Geographic Information Systems (GIS) and Library Services

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Overview

- What is GIS?
- Why Library GIS Services?
- GIS Terminology and Concepts
- GIS Software
- GIS Data Sources
- GIS Library Services
- Other Resources
WHAT IS A GEOGRAPHIC INFORMATION SYSTEM?
“Geography is the study of the world and all that is in it: its peoples, its land, air, and water, its plants and animals, and all the connections among its various parts [...] Knowing where something is, how its location influences its characteristics, and how its location influences relationships with other phenomena are the foundation of geographic thinking.”

Esri - Geographic Inquiry: Thinking Geographically.
GIS is a Multidisciplinary Tool

<table>
<thead>
<tr>
<th>Government</th>
<th>Business</th>
<th>Utilities &amp; Communications</th>
<th>Natural Resources</th>
<th>Additional Industries</th>
</tr>
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<tbody>
<tr>
<td>Federal</td>
<td>Insurance</td>
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<td>Telecommunications</td>
<td>Forestry</td>
<td>Mapping and Charting</td>
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<td>Media</td>
<td>Water/Wastewater</td>
<td>Mining</td>
<td>Transportation</td>
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<td>Oceans</td>
<td>Public Safety</td>
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<td>Petroleum</td>
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<td>Economic Development</td>
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<td>Water Resources</td>
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<tr>
<td>Elections and Redistricting</td>
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Satellite Photos Show How the Washington Landslide Area Changed Over Time
GIS in the News

Looking at the Battle of Gettysburg Through Robert E. Lee’s Eyes
GIS in the News

How Big Data Helps Chains Like Starbucks Pick Store Locations -- An (Unsung) Key To Retail Success.

A cartographic guide to Starbucks’ global domination.
GIS in the News

Geography Research Could Improve The Effectiveness Of Hospital Patient Transport Services

GIS technology verifies Caesar and Helvetii history

Tracking Technology Sheds Light on Shopper Habits: Mall Operators, Retailers Monitor Patterns and Actions
Texas Public Libraries in Google Earth
Data from NCES

Youtube Video
Quick Map Creation with ArcGIS

Youtube Video
Maps + Tabular Data + Analysis Capabilities
A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. - Esri [http://www.esri.com/what-is-gis](http://www.esri.com/what-is-gis)
More than Interactive Mapping

- Geographic Information Systems are more than just maps.
- GIS empower users to:
  - Take information
  - View that information spatially
  - Analyze that information
And therefore:
  - Recognize patterns
  - See correlations
  - Formulate better questions
  - and possibly...come to conclusions
WHY ARE LIBRARIES PROVIDING GIS SERVICES?
New Ways of Analyzing Information

In addition to traditional information formats, such as books and media, libraries are recognizing the necessity of providing access and the tools to effectively use information in different formats. Some examples:

- Makerspaces
- Digital Media Design Software
- Geographic Information Systems
Data and information compiled by the government and other entities have existed for quite some time.

Geographic Information Systems empower patrons to visualize this information and analyze it more effectively than before.
GIS TERMINOLOGY & CONCEPTS
Related Geospatial Technology

- **Global Positioning Systems (GPS)**

- **Remote Sensing**
GPS

GPS receivers let you record your coordinates, as well as collect attribute data (such as text, time stamps, images, etc.)

This information can be imported into a GIS.

Many libraries have geocaching events, where patrons use GPS to find ‘caches’ in a treasure hunt activity.

DataPoint App
Remote Sensing

- Remote Sensing is where information is obtained from a distance.
- Planes or satellites gather information from the earth’s surface, such as photographs, infrared, RADAR, and LiDAR.

http://www.kidsgeo.com
Most important GIS concept: Layers!

Layers of geographic data can be overlaid. Relationships between data can be analyzed and visualized.

When data is divided up the data into layers that can be overlaid over the same coordinates, one can better analyze the relationships between the data.
Two General Types of GIS Data:

• **Spatial Data**: Identifies the geographic location of features. It includes coordinates and projection information. It is the ‘Where”
  – **Vector**: Points, lines, polygons, shapefiles
  – **Raster**: Images

• **Attribute Data**: Describes and classifies the features. It is the ‘What, Where, and Why’
  – **Tabular**: tables, Excel, CSV, txt
# Spatial Data Formats

<table>
<thead>
<tr>
<th>Vector</th>
<th>Raster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points, Polylines, and Polygons</td>
<td>Cells in a grid; Pixels in an image</td>
</tr>
<tr>
<td>Definite x,y coordinates</td>
<td>Georeferenced to a coordinate system.</td>
</tr>
<tr>
<td>File Types: Geodatabases, Shapefiles, KML</td>
<td>File Types: .JPG, .PNG, .TIFF</td>
</tr>
</tbody>
</table>

![Diagram of Vector and Raster Data Formats]
A **shapefile** is a vector data format developed by ESRI.
Attribute Data

- Attribute data describes and classifies the features.
- It is the ‘What, Where, and Why.’
- Attributes are often in the tabular formats: tables, Excel, CSV, txt.
POPULAR GIS SOFTWARE
GIS refers to powerful software that not only allows the user to import spatial and attribute data to view visually, but also to run analysis on the data.

Popular GIS Software:

- **ArcGIS**: Proprietary, prominent software
- **Quantum GIS (QGIS)**: Open source software
- **GRASS GIS**: Open source software
There is software that provides the ability to combine attribute and spatial data, but do not have the robust analysis capabilities. These are sometimes called **GIS-Lite**.

As software becomes more powerful, the lines between GIS & GIS-Lite are blurred.

- **Popular GIS-lite Software:**
  - [Google Earth & Google Earth Pro](https://www.google.com/earth/)
  - SimplyMap
  - Social Explorer
  - Scribble Maps
GIS & GIS-Lite Software Costs

Proprietary $ Software

• Esri’s ArcGIS
• SimplyMap
• Social Explorer
• Google Earth Pro

FREE Proprietary Software

• Esri’s ArcGIS Explorer Online – as of December 2013, is in ‘retired phase support.’
• ArcGIS Online for individual users.
• Google Earth
Open Source Software

- QGIS (Quantum GIS)
- GRASS GIS

Photo by Nathan Woodrow.
Mobile GIS

- There are many mobile versions of GIS software.
- Most often, these are less powerful.
Online Interactive Mapping Tools

• Not officially GIS, but very useful. As analysis abilities increase, may be considered GIS. Examples include:
• **National Map Viewer** (Note – National Map and National Atlas will be combined in 2014)
• **CDC’s Interactive Cancer Atlas**
• **American FactFinder**
• **Abilene’s Interactive Web Mapping**
National Map Viewer

Not only does National Map Viewer allow you to overlay layers, but it also lets you easily download data!
ArcMap

• ArcMap is the main component of ESRI’s ArcGIS product.

• Because it is the standard in GIS software, we will be exploring GIS applications and techniques in ArcMap.
Important!

- ArcMap projects do not contain the data. They contain the settings, formats, information to view the data in a certain way.

- You must be sure to save the data in a location that ArcMap can access later.
Toolbars

- Main Menu
- Standard Toolbar
- Tools Toolbar
- Numerous toolbars available by right-clicking.
Views

- **Data view**: to explore and query data.
- **Layout view**: to add map elements to your map for printing.
Create a Map in ArcMap

- Data from the data layers is displayed in the data frame. The layers are listed in order in the Table of Contents. Changing the order of the layers changes how they are overlaid in the data frame.
Layers

• You can easily turn on and off layers by checking or unchecking the box in the Table of Contents.

• The order of the layers in the Table of Contents determines the order of which the layers are drawn in the data frame.
Windows

- Catalog window – ArcCatalog
- ArcCatalog is the preferred method to manage GIS data.
Add data

You can use the **Add Data** button to add basemaps, shapefiles, images, and other datasets to the data frame.
Add a Basemap

- **Basemaps** are maps with reference information that can serve as a ‘base’ onto which you can place other data layers.

- There are several basemaps preloaded into ArcGIS.
Contextual Menus

Right-clicking on buttons and layers will usually reveal context menus with more options.
Attribute Tables

• Features can have several different properties referred to as attributes. Say one of the points on a map represents a house. Information about this point is stored in an attribute table.

• Data could include street address, latitude & longitude, color, appraised value, owner, age, architectural style, roofing material, builder – a staggering amount of data can describe a feature.
Attribute Tables

- The columns in an attribute tables are fields.
- The rows in an attribute tables are individual records for features.
Find a Feature or Location

- To search for a particular location or feature, click the binoculars button (the find tool).

- Right-clicking on a location lets you place a point at the location and zoom to the location. Right-clicking on buttons and layers will usually reveal context menus with more options.

- Create a bookmark to quickly display regions at a certain scale.
Spatial Bookmarks

Bookmark a specific location and scale to easily access it at a later time.
Identify Features

• To get more information about data on the map, click the identify button

• FID: Feature ID
Query Data

Use SQL to select features by certain requirements.

- Select by Attribute
- Select by Location

![Select By Attributes window with SQL query example: `SELECT * FROM psout1b WHERE "CNTYPOP" > 26000`]
GIS offers advanced analysis capabilities.
Geocoding

- Geocoding is converting addresses and other geographic data to geographic coordinates, such as latitude and longitude.
- ArcGIS has geocoding available if you subscribe.
- See TAMU’s excellent list of geocoding services.

712 S Stagecoach Trail, San Marcos, TX
29.865505, -97.953726
Georeferencing

- You can **georeference** images such as aerial photography and old maps, matching up images to their correct locations.
Possible Uses

Applicable to almost any field of study.

GIS can not only can show you where things are, but also where things should be, such as public transportation, emergency response supplies, a homeless shelter, or another Starbucks.
Possible Uses

Investigating possibility of building a highway across West Africa. Considerations:

– Topology
– Water resources
– Ethnicities (possible civil conflicts)
– Population
– Existing transportation networks
– Natural resources
A family wants to move to another apartment complex but wants to not move out of their current school district. Possible sources:

- School district boundaries from Census TIGER files
- Spreadsheet of local apartments from a commercial source like ReferenceUSA
Possible Uses

Planning out a dream vacation. Variables:

- Hiking trails
- Surfing conditions
- Natural disasters
- Climate
- Evacuation zones for nuclear plants
- Visa requirements
- Crime
GIS DATA SOURCES
 Dataset Sources

There are several different resources for datasets, including, but not limited to:

- Local Government
- State Government
- Federal Government
- Nonprofit Organizations
- University Data Repositories
- Commercial Companies
- Make Your Own
## Data Resource Examples

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Government</td>
<td>City of San Antonio, Edwards Aquifer Authority</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>State Government</td>
<td>Texas Natural Resources Information System, Texas General Land Office, Texas Commission on Environmental Quality</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Federal Government</td>
<td>Data.gov, USGS, National Oceanic and Atmospheric Administration, Census Bureau</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Profit Organizations</td>
<td>ORNIS, OpenStreetMap, David Rumsey Map Collection, FAO GeoNetwork</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial Companies</td>
<td>ESRI, SimplyMap, ReferenceUSA, GeoLytics</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Make Your Own!</td>
<td>Data from GPS devices, spreadsheets, images</td>
</tr>
</tbody>
</table>
Government produces and compiles a ton of data.
A lot of this is accessible through a portal www.data.gov.
However, you may want to check individual local, state, and federal government websites to access datasets.
Data.gov

DATA CATALOG

Datasets

Filter by location

fracturing

12 datasets found for "fracturing"

Dataset Type: geospatial

Utility of the Data Gathered From the Fenton Hill Project for Development of Enhanced Geothermal Systems
TIGER FILES

- **Topologically Integrated Geographic Encoding and Referencing**
- Developed by the Census Bureau.
- Vector files of streets, railroads, rivers, school districts, and other features.
- TIGER files have been available as shapefiles since 2008.
Commercial Sources

• GeoLytics
• Experian Consumer Research
• Dun & Bradstreet
• The Nielsen Company
• Reference USA
• ESRI
Create your own data!

- GPS Units
- Spreadsheets

<table>
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<tr>
<th></th>
<th>ID</th>
<th>Species</th>
<th>Date Sighted</th>
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<th>Longitude</th>
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<td>29.306378</td>
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<td>5</td>
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<td>Bigfoot</td>
<td>11/7/2010</td>
<td>31.196798</td>
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<td>6</td>
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<td>7</td>
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<td>Abominable Snowman</td>
<td>2/15/2011</td>
<td>35.217496</td>
<td>-99.9712</td>
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</table>
GIS LIBRARY SERVICES
• A large service to patrons is just providing access to GIS software. This access can be to proprietary software, such as Esri's ArcGIS, or it can be to open source and/or free software, such as GRASS and QGIS or GIS-Lite applications, such as Scribble Maps and Google Earth.
GIS Access

ArcGIS is located on 8 computers in Government Information on the 4th Floor
Data Portals

• While there are many sources of data, it may be difficult for patrons to locate what they need.
• Creating a customized portal to GIS datasets tailored to the local community can help.

Texas A&M Map & GIS Library’s GIS Online Data website
Individual GIS Assistance & Classroom Instruction

• Help patrons with:
  – Locating and accessing datasets
  – Using GIS software
  – Geocoding
  – Georeferencing
  – Formulating queries
  – Converting data to other formats
  – Generating maps, images, as well as other geographical products
  – Providing guidance on data management
Hosting Events

**GIS Day:**
Third week in November during Geography Awareness Week.

http://www.gisday.com/

November 19, 2014
ADDITIONAL RESOURCES
Additional Resources

- MAGIRT – Map & Geospatial Information Round Table
- Esri ArcGIS Resources
- Esri Training
- Joseph Kerski’s Youtube Channel
Helpful Blogs & News Feeds

- **Esri News Feed**
- **All Points Blog**
- **Google Maps Mania**
- **Slashgeo.Org**
- **GIS Lounge**
Webinars and Courses

• Coursera Courses:
  – Geodesign: Change Your World (August 2014)
  – From GPS and Google Maps to Spatial Computing
  – Geospatial Intelligence & the Geospatial Revolution (January 2015)

• LITA (Library and Information Technology Association) Courses:
  – Getting Started with GIS

• ESRI Courses:
  – Esri Training
QUESTIONS?
Contact information

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