Geographic Information Systems (GIS) Methods and Tools

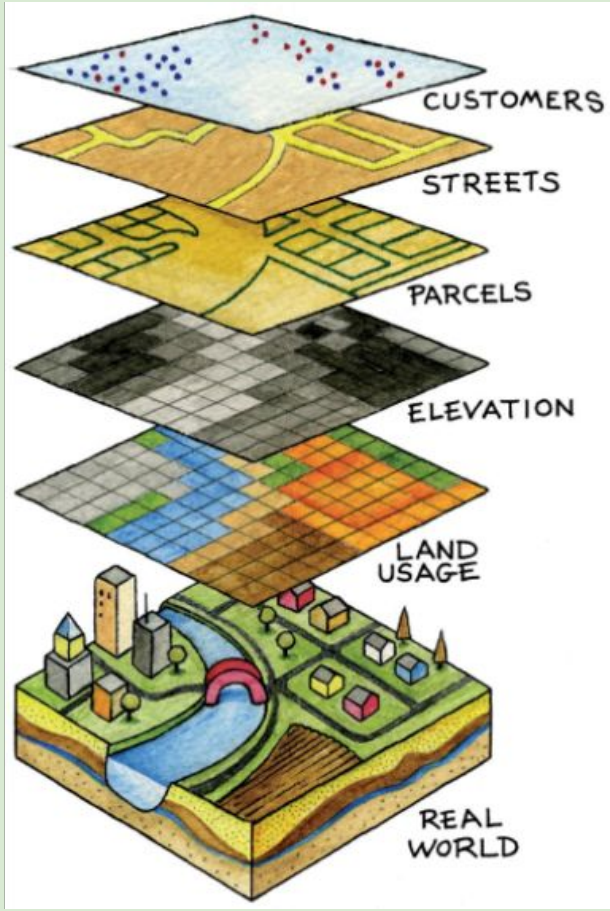
Class One: Basic Concepts and Maps
May 4, 2024

What is GIS?

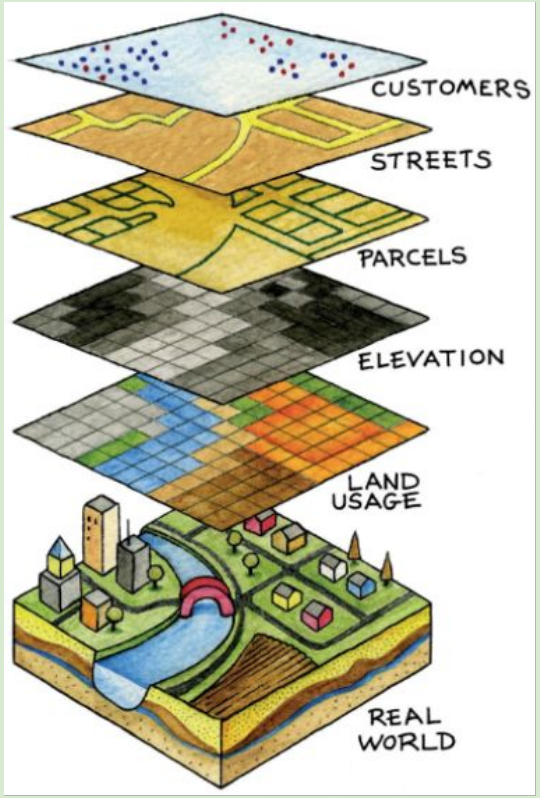
- A geographic information system (GIS) is a platform used to capture, store, analyze, manage, and display various forms of geographically referenced information.
- Today's GIS software is the product of collaboration collaborations between various disciplines like geography, cartography, statistics, computer science, and information science, web design etc.
- GIS is used in dozens of disciplines, ranging from ecology to literary studies to economics.
    - The flexibility of GIS, and its diverse uses, means that by learning about GIS, you acquire a language or framework of analysis that can allow you to make sense of research in a variety of disciplines.

With GIS, we can…

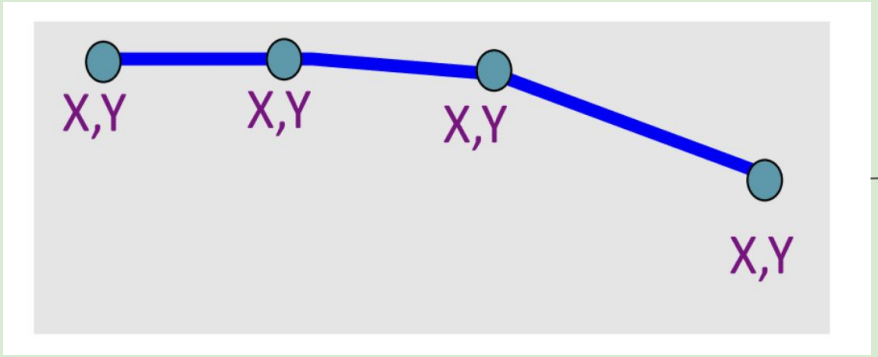
- Combine disparate layers of geospatial information to explore and highlight interesting and relevant connections and relationships
- Analyze geospatial information (i.e. calculate distances, find intersections between different data, compute spatial statistics etc.)
- Visualize variables (such as crime prevalence, election results, Census data) in a spatial context

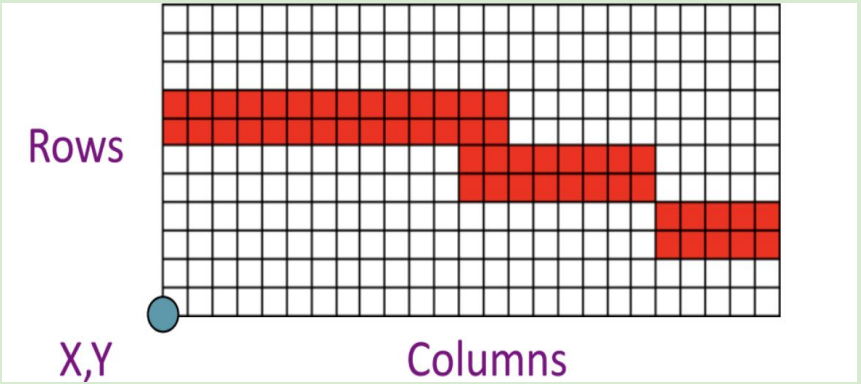


GIS data types



- There are two main GIS data types used to represent real-world spatial relationships: vector data and raster data.
- The building blocks of vector data are georeferenced points, which can also be combined to form lines and polygons.
  - In the picture on the left, customers (points), streets (lines), and parcels (polygons) are examples of vector data.
- Raster data consists of georeferenced grid-cells (pixels) that contain data of interest (such as temperature) .
  - In the picture on the left, elevation and land usage are represented using raster data.





Reality
(A highway)

Source: Gordon McCord, University of California San Diego (UCSD

GIS Software

- ESRI products such as ArcMap and ArcGIS Pro (proprietary software, which NYU licenses)
- Dedicated GIS packages written for the R programming language (such as sf and tmap).
- Dedicated GIS packages written for Python (such as GeoPandas)
- Google Products (Maps, Earth Engine, BigQuery etc.)
- QGIS (point-and-click GIS software that is the open-source analogue of ArcGIS)
- The advantage of R over Esri products and Google geospatial applications is that R is free and open-source; its advantage over QGIS is that it is relatively more flexible, and better at handling larger datasets and complicated spatial statistics.
- R vs Python

Tutorial

- Downloading and cleaning data for use in R Studio
- Loading a vector spatial dataset (a data format used to store vector data) into R Sutdio.
- Joining tabular (non-spatial) data to a GIS layer so that it can be visualized on a map
- Displaying and visualizing data on a map
- Exporting the map for use outside R Studio

Commercial Integration By Country, 2010

Exports + Imports as a Share of GDP

Legend

Country Trade (Exports + Imports) as % of GDP

- 0 - 27
- 27 - 69
- 69 - 113
- 113 - 220
- 220 - 400
- NODATA

Data Source: World Bank Developme
Indicators
CRS: WGS 1984
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