# Geographic Information Systems

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What is GIS?

- Hardware, software, and geographic data for capturing, managing, analyzing, and displaying geographically referenced information.

- A GIS can link information to location data. Then it can layer that information to give a better understanding of how all the data works together.

- A GIS can also convert existing digital information into forms it can recognize and use.

- Specific questions can be answered by combining data and applying some analytic rules.
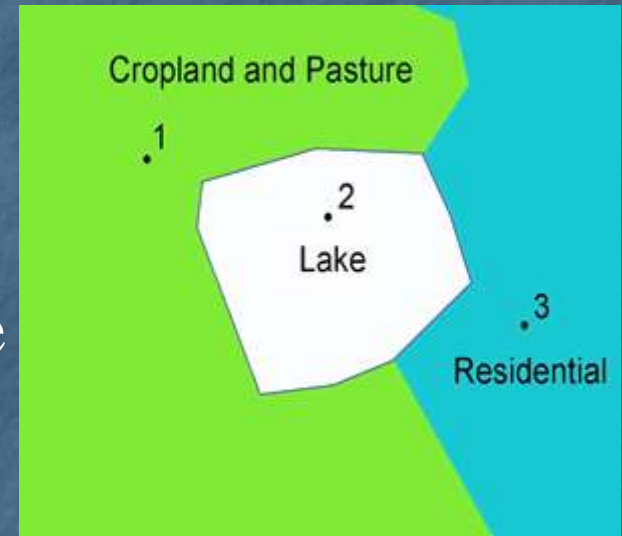
Raster Data

- Rows and columns of cells containing

  a single value

- Raster data could be a continuous value,

  discrete value, or just an image.

- Raster datasets record a value for all points in the area covered.

- Allows easy implementation of overlay operations.
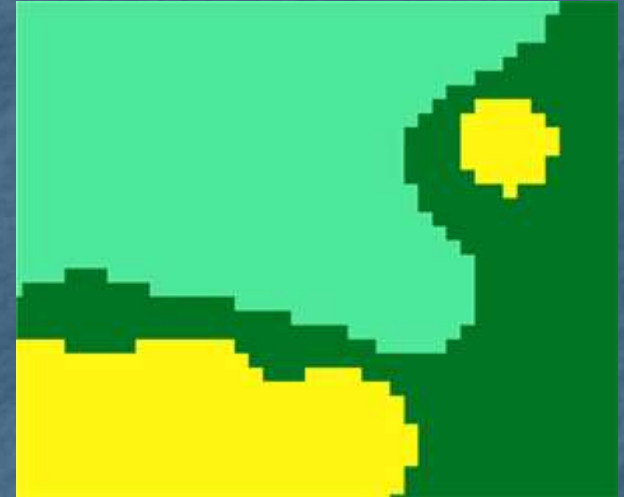
Vector Data

- Uses geometric objects such as points, lines, or polygons to represent objects.
- Can respect spatial integrity through the application of topology rules.
- Can be displayed clearly on traditional maps.
- Is used to represent continuously varying phenomena.

Data Capture

- Techniques:
    - Scanning data from existing maps, etc
    - surveying data directly input to GIS from digital surveying tools (GPS)
    - remotely sensing data (cameras, digital scanners)

- Remote sensing collects raster data that can be further processed to identify objects and classes.

- Attribute data must also be entered, including what the objects represented in the system.
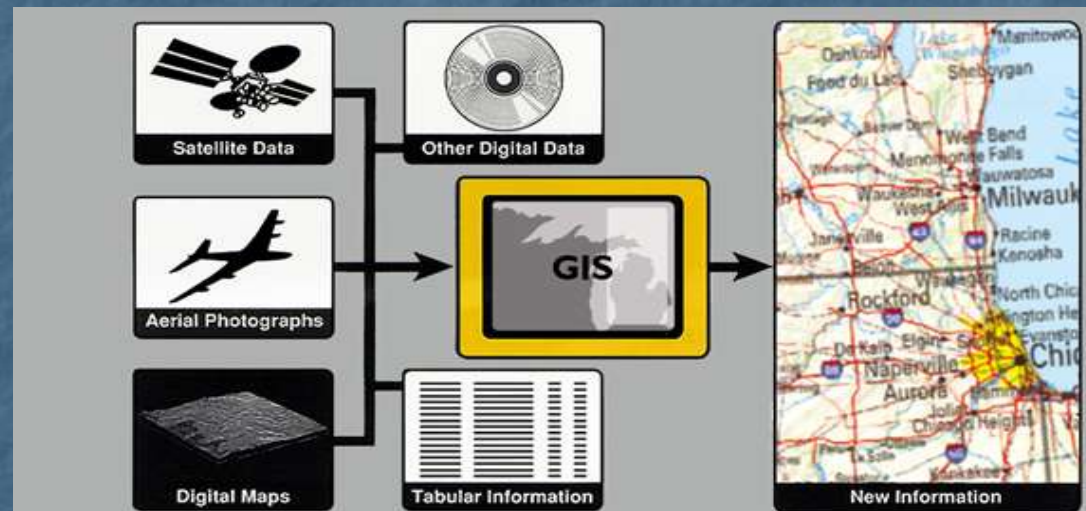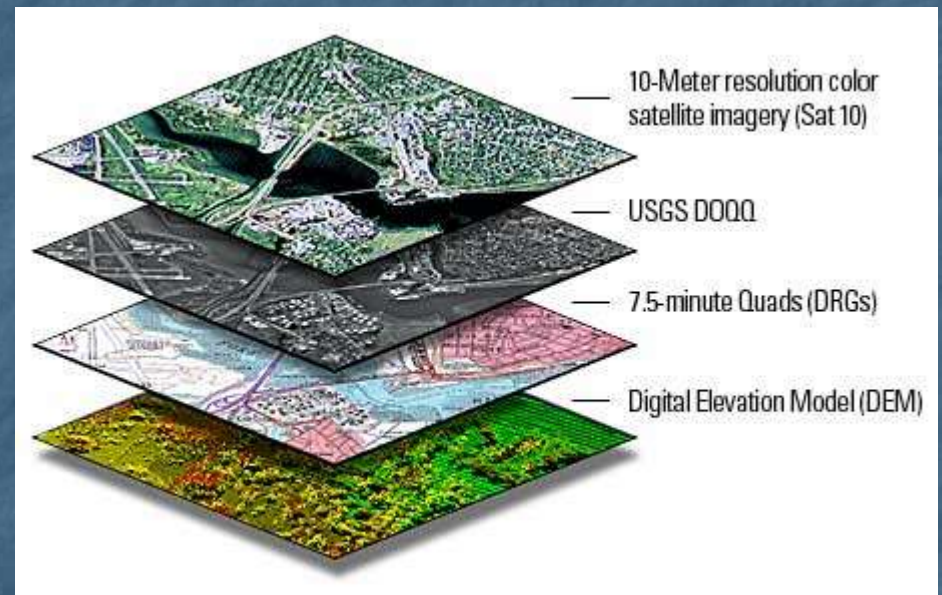
Data Manipulation

- Due to scale and model differences, data may need to be restructed as it is transported.

- Map projection may be necessary.

- GIS transforms the digital information to a common projection and coordinate system.
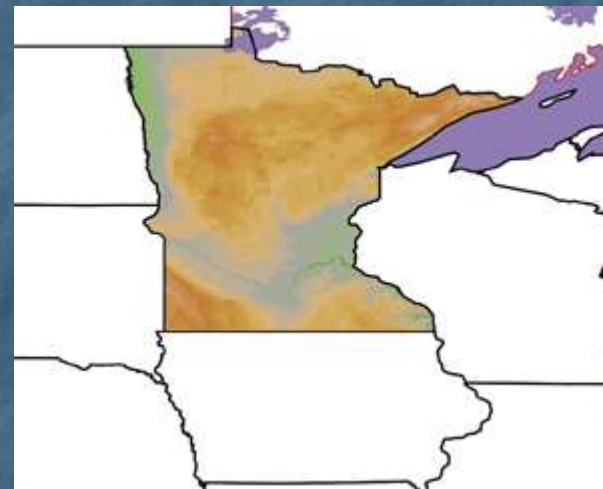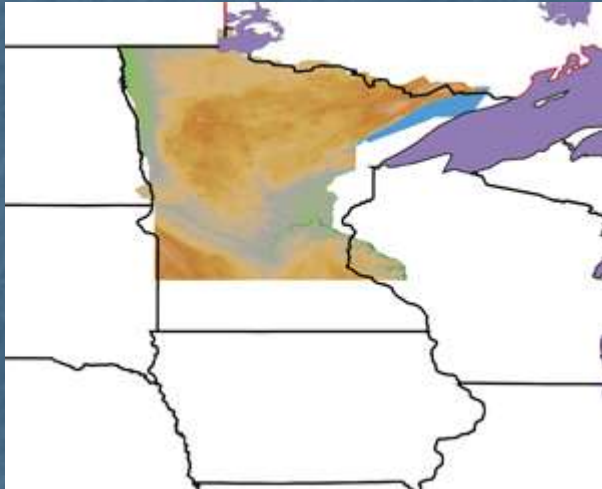
Data Modeling

- A GIS can depict 2D and 3D characteristics of the Earth from information points.

- A GIS can recognize and analyze the spatial relationships within data.

- Several layers of the same area can be combined to create a new output vector dataset.

- Extraction is combining the features of datasets that fall within a given space.

10-Meter resolution color satellite imagery (Sat 10)

USGS DOQQ

7.5-minute Quads (DRGs)

Digital Elevation Model (DEM)

Geostatistics

- Predict fields of data from data points.

- Spatial Autocorrelation Principle: Data collected at any position will have a greater similarity to, or influence on, those locations within its immediate vicinity.

- Observation methods dictate the accuracy of subsequent analysis.

- Data for points outside of the measured area must be inferred from measured points.

OpenMap
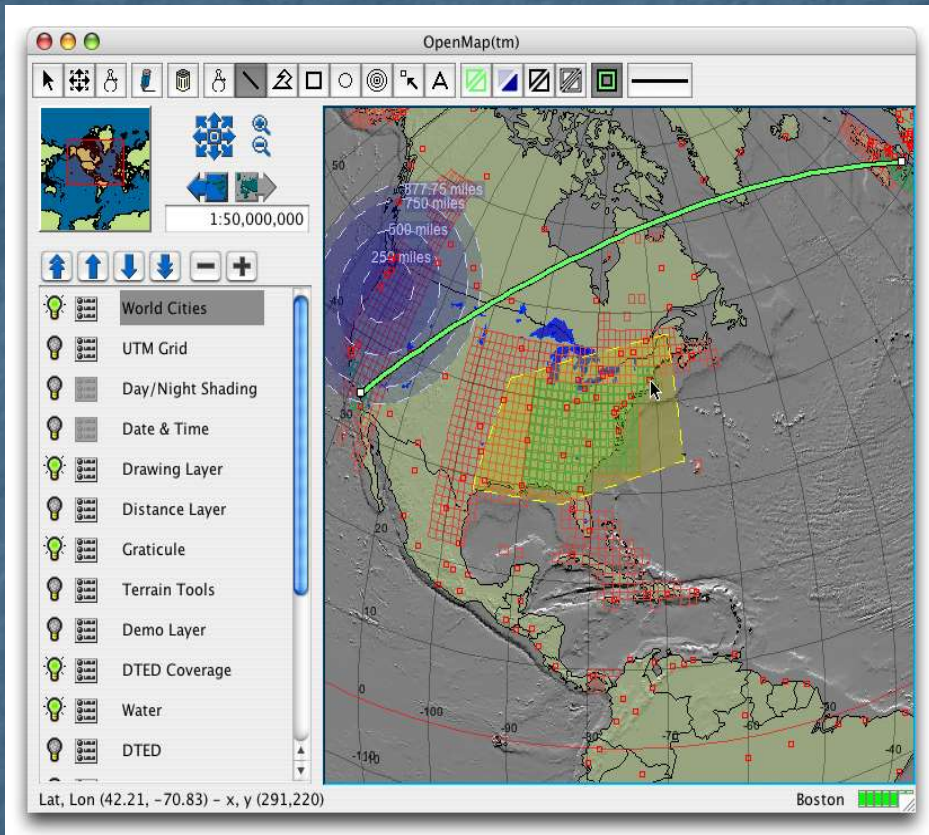
- Java Beans based toolkit for geographic applications .

- Access data from databases and applications.

- Uses layers to apply data to a map

- Manipulate geospatial information.

Geographic Resources Analysis Support System (GRASS)

- Developed by U.S. Army Corp of Engineers

- A raster/vector GIS, image processor, and graphics production system

- SQL support

- Supports a wide range of raster and vector formats
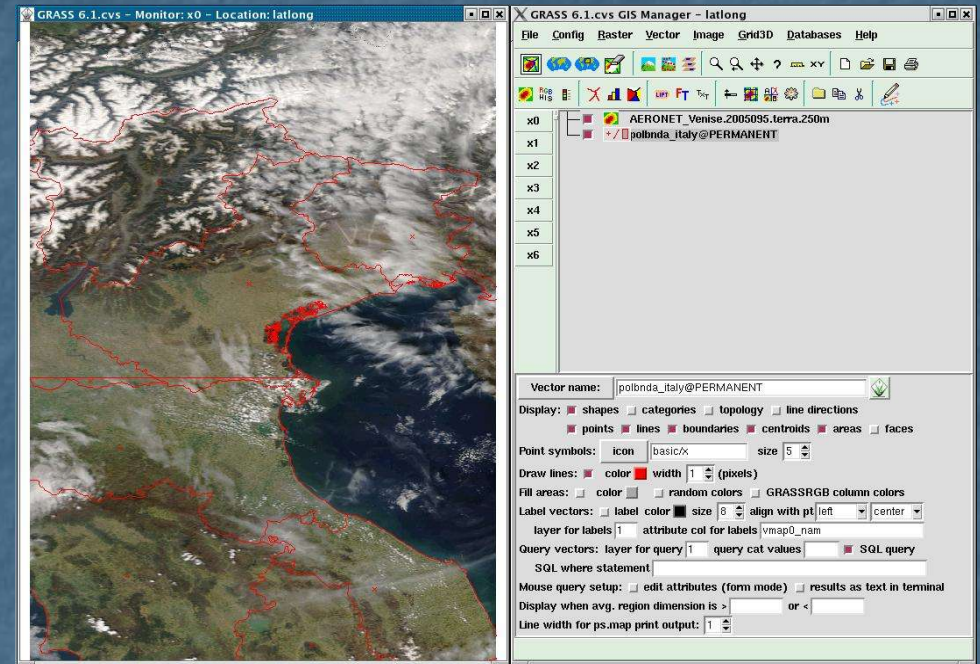
ArcGIS

- Developed by Environmental Systems Research Institute (ESRI)

- Includes much GIS software, namely ArcMap

- Programming languages can extend functionality, including perl, Python, and VBscript

- Used by 77% of GIS professionals