Lecture 1

What is GIS?

- "An automated system for the capture, storage, retrieval, analysis, and display of spatial data"
- "Computer-based mapping, analysis, and retrieval of location based data"
- "GISs are simultaneously the telescope, the microscope, the computer, and the Xerox machine of regional analysis and synthesis"
- "a system that includes computer software, hardware and the personnel (human-ware) to help manipulate, analyze, and present geographical information"

Why GIS and Empirical Methods?

- Geospatial Data
- Location Intelligence – Location Matters
- Data Collection
- Web Mapping Trend
- Data vs Information
- Open Data and Opensource GIS
- Consumer-oriented GIS – location
- Job Market - skills that are transferable

Why Intelligence & GIS?

- Population Growth
    - Population has doubled in the last 50 years.
- Location intelligence is more than just a map

Big Data & GIS

- Big Data
    - Extremely large structured or unstructured data that contains
        - High Volumes
        - High varieties
        - High velocity
- Big Data Movement:
    - "You can't manage what you don't measure" – the evidence!
- Artificial Intelligence
    - GIS helps us identify and create hotspots of environment, social, political &U economic problems (among many others)
    - Helps solve them
    - Human brians can not compute the information to the extent
    - An intelligent system with location at the center piece

Internet of things and GIS

- Siri, google home, alexa can turn on thermostat
- how things are being connected to the internet (IFTT)
- Geofencing

What is common among these topics? LOCATION

Disruption through location are worth billions. For example companies such as:

- Airbnb
- Waze
- Uber
- Foursquare

Lecture 2

Spatial: Related to the space around you, in which we live and function

GIS – geographic information system is a powerful toolbox. It transforms and displays spatial data from the real world for a set of purposes.

GIS – collects data, shifts, sorts, rebuilds – all for the right piece of information

Empirical evidence: scientists and measurement

Spatially distributed

- Different time and different location
- Different location and same time

GIS is a multidisciplinary approach

GIS consists of:

1. Points
2. Lines
3. Polygons/Areas

Deductive reasoning: From general premises or facts to predict results Strong conclusions ifpremises are true an the form of the argument is valid

Inductive reasoning: from specific observations to some examples to draw more general conlcsions, conclusions not as strong.

Abductive reasoning: begins with incomplete set of observation and proceeds ot te likeliest possible explanation.

Empirical Methods/Evidences:

- Systematic observations or experimentation about relevant aspects of the world using a method/technology and our senses.
- Evidence based: measuring the amount of lead found in drinking water

Phenomena: are all the stuff in the real world.

Data are records of observation of phenomena. Data is broken up into two sections qualitative and quantitative:

Quantitative: Things you can measure, class with intervals

Qualitative: observed but not measured, classes with intervals

Frequency: the number of times a value occurs in a data set

Mutually exclusive vs mutually exhaustive:

In mutually exclusive: data falls only in one class

Mutually exhaustive – all data is represented

Lecture 3

CLASS POSTPONED NEXT WEEK

- Slides will be posted in advanced

QUIZ DUE SUNDAY NIGHT NEXT WEEK

- No class tomorrow

RECAP:

inductive reasoning: sounds logical but not universal truth. Eg I leave work at 4:00 from DT everyday and reach Scarborough at 5:00. So, I reach Scarborough at 5 if I leave downtown at 4

abductive reasoning: John goes to doctor to headache, john gets Tylenol, doctor hopes Tylenol is the best solution.

GIS is made up of **points, lines, and polygon**

Empirical methods/evidence

Phenomena: all stuff in the real world

Data: are records of observation of phenomena

Qualitative data:

- Deals with descriptions
- Can be observed but not measured

Quantitative data:

- deals with data
- can be measured (temperature, height, age etc.)
- Classes with intervals

Frequency table for Quantitative data

- Numerical
- Think of grades
    - Normally grouped into classes

Mutually Exclusive: Data falls only in one class

Mutually Exhaustive: All data represented

Variable:

- Likely to change
- An element or feature liable to vary
- Data are the answers

Students	Final grade	Letter grade	3- variables
John	78	B-	
Katrina	90	A	
Elizabeth	86	A-	

Empirical Evidence: an information acquire through observation and experimentation

Scientific methods: All evidence – empirical or at least empirically based set of procedure that scientists follow.

Scientific Process: (does not have to follow this order)

1. Question
2. Hypothesis (potential answer)
3. Experimentation
4. Observation
5. Analysis
6. Conclusion
7. Eg newton apple fell from the tree <- observation
8. What is causing apple to fall from the tree? <- questions

You can do linear regression in excel

Lecture 4

Causality vs Correlation:

- Causality:
  - Asks does A cause B?
  - Detecting cause will allow prediction of the effect
  - Controlling the cause will control the effect
- Correlation
  - Asks are A and B correlated?
  - Does A tend to happen when B happens?
  - Correlation (two variables measured together in a setting)
  - No control group or random assignment
  - People assume that one of the variables "causes" another

Correlation doesn't mean causation.

Causes and effect John snow:

- Assumed causes of cholera
  - Unsanitary basements and urban poor
  - Plague pit theory
  - Bad poisonous air

John Snow noticed Cholera out of control in soho.

He noticed the concentration around broad street. He carefully studied and mapped addresses of deaths and realized:

- Outbreak was confined to a small area
- Outbreak was centered near one pump on broad street

Models:

- Data model is a representation of reality
- A map is a model
- Equation for a trendline can be model as well

Lecture 5

Data: in GIS includes

- **Spatial:** geographic coordinate information describing object geometry
- **Attribute:** describing non spatial properties of object or tabular data

The attribute information in GIS – entered, analyzed and reported using Database Management Systems (DBMS).

What is a database?

A collection of information (data) in a compute that is organized in such a away that we can easily access them, manage them, and update them in various ways.

Database terminology:

- Field: a single piece of information (year)
- Record: a complete set of fields
- Files: a file is a collection of records
- Database: a collection of files

Database management system:

Stores properties of spatial objects or tables and their relationships among them.

Relational database management systems:

- Extension of DBMS
- Contains relationship among tables
- Tbales have unique identifiers
-