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

GIS is to Geographic Analysis as:

- Typewriter → Word Processor
  Automation, Editing
- Pen & Ink Drafting → C.A.D.
  Storage, Editing
- Almanacs → Climate Models
  Prediction, Analysis
- Light Table → G.I.S.
  Map Overlay Analysis, Pattern Recognition

This Is A Class About Maps

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)
What is GIS?

Historical Development—GIS timeline

- 1963-1977 Innovation
- 1981-1999 Commercialization
  - ESRI/ArcInfo, GPS, Mapinfo, TIGER, NSDI, MapQuest
- 2000-present Exploitation
  - $7 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

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

- 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

Features are linked to information

Spatial relationships can be queried

Applications

- 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

- Zooming, scaling, variable detail rendering
- Every Feature (e.g. road) has several Attributes (e.g. name, length) in an Attribute Table.
- 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
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

ESRI - Scalable Product Lines

"Personal" GIS
"Departmental GIS"
"Enterprise" GIS

Multi-user Single user Server Software

Desktop Software

Data storage
What is GIS?

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. 10.2

ArcGIS Extensions

Licensing and “Floating Seats”
What is GIS?

Online GIS – e.g. Google Earth

Online GIS – Google Maps