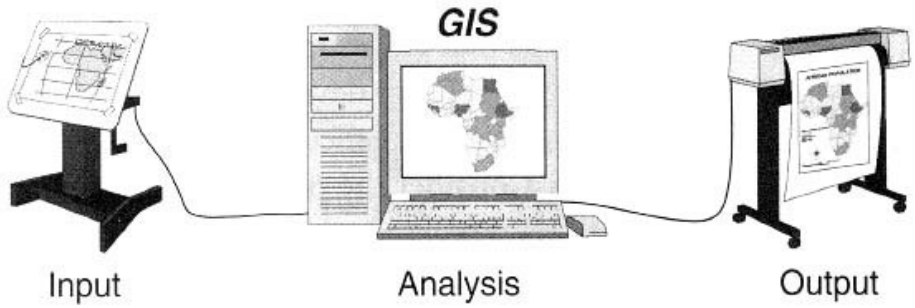
Lecture 1: Introduction to GIS

What does GIS stand for?

- Geographic
  (Geography)
- Information
- System

Attributes of States.shp

Shape	Area	State_name	State_fips	Sub_region	State_abbr	Pop1990	Pop1999	Pop90_sqmi	Households
Polygon	67290.061	Washington	53	Pacific	WA	4866692	5773907	72	1872431
Polygon	147244.653	Montana	30	Mtn	MT	799065	884214	5	306163
Polygon	32161.925	Maine	23	N Eng	ME	1227928	1248908	38	465312
Polygon	70812.056	North Dakota	38	W N Cen	ND	638800	637016	9	240878
Polygon	77195.055	South Dakota	46	W N Cen	SD	696004	739508	9	259034
Polygon	97803.199	Wyoming	56	Mtn	WY	453588	482025	5	168839
Polygon	56088.178	Wisconsin	55	E N Cen	WI	4891769	5251093	87	1822118
Polygon	83343.643	Idaho	16	Mtn	ID	1006749	1250247	12	360723
Polygon	9603.272	Vermont	50	N Eng	VT	562758	593960	59	210650
Polygon	84520.490	Minnesota	27	W N Cen	MN	4375099	4765612	52	1647853
Polygon	97073.594	Oregon	41	Pacific	OR	2842321	3327589	29	1103313
Polygon	9259.527	New Hampshire	33	N Eng	NH	1109252	1198080	120	411186
Polygon	56257.965	Iowa	19	W N Cen	IA	2776755	2870332	49	1064325
Polygon	8172.561	Massachusetts	25	N Eng	MA	6016425	6179380	736	2247110



What is a Geographic Information System?

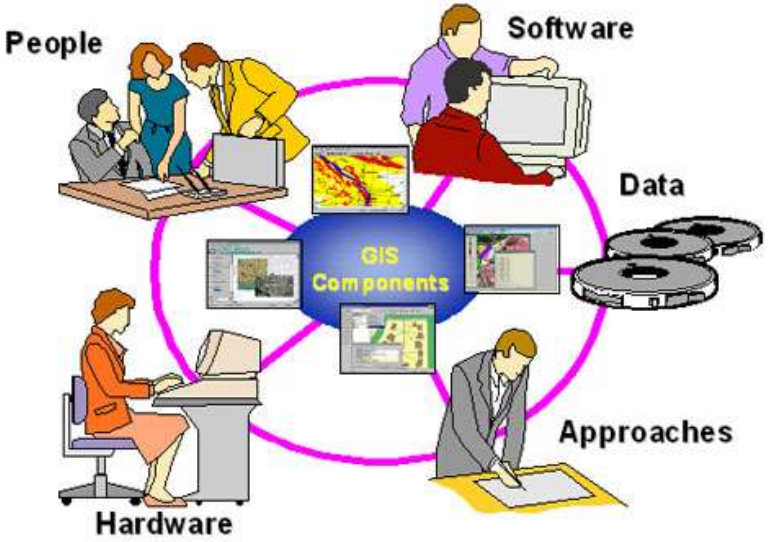
- **Geographic Information System (GIS)** – A *computer-based* system for the collection, storage, organization, maintenance, and analysis of spatially-referenced data, and the output of spatially-referenced information.
  - **Data** – Any collection of related facts; the basic elements of information.
  - **Information** - Data that have been processed to be useful; provides answers to "who", "what", "where", and "when" questions
- Information can only come from accurate data (GIGO).

What are the components of a GIS?

We understand GIS to be computer facilitated system

But it is NOT only software and hardware

Also includes:
- Data – both spatial and aspatial
- Trained personnel
- Supporting Institution
- Protocols for use



GIS Software Tools

GIS started at universities as research tools – Harvard, Yale, Minnesota, Clark University
GIS software have evolved to robust (sort of) tools capable of a wide variety of tasks

Primary flavors

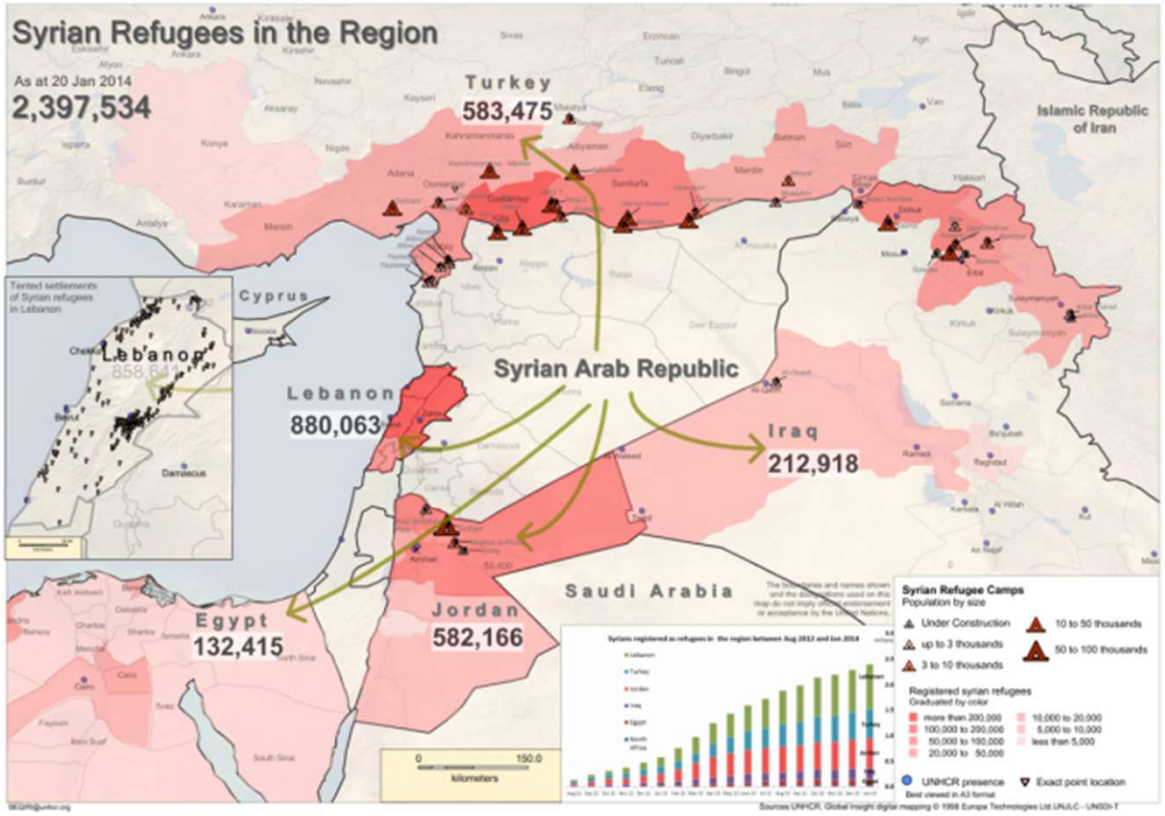
ESRI (ArcGIS) **Intergraph** **QGIS** **Bentley Map**

Microimages **Autocad** **MapInfo**

ERDAS **Idrisi** **Manifold** **Smallworld**

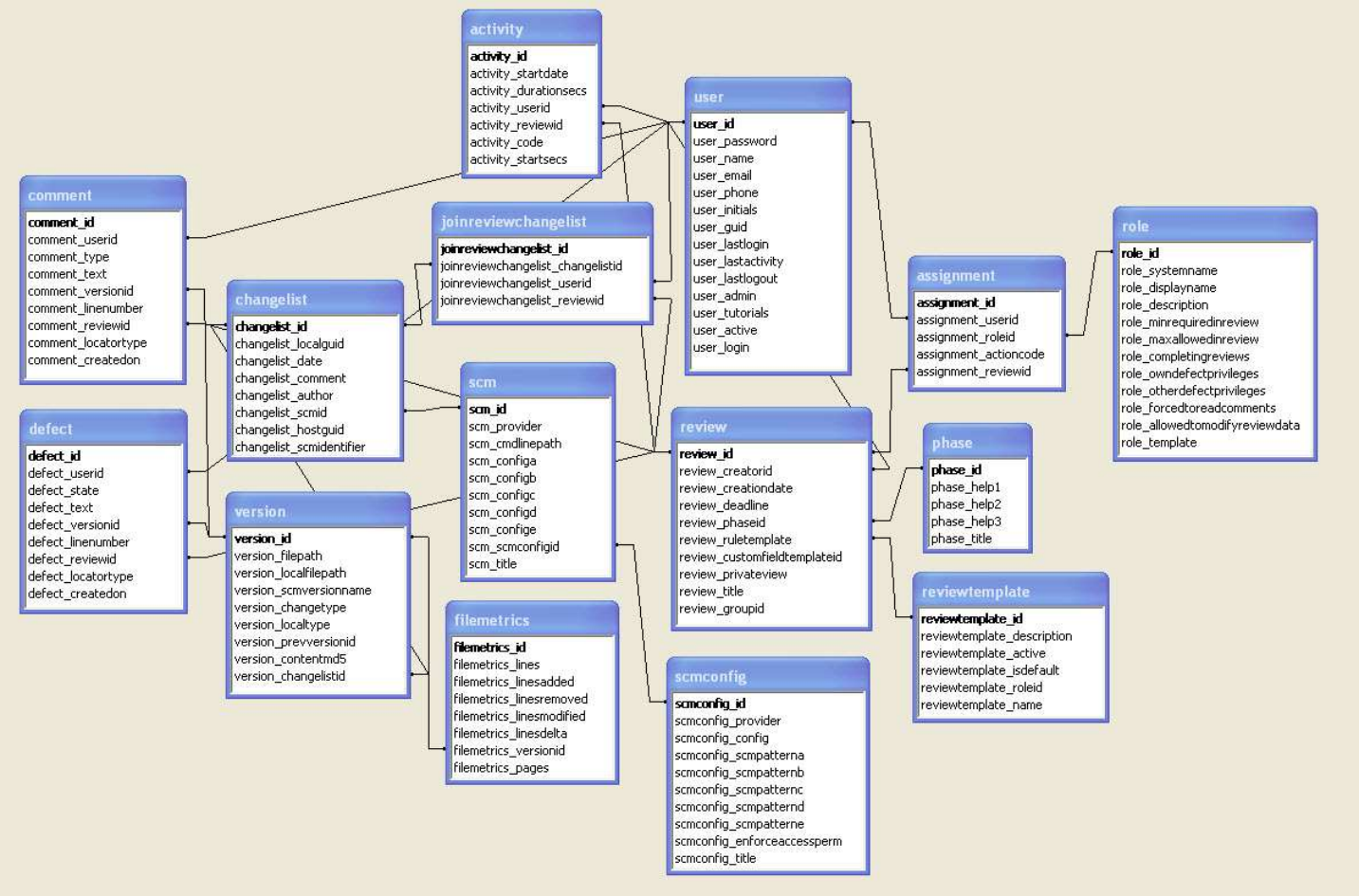
GRASS **GeoMedia** **AUTOCAD MAP 3D** **Maptitude**

The Map

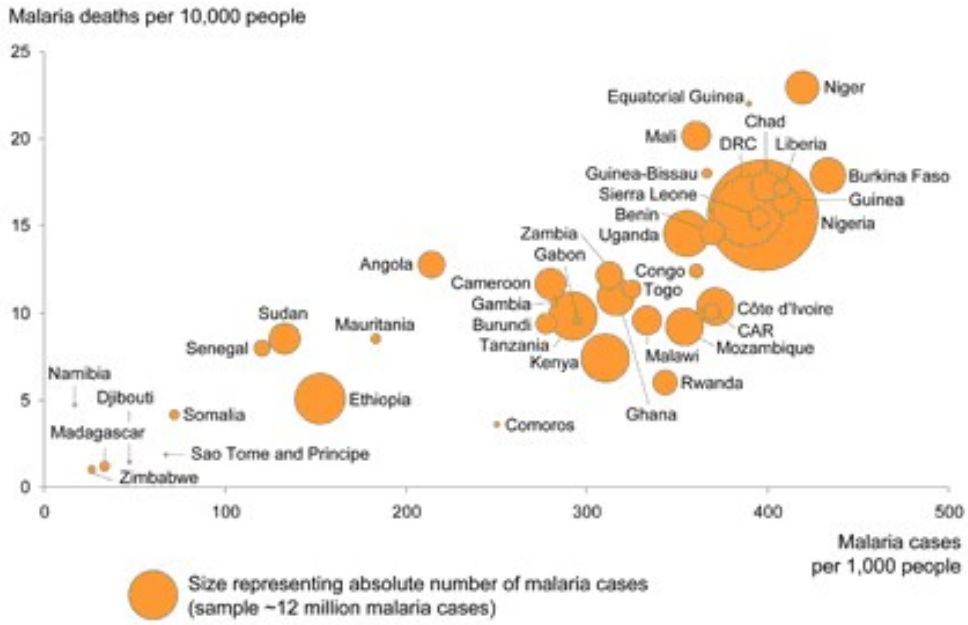


Lecture 1
http://reliefweb.int/map/syrian-arab-republic/syrian-refugees-region-20-january-2014

The Database



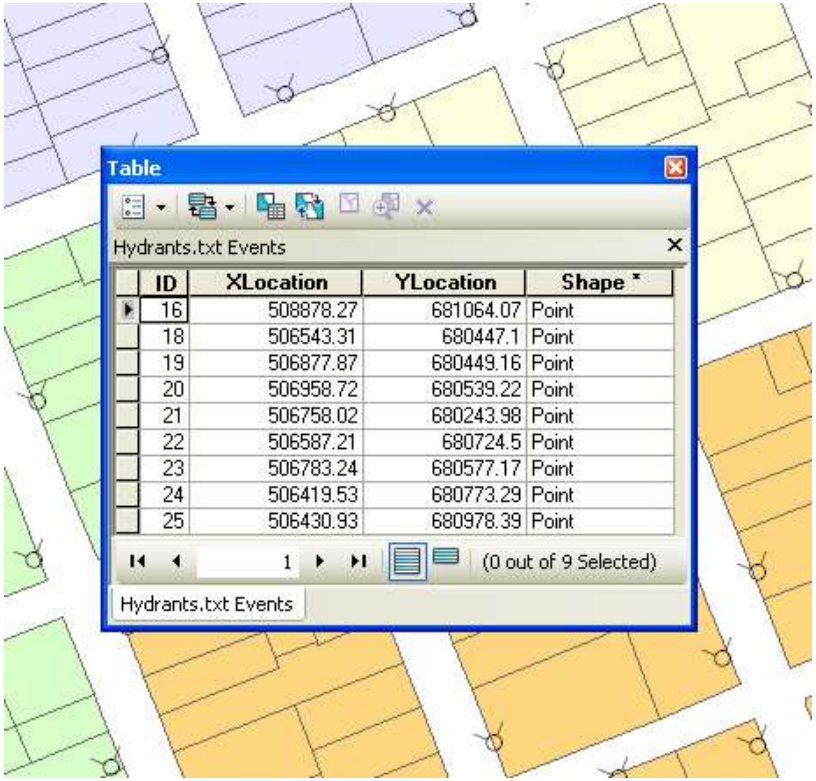
Other Features Graphs



Malarial Deaths per 10,000 People

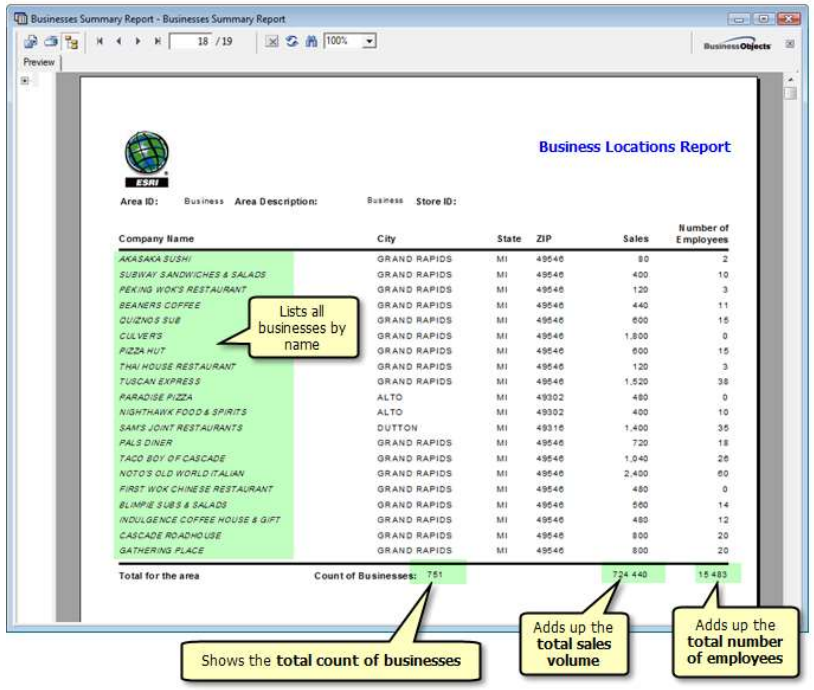
Lecture 1
http://www.rollbackmalaria.org/microsites/gmap/3-2.html

Other Features Tables



https://desktop.arcgis.com/en/arcmap/10.3/manage-data/tables/GUID-5A309AD2-B84E-4ECF-A475-7E4B492660EC-web.png

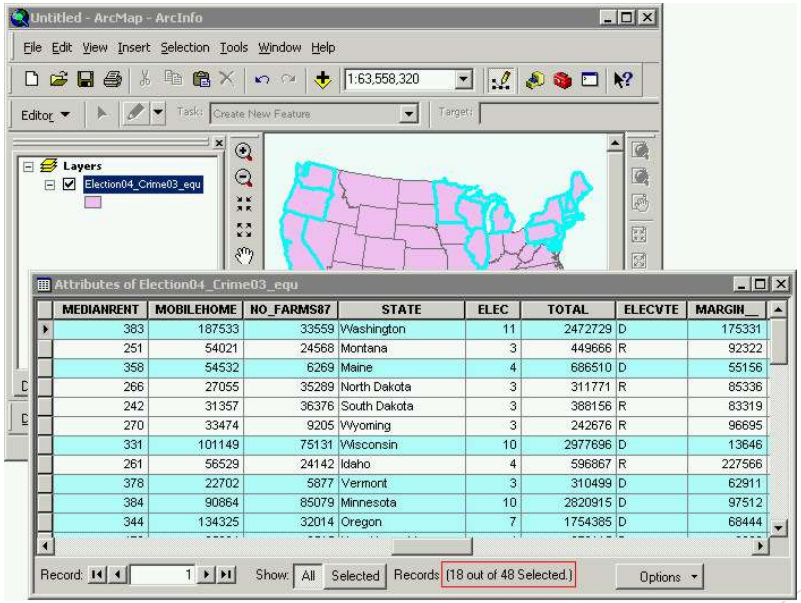
Other Features Reports



http://desktop.arcgis.com/en/arcmap/10.3/guide-books/extensions/business-analyst/GUID-389C0E81-9313-4C5C-94B0-51D7650E3B53-web.png

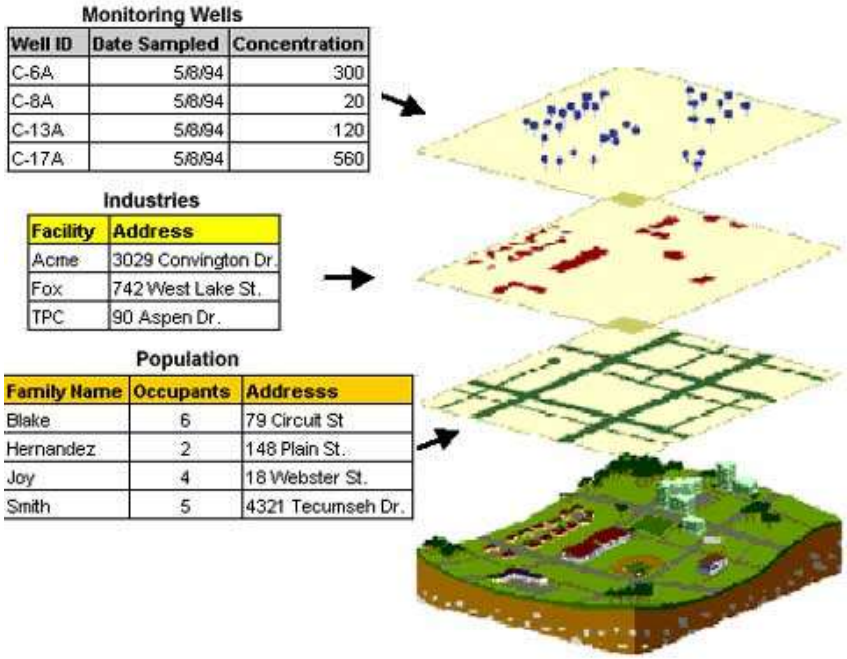
The Power of GIS

- The interaction between the database and the map, along with the ability to create graphs, tables and reports.



How does a GIS answer spatial questions?

GIS allows us to abstract information from the physical world and display it in layers or themes. It allows us to:



Monitoring Wells

Well ID	Date Sampled	Concentration
C-6A	5/8/94	300
C-8A	5/8/94	20
C-13A	5/8/94	120
C-17A	5/8/94	560

Industries

Facility	Address
Acme	3029 Convington Dr.
Fox	742 West Lake St.
TPC	90 Aspen Dr.

Population

Family Name	Occupants	Addresss
Blake	6	79 Circuit St
Hernandez	2	148 Plain St.
Joy	4	18 Webster St.
Smith	5	4321 Tecumseh Dr.

- Input and edit both spatial and attribute data.
- Display data on a screen or print a map.
- Analyze the data for making decisions and searching for patterns.
- Create models and ask “what if”.

What types of questions can be answered by a GIS?

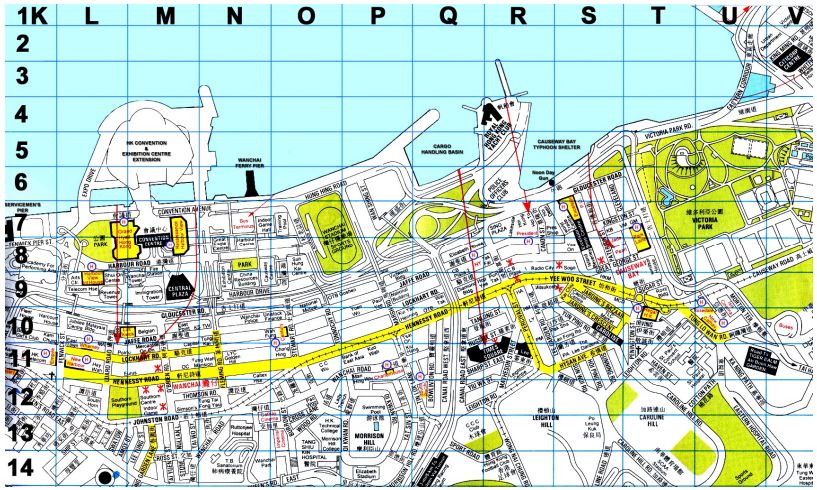
- Where are particular features found?
- What geographic patterns exist?
- Where have changes occurred over a specified time period?
- Where do certain conditions apply?
- What will be the implications if an organization takes a certain action?

What types of data are used in a GIS?

- Coordinate data
- Connection information
- Descriptive information
- Temporal information
- Images
- Documents
- URL's

Coordinate Data for a GIS

- Spatial data – you can attach coordinate information.
- 2D maps (X,Y)



Lecture 1
http://www.mappery.com/map-of/Hong-Kong-Hotel-Map-2

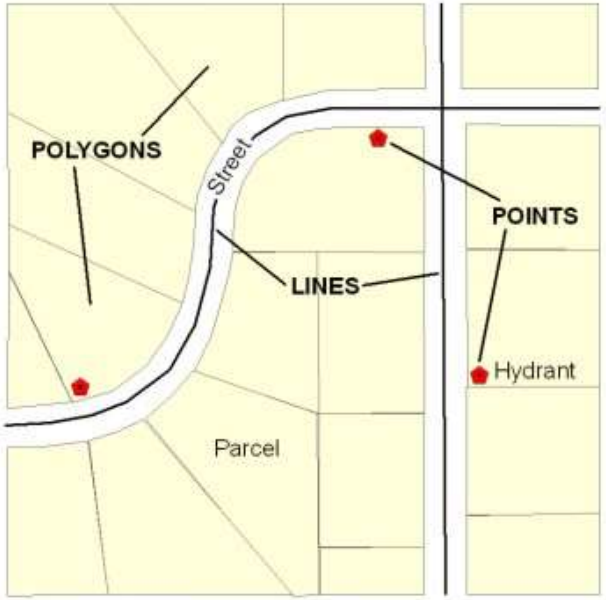
3D –Maps (X,Y,Z)

Lecture 1
https://www.flickr.com/photos/seeminglee/4112874847

How is spatial data represented in a GIS?

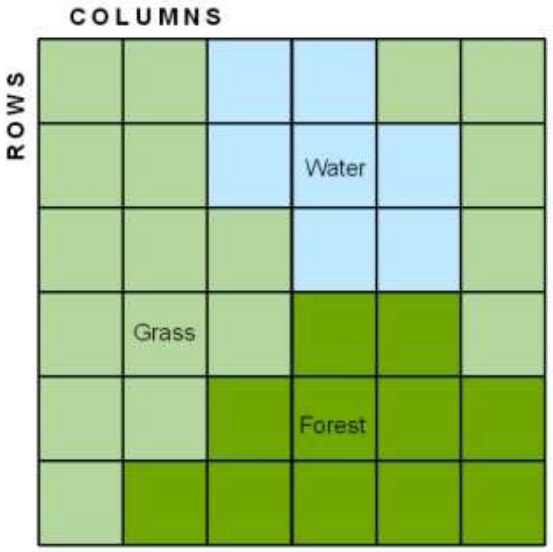
Vectors

- Points, Lines & Areas/Polygons



Raster

- Grids/Tesselations



Applications of GIS

- **Urban Planning, Management & Policy**
  - Zoning, subdivision planning
  - Land acquisition
  - Economic development
  - Code enforcement
  - Housing renovation programs
  - Emergency response
  - Crime analysis
  - Tax assessment
- **Environmental Sciences**
  - Monitoring environmental risk
  - Modeling storm water runoff
  - Management of watersheds, floodplains, wetlands, forests, aquifers
  - Environmental Impact Analysis
  - Hazardous or toxic facility siting
  - Groundwater modeling and contamination tracking
- **Political Science**
  - Redistricting
  - Analysis of election results
  - Predictive modeling

Civil Engineering/Utility

Locating underground facilities
Designing alignment for freeways, transit
Coordination of infrastructure maintenance

Business

Demographic Analysis
Market Penetration/ Share Analysis
Site Selection

Education Administration

Attendance Area Maintenance
Enrollment Projections
School Bus Routing

Real Estate

Neighborhood land prices
Traffic Impact Analysis
Determination of Highest and Best Use

Health Care

Epidemiology
Needs Analysis
Service Inventory

GIS Before Computers

Cholera Map of Dr. John Snow (UK 1850s)