Basics of Geographic Information System

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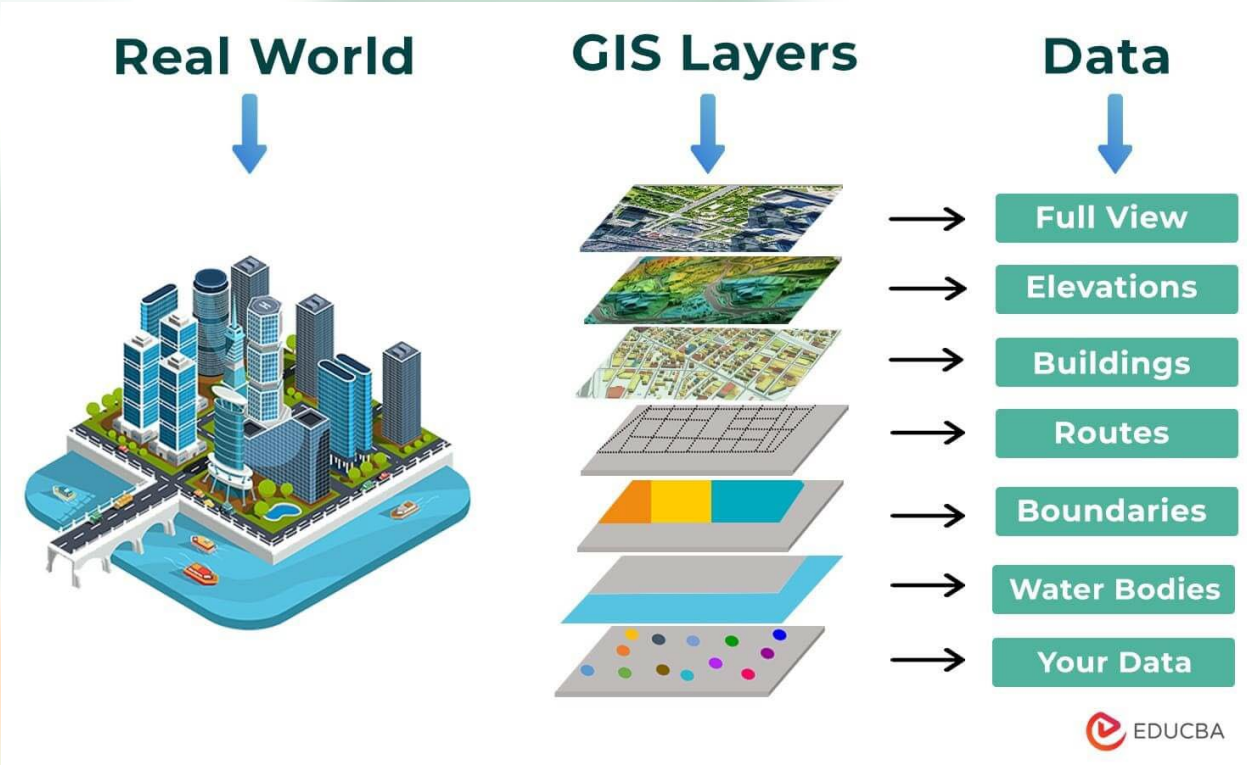
Introduction to GIS

GIS (Geographic Information System) is a framework for

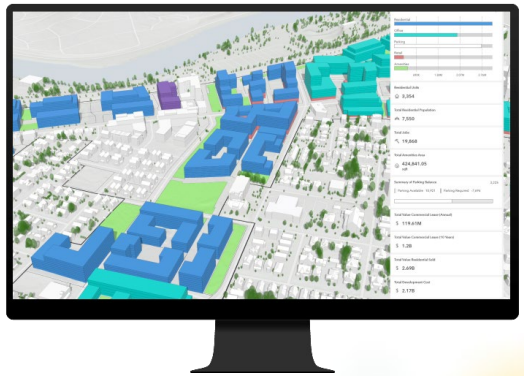
- Gathering
- Managing
- Analyzing
- Manipulating

data related to geographic locations on Earth's surface.

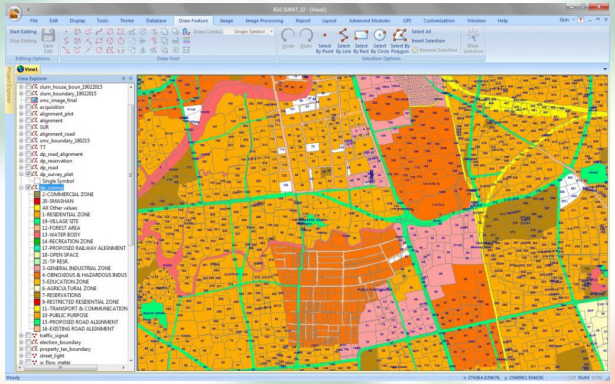
It helps visualize, interpret, and understand patterns, relationships, and trends in data through maps and 3D models.



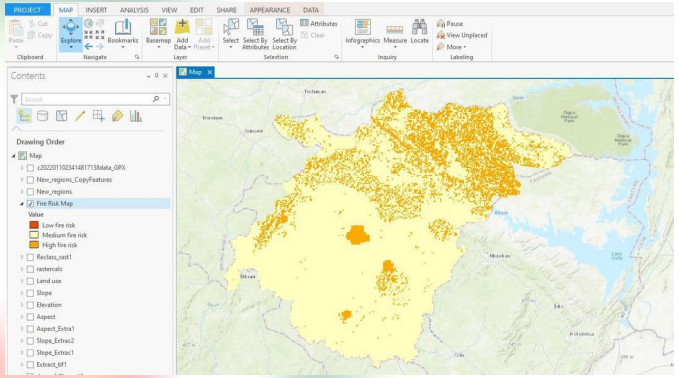
Examples of Real – life Application



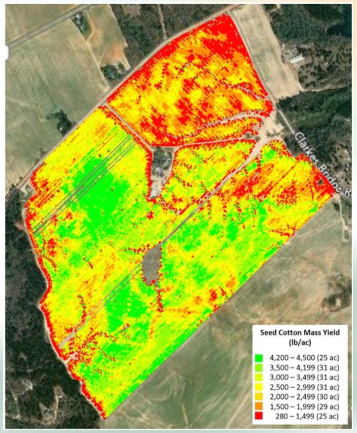
Urban Planning – Zoning, infrastructure design



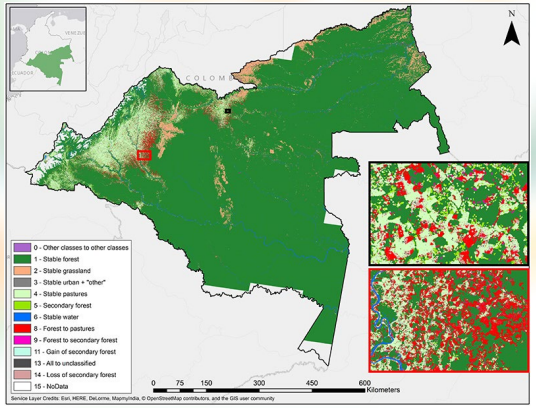
Transportation – Traffic analysis, route planning



Disaster Management – Flood prediction, evacuation planning



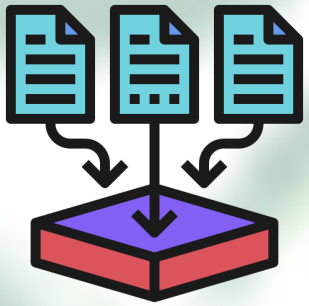
Agriculture – Crop monitoring, soil analysis



Environmental Management – Deforestation tracking, pollution control

Elements of GIS

Geospatial Data



Data Acquisition

Data Management

Data Analysis

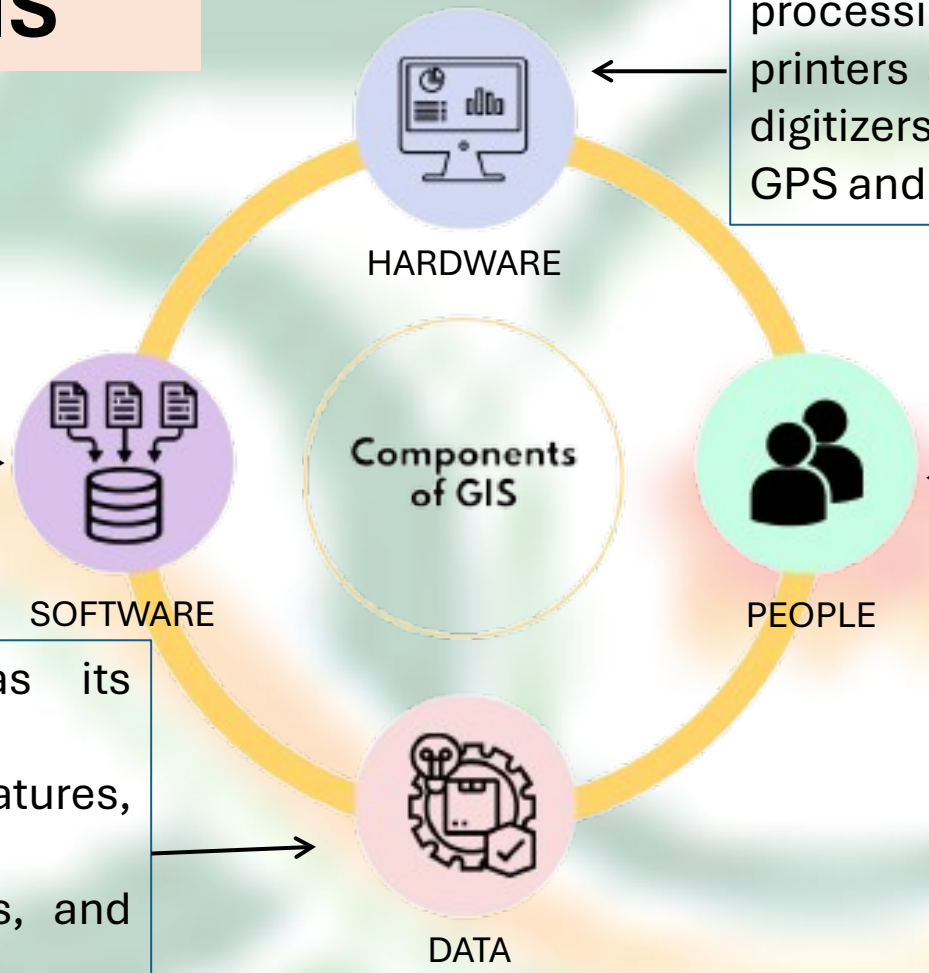
Data Visualization

Data Exploration

Components of GIS

GIS hardware includes computers for processing, storing, and managing data; printers and plotters for reports and maps; digitizers and scanners for spatial data; and GPS and mobile devices for fieldwork.

GIS software, either commercial or open source, includes programs and applications to be executed by a computer for data management, data analysis, data display, and other tasks.



GIS professionals define the purpose and objectives for using GIS and interpret and present the results.

GIS operations has GIS Data as its foundation, including
- spatial data (e.g., geographic features, locations) and
- attribute data (e.g., characteristics, and attributes
associated with spatial data)

A List of Commercial and Free and Open-Source GIS Software

Commercial	Free and Open- Source
Environmental Systems Research Institute (Esri) (http://www.esri.com/): **ArcGIS**	Quantum GIS Project (http://www.qgis.org/): **QGIS**
Autodesk Inc. (http://www.autodesk.com/): **AutoCAD Map3D and Autodesk Geospatial**	SAGA User Group (http://www.saga-gis.org): **SAGA GIS**
Bentley Systems, Inc. (http://www.bentley.com/): **Bentley Map**	Open-Source Geospatial Foundation (http://grass.osgeo.org/): **GRASS**
Blue Marble (http://www.bluemarblegeo.com/): **Global Mapper**	Center for Spatial Data Science, University of Chicago (http://spatial.uchicago.edu/): **GeoDa**
Pitney Bowes (http://www.mapinfo.com/): **MapInfo**	MapWindow GIS Project (http://mapwindow.org/): **MapWindow**
Intergraph/Hexagon Geospatial (http://www.intergraph.com/): **GeoMedia**	International Institute for Aerospace Survey and Earth Sciences, the Netherlands (http://www.itc.nl/ilwis/): **ILWIS**

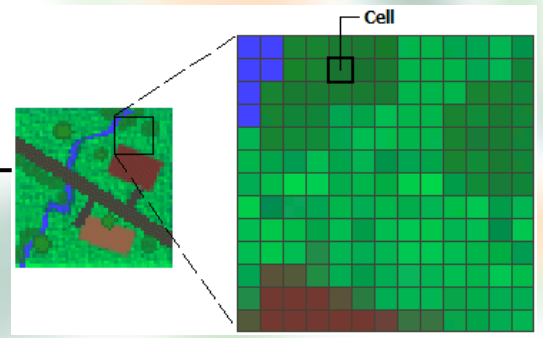
Types of Spatial Data, Working with Raster and Vector Data

The **raster data model** uses a grid and grid cells to represent spatial features: point features are represented by single cells, line features by sequences of neighboring cells, and polygon features by collections of contiguous cells. The cell value corresponds to the attribute of the spatial feature at the cell location. Raster data are ideal for continuous features such as elevation and precipitation

Raster

Vector

The **vector data model** uses points, lines, and polygons to represent spatial features with a clear spatial location and boundary such as streams, land parcels, and vegetation stands. Each feature is assigned an ID so that it can be associated with its attributes.

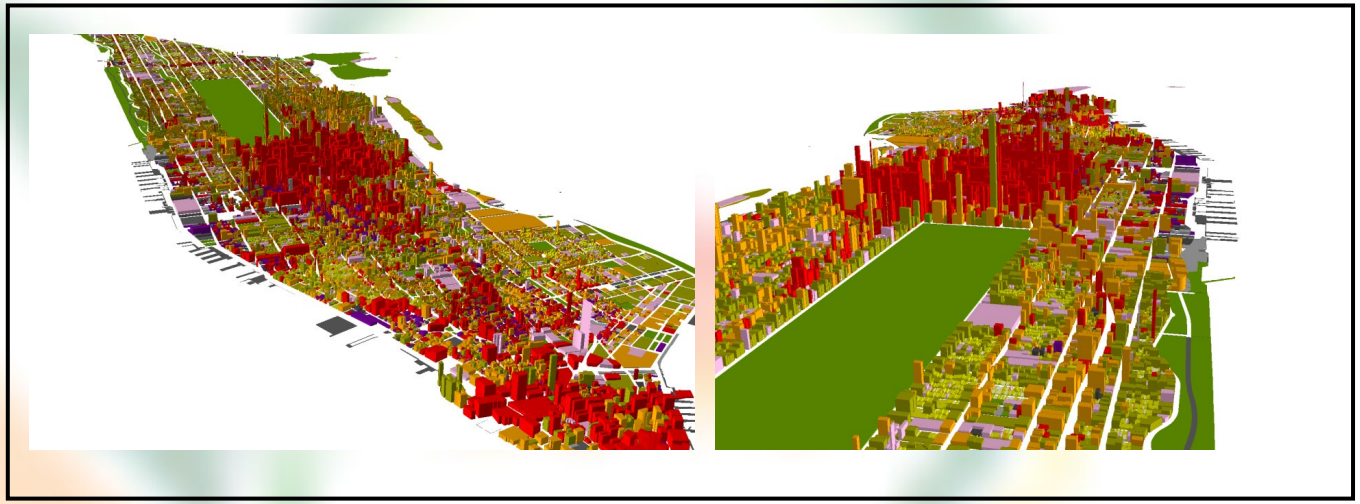


Applications of GIS

View Imagery

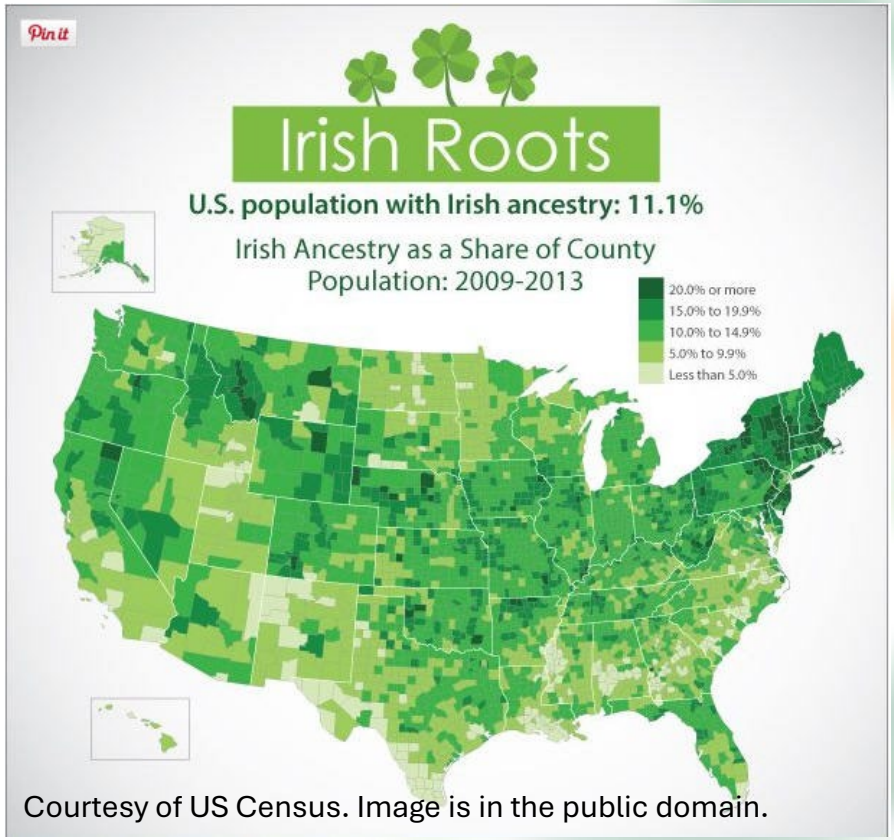
City of Cambridge Aerial Photograph, April 2010

Create 3D models



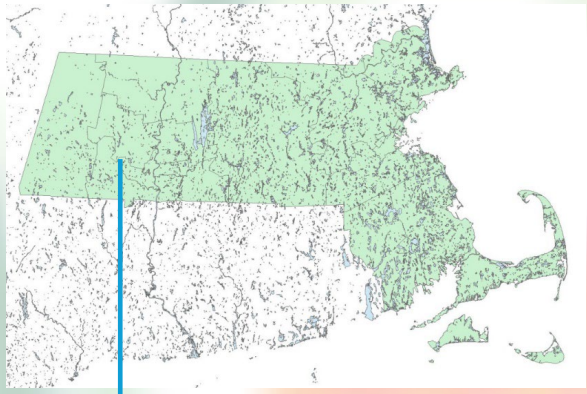
Applications of GIS

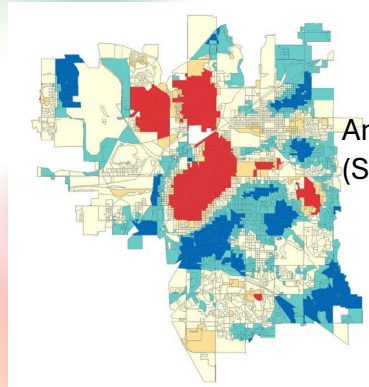
Create Maps



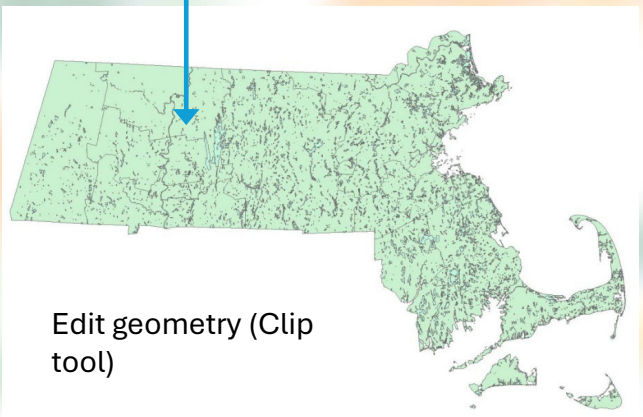
Courtesy of US Census. Image is in the public domain.

Conduct Analysis

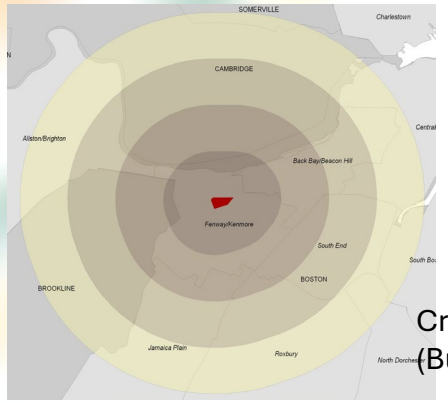




Analyze values (Spatial Statistics)



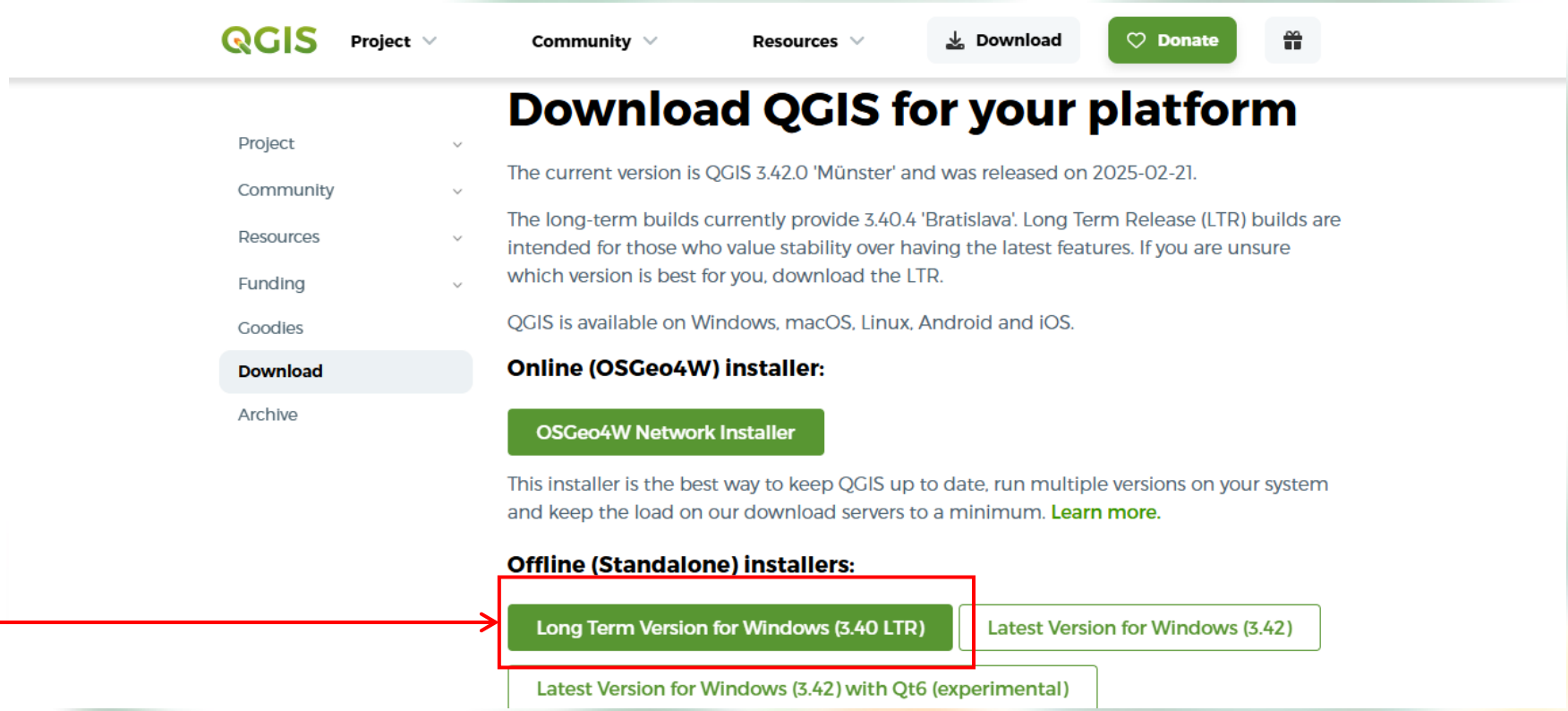
Edit geometry (Clip tool)



Create data (Buffer tool)

Crime hotspots © Scott & Warmerdam

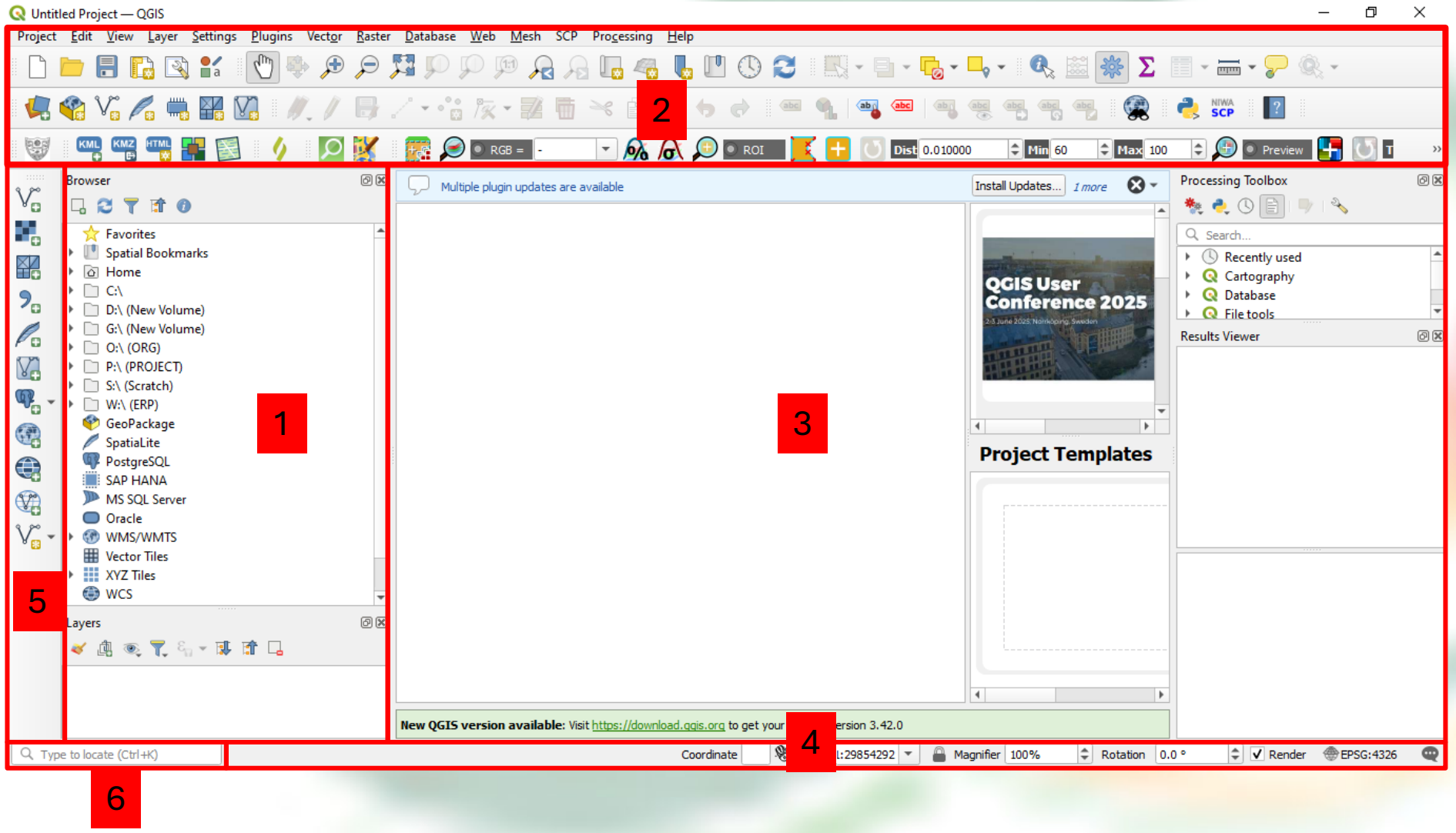
Demonstration of an Open-source Software - QGIS



Step 1: Download the standalone offline version of QGIS

Step 2: Once Downloaded, Hit the run button to start the installation process and follow the prompts. There is no need to install the data sets suggested by QGIS.

https://qgis.org/download/



The elements Identified in the figure are:

1. Layers List / Browser Panel
2. Toolbars
3. Map canvas
4. Status bar
5. Side Toolbar
6. Locator bar

Key Functions

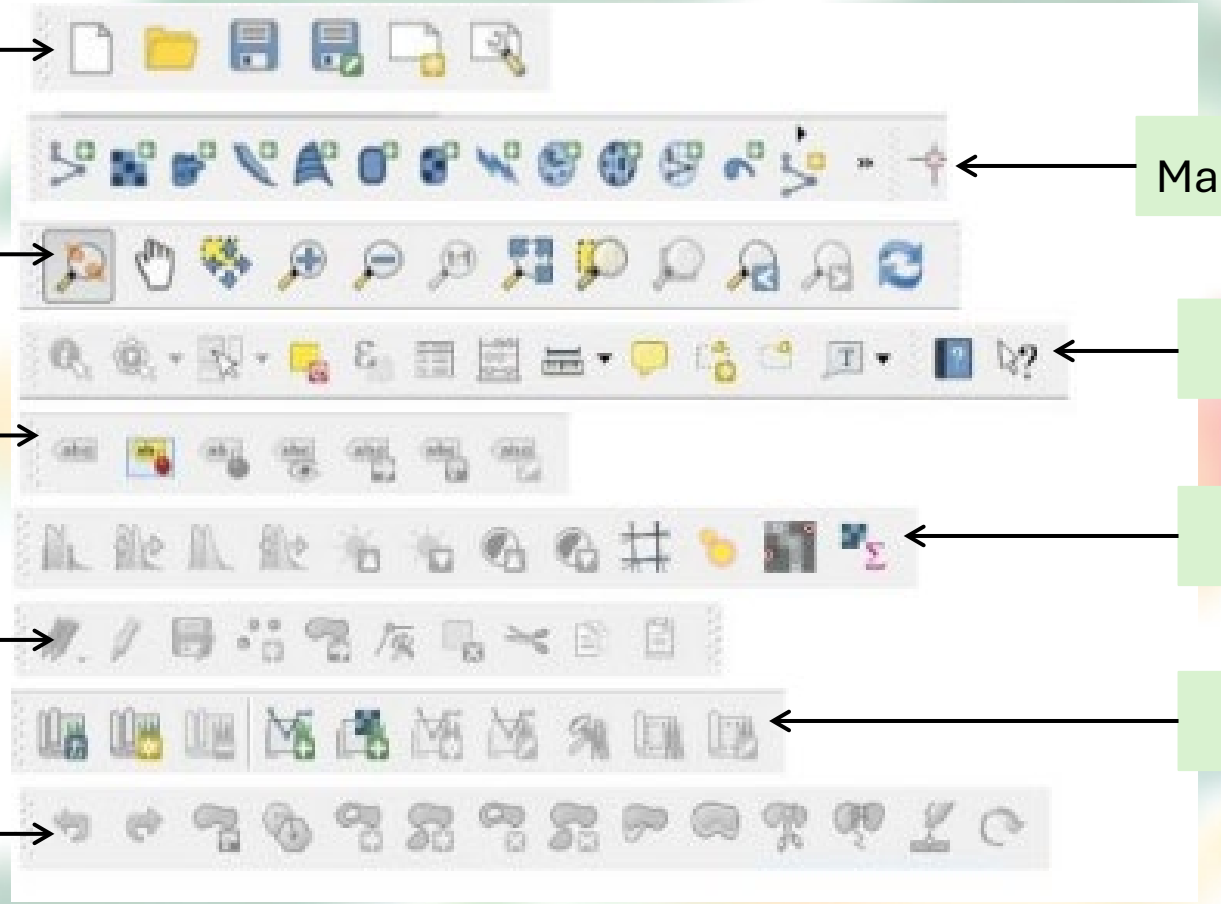
File

Map Navigation

Label

Editing/Digitizing

Advanced Digitization



Manage Layers (Vertical)

Attributes

Raster

GRASS Plugin

Additional Resources

- ArcGIS case Study - 1-Extend Crime Analysis with ArcGIS Spatial Statistics Tools
- QGIS User Guide - https://docs.qgis.org/3.40/en/docs/user_manual/index.html
- QGIS Introduction to GIS - https://docs.qgis.org/3.40/en/docs/gentle_gis_introduction/index.html
- ESRI Introduction to GIS - https://www.esri.com/en-us/what-is-gis/overview#:~:text=Geographic%20information%20system(s)%2C,what%20things%20are%20like%20there).

Thank You