Geog 176A: Introduction to GIS, Fall 2015
Prof. Dr. Werner Kuhn and Teaching Assistants

Lab 4: Network

Objectives

Through this lab, you will gain a deeper understanding of the concept of a network by experimenting with network data in the key application area of wayfinding. Specifically, you will use the campus bicycle network to do routing and analyze the routes for some properties.

Tasks

Provide a technical report (as a single pdf uploaded in GauchoSpace) with precise answers to the following questions. Purple asterisks (*) indicate that the question requires a screenshot! (23 points possible)

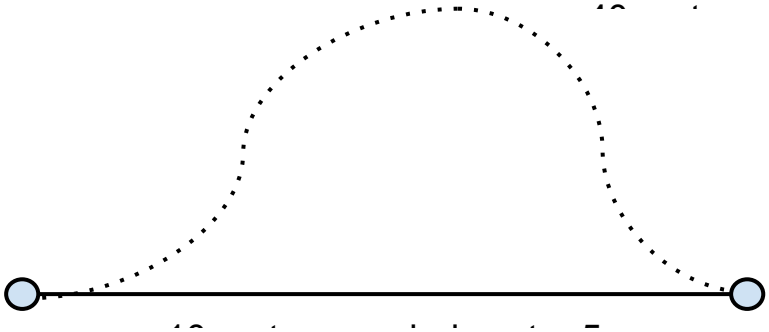
1. **Prepare** a map of the road network dataset that spans UCSB and Isla Vista using ArcMap.
    a. Download and unzip the geodatabase provided on Gauchospace.
    b. Add the "bicycle" feature dataset and the "buildings" feature layer to the map. These layers were obtained from OpenStreetMap, which is a community effort to produce geographic information for the world.
    c. Add an OpenStreetMap basemap to the bottom of your layer stack to see a geographic reference and campus building names.
    d. Open the attribute table of "bicycle_nd_roads" layer. Determine the total length of each road type in the area by summarizing the "highway" column through "sum" of "shape_length". Report the three types of roads (which are called "highways" in OpenStreetMap) that have the greatest total length in the network. What are these types of roads and give an example of each type on campus (2 points).

2. Often, you may want to find the shortest path to get from home to class. **Compute** the shortest route by distance from an origin location on Del Playa in Isla Vista (pick a point west of Camino del Sur) to a destination location at the southern edge of Buchanan Hall (the lecture building just east of Ellison). Remember to uncheck all "Restrictions" in the route properties layer restrictions and then solve for your

route. Your route is under the Network Analyst Routes drop down (there should be only one).

a. Report the length of your route by inspecting the attribute table of the new route (under Routes heading). Be sure to check and set the proper distance units in the Route Properties panel under Impedance first. *Take a screenshot of the attribute table with your distance value along with the route shown on your map (1 point).
b. If you're running late for class, you may additionally want to know how long it will take to get there. Change the route optimization method under Impedance to use CycleTime instead of Length and solve your route again. *Take a screenshot of the cycle time value along with the route shown on your map (1 point).
c. Zoom into the last part of your route and identify the segment of the "bicycle_nd_roads" layer that leads to your endpoint. What type of road is this? Why do you think that it is/is not acceptable to bike here? (1 point)

3. Since not all road types allow all types of traffic (e.g., bike lanes shouldn't be used by cars, and footpaths shouldn't to be used by bicycles), modifications should be made to account for the various types of roads.
    a. **Create** a new route and call it "Cycle_Route_Designated_Pathways" with a Scale Cost Line Barrier by copying and pasting your origin and destination points from your first route, "Cycle_Route_Any_Road". From the bicycle feature layer, drag the "pedways" layer to this new route as a Line Barrier > Scaled Cost. Then, give it an impedance (CycleTime) value of 4. (You will do this again later in lab - we will refer to it as pedway impedance).
    b. *Solve for your new route and take a screenshot of the results. What does Scaled Cost Line Barrier do? What changed? How does the new route compare to "Cycle_Route_Any_Road"? (4 points)
4. To better understand impedance and scaled cost concepts (and understand how a computer algorithm chooses a route), imagine a split in the road where both paths lead to the same point. One path is 40 meters to the destination, the other path is only 10 meters but has a scaled cost of 5 (perhaps because the road has several construction areas that take time to avoid). Which route would you choose? How do you decide? (2 points)



5. **Explain** how impedance affects solving for an optimal route. What does the scaled cost value imply when the impedance factor is time? Give a simple example from your route to support your reasoning (3 points).

6. **Generate** directions *(i.e., wayfinding instructions)* from your new path route "Cycle_Route_Designated_Pathways"from Question 3.
    a. Step through the directions one-by-one and carefully inspect the map overview of each turn. Do you notice any segments of your directions that you should not follow and why? Which segments and why? *Take a screenshot of what you find (2 points). (hint: it's likely that some segments will take you on "wrong way" areas, other issues will be segments that aren't for biking)
    b. Update your route properties to avoid the 6a. situations when the Network Analyst attempts to solve this route. This is done by adding restrictions. *Update your map by solving the route again and take a screenshot of what changes. How does adding each restriction change your route? Give 1 or more examples of what has changed (3 point).

7. Service areas are important for many applications, such as emergency response trying to determine what areas an ambulance can service within 5, 10, and 15 minutes. Alternatively, consider meeting a friend somewhere on campus, but you're coming from different locations. To figure out if it will take you two the same amount of time to get there, you must create service area polygons.
    a. **Create** five service area polygons of 4, 6, 8, 10 and 12 minute breaks from one location on campus. Pick this location yourself. Be sure to include the same pedway impedance as before**.** Change the symbology of the service area layer by opening its properties. Think about what these polygons represent. Next, find any building of interest, one in Isla Vista based on your buildings dataset, and determine which service area it falls within. *Evaluate this by selecting your building, highlighting the respective service area polygon, and

take a screenshot . To double check, open up the polygon attribute table and see the selection. Does your travel time make sense? (2 points)

b. In a different scenario, you have time between chemistry classes to have lunch, and you want to know where you can go within a three minute bike ride. Create a new service area from the front of the chemistry building. Visualize the areas that you can get to the building from within 3 minutes cycle time or less. Do this by setting the direction as “Towards Facility”. Be sure to include the same pedway impedance as before. Change the symbology of the Polygon layer by opening its properties and give your service area polygon different colors. *Take a screenshot of the map (2 point).