GIS Exercise 8
ESRI Geodatabases
in QGIS and ArcGIS
Mar. 09, 2018

Today we'll explore reading ESRI style geodatabases with QGIS, will use a special plugin repository to download my `USGS Color` plugin for adjusting the QGIS display of USGS maps, then will explore ARCGIS. Go through the following exercise and turn in the two files requested.

Part 1: Using QGIS to read an ESRI format Geodatabase

1) Download onto your local storage the `exercise_08_data` file from the class website and unzip it. The data folder contains the Suquamish map we examined during the first lecture – but this time in ArcGIS "Geodatabase" format. Newer versions of QGIS (and GDAL) can read (but not write) most of the vector content in the ESRI "Geodatabase" format. However it cannot read the display style information, and the default style is not very useful for geological maps. While you CAN adjust display style manually, we'll instead install my `usgs_color` plugin to help automate that process.

   (The GDAL driver we are using by default is known as ***`openFileGDB`****. There is also a software library available from ESRI which can let other programs such as QGIS both read and write to this format. However it has some complications, so for now we'll stick with* ***`openFileGDB.)`*** *We may explore the option from ESRI later in the semester. In case you do need to use the write capabilities in that proprietary solution you will be using the GDAL* ***`FileGDB`*** *driver (note the lack of* ***`open`*** *in the name) together with ESRI's* ***`"File Geodatabase API"`*** *library.*

2) To install the plugin you first need to tell QGIS about the private plugin repository I've established. Start QGIS and from the main QGIS menu go to **Plugins / Manage and Install Plugins** then click on the **Settings** tab at the left. Click on the **Add** button at the bottom, in the **Name** field enter **Howell Plugins** and in the **URL** field, after the **http://** which should already be there, type
geofaculty.uwyo.edu/rhowell/software/qgis/plugins/repo/plugins.xml
and click **OK**. Assuming you entered the above text correctly QGIS should show that it successfully connected to the repository. If not, you can click **Edit** to correct the **URL**. Next, click on the **All** tab to show all plugins available both in the main QGIS repository and the one we just added. Scroll down to or search for **USGS Color**, click on that entry, and select **Install Plugin**. QGIS should show a screen with information about the plugin. Look through that screen briefly.

3) If interested (this step is optional) you can click on the **Homepage** link and it will open a browser showing
http://geofaculty.uwyo.edu/rhowell/software/qgis/plugins/index.htm
where you could download a zip copy of the plugin. Unzipping it would let you examine the contents (but you don't need to do this.) You can also find the already unzipped copy which QGIS downloaded in one of the following directories, which vary from operating system to operating system, as listed below. In the following, on Windows **$USERNAME** is your user name and on Linux **$HOME** is your home directory.:

```
Linux:                $HOME/.qgis2/python/plugins
Mac OSX:              /Users/$USERNAME/.qgis2/python/plugins
Windows 10:           C:\Users\$USERNAME\.qgis2\python\plugins
Windows 7 or 8:       C:\Documents and Settings\$USERNAME\.qgis2\python\plugin
```

4) After closing the **Manage Plugins** dialog you should now see a set of four USGS plugin icons appear in the toolbar. If you click on **USGS About** it should show you the version number and date of the plugin. You could also run these commands from the main menu using **Plugins / USGS_Color** .

5) To open an ESRI Geodatabase under QGIS you paradoxically select (from the main menu) **Layer/Add Layer/Add Vector Layer** then in the dialog box which opens, select **Directory** rather than the default **File**. Do NOT select **Database**. You probably should use the **Type** dropdown box to select **OpenFileGDB**, but the following seems to work without that. Next click **Browse**, navigate to the **exercise_08_data** folder, and select **sim3181.gdb**. This is really a directory which contains the many files which make up the ESRI Geodatabase for the main map. When you then click **Select Folder** it will take you back to the previous dialog box. Click **Open** and you should be presented with a list of all the vector layers in the Geodatabase. Click **Select All** then click **OK**. and all these layers should be added to QGIS.

   QGIS seems to misunderstand the information about what CRS is used for the **CMULines**, **CMUMapUnitPolys**, and **CMUText** layers. Just select the default **WGS 84** for those, even though that may not be right, as those layers are not important for the following.

   Repeat the above process to add all the layers in the **sim3181Base.gdb** geodatabase, which is the base topo map used in the creation of the above geologic map. In the Layers panel select **MapUnitPolys** which contain the actual geologic units layer and right click on **Zoom to Layer**. You'll see in the default image that all the polygons are being displayed with the same color, which isn't very useful.

   (QGIS Bug workaround: Sometimes QGIS doesn't seem to properly initialize its on-the-fly projection and the various layers may not be properly located. Right clicking on this layer again, clicking **Set Layer CRS**, then just clicking **OK** to confirm the already selected CRS usually fixes the problem. You may need to repeat the **Zoom to Layer** after doing this.

6) First we will clean up the "z order" of the layers so that annotation is displayed on top of everything else, followed by Points, then Lines, then Polygons. Without this many features will be hidden below other ones. To do this, just click the **USGS ZOrd** icon. The plugin puts anything with **Anno** in the name at the top, followed by **Points**, **Lines**, then **Polygons**. You might want to refine the final order it produces.

7) Next we need to properly color the **MapUnitPolys** polygons. Under the **NCGMP09** standard the colors should be contained in the **DescriptionOfMapUnits** table, which IS loaded as a layer. Open the attribute table for that layer to find that column, labeled **AreaFillRGB**. (Unfortunately not all state geological surveys populate that column and if the column is blank the following procedure will fail, producing blank polygons.) Examine the other fields in the table, then close it.

   Select the **MapUnitPolys** layer in the layer panel then click on the **USGS Set Colors** icon which shows as a set of RGB stripes. You should see the various geologic units and their colors appear in the Layers panel. If you don't see the units appear in the map itself, it may be because one of the other polygons is covering it up. The most likely one is **MapBoundary**. If so, just turn off that layer which is not (for the following) very useful. If the plugin cannot find a **DescriptionOfMapUnits** layer already loaded it will ask you for the name of a file containing one. If necessary you could create your own spreadsheet file specifying colors. The plugin only needs two columns: **Symbols** (containing the abbreviations for the units, matching that used in the **MapUnitPolys** table) and **AreaFillRGB** (containing rrr, ggg, bbb values from 0 to 255). Right now it ignores information about more complex fill patterns.

8) Finally, we need to adjust the style of the text used to label the plot. Select the **GeologicAnno** layer in the layers panel then click the **USGS Label** icon. It will reset the text properties to somewhat reasonable values, although not exactly what ArcGIS would have specified. Repeat this for the **BaseAnno** layer, the **contours5mAnno** layer, and whatever additional annotation layers you care about.

9) With a more-or-less reasonable format configured, use **Project/Save As** to save a project file, which contains the display information you just set. You can experiment further with adjusting display properties if you want. For example you may want to turn off the **LithObservationPoints** layer which clutters up the map, and perhaps turn off both sets of contours and their annotation.

10) Use **Project/Save As Image** and turn in a copy of that image next Friday. You can now close QGIS.

Part 2: Exploring ArcGIS

You will need to use the ESB1006 machines, or some other machine which holds an ArcGIS license for this part of the exercise.

11) In the next step we want to use ArcGIS to open the **sim3181.mxd** file in the **exercise_08_data** directory. By default Windows hides the **.xxx** extension of files where it thinks it understands the file type. To explicitly show this, from the Windows Explorer menu select **View** then check the **File Name Extension** checkbox. (Microsoft has changed the exact procedure for this in almost every new version of Windows. If you can't Windows to display the extension, in the next step just select the file which will probably be shown as simply **sim3181.** It probably will be the right one.) You should now see in the exercise data folder a file named **sim3181.mxd**. The ***.mxd** files are ArcGIS's equivalent of the QGIS project files. They don't contain the map data themselves, but instead contain pointers to the actual data files, and other information controlling how that data will be displayed. You should also see two directories **sim3181.gdb** and **sim3181Base.gdb**. The former contains the Geologic Map information, the latter contains the Base topographic map upon which that Geologic information was added.

12) Open the map in ArcGIS. You can do that either by double clicking on the **mxd** file, or by starting ArcGIS from the Windows Start button with **Start/ArcGis/ArcMap 10.x**. If you do that latter it will initially give you the option of creating a blank map. **Cancel** that. Then from the ArcGIS menu select **File/Open** and navigate to the **sim318.mxd** file and select it.

13) When the map is opened you should see a display very similar to that from QGIS, although the details of the menus and the icons will be different. Explore some of the following options in ArcGIS.

1) Explore using the zoom and pan icons.

2) Try turning on and off various layers in the Layer panel.

3) Explore using the Identify tool (the "I" inside a blue circle).

4) Right click on **ContactsAndFaults** in the Layers panel and select **Open Attribute Table**. Examine the various columns. In particular note the **Type, ExistenceConfidence, IdentityConfidence, Symbol**, and **DataSource ID** columns. Note that several of these are described in the NCGCP09 geologic map standards document. Explore the attribute tables of a few other layers.

14) Create an ArcGIS Python routine, equivalent of what we did earlier with QGIS. To run Python from ArcGIS from the main menu select **Geoprocessing/Python** and a Python window will open.

1) The **sim3181.mxd** map should have a **GeochronPoints** layer. You might want to open that layer's attribute table to compare with the following.

2) In the Python window, first import the **arcpy** library as follows, then use functions within **arcpy** to obtain information about the above layer. Note we could even list the values of the ages and do some processing on those ages. But for now we'll just look at general properties. While Python itself the same on QGIS and ArcGIS, unfortunately the **arcpy** commands are different.

```
3) import arcpy          # Import the Arcpy library

4) desc = arcpy.Describe("GeochronPoints")      # Retrieve information
                                                # about this layer

5) sr = desc.SpatialReference                   # Retrieve its
                                                # spat. ref info
      print (sr.Name)                           #  and print its name.

6) flds = desc.fields                           # Get the fields in the
                                                # layer attribute table

7) for field in flds :                          # Print the field names
       print( field.name)                       # Enter a blank line to
                                                # tell python the loop
                                                # has ended.
```

15) Note **arcpy** isn't entirely consistent about when it capitalizes attributes and when it doesn't, and capitalization does matter.

16) Save the output of the above Python test as follows and turn it in next Friday with the QGIS image. To save the output of the Python window, right click in it and select **`Save as`** , select a writable directory, name the output file **`exercise_08_output`**, and set the **Save as type** value to **text**.

Turn in the QGIS generated image and the ArcGIS generated Python text output.