Lecture 17: How to Pick a GIS II  
(chapter 9)  
Rui Zhu
Recall: 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?
Recall: What functions should a GIS have?

Six critical perspectives:

- Data capture
- Storage
- Management
- Retrieval
- Analysis
- Display / Visualization
Recall: Data analysis

- **General analysis:**
  - Descriptive analysis
  - Inferential analysis

- **Spatial analysis:**
  - Spatial pattern analysis
  - Clustering detection
  - Layer overlay
  - Terrain analysis
  - Map algebra -> for raster
Recall: Map algebra

- Local (per pixel)
- Focal (around entity)
- Zonal (by patch)
- Global (by the whole map)
Recall: Map algebra - local

E.g., sum/mean of population based on male and female
Recall: Map algebra - focal

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

- terrain analysis
Recall: Map algebra - zonal

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

E.g., Euclidean distance tool - calculate the shortest distance between a cell and a source (labeled as 1)
Map algebra in ArcGIS

![Image of ArcGIS Raster Calculator]

![Image of ArcGIS Zonal Statistics as Table]

![Image of ArcGIS Neighborhood Settings]
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 **documentation**s for users to find helps?
  - an easy-to-use **GUI**?
  - “**batching**” commands?
  - a “**language**” for users to communicate with or program the system’s functions?
Summary: What functions should a GIS have?

Six critical perspectives:

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

Additional techniques/tools covered: Dissolving, Mosaicing, Rubber sheeting, Generalization, Masking, Identify, Buffer, Map algebra
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
      - e.g., ArcGIS Extensions

- Choose a GIS based on the needs of your project / organization!
Recall: 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?
Commercial GIS or Open-Source GIS

● Advantages of commercial GIS
  ○ Stable and robust
  ○ Good documentation
  ○ Good training and tutorials
  ○ Maintenance support

● Disadvantages of commercial GIS
  ○ Purchasing the software is expensive
  ○ Maintenance is expensive
  ○ Even a support call can charge your organization’s money
  ○ Not flexible!

Commercial GIS or Open-Source GIS

- Advantages of open-source GIS
  - Low cost (still might not be free!)
  - Flexible: can be combined to a project in your way
  - High extensibility: you can extend its existing functionality by modifying its codes

- Disadvantages of open-source GIS
  - May not be robust
  - May not have well-organized documentation
  - You have to do maintenance yourself
# Commercial GIS

<table>
<thead>
<tr>
<th>Software</th>
<th>About</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autodesk</td>
<td>Map 3D, Topobase, MapGuide and other products that interface with its AutoCAD CAD package.</td>
<td>usa.autodesk.com/</td>
</tr>
<tr>
<td>Bentley Systems</td>
<td>Products include Bentley Map, Bentley PowerMap, and other products that interface with its MicroStation software.</td>
<td><a href="http://www.bentley.com/en-US/">www.bentley.com/en-US/</a></td>
</tr>
<tr>
<td>Intergraph</td>
<td>GeoMedia, GeoMedia Professional, GeoMedia WebMap, and add-on products for industry sectors, as well as photogrammetry.</td>
<td><a href="http://www.intergraph.com/">www.intergraph.com/</a></td>
</tr>
<tr>
<td>ERDAS</td>
<td>Leica Geosystems subunit encompassing GIS, Photogrammetry, and Remote Sensing. Main software is Imagine.</td>
<td><a href="http://www.erdas.com">www.erdas.com</a></td>
</tr>
<tr>
<td>ESRI</td>
<td>ArcView 3.x, ArcGIS, ArcSDE, ArcIMS, ArcWeb services, and ArcServer.</td>
<td><a href="http://www.esri.com">www.esri.com</a></td>
</tr>
<tr>
<td>MapInfo</td>
<td>From Pitney Bowes. Includes MapInfo Professional and MapXtreme. Integrates GIS software, data and services.</td>
<td><a href="http://www.mapinfo.com">www.mapinfo.com</a></td>
</tr>
<tr>
<td>Manifold</td>
<td>Full capability GIS software package.</td>
<td><a href="http://www.manifold.net">www.manifold.net</a></td>
</tr>
</tbody>
</table>
## Commercial GIS (cont.)

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadcorp</td>
<td>Cadcorp SIS (desktop), GeognoSIS (web), mSIS (mobile), and developer kits.</td>
<td><a href="http://www.cadcorp.com">www.cadcorp.com</a></td>
</tr>
<tr>
<td>Caliper</td>
<td>Maptitude, TransCAD, and TransModeler. Develops GIS and the only GIS for transportation.</td>
<td><a href="http://www.caliper.com">www.caliper.com</a></td>
</tr>
<tr>
<td>IDRISI</td>
<td>Taiga GIS product developed by Clark Labs.</td>
<td><a href="http://www.idrisi.com">www.idrisi.com</a></td>
</tr>
<tr>
<td>TatukGIS</td>
<td>TatukGIS Developer Kernel (SDK), GIS Internet Server, GIS Editor, and free GIS Viewer software products.</td>
<td><a href="http://www.tatukgis.com">www.tatukgis.com</a></td>
</tr>
</tbody>
</table>
# Open Source GIS

<table>
<thead>
<tr>
<th>Software</th>
<th>Description</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>QGIS</td>
<td>Quantum GIS-QGIS is a user friendly Open Source GIS that runs on Linux, Unix, Mac OS X, and Windows.</td>
<td><a href="http://www.qgis.org/">http://www.qgis.org/</a></td>
</tr>
<tr>
<td>uDig</td>
<td>uDig is an open source desktop application framework, built with Eclipse Rich Client technology.</td>
<td><a href="http://udig.refractions.net/">http://udig.refractions.net/</a></td>
</tr>
<tr>
<td>Capaware rc1 0.1</td>
<td>General purpose virtual worlds 3D viewer. A free software project started in 2007 to promote the development of free software.</td>
<td><a href="http://www.capaware.org/">http://www.capaware.org/</a></td>
</tr>
<tr>
<td>Kalypsos</td>
<td>An Open Source GIS (Java, GML3) that focuses on water management. Supports modeling and simulation.</td>
<td><a href="http://www.oltoh.net/pkalypsos">http://www.oltoh.net/pkalypsos</a></td>
</tr>
<tr>
<td>TerraView</td>
<td>Desktop GIS that handles vector and raster data stored in a relational or geo-relational database, a front-end for TerraLib.</td>
<td><a href="http://www.dpi.inpe.br/teraview/index.php">http://www.dpi.inpe.br/teraview/index.php</a></td>
</tr>
<tr>
<td>GeoServer</td>
<td>GeoServer is an open source software server written in Java that allows users to share and edit geospatial data.</td>
<td><a href="http://geoserver.org/display/GEOServerWelcome">http://geoserver.org/display/GEOServerWelcome</a></td>
</tr>
<tr>
<td>WebMap Server</td>
<td>Open source protocol and tools for serving GIS data over the Internet.</td>
<td><a href="http://teraserver.usa.com/webgwsms.aspx">http://teraserver.usa.com/webgwsms.aspx</a></td>
</tr>
<tr>
<td>MapGuide Open Source</td>
<td>Web-based platform that enables users to quickly develop and deploy web mapping applications and geospatial web services.</td>
<td><a href="http://mapguide.osgeo.org/">http://mapguide.osgeo.org/</a></td>
</tr>
<tr>
<td>MapServer</td>
<td>Web-based mapping server, developed by the University of Minnesota.</td>
<td><a href="http://mapserver.org/">http://mapserver.org/</a></td>
</tr>
<tr>
<td>Spatialite for SQLite</td>
<td>Spatialite extension enables SQLite to support spatial data in a way conformant to OpenGis specifications.</td>
<td><a href="http://www.gaia-gis.it/spatialite-2.0/index.html">http://www.gaia-gis.it/spatialite-2.0/index.html</a></td>
</tr>
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</table>
Quantum GIS (QGIS)

A Free and Open Source Geographic Information System

Create, edit, visualise, analyse and publish geospatial information on Windows, Mac, Linux, BSD (Android coming soon)

For your desktop, server, in your web browser and as developer libraries

Download QGIS for your platform

- Binary packages (installers) are available from this page.
- The current version is QGIS 3.8.2 'Zanzibar' and was released on 17.08.2018.
- The long term repositories currently offer QGIS 2.18.23 'Las Palmas'.

QGIS is available on Windows, macOS X, Linux and Android.

Download QGIS for Windows
Download QGIS for Mac OS X
Download QGIS for Linux
Download QGIS for BSD
Download QGIS for Android

GET INVOLVED!


For testing and learning purposes, a sample dataset is available, which contains collections of data from different sources and in different formats.
GRASS

- First UNIX GIS
- Developed by the army

https://grass.osgeo.org/

FIGURE 8.12: Left: The GRASS GIS Web page. (http://ww3.baylor.edu/grass/index2.html) Right: The GRASS user interface; Bottom: Sample applications from the image galley.
Human factors in selecting a GIS

- Can people in your organization learn new technologies quickly?
- How much are people in your organization familiar with GIS?
- Is there any GIS that has been previously used in your organization?
- ...
Recall: choosing a GIS

- The first decision for a GIS analyst is often “Which GIS?”
  - What functions should this GIS have?
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GIS development

- What if you want to develop your own GIS for a particular application?
- GIS development components
  - Commercial software: ArcGIS Engine, ArcGIS Server, ArcGIS Javascript API, ....
  - Open source: Open Layers, Leaflet, cgal, JTS, OpenCV, ....
GIS development

- ArcGIS Engine: for developing custom GIS applications on desktop GIS
- Support C++, Java, .Net, ....

http://mapdev.geog.ucsb.edu/
GIS development

- ArcGIS Server: for developing GIS application running on servers
- Support multiple programming languages
GIS development

- ArcGIS Javascript API: for developing lightweight web-based GIS

https://www.arcgis.com/home/webmap/viewer.html?webmap=ec9771b2d40d46c1af4324a6be9a2f78
GIS development

- **OpenLayers:** an open source JavaScript library for developing web-based GIS
GIS development

- Leaflet: an open source Javascript library for mobile-friendly interactive maps

https://leafletjs.com/
GIS development

Cgal: **an open source** project based on C++ to provide easy access to efficient and reliable **geometric algorithms**
GIS development

- **JTS**: an open source java library for geometry algorithms

![JTS Topology Suite](image)
GIS development

- **OpenCV**: an *open source image processing library* based on C++
Algorithms v.s. Applications

- **Algorithm development:** inventing **new methods** to improve the efficiency of existing GIS functions or **creating new GIS functions**.
  - Requires good backgrounds in computer science (CS 130A, CS 130B, GEOG 178)
  - Competitions: ACM GIS Cups
    - Spatial Networks
    - Spatial Data Structures and Algorithms
    - Indexing and Retrieval in Spatial Computing
    - ...
Algorithms v.s. Applications

- Applications development: integrating existing GIS components and APIs
- API: Application Programming Interface
  - Interfaces from existing software that allow a third-party application to access the data and function
  - E.g., Twitter API, Foursquare API, Google Geocoding API, Google Maps API, …
- A lot of GIS developments are application developments
  - Requires brilliant ideas
  - Requires less on programming
  - Requires the capabilities to learn new technologies
- Examples:
  - Using twitters to predict disasters (e.g., tornados)
  - Suggesting places based on Foursquares
  - ……