GEOG 4140/6140 – Winter 2021
Lab 3: Parcels and Topological Editing
Due Thursday, February 18th by 11:59 PM

Overview

The partitioning of land lots, or parcels, is a primary concern of land managers and surveyors. Parcels contain information on plots of land, including geographic attribute information, ownership histories, land values, and other items of concern. Two main systems of describing parcels used in the United States are the Public Land Survey System and the Metes and Bounds system. The Public Land Survey System (PLSS) is a way of uniformly subdividing and describing land in the United States. All lands in the public domain are subject to subdivision by this rectangular system of surveys, regulated by the U.S. Department of the Interior, Bureau of Land Management. This lab will familiarize you with the use of the PLSS system, as well as Metes and Bounds.

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The following resource may be of use in completing this assignment:
Layouts in ArcGIS Pro
Turn snapping on or off
Merge features into one feature
Create a feature class
Enable COGO
Create a traverse
A quick tour of editing
Introduction to editing topology
Feature To Polygon
Copy and paste using the clipboard

Required Data (*Sources*)

1. Utah AGRC PLSS (*All Portal*)
2. Parcels_Study_Area_Lab03 feature class (*Lab data on Canvas*)

Workflow (3 Parts)

Part 1: Identifying work area via Public Land Survey System (PLSS)

The goal of Part 1 is to identify and isolate the four quarter-quarter sections listed below based on their PLSS legal description. The base meridian is the Salt Lake Meridian, number 26.

- **SE ¼ SE ¼ S19, T1S R1E**
- **SW ¼ SW ¼ S20, T1S R1E**
- **NW ¼ NW ¼ S29, T1S R1E**
- **NE ¼ NE ¼ S30, T1S R1E**

1. Open ArcGIS Pro and create a new project titled *Lab03YourLastName* in your working directory for this lab.

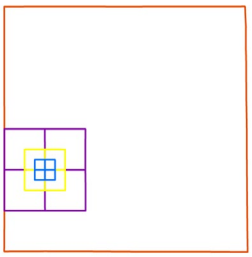
2. From *All Portal*, add the Utah AGRC PLSS data hosted online. The search term "Utah AGRC PLSS" returns many subdivisions, including townships, sections, quarter sections, and quarter-quarter sections. Start by loading the township feature *Utah PLSS Townships GCDB*. (If issues arise with the online data, the datasets can be downloaded from AGRC's website.)

3. Use the legal descriptions above to identify the township of interest. (Hint: Create a **definition query** for the township and range of interest.)

4. Add the remaining PLSS subdivisions to the map (sections, quarter sections, and quarter-quarter sections).
    a. Create a **definition query** for each subdivision to display only the section or subsection of interest, as indicated in the legal description above. (Hint: Investigate each subdivision's attribute table to determine which field to use in the definition query.)
    b. Start with *sections*, then *quarter sections*, and finally *quarter-quarter sections* (each is nested within the previous level).
    c. What is currently located at the intersection of the four quarter-quarter sections? (Deliverable 4a.)

5. Create a map (Deliverable 1) with the queried PLSS subdivisions nested and mapped in the following colors:
    a. Quarter-Quarter sections of interest: Blue Boundary
    b. Quarter sections of interest: Yellow Boundary
    c. Sections of interest: Purple Boundary
    d. Township of interest: Orange Boundary
    e. Keep the interiors hollow to show the underlying topographic basemap.

Example (with the exception of the topographic basemap):



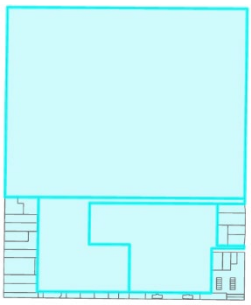
6. The final task in Part 1 is to locate your current residence and provide the PLSS legal description down to the quarter-quarter section. (Deliverable 4b.)
    a. Utilize the attribute table fields with which you created the queries to pull the information identifying the township, section, quarter section, and quarter-quarter section values. You can either temporarily remove the definition query or add these data again from the online source.

Part 2: COGO Editing of Parcels utilizing Metes and Bounds

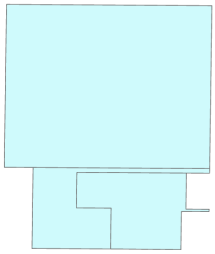
While the PLSS provides a standardized grid for public land parcels, it is generally only used in the Western United States and often breaks down at the local urban level with subdivisions and neighborhoods. At this scale, the *Metes and Bounds* system can be used to convey the legal boundaries of a parcel. For Part 2, we will conduct the editing of parcels by splitting, merging, and creating new parcels from existing features. This will be done utilizing standard editing tools, as well as the use of coordinate geometry (COGO) tools.

1. **Import** the *Parcels_Study_Area_Lab03* feature class from the *GEOG4140_Lab03.gdb* into your *Lab03YourLastName.gdb*.
    a. While this parcels feature class is restricted to a small section of Salt Lake County, it needs to be clipped to the quarter-quarter sections of interest.
    b. In order to prevent the line that separates the four previously identified quarter-quarter sections from also clipping the parcels, **dissolve** the quarter-quarter sections into a single polygon and use this dissolved feature as the clipping boundary.
    c. **Clip** the parcel feature class.

2. From here, we are only interested in editing parcels that are owned by Salt Lake City Corporation as shown by the selected parcels below:



a. **Query** this dataset so that only the parcels of interest remain as shown below:

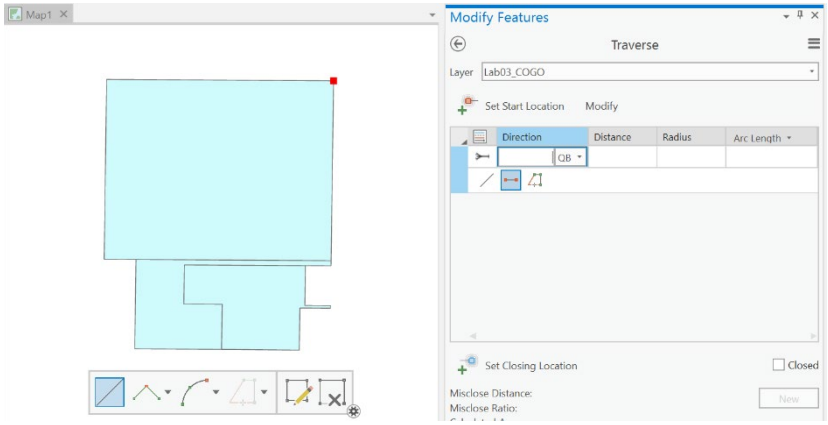


3. Prior to any editing, make sure that **Snapping is enabled** via the Edit tab.

4. The remaining steps for Part 2 will use coordinate geometry (COGO) tools to split the large, northern most polygon into four separate parcels. However, these four parcels will not be rectangular, so COGO will be used to create the new parcels based on distances and bearings.
    a. COGO feature construction requires a line feature rather than a polygon. Navigate through the Catalog panel to your working geodatabase and **create a new polyline feature class** named *Lab03_COGO*. (Alternatively, you can use the *Create Feature Class* geoprocessing tool.)
    b. Make sure the *Lab03_COGO* feature class is in the same coordinate system as parcels feature class, and that the Map coordinate system is also set to NAD83 UTM Zone 12.

5. Enable COGO on your new polyline feature class by running the **Enable COGO** tool (see the Data Management toolbox). This will add COGO required attributes including direction, distance, radius, arc length, and radius2.

6. Under the Edit tab, select **Modify** Features. Then, under the COGO section, select **Traverse**. This will allow you to create polyline features using distances and bearings.
    a. Make sure your active layer is set to *Lab03_COGO,* and then click in the northeast corner of the polygon of interest to set your start location.

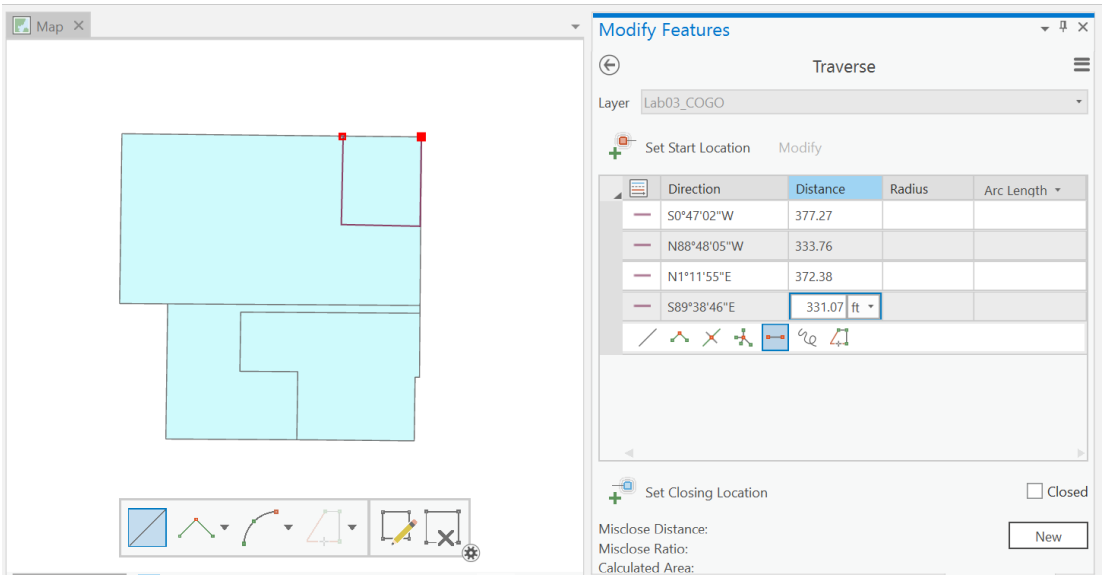


7. Digitize features in a clockwise manner from the provided initial starting point. When finished with a parcel, **save your edits using the Edit Gallery**, and then begin a new Traverse from your next starting point. Your final line feature should resemble the feature below.

a. PARCEL 1 (Northeast parcel)

Starting point northeastern corner of original polygon boundary:

1. Direction: S0-47-02W, Distance: 377.27 ft
2. Direction: N88-48-05W, Distance: 333.76 ft
3. Direction: N1-11-55E, Distance: 372.38 ft
4. Direction: S89-38-46E, Distance: 331.07 ft
   (Hint: Press 'Enter' on your keyboard after specifying the direction and distance values.)



b. PARCEL 2 (Southeast parcel)

Starting point is southeastern corner of parcel 1 (Step 7a):

1. Direction: S0-47-02W, Distance: 770.73 ft
2. Direction: N89-38-45W, Distance: 1450.50 ft
3. Direction: N0-47-03E, Distance: 259.54 ft
4. Direction: N76-26-45E, Distance: 878.00 ft
5. Direction: N41-41-28E, Distance: 406.28 ft
6. Direction: S88-45-05E, Distance: 333.76 ft

c. PARCEL 3 (Curved central parcel)

Starting point is southwestern corner of parcel 1 (Step 7a):

1. Direction: S41-41-28W, Distance: 406.28 ft
2. Direction: S76-26-45W, Distance: 878.00 ft
3. Direction: N36-23-43E, Radius: 1263.24 ft, ArcLength: 1288.93 ft

d. PARCEL 4 (Northwest parcel)

Starting point is northwestern corner of parcel 1 (Step 7a):

1. Direction: S1-11-54W, Distance: 372.38 ft
2. Direction: N85-08-38W, Radius: -1263.24 ft, ArcLength: 1288.93 ft
3. Direction: N0-47-02E, Distance: 888.46 ft
4. Direction: S89-38-45E, Distance: 1119.43 ft

When finished, convert your line feature to a polygon using the **Feature to Polygon** tool.

8. **Copy** the new polygon parcel feature and **paste** it into the existing parcel feature (the Parcels_Study_Area_Lab03 that was clipped in Step 1) using the *Paste Special* option.
    a. Create a map of your edited parcels showing the six newly created parcels from the dissolved Nibley Park land. These will include the two southern parcels and the largest northern parcel subdivided into four parts using the COGO instructions. (Deliverable 2)

Part 3: Topological Editing

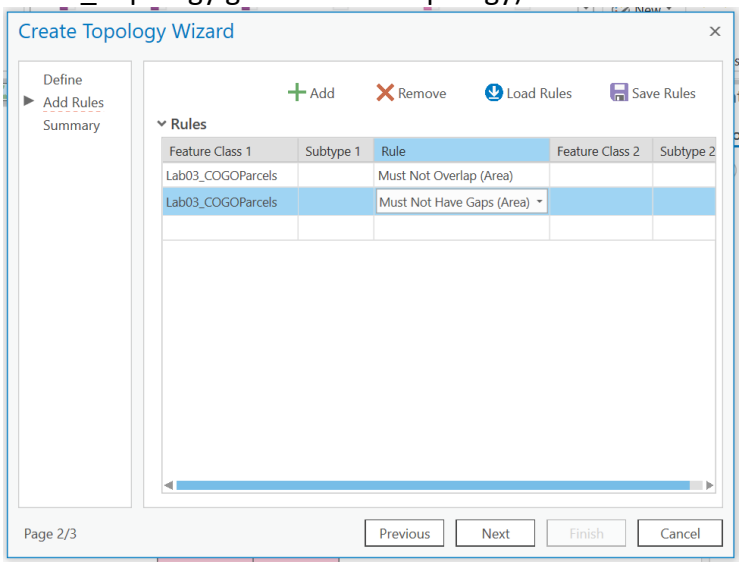
The final step of this parcel-editing lab is to check the topology to analyze the quality and arrangement of the polygons and to identify and fix any issues with the neighboring features. Topology is the arrangement that defines how points, lines, and polygons share coincident geometry. The rules that your topology will enforce depends on your construction of it and your specifications. This lab will primarily focus on the removal of overlapping polygons and the filling in of slivers or gaps between parcels.

1. We will first need to **create a geodatabase** that incorporates the use of a Feature Dataset to contain our parcels dataset.

a. From the Catalog Pane, right click on *Databases* then select *New File Geodatabase* and name it Lab03_Topology.
b. Within this geodatabase, **add a Feature Dataset** in the NAD83 Zone UTM 12N coordinate system.

2. **Import** the your modified Lab03 parcel with the COGO edited features into the feature dataset directly. (Right click on your Feature Dataset within your Lab03_Topology.gdb > Import > Feature Class)

3. **Create a new topology** within the feature dataset, following the wizard and including the topology rules for your Parcels feature of "Must Not Overlap" and "Must Not Have Gaps". Most other options can remain defaults. (Right click on your Feature Dataset within your Lab03_Topology.gdb > New > Topology)



4. Once the topology is created, it will need to be validated to identify errors based on the included rules.
   a. When the topology is finished, run the **Validate Topology** tool. It will automatically add the feature associated with the topology. Errors within the topology will appear as shades of red.
   b. Prior to any editing, take a screen shot of the topology with the errors present. (Deliverable 4c.)

5. The first goal is to remove any topological errors near Nibley Park.
   a. Open the **Error Inspector** via the Edit tab. If you see an error, use the tools under *Validate* to resolve the issue. You may need to **Split** and **Merge** the created feature into the proper neighboring parcels. Note that you may also use the **Mark as Exception** option if you don't believe an error is actually present.

6. When finished, take a quick screenshot of the topology showing that the errors have been resolved (Deliverable 4c.)

Parcel Fabrics

In addition to the using a geodatabase feature class to store and edit parcels, Esri has a system known as a parcel fabric. Parcel fabrics store continuous surfaces of connected parcels and contain both points, lines, and polygon features. The line features store the COGO dimensions, similar to the actions taken in part 2 of this lab. Additionally, parcel fabrics allow for the storage of historical records of all changes to parcels over time. While allowing for greater control of both your current and historical features, parcel fabrics are significantly more complicated than utilizing a geodatabase feature class. This lab will not go into the specifics of parcel fabrics. However, if you are interested in learning more about parcel fabrics, in depth tutorials are provided at Esri's Online Tutorial website, starting with "Get Started with Parcel Fabric Editing".

Deliverables

1. A map of the nested tiles queried for each level of the PLSS with an underlying topographic basemap. Include required map elements (legend, north arrow, scale bar, etc.).

2. A map of your edited parcels showing the six newly created parcels. These will include the two southern parcels and the largest northern parcel subdivided into four parts using the COGO instructions.

3. Your final parcels and COGO line feature zipped into a geodatabase (*Lab03YourLastName.gdb*).

4. Responses to the following.
    a. What is located at the intersection of the four quarter-quarter sections from Part 1?
    b. Provide the PLSS legal description of your current residence down to the quarter-quarter section.
    c. Two screenshots of the study area. One screenshot of the area before topological editing, and a second screenshot of the area after editing.

Scoring Rubric (16 points total)

D1: 4 points

2 points – Correct PLSS subdivisions mapped with specified colors and topographic basemap included
0.5 point – Title
0.5 point – Legend
0.5 point – North arrow
0.5 point – Scale bar

D2: 6 points

4 points – 6 parcels from study area clearly visible and edited according to COGO instructions
0.5 point – Title
0.5 point – Legend
0.5 point – North arrow
0.5 point – Scale bar

D3: 2 points

1 point if both parcels and COGO lines are included
1 point for quality of the data (projection, metadata, etc.)

D4: 4 points

1 point for each question (a and b) and 1 point for each screenshot (c)