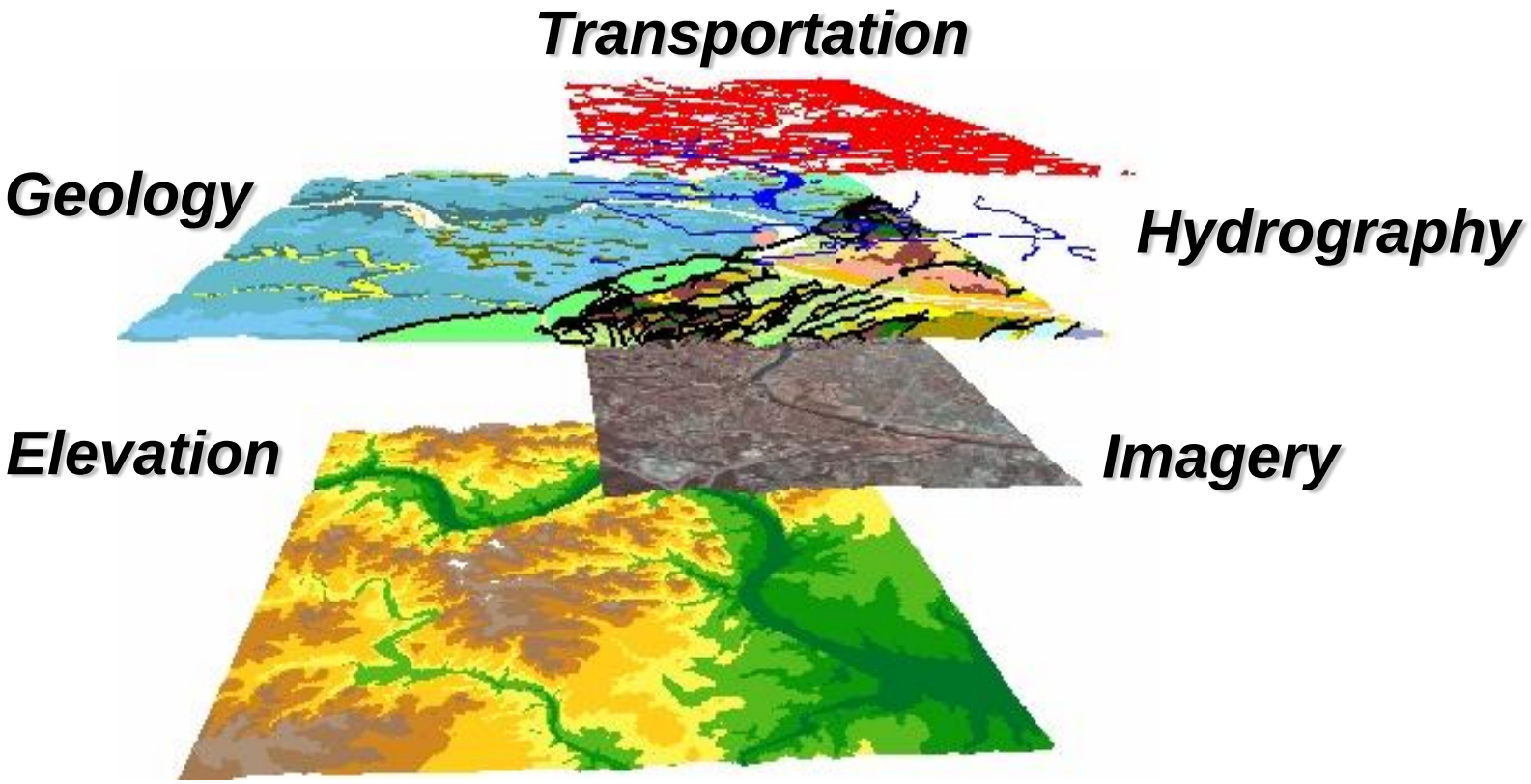
What is GIS?



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?

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 → 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

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
  - ~50,000 professionals in US, 2005
- Hardware
- Software
  - ~ $1 billion annual sales in 2000
- Data
  - >$4 billion/yr by gov. agencies

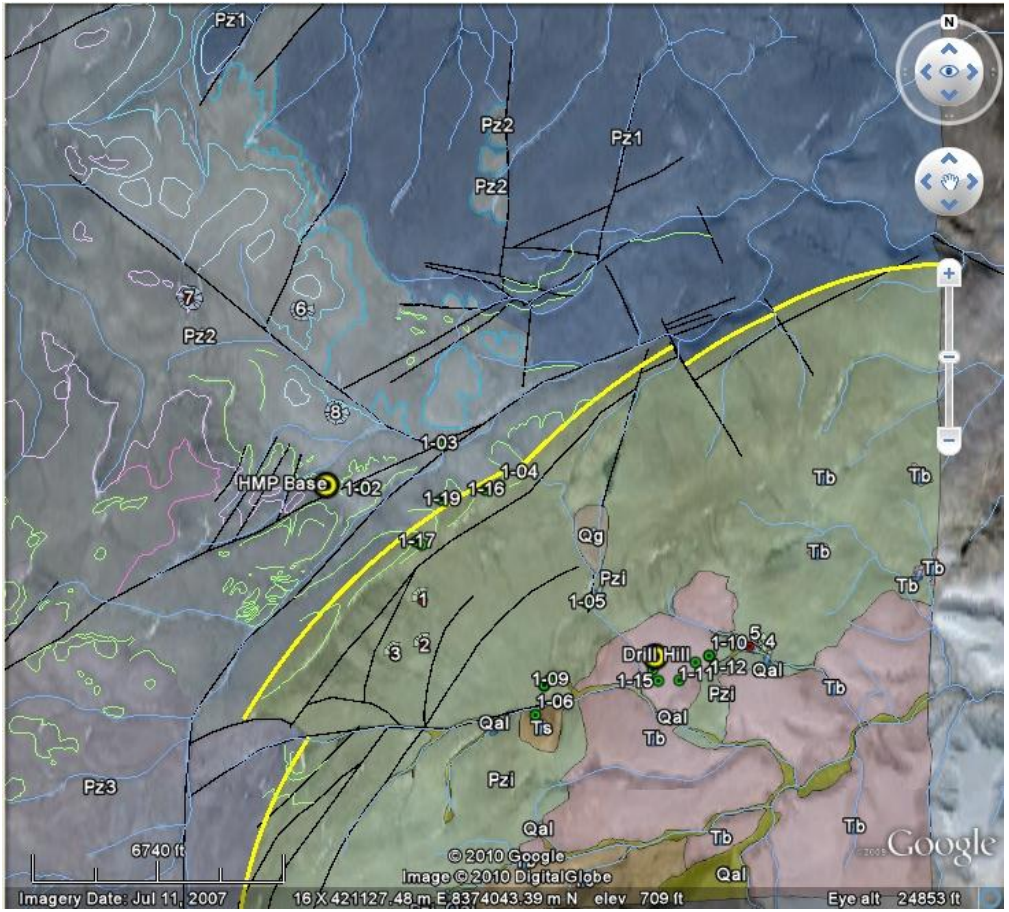
Demand for GIS Professionals

- 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

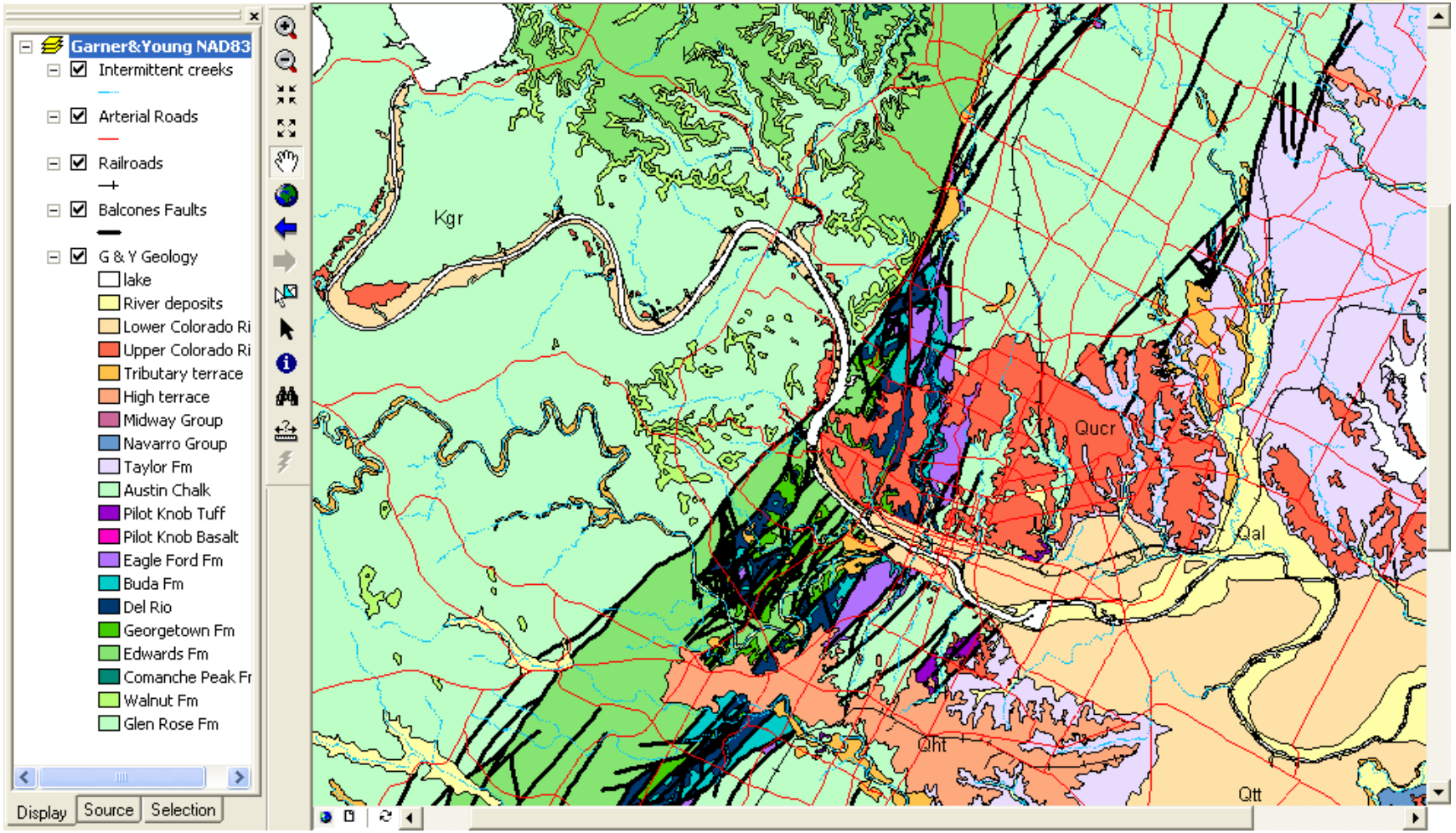
Source: ESRI:
http://www.esri.com/news/arcuser/0700/umbrella11.htm

Online GIS – e.g. Google Earth

- Haughton Crater geology, Devon Island, Canada

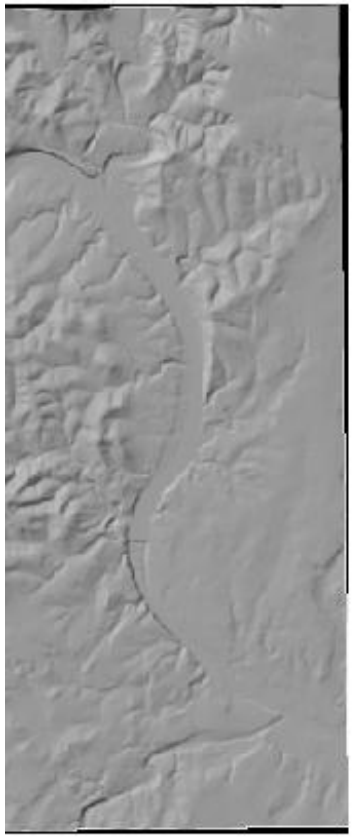


GIS for Austin Geology – ArcGIS software



A GIS is Composed of Layers

Geology



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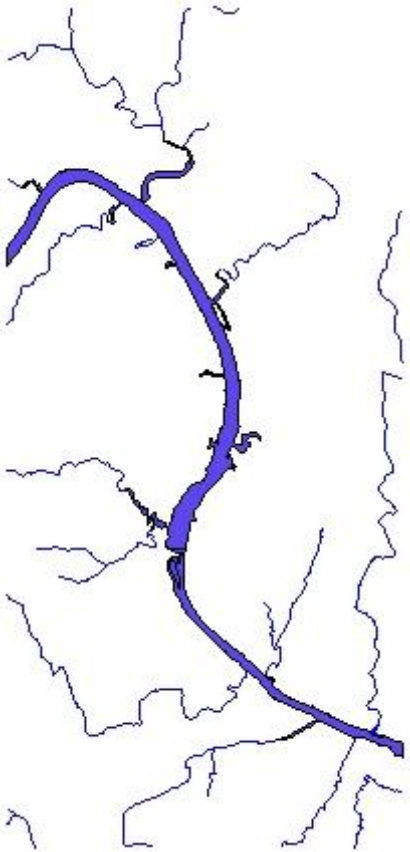
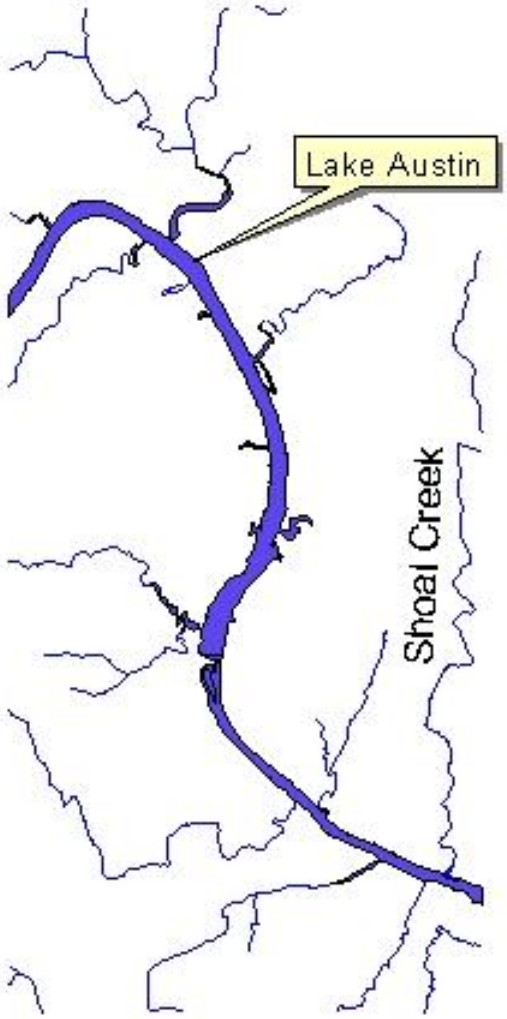


Hydro.

Roads

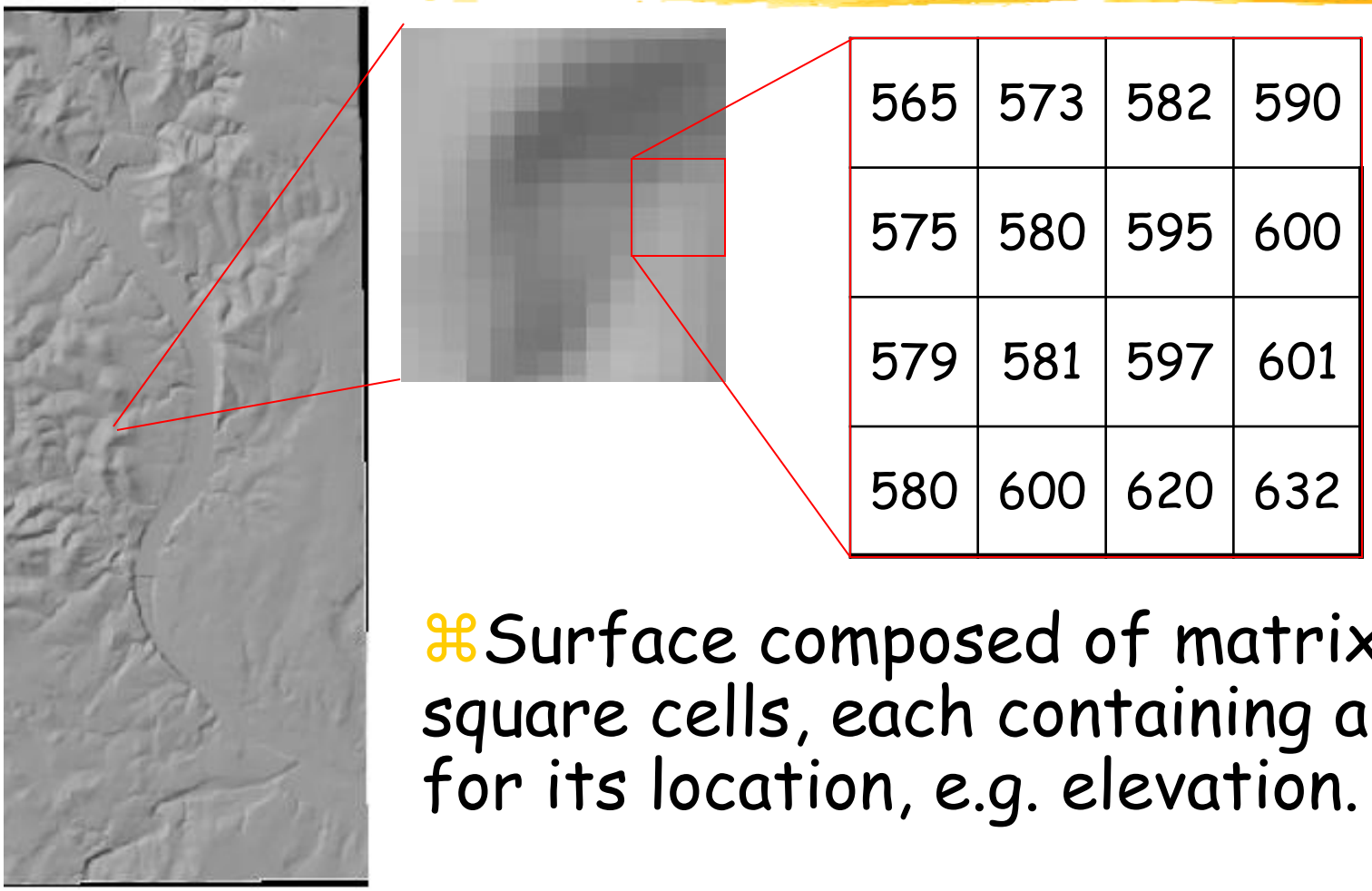
Layers contain *Features* or Surfaces



- 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

M. Helper
1-17-12

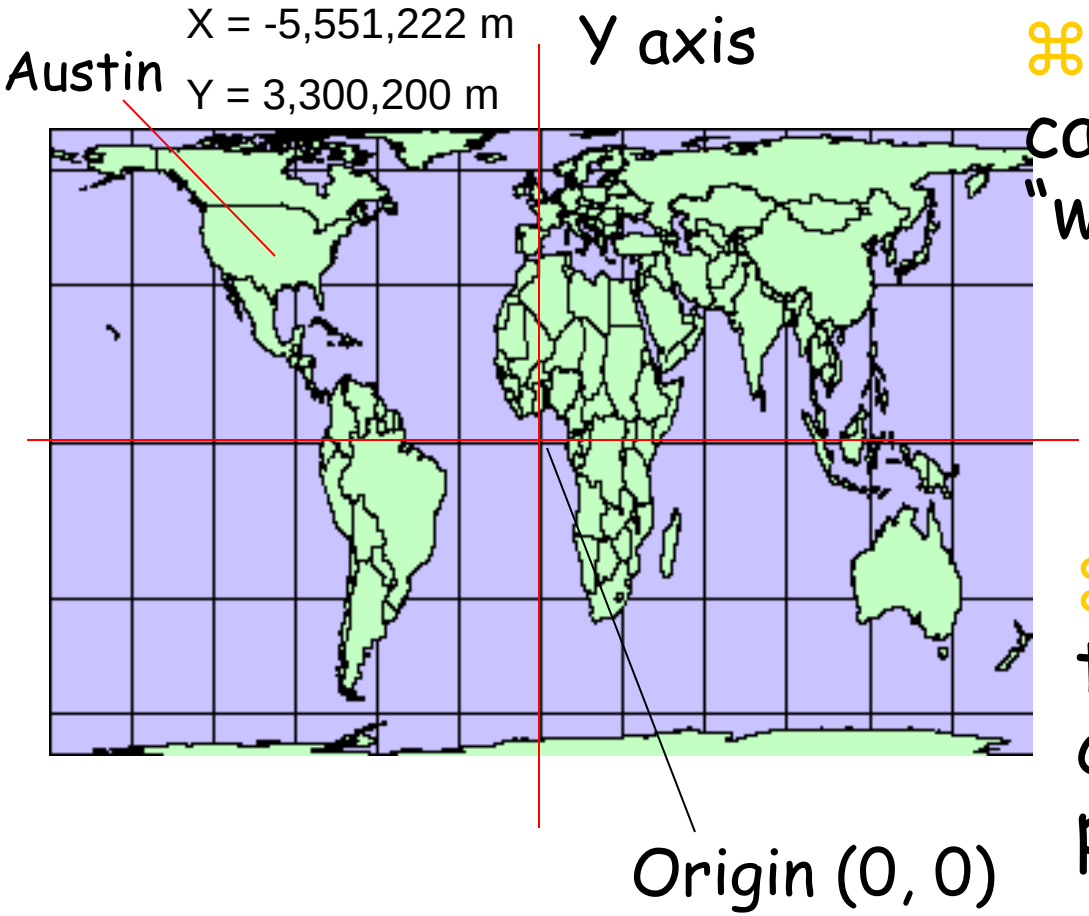
Layers contain Features or *Surfaces*



565	573	582	590
575	580	595	600
579	581	597	601
580	600	620	632

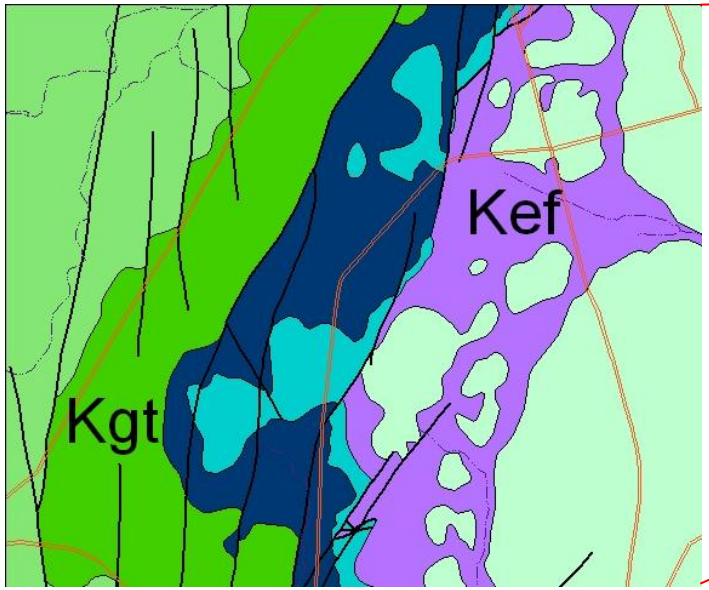
- Surface composed of matrix of square cells, each containing a value for its location, e.g. elevation.

Features have locations

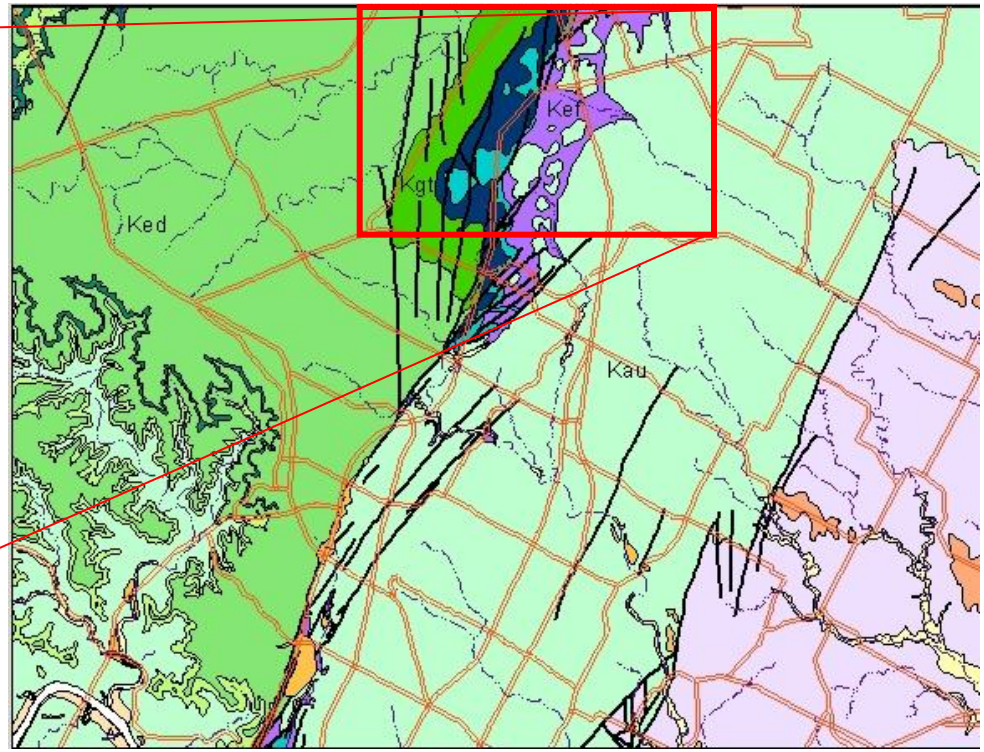


- Coordinate Systems can be orthogonal or "warped" (projected)
- GIS software transforms coordinates from one projection to another

Features can be displayed at different scales



1 : 40,000



1 : 150,000

- Zooming, Scaling, Variable detail rendering

Features are linked to information

Attributes of central arteries

Length	Centerarc_	Street_nam	Street_typ	Suf_dir	Alts	Type
1987.841	1379	CAPITAL OF TEXAS	HWY	N	0	MAJOR
530.507	2028	BEE CAVES	RD		0	MAJOR
609.973	926	F M 2222	RD		0	MAJOR
155.524	3851	MO-PAC	EXPY	N	0	MAJOR
6065.322	946	CAPITAL OF TEXAS	HWY	N	0	MAJOR
1022.476	960	CAPITAL OF TEXAS	HWY	N	0	MAJOR
2459.327	965	F M 2222	RD		0	MAJOR
228.862	2118	BEE CAVES	RD		0	MAJOR
779.617	2148	BEE CAVES	RD		0	MAJOR
210.440	2060	BEE CAVES	RD		0	MAJOR
2916.411	3852	MO-PAC	EXPY	N	0	MAJOR

- 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

- 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

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

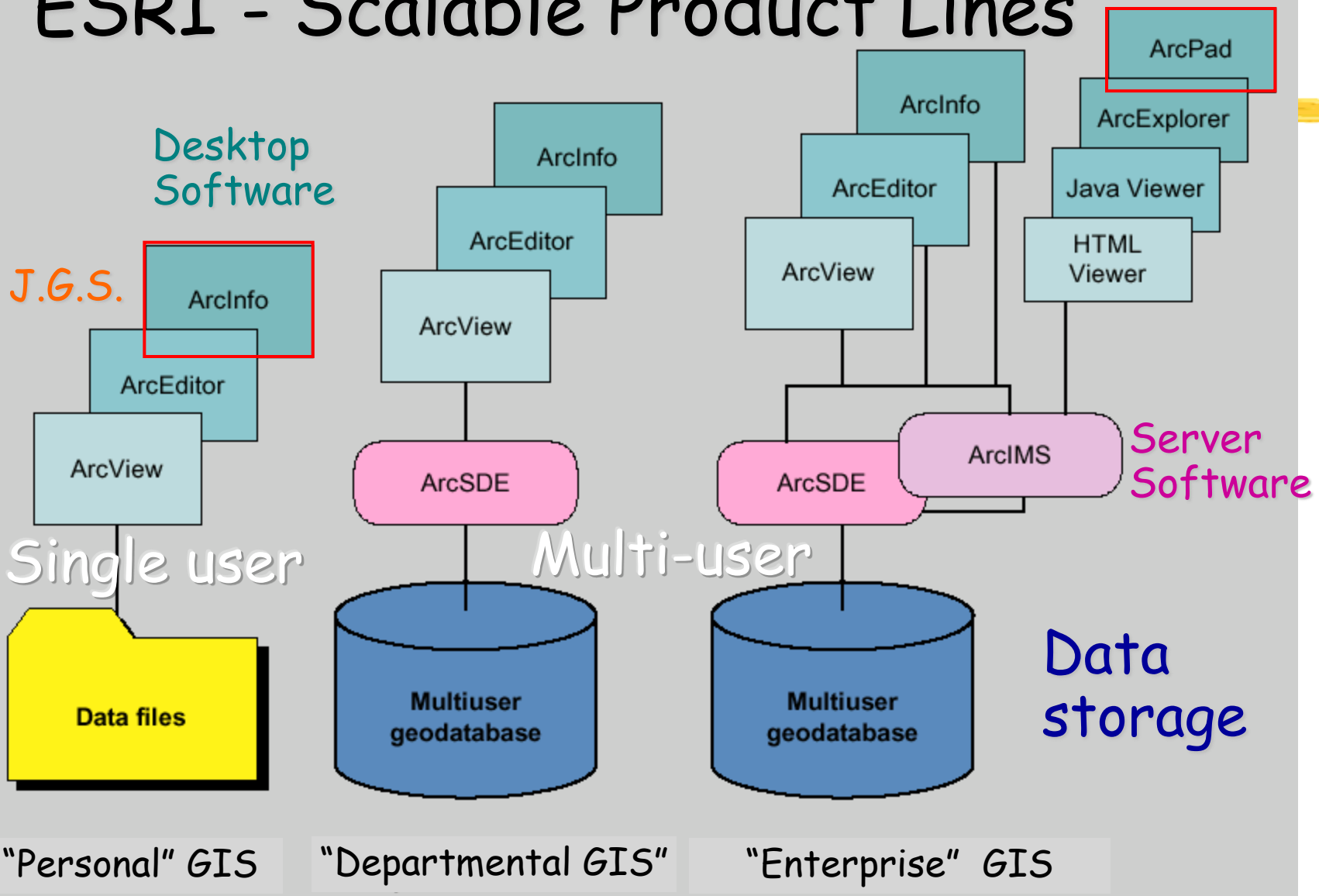
GIS Advantages:

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

GIS Drawbacks

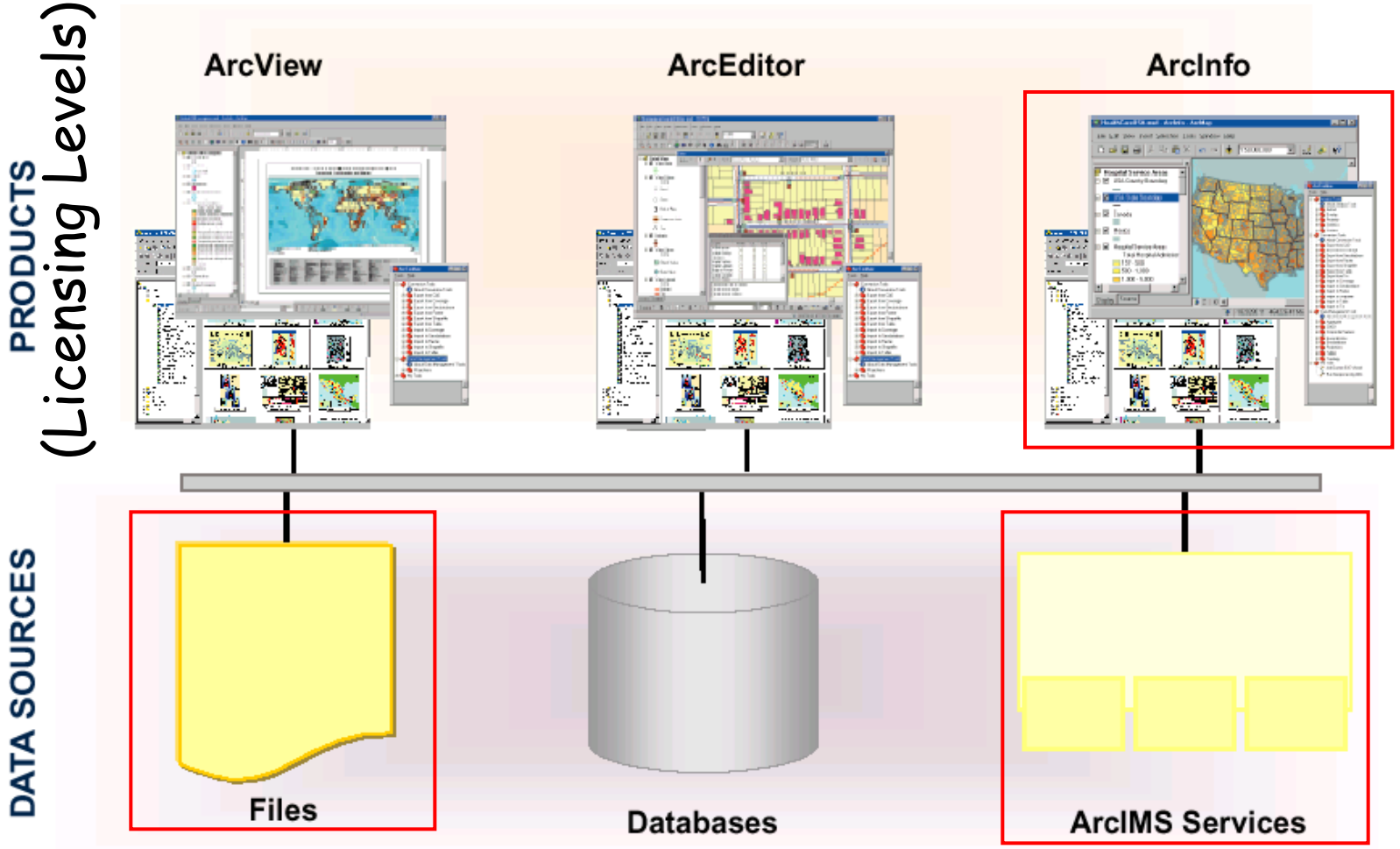
- Errors play significant role in queried results – not always apparent
- Abstract concepts difficult to implement – different approaches may yield different answers
- Pretty pictures can obscure uncertainties – promotes uncritical thinking, black-box approach

ESRI - Scalable Product Lines



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

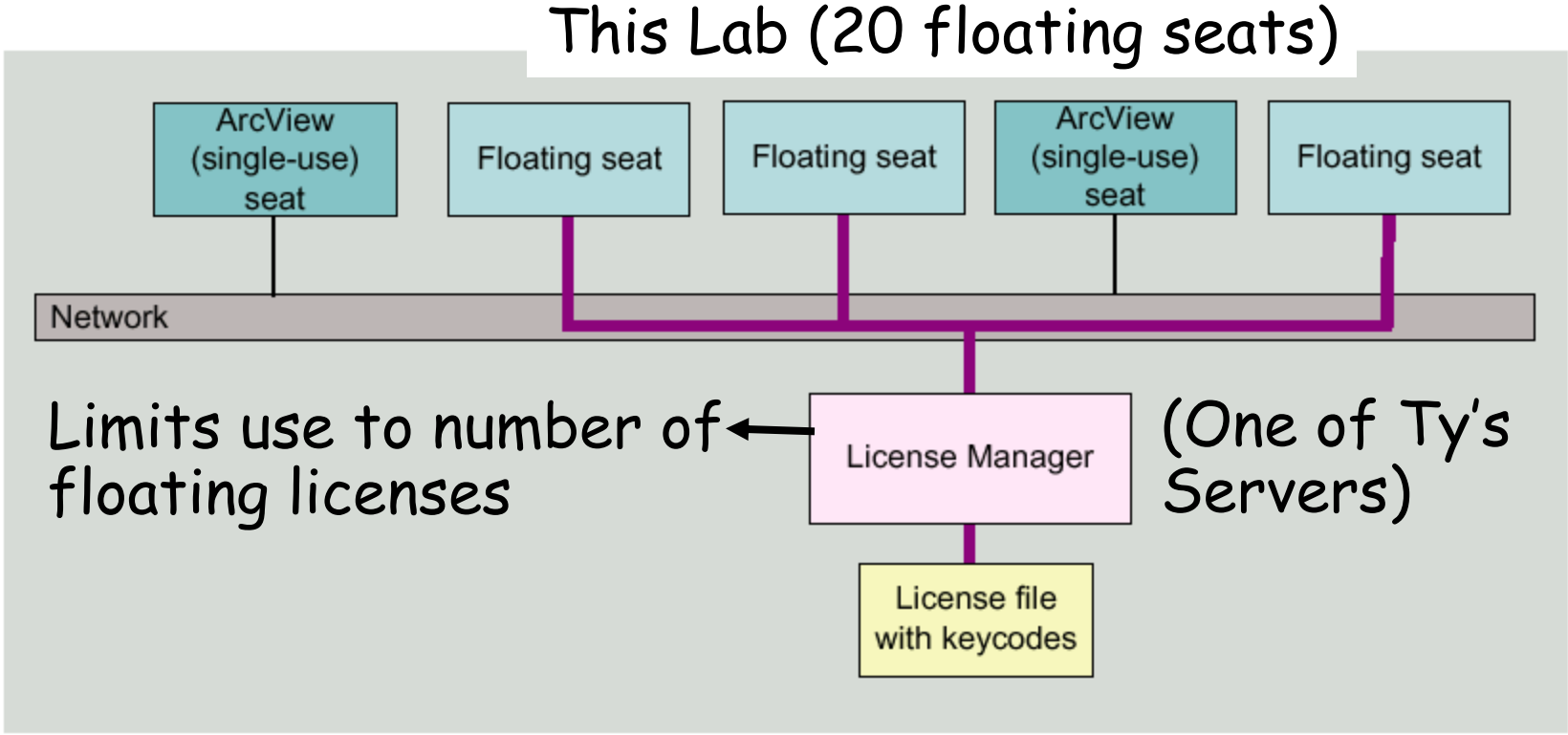
ArcGIS Desktop Levels



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

Licensing and "Floating Seats"



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		

Online GIS –e.g. Google Earth