Mapping and GIS

Learning Objectives

- Outline the cartographic process
- Identify various map scales and describe their purpose
- Differentiate between GIS and a map; and GIS and the cartographic process
- List requirements for an effective georeference system
- Be familiar with problems associated with place names, addresses and other systems

The Map

- The most efficient shorthand to show location of objects in space
  - Objects can be physical, cultural or even abstract
  - Attributes and spatial distribution is displayed
- Paper – the conventional storage medium
- GIS
  - Holistic
  - Shows features on demand
  - Electronic

The Mapping Process

- Four stages:
  1. Planning
  2. Data Acquisition
  3. Cartographic Production
  4. Product Delivery
- Map Planning:
  - Study user requirements
  - Build consensus (resolve conflicts)
  - Develop specs

The Mapping Process (2)

- Data Acquisition
  - Establish geographical reference framework (in loose terms, you can call it a "standardized coordinate system")
  - Conduct land surveys, photogrametry and/or remote sensing
  - Note that not all map products will need new data
  - The process is similar even for GIS

The Mapping Process (3)

- Cartographic Production
  - Start with cartographic design (which defines the looks of the end product)
  - Drafting, proof reading and final printing of the actual map
- Product delivery
  - For GIS, the product is more often the data
  - Paper maps by USGS have distribution centers
  - Data are distributed through disks and internet

Map Essentials

- Every map should have:
  - A scale (Map Scale)
    - Representative fraction or RF (e.g. 1:100,000) OR
    - Verbal Scale (e.g. one inch to one mile)
    - Scale Bar
  - Map Orientation
    - Which way is North?
  - Map Legend
    - What symbol represents what?
  - These are very essential to your lab work

Classes of Maps

- General Purpose or reference maps
  - Adhere to standards of accuracy and content
  - Serve as good base maps for determining:
    - Distances
    - Areas
    - Direction and
    - Coordinates of well defined geographic features
  - E.g. USGS 7.5 minute quadrangles or simply 7.5 quads
- Special purpose or thematic maps
  - Designed to depict a particular type of feature or measurement only (e.g. vegetation cover)

Map Symbolism

- You drive in CA or in Alabama, the Stop sign looks the same
  - Thanks to the legal requirement and the Manual of Uniform Traffic Control Devices (MUTCD)
- If all maps have a common symbology for objects, life would be easier:
  - If you see an airplane on the map what will you identify that place with?
- Representing spatial elements on a map
  - Not unlike uniform traffic control signs
    - "intuitive" symbols and themes
  - Yet, there are no rigid rules - room for creativity

Comp. Aided Cartography (Map) vs. GIS

- Data collection – nearly identical
- Data Storage
  - Map: archival in traditional ways, clumsy
  - GIS: efficient storage and retrieval
- Data processing (aggregation, classing)
  - Map: linear process, extremely limited analytical capabilities, laborious
  - GIS: circular process, unlimited analytical capabilities, very efficient
- Map production and reproduction
  - Map: final step, reproduction on Mylar or paper
  - GIS: not always final step
- Updating
  - Map: laborious
  - GIS: less effort

The Map vs. GIS

(Physical Entities)

Map	GIS
Input recoded as *points, lines, areas*	Input encoded as *points, lines, areas*
Data Sources: ➢Aerial photography ➢Digital remote sensing ➢Surveying ➢Visual descriptions ➢Census data ➢Statistical data, etc.	Data Sources: ➢ Same as map data ➢ Digital line graphs (DLG) ➢ Digital elevation models (DEMs) ➢ Digital orthoquads ➢ Other digital databases
Retrieval: Simply read the map	Retrieval: need efficient search techniques

Typical GIS Analytics

- ➢Point Data (e.g. Zip code centroids)
  - Proximity analysis
  - Location problems (p-median)
- ➢Line Layers
  - Network routing
  - Network assignment
- ➢Area and Surface Data
  - Volumetric measurements
  - Coverage analysis
- ➢And then, images

Spatial Elements

Spatial elements can be real or imaginary

- ➢ Points
  - No length and width
- ➢ Lines
  - Only length, negligible width
- ➢ Areas
  - Length and width
- ➢ Surfaces
  - Areas with an additional element, elevation!

Measurement(s)

- Nominal – *A Name*
  - Washington DC is a city, it has a name and the city's nominal measurement is "Washington DC"
- Ordinal – *Qualitative*
  - Traffic congestion on roads inside beltway is "bad" and on the beltway itself it is the "worst"
- Interval – *Numeric*
  - Average driving speed on the beltway
- Ratio – *Relative Measure among entities*
  - Average annual household income in Fairfax County

Features of "Spatial" Elements

- Coordinate data
- Other attributes (of any of the 4 levels of measurements)
  - Primary and secondary attributes
  - Some primary attributes can not be measured using GIS, they can only be "displayed" and/or analyzed
  - Some can be measured using GIS and viewed
- *Aspatial* elements
  - No coordinate data but has a "relation" to the spatial elements
  - GIS is useful in analyzing and displaying *aspatial* data within the specified "spatial" criteria!