# Introduction to ArcGIS Pro I
## S4 GIS Institute

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May 17, 2023

`https://libguides.brown.edu/gis_data_tutorials/s4arcpro`

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## Introduction

This tutorial introduces the basic functionality of ArcGIS Pro (version 3.1). Before we begin, please download the tutorial data file `gisintro_sampledata.zip` from the link at the top of this page. Save it on your desktop or in the downloads folder for now. After launching ArcGIS Pro you will need to be connected to the internet so you can log into the software using your ArcGIS Online credentials, obtained through Brown's ESRI site license.

This and subsequent tutorials will cover the basics. For additional reference, visit the following sources:

**ArcGIS Pro Getting Started** :
> `https://pro.arcgis.com/en/pro-app/latest/get-started/get-started.htm`

**ArcGIS Pro Quick Start Tutorial** :
> `https://pro.arcgis.com/en/pro-app/latest/get-started/pro-quickstart-tutorials.htm`

**ESRI Academy Course Catalog** : `https://www.esri.com/training/catalog/search/`

Conventions used in this tutorial:

- Summaries of steps appear in **bold face**.

- Names of windows, tabs, and tools appear in *italic face*.

- Names of files, layers, and fields appear in `typewriter face`.

## Notes on Sample Data

The sample data for this tutorial includes pre-processed GIS data files for all public libraries in Rhode Island (from the Institute of Museum and Library Services Public Library Survey), census tracts in Rhode Island from the US Census Bureau's Cartographic Boundary Files, and basic demographic data from the Census Bureau's 5-year American Community Survey. While public libraries serve all constituents in their communities, studies show that children and seniors tend to be particularly frequent library users. Libraries rely on census data for understanding their constituents and purchasing / providing relevant services and materials. In this tutorial and the ones that follow, we will use this data to showcase the basic features of ArcGIS Pro.

# 1  The ArcGIS Pro Interface

This section will familiarize you with the ArcGIS Pro interface.

1. **Launch the software**: Open the *Start Menu* in Windows, select the *ArcGIS* folder, and select *ArcGIS Pro* to open the software.

2. **Log in**: On the ArcGIS Pro Start Page, make sure that you are logged into your ArcGIS Online account; sign in in the upper-right hand corner of the screen.

3. **Start page**: The Start page lists objects for launching new projects at the top, with a list of shortcuts to recent projects underneath. Click on the *Map* icon to start a new, blank project. Name your project `gis_introduction`. Save it in the default location on your machine, or navigate to another location on the network. The default location: `Users\[username]\Documents\ArcGIS\Projects`. Note: once created, project files can *not* be renamed. ArcGIS Pro will launch.

4. **Interface**: ArcGIS Pro's interface is divided into three sections: on the left is the *Contents* pane, which shows you a list of layers in your project. In the middle is the *Map* view, which shows a visual image of your map layers; by default a topographic web map is displayed as a base map. On the right is the *Catalog* pane, which you can use for exploring data and other content stored on your file system. It is possible to add multiple views to Pro, so you will have tabs of views in the middle of the screen that you will toggle through. As you click on particular tools and features, the default panes may be temporarily swapped out with a different pane.

5. **Ribbon and tabs**: ArcGIS Pro employs a ribbon interface similar to many Microsoft Office products. Tools are logically grouped together under various tabs, and those tabs provide buttons and links for accessing different tools and features. Some of the tabs are constant, while others only appear when a particular layer is selected or a specific view is open. Click on the various tabs to explore their content. Select the `Topographic` map in the *Contents* pane, and notice that a context-dependent *Vector Tile Layer* tab appears.

6. **Map tab and zoom**: Click on the *Map* tab. The *Explore* button allows you to pan and zoom around the *Map* view with your mouse. Hold the left mouse button down, and drag the cursor around the map to pan. Use the mouse wheel to zoom in and out (or, use the fixed zoom buttons that are beside the *Explore* button). Notice how the resolution and detail of the base map changes as you zoom.

7. **Explore base maps**: The base map is a tile layer accessed via the internet. It provides context for your project's layers. On the *Map* tab ribbon you can hit the *Basemap* button to select different maps. Experiment with this, and then return to the `Topographic` map.

## Interface Summary

1. **Contents pane**: lists layers in the project.

2. **Map view**: visual depiction of active layers. Multiple views of different types can be added to this area and accessed via tabs.

3. **Catalog pane**: easy access to content and file system associated with the project. This pane can be replaced with other panes as needed.

4. **Quick tools**: shortcuts for saving projects and un-doing and re-doing actions.

5. **Permanent tabs**: used for accessing a specific ribbon of tools.

6. **Ribbon**: groups of thematically related tools. Tools are subdivided into groups, and in some cases additional options are available via dropdowns and call outs.

7. **Context dependent tabs**: only appear when specific actions are taken, such as activating a specific layer or accessing a specific view.

 To reset panes to their original configuration, click the *View* tab on the ribbon and select *Reset Panes - Reset Panes for Mapping*.
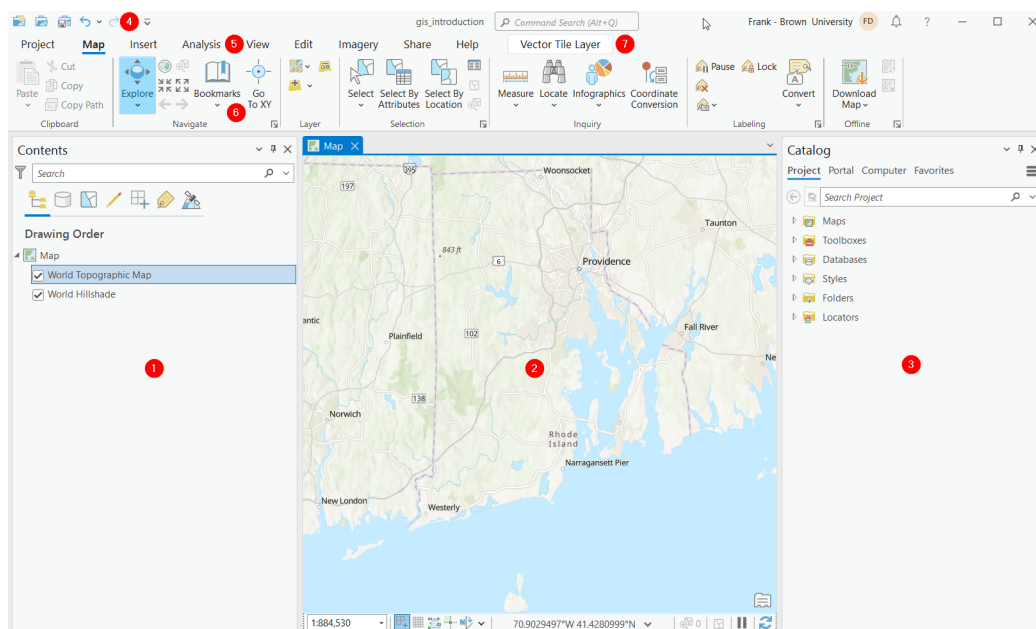


# 2   Add Data to Your Project

There are several ways that you can add data to a project. It's important to keep files for a project together in the same place, and advantageous to keep features in a geodatabase for organization and efficiency. In this section, we will copy our sample data folder into the project folder, import shapefiles into our project geodatabase, and add the features from the database to a map.

1. **Explore the Catalog pane**: In the *Catalog* pane on the right, hit the down arrow beside the *Databases* icon. You will see the gis_introduction.gdb, which is the geodatabase for this project; it was created automatically when you created the project, and is the default

destination for storing files you create. Click the down arrow beside the *Folder* icon. This displays all folders on your file system that are part of this project; the default project folder is shown. If you want to add any other data to your project, you need to move it into this folder, or connect to another folder by selecting the *Folder* icon, right clicking, and adding a new folder.

2. **Move tutorial data**: To ensure that all the pieces for your project stay together, let's add data to our project folder rather than connecting to another folder. Select the `gis_introduction` folder, hover your cursor over it, and in the pop-up window, click on the folder path. This opens the MS Windows file explorer (alternatively, you could select `gis_introduction`, right click and choose *Show in File Explorer*). Take the tutorial data that you downloaded and move it into this folder. Then select the file, right click, and extract or unzip it.
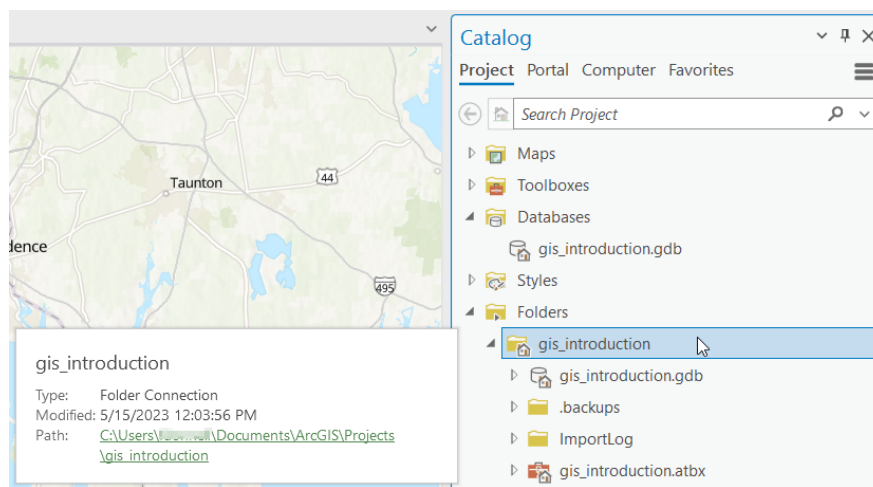


3. **Examine shapefiles**: The sample data folder contains a number of subfolders that contain different types of data. In the MS Windows Explorer, click on the `shapefiles` subfolder. Shapefiles are a GIS file format for storing vector data (points, lines, and polygons), and are a format you will encounter when downloading data from the internet. A shapefile actually consists of several files, with the same name but different extensions. Our folder contains two shapefiles, one for census tracts and another for public libraries. It's important to keep all the pieces of a shapefile together in the same folder, otherwise it will not function.

4. **Refresh catalog pane**: Whenever you make changes in your filing system, you must refresh folder views in ArcGIS Pro to detect them. Return to ArcGIS, select the `gis_introduction` folder, right click, and hit the *Refresh* button. You should now see the new `gisintro_sampledata` folder, and if you select the down arrows to expand each of its subfolders you will see features in each.
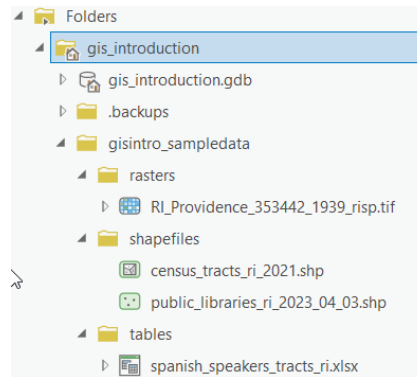


5. **Add shapefiles to geodatabase**: While we could add the shapefiles directly to our map, we will import them to our geodatabase first, for the sake of keeping our project more organized and efficient. In the *Catalog* pane on the right, under the *Databases*, select `gis_introduction`, right click, and choose *Import - Features Classes*. Under *Input* hit the folder icon, browse into the `gisintro_sampledata` - `shapefiles` folder, hold down the shift key and select the `census tracts` and `public libraries` shapefiles, and hit *OK*. Back in the import tool, hit *Run*. When finished, go the *Catalog* pane, select `gis_introduction`, right click and choose *Refresh*. Hit the down arrow beside the database, and you will see the features in the database. Close the *Feature Class to Geodatabase* window.
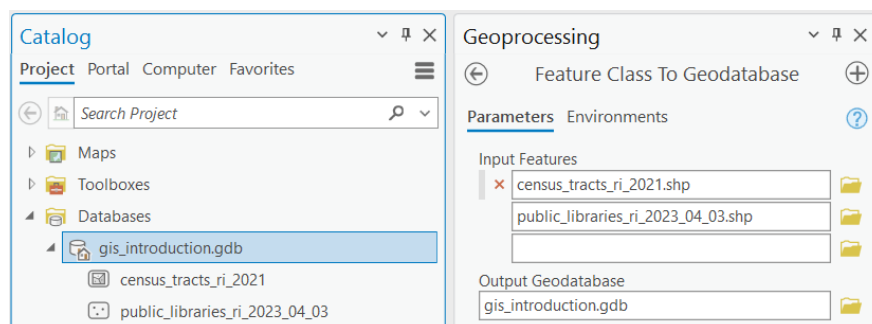


6. **Add features to map**: Add the `census tract` and `public library` feature classes in the database to the map by selecting and dragging them into the map, or select the feature class, right click, and choose *Add to Current Map*.

## 3  Exploring Features

Now that we have converted the shapefiles to features classes in our geodatabase and have added them to a map, let's explore some details of the features.

1. **Explore layers in contents pane**: The layers are added to the *Contents* pane and are drawn in the *Map* view, and the view is transformed to take the spatial reference system (SRS) of the first layer added to the project. In the *Content* pane you can uncheck and check the boxes to turn a layer on and off. If you select the bottom layer and drag it over the other, the drawing order of the layers changes. In this case, the libraries must be on top of the census tracts; otherwise the tracts will cover them up and they won't be visible. *Drawing Order* is the default display on the *Contents* pane. Selecting one of the other icons will display alternate info; for example, the grey *Data Source* cylinder will indicate where the data is stored.

2. **View properties of layers**: Select the `public_libraries` feature in the *Contents* pane on the left, right click, and choose *Properties*. Under the *Source* tab expand the sections for *Data Source* and *Spatial Reference*. The former will give you details about the features and where they are stored, and the latter provides information about the spatial reference system (SRS) of the features. Layers with the same SRS can be overlaid in a map and used in the same analysis; if the layers have different systems you will run into trouble. Explore the properties of the `census tracts` as well.
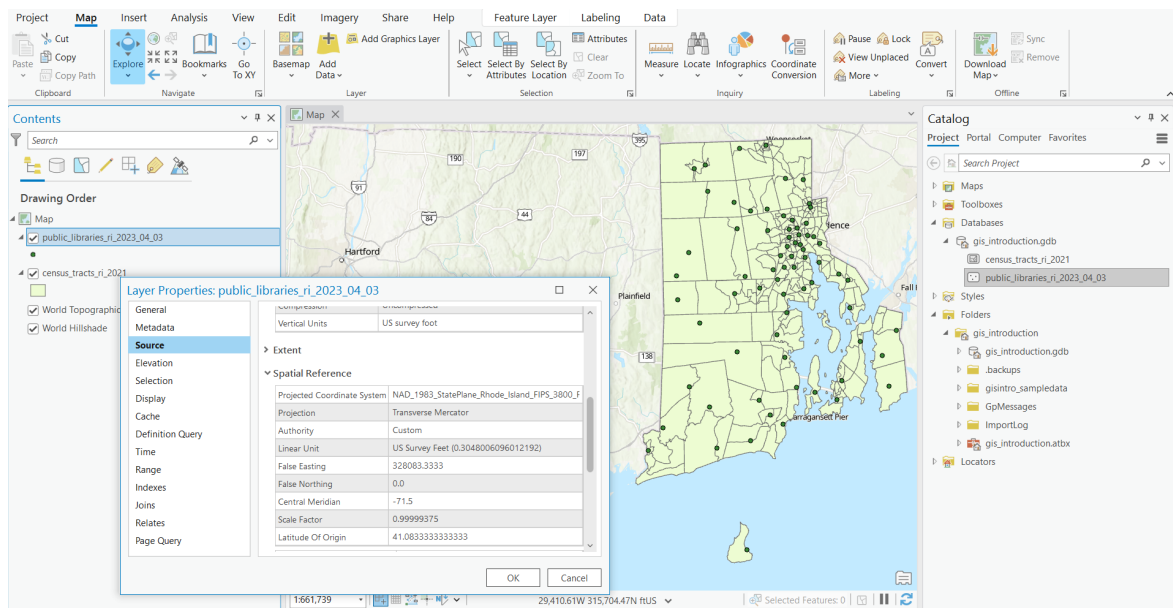


3. **Identify specific features**: On the *Map* tab hit the blue *Explore* button. Zoom into the map a little and click on a library. This will open a window that displays info about the library stored in the layer. Click on a census tract, and you will see info about the tract.
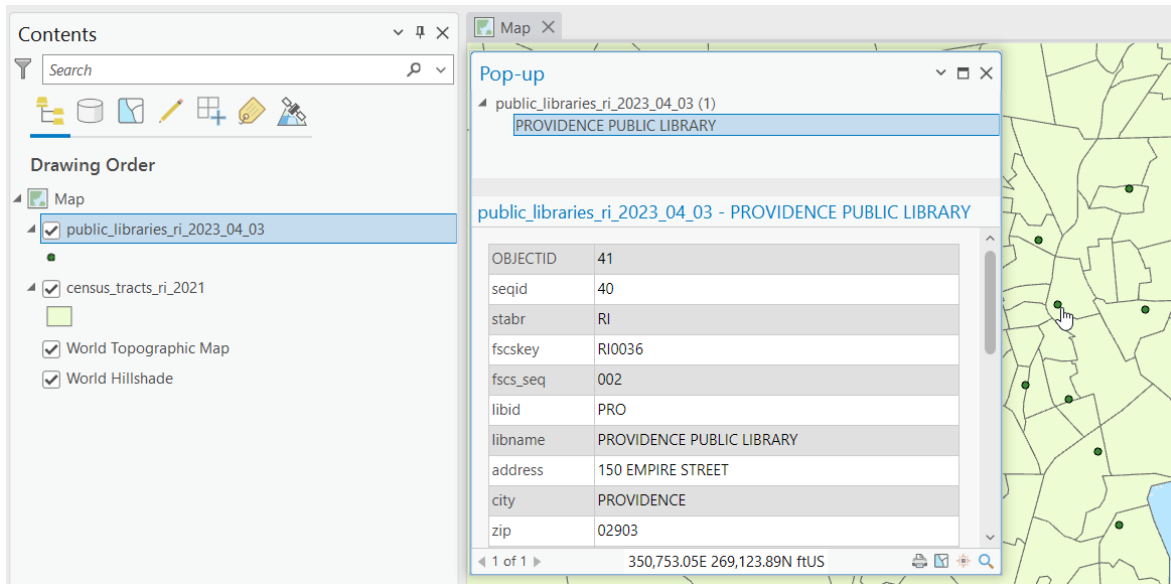
4. **View an attribute table**: To see where this data is coming from, select the `public_libraries` layer in the *Contents* pane, right click, and select *Attribute Table* in the menu. The table will open below the map, but you can pull out the window to undock and expand it to see it better. Scroll over and explore the table. If you select a column and right click, a number of options appear. For example, click on the `city` field. You can sort the cities alphabetically, or run some statistics to count records by city (if you do the latter, a new pane will appear in our project, and a new chart object appears in our layer list; when you are finished you can remove them both). When you are finished, close the table.



5. **Select some features**: On the *Map* tab, hit the *Select* button. Click on a census tract in the *Map* view to select one. Then, while holding down the shift key, select a couple of additional tracts. Then, select `census_tracts` in the *Contents* pane, right click, and open the *Attribute Table*. Scroll through the table, and you will see the tracts you selected highlighted in blue. You can select features in the map and highlight them in the table. You can also do the opposite; select a row in the table, and the feature will be highlighted on the map. When finished, close the table, and in the *Selection* portion of the ribbon, hit the small *Clear* button.

# 4 Symbolize Layers

All layers that you add are symbolized as single symbols. You can modify how these symbols are displayed, and can map data in the attribute table as categorized or graduated symbols (for qualitative and quantitative data respectively).

1. **Symbolize public libraries**: Select the `public_libraries` layer in the *Contents* pane to activate it. Right click on the layer and hit the yellow *Symbology* button. This opens the *Symbology* pane. Click on the circular library symbol to format it. On this next pane, you can choose from a number of different symbols under the *Gallery* option. Instead, click on the *Properties* option to format the basic properties of the existing symbol. Try changing the color of the fill, make the outline of the circle a little thinner, and make the circle size a little larger. Hit the *Apply* button, then close the window.
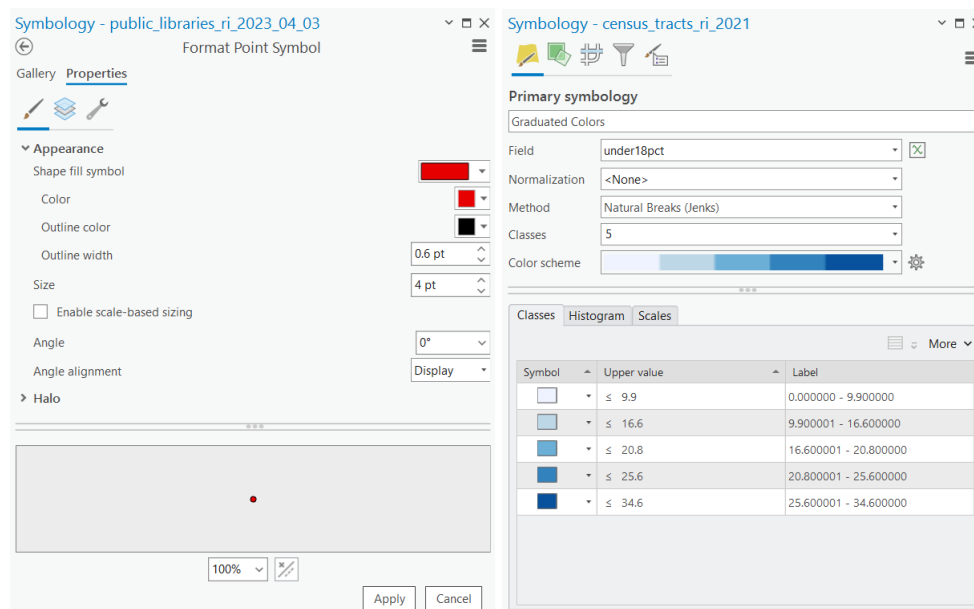


2. **Symbolize census tracts**: Open the *Symbology* pane for the `census_tracts`. Change the dropdown option from *Single Symbol* to *Graduated Colors*. In the *Field* dropdown, change the option from `ALAND` which is mapping the tracts by size of land area to `under18pct`, which is the percentage of the population under 18 years old. Hit the *Color Scheme* dropdown to choose a different scheme (choose an option that goes from light to dark using a single shade of colors; oranges, greens, blues, etc). Under the *More* dropdown, select *Format All Symbols*, change the outline width to make it a little thinner, and hit *Apply*. Hit the back arrow button to return to the main symbology screen. Note some of the other options that you can modify here. When finished, close the *Symbology* pane and examine your map.
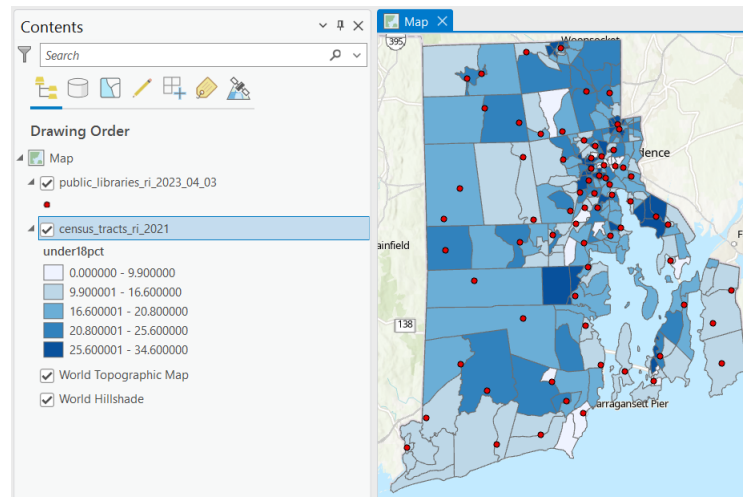
3. **Save your project**: Hit the quick save button (disk with folder) in the upper left hand corner of the screen.

# 5    Project Files

By default, all ArcGIS Pro projects in MS Windows are stored under the user's `Documents` folder, in a subfolder called `ArcGIS` that has subfolders named for each project. The actual project file has the extension `.aprx`. This file contains links to all databases and files in the project, and stores the map extent, symbolization, layer order, views, pane configuration, all map layouts. The project file does *not* contain your data or databases, it simply contains links to them. For this reason, you cannot share the project file alone with someone else; the connections to the data sources will be lost and nothing will be displayed. To share projects, you must share the *entire project folder*. For this reason, it's good to be organized and to save all your data and outputs in the project folder, to ensure that you can transfer it. For more information about project files and management, visit:

    https://pro.arcgis.com/en/pro-app/latest/help/projects/what-is-a-project.htm

Project files are specific to ArcGIS Pro and cannot be opened in other software packages. Most data sources (shapefiles, geopackages, rasters) are cross-platform and can be used in any software. ArcGIS geodatabases (which look like folders in your MS Windows file system) can be used with other software packages, but there can be issues with backward compatibility as the format changes over time. You can always export feature classes out of a database as shapefiles or tables in the *Catalog* pane, if you wish to use them in other GIS packages.

# 6    Download and Add Data

In this section, you'll download data from the internet and add it to a new map. The `census tract` and `public libraries` datasets we've worked with were preprocessed: specific to Rhode Island, in a relevant local coordinate system, and containing useful attribute data. In practice, you will

need to do this processing first, and won't want to mix up these preliminary layers with your final ones. The US Census Bureau's *Cartographic Boundary File* repository is typical for what you'll encounter when downloading vector (point - line - polygon) files.

1. **US Census Bureau boundaries**: The *Census Bureau's Cartographic Boundary Files* are generalized, formatted versions of their base layers where line work has been simplified and large bodies of coastal water have been removed. Go to `https://www.census.gov/geographies/mapping-files/time-series/geo/cartographic-boundary.html`.

2. **Examine page contents**: Click on the link at the top to see the 2021 files (if you don't see this option, you're on the wrong page). The files are arranged alphabetically; there are files for the nation, and in some cases subsets for individual states. Some files come in different scales; the smaller the number, the more detailed or less generalized the line work is.

3. **Download county file**: Scroll down to the files for `Counties`, and click on the 1:500,000 (national) shapefile to download it. When given options for vector data, always avoid Google KML files in favor of other formats.



4. **Move file to project folder**: Use the MS Windows Explorer to move the zip file `cb_2021_us_county_500k.zip` into your project folder where our sample data is stored: `...\Documents\ArcGIS\Projects\gis_introduction\gisintro_sampledata\shapefiles`. Unzip the file, and you will see the shapefile's individual components.

5. **Add a new map to project**: Return to your project in ArcGIS Pro. On the *Insert* tab on the ribbon click the *New Map* button. This adds a second map to our view. In the *Contents* pane, single click on Map 1 and rename it USA.

6. **Add shapefile directly to project**: On the *Map* tab on the ribbon, click the large yellow *Add Data* button. Browse to the project folder (top of tree on left, under Folders - gis_introduction - gisintro_sampledata - shapefiles, select cb_2021_us_county_500k and hit *OK*. (Alternative - use the *Catalog* pane, refresh the folder to see the recently added file, and add it).
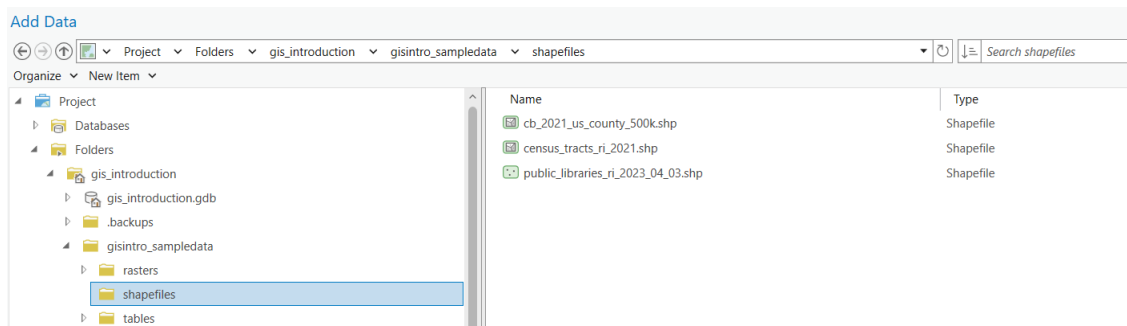
7. **View properties of shapefile**: Select the counties feature in the *Contents* pane, right click, and choose *Properties*. Under the *Source* tab expand the sections for *Data Source* and *Spatial Reference*. You'll see that the counties are in the basic NAD 83 SRS; all files from the Census Bureau come in this system. Take some time and explore the features and attributes of this layer.
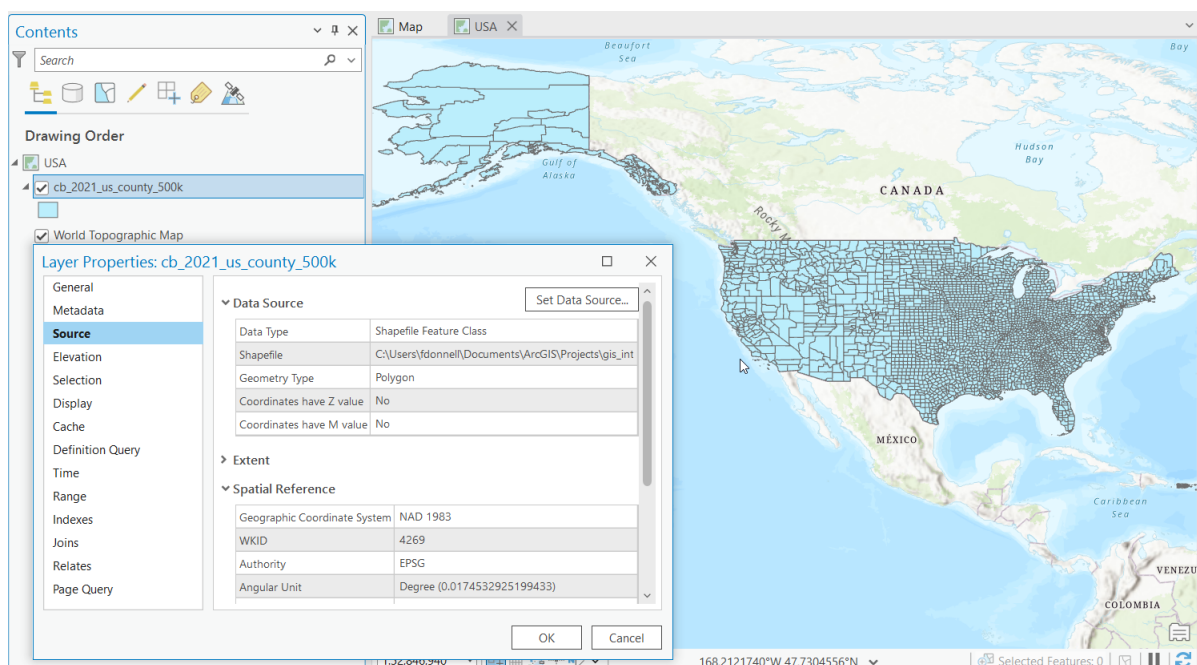
8. **Save your project**: Hit the quick save button (disk and folder) in the upper left hand corner of the screen.

Since the `counties` layer is national in scope and is in a different SRS from our other layers, we added it to a new map and didn't move it into our project geodatabase. In the next tutorial, we'll extract just the counties for Rhode Island, and will transform its projection to match the local state plane system of our other layers.

# 7    Experiment on Your Own

The next lessons in the seminar will delve into spatial reference systems and cartography, and then queries and analysis. Now that we have covered the basics, here are some things to try on your own:

1. Explore the different tabs and panes in the interface.

2. Try the different feature selection methods.

3. Experiment with different single symbols for mapping the public libraries.

4. Try mapping the public libraries as categorical variables. `c_out_ty` is the library outlet type (CE = Central Library, BR = Branch Library) while `fscskey` identifies libraries that are part of the same system.

5. Try mapping the public libraries as graduated circles, based on square footage or the number of hours the library is open per week (these variables are in the attribute table).

6. Experiment with mapping the population that is over 64 by `census_tract`.

7. Try downloading some data on your own from the websites below, and adding them to separate maps or projects (do *not* add additional layers to our existing map views).

## GIS Data Sources

We will cover GIS data sources in more detail in our final tutorial. Some sample GIS data repositories are listed below. For a larger list, visit:
`https://libguides.brown.edu/gis/data`.

**Cartographic Boundary Files** : Generalized boundaries from the US Census Bureau:
`https://www.census.gov/geographies/mapping-files/time-series/geo/cartographic-boundary.html`

**TIGER / Line Shapefiles** : The original, un-generalized census database contains admin and statistical areas, also bodies of water and roads:
`https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html`

**Natural Earth** : Generalized boundary files for the world with countries, cities, and water bodies:
`https://www.naturalearthdata.com/`