02.221 – Lab 1: Making your first map

The data needed for this lab can be found on the course website or downloaded from Dropbox: https://dl.dropboxusercontent.com/u/4837647/lab-week1.zip. Extract the data from the zip file to an appropriate location within your documents.

Goals

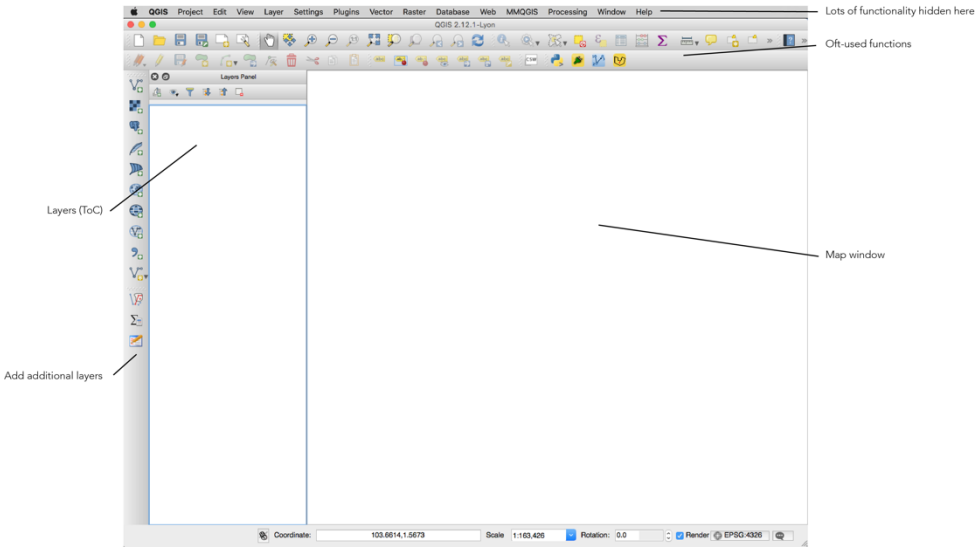
The primary goal of this lab to acquaint yourself with QGIS. You will get familiar with its general structure and layout and with some of its basic functionality. You will practice these skills by styling and adapting a reference map of Singapore.

Background

QGIS, the program you will start using today, is a so-called desktop GIS software. It is designed to help you collect, store, analyze and visualize geographic data from within the convenient environment of a graphical user interface. It is the primary competitor to ESRI's commercial ArcMap software. As it is free, open-source and has a very active developer community around it, it has grown to be quite a capable package. Do not be fooled: QGIS is written in Python and, if you wanted, you can dive under the hood and execute Python code directly without ever touching the graphical menu items.

Getting Familiar with QGIS

To get started, let's open QGIS and get familiar with its basic layout. If you are working on a Mac, you'll find QGIS installed in the 'Applications' folder. Once the program has opened, it should look similar to screenshot below.

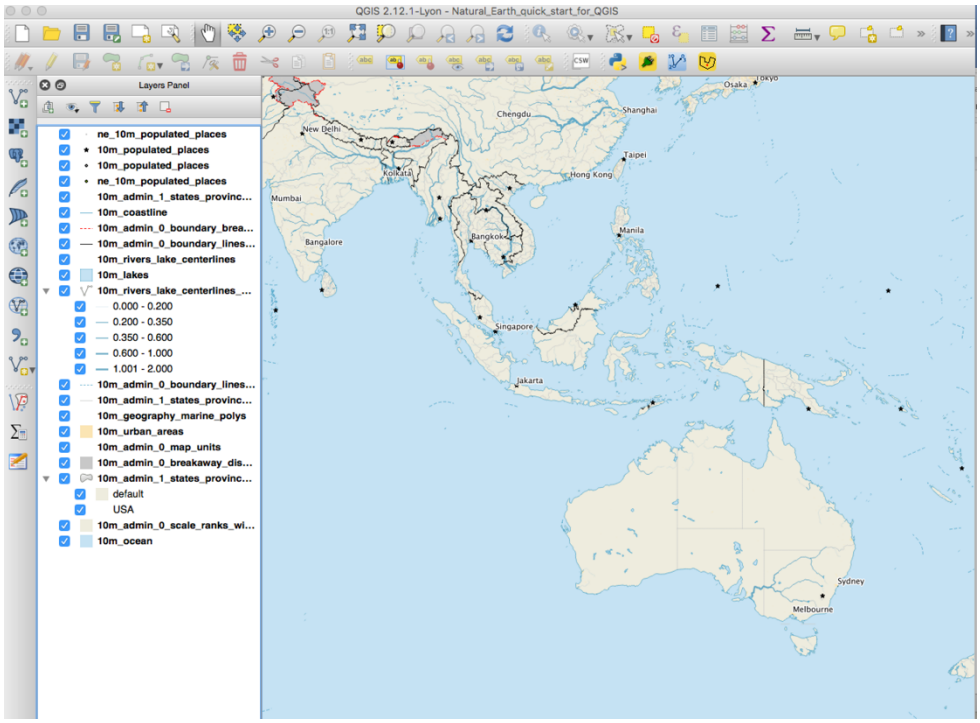


On the left hand side, you will see the Table of Contents or Layers Panel. This is where you find an overview of all the layers in your current map. Currently, of course, it is still empty. The main part of the program is the 'Map Window' where

you see a visual plot of your map/layers. The top part of the window consists of the menu bar and a variety of toolbars. This is where you start your analysis, add layers, zoom in/out: in short, anything you do to manipulate the map goes via one of these buttons or menu items.

Most GIS programs, including QGIS, use two types of files. The first are actual data files – they contain the geographic data to be analyzed or visualized. The second are 'project' files. They basically consist of metadata for a single project: what data files are used and how they are to be visualized. In QGIS, project files have the .qgs extension.

Navigate to Project | Open. Within the zip file for this lab, you find two directories: 'singapore' and 'world'. To get started, open the project file: world/Natural_Earth_quick_start_for_QGIS.qgs.



Like most maps, this map is built from a number of different data layers or files. The files are listed in drawing order in the Layers Panel. Try to change the order of the layers or toggle some of them off to see what effect that has.

Just like you are used to from Google Maps, you can interact with the map. Using the toolbar displayed below, click on the magnification symbol and try zooming in on Singapore (tip: you can draw a rectangle around the area of interest). You can use the little hand symbol to pan around the map. Whenever you're lost and want to

go back to the full extent of the map, click the icon  or use the back-and-forth arrows to go to the previous zoom level  .

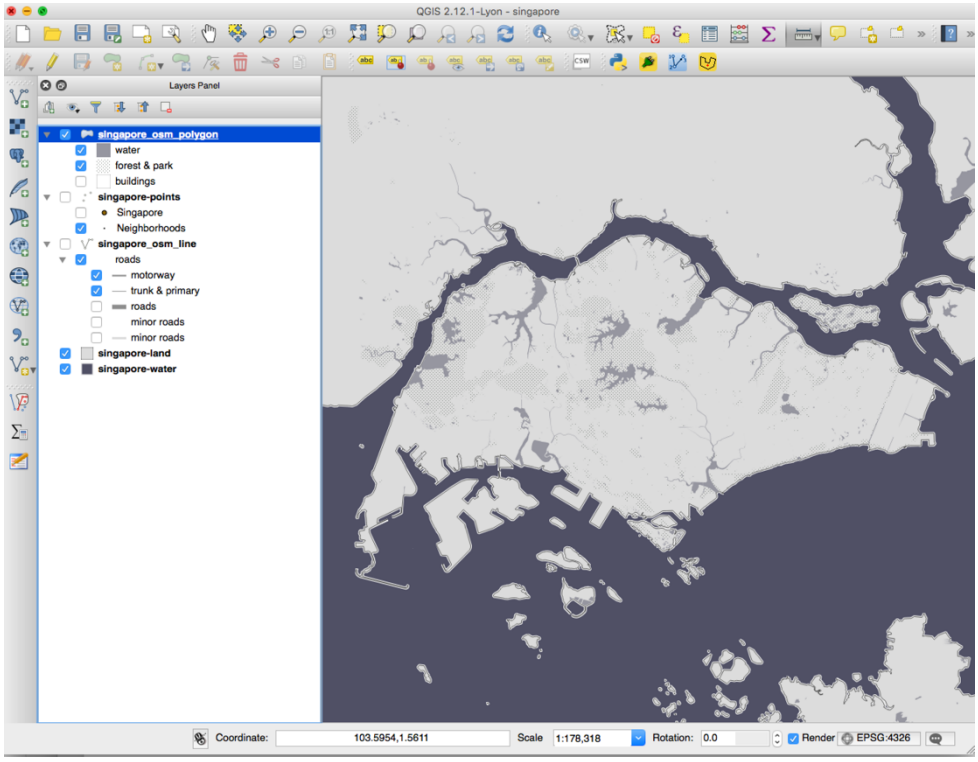
Zoom back out and use the Measure tool  to calculate the distance between Singapore and Taipei in kilometers. *Write your answer down.*

There is a lot of data behind what we see visually. This is a big difference with, for example, Google Maps. QGIS allows us to explore, interact and analyze the data instead of just looking at a visual representation. We can use the Identify tool  to explore some of that data. Pan and zoom to the Middle East and click on Afghanistan with the Identify tool. You will see a little table 'Identify Results' with all kinds of information in the left column of your screen. Note that QGIS will display the data of the currently *active* layer. In other words, if you want to see a country's information, you have to make sure you click once on the country layer in the Layers Panel first! You might have to search a bit for the correct layer – in international context, countries are often referred to as admin 0 units. What is the estimated population (*pop_est*) of Afghanistan? *Write your answer down.*

If you wanted to determine the population of a whole set of countries, clicking each and every single one of them would be rather inefficient. We know that QGIS visualizes each data layer you see based on a table of data. You can look at the underlying table easily. Right-click (ctrl-click on Mac) on the layer of interest in the 'Layer Panel' and choose 'Open Attribute Table'. For example, let's find out which countries have the highest Gross Domestic Product (GDP) in the world according to this data source. Open the attribute table for the country layer and find the right variable. Now try to *sort* the data table based on that variable. What country is ranked number 5 in the world in terms of GDP? *Write your answer down.*

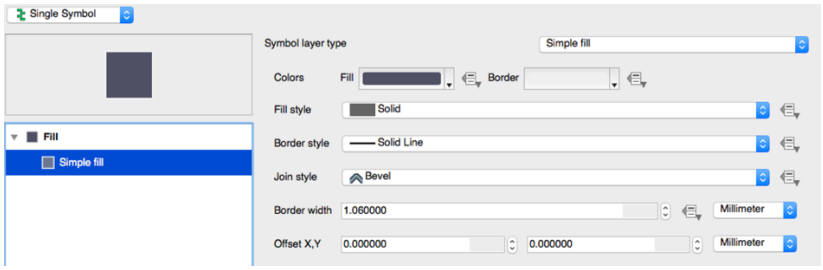
The map you are currently looking at is a so-called reference map. Reference maps mainly focus on portraying the specific location of geographic features. Google Maps is a reference map; as is, for example, a road atlas or a world map you hang on the wall. The other type of maps, thematic maps, show *themes*. These do not have to be geographic features but could be any aspect of the social or physical world: from temperature and rainfall maps to maps of population and poverty. You can imagine that, for this type of map, a variable like GDP can be used to dynamically change the color of a country based on its GDP. We will make many of these thematic maps in the upcoming labs but for now we will focus on reference maps. In the next section, you will style such a map for Singapore.

Go to File | Open to open a new project. Do not worry about saving this one – we do not need it anymore. Choose to open the singapore/singapore.qgs project now.

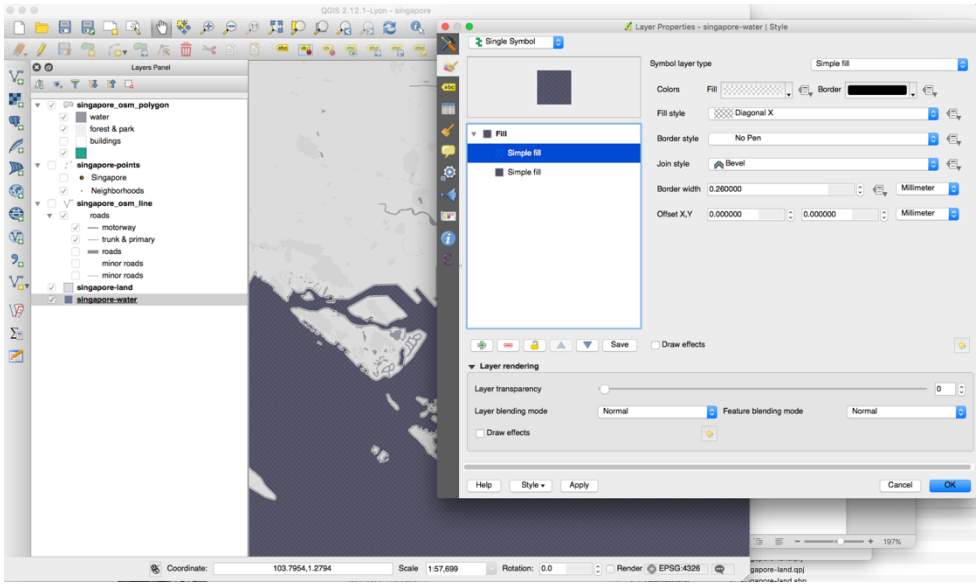


Similar to the previous project, you see that a number of data layers and some basic styling has already been set up for you. By toggling each layer on and off, you should get a quick sense of what each layer represents. The water layer represents the sea; the land layer the surface of dry land; the lines seem to be mostly roads; while the polygons consist of water bodies, forest and buildings.

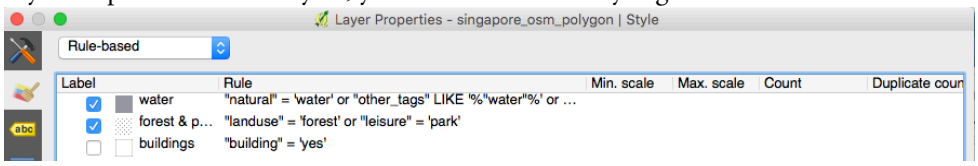
The first thing we are going to do is figure out how specific colors are assigned to each of these layers and geographic features. Right-click on the singapore-water layer and select Properties. *Tip: you can do the same by just double-clicking on a layer.* Within the Layer Properties window, you see a number of tabs on the left-hand side. The one we are concerned with now is called 'Style' . Here, you see that water is currently represented by a simple fill color. Clicking on 'Simple Fill' will show how that fill is constructed out of a solid fill color and a light gray border with a width of 1.06mm:



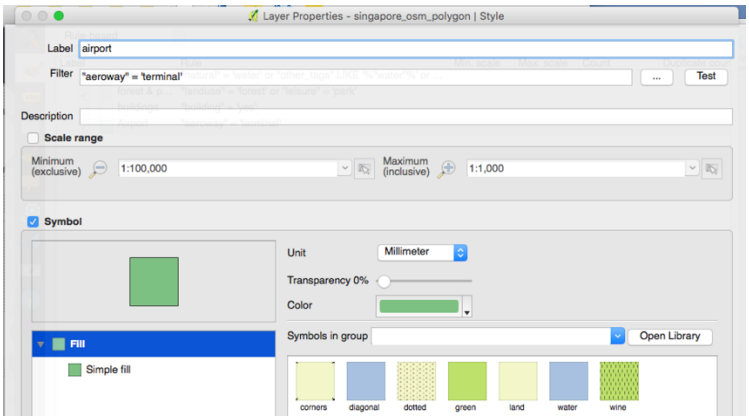
Try to change the fill color, border color and border width to see its effect. Note that you can also layer multiple fill colors and effects on top of each other. You could for example create a subtle hatch pattern on top of the water. Try to recreate this effect:



You can use the same technique to change the colors, outlines and line widths of some of the other features on the map. However, you will soon notice that the 'line', 'points' and 'polygon' layers are bit different from the 'singapore-water' layer. While the latter represents a single feature type ('ocean'), the former has multiple different types of geographic features contained within one single layer. When you look at the Style Properties of these layers, you will see that the styling is *rule-based*:

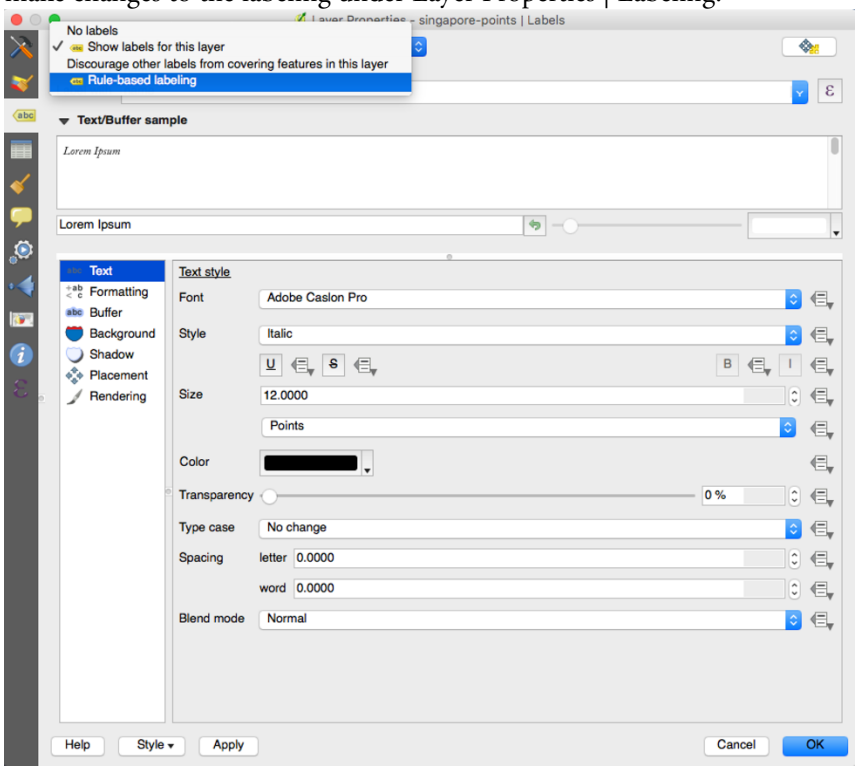


In fact, these layers contain information on a myriad of different features that are not even displayed here. The rules listed here are applied to make a selection of features that fit the rule and then style accordingly. You can add new features/rules quite easily. For example, to add airports, you would type either "aeroway" = 'terminal' to display only the terminal buildings, or "aeroway" IS NOT NULL to display the entire area of the airport.



You can use the same technique to, for example, add symbols for MRT stations ('railway' = 'station'). *Tip: you can use the Attribute Table to explore all the features in each layer and find out additional filters you could use to add features to your map.*

With just a few of these layers and a good set of colors you can design quite an effective reference map in no time! But there is one aspect of reference maps we haven't discussed yet: labeling. Although many maps do not have any labels, often it is useful to include a few labels to serve as reference for the map reader. When you activate the 'singapore-points' layer, you will see that each neighborhood in the dataset gets labeled with its name in italic type. You can see how this is set up and make changes to the labeling under Layer Properties | Labeling.



Here, you can change the font, style, spacing and many additional elements. You can add a halo, change the exact placement of the label or use rules to display labels for some features but not for others. As the semester progresses, we will use some of these more advanced features but for now try to experiment with these options and see the changes reflected on the map.

Assignment

On the class website, you will find the assignment for this lab. It consists of the questions above where you were asked to write down your answer. In addition, you need to prepare and design your own reference map of Singapore. You have creative freedom to design as you see fit but do need to take the following into account:

- Change the color scheme from the default. You can think of going completely black-and-white, revert from dark-on-light to light-on-dark or pick a more colorful representation. We will talk about color theory and the use of color in maps in more detail in subsequent weeks. If you need some quick inspiration now, check out the palettes at colourlovers.com.
- Experiment with line widths, borders, hash patterns or labeling styles. You will notice that, when it comes to map design, less is often more. Maps generally tend to contain a lot of information and to display that much information without turning it into a visual cacophony is a real challenge!
- You can display as many or as few layers as you want but you do need to display at least one feature type that was not present yet in the project originally. This could be the airport referenced above, but I encourage you to be creative (MRT stations, train tracks, ferry lines etc.).
- Remember to save your project (Project | Save) often. We will use this map as an underlying basemap for future thematic maps so please be sure to save your project in a way that you can find it again!
- When you are done, save a PNG image of your map (either showing the entire island or a zoomed-in view of a neighborhood) by going to Project | Save As Image
- Embed the image in your assignment and write 1-2 paragraphs on your design: what features did you choose to display, how did you style them display and why; were there any design aspects that you wished to achieve but were not able to?

The assignment needs to be submitted as a single PDF file. Please make sure you submit the assigned by **February 2.**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Tiong Bahru
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Sentosa