GST 102: Spatial Analysis Lab Series

Lab 1: Reviewing the Basics of Geospatial Data

Document Version: 2013-07-31 (Beta)

Organization: Del Mar College
Author: Richard Smith

The development of this document is funded by the Department of Labor (DOL) Trade Adjustment Assistance Community College and Career Training (TAACCCT) Grant No. TC-22525-11-60-A-48; The National Information Security, Geospatial Technologies Consortium (NISGTC) is an entity of Collin College of Texas, Bellevue College of Washington, Bunker Hill Community College of Massachusetts, Del Mar College of Texas, Moraine Valley Community College of Illinois, Rio Salado College of Arizona, and Salt Lake Community College of Utah.

Contents

Introduction

This lab is part of a series of lab exercises designed through a grant initiative by the National Information, Security & Geospatial Technologies Consortium (NISGTC), funded by the United States Department of Labor in partnership with the Department of Education under the Trade Adjustment Assistance Community College and Career Training Grant Program (TAACCCT).

This exercise features questions and activities designed to review some basic GIS and geospatial concepts that are crucial to preparing and managing data for use. This lab will cover data structures, file types, geodatabases, coordinate systems, and data attributes.

Your instructor may require that you provide screen captures and/or a copy of this lab with tables completed (as directed within the lab) and questions answered. Please check with your instructor for requirements specific to your class.

This lab includes the following tasks:

1. Examining GIS Data Structures
2. Examining GIS File Types
3. Exploring Geodatabases
4. Exploring Coordinate Systems
5. Understanding GIS Data Attributes and Attribute Tables

Objective: Explore and Understand data structures, file types, geodatabases, coordinate systems, and attributes

Spatial analysis, which encompasses all the operations performed on geographic data that add value, is a crucial aspect of GIS. Spatial analysis tools allow the user to analyze the patterns and relationships of the various data. An understanding of the concepts of data structures, the variety of file types, geodatabases, coordinates systems, and attributes is necessary in the design and the function of spatial analysis.

There are a variety of file types within the GIS realm:

- **shapefiles** – a data format for vectors
- **points** – single coordinate pair to define location
- **lines** – uses an ordered set of coordinates to define location
- **polygons** – formed by a connected set of lines
- **raster** – represents continuous objects

Discrete and Continuous objects:

- **discrete** – individually distinguishable, doesn't exist between observations (ie. streams, lakes)

- **continuous** – exists between observations, represents data of a continuous nature (ie. elevation, temperature)

Data Management Options:

- **geodatabase** – storage container for GIS data
- **feature dataset** – collection of feature classes
- **feature class** – collection of common features

Lab Settings

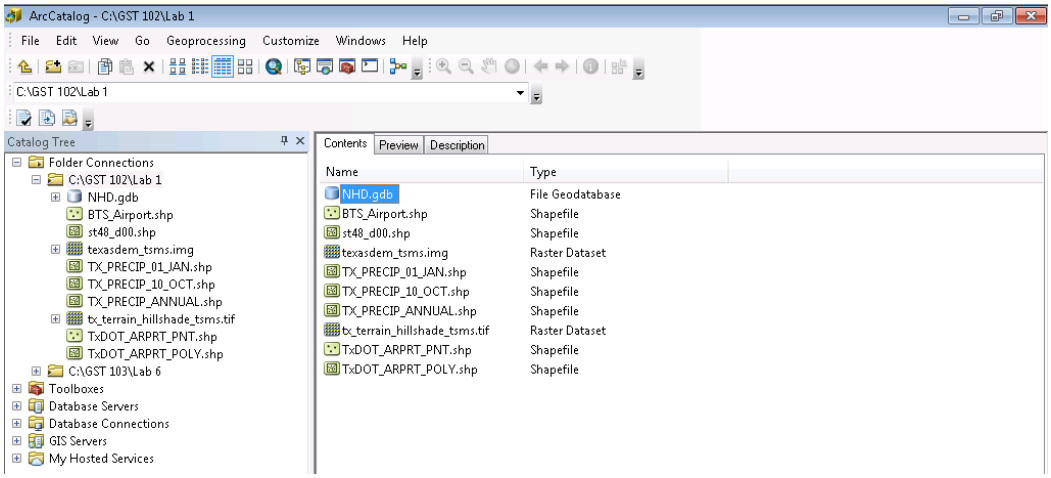
Required Virtual Machines and Applications

Windows Machine User Account	Train
Windows Machine User Password	Train1ng$

1 GIS Data Structures and File Types

We will examine the properties of several data layers to identify their data structure and file types.

1. Log into the computer, using the information provided in the Lab Settings section.
2. The data for this lab is located on the lab machine at: *Shared Drive\GST 102\Lab 1.* Open Windows Explorer and create a folder called **GST 102**. Copy the ***Lab 1*** folder from the shared drive to your newly created *GST 102* folder on the C:\ drive. Close down Windows Explorer.
3. Click **Start->All Programs->ArcGIS->ArcCatalog 10.1**. ArcCatalog will open. Click on the **Connect To Folder** button and create a connection to your *C:\GST 102\Lab 1* folder.
4. Looking at the Catalog Tree on the left hand side of the screen, open and expand the ***GST 102\Lab 1*** folder. You should see 9 files and 1 database in the display window as is shown in the screenshot below.

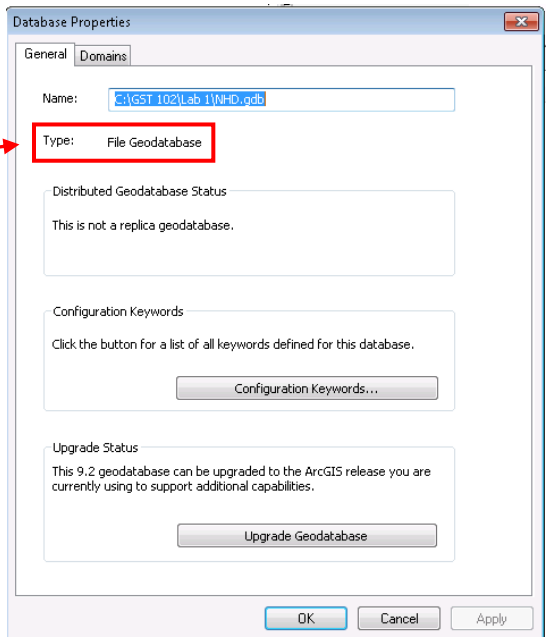


1.1 Identifying Data Structure Type

1. Identify the data structure type of the **NHD.gdb** file by examining the file's properties. Select the file and **right click->Properties**. This is shown in the screen shot below. You can also find file information by selecting the file in the list of files in the Catalog Tree. For some files, this may be an easier way to find the information.

   You will see that the file's data structure type is Geodatabase.

File type of NHD.gdb shown in Properties window



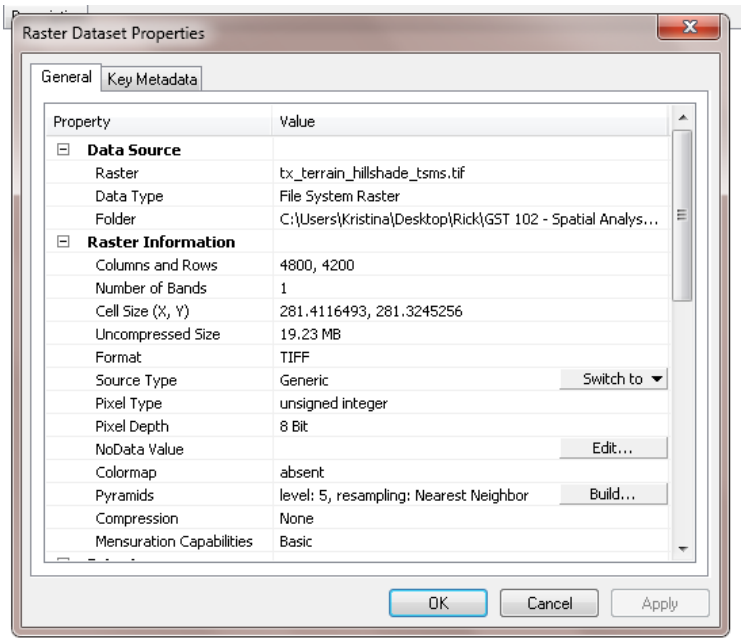
2. Click the plus sign next to the ***NHD.gdb*** file to see the contents within the geodatabase as well.
3. Complete the table below by examining the properties of the remaining files and identifying their data structure type.

File	Data Structure Type (Geodatabase, Feature Dataset, or Feature Class)
NHD.gdb	Geodatabase
TX_PRECIP_10_OCT	
Hydro_NHDnGEO	
NHDLINE	
TxDOT_ARPRT_POLY	
TX_PRECEP_ANNUAL	

1.2 Identifying GIS File Types

We will determine if a layer is composed of vector or raster data. If it is a vector layer, we will determine whether it is a point, line, or polygon vector type. If it is a raster layer, we will determine whether it is discrete or continuous.

1. Identify the data structure type of the ***tx_terrain_hillshade_tsms*** file by examining the properties. Select the file and **right-click->Properties**.



You will see from the file properties that the file's data type is **Raster.** This raster shows depth by shading a randomly-selected side opposite a light source. Review discrete versus continuous data and determine whether the data shown in this raster fits in the discrete or continuous category.

2. Complete the table below by examing the properties of the remaining files.

File	File Type (Raster or Vector)	Point, Line or Polygon? (vector layers only)	Discrete or Continuous? (raster layers only)
tx_terrain_hillshade_tsms	Raster		
TxDOT_ARPRT_PNT			
NHDFLOWLINE			
NHDAREA			
TX_PRECIP_01_JAN			
NHDWATERBODY			
st48_d00			
NHDLINE			
texasdem_tsms			

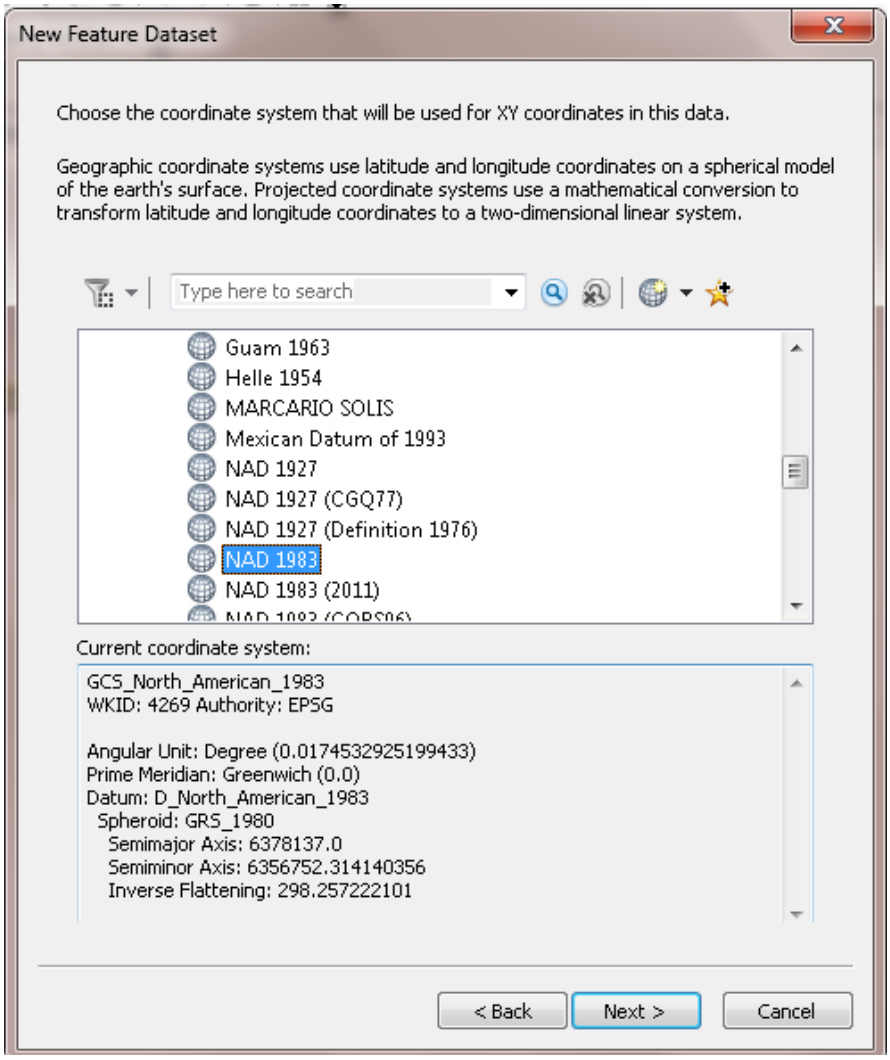
Question 1: What do texasdem_tsms and tx_terrain_hillshade_tsms each represent? How are these GIS file types similar and how are they different?

Question 2: How many feature datasets are in the *NGD.gdb* geodatabase?

2 Geodatabases

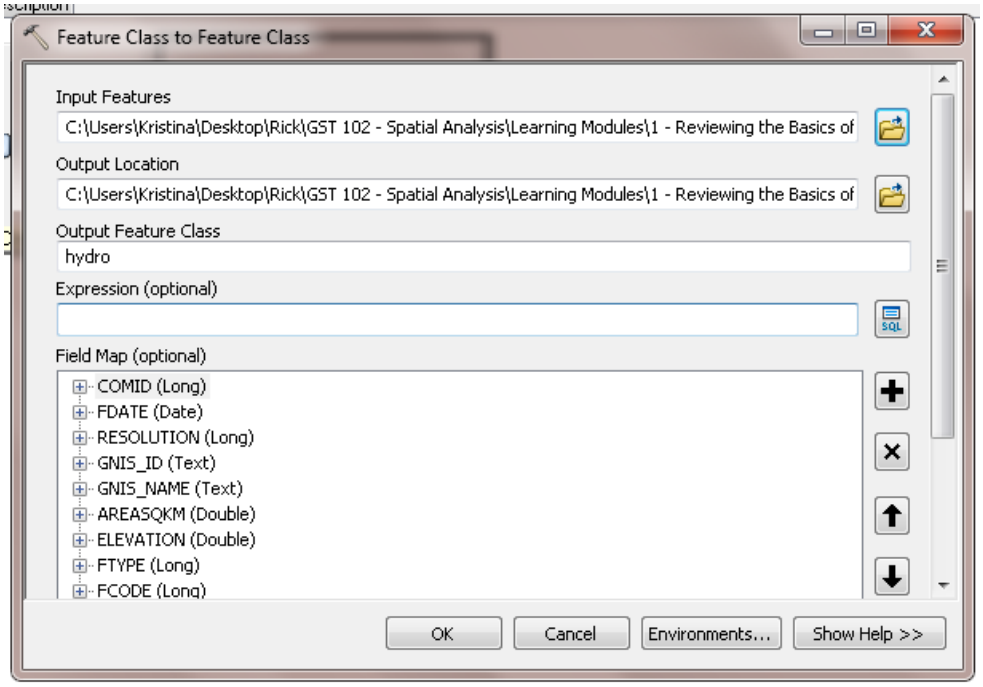
Create a feature dataset within a geodatabase. This helps us to combine similar features in an organized manner.

1. To create a feature dataset within the NHD.gdb, **right-click->New->Feature Dataset.** Name the new dataset NHD_dataset. Import the **GCS_North_American_1983** as the coordinate system **in Geographic Coordinate Systems->North America**.



2. Complete the dataset, accepting all default settings, by clicking **Next** until you reach **Finish**.
3. Import the **NHDAREA** feature class from the Hydro_NHDnGEO dataset into the dataset you just created by **right-clicking on the file NHD_dataset->Import->Feature Class(single).**

4. The Input Features should indicate the **NHDAREA** Feature Class and the Output Location default may be kept as is. Name the Output Feature Class **hydro**.



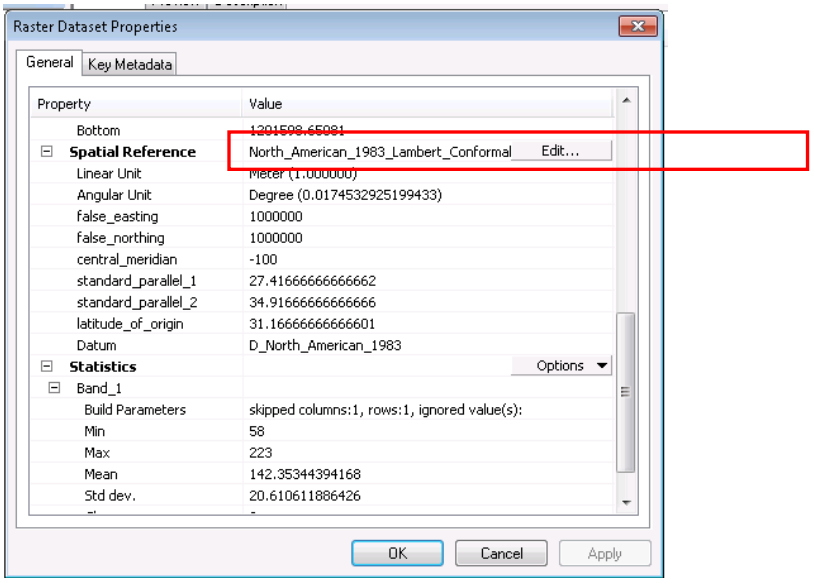
5. Import the **NHDLINE** feature class into the dataset you created as well, name it **hydroline**.

Question 3: What is a reason one might put these layers in a Feature Dataset, instead of just a Geodatabase?

3 Coordinate Systems

We will identify the coordinate systems for several files.

1. Identify the coordinate system of the **tx_terrain_hillshade_tsms** file by examining the properties. Select the file and **right-click->Properties**. See screenshot below to see where to find where to locate the coordinate system. If the name of the coordinate system is partially cut off by the Edit. . . button, click on the **Edit. . .** button to view the entire name, then click Cancel.



2. Complete the table below by examining the properties of the remaining files and identifying their coordinate system.

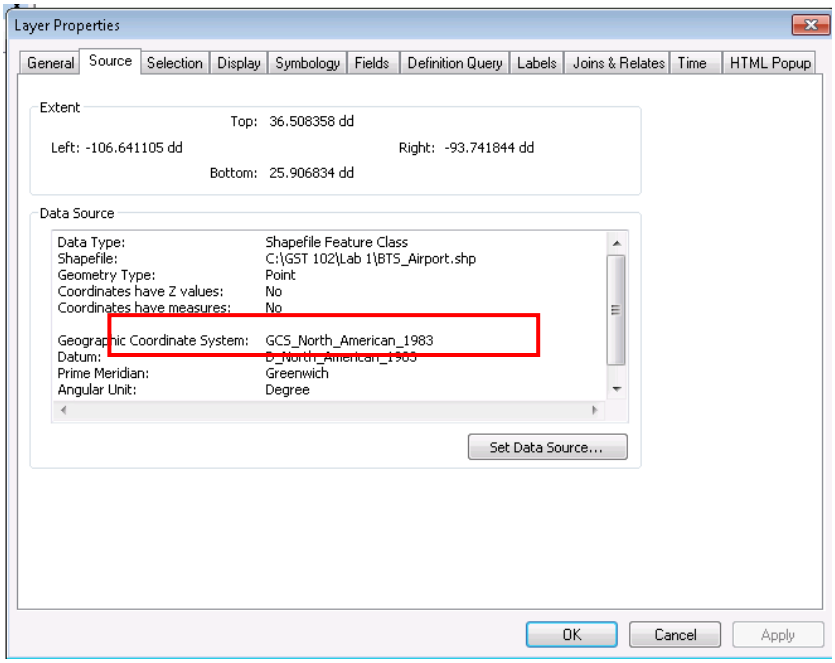
File	Coordinate System
tx_terrain_hillshade_tsms	North American 1983 Lambert Conformal Conic
NHDAREA	
texasdem_tsms	
BTS_Airport.shp	

3. Close ArcCatalog.

3.1 Project to a Different Coordinate System

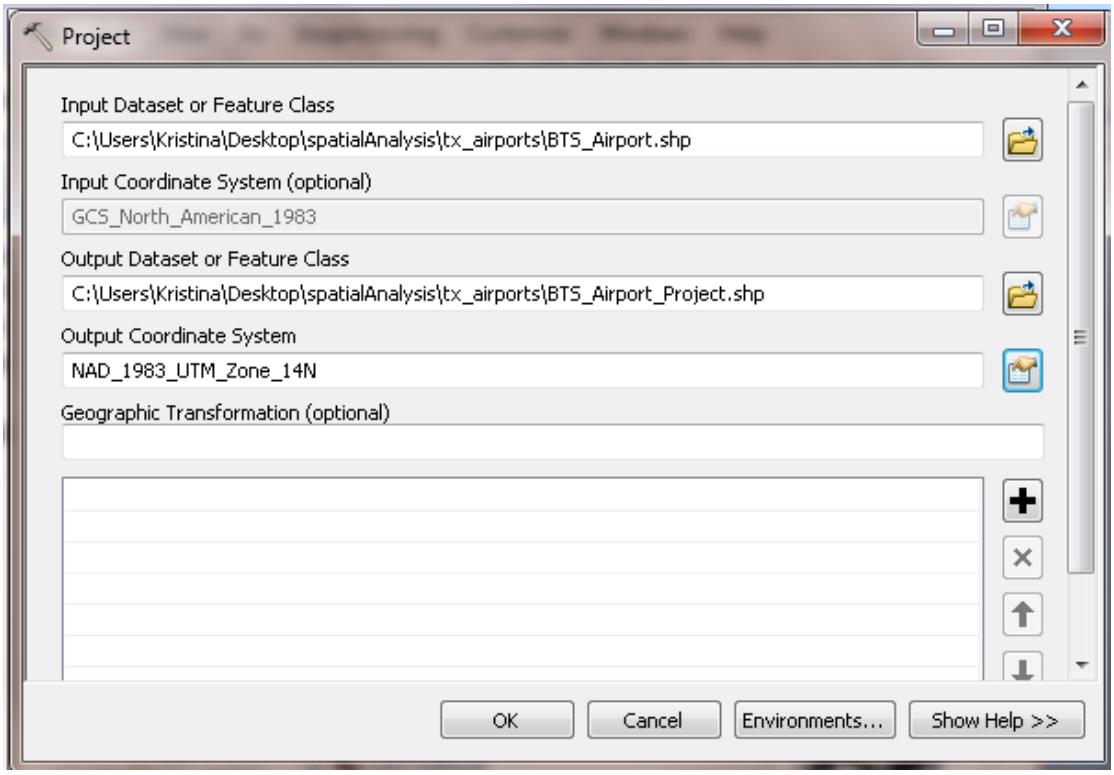
When performing spatial analysis, it may be necessary to project a shapefile to a different geographic coordinate system.

1. Start **ArcMap**, creating a new blank map.
2. Add the shapefile **BTS_AIRPORT.shp** to your data by clicking the **Add Data** button and browsing for the shapefile.
3. To identify the coordinate system of the shapefile, **right-click->Properties** and navigate to the **Source** tab. In here, you will be able to see the Geographic Coordinate System.



Question 4: What is the current coordinate system of this data?

4. Let's say for purposes of our analysis that we would like to change the coordinate system of the **BTS_Airport.shp** layer.
5. The tool we use to do this is in **ArcToolbox**, and it is named **Project**.
6. To find the tool, click on the Geoprocessing tab in your main menu. Then click on Search For Tools. You can then type the word "project" into the search field and click on the search icon. Several results will show up. Click on the eighth one down that says **Project (Coverage) (Tool).** It describes the tool's ability to change a layer's coordinate system, which is what we want. Click on **Project**, or the file path below its description. Then double-click on Project to launch this tool. If the search method doesn't work, try clicking on **Geoprocessing ->Data Management Tools ->Projections and Transformations ->Feature -> double click**
7. Use this tool to project the BTS_Airport.shp layer to **NAD83, UTM Zone 14N** (found in **Projected Coordinate systems ->UTM->NAD 1983**)by filling out the dialogue box so it looks like the one shown below:



8. Click OK.
9. In ArcMap, add the shapefile named *st48_d00.shp* as was done for the *BTS_Airport.shp* in Step 3. Dismiss warning. Now, add the TxDOT_ARPRT_PNT.shp shapefile.

Question 5: What is the coordinate system of the st48_d00.shp shapefile?

Question 6: What is the coordinate system of the TxDOT_ARPRT_PNT.shp shapefile?

Question 7: What is the coordinate system of the data frame (to figure this out, right-click on "Layers")?

4 GIS Data Attributes and Attribute Tables

1. In ArcMap, open the attribute table for the ***TxDOT_ARPRT_PNT.shp*** shapefile **by right-click->Open Attribute Table.**

Question 8: How many records are in this table?

Question 9: How many **attributes does eac**h point in thi**s shapefile have?**

2. **Open the attribu**te table for the *st48_d00.shp* shapefile.

Question 10: How many records are in this table?

Question 11: How many attributes do the polygons in this shapefile have?

Conclusion

In this lab, you learned how to decipher between the various file types, project files into specific coordinate systems, create feature datasets and feature classes within a geodatabase, and review attributes in an attribute table. An understanding of various data types is a necessary step in spatial analysis.

Discussion Questions

1. What is the importance of coordinate systems? Why are there so many different coordinate systems and map projections?

2. Describe the pros and cons of rasters and vectors.