What is GIS?

Transportation

Geology

Hydrography

Elevation

Imagery

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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 performed?

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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

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GIS is to geographic analysis as:

⌘ Typewriter → Word Processor
   Automation

⌘ Pen & Ink → C.A.D.
   Storage, Editing

⌘ Almanacs → Climate Models
   Prediction, Analysis

⌘ Light Table → G.I.S.
   Map Overlay Analysis, Pattern Recognition

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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

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Components of a GIS

⌘ Network
⌘ People
- ⬡ ~50,000 professionals in US, 2005

⌘ Hardware
⌘ Software
- ⬡ ~ $1 billion annual sales in 2000

⌘ Data
- ⬡ >$4 billion/yr by gov. agencies

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Demand for GIS Professionals

⌘ In the U.S. in 2005:
- ⬡ ~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

Source: ESRI: http://www.esri.com/news/arcuser/0700/umbrella11.htm

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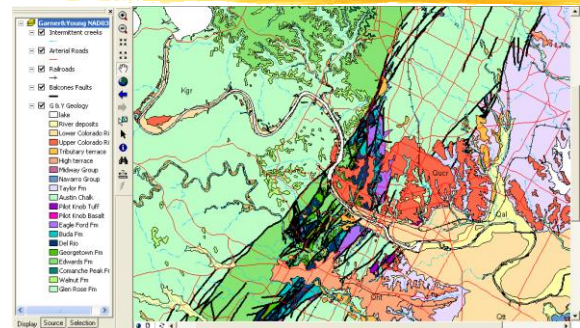09-03-13   Geo327G/386G UT Austin   7

GIS for Austin Geology – ArcGIS software

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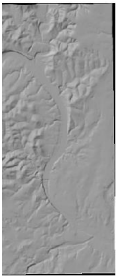09-03-13   Geo327G/386G UT Austin   8

A GIS is Composed of Layers
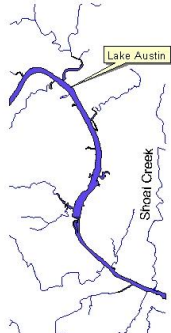
Geology   D.E.M.   Hydro.   Roads
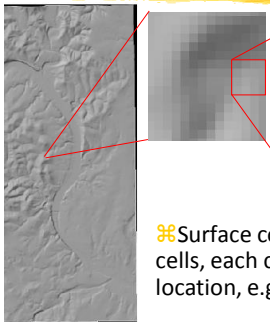
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Layers contain *Features* or Surfaces

⌘ 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

Lake Austin

Shoal Creek

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Layers contain Features or *Surfaces*
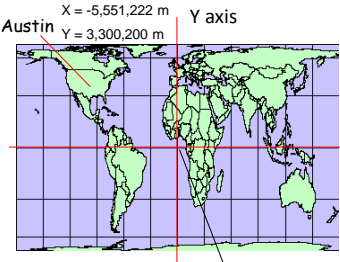
565	573	582	590
575	580	595	600
579	581	597	601
580	600	620	632

⌘ Surface composed of matrix of square cells, each containing a value for its location, e.g. elevation.

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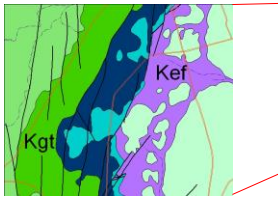09-03-13

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Features have locations

Austin
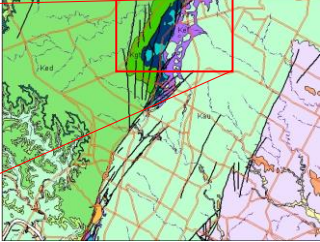X = -5,551,222 m
Y = 3,300,200 m

Y axis

X axis

Origin (0, 0)

⌘ Coordinate Systems can be orthogonal or "warped" (projected)

⌘ GIS software transforms coordinates from one projection to another

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Features can be displayed at different scales

1 : 40,000

1 : 150,000

⌘Zooming, scaling, variable detail rendering

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Features are linked to information

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

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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

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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. mine reclamation

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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

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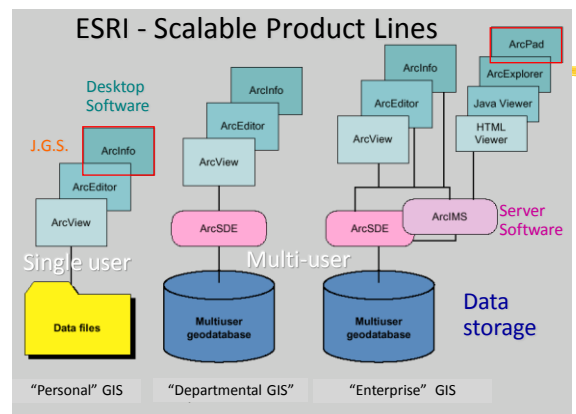## GIS Advantages:
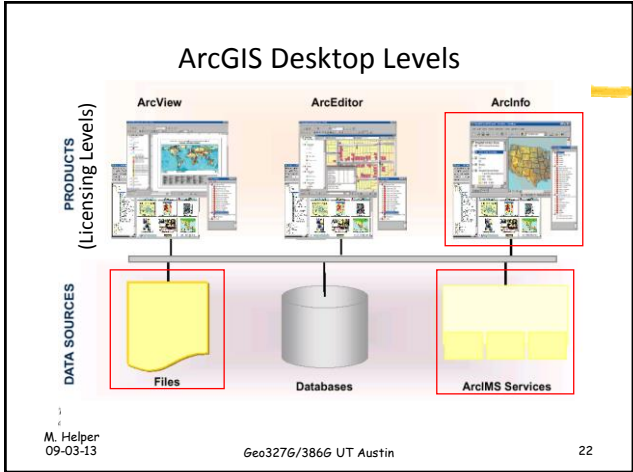
⌘ Manage & organize vast amounts of geospatial data
  ◻ Rapid updating, info. dispersal
⌘ VERIFIABLE methods
⌘ Modeling, hypothesis-testing, PREDICTION
⌘ Automate & customize map production

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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

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ESRI - Scalable Product Lines

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ArcGIS Desktop Levels

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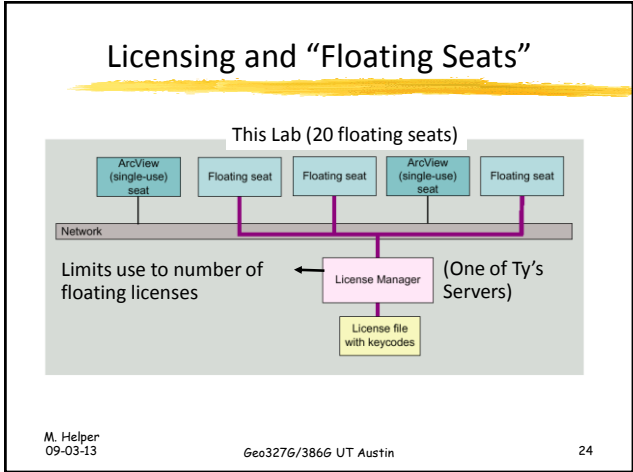## ArcGIS Licensing Levels

⌘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. 9.3

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Licensing and "Floating Seats"

This Lab (20 floating seats)

Limits use to number of floating licenses

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ArcGIS Extensions

	ArcView, ArcEditor, and ArcInfo	ArcInfo only
ArcGIS Spatial Analyst	• Advanced raster modeling • ARC GRID calculator with ARC GRID algebra • VBA for raster analysis	• ARC GRID program in ArcInfo Workstation • ARC GRID commands in Arc program
ArcGIS 3D Analyst	• ArcScene™–real-time interactive three-dimensional scenes • Scene views in ArcCatalog • Three-dimensional modeling tools • ARC TIN tools	• ARC TIN™ commands in Arc program • Surfacescene command
Geostatistical Analyst	• Advanced kriging and surface modeling • Exploratory spatial data analysis tools • Probability, threshold, and error mapping	

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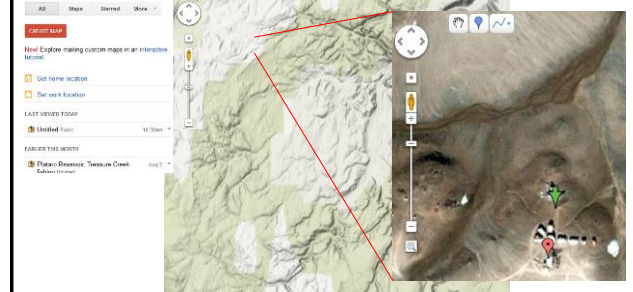## Online GIS –e.g. Google Earth
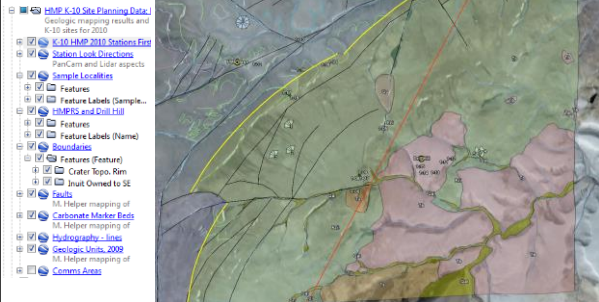
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Online GIS –Google Maps

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