GEOG 176A: Introduction to Geographic Information Systems

Lecture 17: How to Pick a GIS I

(chapter 9)

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Now, imagine that you are hired in a big organization, and on the first day of your work, your manager asks your advice on choosing a GIS software for the whole organization . . . what are you gonna do?
Choosing a GIS

- The first decision for a GIS analyst is often “Which GIS?”
  - What functions should this GIS have?
  - Commercial or Open Source GIS?
  - Do you need to develop your own GIS applications?

![GIS Software Logos]
What functions should a GIS have?

Six critical perspectives:

- Data capture
- Storage
- Management
- Retrieval
- Analysis
- Display / Visualization
What functions should a GIS have?

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- Data capture
- Storage
- Management
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Data capture

- How do you get data into GIS?
  - Digitizing
  - Scanning
  - On-screen digitizing

- Data preprocessing
  - Topological cleaning
  - Dissolving
  - Mosaicing (zipping)
  - Rubber sheeting
  - Generalization
Dissolving

- Aggregate features based on specific attributes
Mosaicking

- A combination or merge of two or more images
Rubber sheeting

- Assign spatial reference to an image
  - The image does not have reference initially (e.g., remote sensing images or a scanned map)
  - Assign spatial reference using **control points**
Generalization

- Line generalization
  - Example: reduce the number of points for a polyline
  - Types of line generalizations
Generalization

Example:  http://mapshaper.org/
Generalization

- The subway map (network map) we learned is an example of map generalization!
What functions should a GIS have?

Six critical perspectives:

- Data capture
- Storage
- Management
- Retrieval
- Analysis
- Display / Visualization
Storage

- **Data models**
  - Vector only, raster only, TIN?

- **Data formats**
  - Shapefile, jpeg, dem, tiff, …

- **Metadata handling**
  - Can this GIS store metadata?

- **Data fusion**
  - Can the GIS integrate geospatial data from different sources?
Data fusion

- Solution: Geo-ontologies!
  - This is a hot topic in current GIS research

![Diagram showing the difference between mountains in DBpedia Places and Geonames]
What functions should a GIS have?

Six critical perspectives:

- Data capture
- Management
- Retrieval
- Analysis
- Display / Visualization
Data management

- Adding, deleting, updating
  - Attributes
  - Geometries / spatial coordinates

- Generating new data from existing
  - Address matching: creating coordinates from text address (geocoding)
  - Masking: define an area using a mask, and extract the data based on this mask
  - ...

Masking

- Extract data using a mask (polygon)
What functions should a GIS have?

Six critical perspectives:

- Data capture
- Storage
- Management
- Retrieval
- Analysis
- Display / Visualization
Data retrieval

- Retrieval data from coordinates (select by location)
  - Clicking on the map
  - Using a buffer zone
- Retrieval data from attributes (select by attribute)
  - Attribute equals to a particular value
  - Attribute falls into a value range
  - ...
Click on maps to retrieve data
Buffer zone to retrieve
What functions should a GIS have?

Six critical perspectives:

● Data capture
● Storage
● Management
● Retrieval
● Analysis
● Display / Visualization
Data analysis

● General analysis:
  ○ Descriptive analysis
  ○ Inferential analysis

● Vector analysis:
  ○ Spatial pattern analysis
  ○ Clustering detection
  ○ Layer overlay

● Raster analysis:
  ○ Terrain analysis
  ○ Map algebra
Map algebra

- Local (per pixel)
- Focal (by neighboring entities)
- Zonal (by patch)
- Global (by the whole map)
Map algebra - local

E.g., sum/mean of population based on male and female

\[
\begin{bmatrix}
1 & 4 & 5 \\
5 & 3 & 2 \\
2 & 5 & 2 \\
\end{bmatrix}
+ \begin{bmatrix}
5 & 1 & 3 \\
1 & 2 & 1 \\
1 & 4 & 2 \\
\end{bmatrix}
= \begin{bmatrix}
6 & 5 & 8 \\
6 & 5 & 3 \\
3 & 9 & 4 \\
\end{bmatrix}
\]
Map algebra - focal

E.g., sum/mean of neighborhood operation (moving window)

- terrain analysis

Slope and aspect
Map algebra - zonal

E.g. the highest value (maximum) in each zone is assigned to all cells in that zone
Map algebra - global

E.g., Euclidean distance - calculate the closest distance away from the closest source
Map algebra in ArcGIS
What functions should a GIS have?

Six critical perspectives:

- Data capture
- Storage
- Management
- Retrieval
- Analysis
- Display / Visualization
Data display

● Does this GIS automatically include cartographic principles for output maps?
● Does this GIS provide cognitive suggestions for output maps?
● What formats can this GIS export maps?
Some other considerations

- Does this GIS provide
  - good documentations for users to seek helps?
  - an easy-to-use GUI?
  - “batching” commands?
  - a “language” for users to communicate with or program the system’s functions?
The more the better?

- Is a GIS with more functions always better for you? → Not necessarily!
  - More functions might confuse the end users
  - GIS with more functions are often more expensive
    - Many GISs are sold by modules
      - [https://developers.arcgis.com/pricing/](https://developers.arcgis.com/pricing/)

- Choose a GIS based on the needs of your project / organization!
Your tasks

● Read Chapter 9
● Review slides
● Conduct lab 5: **Due on Sunday September 9th, at 23:55 pm**

Next lecture: How to pick a GIS II

○ Commercial or Open Source GIS?
○ Do you need to develop your own GIS applications?