Using Networks in Arcgis

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Introduction

The goal of this exercise is to introduce you to the network tools in Arcgis. Networks allow you to calculate distances as you walk, ride, or drive along sidewalks and streets as well as find directions to one or more locations. While there are great network datasets available for large parts of the world, this workshop will contain instructions on making a network dataset for those sites that one is not available.

A prerequisite of this workshop is prior experience with Arcgis. Given that assumption, the workshop starts with detailed instructions with illustrations and moves towards relatively little instruction and few illustrations. If you need help as you work through the exercise, please don’t hesitate to ask.

Data

You will be using Cambridge data, including streets, schools, and origin and destination shapefiles. The data is located in the T:\Network2014 folder. Copy this folder to your desktop.

Step 1: Opening the software

Open Arcmap 10.1 from the Arcgis branch of the Start menu. You will need to add the Network Analyst extension to use the interpolation tools. To do this, find the Customize menu item, click on it then click on Extensions. This opens the Extensions window. Click on the Network Analyst checkbox and close the window.

You will also need the Network toolbar. Open the toolbar and once it is visible, open the Network Analyst window.

You will create the network dataset in ArcCatalog so open ArcCatalog 10.1 from the Arcgis branch of the Start menu. Enable the Network Analyst extension as you did in your Arcmap window.

Step 2: A distance column to the streets.shp layer in Arcmap

Open the attribute table for the streets layer (right click on layer name in table of contents). Look for the drop down menu and add a field called distance, defined as seen below:
Right click on the column and select Calculate Geometry. Select Length as the property and use the coordinate system of the data source. You can use whatever units you prefer but keep this in mind later.

Step 3: Create a network dataset

In Arcmap, navigate to the desktop and then to the folder you copied earlier.

Right click on the streets.shp layer and select New Network Dataset. A new window opens. Use the default name and click next.

In the next window accept the default of modeling turns and click next.

In the next window, click on the Connectivity button, which opens a sub window. Click on OK then Next on the main window after the sub window closes.

You don’t have elevations so leave the default on the next window and click Next.

In the next window, click on Remove All to remove the Length attribute, which doesn’t exist. Then click on Add (an impedance attribute). Add DISTANCE, which you need to enter by hand, even though it is an attribute. Change the units to the unit you selected when you used the Calculate Geometry tool earlier.
Click Next on the main window after you click on OK on the above window.

On the next window and click on Directions. You should see the length attribute. If you have a time attribute and added it in the earlier step, you would see that as well. Click OK on the Directions Window and then click on the Next button.

On the final window, click on Finish to complete the process. You may be prompted to build the dataset, which you should do so now.

**Step 4: Add the data to Arcmap**

Add the new network dataset to the map. You will be prompted to add the files that participate in the dataset. Click on Yes. Add the origin.shp, destinations.shp, and schools.shp layers as well.

origin.shp has one entry – 77 Mass Ave. destinations.shp has random sites in Cambridge. schools.shp has the locations of all elementary schools in Cambridge. SDE_DATA_US_MA_CAMBRIDGE_P1PVMMARK_2010.shp has all Cambridge street line markings, including crosswalks. SDE_DATA_US_MA_CAMBRIDGE_P21WLKSIG2010.shp has all traffic signals. The latter two are included for reference and ideas but aren’t directly used in the exercise.

**Step 5: Find routes to multiple stops**

The goal of this tool is to find the least cost route (as your defined cost) along the network (Cambridge streets) from an origin (or origins) and one or more destinations. Imagine route a bike messenger as she or he picks up packages and then delivers them. You would want your messenger to minimize her or his travel time.

Make sure the Network Analyst window is open. On the Network Analyst toolbar dropdown menu, select New Route. Right click on Stops and then Load Locations. First add origin.shp. Repeat, adding schools.shp. This forces the starting point as MIT and then each of the schools will be visited, in an order that minimizes distance. Click on the Solve icon. You should see the routes. Directions are available.
**Step 6: Finding the Closest Facility**

Perhaps the best use case for this tool is how to determine the best fire station to respond to a fire. You would want the least travel time in this case.

On the Network Analyst toolbar dropdown menu, select New Closest Facility. Right click on Facilities and then Load Locations. Use the origin.shp shapefile as the Facility. Right click on Incidents and then Load Locations. Use the schools.shp shapefile as the Incidents. Solve this. The result will be a shapefile with the routes from all (one in our case) facilities to all incidents. You can also see the directions.

**Step 7: Finding Service Areas**

Our example for finding service areas are using Cambridge elementary schools. You might optimally want to restrict the distance that a student in elementary school may walk to some reasonable limit. You might already be familiar with buffers, which show the polygon that is within a specified distance from a location. A service area is the same polygon, except that the distance is not ‘as the crow flies’ that buffer uses but instead uses the distance along the network, which is much more realistic.

On the Network Analyst toolbar dropdown menu, select New Service Area. Right click on Facilities and add schools.shp as the facilities. You can change the size of the service area in Service Area Properties. Click on the icon outlined in red below to open the properties. You change the Default Breaks in the Analysis Settings tab.

![Network Analyst interface](image)

Change the Click on Solve to find the service areas.

You might want to work with other issues than just streets. You can add additional impedance at traffic signals and restrict crossings only where there are crosswalks. The concept of impedance at traffic signals can also be used in the Route problem you solved earlier.