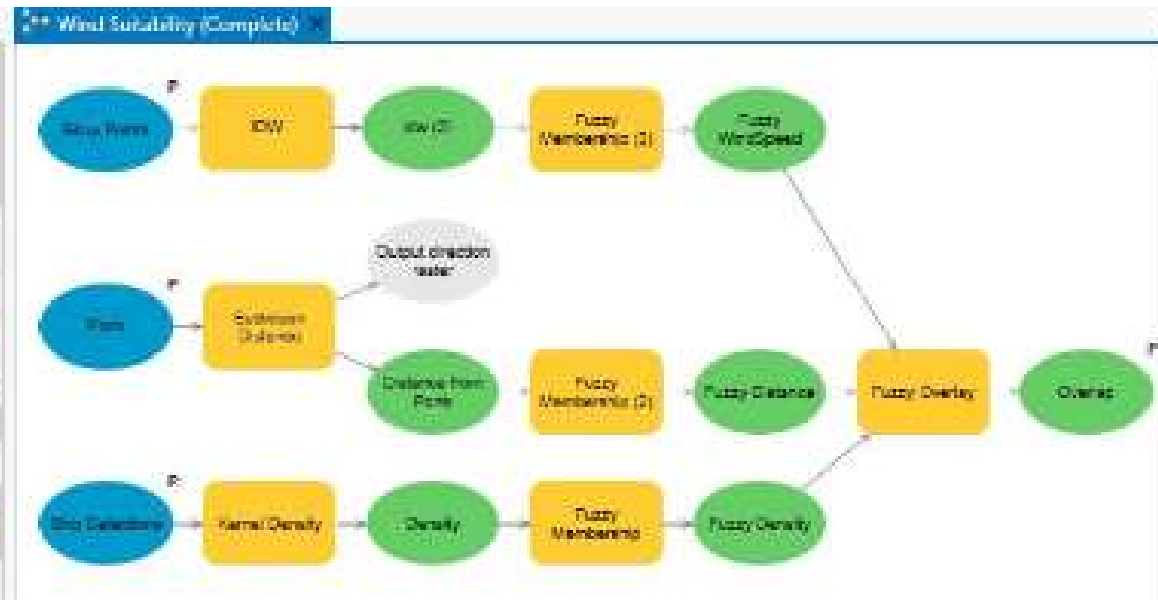
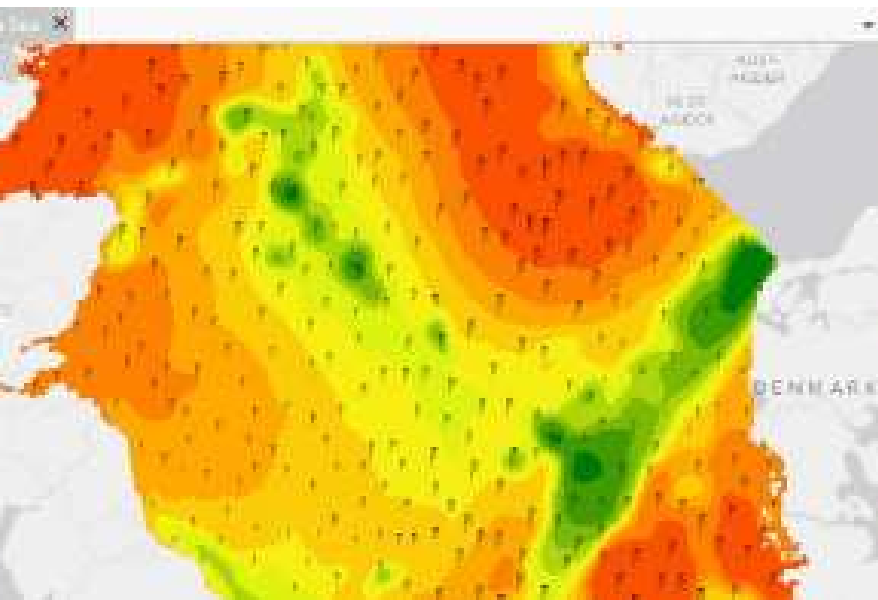
Communicate and collaborate with citizens and external communities of interest

Sharing & Collaboration

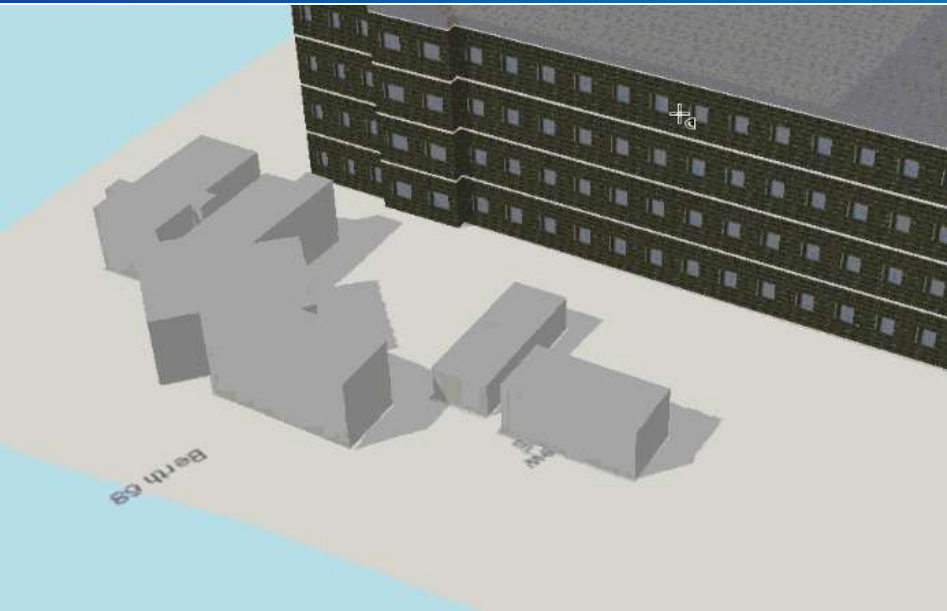


Empower everyone to easily discover, use, make, and share geographic information

2. Use Your Tools



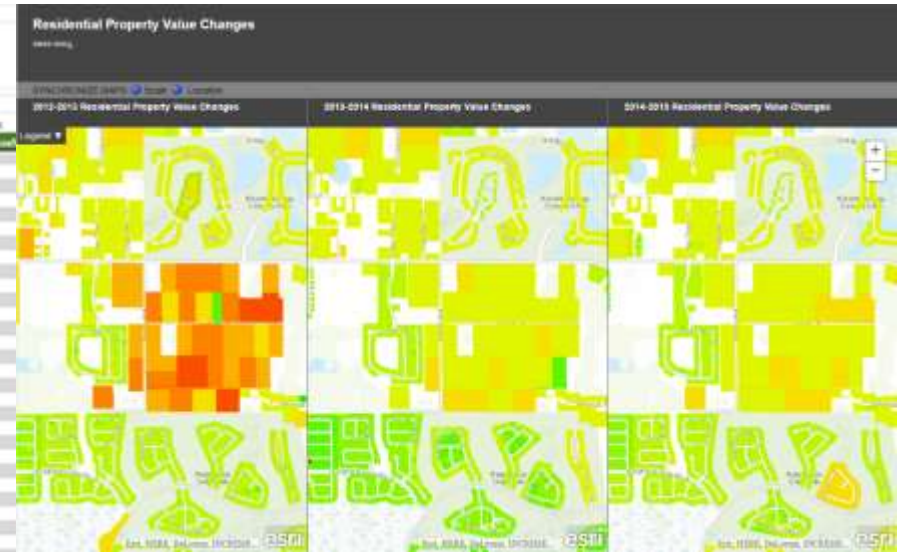
3. Stay Current



4. Create New Services



Shop ID	Address	City	State	Zip Code	Annual Sales	Employees	Shop Size	Population	Household	Av. Household
2001	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2002	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2003	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2004	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2005	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2006	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2007	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2008	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2009	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2010	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2011	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2012	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2013	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2014	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2015	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2016	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2017	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2018	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2019	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2020	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2021	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2022	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2023	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2024	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2025	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2026	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2027	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2028	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2029	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000
2030	3842 STEVENS CREEK BLVD	CUPERTINO	CA	95014	\$400,000	10	2,500 - 3,000 sqft	21,000	7,000	3,000



5. Be Free or Affordable

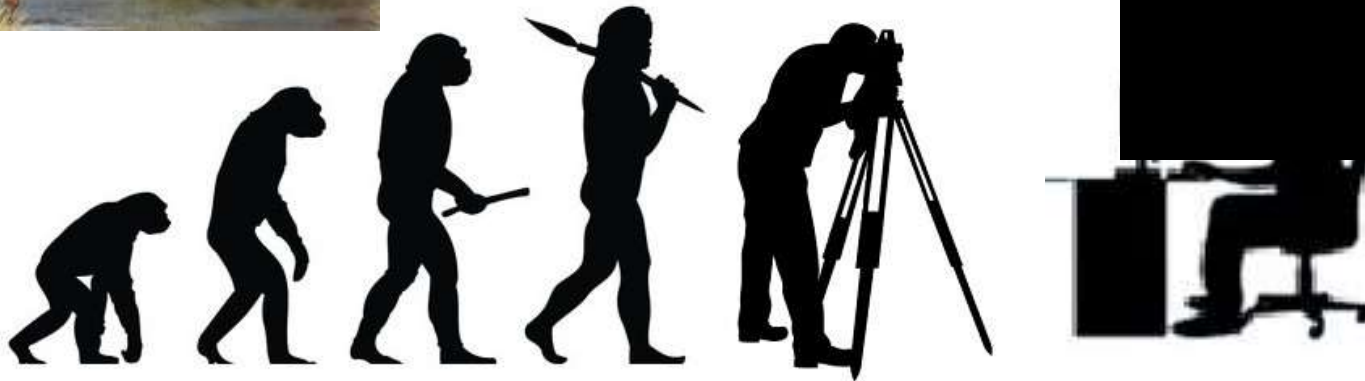


<http://www.esri.com/software/arcgis/arcgis-open-data>

6. Move Quickly & Evolve



"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change."



7. Get Started Now



Brent Jones, PE, PLS

bjones@esri.com

