

GEOG3600. Geographical Information Systems

Lab 9. Network Analysis

Objective

The exercise demonstrates how the GIS network analysis functions can be used to solve daily transportation problems in an urban environment. The students will practise the techniques in establishing network database, assigning impedance and other network parameters, and problem solving in selecting the optimum route, finding the closest facilities and identifying the service area of a given facility.

The data sets to be used for this exercise are listed below:

File name	Feature type	Contents
HK_territory.shp	Line	The outline of Hong Kong SAR territory
Current_roads.shp	Line	The current road network for entire Hong Kong SAR territory
Hospital_selected.shp	Point	The locations of selected hospitals
Baptist.shp	Point	The location of Hong Kong Baptist Hospital
Day_trip.shp	Point	The stops of proposed day trip
Service_stops.shp	Point	The stops of service trip
Accidents	Point	The locations of accidents

The Exercise

1. Establish a new workspace and a new project. Copy all data sets as list above into the newly created workspace. Create a new view with map unit as "metres" and distance unit as "kilometres". Add all data sets into the view. Do not forget to check and make sure that the ArcView "Network Analyst" extension is installed.
2. Before you can solve anything, you need to get your database ready for the analysis. The network data set "current_roads.shp" contains all necessary information except the travel time that is required. The travel time is defined as the time required to drive through the given road segment which should be specified as an attribute field in the Attribute Table for current_roads.shp. Edit the attribute table by selecting the table icon on the project window and then double click on the "Attributes of current_roads.shp". Use "Table" → "Start Editing", then "Edit" → "Add Field" to add a new field called "DriveTime". Select the newly created field, then "Field" → "Calculate..." to assign the travel time. The travel time is defined as: $T = \frac{L}{S} \times T_0 \times R$, where T is the required travel time (i.e. field "DriveTime") in minutes, L is the distance (field "Length") in metres, S is the speed limit

(field "Speed_limit") in km/hour, T_0 is the time unit scalar for speed unit (equal to 0.06 for the unit of T as minutes), and R is the road type (field "Type") which specified expected travel delays in different types or road. For example, for road type 1 (i.e. Highway), the extra delay is assumed minimal, while for road type 3 (i.e. local back street), substantial delay would occur. For this exercise, we assume that the back street would cost us about 3 times travel time as that of speed limit. The actual field calculation equation should look like this:

$$[\text{Length}] / [\text{Speed_limit}] * 0.06 * [\text{Type}]$$

After completing the calculation, stop editing and save the result: "Table" → "Stop Editing". Now you are ready to solve few problems.

3. We are propose a day field trip to Tai O on Lantau Island. A student who lives in Sha Tin needs to come to Hong Kong Baptist University at Kowloon Tong to catch the bus, which will try to get Tai O as quick as possible. Select the best route for this student by highlighting the "current_roads.shp" theme, then "Network" → "Find Best Routh...". The day trip stops are pre-defined in the theme "day_trip.shp" and can be loaded in the "Problem Solving Dialog", or you can input by yourself using the "Add Location" tool. I assume that you know where Sha Tin, Kowloon Tong and Tai O are. If not, find a map! After loading the stops, make sure that they are in the order of Sha Tin → Kowloon Tong → Tai O. Press the "Solve Problem" button to see the result.
4. The next problem is for a service man who need to visit a number of places to do the job. He needs to start from his Tsim Sha Tsui office, and visit places in Kowloon Tong, Sha Tin, Fan Ling, Ap Lai Chau and Tuen Mun, then return to his office. Note in this case, he has to keep the travel in the above order, i.e. visit Tuen Mun after Ap Lai Chau before going home office at Tsim Sha Tsui. The stops are given in Theme "service_stops.shp". How long does he have to travel on the road for the day?
5. Now if the service man can plan early so that he can re-arrange the visit order, can he save much travel time?
6. There have been 5 road accident cases specified in theme "accidents.shp". For each of the cases, find the closest hospital within the travel time of 15 minutes. The hospital facilities are defined in theme "Hospital_selected.shp" (HINT: "Network" → "Find Closest Facility...").
7. Location of Hong Kong Baptist Hospital is given in theme "Baptist.shp". Define its service area by travel time of 30 minutes, 15 minutes and 5 minutes. Draw a map showing the extent of all service time zones and streets in colours indicating their travel time.

That is all required for this lab exercise. If you want to continue to explore the network analysis capability, have fun!