

# OPEN MAPPING EDUCATION SERIES

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GIS MODULES 1-5

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# 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
- About data and U.S. Census datasets
- How to download Census TIGER data

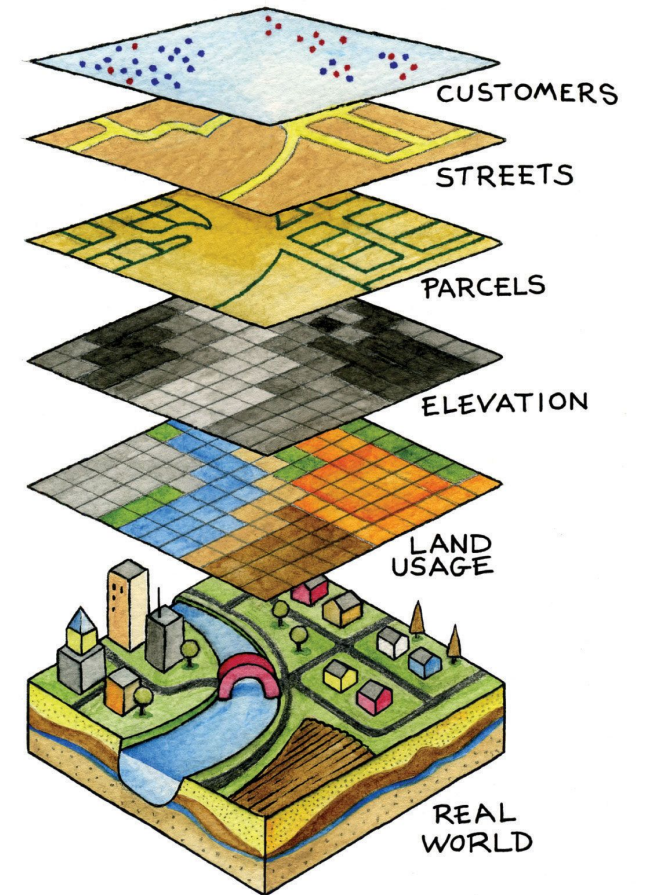
# PART ONE - GEOGRAPHIC INFORMATION SYSTEMS (GIS)

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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

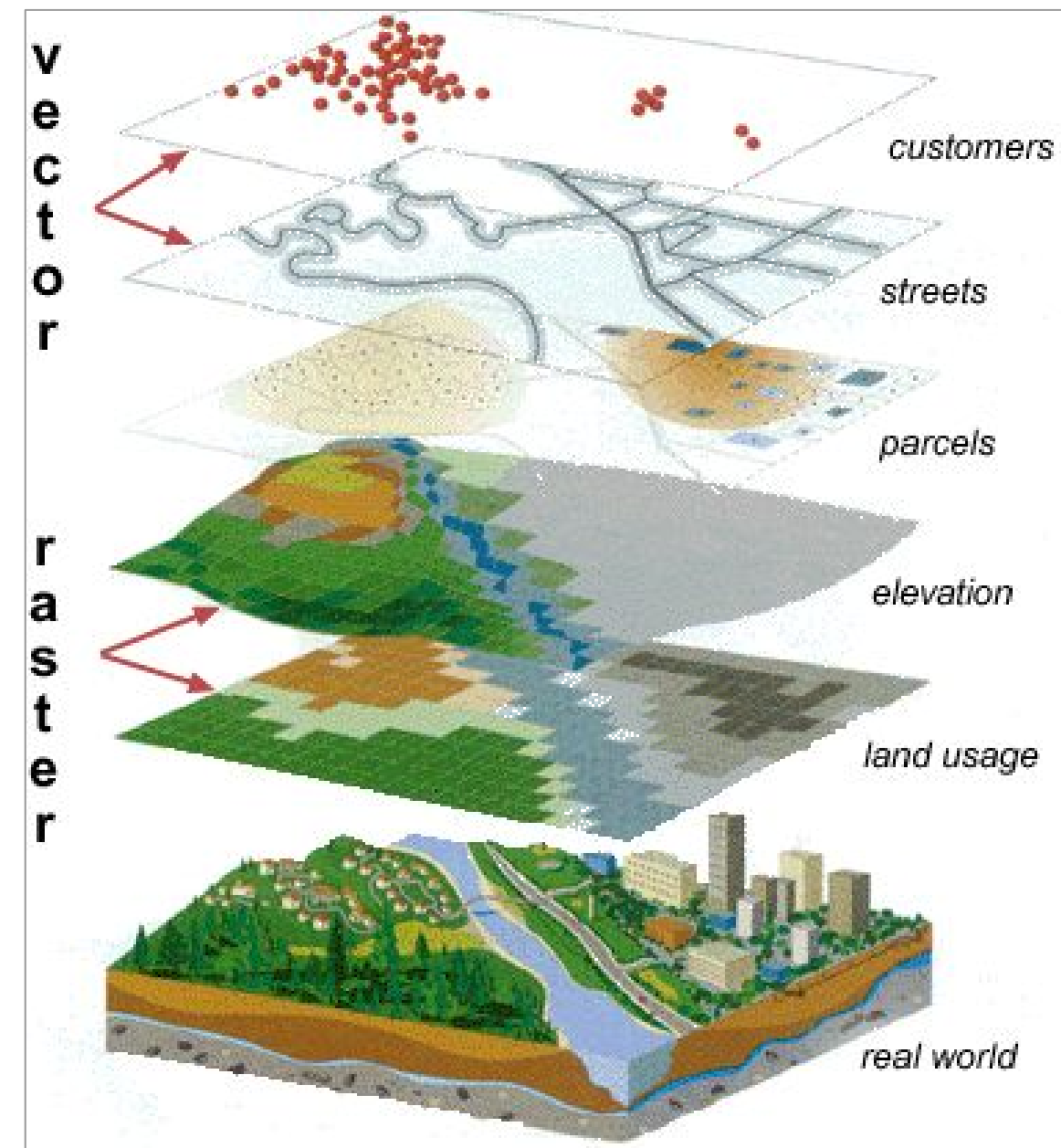
# A FEW APPLICATIONS OF GIS

- **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.

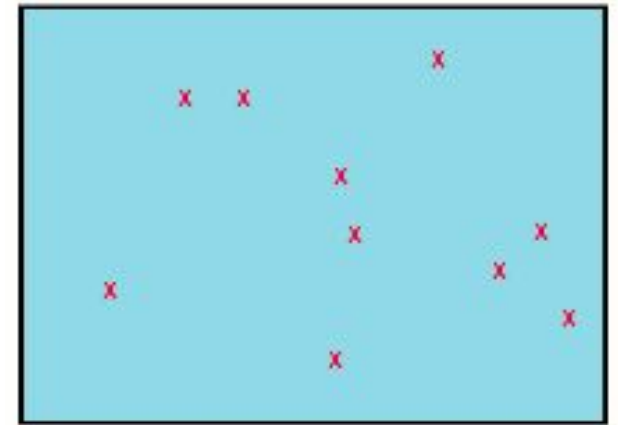




# MAP COMPONENTS - VECTOR LAYERS

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.



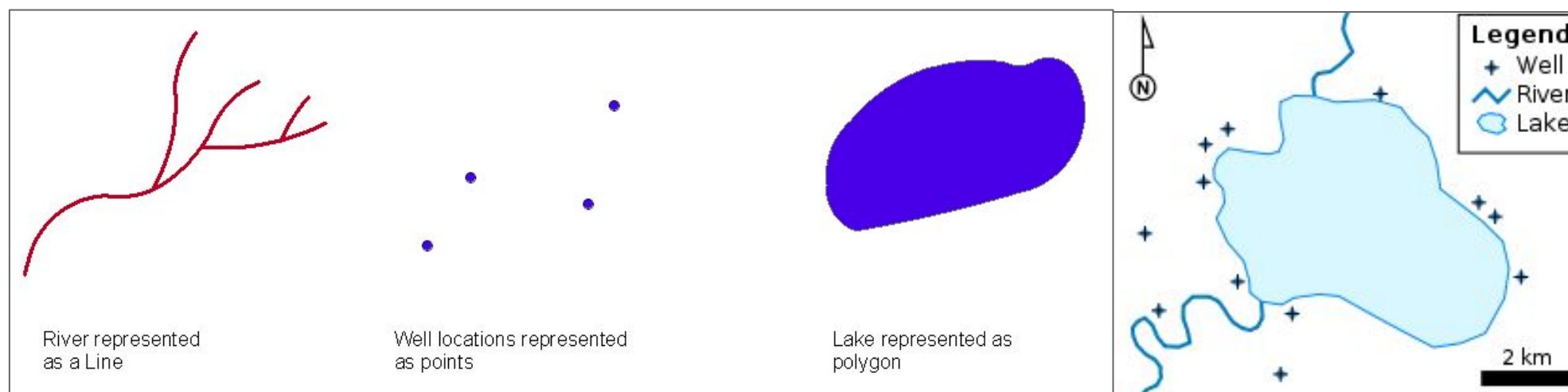
Vector Point Features



Vector Line Features



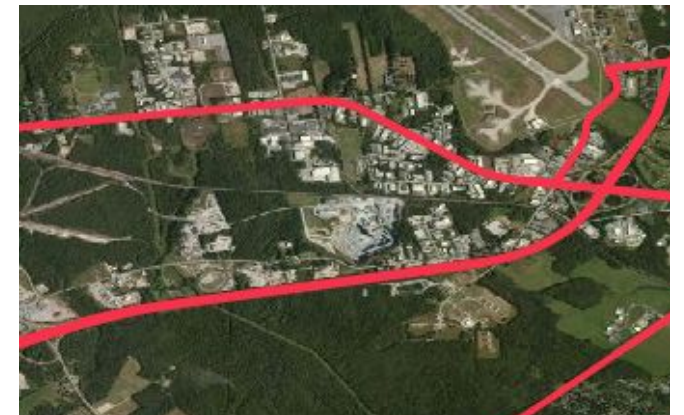
Vector Polygon Features



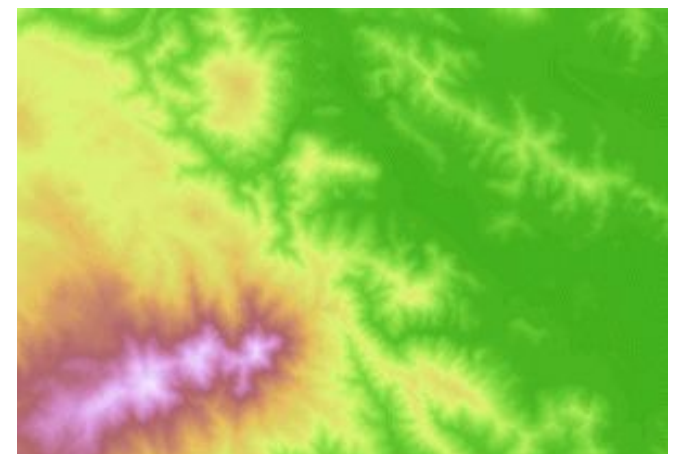


# MAP COMPONENTS - RASTER LAYERS

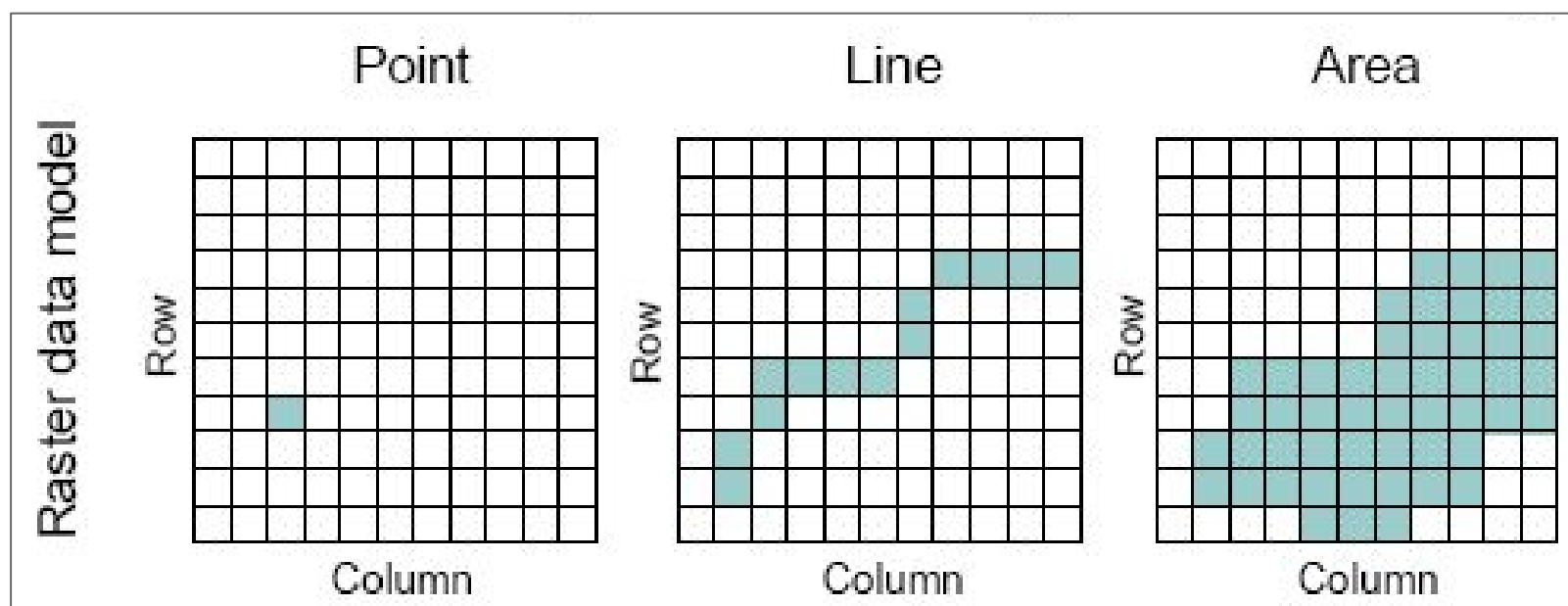
- An image file made up of *pixels* that represent values, just like a photograph.
- Used as base maps, often as satellite images, digital photos or scanned maps.
- The best format to represent data that changes continuously across a landscape (surface)
- Used for thematic maps, often visualizing land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



Raster as satellite image base map



Raster visualizing elevation data



Raster visualizing land cover data

# PART TWO - INTRODUCING QGIS

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# ABOUT QGIS



- A robust, desktop GIS software used to create maps and conduct more advanced geospatial analysis.
- A full-functioned, open source GIS package that allows for simple mapping and cartography as well as sophisticated spatial analytical functions, such as cluster analysis and spatial autocorrelation.
- Open Source: GNU General Public License (GPL) “which guarantees end users (individuals, organizations, companies) the freedoms to use, study, share (copy), and modify the software.[1]”
- This series will introduce you to the key functions of QGIS.

<https://qgis.org>

[1] “GNU General Public License”. [http://en.wikipedia.org/wiki/GNU\\_General\\_Public\\_License](http://en.wikipedia.org/wiki/GNU_General_Public_License). Retrieved 06 November 2013



# DOWNLOAD QGIS

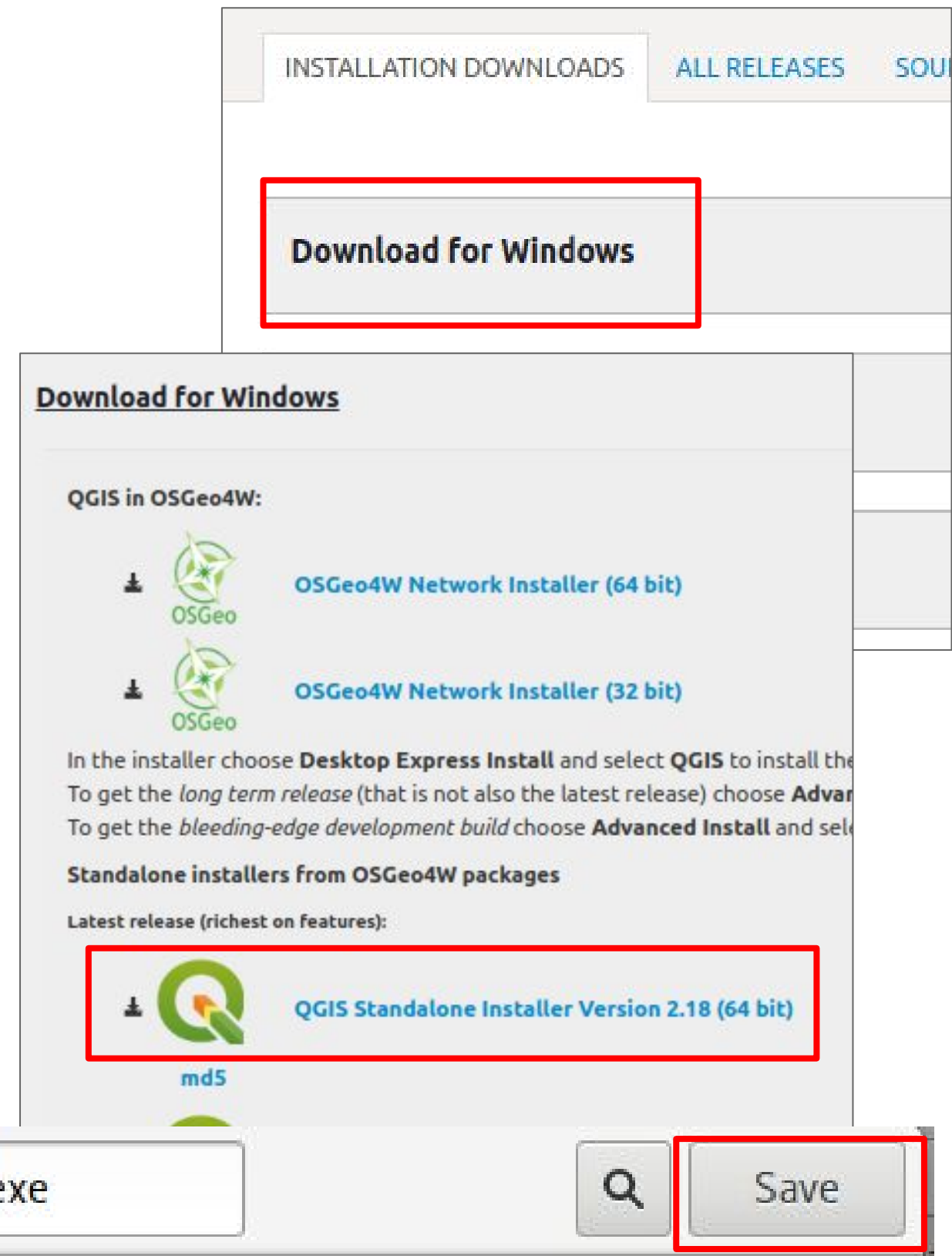


- Navigate to [www.qgis.org](http://www.qgis.org)
- Click 'Download Now'.
- Find your operating system. Click to expand the box.

# 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.





# 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.

The image shows a screenshot of a web browser displaying the QGIS download page on the KingChaos Wiki. The page has a header with a yin-yang logo and a quote. A navigation menu on the left includes 'Main Menu' and 'Software Menu'. The 'Software Menu' lists various software categories, with 'QGIS' highlighted. The main content area is titled 'QGIS' and provides instructions for downloading the Mac OS X installer. A red box highlights the 'Download for Mac OS X' button in the top navigation bar. Another red box highlights the 'Download:' section, which lists the file 'QGIS 2.18.15-4 [287.4 MiB]'. Below the webpage, a file save dialog is visible, showing the filename 'QGIS-2.18.15-4.dmg' and buttons for 'Save' and 'Cancel'.

Download for Windows

Download for Mac OS X

Download for Linux

“The beast is actively interested only in now, and, as it accom  
- the

You are here: KingChaos Wiki » Software » QGIS

**Main Menu**  
Anime & Manga  
Mac OS X Porting  
Software

**Software Menu**  
SumomOS  
UNIX Porting Downloads

- Frameworks
- QGIS
- PostgreSQL
- Python Modules
- GRASS GIS
- PHP
- MapServer
- Download Archive

FAQ  
Installation Guide  
Developer Notes

Search Search

**QGIS**

Mac OS X installers for [QGIS](#). For OS X Mt Lion and newer. Inst version for feature stability for a year.

*Install Note:* OS X security may block installation, as I'm not an "ider it to install - right-click the installer file and select **Open**, this will trig this once, the system will remember the QGIS installer for any future

**Current**

All required items are included on the disk image.

**WARNING:** QGIS will crash if Qt4 developer components are inst QGIS.

**Optional:**

- other Python Modules for plugins

**Download:**

- QGIS 2.18.15-4 [287.4 MiB].

See the [QGIS website](#) for more information about, and help with

QGIS includes its own internal copies of GRASS, Orfeo Toolbox, S

Name QGIS-2.18.15-4.dmg

Save

# 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>



# PART THREE - GIS & DATA

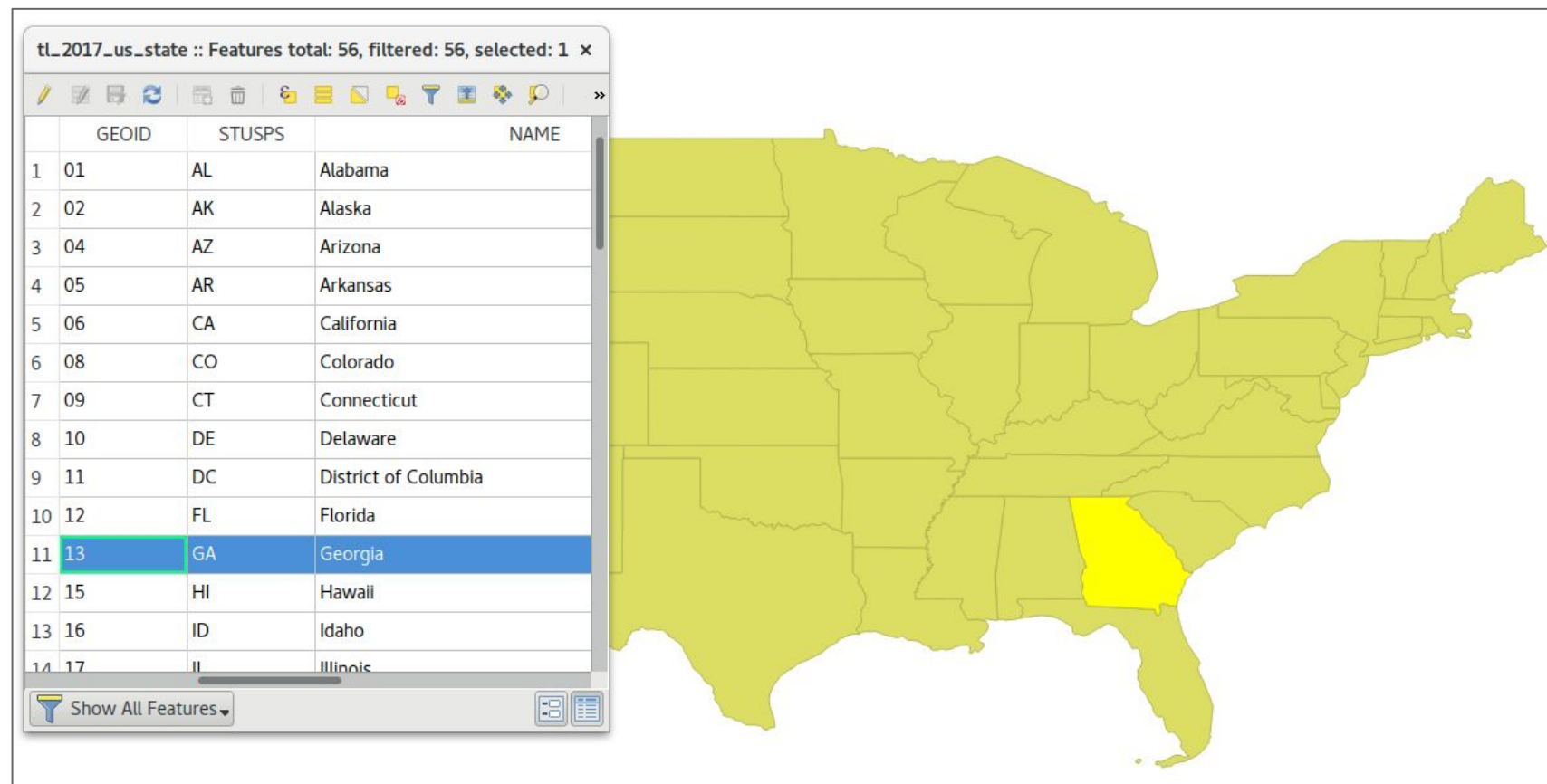
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# GIS & DATA

- 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.

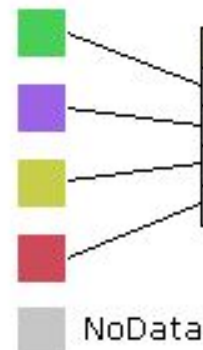
# GEOSPATIAL DATA - VECTOR DATA



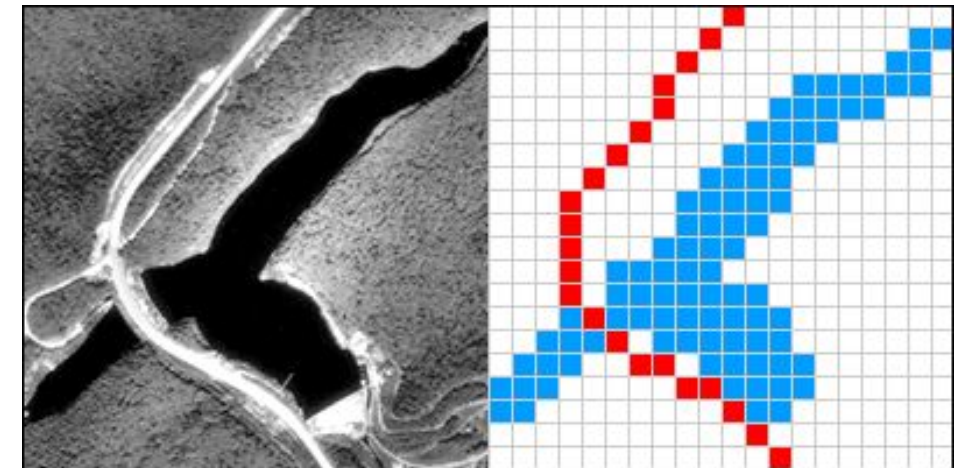
This vector layer is of US states. Each feature, or state, has a row in the attribute table. In this visual, Georgia is highlighted in the attribute table and that reflects the map.

- 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.

# 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



- 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).



# US CENSUS GEOGRAPHIC DATASETS

- 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 - 25 YEARS OF NATIONWIDE DATA

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. Use in a GIS.

**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'

The screenshot shows the United States Census Bureau website. The 'Geography' section is active, with a sub-menu for 'Maps & Data'. Under 'Maps & Data', the 'TIGER Products' link is highlighted. A red box highlights the 'TIGER/Line Shapefiles - New 2017 Shapefiles' link. Below this, a table of years is shown, with '2017' selected. A red box highlights the 'Download' button under the '2017 TIGER/Line Shapefiles' section.

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 service.

- [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](#)

The screenshot shows a dropdown menu with the title 'Download'. It contains two options: 'Web interface' and 'FTP site'. A red box highlights the 'Web interface' option.

Download

- [Web interface](#)
- [FTP site](#)



# 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: 2017 ▼

Select a layer type: States (and equivalent) ▼

Submit

**State and Equivalent (current)**

Download national file

Name: tl\_2017\_us\_state.zip

maggie Documents Census Data

Save

# 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 'Maine' 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

Select a layer type

### Primary Roads

### Primary and Secondary Roads

Select a State:

### All Roads

Select a State:

Name

# 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 'Maine' 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

## 2017 TIGER/Line® Shapefiles: Places

Place (current)

Select a State: Maine ▼ Download

Name	tl_2017_23_place.zip		
aggie	Documents	Census Data	▶



# NEXT IN THE SERIES - GIS MODULE 2

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## QGIS BASICS I - THE INTERFACE

