



ArcGIS Online: Using the Python API for Transportation Network Analysis

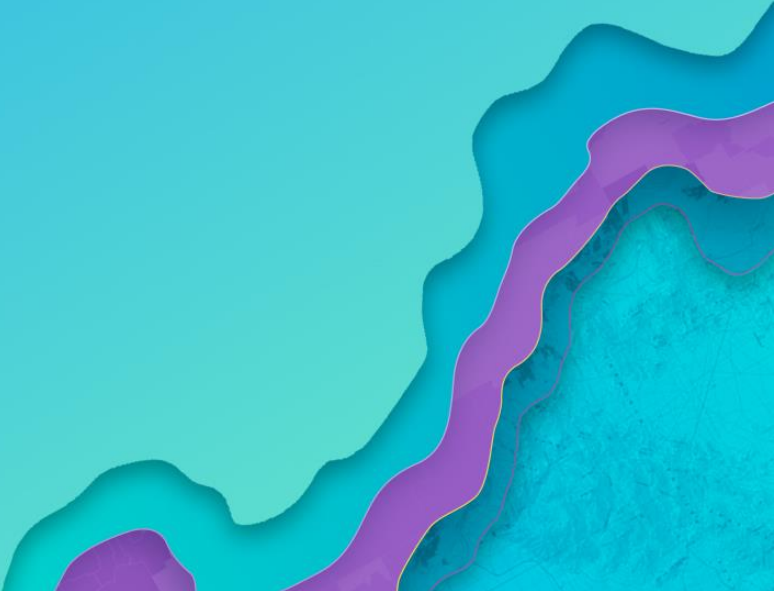
Deelesh Mandloi and Dmitry Kudinov

2018 Esri Developer Summit | Palm Springs, CA

Metadata

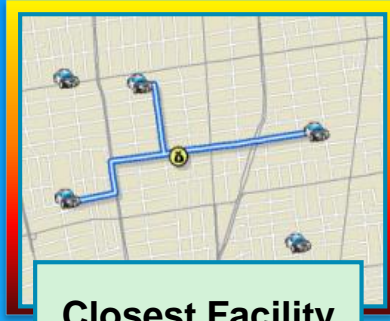
- Slides and code samples available at <http://esriurl.com/ds18napy>
- Documentation at <http://developers.arcgis.com/features/directions>
 - First read the REST API doc and then read the ArcGIS API for Python [guide](#)

Topics

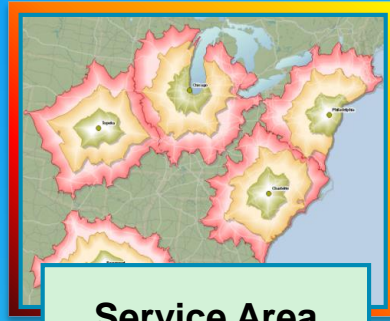
- **Different types of analysis that can be performed on transportation networks**
 - **Services that are available to perform the analysis**
 - **Access the services using ArcGIS API for Python**
- 



Route



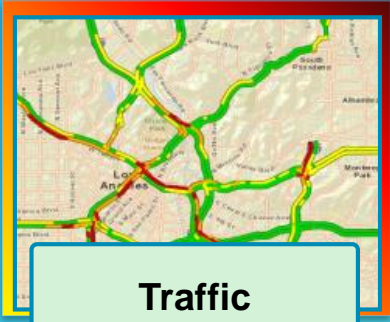
Closest Facility



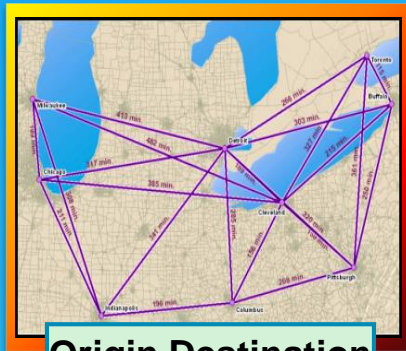
Service Area

Directions and Routing Services

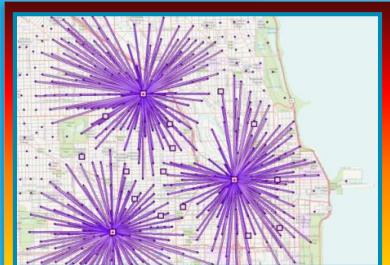
Perform analyses on transportation networks



Traffic



Origin Destination Cost Matrix



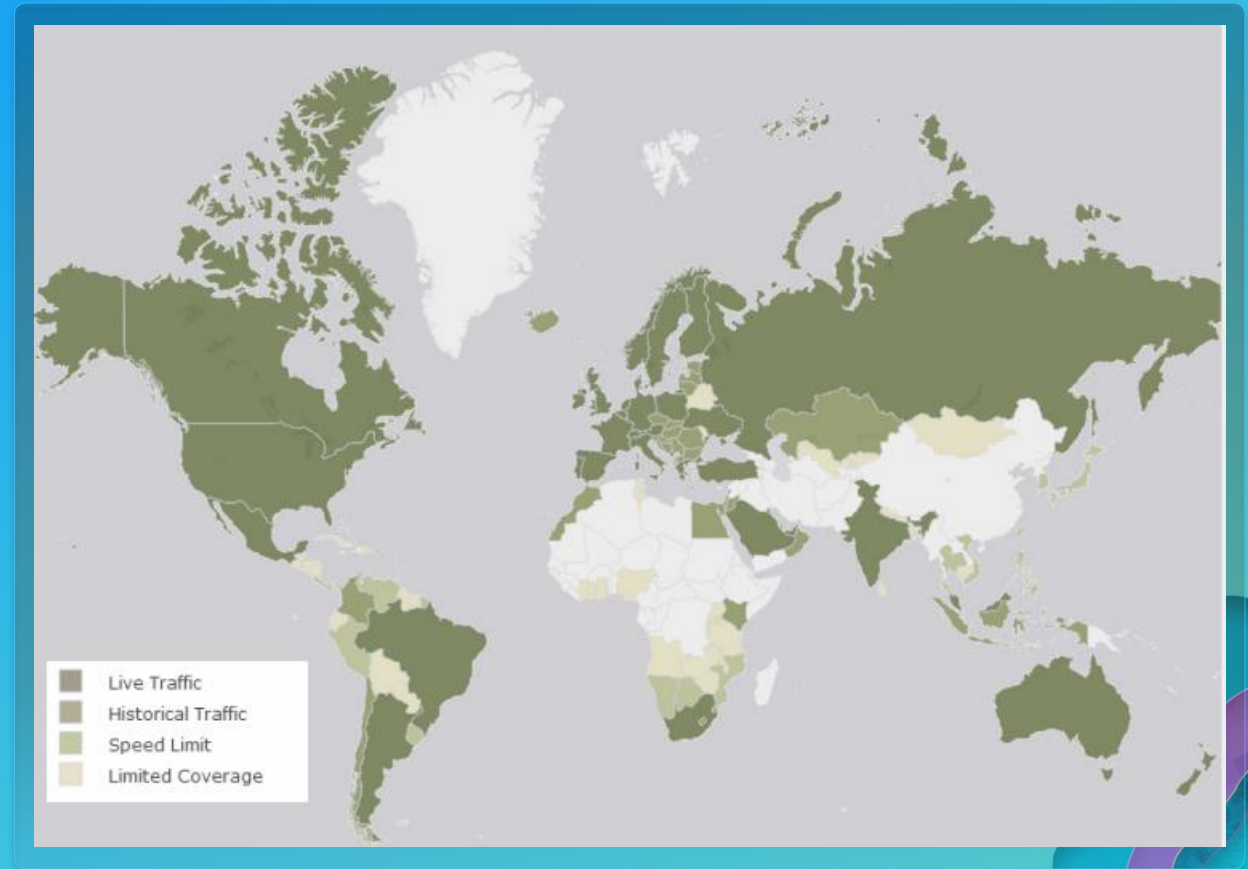
Location-Allocation



Vehicle Routing Problem

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](#)

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. ArcGIS Transportation Routing and Network Analytics services help you streamline movement of goods, coordinate vehicles, and create intelligent analyses to maximize efficiency and minimize transportation costs.

Demo

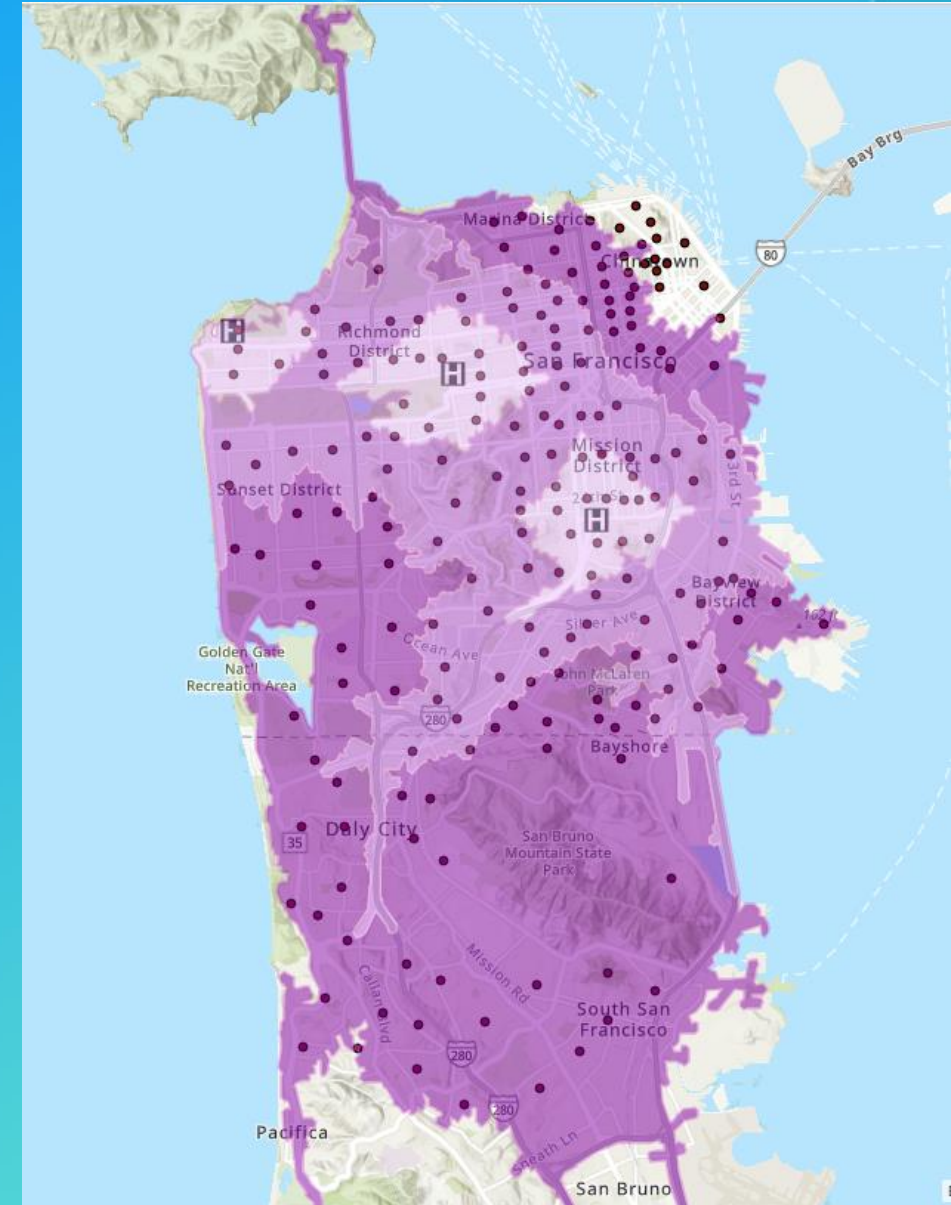


Select the appropriate analysis type

- 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.

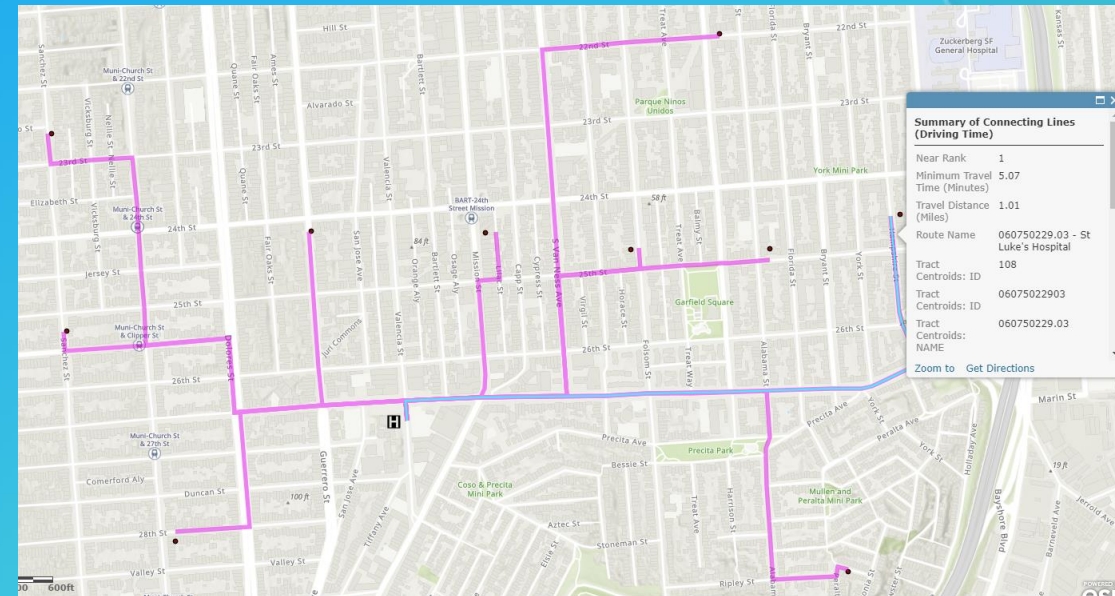
Select the appropriate analysis type

- 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.

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

Services to perform network analysis



Available services

- **Network Analysis in the Python API is performed using services**
- **Routing and Directions services expose all the capabilities**
- **Spatial Analysis service tasks solve focused workflows and 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

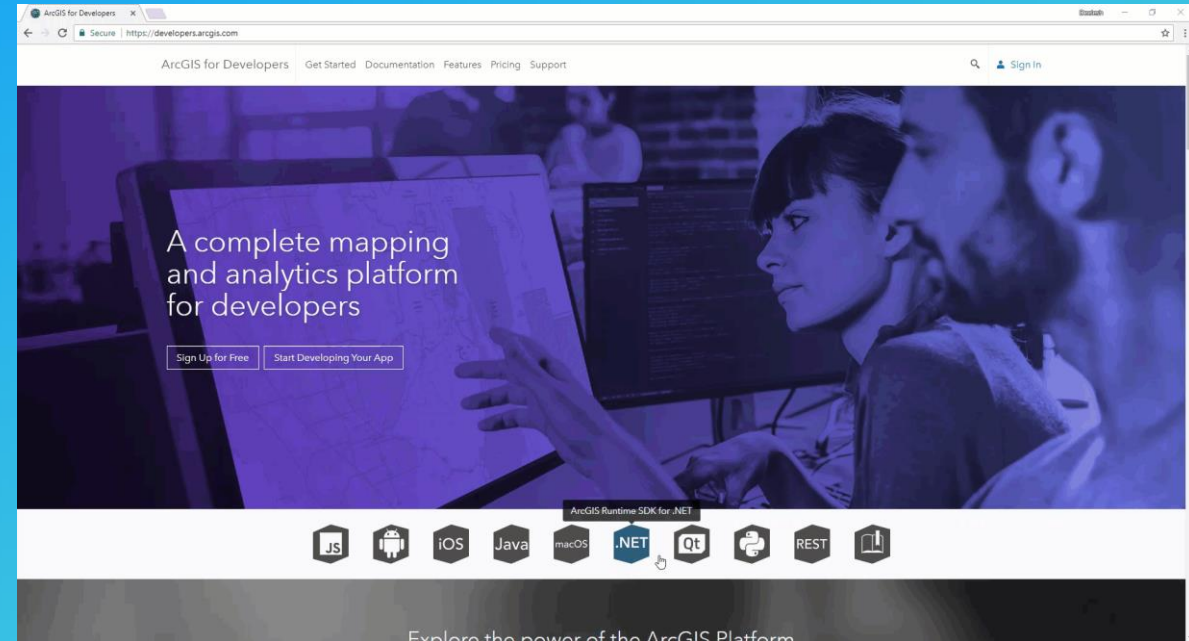
- Connect Origins to Destinations
- Find Nearest
- Create Drive-Time Areas
- Enrich Layer
- Summarize Within
- Choose Best Facilities
- Plan Routes
- Create Route Layers

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)

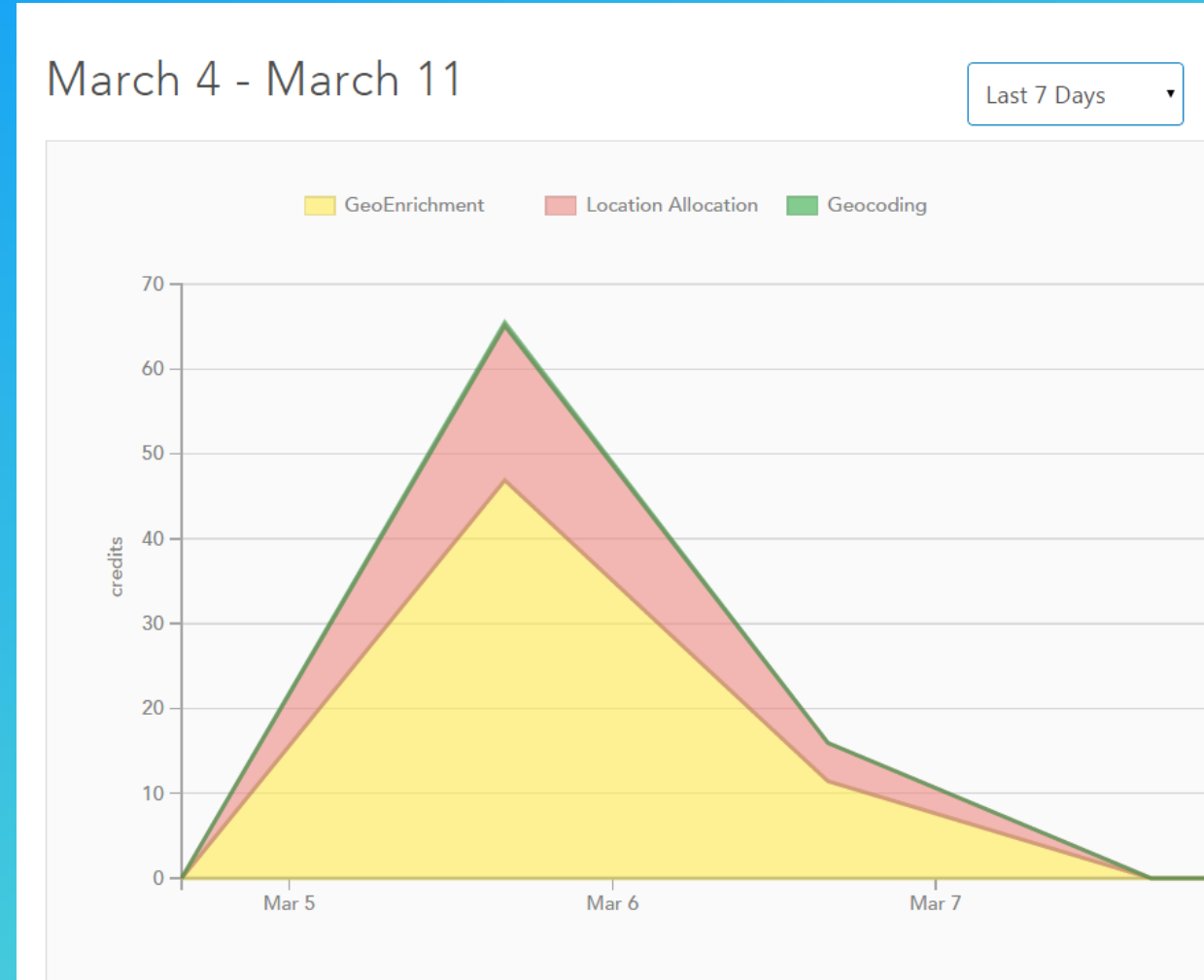
Service limits

- 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

Workflow	Required privileges	
	General privileges	Administrative privileges
Use the analysis tools	<ul style="list-style-type: none">• Content: Create, update, and delete• Content: Publish hosted feature layers• Premium Content: Spatial Analysis <div><p>Note: Some tools require the following additional privileges:</p><ul style="list-style-type: none">• Premium Content: GeoEnrichment• Premium Content: Network Analysis</div>	

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

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
- Learn about the data frames in the **pandas** Python 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	

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

The screenshot shows a web browser window with the URL <https://notebooks.esri.com/user/XrVP6ToEYcnDcxsiCmEVGKppo/tree>. The page features the Esri logo and navigation tabs for 'Files' and 'Running'. Below the navigation, there are buttons for 'Upload', 'New', and a refresh icon. A table lists the contents of the directory:

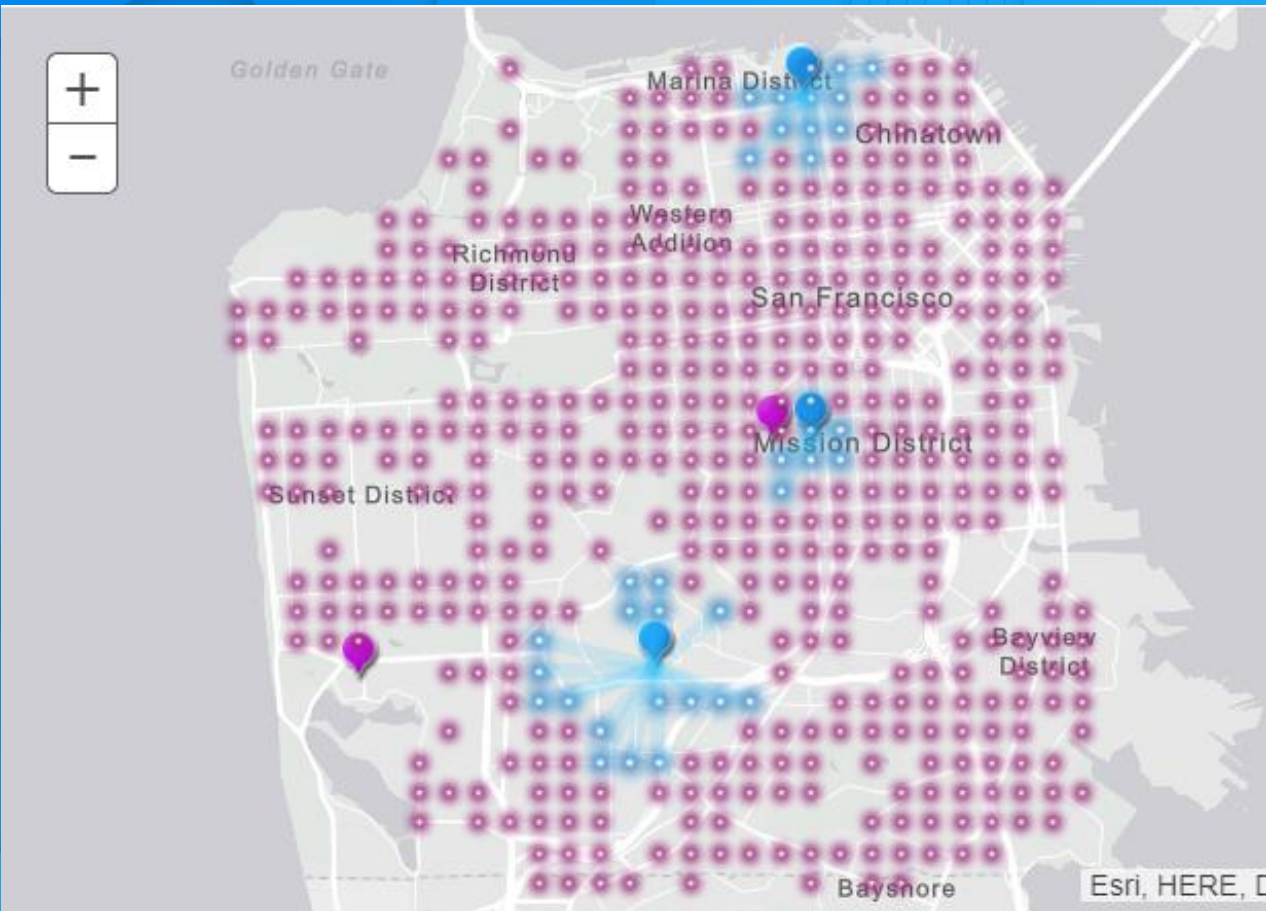
	Name ↑	Last Modified ↑
<input type="checkbox"/>	0	
<input type="checkbox"/>	guide	8 days ago
<input type="checkbox"/>	labs	8 days ago
<input type="checkbox"/>	samples	8 days ago
<input type="checkbox"/>	LICENSE	8 days ago
<input type="checkbox"/>	README.md	8 days ago

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!!

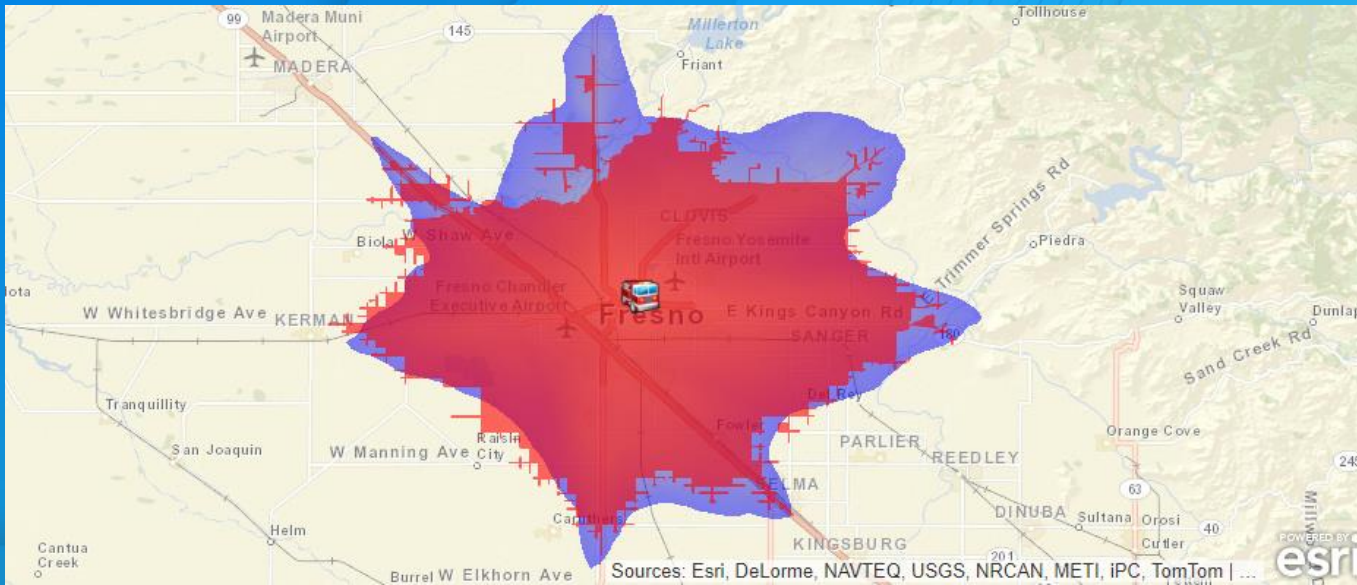


Site Child Care Facilities

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**



Python API and Machine Learning

Estimate travel times using machine learning

Summary

- Choose the correct analysis type
- Select the best service to perform the analysis
- Slides and code samples available at

<http://esriurl.com/ds18napy>



esri

THE
SCIENCE
OF
WHERE