What is GIS?

- Transportation
- Geology
- Hydrography
- Elevation
- Imagery
Key Questions and Issues

What is GIS?
What are the applications of GIS?
How is the real world represented in GIS?
What analyses can GIS perform?
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
- Others, e.g. Bolstad
GIS is to geographic analysis as:

- Typewriter $\rightarrow$ Word Processor
  - Automation
- Pen & Ink Drafting $\rightarrow$ C.A.D.
  - Storage, Editing
- Almanacs $\rightarrow$ Climate Models
  - Prediction, Analysis
- Light Table $\rightarrow$ G.I.S.
  - Map Overlay Analysis, Pattern Recognition
Historical Development – GIS timeline

- **1963-1977 Innovation**
  - Canadian Land Inventory system, Harvard Graphics & S.A. Lab, US Census Bureau, ERTS-1 (Landsat 1)

- **1981-1999 Commercialization**
  - ArcInfo, GPS, MapInfo, TIGER, NSDI, MapQuest

- **2000-present Exploitation**
  - >$7 billion industry, >1 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 2012:

- ~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
Layers contain Features or *Surfaces*

A surface composed of a matrix of square cells, each containing a value for its location, e.g. elevation.
Features have locations

Coordinate Systems can be orthogonal or “warped” (projected)

GIS software transforms coordinates from one projection to another

Austin

\[ X = -5,551,222 \text{ m} \]
\[ Y = 3,300,200 \text{ m} \]

Origin (0, 0)
Features can be displayed at different scales

Zooming, scaling, variable detail rendering
Features are linked to information

 располагаются связи с информацией

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

- Каждая Фича (например, дорога) имеет несколько Атрибутов (например, название, длина) в Атрибутной Таблице.
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

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
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

**Desktop Software**
- ArcInfo
- ArcEditor
- ArcView

**Single user**
- Data files

**Multi-user**
- Multiuser geodatabase

**Server Software**
- ArcPad
- ArcExplorer
- Java Viewer
- HTML Viewer

**Scalable Product Lines**
- ArcInfo
- ArcEditor
- ArcView
- ArcSDE
- ArcIMS

**“Personal” GIS**

**“Departmental GIS”**

**“Enterprise” GIS**

M. Helper 01-19-16
ArcGIS Desktop Levels

PRODUCTS (Licensing Levels)

ArcView
ArcEditor
ArclInfo

DATA SOURCES
Files
Databases
ArclMS Services
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
Licensing and “Floating Seats”

This Lab (20 floating seats)

ArcView (single-use) seat  |  Floating seat  |  Floating seat  |  ArcView (single-use) seat  |  Floating seat

Network

License Manager

License file with keycodes

(CNS Server)

Limits use to number of floating licenses
## ArcGIS Extensions

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