ArcGIS Online: Using the Python API for Transportation Network Analysis

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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
Directions and Routing Services
Perform analyses on transportation networks

Route
Closest Facility
Service Area
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
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.
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.
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
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](#)

**Guide**

- Performing network analyses
- 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
Python API Playground

https://notebooks.esri.com
Demo takeaways

- [https://notebooks.esri.com](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