Massachusetts Institute of Technology
Department of Urban Studies and Planning

11.188: Urban Planning and Social Science Laboratory
11.520: Workshop on GIS (2nd half-semester)

Lab Exercise 8: GPS Data Gathering

Class: Wed. April 19, 2017; Field work: Monday April 24th; Due: May 1st, via Stellar

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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 FlockTracker[1] to gather data in the field, and a few tools in ArcMap to visualize, analyze and summarize your results:

- Create CSV point dataset with FlockTracker using the survey form created for Lab8;
- 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 FlockTracker using ArcMap;
- Use Network Analyst to indicate your trajectory in ArcMap; and
- Create a new shapefile to summarize data observations using new polygons that sub-divide 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[2]. You can switch groups, as long as someone else is willing to switch with you. Let the instructors know if you want to switch during class on Wednesday 04/19. You are expected to use class time on Monday 04/24 to gather the data for the exercise using a mobile app called FlockTracker that has been setup 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 FlockTracker server on Tuesday 04/25 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.

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[1] FlockTracker is developed by MIT-DUSP Associate Professor Chris Zegras. This is a standalone mobile platform, including surveyor and tracker capabilities, project builder, credential system, data visualization and survey monitoring capability.

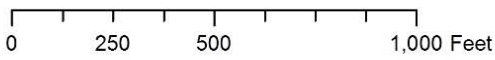[2] People with an asterisk indicated having an Android.

Team 1: Kendall Square Team & Study Area

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
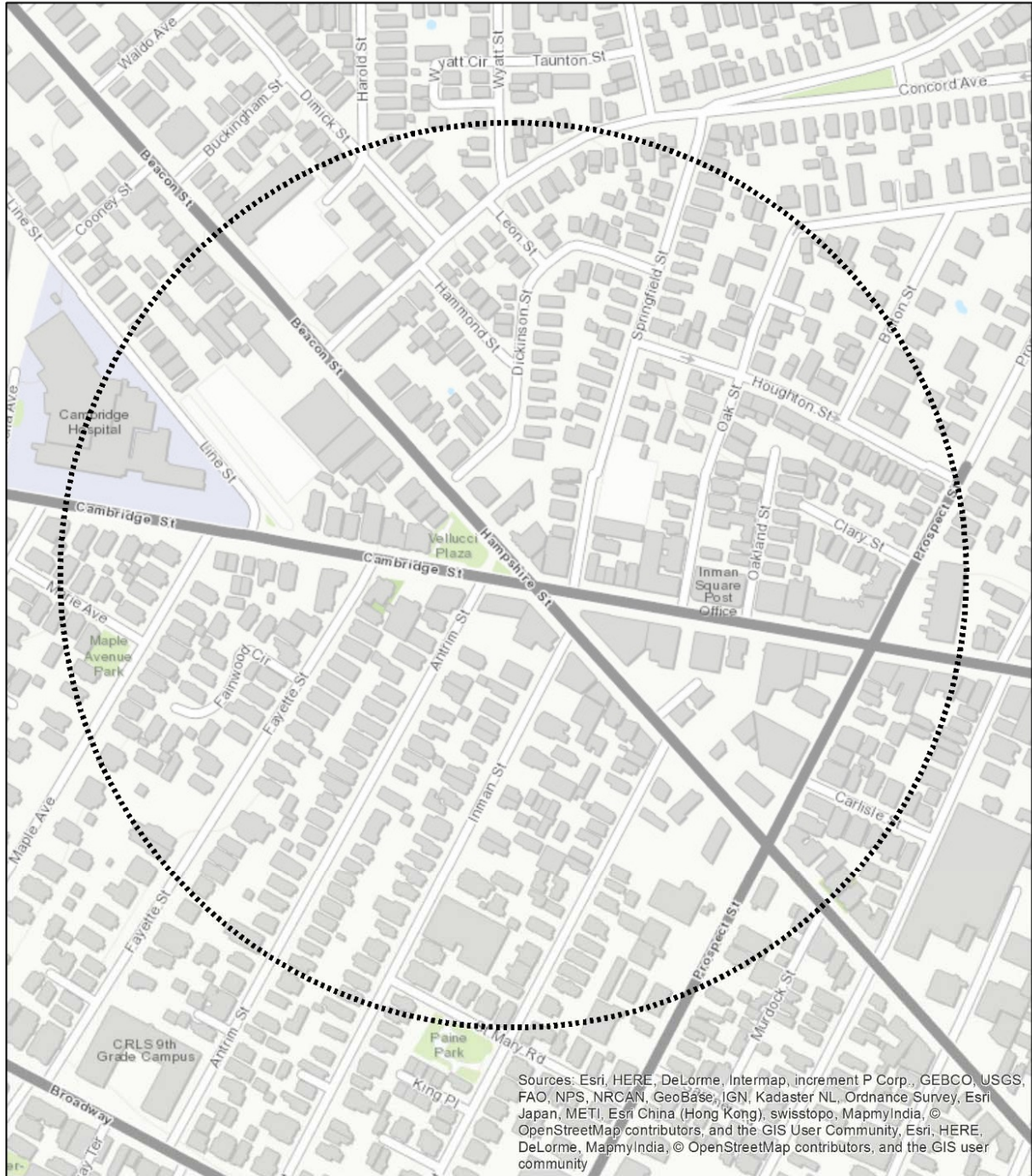
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Team 2 Central Square Team & Study Area

Team 3: Inman Square Team & Study Area

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

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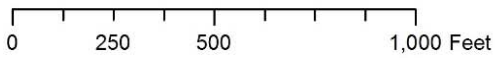
We will use the class on Wednesday 04/19 to help you access the questionnaire created for you in FlockTracker. The teams have been created to have at least one person with an Android device per group (FlockTracker is not available for iPhone yet). In addition, the instructors will provide one or more Android devices per team to carry out the exercise. Use class time to confirm access to the app and test the devices that you will use in the exercise. Follow the instructions in PART 1 to create a couple of track points, and confirm with the FlockTracker representatives in class to make sure the observations were recorded in the server.

If you have an Android, look for an email from the FlockTracker team inviting you to use FlockTracker at the Gmail address that you provided to the instructors. Go to the link in the email and accept the conditions to use the app. Then go to "Google Play" to download the app.
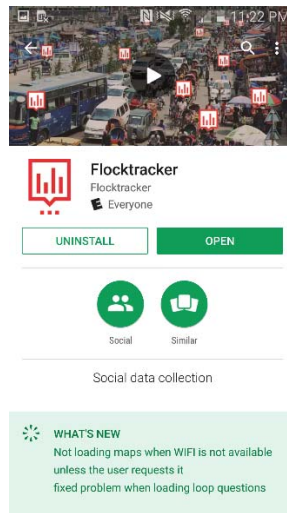

Open the app and fill out your personal information to create an account with FlockTracker. Make sure to write your password in a safe place, because it will take a couple days to retrieve it.
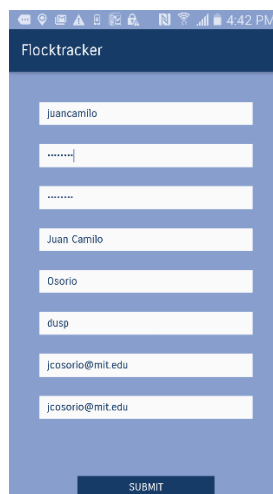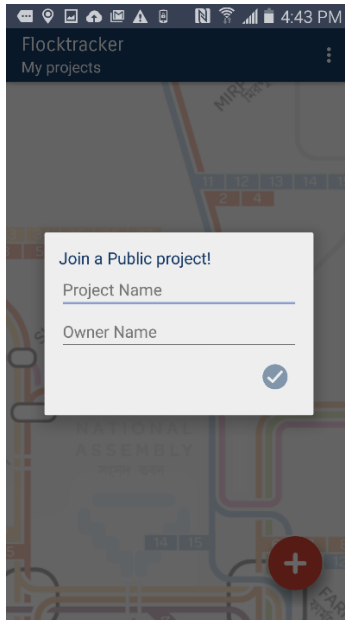

Open FlockTracker and familiarize yourself with the app. Locate the '+' button in red at the bottom-right corner, and tap it.
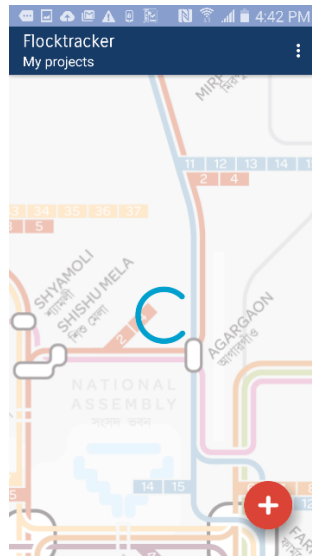
You will be prompted to "Join Public Projects". Tap the blue '+' sign. You can come back to this screen and create a new project to use FlockTracker again for another project.
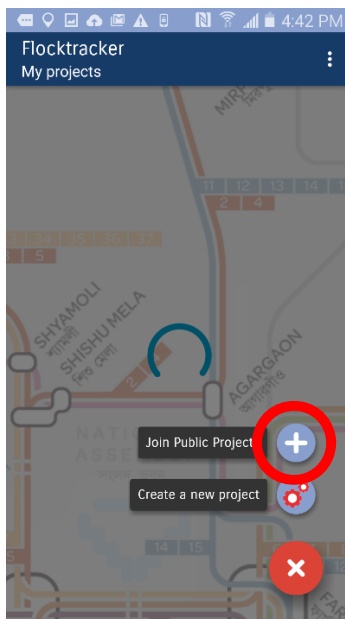

Type "Lab8" as project name, and 'smart_ft' as owner name.

This screen displays all of your projects. The instructors have created a project called Lab8. You will find three versions of lab8 here, tap the one with your team's name to access the questionnaire.
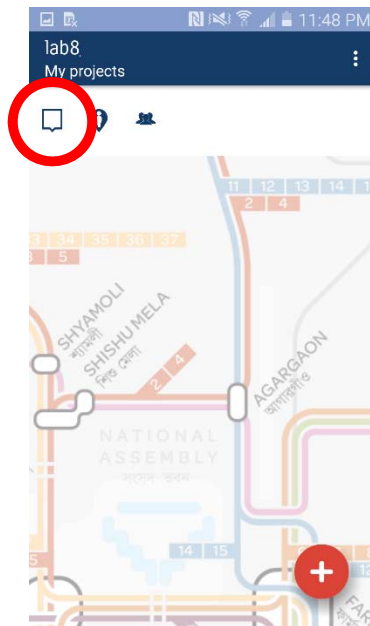
Now you will see the questionnaire for this exercise, called 'Lab8'. Tap the red icon on the bottom-right corner of the screen to access the questionnaire. Create a couple of track points to test the app. You are done for now.
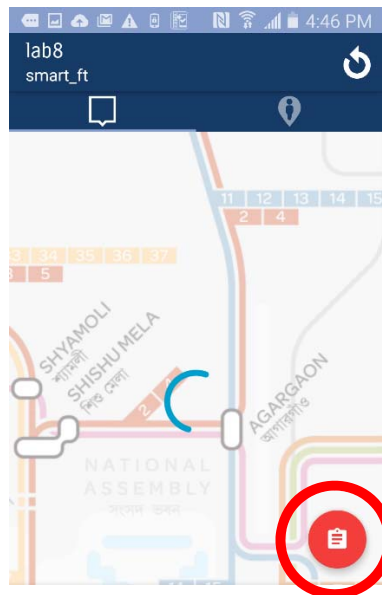
 Once you finish setting the app, create a work plan for the group:

1. Make sure to agree on a meeting point in the study area on Monday 04/24 at 2:30pm.
2. Establish dates/times when you will meet as a group in the lab to analyze your data and prepare the submissions.
3. Identify who will be responsible for bringing the devices (both your own and the ones that we provide) to the field,
4. Create a plan to charge the devices ahead of time, and bring a power cord or extra battery back with you to the field in case you need to re-charge.
5. Plan to work outdoors for at least 2.5 hours on Monday 04/24 – you will need to drink plenty of water and dress accordingly.
6. Return the devices that the instructors provide back to the class staff

Data gathered will be retrieved by the instructors from the FlockTracker server and saved in the data locker on <u>Tuesday 04/25 at 5pm</u>. At that time, launch ArcMap and copy the following files from the class data locker **Q:\data\lab8** into the directory C:\TEMP on a local drive:

- CSV file containing your track points downloaded from the FlockTracker server. This file will be retrieved from the FlockTracker server by the instructors and saved in the data locker (**Q:\\data\lab8**); and
- Network dataset 'camb_RN' that the lab instructors have prepared for you. This is located in a geodatabase called **Q:\data\lab8\cambridgenetwork.mdb**.

PART 1: GATHER TRACK POINTS USING FLOCKTRACKER

The purpose of the exercise is to use FlockTracker 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 FlockTracker. Now, you will go out and collect your own information. All students will use the same FlockTracker form to gather data in the field.
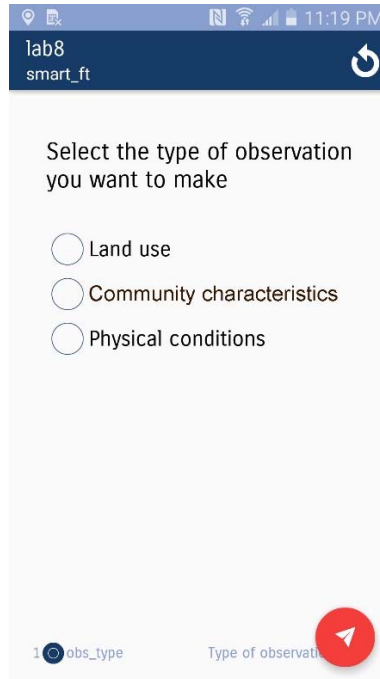
This exercise will focus on potential signs of 'neighborhood change':

1. You should start by walking the neighborhood to familiarize yourself with the study area. We ask that you <u>walk the entire study area</u> 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. <u>Land use trends</u> 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. <u>Community characteristics</u> 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. <u>Physical conditions</u> of the building stock or public spaces (e.g. evidence of well-maintained 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 FlockTracker 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 FlockTracker.

As demonstrated in class, we have created a form in FlockTracker 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, responding to the following questions:

1. Select the type of observation you want to make:

- 1 = Land use
- 2 = Community characteristics
- 3 = Physical conditions

From this point one, you should simply answer the questions in the survey by taping the desired response or filling out the text (depending on the questions). Once you are done answering a question, swipe to the left in order to advance to the next question. Swipe to the right to return to the previous question.

2a. Land use: Look for land uses that suggest differences between portions of your area by documenting variation in terms of:

- <u>Land Use</u>? (Residential, Commercial, Industrial, Vacant, Open Space, Other?
  - o If other specify which one
- <u>Development Status</u>? (construction completed, under construction or demolished)
- <u>Number of floors</u>? (Number of stories)

2b. Community Characteristics:

- <u>Age groups</u>? (families with children, young adults, seniors)
- <u>Ethnic communities?</u> (specialty restaurants or shops, religious institutions, etc.)
- <u>Income groups</u>? (high-income, mixed, low-income)

2c. Physical characteristics:

- Ongoing maintenance (evidence of ongoing maintenance (like recent maintenance)
- Disrepair? (buildings or public spaces with broken elements, like windows, benches, etc.)
- Major infrastructure work? (construction in public spaces, sidewalks, roads, parks)

3. Take a picture of each of your observations

After completing the questions above, the questionnaire will ask you to take a picture of the observation documented. Tap the camera icon and take the picture with the phone's camera.
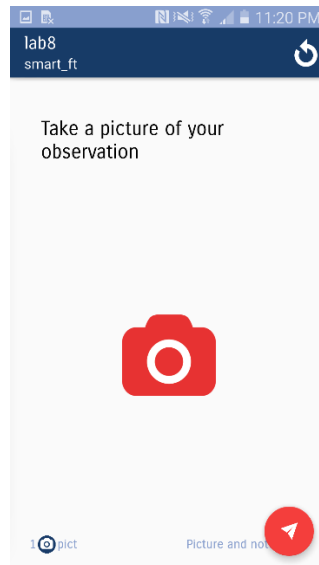

Then the questionnaire will ask you to determine the direction in which you took the picture. Use the compass app discussed in class to select an option from the list (i.e. N, NE, E, S, SW, W). It is very important that you place the device horizontally to maximize the accuracy of the measurement. Finally, 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 red icon with the triangle in order to upload the new survey to the database, and clear the survey to enter the next record. Each track point will be a new line in the database.

PART 2: CONVERT A CSV FILE TO A POINT SHAPEFILE

In this section of the exercise you will use the CSV exported by FlockTracker 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'.
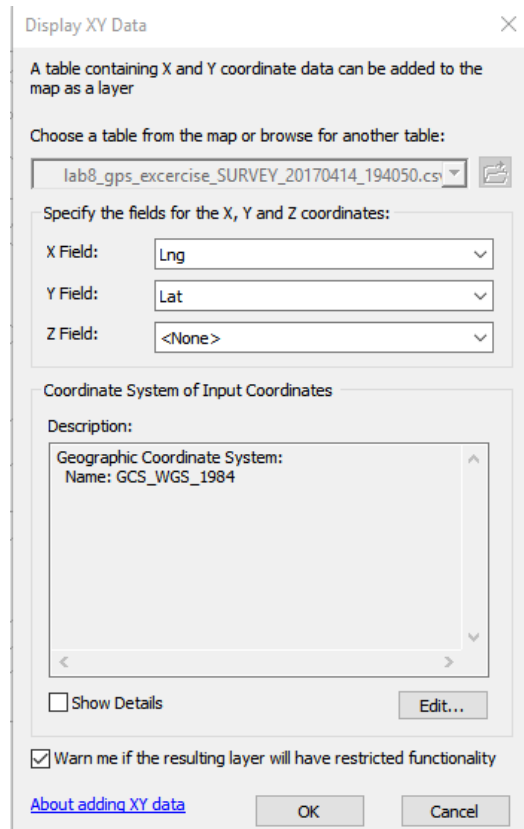
- Review the data to confirm all of your observations were successfully loaded in the shapefile.
- Then export the 'temporary' point shapefile that you can already see on the map to a 'permanent' shapefile in your private folder, and name it as 'track_points.shp'.

PART 3: ANALYZE YOUR DATA USING ARCMAP

a. 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.
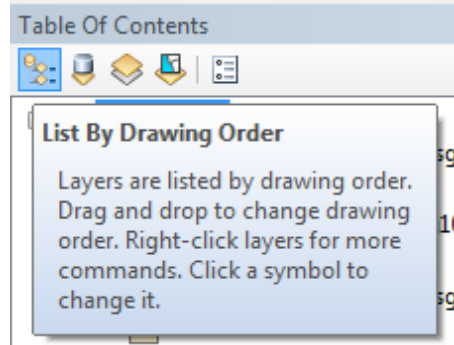
b. Review the pictures taken

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 in the server of Flocktracker, but there is a link to each file in the corresponding row in the attribute table. The field is called 'pict'. 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', and specify it as 'URL'.
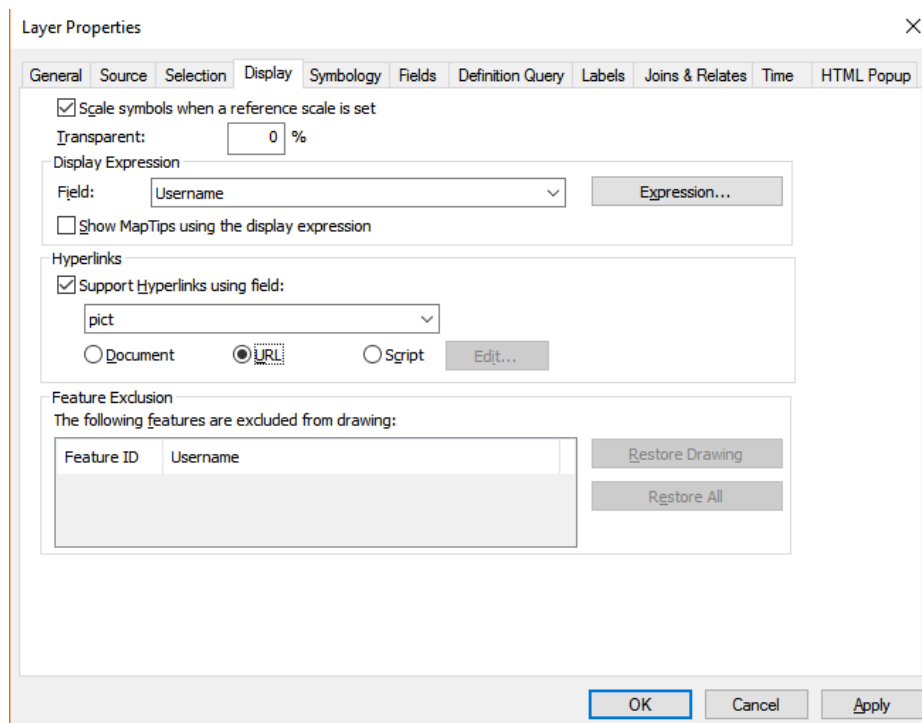
Then, using the Hyperlink tool (the flash icon ⚡ right next to the identify tool), you can quickly check the picture that you took at that point, in a browser window. You may also want to save your pictures to local folders for later mapping use.

c. Connecting your points to map a trajectory

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.
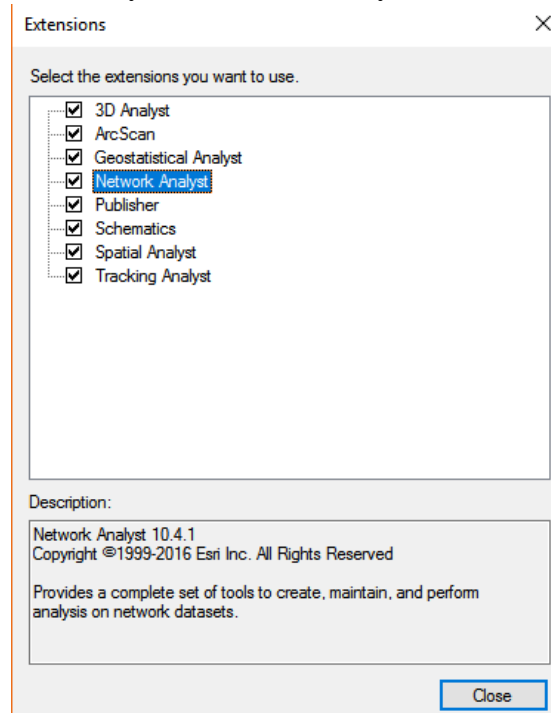
- After activating the Network Analyst, right click the empty space in your menu bar, and check 'Network Analyst' to add this toolbar. It looks like
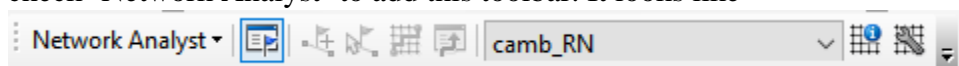
- Also make sure that the Network Analyst panel is opened, by clicking the 'blue-flag' icon in the picture above.

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.
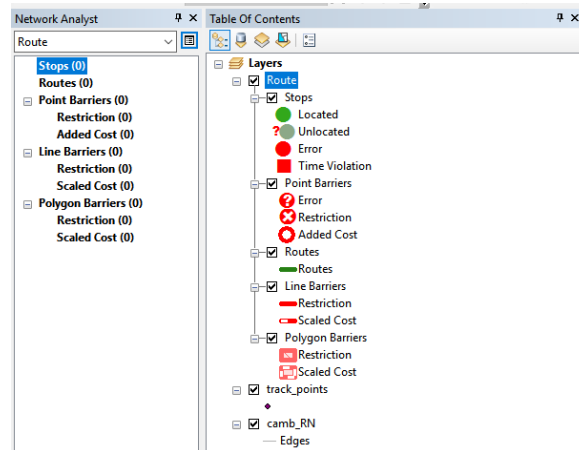
- Right click 'Stops', and select 'Load locations', then we can load our track points. Remember to use 'Date', which includes both date and the time stamp of each point, for the **'Sort Field'**, so the points will be connected based on the sequence of time occurrence.
- Set the search tolerance to be 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.
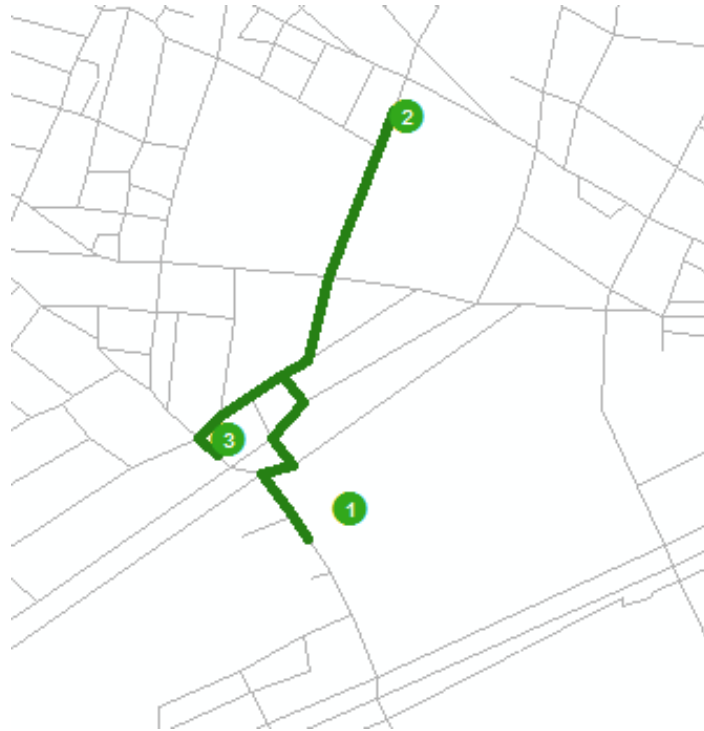
d. Summarize your observations through a new shapefile

Have a discussion within the 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 synthetize 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 FlockTracker 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, May 1ˢᵗ, 2017**.

Developed by Joseph Ferreira, Juan Camilo Osorio and Hongmou Zhang, April 04, 2017

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