What is GIS?

GIS = Geographic Information System(s)

- Computerized management & analysis of geographic information
- Group of tools (and people) for collection, management, storage, analysis, display and distribution of spatial data & information
- Computer-based tool for mapping and analyzing things that exist and events that happen

This Is A Class About Maps

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What do Maps Provide?

- Where (absolute, relative)
  - Navigation, Location, etc.
- What (absolute, relative)
  - I.e. Map legend information – codification of objects, properties and fields of information
- Spatial relationships, arrangements – combinations of where and what, networks of interconnections (e.g. rivers, routes)

GIS is to Geographic Analysis as:

- Typewriter → Word Processor
  - Automation, Editing
- Pen & Ink Drafting → Computer Automated Drafting (CAD)
  - Storage, Editing
- Almanacs → Climate Models
  - Prediction, Analysis
- Light Table → G.I.S.
  - Map Overlay Analysis, Pattern Recognition
What is GIS?

Historical Development—GIS timeline

- 1963-1977 Innovation
- 1981-1999 Commercialization
  - ESRI/ArcInfo, GPS, MapInfo, TIGER, NSDI, MapQuest
- 2000-present Exploitation
  - >$10 billion industry, >10 million users

Components of a GIS

- Network
- People
  - ~250,000 professionals in US, 2010
- Hardware
- Software
  - ~ $1 billion annual sales in 2000
- Data
  - >$4 billion/yr by gov. agencies

Components of a GIS

Demand for GIS Professionals

- In the U.S. in 2014:
  - ~500,000 using GIS as part of job; growing at 15% each year.
  - Job market demand is ~75,000/year
  - ~50,000 US students/year take a GIS class
  - 4000 "certified" graduates/year


GIS for Austin Geology – ArcGIS software
A GIS is Composed of Layers

- Geology
- D.E.M.
- Hydro.
- Roads

Layers contain Features or Surfaces

- Features are geographic objects represented by a point, line or polygon
- Polygons (filled or unfilled) for things large enough to have boundaries
- Lines for things too narrow to be polygons
- Points for things too small to be polygons

Features Have Locations

- Coordinate Systems can be orthogonal or "warped" (projected)
- GIS software transforms coordinates from one projection to another

Surface composed of matrix of square cells, each containing a value for its location, e.g. elevation.
**What is GIS?**

Features can be displayed at different scales

- **1:150,000**
- **1:40,000**
- **1:150,000**

Features are linked to information

- Every Feature (e.g. road) has several Attributes (e.g. name, length) in an Attribute Table.

Spatial relationships can be queried

- What crosses what?
- Proximity – What is within a certain distance of what?
- Containment - What’s inside of what?
- Which features share common attributes?
- Many others

Applications – a short list

- What is where?
  - Query and info. retrieval – e.g. MapQuest, Google Maps
  - What geographic patterns exist?
    - e.g. Geostatistics; e.g. prediction of ore grades from limited data
  - Where have temporal changes occurred?
    - e.g. LULC change, water table levels, morphologic studies
  - Where do certain conditions apply?
    - e.g. suitability analyses – “where is the best place for...”
  - “What if?” forward modeling; what are spatial implications for certain actions?
    - e.g. strip mining reclamation
What is GIS?

The Five M’s
- Mapping
  - Accuracy, Reproducibility, Portability, Customization
- Measuring
  - Automation, Accuracy
- Modeling
  - Scaling, Verifiability, Analytical Tools
- Monitoring
  - Automation, Flexibility
- Management
  - Storage, Updating, Data Integrity, Security

GIS Advantages:
- Manage & organize vast amounts of geospatial data
- Rapid updating, info. dispersal
- VERIFIABLE methods
- Modeling, hypothesis-testing, PREDICTION
- Automate & customize map production

GIS Drawbacks
- Errors play significant role in queried results — not always apparent
- Abstract concepts difficult to implement — different approaches may yield different answers
- Pretty pictures can obscure uncertainties — promotes uncritical thinking, black-box approach
ArcGIS Licensing Levels

- **ArcView** – Make maps, do queries, some spatial analysis, some editing (shapefiles, personal geodatabases) – included with GTK ArcGIS Desktop
- **ArcEditor** – plus edit multi-user geodatabases; more tools in toolbox
- **ArcInfo** – full functionality; comes with ArcInfo Workstation (i.e. legacy version ArcInfo v. 7). UT D.G.S. licenses.
- **Current ArcGIS = v. 10.5**

ArcGIS Extensions

**ArcGIS Spatial Analyst**
- ArcView, ArcEditor, and ArcInfo
  - ArcView
  - ArcEditor
  - ArcInfo only

**ArcGIS 3D Analyst**
- Advanced 3D visualization
- 3D vector data editing
- 3D spatial analysis

**Geostatistical Analyst**
- Advanced interpolation and surface modeling
- Spatial data analysis tools
- Spatial data analysis tools

**ArcGIS Desktop**

This Lab (30+ floating seats)

Licensing and “Floating Seats”
What is GIS?

- Online GIS – e.g. Google Earth
- Online GIS – Google Maps