

Lab Exercise 7: GPS Data Gathering

Field Work: Monday April 9

Due: April 23, via Stellar

OVERVIEW

In this exercise, you will be describing neighborhood conditions based on field observations to be mapped and analyzed in ArcMap. You will use a mobile app called Mobile Forms by a company called Device Magic to gather data in the field, and a few tools in ArcMap to visualize, analyze and summarize your results:

- Create CSV point dataset with Mobile Forms using the survey form created for Lab 7;
- Load your dataset into ArcMap to create a Shapefile, and symbolize the track points to analyze patterns in the data;
- Load and review the pictures taken with Mobile Forms using ArcMap;
- Use Network Analyst to indicate your trajectory in ArcMap; and
- Create a new Shapefile to summarize data observations using new polygons that subdivide the study to help you describe your characterization of the neighborhood.

PRELIMINARIES

This exercise will be conducted in groups and includes an activity to be carried out in the field. Locate your team using the information below, and jot down the names and contact information of your teammates in order to coordinate your site visit. You can switch groups, as long as someone else is willing to switch with you.

You are expected to use class time on Monday 4/9 to gather the data for the exercise using a mobile app called Mobile Forms that has been set up by the instructors. If you need more time to gather the data, email the instructors by Tuesday at noon. The instructors will retrieve data from the Device Magic server on Tuesday 4/10 at 5pm, and make this available via the class locker. In addition, please note that you will also need to schedule lab time as a group to analyze your data, analyze the results, and prepare your submission.

Plan to work outdoors for at least 2.5 hours on Monday 4/9 – you will need to drink plenty of water and dress accordingly.

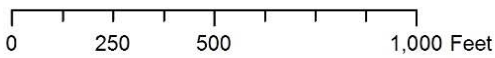
Team 1: Kendall Square Team & Study Area



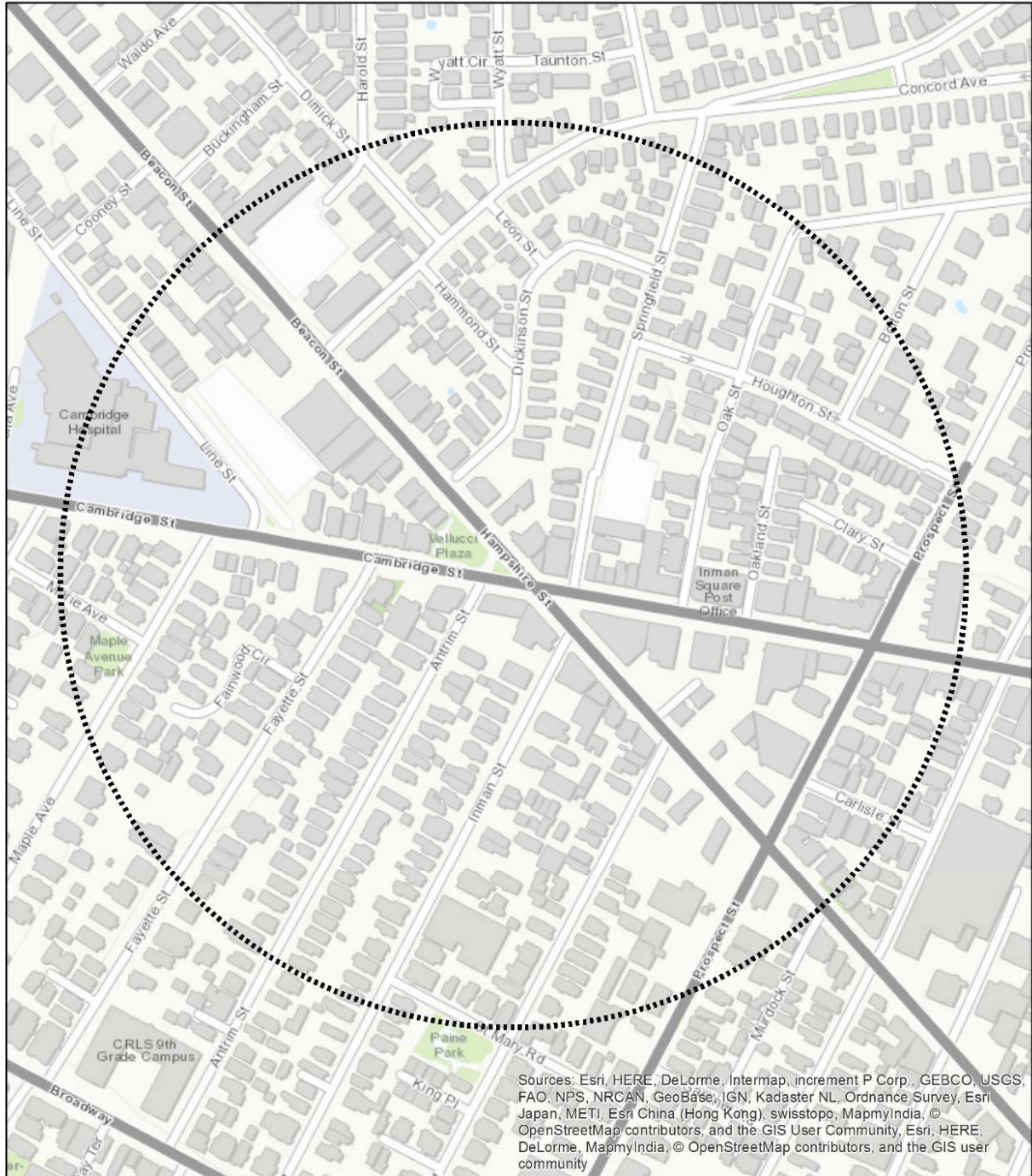
0 250 500 1,000 Feet



Team 2 Central Square Team & Study Area



Team 3: Inman Square Team & Study Area



0 250 500 1,000 Feet



SETUP

Setting up Mobile Forms is simple! You should have already done this in class on Wednesday, April 4, but if not these are the steps you will follow:

1. Download Mobile Forms from your mobile device's App store.
2. Open the app and choose Sign in to An Existing Team.
3. Use your full name and the organization key MIT294 to log in. Do this in advance! The instructors will need to give you permission to access the Lab 7 form.
4. The instructors have created a project called Lab 7, which you should see on your dashboard. You'll use this form to generate observations of built environment and community conditions.

PART 1: GATHER TRACK POINTS USING MOBILE FORMS

The purpose of the exercise is to use Mobile Forms to record observations that serve as evidence of 'neighborhood change'. Look for factors differentiating certain blocks within your area, based on characteristics that typically occur when a neighborhood is undergoing a major transformation. Such changes take place when sections of the community move in/out, and the neighborhood adapts to the needs of those living or working there. In class, you learned how to collect GPS track points using Mobile Forms. Now, you will go out and collect your own information. All students will use the same Mobile Forms form to gather data in the field.

This exercise will focus on potential signs of 'neighborhood change':

1. You should start by walking the neighborhood to familiarize yourself with the study area. We ask that you walk the entire study area assigned to your group .
2. Then identify potential boundaries that could sub-divide the study area into a few large regions with various predominant characteristics:
 - a) **Land use** trends observed as you walk the area (e.g. concentration or dispersal of certain land uses – like high-density residential, industrial or open spaces, among others);
 - b) **Community characteristics** based on signs denoting the presence or lack of services catering to particular groups (e.g. high-end boutique stores, child care facilities or senior centers);
 - c) **Physical conditions** of the building stock or public spaces (e.g. evidence of wellmaintained facades or landscaping, buildings in clear need of repair (like broken windows or broken sidewalks, benches, etc.) or signs of major infrastructure repairs in place.
3. Sketch the preliminary neighborhood boundaries on the paper map provided while in the field. This will be useful once you return to the lab to work in ArcMap.
4. While you are sketching the boundaries, use Mobile Forms to record observations that could be indicators of typical (and/or atypical) uses, community characteristics, and physical characteristics in each 'neighborhood.' In other words, these observations become the evidence supporting your rationale behind the boundaries selected.
5. Return to the lab to finalize your (rough) boundaries in ArcMap, in the light of the data gathered with Mobile Forms.

As demonstrated in class, we have created a form in Mobile Forms that you will use to complete the exercise. The form requests you to fill out both quantitative and qualitative data. You should collect 30 track points, at least 10 track points in each category (Land use, Community characteristics, Physical conditions). For each observation, the questionnaire will ask you to take a picture. Tap the camera icon

and take the picture with the phone's camera. Then the questionnaire will ask you to determine the direction in which you took the picture. Use an app to select an option from the list (i.e. N, NE, E, S, SW, W). It is very important that you place the device horizontally to maximize the accuracy of the measurement. Finally, use the space provided to describe any other relevant aspects of what you saw. Once you are done with the last question, please make sure to tap the blue check box in order to upload the new survey to the database. Each track point will be a new row in the database.

Data gathered will be retrieved by the instructors from the Device Magic server and saved in the data locker on Tuesday 4/10 at 5pm. At that time, copy the following files from the class data locker into the directory C:\TEMP on a local drive:

- CSV file containing your track points downloaded from the Device Magic server. This file will be retrieved by the instructors and saved in the data locker (Q:\data\lab7); and
- Network dataset 'camb_RN' that the lab instructors have prepared for you. This is located in a geodatabase called Q:\data\lab7\cambridgenetwork.mdb.

PART 2: CONVERT A CSV FILE TO A POINT SHAPEFILE

Here, we format our data to work in GIS.

Parsing Latitude and Longitude

Before we import our data into ArcGIS, we need to make sure it is formatted correctly using Excel. First, let's create 'lat' and 'lng' fields from the single Location field provided by Device Magic.

1. Locate the column that contains latitude and longitude.
2. Add columns to your excel file named "lat" and "lng"
3. We can parse the 'Location' field using Excel's MID function. We will use the following for our function:

=MID(G2, 5, 9)

Where G2 is the second row of the 'Location' column (column G). This extracts the nine characters in the location field starting with the character that is fifth in the string.

4. Do this for longitude as well, populating the LONG field you created. To get the longitude, use the following MID function:

=MID(G2, 21, 10)

Like above, this extracts the ten characters in the location field starting with the character that is 21st in the string. It is important to preserve the negative sign in front of the longitude!

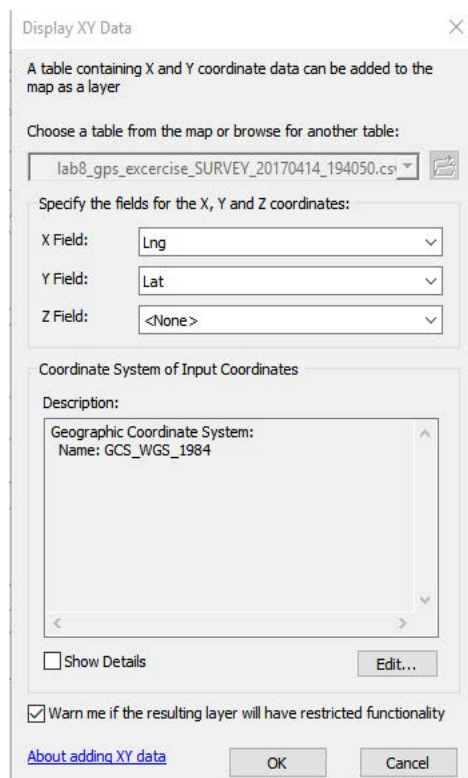
5. Copy and "Paste Values" in the two new fields you created to remove the function reference, and delete your original location storing field.
6. Right now the LAT and LONG fields are in a text format, convert them to number format for use in ArcGIS.

7. Lastly, rename the other fields in your Excel spreadsheet to make it ready for opening in ArcGIS. Remember: ArcGIS cannot read spaces and punctuations in field headers, so rename them accordingly!

Adding Data to ArcMap

In this section of the exercise you will use the CSV exported by Device Magic to work with the data in Shapefile format in ArcMap.

- Add your CSV file to ArcMap, right click the file in the table of content, and select ‘Display XY Data’
- Set X to be ‘lng’, Y to be ‘lat’, and coordinate system to be ‘WGS 1984’.
- Review the data to confirm all of your observations were successfully loaded in the Shapefile.



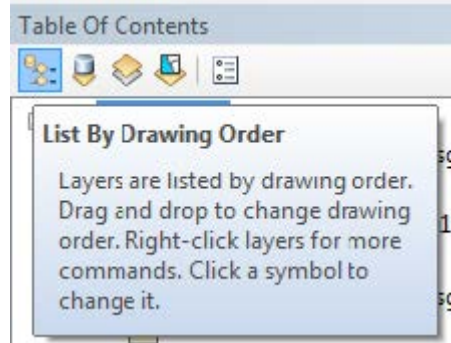
- Export the ‘temporary’ point Shapefile that you can already see on the map to a ‘permanent’ Shapefile in your private folder, and name it ‘track_points.shp’.

PART 3: ANALYZE YOUR DATA USING ARCMAP

Explore the data in ArcMap

Open the attribute table of ‘track_points.shp’ to understand the structure of the table. Compare the questions in the survey (PART 1) to the attributes in the table. Symbolize all of the different attributes to observe potential spatial patterns. You may want to display various copies of ‘track_points.shp’. Make sure the ‘table of contents’ is set to ‘List by Drawing Order’. Then, right-click on the layer in the

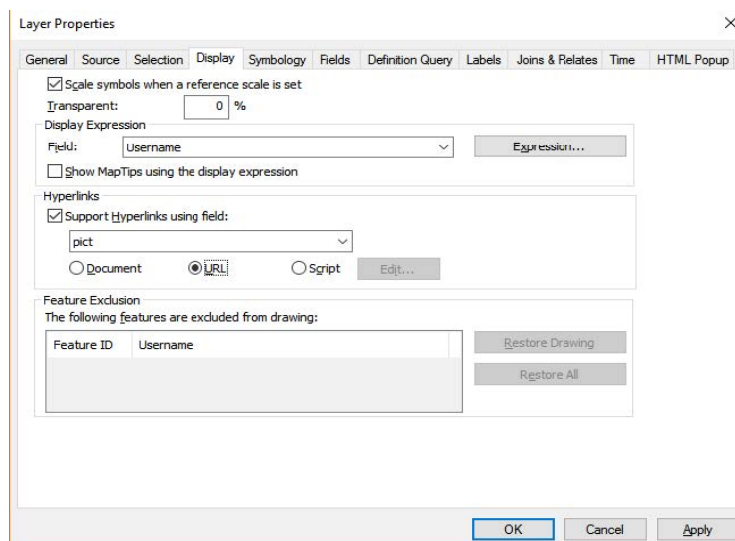
'table of contents' and click on 'copy', then right-click on 'Data frame' to 'paste layer(s)'. You can then use the different copies of the layer to symbolize different attributes.



Review the pictures taken

Think about what you saw and where you could draw the boundaries of the phenomena observed. Of course, you would need much more data to make scientific observations. The purpose here is to draw preliminary conclusions to begin studying the study area. To this end, you will also like to review the pictures taken at each location. Currently the pictures are saved on a Device Magic server, but there is a link to each file in the corresponding row in the attribute table – I renamed this column 'pict', though you may have chosen a different name. We are going to use the hyperlink feature of ArcMap to quickly locate the picture of each point.

- In the layer property of 'track_points', find the 'Display' panel.
- In the 'Hyperlinks' tab, check 'Support Hyperlinks using field', select 'pict' (or the name you chose to give the column containing the image URL), and specify it as 'URL'.

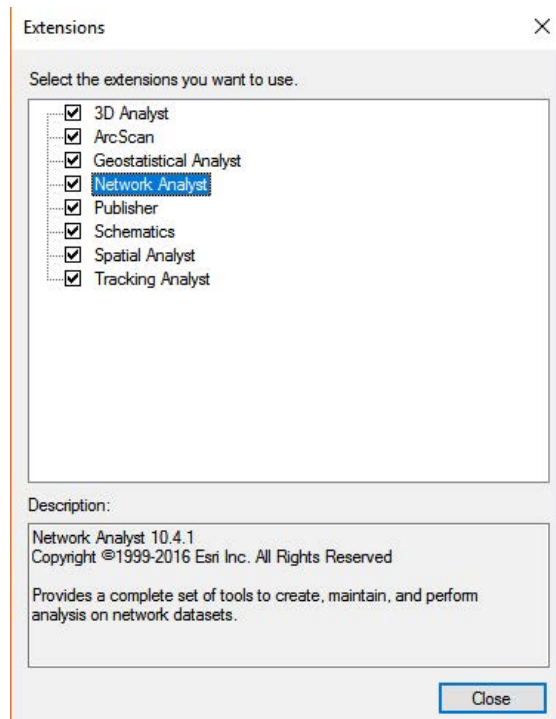


Then, using the Hyperlink tool (the lightning bolt icon right next to the identify tool), you can quickly check the picture that you took at that point in a browser window. You may also want to save your pictures to local folders for later mapping use.

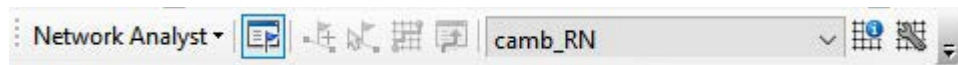
Map a Trajectory Using Network Analyst

Add the network dataset 'camb_RN' in your map. This is a road network dataset that we made based on the road Shapefile for Cambridge. Different from a Shapefile, a network dataset includes the 'topology' of the road network, which is used to construct routes from your waypoints. (If you are interested in how to construct a network yourself and use this for another network analysis (beyond the scope of this class) you can go to ArcGIS Network Analyst extension tutorial.) Once you add 'camb_RN', ArcMap will ask you whether to also add the feature classes to the map, and you can choose 'no'. Then we are going to use the Network Analyst toolbox in ArcMap to find a route connecting all the points. Before we start, make sure that:

- In 'Customize' -> 'Extensions', your Network Analyst module is activated.



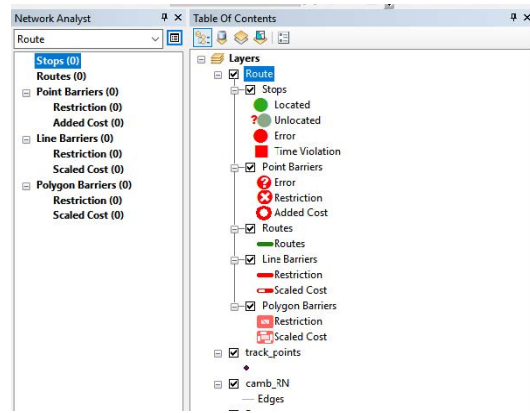
- After activating the Network Analyst, right click the empty space in your menu bar, and check 'Network Analyst' to add this toolbar. It looks like this...



- Also make sure that the Network Analyst panel is opened, by clicking the 'blue-flag' icon in the picture above.

Then let's create the route.

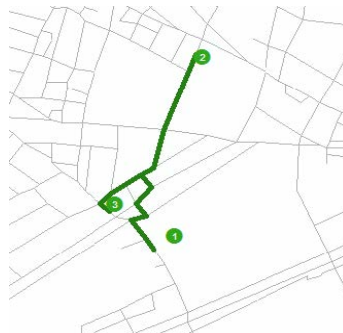
- In the drag-down menu of Network Analyst, select 'New Route'. This will create a new group of layers in your map called 'Route'. In the meantime, in the Network Analyst panel, the items for a route analysis will also show up.



- Right click 'Stops', and select 'Load locations', then we can load our track points. Remember to use 'Date', which includes both date and the time stamp of each point, for the 'Sort Field', so the points will be connected based on the sequence of time occurrence.
- Set the search tolerance to be 50 meters, and click OK. You will find that the points are labeled with numbers indicating sequence.



- Click the Solve button in the Network Analyst menu, and we will get the route that connects all the points by traversing links in the road network that you provided earlier, camb_RN. It may look different from your actual trajectory, but is the best guess from the Network Analyst package based the points, and the shortest path algorithm.
- You can export the route to a Shapefile, and use it for mapping.



Summarize your observations through a new Shapefile

Have a discussion within your team to define the most important observations, for each of the three thematic areas of the questionnaire (i.e. land use, community characteristics, and physical conditions). The team should create consensus around the most important findings for each of these categories. Then create a Shapefile for each of these categories, using polygons to indicate zones where you observed specific patterns. Review Lecture from April 02 for guidance on how to create and modify a Shapefile in ArcMap.

Create an MXD Project for each of the categories. Include images as evidence to support your work, and a note on the map describing what you found. Make sure each map has all of the map components discussed in class. Once you are finished export your maps as JPGs, 300 dpi. Combine your maps into one PDF file and submit via Stellar.

PART 4: ASSIGNMENT

Please use Stellar to submit your lab exercise. Your submission should include three complete maps (make sure to include all map elements), featuring your observations on “land use”, “community characteristics”, and “physical conditions”, on separate maps. In addition, include one paragraph summarizing your findings. This should synthesize the information that you have noted in each of the three maps. Each of these maps should include the original track points, the line trajectory, the polygon(s) that summarize your analysis, and a couple photos taken with Mobile Forms to describe the type of observations made. The layout of these documents should be prepared in ArcMap, with no need to use additional graphic design software. You should submit ONE PDF per group, including your three maps and the names/roles of all members of the group. The assignment is due on Monday, April 23, 2018.

Developed by Joseph Ferreira, Juan Camilo Osorio and Hongmou Zhang, April 04, 2017. Updated by Eric Huntley, April 07, 2018.