

EARTH SC/ENVIR SC/GEOG 2G13: GEOGRAPHIC INFORMATION SYSTEMS

EXERCISE 4: GEOREFERENCING, ON-SCREEN DIGITIZING, AND GPS

Data entry is a key component of GIS. An important means of data entry is on-screen or “heads-up” digitizing. In this exercise, you are provided with a ©2010 DigitalGlobe satellite image of the McMaster campus that has yet to be georeferenced. Your tasks in this exercise are to georeference the image and update a shapefile of campus buildings. You will also notice that less information is provided in this exercise concerning how to complete your assigned tasks. The reason for this is to acquaint you with the real world of GIS. Specifically, the ArcGIS software package is so vast that few people, if any, can use every component of it without using the help system. In order to build self-sufficiency, in this exercise and those that follow, you must make use of the resources at your disposal – namely, the ArcGIS help system, which is an excellent source of information. Additionally, you can refer back to your previous exercises as some of the steps may be similar.

Part II of this exercise involves GPS fieldwork that must be completed during your lab period on Week 10. Please dress for the weather! Specifically, you will work in teams of two and record the locations of entrances to specific digitized buildings using a Garmin eTrex Legend H GPS receiver. After completing your fieldwork, you will create a shapefile of the locations using the GPS Utility – software for downloading GPS data from your receiver, which can then be exported using various file formats. You will then map the locations of your features in relation to the satellite image and building shapefile.

Due: Beginning of your lab period on Week 11.
Instructions: Answers must be typed using MS Word, OpenOffice, or some other word-processing package.
Grading: Style and format is worth 20% of your mark. 1 mark is deducted for each mistake up to a total of 7 marks since your exercise is worth 37 marks. Please consult lab notes for Exercise 4 (Exercise 4: Overview, which is found under Exercises) for style and format.

Exercise (37 marks)

Part A: Georeferencing a Raster Dataset

- A. For this exercise, you are given two shapefiles: one containing 10 campus buildings and the other containing road curbs. The coordinate system for the shapefiles is NAD_1983_UTM_Zone_17N. You are also given a satellite image of McMaster’s campus.
- B. Create a new map document. Add the two shapefiles to it followed by the satellite image. When prompted to create pyramids, click Yes. Do not change the defaults. Make sure that the coordinate system of the data frame is set to that of the shapefiles.

Question (2 marks)

- 1. With respect to raster datasets, what are pyramids? (1) What is their purpose? (1) (use the Help menu to answer this question)
- C. In order to digitize missing campus buildings from the satellite image, it must first be registered (georeferenced) to the same coordinate system as that of the shapefiles. ArcMap comes with a toolbar called Georeferencing, which assigns spatial reference information to data. Load the toolbar by right clicking near the top of the screen,

making sure that the “Georeferencing” item has a check next to it (this indicates that the tool has been loaded). When it has been loaded, you will see a toolbar that looks like this:



Question (2 marks)

2. The Georeferencing toolbar has a variety of tools embedded. Answer the following question related to this toolbar: What is the difference between “updating” and “rectifying” your image? (2) (use the Help menu to answer this question)

- D. To georeference the satellite image of McMaster’s campus, first right click one of the shapefiles in the data frame and select Zoom to Layer. Make sure that the image you want to georeference is shown in the Georeferencing toolbar. Click Georeferencing | Fit to Display to display the satellite image in the same area as the shapefiles. Next, simply select control points on the image that can be georeferenced properly to the data. The control points should be features that are clearly identifiable on both the image and the shapefiles. Click the Add Control Points button on the Georeferencing toolbar. This will turn your mouse pointer into crosshairs. Zoom to a point on the image and add a control point. Then zoom into the shapefile and find the same location and add a control point. Continue this process until your image lines up with the corresponding shapefiles and you achieve an acceptable RMS error. You can delete bad control points through the Link table (accessed through the View Link Table button). When completed, save the newly georeferenced image either by updating or rectifying it. Also, save your map document.

Questions (9 marks)

3. What features did you use for the control points? (1) Why? (1)
4. What happened to the image after you selected your first control point? (1)
5. What happened with each successive control point you added? (1)
6. What is RMS error? (1)
7. What do you think is an acceptable level of RMS error? (1) Why? (1)
8. Provide a screen capture of your Link table. **To receive full marks, the attribute table must not be maximized.** Your screen capture must not be cropped in any way – that is, all parts of the screen must be shown – otherwise, you will receive a 0 on this question. (1)
9. What is the spatial reference and linear unit of the image after it has been saved (you can obtain this information from the Source tab of the Layer Properties of the image)? (1)

Part B: Spatial Data Editing

- A. Now that you have a georeferenced image, you can digitize missing buildings from it using the correct coordinate system. To do so, in the data frame, right click on the CampusBuildings shapefile and select Edit Features | Start Editing. Use the Construction tools to digitize the following eight missing buildings: Burke Science Building, David Braley Athletic Centre, General Sciences Building, Hedden Hall, John Hodgins Engineering Building, Michael G. DeGroote Centre for Learning and Discovery, Psychology Building, and University Hall. These buildings are shown on the McMaster Campus Map (a pdf document accompanying this exercise). The Construction tools are accessed through the Create Features button on the Editor toolbar (last button on the bar).

- B. When finished adding buildings, you will need to update the shapefile’s attribute table. Create two new fields: one for building numbers and the other for building abbreviations (you need to choose field names, data types, etc.). Numbers and abbreviations are shown on the campus map. If a building does not have an abbreviation create one based on the name of the building; however, ensure that it is unique. Insert the correct building

number and abbreviation for each building (there are 18 buildings in total). Add each building's name in the Name field by replacing the generic descriptor "Educational Building". Delete the ID, Category, and Code fields.

- C. Make sure that you save all of your work to your flash drive as you will need it next lab period for Part C.

Question (9.5 marks)

10. Provide a screen capture of your CampusBuilding attribute table. **To receive full marks, the attribute table must not be maximized.** Your screen capture must not be cropped in any way – that is, all parts of the screen must be shown – otherwise, you will receive a 0 on this question. (9.5)

Part C: GPS Fieldwork

The Garmin eTrex Legend H GPS receiver is easy to use. Turn on the receiver by pressing the bottom button on the right of the unit. The first page you see shows you the positions of available satellites. The center point represents you (and thus satellites directly overhead); the outer circle, the horizon; and the inner circle, 45° above the horizon. At the bottom of the page, you will find signal strength bars for each satellite. Click on the Page button to move to the next page. This page shows you your location, speed, and altitude. Scroll through the following pages until you come to the Main Menu. **Your task is to record the locations of all entrances to the following three buildings: Burke Science Building, General Sciences Building, and John Hodgins Engineering Building. Further, you must make note of those that are wheelchair accessible.** Before beginning this task, delete all existing waypoints from the receiver. To record a location, simply press and hold the Rocker button until the Mark Waypoint page appears. To change the names of the default, select the appropriate field using the Rocker to move up or down on the page, then press Enter (hit the Rocker once) to open the on-screen keypad. Make your changes and select OK to record the point. Once you have recorded locations for building entrances, return to the lab to download the coordinates using the GPS Utility. Ensure that the software is configured for your receiver by clicking on GPS | Setup. The GPS make/interface mode must be Garmin (USB) and the type/family must be other. Next, go to GPS | Download Waypoints. You should now see a table with all of your points. The default display is latitude and longitude, but this can be changed easily by clicking the button marked LAT/LONG and selecting UTM/UPS. After the transfer is completed, press the Power button to turn off your receiver. The GPS Utility can export the points as a shapefile by configuring the Save/Export Options under the File menu. **After creating your shapefile, in ArcMap add a new field to its attribute table called ACCESS. Enter a value of 1 into this field if the entrance is wheelchair accessible; 0 otherwise.**

Questions (14.5 marks)

11. Provide a screen capture of your building entrance attribute table. **To receive full marks, the attribute table must not be maximized.** Your screen capture must not be cropped in any way – that is, all parts of the screen must be shown – otherwise, you will receive a 0 on this question. (2.5)
12. Provide a screen capture of your work including satellite image, buildings, and entrances. Label buildings with their abbreviations. Use a different colored icon to distinguish between accessible and non-accessible entrances. Your screen capture must not be cropped in any way – that is, all parts of the screen must be shown – otherwise, you will receive a 0 on this question. (12)