

# OPEN MAPPING EDUCATION SERIES

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GIS MODULES 1-3

Developed By: Maggie Cawley & Steven Johnson



# GIS MODULE 1

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## INTRODUCTION TO GIS & DATA



# LEARNING OBJECTIVES

In this module, you will learn:

- What is a Geographic Information System (GIS)
- How to download and install your own GIS
- Find QGIS help & technical support
- Information about data and U.S. Census datasets
- How to download TIGER shapefiles from the U.S. Census website
- Time Required: 10-15 minutes

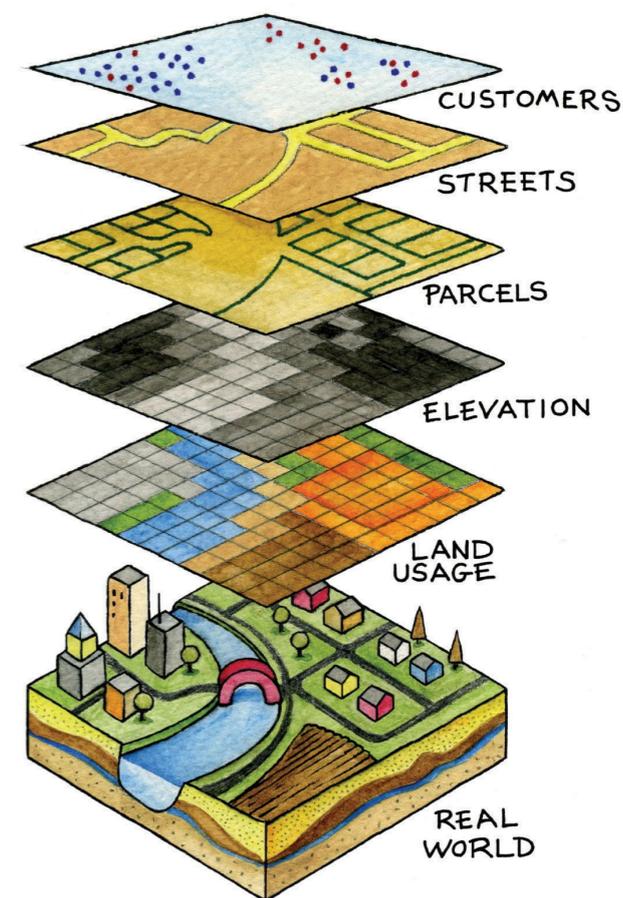
# PART ONE - GEOGRAPHIC INFORMATION SYSTEM (GIS)

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# WHAT IS A GEOGRAPHIC INFORMATION SYSTEM (GIS)?

- Software designed to capture, store, manipulate, analyze, manage, and present all types of geographical data.
- The key word is *Geography* – meaning that some portion of the data is spatial. Spatial describes how objects fit together in space, either among planets or down here on earth
- With a GIS application you can:
  - Identify distributions, relationships, and trends
  - Combine and overlay data to solve problems
  - Map and model scenarios.
  - Answer questions and visualize answers.
  - Make predictions based on spatial data trends.



Layers representing features in our environment can be visualized in a GIS

# A FEW APPLICATIONS OF GIS

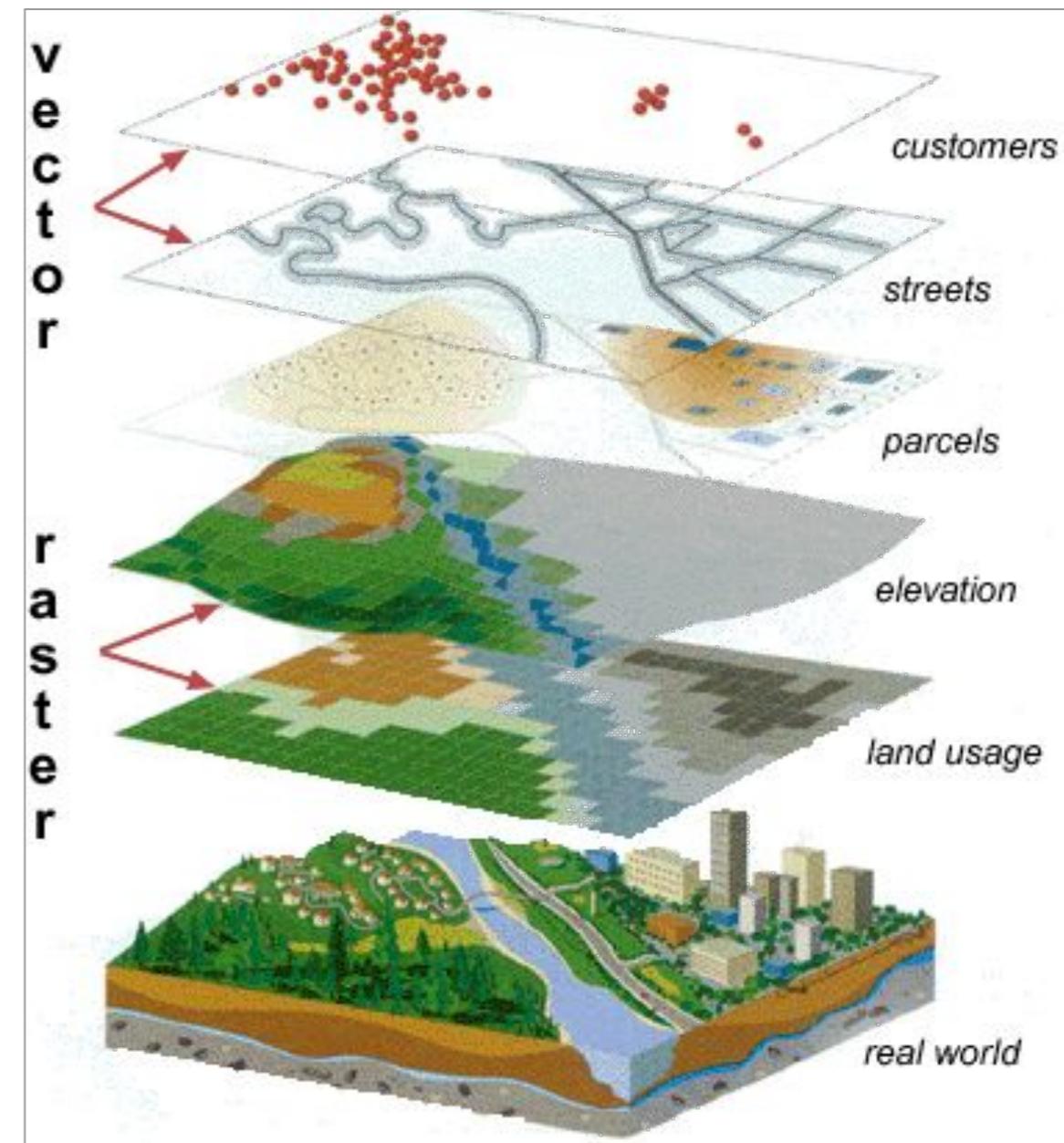
- **Agriculture** - Analyze soil data and decide where to plant crops, estimate crop yields, and create more effective farming techniques.
- **Disaster Risk Management** - Display areas likely to be prone to natural or man-made disasters and develop preventive measures.
- **Urban Planning** - Map urban growth and find suitable sites for further development; map and plan transportation networks.
- **Business Applications** - Map customer location, business location, optimize sales territories, and model retail spending patterns.
- **Public Health & Epidemiology** - Map patterns of disease and causal relationships with the environmental factors and other correlations.



# GIS & MAP COMPONENTS

In a GIS, a map is made up of layers.

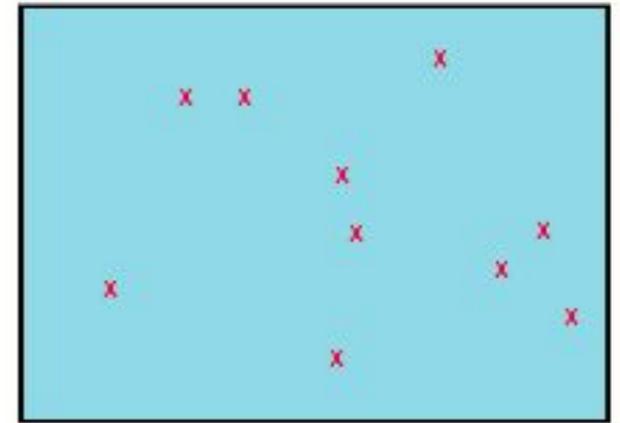
- Layers represent real world features, which are anything you can see on the landscape.
- GIS allows you to overlay multiple features.
- Features have attributes, which consist of text or numerical information that describe the features.
- Layers data are either *vector* or *raster* format.



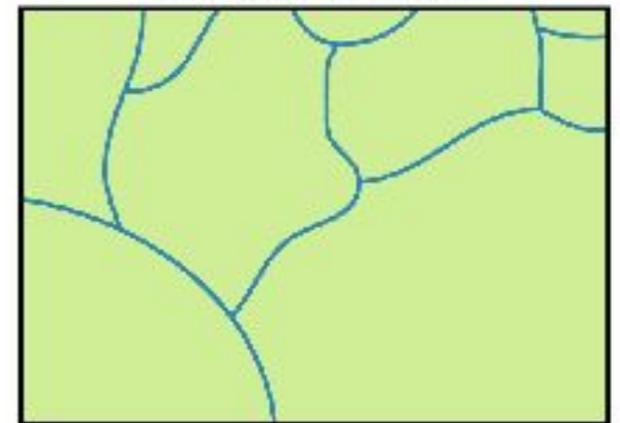
# MAP COMPONENTS - VECTOR LAYERS

All vector map features fall into one of three geometric types:

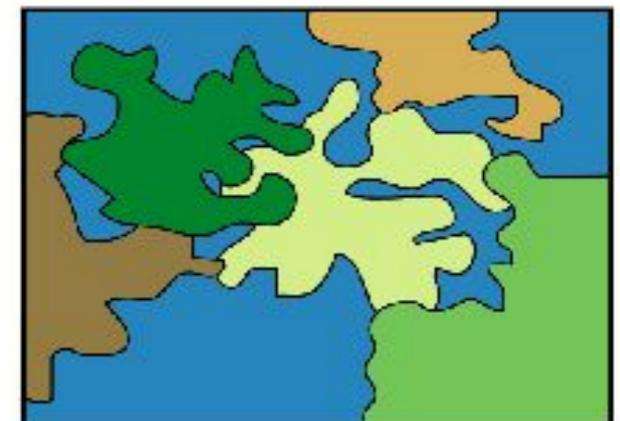
- **Points** - Consists of only a single vertex. E.g. an address, tree, lamp post.
- **Lines** - Consists of two or more vertices and the first and last vertex are not equal. E.g. roads, rivers, trails.
- **Polygons/Area** - Consists of three or more vertices that form an enclosed polygon feature. E.g. a house, soccer field, forests, lakes.



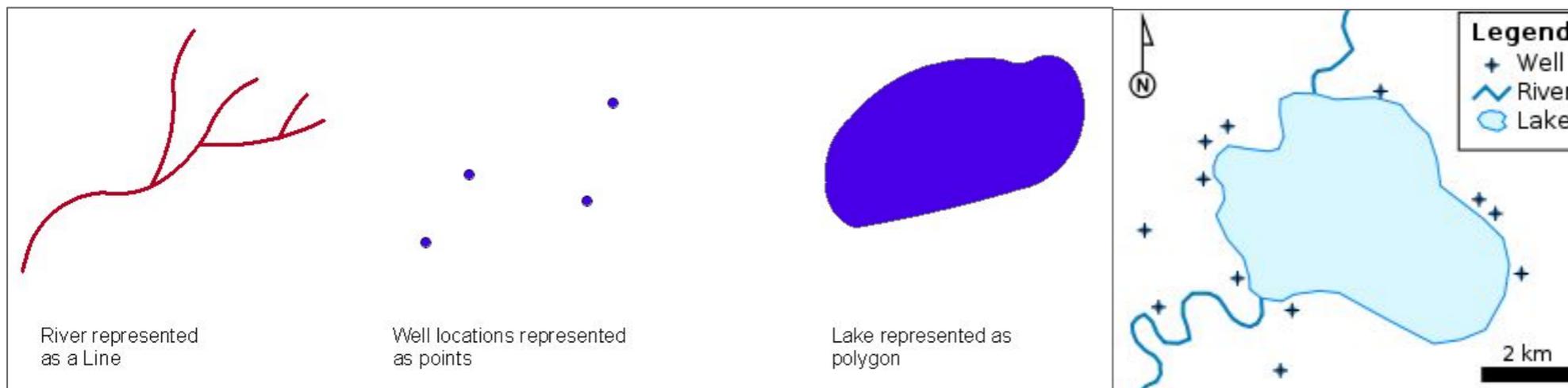
Vector Point Features



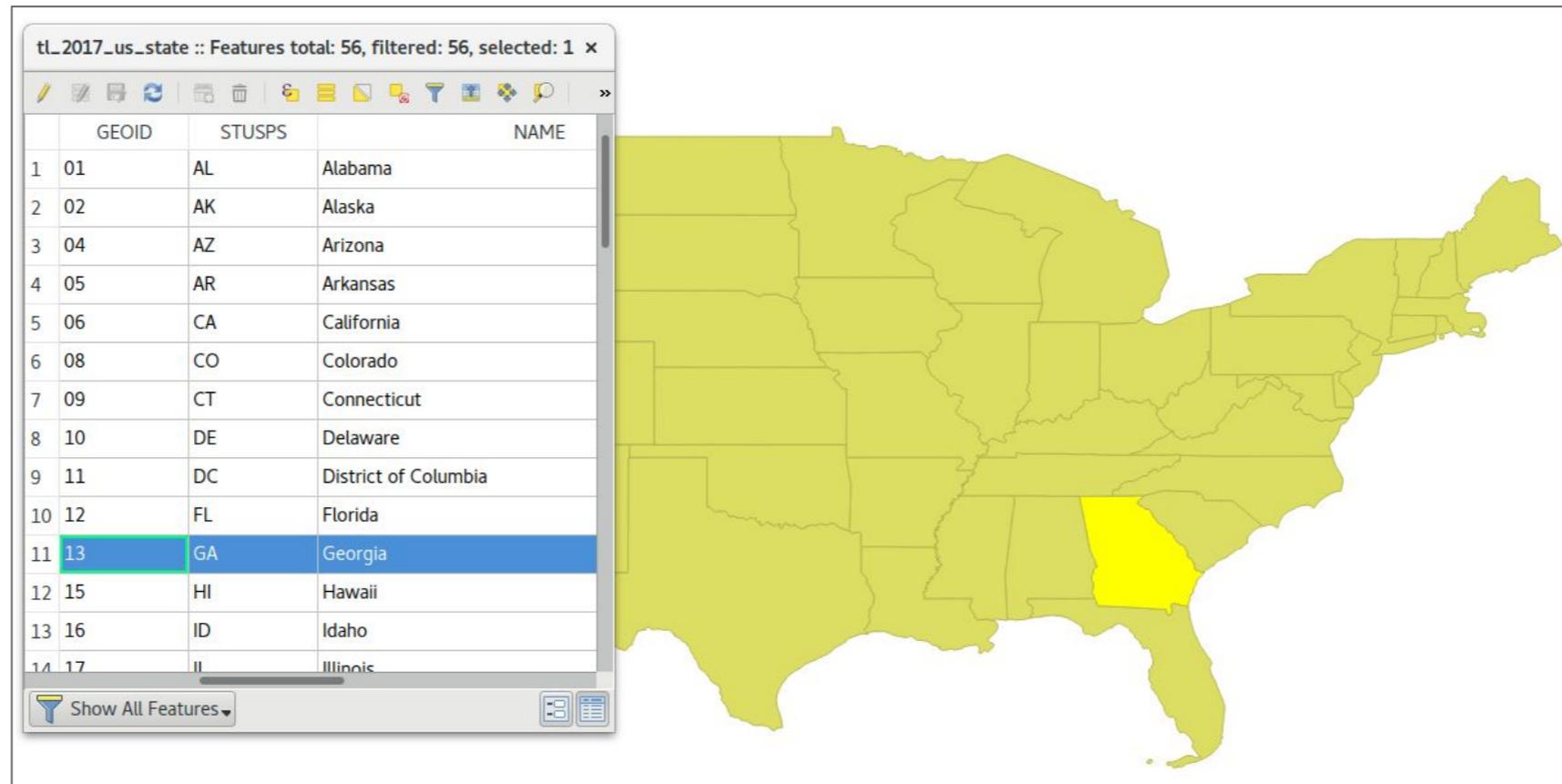
Vector Line Features



Vector Polygon Features



# GEOSPATIAL DATA - VECTOR DATA



This vector layer is of US states. Each feature, or state, has a row in the attribute table. In this visual, Georgia is highlighted in the attribute table and that reflects the map.

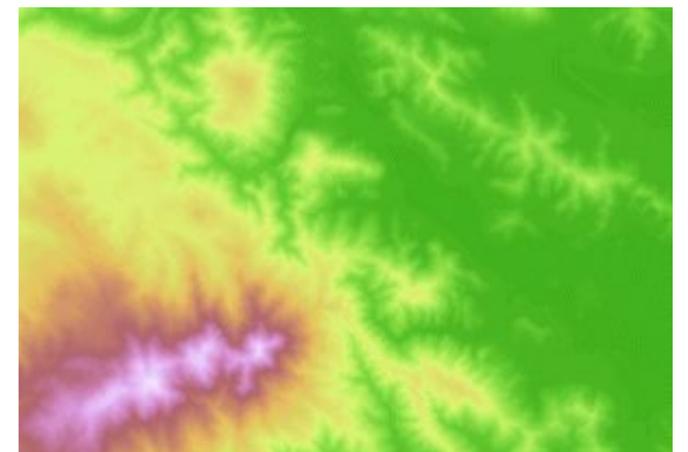
- *Tables* are used to organize feature attributes.
- For each feature in the data layer there is one entry in the table.
- Associated data is held in a relational database system
- You will learn more about attribute tables in Module 2.

# MAP COMPONENTS - RASTER LAYERS

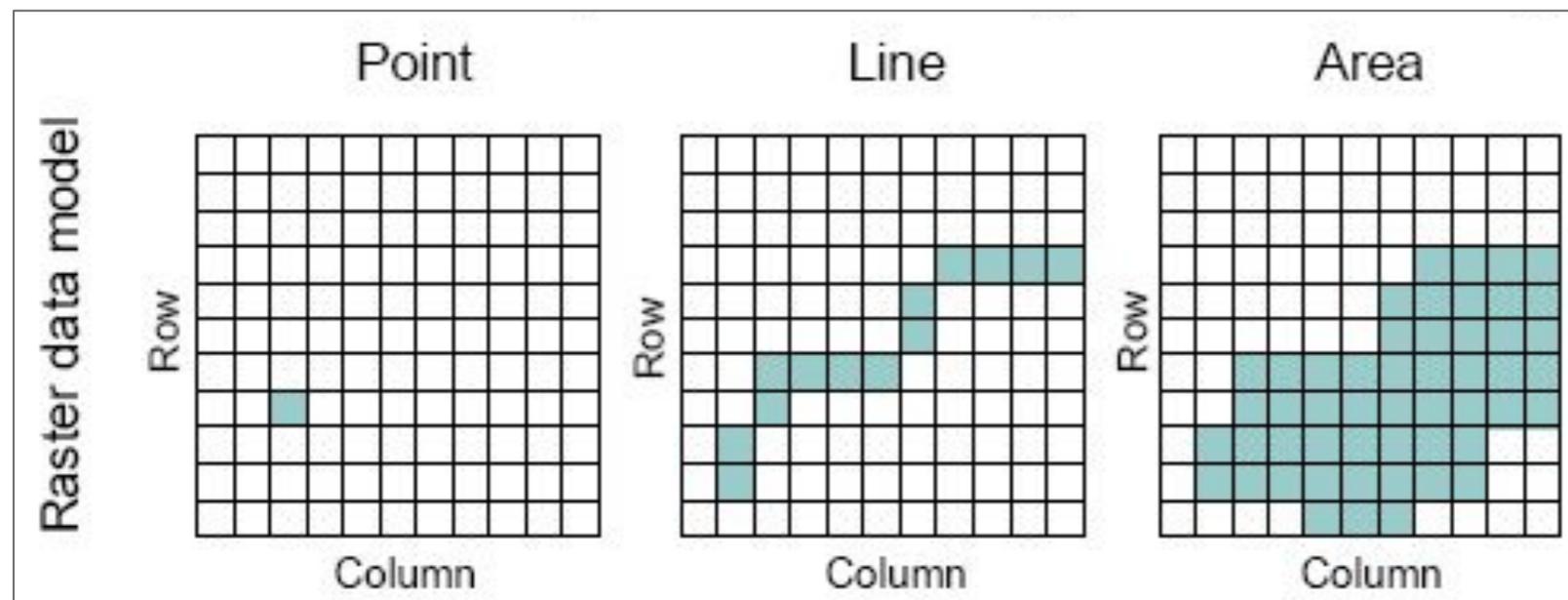
- An image file made up of *pixels* that represent values, just like a photograph.
- Used as base maps, often as satellite images, digital photos or scanned maps.
- The best format to represent data that changes continuously across a landscape (surface)
- Used for thematic maps, often visualizing land use land cover data.



Raster as satellite image base map



Raster visualizing elevation data



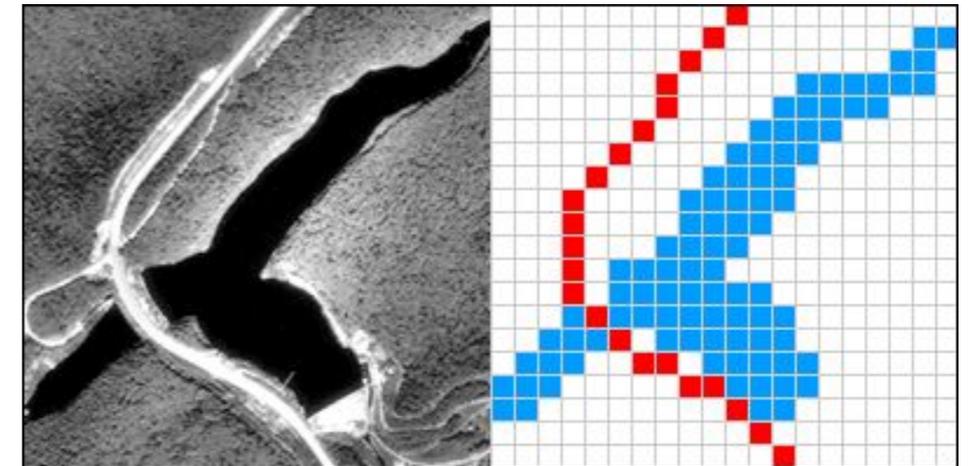
Raster visualizing land cover data

# GEOSPATIAL DATA - RASTER DATA



OID	VALUE	COUNT	TYPE	AREA	CODE
0	1	9	Forest land	8100	FL010
1	2	5	Wetland	4500	WL001
2	3	9	Crop land	8100	CL301
3	4	11	Urban	9900	UL040

Legend: Green, Purple, Yellow, Red, Grey (NoData)



- Cell-based data (not necessarily square) arranged in a regular grid pattern in which each unit (pixel or cell) within the grid is assigned an identifying value based on its characteristics
- Discrete raster data - e.g. population density
- Continuous raster data - e.g. temperature and elevation measurements.
- Three types of raster datasets: thematic data, spectral data, and pictures (imagery).

# GIS IS MAPPING POWERED BY DATA

- A GIS relies on digital geographic data for mapping and analysis.
- A GIS provides the ability to query or search the data, based on one or more criteria, e.g. the state with the highest population density.
- Spatial data enhances the value of the information and allows it to be visualized.
- Trends are easier to spot in a graphic (map) than on a data table 1000's of rows long. GIS enables you to create this visual.
- It is difficult to stack two excel sheets on top of one another and hope to see a pattern, but you can visualize this information and potentially see a pattern in a graphic or map.
- GIS Data Types: Attribute tables - represented in tabular format & Spatially Referenced Data - represented by vector & raster formats.



# GEOGRAPHIC DATA FROM THE US CENSUS

- The Census Bureau's history of mapping population data dates back to the 1790s, but was firmly established in the 1850s.
- Geography plays an important role in creating surveys and collecting data, and it provides meaning and context for our statistics.
- The Census Bureau conducts geographic research, makes reference maps to support censuses and surveys.
- This series introduces you to the **TIGER** and **American Community Survey** datasets.



See all Census geographic datasets here: <https://www.census.gov/geo/maps-data/>



# TIGER - A BASEMAP FOR THE NATION



The Census Bureau offers TIGER data in several formats. For simplicity, these modules will use the most popular options:

**TIGER/Line Shapefiles** - The most comprehensive dataset, designed to be used in a GIS.

**TIGER/Line with Selected Data** - Includes economic & demographic attributes from 2010 Census, ACS 5 year estimates & county business patterns.

## **TIGER = Topologically Integrated Geographic Encoding & Referencing**

- Over 25 years, TIGER has evolved into a dynamic mapping system that helped catapult the growth of the GIS industry and improve Census Bureau data products.
- Developed in preparation for the 1990 Census by the Census Bureau & the U.S. Geological Survey.
- TIGER was the first nationwide digital map of the U.S., Puerto Rico and other territories. Data updated annually and free to download by all.
- TIGER supports the Census Bureau's data collection and dissemination programs, and also support GIS work in many state and local governments.

# DOWNLOAD A TIGER DATASET



- Create a new folder on your desktop called 'Census Data'
- Navigate to <https://www.census.gov/geo/maps-data/data/tiger.html>
- Click on 'TIGER/Line Shapefiles'
- Scroll down and click 'Download'
- Select 'Web Interface'

United States Census Bureau

Topics: Population, Economy; Geography: Maps, Products; Library: Infographics

You are here: [Census.gov](#) > [Geography](#) > [Maps & Data](#) > [TIGER Products](#)

## Geography

Main | About | Maps & Data | Reference | Partnerships | Education

### Maps & Data

- Maps & Data Main Page

### Maps

- Census Data Mapper
- Reference
- Thematic

### TIGER Products

TIGER = Topologically Integrated Geographic Encoding

TIGER products are spatial extracts from the Census Bureau. The Census Bureau offers several file types and an online map.

- [TIGER/Line Shapefiles - New 2017 Shapefiles](#)
- [TIGER/Line Geodatabases](#)

### TIGER/Line Shapefiles - New 2017 Shapefiles

2017	2016	2015	2014
2006SE	Census 2000	1992	

### 2017 TIGER/Line Shapefiles

All legal boundaries and names are as of 2017.

- Download
- Technical Documentation
- File Availability

Download

- Web interface
- FTP site

United States Census Bureau



# DOWNLOAD A TIGER DATASET - STATES



Use the dropdown arrows and select:

- Select Year: 2017
- Select a layer type: States (and equivalent)
- Click 'Submit'
- Click 'Download national file'
- Save the file in your Census Data folder

## TIGER/Line® Shapefiles

Select the year and layer you are interested in from the dropdown menu below and click "Submit" for a list of the available geographic areas.

Select year

Select a layer type

**State and Equivalent (current)**

Name

maggie Documents Census Data



# DOWNLOAD A TIGER DATASET - ROADS



- Return to the web page.
- Click on Return to: 'TIGER/Line Shapefiles Main'.
- Repeat the steps to download a Roads shapefile.
- Select 'Florida' from the dropdown in 'Primary and Secondary Roads'. Click Download.
- Save to your Census Data folder. We will use these two files in the next Module. Let's go!

Return to: [Main Download Page](#) | [TIGER/Line Shapefiles Main](#)

## TIGER/Line® Shapefiles

Select the year and layer you are interested in from the dropdown menus below and click "Submit" for a list of the available geographic areas.

Select year: 2017 ▼

Select a layer type: Roads ▼

Submit

### Primary Roads

Download national file

### Primary and Secondary Roads

Select a State: Florida ▼ Download

File name: tl\_2017\_12\_prisecroads (1)

Save as type: Compressed (zipped) Folder



# DOWNLOAD A TIGER DATASET - PLACES



- Return to the web page.
- Click on Return to: 'TIGER/Line Shapefiles Main.
- Repeat the steps to download a 'Places' shapefile.
- Select 'Florida' from the dropdown. Click Download.
- Save to your Census Data folder.
- We will use these three files in the next Module. Let's go!

Return to: [Main Download Page](#) | [TIGER/Line Shapefiles Main](#)

## TIGER/Line® Shapefiles

Select the year and layer you are interested in from the dropdown menus below and click "Submit" for a list of the available geographic areas.

Select year: 2017 ▼

Select a layer type: Places ▼

Submit

Place (current)

Select a State: Florida ▼ Download

File name: tl\_2017\_12\_place

Save as type: Compressed (zipped) Folder



# PART TWO - INTRODUCING QGIS

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# ABOUT QGIS

- A robust, open source desktop GIS software used to create maps and conduct more advanced geospatial analysis.
- Allows for simple mapping and cartography as well as sophisticated spatial analytical functions, such as cluster analysis and spatial autocorrelation.
- This series will use QGIS to introduce you to key GIS operations.

## OPEN SOURCE: What & Why

- Open source software (OSS) can be defined as computer software for which the human-readable source code is made available under a copyright license (or arrangement such as the public domain) that meets the Open Source Definition.
- This permits users to use, change, and improve the software, and to redistribute it in modified or unmodified form. It is very often developed in a public, collaborative manner.
- Open source has advantages over proprietary solutions such as cost, security, reliability, transparency, and community.

[1] “GNU General Public License”.

[http://en.wikipedia.org/wiki/GNU\\_General\\_Public\\_Lic](http://en.wikipedia.org/wiki/GNU_General_Public_Lic)

See the entire range of documentation and resources at: <https://qgis.org>



# DOWNLOAD QGIS

**QGIS**  
A Free and Open Source Geographic Information System

Get ready for QGIS 3  
Test the release candidate now!

Help test the new version!  
Get the [development version](#) for your Operating System and report any issue you find, so it can be fixed for the 3.0 release!

Create, edit, visualise, analyse and publish geospatial information on Windows, Mac, Linux, BSD (Android coming soon)

For your desktop, server, in your web browser and as developer libraries

[Download Now](#) [Support QGIS](#)

- Navigate to [www.qgis.org](http://www.qgis.org)
- Click 'Download Now'.
- Find your operating system. Click to expand the box.

# DOWNLOAD & INSTALL QGIS

## Windows OS:

- Choose the correct processor speed for your computer (32 or 64 bit) and Click 'QGIS Standalone Installer \_\_\_ bit'.
- Save the file to your desktop or downloads folder.
- Find the downloaded file and click to run. Installation should begin.

The screenshot shows the QGIS download page for Windows. At the top, there are tabs for 'INSTALLATION DOWNLOADS', 'ALL RELEASES', and 'SOURCE CODE'. A red box highlights the 'Download for Windows' button. Below this, the page is titled 'Download for Windows' and lists 'QGIS in OSGeo4W:' options. There are two download links for OSGeo4W Network Installers: 'OSGeo4W Network Installer (64 bit)' and 'OSGeo4W Network Installer (32 bit)'. Below these, there is a section for 'Standalone installers from OSGeo4W packages'. Under 'Latest release (richest on features):', there is a red box around the 'QGIS Standalone Installer Version 2.18 (64 bit)' option. At the bottom of the page, there is a search bar with the text 'QGIS-OSGeo4W-2.18.16-1-Setup-x86\_64.exe' and a 'Save' button, both highlighted with red boxes.

Name

QGIS-OSGeo4W-2.18.16-1-Setup-x86\_64.exe

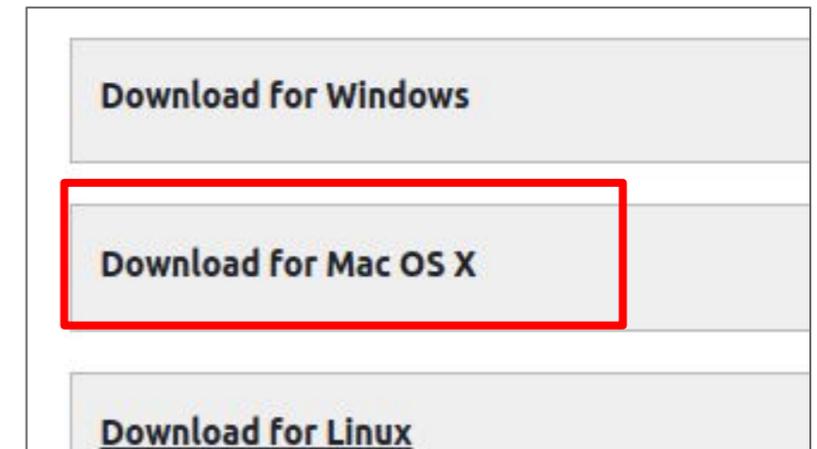


Save

# DOWNLOAD & INSTALL QGIS

## Mac OS:

- Click on 'Download for Mac OS X'
- Click the King Chaos link. A new window will open.
- Scroll down to the Download section and click to download.
- Save the 4 files to your desktop.
- Install the GDAL, NumPy, etc first, then install QGIS.



A screenshot of a web browser displaying the QGIS download page on the KingChaos Wiki. The page features a yin-yang logo and a breadcrumb trail: 'You are here: KingChaos Wiki » Software » QGIS'. A sidebar on the left contains a 'Main Menu' with links to 'Anime &amp; Manga', 'Mac OS X Porting Software', and 'Software Menu' (which includes 'SumomOS', 'UNIX Porting Downloads', 'Frameworks', 'QGIS', 'PostgreSQL', 'Python Modules', 'GRASS GIS', 'PHP', 'MapServer', and 'Download Archive'), and a 'FAQ' section with links to 'Installation Guide' and 'Developer Notes'. The main content area is titled 'QGIS' and contains text about Mac OS X installers, an installation note, and a 'Current' section. A red box highlights the 'Download:' section, which lists 'QGIS 2.18.15-4 [287.4 MiB]'. At the bottom of the page, there is a search bar and a 'Save' button.



# TECHNICAL SUPPORT

Additional installation support can be found on the QGIS All Downloads page:

<https://qgis.org/en/site/forusers/alldownloads.html>

## NOTE:

If you do not have a computer available, there is also an experimental version of QGIS available for Android.

<https://play.google.com/store/apps/details?id=org.qgis.qgis>

# NEXT IN THE PATH - GIS MODULE 2

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QGIS BASICS I - THE INTERFACE

