

Intro to QGIS

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This tutorial will introduce you to digital mapping and spatial analysis using QGIS 2.8.3-Wein. You will learn:

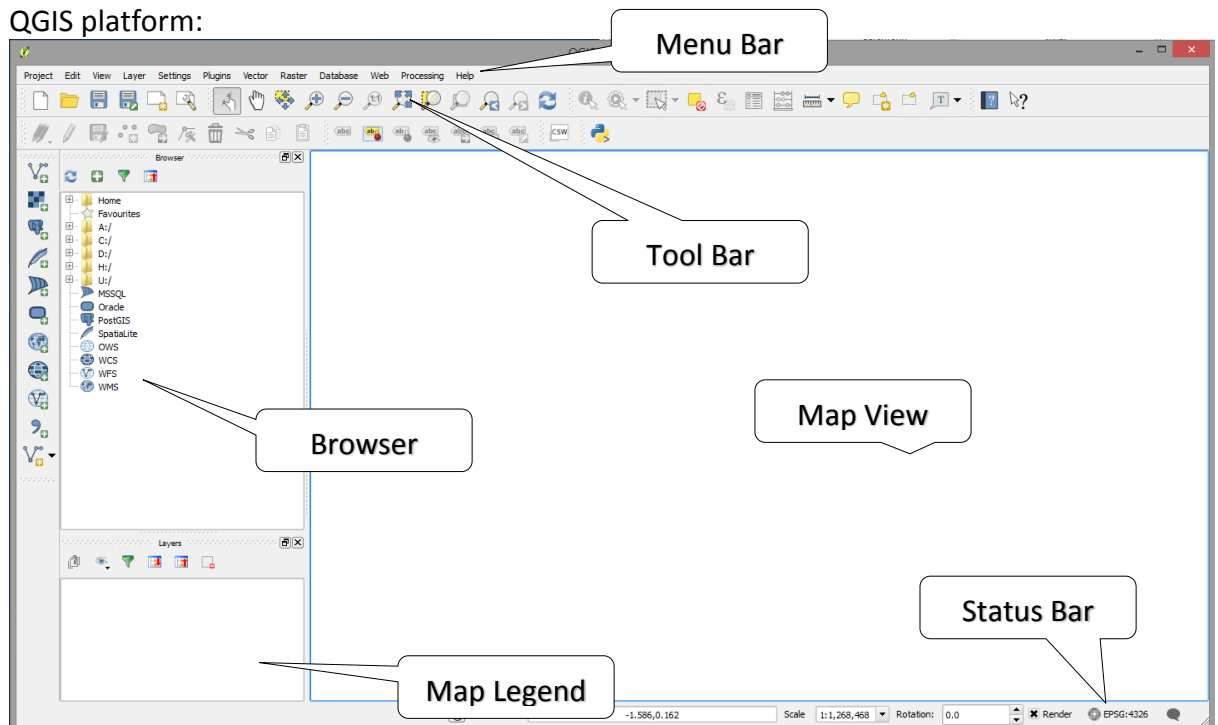
- QGIS software navigation
- Spatial data visualization and manipulation
- How to create a map


***Before Step 1:

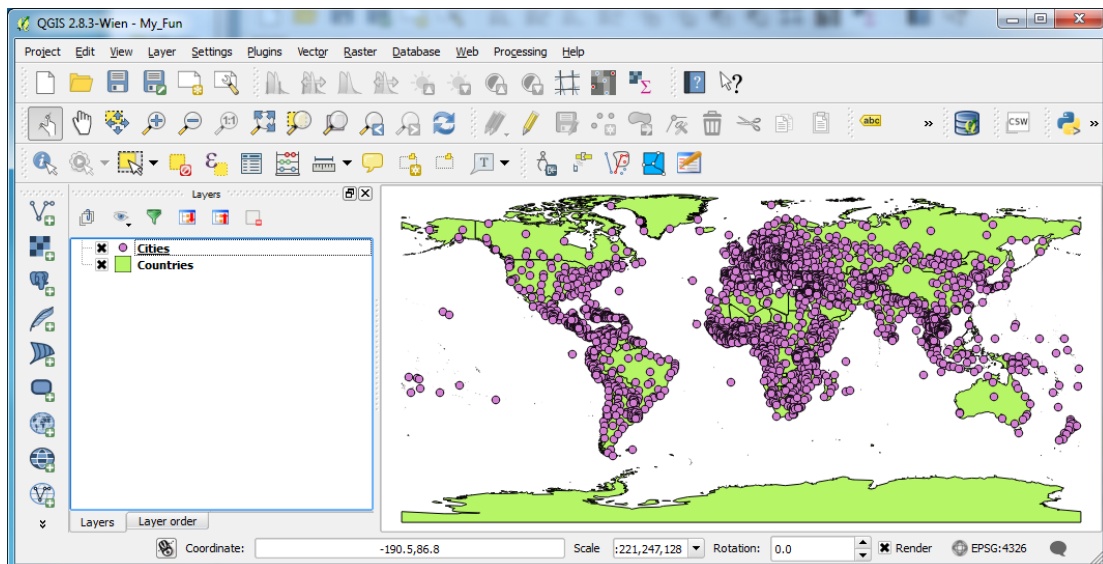
- Create a folder called demoproj (if on an OAL, place the folder on the Home Drive (H:))
- Visit <http://tamu.libguides.com/IntroToQGIS>
- Download the sample data under Workshop Materials to your demoproj folder
- Unzip the folder

QGIS Software Navigation: Add Data

1. Open **QGIS Desktop**. **QGIS Desktop** is part of the desktop mapping interface of the QGIS platform:



2. The **Layers Panel** is where you will manage data layers.
3. Right-click in an empty space within the toolbar to see a list of toolbars that can be added for different tasks. Toggle off the **Browser** option. Left-click in the **Map View** to close the menu.
4. Since our data are in vector format, click the **Add Vector Layer**  button found on the **Manage Layers** toolbar.
5. In the pop-up menu, click the **Browse** button under Source and navigate to the *Countries.shp* file in your demoproj folder.
6. Double click on *Countries.shp* that of the file type **3dsshp**, then click **Open**. You should see a layer in the **Layers Panel** containing the countries of the world.
7. Repeat the process in steps 5-7 and add *Cities*. Your **Layers Panel** and **Map View** should look similar to the next figure:



8. Within the **Menu Bar**, select **Project** → **Project Properties**. Within the window that pops up, ensure that the General tab is activated and that **relative** is toggled on (next to save paths option). This will help you when transferring your map documents (.qgs) and your data to new folders and devices.

Layers Panel

9. The **Layers Panel** shows all layers in a particular project. Click on the word *Countries* in the **Layers Panel** and drag it above *Cities* and let go. Notice that the *Countries* are now being drawn on top of the *Cities*. Drag *Cities* back above *Countries*.

10. Right click on *Cities* in the **Layers Panel** and select **Properties**.
11. Within the **General** tab, you will notice two categories of data presented to you, **Layer Info** and **Coordinate Reference System (CRS)**. Notice the layer name and layer source are in the **Layer Info**. **Layer source** is equivalent to the directory or path to the data. Under the **Coordinate Reference System** category, the geographic coordinate system, is set to WGS 84. If a projection needs to be changed, that can be done in this menu.
12. For now, close the **Properties** window.
13. Right click on *Cities* in the **Layers Panel** and select **Open Attribute Table**. A window will open showing the variables, or attributes, associated with each of the points that represents a city. Close the table by clicking the X in the top, right corner.

Map View

Map View is the component of the QGIS Desktop interface where data visualization occurs. This window represents the portion of your data that is displayed when making a map.

14. The **Touch Zoom and Pan (A)** button in the **Map Navigation** toolbar (illustrated below) is for touch-screen displays, and allows a two-fingered zoom and pan gestures that are familiar to users of mobile devices.



15. Click on the **Zoom In (C)** button in the **Map Navigation** toolbar:
16. Click somewhere on the data in the **Map View** and the image will zoom in.
17. Click and drag a box over a portion of the data, then let go. This zooms you into that portion of the data.
18. Explore the **Zoom Out (C)** button:
19. Select the **Pan Map (B)** tool to pan around the map view. Once you've selected a space to 'grab', you can click that location in the map view to move the visible extent of the **Map View**.
20. Click the **Zoom Full (D)** button:
21. This button zooms out to the full extent, or edge, of the data.

22. The **Zoom Last/Next (E)** buttons can be used to go back to an extent you were just looking at, or to move forward to one.
23. On the **Attributes** toolbar, there is another commonly-used button, **Identify (F)**. It is on the Attributes tool bar (illustrated below). Click on the Identify Button:

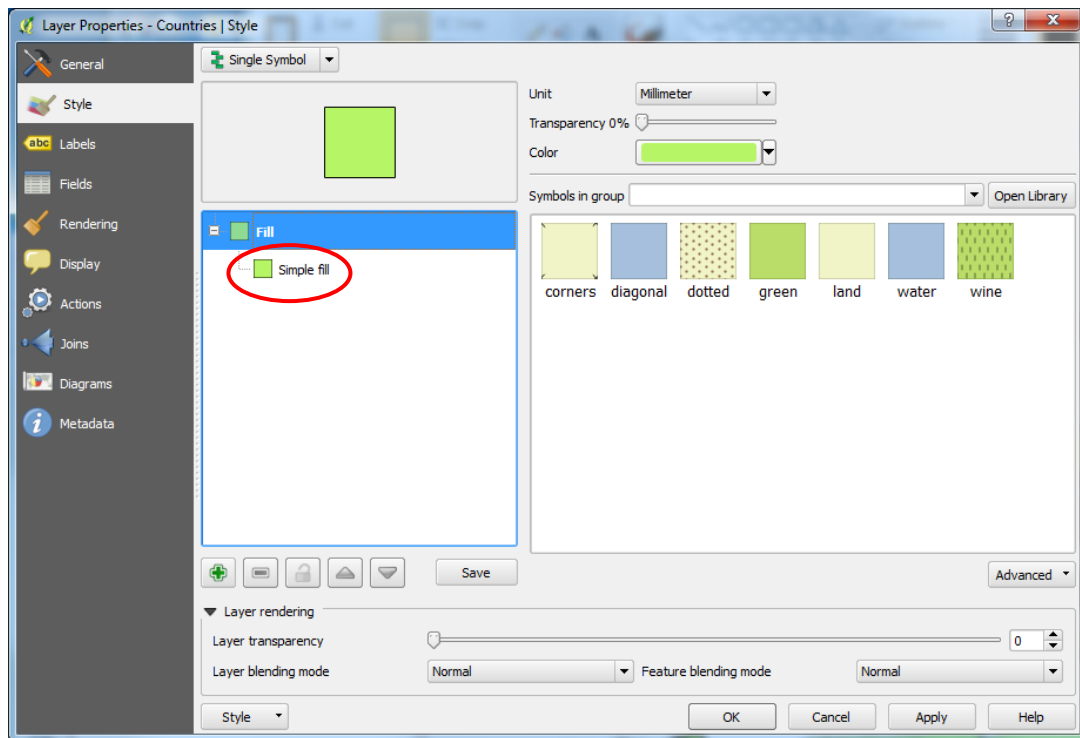


24. Select a Country or a City. A pop-up will appear that will show the attributes associated with that feature if it is highlighted in the **Layers Panel**.
25. There are other tools on the **Map Navigation** and **Attributes** toolbars, but for now zoom out to the furthest extent by clicking the **Zoom Full (D)** button again.

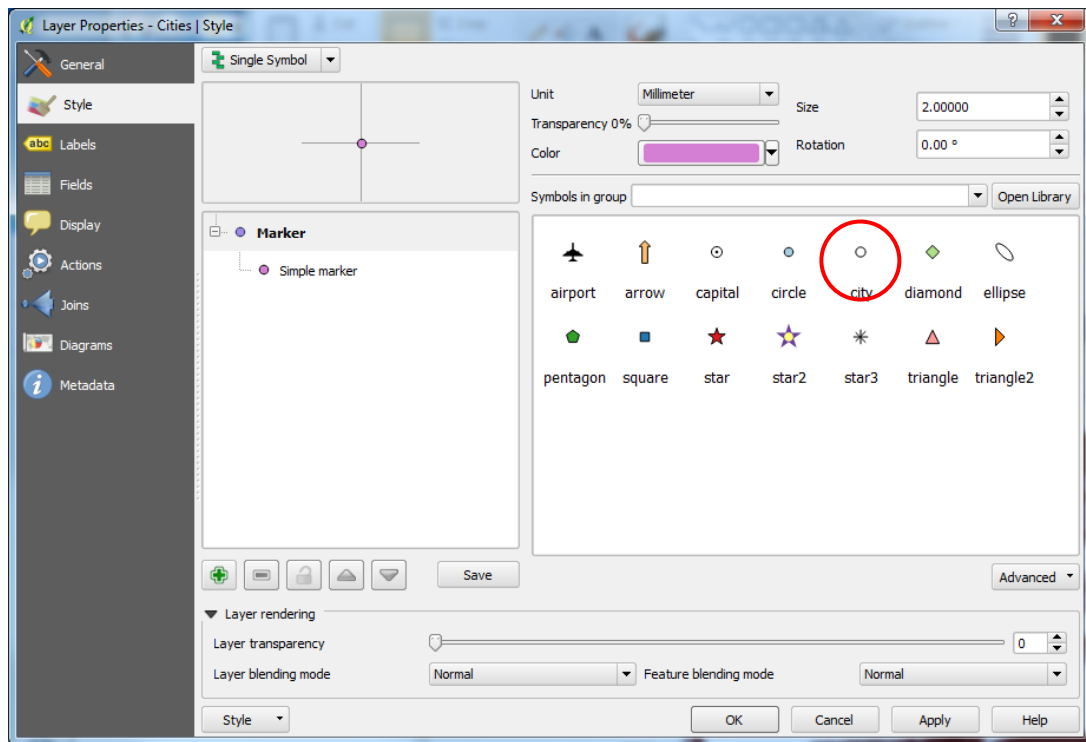
Layer Properties

In QGIS, layers are displayable entities associated with each added feature class or raster. The Properties dialog provides access to configurable elements associated with each layer. Among the ones we shall show are **General**, **Labels**, and **Style**.

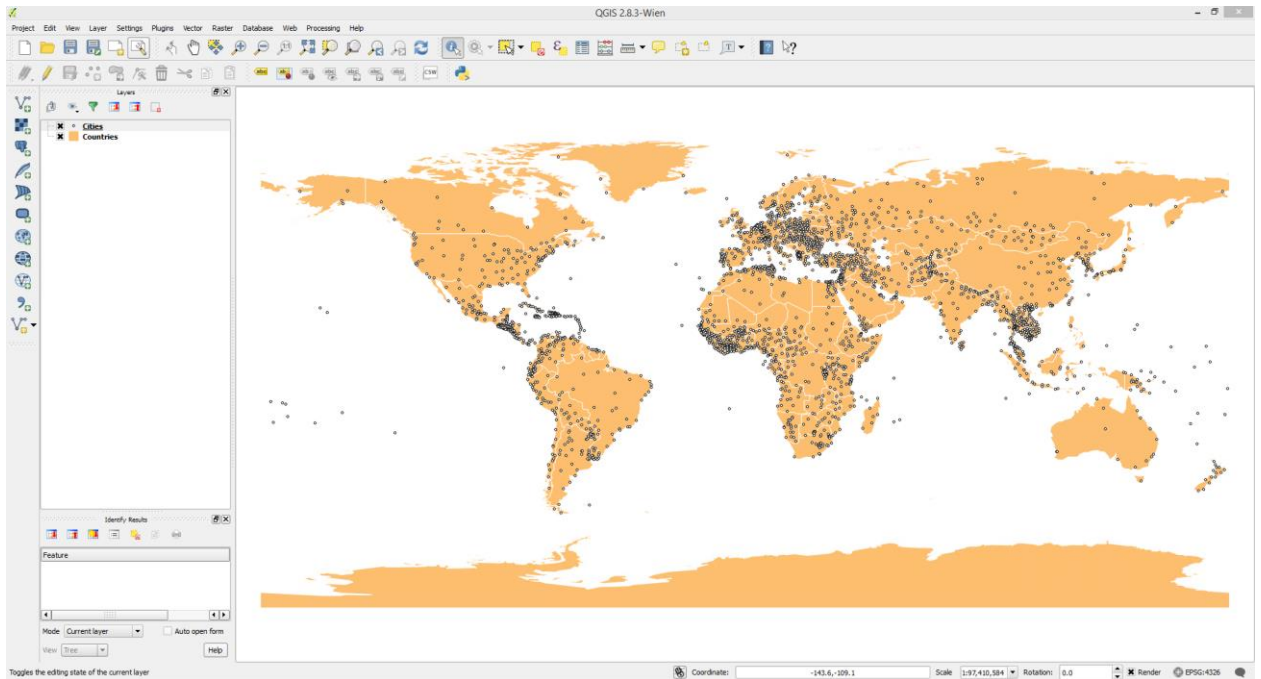
26. In the **Legend**, toggle off the *Cities* layer. The data is still linked in QGIS, but the points are no longer visible.
27. Right click on *Countries* and select **Properties**.
28. Explore the **General** tab, where **Layer name**, **Layer source**, scale range, and selected **Coordinate Reference System** (CRS) are displayed.
29. Click on the **Metadata** tab. At the bottom section of the window, is the **Properties** section. This section includes the spatial extent of the data, where the data are located on your computer, and the geographic coordinate system and projection (if present) of the data. Before creating a map or performing analysis, you will want to ensure that all layers' projections are the same. In this lab, the data are all assigned to *datum=WGS84* and *proj=longlat* - which indicates that it is not projected, and that WGS84 refers to a geographic coordinate system.
30. Select the **Style** tab, and change the color fill and outline of the *Countries* layer by clicking on **Simple Fill** (circled in red ink).



31. In the right panel, select the down arrow next to the fill color and select a **Standard Color**.
32. Once done, click the **Apply** button to reflect these changes in the data frame. And click **OK** to close the menu.
33. Toggle on the *Cities* layer. This time, instead of navigating to the Properties menu via right-click, try this short cut: double click on *Cities*. You will notice the **Style** window looks slightly different. There are several options to note here. The first is the Symbol Type that is on the upper left dropdown box. It should default to Single Symbol. There are several options here, such as **Categorized** and **Graduated**. These two options change the color or size of the symbol according to data. Here, we will keep the value at **Single Symbol**.
34. Select the pre-defined **City** style (circled in red).



35. Colors options are similar to those found in steps 39-43. We will not change these. However, we will look at the size.
36. Change the value in the text box next to **Size** to 1. This can be done by typing it in or by utilizing the up/down arrows next to the box.
37. Click the **Apply** button to see the changes reflected in the **Map View**. And click **OK** to close the window. Your **Map View** should look similar to the figure below:



Exploring the Data: Attribute Table

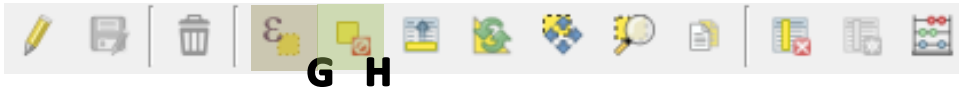
38. Let's explore the attribute table. Right click on *Countries* and select **Open Attribute Table**. Notice that the title bar of the **Attribute Table** indicates that 0 features are selected.
39. Click on the column header titled *NAME* and notice that the records are recorded in ascending alphabetical order:

Attribute table - Countries :: Features total: 246, filtered: 246, selected: 0

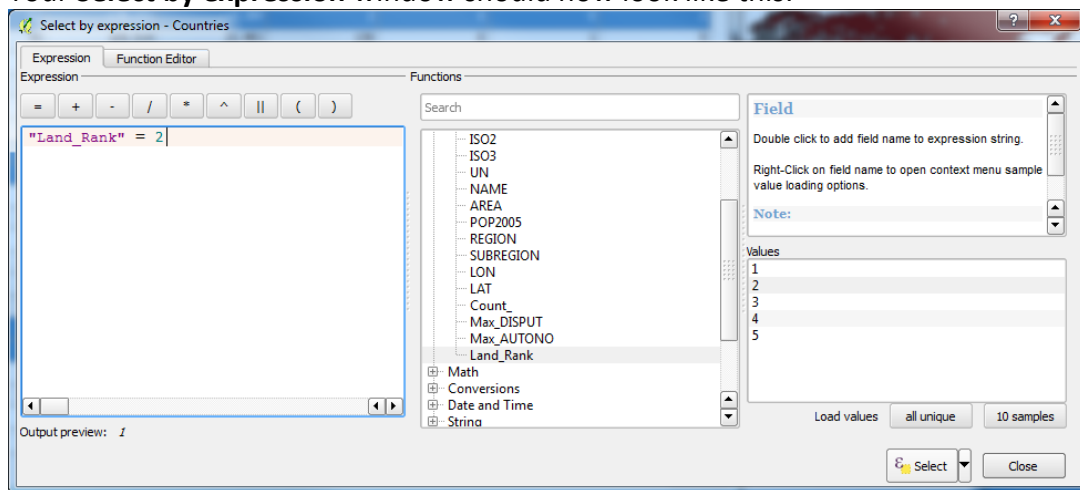
	FIPS	ISO2	ISO3	UN	NAME	AREA	POP2005	REGION
141	NULL	AX	ALA	248	Å. Land Islands	0	0	15
30	AF	AF	AFG	4	Afghanistan	65209	25067407	14
3	AL	AL	ALB	8	Albania	2740	3153731	15
1	AG	DZ	DZA	12	Algeria	238174	32854159	
6	AQ	AS	ASM	16	American Samoa	20	64051	
132	AN	AD	AND	20	Andorra	0	73483	15
5	AO	AO	AGO	24	Angola	124670	16095214	
127	AV	AI	AIA	660	Anguilla	0	12256	1
144	AY	AQ	ATA	10	Antarctica	0	0	
0	AC	AG	ATG	28	Antigua and Barb...	44	83039	1
7	AR	AR	ARG	32	Argentina	273669	38747148	1
4	AM	AM	ARM	51	Armenia	2820	3017661	14
126	AA	AW	ABW	533	Aruba	0	102897	1
8	AS	AU	AUS	36	Australia	768230	20310208	
56	AU	AT	AUT	40	Austria	8245	8291979	15
2	AJ	AZ	AZE	31	Azerbaijan	8260	8352021	14
12	BF	BS	BHS	44	Bahamas	1001	323295	1
9	BA	BH	BHR	48	Bahrain	71	724788	14
13	BG	BD	BGD	50	Bangladesh	13017	15328112	14
10	BB	BB	BRB	52	Barbados	43	291933	1
101	BO	BY	BLR	112	Belarus	20748	9795287	15
128	BE	BE	BEL	56	Belgium	0	10398049	15
14	BH	BZ	BLZ	84	Belize	2281	275546	

Show All Features

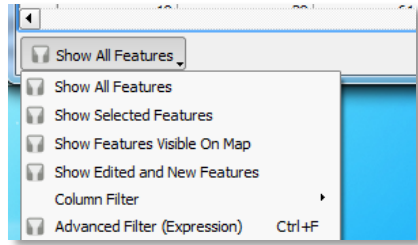
40. Let's explore the relative sizes of the administrative areas in the *Countries* shapefile. In the **Attribute Table**, Scroll right to view the last field, called *Land_Rank*. Scroll down to see the spread of values in the column, *Land_Rank*.
41. In the following steps, we will look at one of the smaller ranks by selecting only those attributes that fall into *Land_Rank* with the value of 2. Click on the **Select features using an expression (G)** button at the top of your **Attribute Table** window, as shown here:



42. In the panel under **Functions**, expand the the **Fields and Values** dropdown. Scroll down, and double click on *Land_Rank*.
43. In the **Expression** panel, click on the **= (equals sign)** button.
44. With the field, *Land_Rank* still selected, look at the right-most panel, and click the button beneath it called **all unique**. All unique values within *Land_Rank* will appear. Double-click the number 2.
45. Your **Select by expression** window should now look like this:



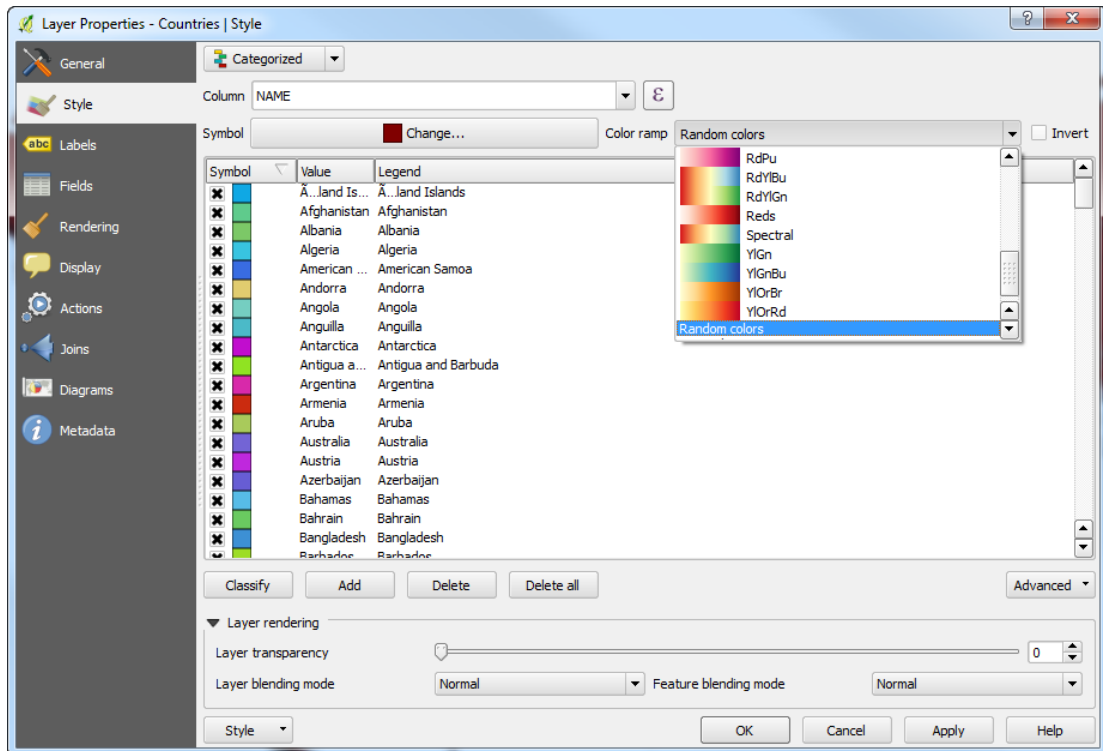
46. Click the **Select** button and then click **Close**.
47. Notice that all the records with a *Land_Rank* of 2 are highlighted blue within the attribute table. You can select the **Show Selected Features** button at the bottom of the **Attribute Table** to only see those highlighted:



48. Close the **Attribute Table** by clicking the **X** in the top right corner. Use your **Zoom Tools (C)** to explore the *Countries* feature class. (Hint: Look in the Caribbean). Once sufficiently zoomed in, notice that places with a *Land_Rank* of 2 are highlighted in yellow (by default).
49. Next we will export this subset of data into a new shapefile. Right click on *Countries* in the **Layers Panel** and select **Save As**.
50. A **Save vector layer as...** window appears. Ensure that the checkbox next to **Save only selected features** is checked under **Encoding**.
51. Using a menu provided by clicking the **Browse** button, navigate to where your other data are stored and save the shapefile as *RankTwo.shp*. It is automatically added to the map.
52. Toggle off selected features in the *Countries* layer. This is accomplished by clicking the **Deselect Features from all layers (H)** button within the **Attributes** tool bar (above).
53. Furthermore, turn off the *Countries* layer in **Layers Panel** by clicking the checkbox next to it. The selected countries from the query in steps 54-58 should be more apparent.

Exploring the Data through Visualization

54. Turn the *Countries* layer back on, and turn off *RankTwo*.
55. Right click on *Countries* and select **Properties**.
56. Select the **Style** tab. Click the button on the upper left that is labeled as **Single Symbol**. A menu should appear. Select **Categorized** from that menu.
57. In the **Column** dropdown, select the *NAME* field. Then, click the **Classify** button below the panel.
58. Select any **Color Ramp** of your choosing. Your menu should look similar to this:



59. Once a color ramp is selected, all the colors should be arranged accordingly. In this case, by alphabetic order of country name. We have given each country its own color. Click the **Apply** button to assign the given colors to each county and click **OK** to close the window.
60. Close the **Properties** dialogue. Ensure that the *Cities* layer is turned on.
61. Double click on *Cities* in the **Layers Panel**.

Graduated Symbol by Size

62. Select the **Style** tab. Click the button on the upper left that is labeled as **Single Symbol**. A menu should appear. Select **Graduated** from that menu.
63. In the Column dropdown, select *POP* (which stands for population). Select a **Color** ramp.
64. Click **Classify** at the bottom of the panel, and then **Apply**.
65. In the bottom right, click **Advanced**. Select **Size scale field** which will produce a symbol size proportional to the selected field. Because using the raw population numbers will produce very large symbols, we will create an expression that uniformly reduces the

overall size of symbols that will represent population size as proportional symbols. Toggle on **Expression**.


66. In the popup menu, expand the **Fields and Values** dropdown under **Functions** and select **POP** by double clicking.
67. Select the divide symbol **/** and type in 100000. This will divide each population by 100,000, making the values smaller for scaled symbols. Click **OK**.
68. Click **Apply** to apply the symbols and **OK** to close the window.
69. Zoom into the **Map View** to see how the symbols are being produced.

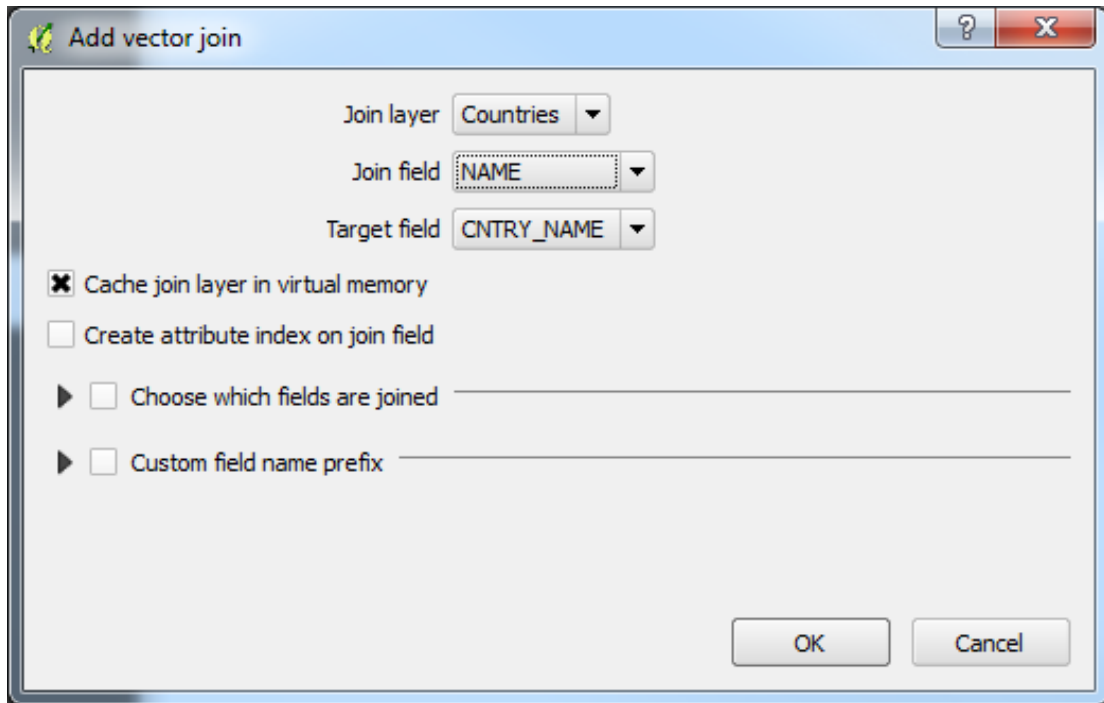
Labeling Data


70. Let's explore labeling our features. To do so, first use what we have learned so far to create a new shapefile of cities with the *Pop_Rank* of 1 (which are the largest cities) and give it a meaningful name, like *LargeCities.shp*. It should be added to your **Layers Panel**.
71. Toggle off the *Cities* layer.
72. Double click on your new shapefile and select the **Labels** tab.
73. Toggle on **Label this layer with** and make sure the **Label Field** dropdown is set to *CITY_NAME*.
74. Click **OK** to see the large cities labeled.

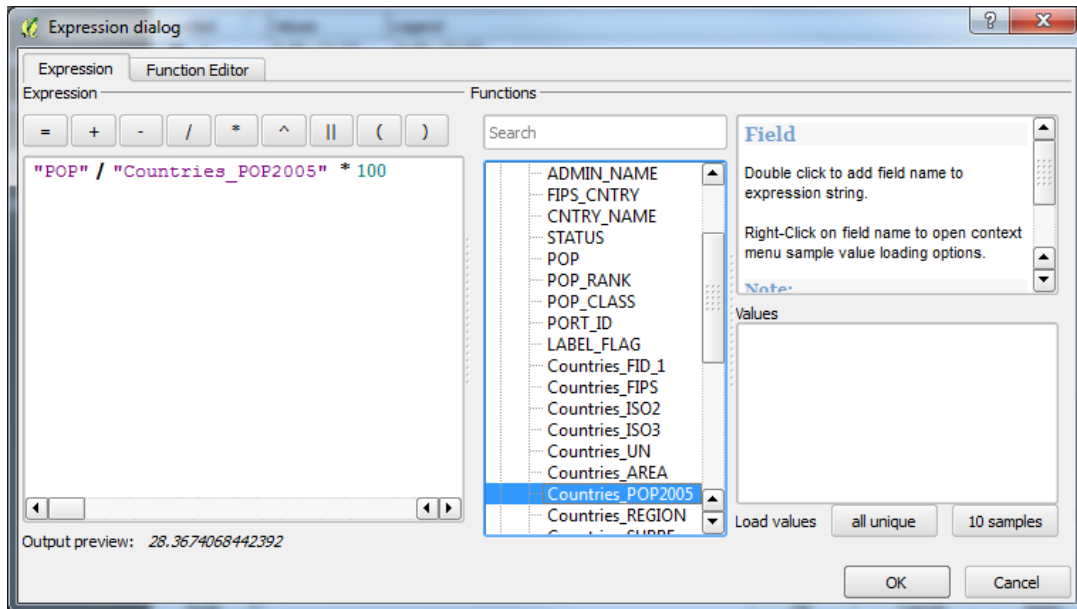
Combine Data by Joining Tables

Let's compare the populations of large cities with the populations of their respective countries. Until now, we have restricted our data to attributes that are within the feature class that we are displaying. However, methods exist to associate data from one feature class or table to another. We can create this association through table joins. By linking uniquely identifying information from one table to corresponding information in another, we can display the joined feature class using data from both.

75. Double click on your *LargeCities* layer and select the **Joins** tab.
76. Click the  button. A menu appears. Complete the menu so it looks like this one:



77. Click **OK** on both windows. Open the **Attribute Table** for your *LargeCities* layer to see that the corresponding country data has been added. Note that in some cases, there are null values. This is because the *CNTRY_NAME* field from the *LargeCities* layer and the *NAME* field from the *Countries* layer are not exactly the same in those cases.
78. Open the **Style** panel to apply **Graduated Symbols** to *LargeCities* layer. This time, instead of selecting the POP field, click the **Expression** button, . We will use the **Expression Dialog** window to normalize each city by its country's population size (city population/country population).
79. Expand **Fields and Values** group in the middle text box, and select the *POP* field.
80. Click on the **Divide** button on top of the left text box. Then select *Countries_POP2005* field.
81. We wish to display the data as percentages. So, we opt to multiply the data by 100. By clicking the **Multiply** button on top of the left text box. Next, key the text, **100**. Your window should be similar to the one below.



82. Click **OK**, then select **Classify** and **OK**.

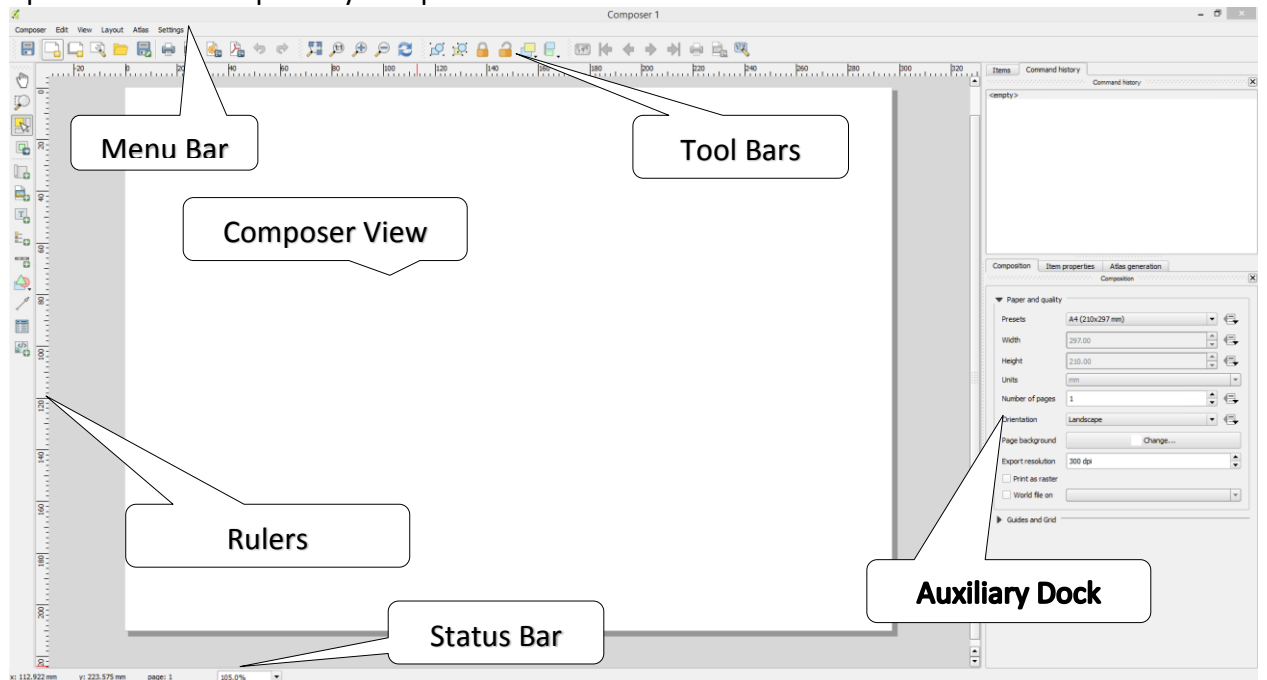
Adding a Basemap

83. QGIS allows you to download a map from the internet, and use it as a base layer in your map. Toggle on only *Countries* and *LargeCities*.
84. Zoom into an area that has a few large cities present, such as South Asia.
85. To see the available maps, we first will need to install a plugin. Select **Plugins** from the **Menu Bar** and select **Manage and Install Plugins**.
86. Search or navigate to **OpenLayers Plugin**. Select it the plugin and click **Install plugin** and click close when the install is complete.
87. On the menu bar, click **Web >> OpenLayers plugin >> Google Maps >> Google Satellite**.
88. The new web map may sit on top of your data. If so, move the Google Maps layer to the below your data within of the **Layers Panel**.
89. Toggle the *Countries* layer on and off to see the web map underneath your other data.
90. Change the transparency of the *Countries* layer by going to right-clicking on the layer and selecting **Properties**. In the **Style** tab, scroll down until you see the **Layer Rendering** section. Move the **Transparency slider** until the value to the right of it is

close to 75. Click the **OK** button. You should be able to see the web map beneath the *Countries* layer now.

Creating a Map

91. In QGIS, the user has an option for making maps called **Print Composer**. To create a new print composer, click on **Project → New Print Composer**.
92. A new window appears that asks for the name of your print composer. You can leave this blank, since we are only making one map from these data.
93. Once a name is assigned to the print composer, an interactive print composer window opens. Review the primary components of the interface:



94. To navigate around **Composer View**, we need to use the **Composer Items** Toolbar, as shown below.

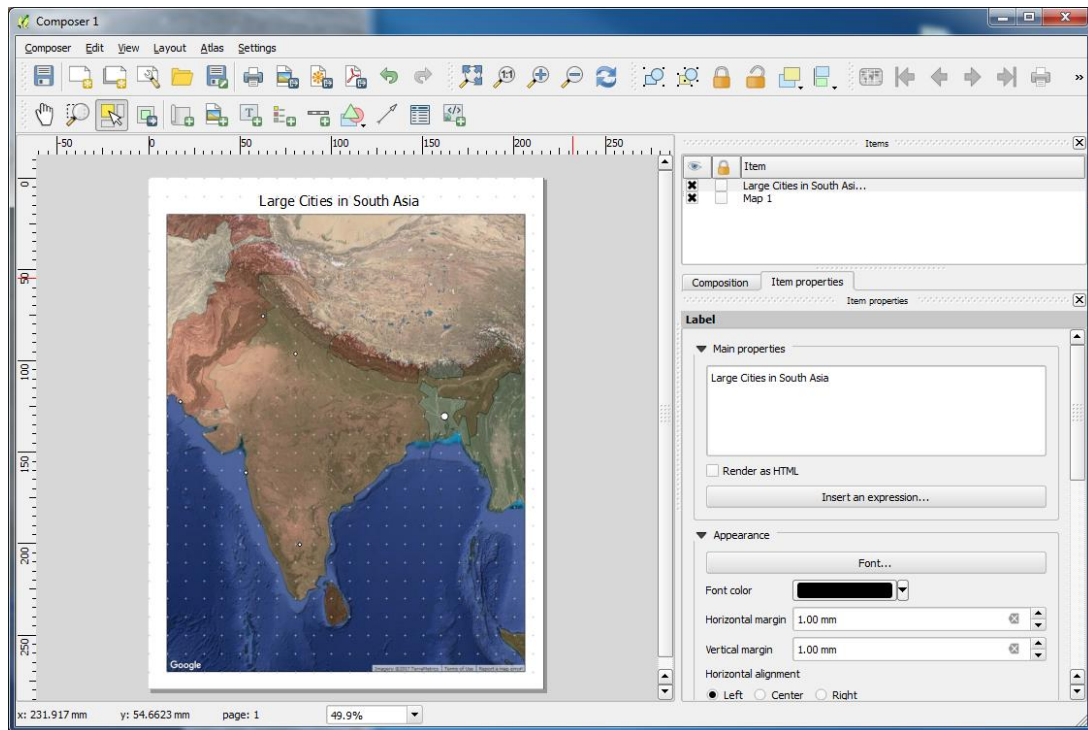


95. Data in composer are organized as maps—which are panes within a composer that contain data and formatting. To navigate within these panes, we use the **Paper Navigation** toolbar (below). To navigate and change display of data, we will make changes within QGIS Desktop, and not composer.



96. To ensure that Composer has the correct page settings, take a moment and navigate to **Composer** → **Page Setup** in the **Menu** bar.
97. Furthermore, ensure that the **Composition** toolbar is visible. To do this, right-click on any blank space in the toolbar location. A list of toolbars appears, ensure that **Composition** is selected. This window, upon activation, is generally within the Auxiliary Dock.
98. Since India is a country that has greater size in the north-south direction, we opt for a map of letter size in the *Portrait* orientation. Using the drop-down box next to **Presets**, select **ANSI A (Letter; 8.5X11 in)**
99. Add a map to composer using the **Add Map (I)** button within the **Composer Items** toolbar. Once depressed, you can use your pointer to drag and hold until the desired shape and position of your map is featured in composer. Once you are satisfied, you may let go of the mouse button. A map pane resembling the **Map View** region in QGIS desktop appears. You may need to move the map to a location of your liking, and you can do this by selecting using the **Select/Move item (J)** button.
100. In **QGIS Desktop**, zoom into South Asia—with India fully displayed in the extent. The map in composer will often not be to the scale that you desire. To fix this, we can copy the extent used in **QGIS Desktop** to our map panel by clicking on the map panel, looking at **Item properties** tab within the **Auxiliary Dock**, and clicking the **Set to map canvas extent** button.
101. Let's try changing data display within the map pane. Try toggling your Country layer off. Then, click the **Refresh View (K)** button. The map panel should update accordingly. You can toggle your country layer back on and click **Refresh View (K)** accordingly.
102. We can add a frame around our map in the **Auxiliary Dock** under **Item properties** tab and toggling on **Frame**.
103. We will use the **Composer Items** toolbar to add map elements. In particular, we will use **Add new label (L)**, **Add new legend (M)**, **Add new scalebar (N)**.
104. Select **Add new label (L)**. Your cursor will turn into tiny cross-hairs. Select a region on the Composer View that you would like to place your title. (This is generally in the upper and central portion of your map.) The default text is **QGIS**. Ensure that the title describes the map content, such as *Large Cities in South Asia*.

105. Notice the text is quite small. To remedy this, look into the **Item properties** tab within the **Auxiliary Dock**, and click the **Font...** button under **Appearances**. The **Select Font** window appears. Choose a suitable font size, such as 22pt. The text size should be more appropriate. Take some time center the item and position it to your liking.
106. To use a grid to help you compose your map, select **View** in the **Menu Bar** and select **Show Grid**. Your map should look similar to this:



107. Next click on the **Add New Legend (M)** button. Drag the cross hairs as a rectangle with suitable location with desired size—one such place is the in lower left of our extent within the ocean.
108. With the newly-made legend still selected, look at the **Auxiliary Dock** within the **Item Properties** tab. Ensure that Auto Update is unchecked. Under **Legend Items**, select and remove items that are not the *LargeCities* layer with the **Remove (minus)** button.
109. In the **Main Properties** box within **Item Properties** by delete the word **Legend**. If your legend is well made, you should not need to tell the viewer what it is.
110. Next, we will insert a north arrow. To start this process, click the **Add Image (O)** button. As with other features, draw a rectangle where you plan on inserting this image.

111. Look toward the **Auxiliary Dock** and under the **Item Properties** tab. There will be a word, **Search Directories**. Click on the arrow to the left of this word to expand it.
112. Below is a box that has preloaded images. Scroll down to the bottom of this list to see north arrows. Choose a north arrow to your liking.
113. Below **Search Directories** is **Image Rotation**. Check the box that says **Sync with Map**.
114. The next item to insert is the scale bar. Click **Add new scalebar (N)**. With the scalebar, you only need to select the location, and not the size.
115. Let's configure the scalebar. Look at the **Auxiliary Dock** under the **Item Properties** tab. Here, we have several categories of choices bound by boxes. The first is **Main properties**.
116. Within **Main properties**, please make a choice as to which style you'd like to see your scalebar use.
117. Below **Main properties** is Units category. Under **Units**, you can have the option to change the unit label as well as the scaling parameter. For instance, if you have a unit of Meters and want Kilometers, then you'd select meters as the unit and *1000.0* as the Map units per bar unit. You'd probably change the label to *kilometers*.
118. You can use the **Add new label (L)** in a way similar to how you added the title—just with smaller text. Recommended items to add to a map would be, Geographic and/or Projected Coordinates as well as a brief description of what the map is trying to show.
119. We are officially done with this tutorial with the exception of providing map output. It is recommended that you explore the different options for to style/format your map content.
120. Text fields can accept HTML tags. So, to help you format the data, here are some popular HTML tags (list is not exhaustive by far).

<h1></h1>
<center></center>
121. Let's export the map for use in presentations, papers, or further editing with the image processing software of your choice. This is done by selecting from the **Menu bar >> Composer >> Export as Image**.
122. You can now close the Composer window. Before closing QGIS Desktop, you can select **Project >> Save**. This will save the map document as an .qgs file. The next time you

open the map document, the data layers in the Table of Contents will already be loaded into the program.

123. Your finished product will contain elements similar to the below map:

