



ArcGIS Online: Using the Python API for Transportation Network Analysis

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Metadata

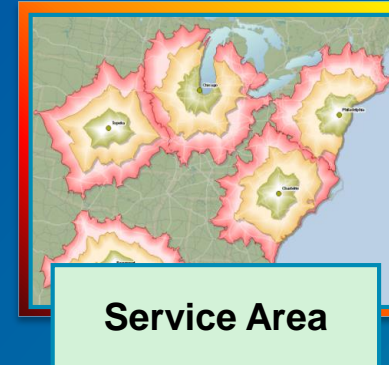
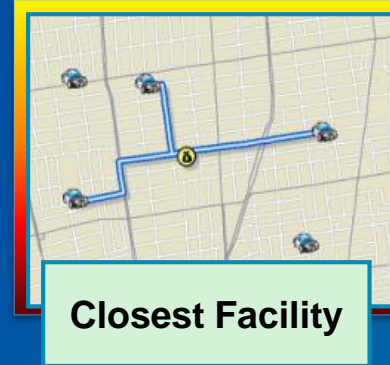
- Slides and code samples for this workshop on Using the Python API for Performing Transportation Network analysis are available at

<http://esriurl.com/ds19napy>

- Documentation at <http://developers.arcgis.com/features/directions>
 - First read the [REST API](#) doc and then read the ArcGIS API for Python [guide](#)

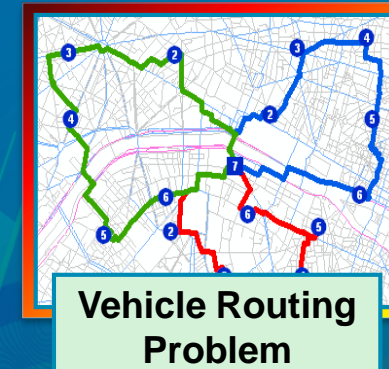
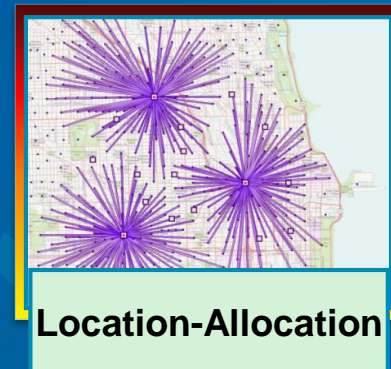
Topics

- Different types of analysis that can be performed on transportation networks
 - Services that are available to perform the analysis
 - Access the services using ArcGIS API for Python
- 



Directions and Routing Services

Perform analyses on transportation networks



Routing and Directions with ArcGIS

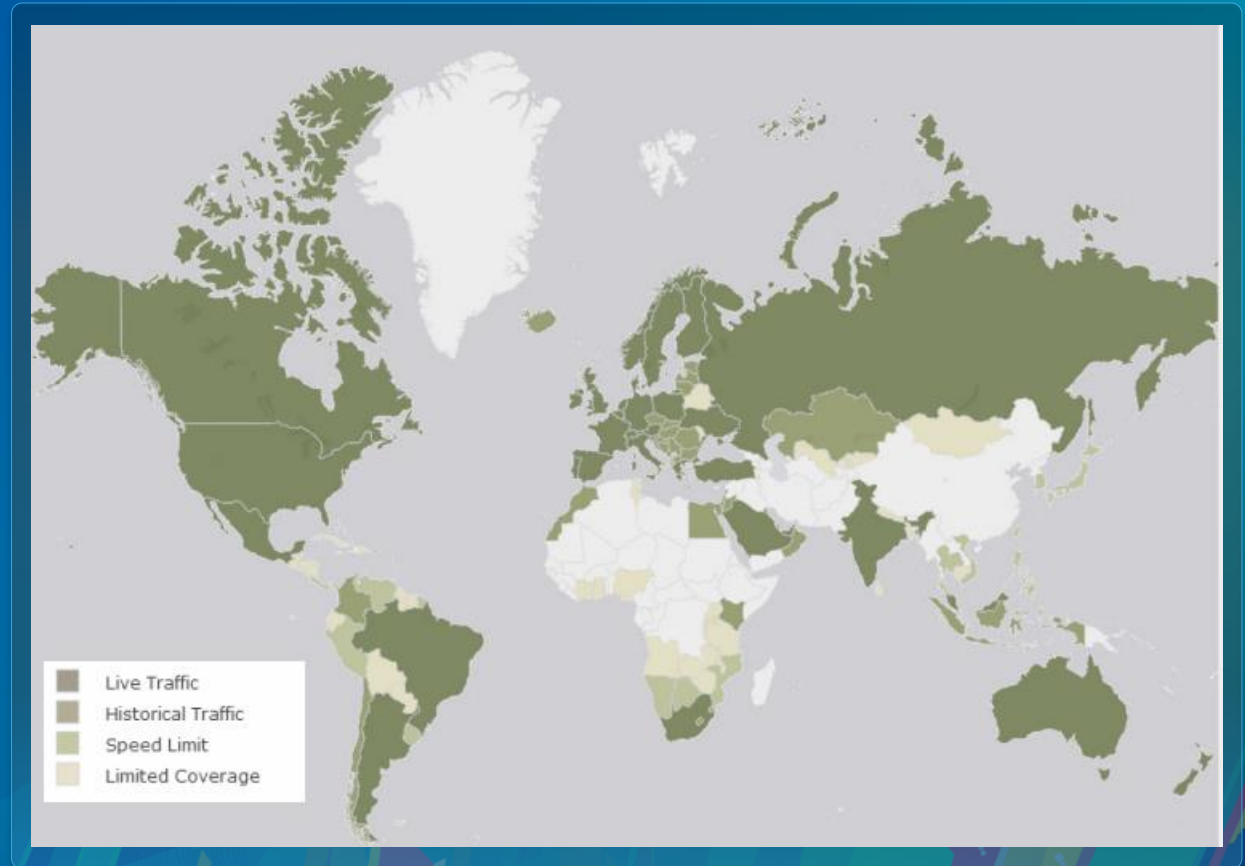
Optimize routes and generate turn-by-turn directions, react to real-time traffic conditions, route multiple vehicles to multiple destinations, and increase the overall efficiency of your daily workflows.

- Global coverage
- Localized directions
- Use your own data
- Route multiple vehicles
- Work offline
- Display and use traffic data
- Modify routes with restrictions and barriers
- Industry-leading reference data

Demo: Available Services

Common to all Services

- **Work globally**
- **Use high quality street data**
 - Predictive and real time traffic where available
 - Support for vehicle weight, width and height restrictions
 - Can use preferred truck routes or avoid toll roads
- **Driving, Walking, Trucking, or your own travel modes**



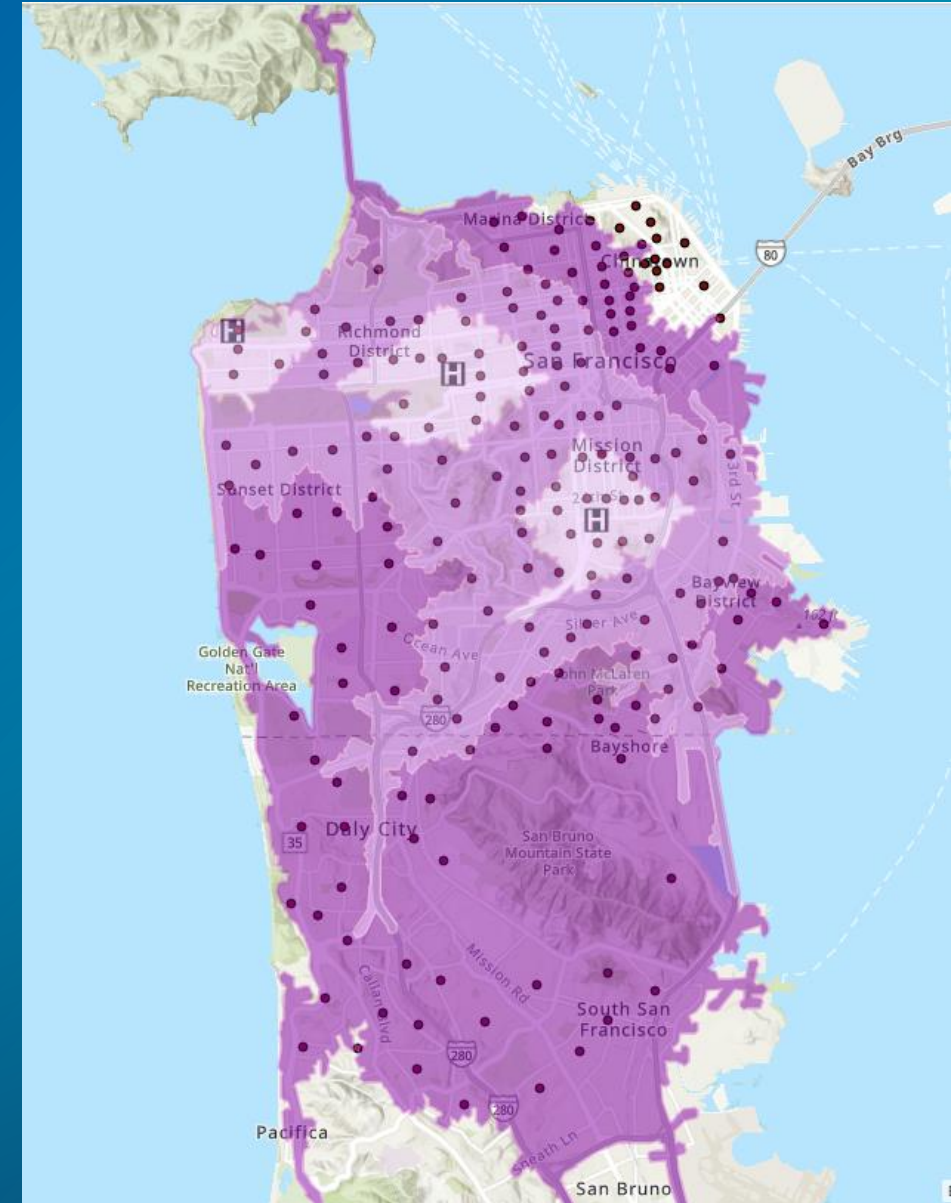
[View larger map](#)

Select the appropriate analysis type

- Example: A health care provider wants to find **driving time** and **driving distance** to **five closest** health care facilities from every patient locations. Knowing the exact drive time value is important to evaluate accessibility to health care.

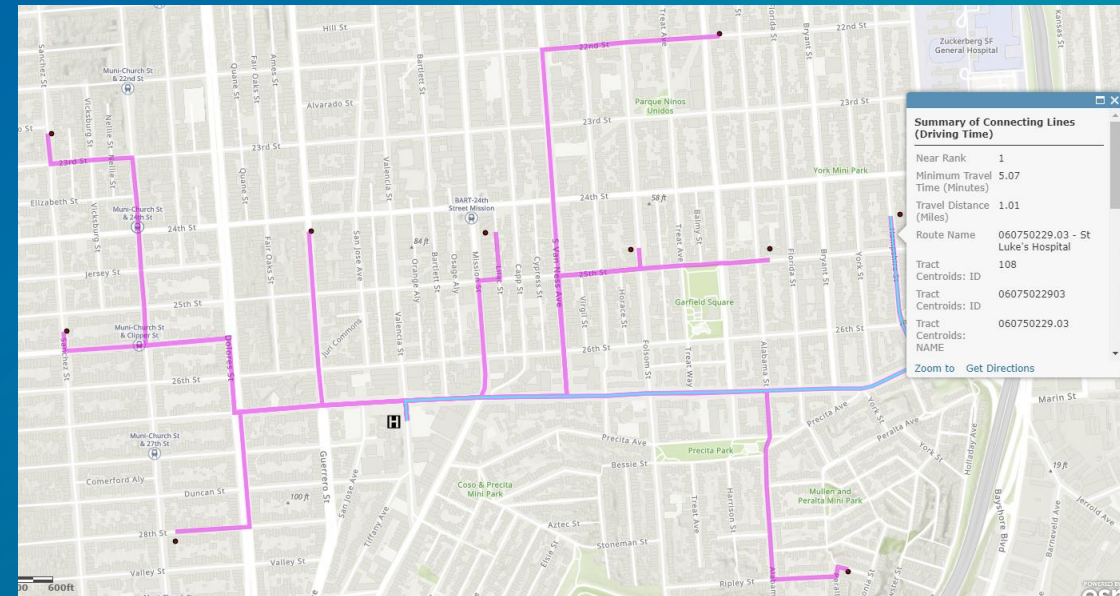
Select the appropriate analysis type

- Solution 1: Let's create 5, 10, 15 minutes **drive time polygons** around health care facilities and then determine how many patients are in each polygon.
- This analysis will **not produce** accurate results. You will determine if a patient location is within 5 minutes or 10 minutes polygons. But you will not know the exact drive time value.
- Drive time polygons can grow big in size very quickly as they store a lot of vertices. So it is **harder to post-process** drive time polygons especially using services.



Select the appropriate analysis type

- Solution 2: Let's perform **closest facility analysis** with patient locations as incidents and health care locations as facilities and **find five** closest facilities.
- While this analysis will give **accurate** results. It is **not efficient** for the workflow. We only need to calculate the driving time and driving distance values. The closest facility analysis calculates route shapes as well as driving directions which are not required for this scenario.



Select the appropriate analysis type

- Solution 3: Let's generate an **origin destination cost matrix** with patient locations as origins and health care facilities as destinations. **Find five** destinations from each origin.
- This analysis gives **accurate** results and is most **efficient** for our workflow since origin destination cost matrix only calculates travel time and travel distances and not route shapes or driving directions.

Nearest Health Care Providers (Features: 10, Selected: 0)			
Patient ID	Route Name	Minimum Travel Time (Minutes)	Travel Distance (Miles)
103	060750214.00 - St Luke's Hospital	3.14	0.66
107	060750229.02 - St Luke's Hospital	3.95	0.76
108	060750229.03 - St Luke's Hospital	5.07	1.01
111	060750251.00 - St Luke's Hospital	5.23	0.96
117	060750215.00 - St Luke's Hospital	2.90	0.55
121	060750210.00 - St Luke's Hospital	2.07	0.41
122	060750229.01 - St Luke's Hospital	2.93	0.60
123	060750209.00 - St Luke's Hospital	2.61	0.41
146	060750211.00 - St Luke's Hospital	4.75	0.95
156	060750228.03 - St Luke's Hospital	5.11	1.04



Services for Network Analysis

Available services

- Network Analysis in the Python API is performed using services



Geocoding

Converts addresses to locations and vice-versa including support for suggestions and place searching.

[API Reference](#)



Routing and Directions

Get directions, optimize routes and perform network analysis on a worldwide road dataset.

[API Reference](#)



Demographics and GeoEnrichment

Query hundreds of demographic, lifestyle variables and use them to enrich your existing datasets.

[API Reference](#)



Elevation

Analyze elevation, viewsheds and watershed against a worldwide elevation dataset.

[API Reference](#)



Spatial Analysis

Run a variety of analysis tasks to gain new insight into your data.

[API Reference](#)



Packaging

Bundle and package maps and data for offline use.

[API Reference](#)

Available services

- **Routing and Directions services expose all the capabilities**
- **One or more tasks within the spatial analysis service solve focused network workflows**
 - **The spatial analysis tasks may not expose all the capabilities**

Routing and Directions services

- Route Service
- Closest Facility Service
- Service Area Service
- Utilities Service
- Location-Allocation Service
- Vehicle Routing Problem Service
- Origin Destination Cost Matrix Service
- Traffic Service

Spatial Analysis service tasks

- Connect Origins to Destinations
- Find Nearest
- Create Drive-Time Areas
- Enrich Layer
- Summarize Within
- Choose Best Facilities
- Plan Routes
- Create Route Layers

Execution modes

- A service can support **synchronous** or **asynchronous** execution mode
- Use synchronous mode for requests that execute quickly
- Use asynchronous mode for long running requests (batch processing)

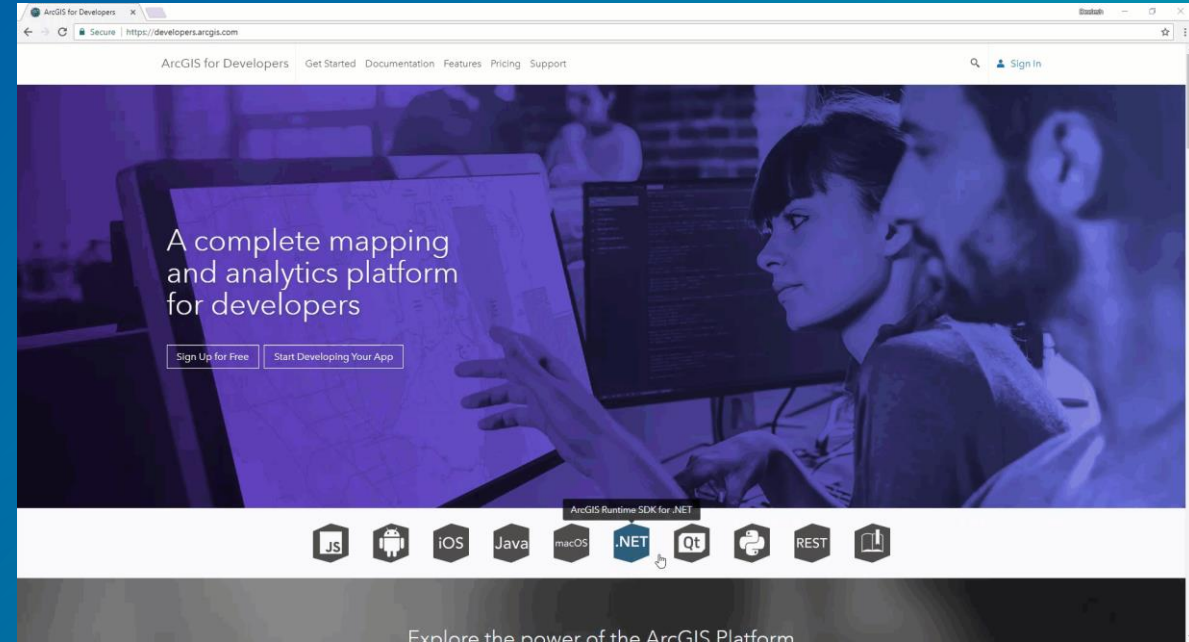
Choose the correct service for your analysis

Evaluate your options

- A particular analysis can be performed using many different services
- Example: Route analysis can be done using
 - Synchronous route service
 - Asynchronous route service
 - Connect Origins to Destinations spatial analysis task
- Use the correct service based on
 - Capabilities supported by the service
 - Service execution mode
 - Service limits
 - Service access privileges
 - Supported output formats

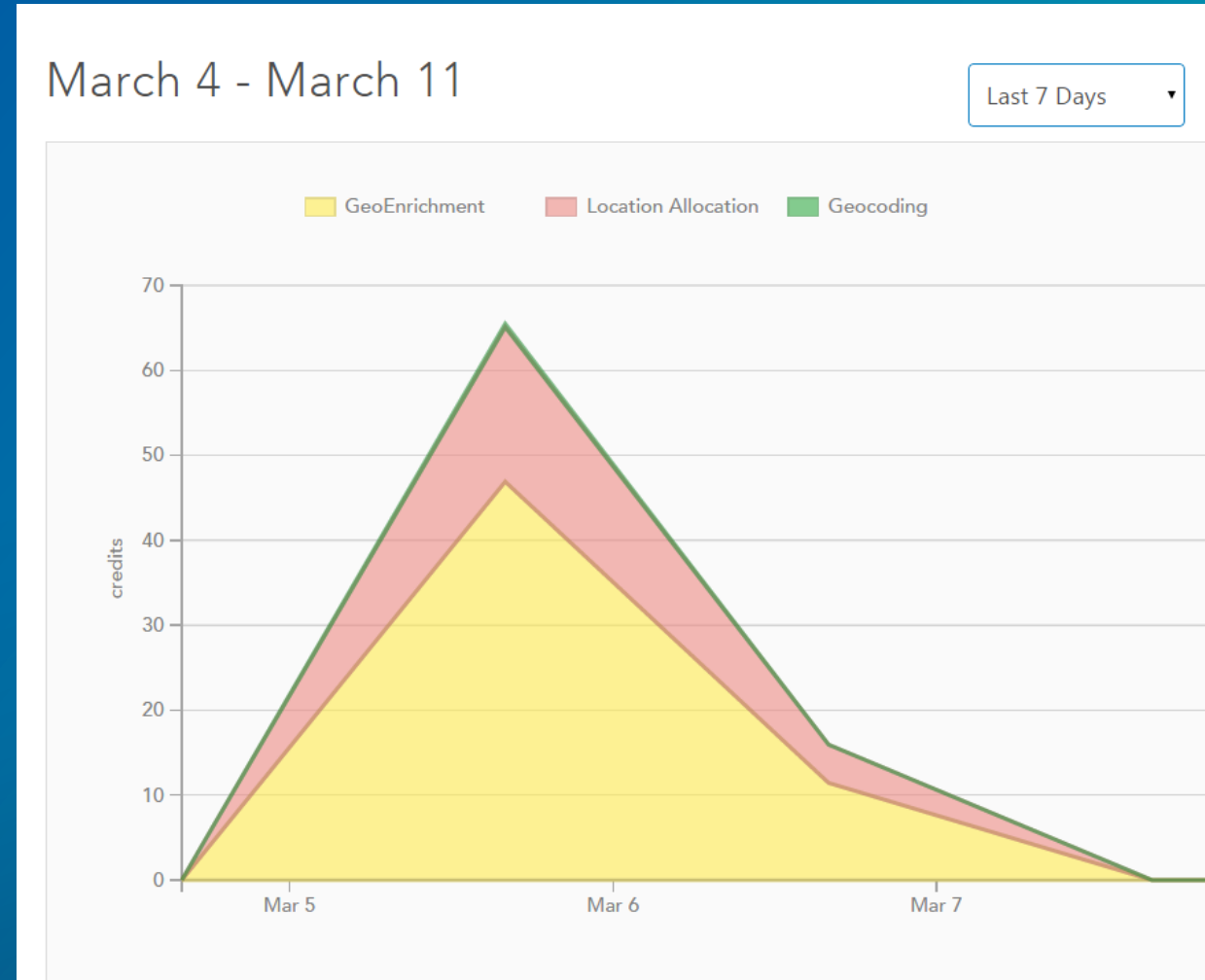
Service limits

- Every service has limits on the size of inputs it can accept
- Check the REST API documentation for the service to evaluate the limits
- Can also determine the service limits programmatically using the `GetToolInfo` task within the Utilities service
- If your inputs exceed the service limits, chunk inputs into smaller size and send multiple requests



Understanding Your Bill – Service Credits

- Every successful request to services deducts credits
 - Use of traffic and Utilities services does not deduct credits
- Track credits in your ArcGIS Online organization
- Credits explained



Service access privileges

- Your ArcGIS Online named user needs to have certain privileges to access the services
- Routing and Directions services require network analysis privilege
- Spatial Analysis service tasks require network analysis, spatial analysis, create content, and publish hosted services privileges
- Privileges explained

The screenshot displays the 'General Privileges' configuration page. It is organized into sections with expandable/collapsible headers. The 'Groups' section is expanded, showing a checked checkbox. The 'Content' section is expanded, with a yellow highlight bar above it; it contains a list of privileges where 'Create, update, and delete' and 'Publish hosted feature layers' are checked and highlighted with a purple box. The 'Premium Content' section is expanded, with a yellow highlight bar above it; it contains a list of privileges where 'Network Analysis' and 'Spatial Analysis' are checked and highlighted with a purple box. The 'Features' section is collapsed, indicated by a minus sign and a grey checkbox.

Section	Privilege	Status
Groups	Groups	Checked
Content	Create, update, and delete	Checked
	Publish hosted feature layers	Checked
	Publish hosted tile layers	Unchecked
	Publish hosted scene layers	Unchecked
	View content shared with organization	Unchecked
Premium Content	Geocoding	Unchecked
	Network Analysis	Checked
	Spatial Analysis	Checked
	GeoEnrichment	Unchecked
	Demographics	Unchecked
	Elevation Analysis	Unchecked
Features	Features	Unchecked



Accessing Services

Using ArcGIS API for Python

ArcGIS API for Python

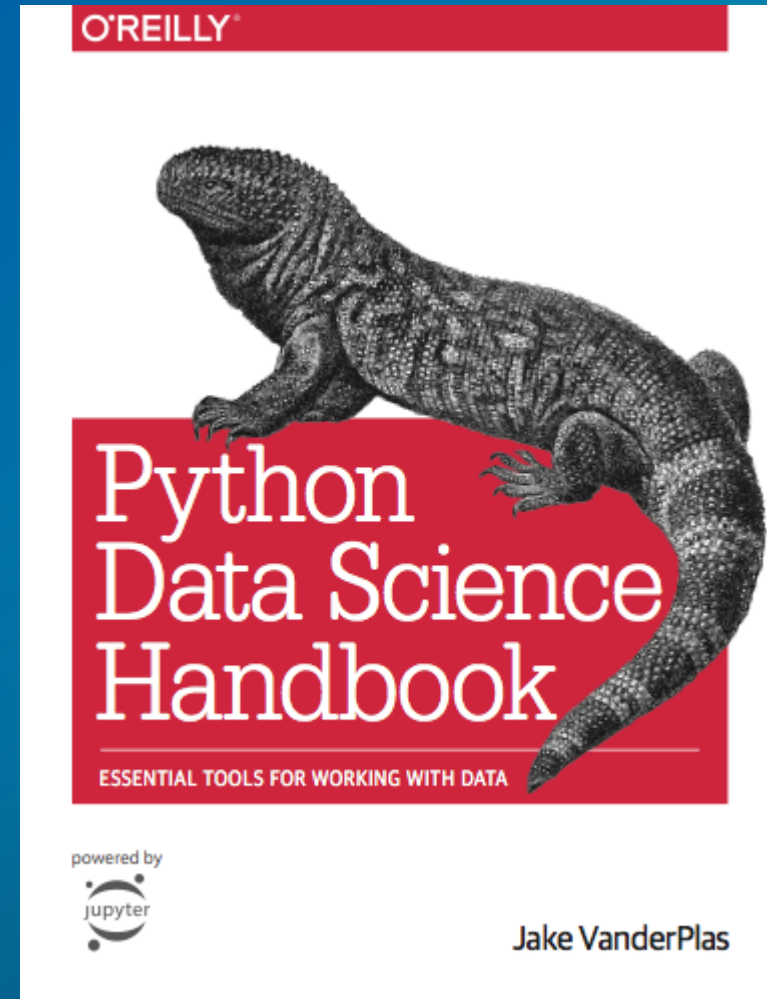
- Access Routing and Directions services from **arcgis.network** module
- Access Spatial Analysis service tasks from **arcgis.features.analysis** module
- Refer to the examples in the [guide](#) and [sample notebooks](#)

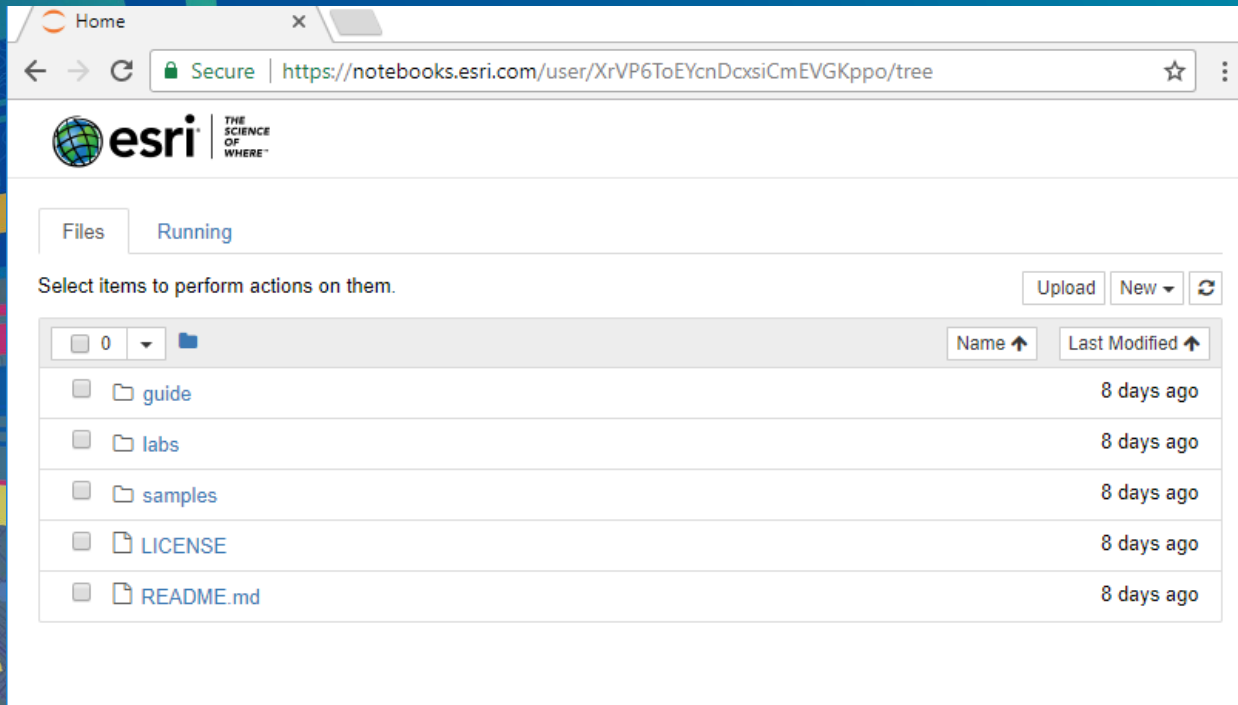
▼ Performing network analyses	Guide
Using network analysis tools	
Performing route analyses	
Performing network analysis tasks asynchronously	

	Sample notebooks
▼ GIS analysts and data scientists	
Constructing drive time based service areas	
Finding hospitals closest to an incident	
Identifying suitable sites for new ALS clinics using location allocation analysis	

ArcGIS API for Python

- Recommended reading if you are new to the Python data science libraries: Python Data Science Handbook
 - Free to read at <https://jakevdp.github.io/PythonDataScienceHandbook/>
- Learn about the data frames in the **pandas** Python module
 - Python API provides Spatially Enabled Data Frame




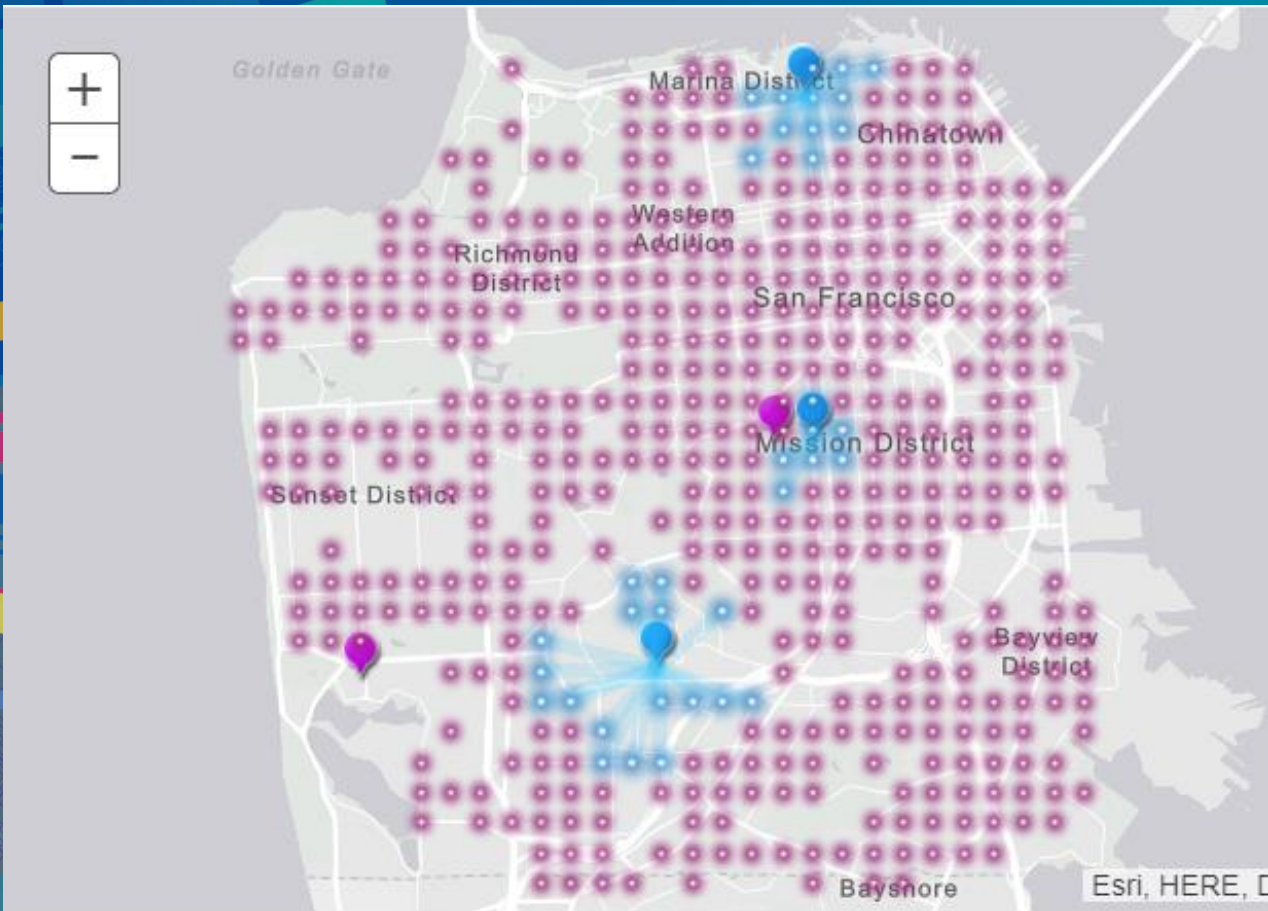


Python API Playground

<https://notebooks.esri.com>

Demo takeaways


- <https://notebooks.esri.com> is the Python API playground
 - Use to run any existing guide or sample notebooks
 - Start a new notebook and explore!!
- 



Site Child Care Facilities

Use geoenrichment, geocoding, and location-allocation services

Demo takeaways

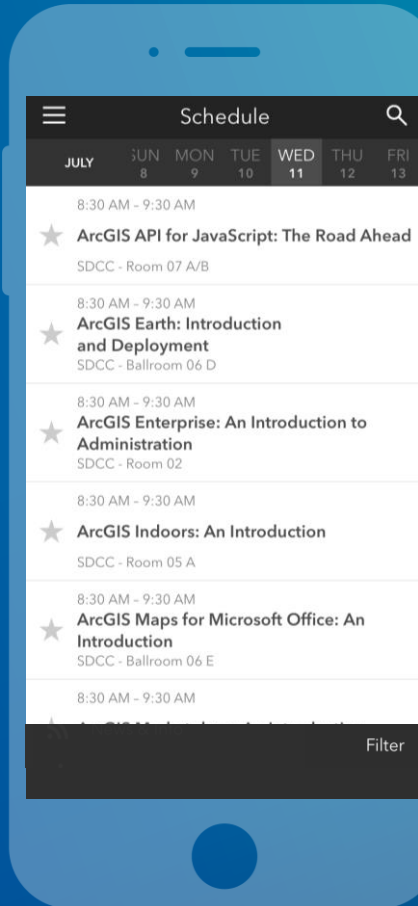
- ArcGIS API for Python allows you to perform analysis using different services
 - Jupyter notebooks to illustrate your analysis
 - Pandas data frame to work with analysis inputs and outputs
- 

Please Take Our Survey on the App

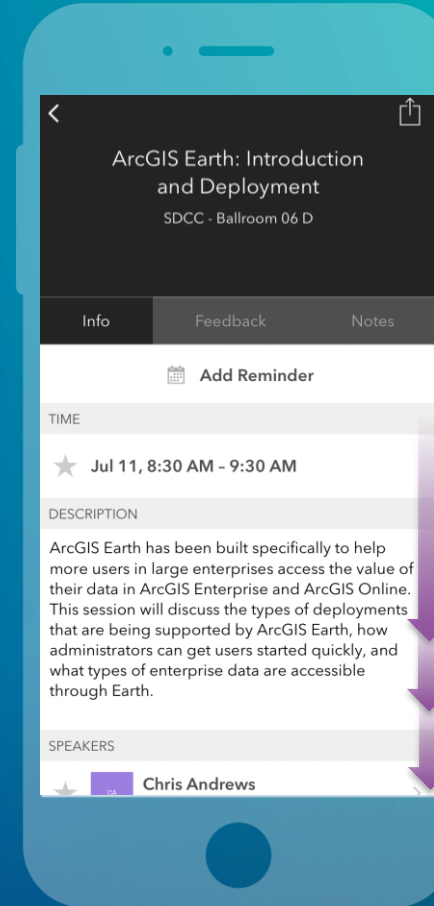
Download the Esri Events app and find your event



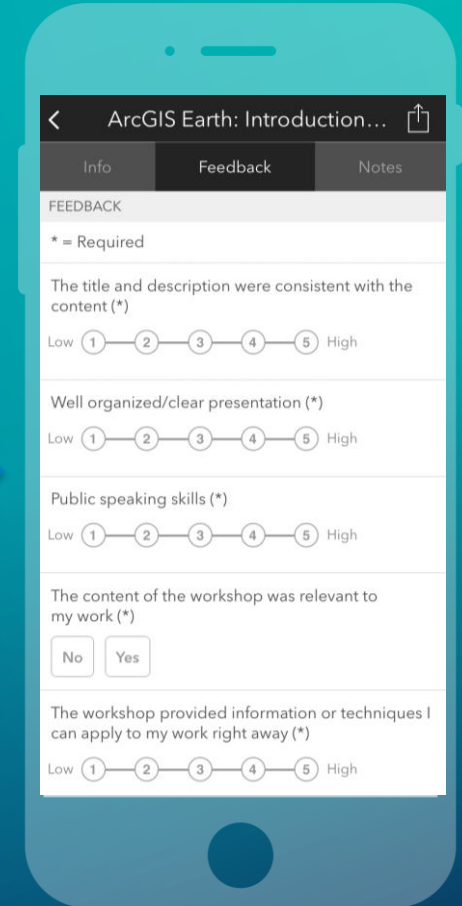
Select the session you attended



Scroll down to find the feedback section



Complete answers and select "Submit"



Summary

- Choose the correct analysis type
- Select the best service to perform the analysis
- Slides and code samples for this workshop on Using the Python API for Performing Transportation Network analysis are available at

<http://esriurl.com/ds19napy>



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