UF UNIVERSITY of FLORIDA
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FOR288

Introduction to Geographic Information Systems[1]

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What Is a Geographic Information System (GIS)?

A GIS may sound daunting, but if you have ever used a website to map out your vacation route or searched for a restaurant, you have used a GIS. A GIS brings together hardware, software, and data. At its simplest, a GIS uses computers to process and store geographic data as layers of information (Figure 1). Each layer corresponds to a specific type of information such as vegetative cover, land use, soil type, or other attribute. When you click on a cell containing one or more layer of data, information pertaining to that feature is displayed. People can use these results to make decisions for a variety of applications. A GIS can also display detailed information visually to help people understand geographic relationships and patterns.

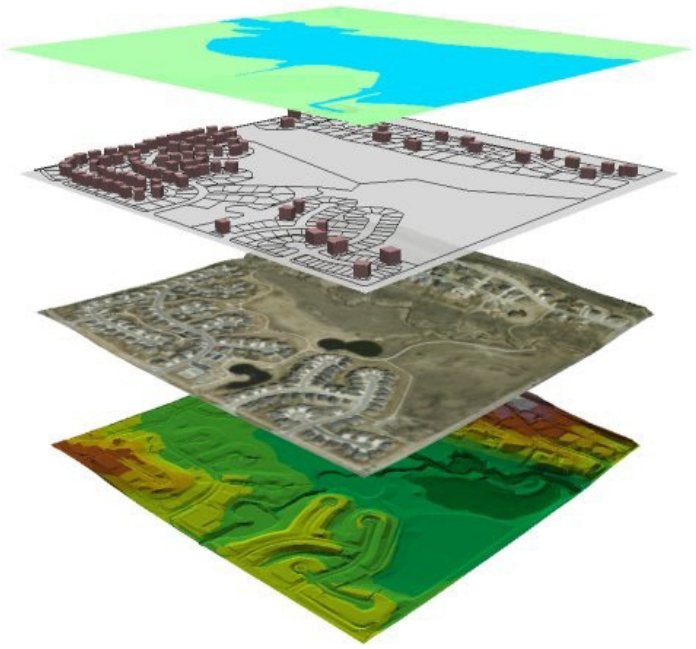

Figure 1. GIS data layers Image courtesy of Malahide, Ontario

How You Can Use GIS

At the corporate or personal level, a GIS can be used in land management to document existing conditions, plan future operations, and archive completed work. These data can be displayed on a map or summarized in a table. Quantities of timber, tree densities, specific areas (e.g., tortoise burrows or water features), and changes in land-cover over time are all examples of the types of data that can mapped.

Farming applications include:

- Soil productivity for different crops
- Crop yield prediction
- Determining fertilizer and pesticide application rates

Forestry applications include:

- Estimating forest stand acreage
- Determining forest stand characteristics such as species and tree density
- Determining where to harvest
- Assessingand monitoring risk (fire behavior model)
- Locating roads

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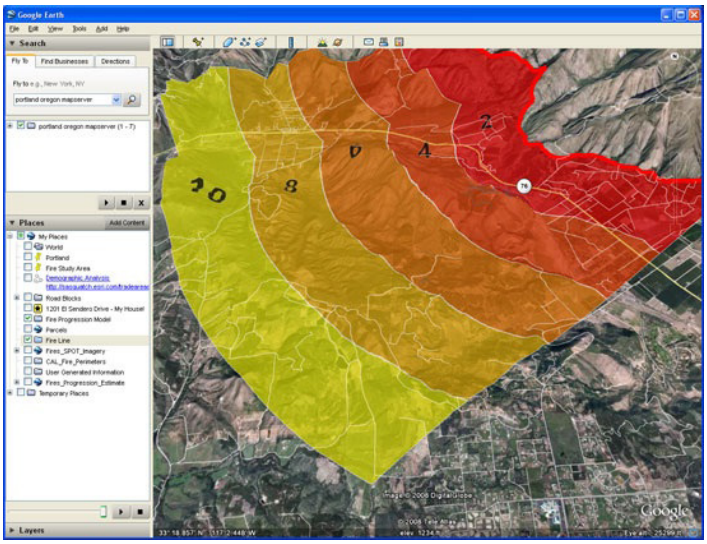

Figure 2. Source: GIS Stuff Blog, http://gis-stuff.blogspot.com/

- Using digital soil information to determine appropriate species to plant on a given site
- Predicting timber yields
- Analyzing logging operations
- Monitoring regeneration
- Visualizing economic valuation geographically

Types of Geographic Information Systems

The three main parts of any GIS software package are the user interface, tools and functions of the system, and data management. All GIS packages use these to operate, but there are differences in how they are implemented. Software packages are generally broken into the following types:

- **Desktop**: Installed and accessed directly on a PC.
- **Web mapping**: Accessed through the internet with results displayed in your browser. Provides 2-D maps based on user requests. Includes such maps as physical, topographic, demographic, and specialty (soil survey, navigation charts, etc.).
- **Server**: Access is the same as web mapping. However, a server GIS offers a much wider range of functions at a higher cost.
- **Virtual Globe**: Web-based GIS that provides 3-D representations of maps.
- **Hand-held**: GIS systems installed on hand-held devices that are ready-to-use. Also includes software that can be installed on smartphones such as the Apple iPhone®.

Software

Open Source

Open source software packages are free and do not require purchase of a license. Open source software packages can provide many of the same functionalities as commercial software packages. The most significant limitations can

Table 1. Open Source

Software Package	Developer	Type(s)	Features	Support
Quantum GIS http://www.qgis.org/	QGIS development team	Desktop, web mapping	Data management, mapping, integrates with other open source software for extensive functionality.	Online documentation. Third-party support available for a fee.
ArcGIS Explorer http://www.esri.com/software/arcgis/ http://www.esri.com/software/arcgis/explorer/index.html	ESRI, Inc.	Desktop, virtual globe	Includes 3-D viewer, basic maps, ability to add data, and perform basic spatial analysis.	None.
MapWindow GIS http://www.mapwindow.org	MapWindow Open Source Team	Desktop	Includes data viewer, modeling system, image processing and map-making tools.	Online community with forums and documentation available. Third-party support available for a fee.
GRASS GIS http://grass.osgeo.org	GRASS development team; Originally US Army Corp of Engineers	Desktop	Includes data viewer, modeling system, image processing, and map-making tools.	Free online book available. Online community with forums and documentation available.
Google Maps & Google Earth http://maps.google.comhttp://earth.google.com	Google, Inc.	Desktop, web mapping, virtual globe, hand-held	2-D and 3-D mapping capabilities. Includes satellite imagery, terrain, 3-D infrastructure, and GPS tracking.	Online forums and documentation available.

include the need for multiple applications for full utilization and advanced technical knowledge. Open source products usually do not provide user support, though support may be available for a fee from a third-party provider. Table 1 lists some of the open source GIS or mapping software available to the public.

Commercial

There are over 100 commercial GIS software packages. Commercial packages require purchase of a license to use the software company's product. These licenses require either a one-time fee or a renewal fee, usually on an annual basis. Commercial packages generally provide some support or provide options to purchase support with greater levels of customer service. Most commercial vendors also offer free and fee-based educational courses. A few of the most common commercial packages are listed Table 2.

Choosing a Software Package

The decision to use one software package over another depends on the features you require. In addition, some users want the peace of mind that comes with knowing they have a dedicated support package included in their license. Others may have more experience using these types of technology and be comfortable with open source packages that may require them to handle any issues they encounter on their own.

Prices for commercial products can range in the thousands of dollars. Most commercial vendors will work with you to design a system tailored to your specific needs. Some, such as ArcGIS and Bentley, require it. Be sure to ask yourself, "Do I *really need* all of these features?" Keep in mind, these vendors are competing for your business, so do not hesitate to contact a number of them before making a final selection.

Finally, GIS is a specialization or discipline with its own concepts and vocabulary. Software packages are not "out of the box" solutions. Rather, it is important to realize that first-time use often comes with steep learning curves. Many resources are available on the internet, in books, and in courses provided by vendors to learn how to use a GIS. A few starting points are listed at the end of this document.

When choosing a package, you should weigh the following carefully:

- Required functionality and types (desktop, web mapping, etc.)
- The user's comfort level with technology
- User support
- Budget constraints

Sources for Additional Information

ESRI's Top 10 Resources for New Users: http://www.esri.com/news/arcuser/newtogis.html

Web-based GIS: http://gis.ednet.ns.ca/gis_uses_in_US.htm

Open Geospatial Consortium–organization that encourages and seeks to set standards for open source GIS development: http://www.opengeospatial.org/

Table 2. Commercial

Software Package	Vendor	Type(s)	Features	Support
ArcGIS http://www.esri.com/software/arcgis/index.html	ESRI, Inc.	All	Offers a full range of 2-D & 3-D GIS products depending on need, including simple visualization and modeling to advanced analysis and presentation.	One-year standard support included with software purchase. Premium support with 24/7/365 telephone and internet help available for additional fee.
Bentley Map http://www.bentley.com/BentleyMap	Bentley Systems, Inc.	Desktop, server	Primarily concerned with infrastructure; Full range 2-D & 3-D mapping application with additional modeling and presentation support in extended editions.	24/7/365 available with "Bentley SELECT" license agreement.
Map3D http://usa.autodesk.com/autocad-map-3d/	Autodesk, Inc.	Desktop	Model-based software with a focus on infrastructure. Provides comprehensive access to GIS data.	Online forums and documentation available. Autodesk subscription available for purchase with access to latest releases and expedited technical support.
GeoMedia http://www.intergraph.com	Intergraph Corp.	Desktop, web mapping, server	Full range software suite that includes data intake and management, mapping, modeling, presentation, and distribution.	Included with license.

Examples of applying GIS for natural resources: http://gis.com/content/natural-resources

GIS Pathway—contains a number of educational articles and tips for Google-based GIS and ArcGIS Explorer: http://gispathway.com/

GIS Learning Modules – contains learning modules for GIS using Google Maps and ArcGIS Explorer as examples: http://www.ccdmd.qc.ca/en/gis/

US government website containing a number of maps and data sets: http://gos2.geodata.gov/wps/portal/gos

Online GIS community: http://www.geocomm.com/

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