Geographic Information Systems

By Richard W. Boss

Geographic Information Systems (GIS) consist of hardware and software that make it possible for digitized maps to be overlaid with data. Another definition commonly used in the literature is that it is a system for capturing, storing, checking, integrating, manipulating, analyzing, and displaying data that are spatially referenced to the earth.

Depending on the complexity and size of the files and the number of users, the hardware may be a PC or a high-end server supporting multiple clients. The software, which is available from any one of several suppliers, is an applications package that includes at least a graphical user interface, a database management system, and an editor.

Much of the data used in GIS has been available for many years, but it is now available in new formats, including digitized maps, machine-readable census data, and other machine readable data—including locally produced machine-readable statistics. The idea is to display a digitized map and then to add information to the map from census data or other machine-readable sources.

Not only does presenting the information visually make it easier to understand, it also makes it possible to ask questions that will result in additional layers of information being added.

Libraries' Use of GIS

Academic libraries have also been offering GIS to faculty and students for their research for at least 20 years. While the primary users have been GIS departments, research in many areas can be enhanced with GIS. The research applications might include overlaying clusters of illness on a digitized map showing the distribution of potential environmental hazards;

overlaying income on a digital map for planning retail locations; or overlaying home values on a map of highways to determine whether proximity to a highway affects the value of a property.

A number of public libraries now offer GIS services to patrons, especially to the business community. They are proceeding cautiously because the decision to do so involves an investment in hardware, software, data sets, and staff resources.

The majority of public libraries that have invested in GIS have done so to improve their planning. For example, GIS might be used in the planning of library facilities and services by layering the various sources of information on a map of the service area overlaid with census data showing income, race, primary language, and number of children; and, on top of that, data about library use.

GIS can also be used in the planning of services to special populations. For example, one might ask where is the greatest concentration of young children with a primary language other than English in order to determine where to offer special programming in other than English.

GIS can also be used in collection development. Using neighborhood demographics a library can decide where to allocate acquisition funds. For example, a large elderly population in a particular area might justify strengthening resources in consumer health. .

Hardware

The minimum hardware requirement for a desktop GIS system is a processor of 2.0 GHz and 1.0 GB of memory. However, any new machine purchased for GIS should be rated at 4.0 GHz with at least 2.0 GB of memory. The monitor should be a 24-inch or larger high-resolution, wide-screen, flat panel. The printer should be a photo printer capable of a resolution of at least 1,200 by 1,200. It is also desirable to add a scanner for entering information that is not already in digital form.

A library has the choice of providing standalone workstations or installing a server for patron use. While the hardware costs are slightly less per concurrent user when the applications software is mounted on a server, individual workstations allow a library to begin with one or two and to increase the number as needed. A server generally is not cost effective with fewer than five concurrent users.

Software

The typical software package includes a graphical user interface for downloading and viewing GIS information, including such simple interactions as magnification and measuring distances; a viewer for formulating queries and simple editing, including selection based on attributes or location, changing color and resolution; merging, labeling, and creating reports; and an editor for data manipulation and editing, including layering.

There are six major GIS software providers:

- Autodesk (www.autodesk.com), which offers Autodesk
- ESRI (www.esri.com), which offers ArcInfo/ArcView
- Geographic Research Inc (www.geographicresearch.com) , which offers Simply Map
- Intergraph (www.intergraph.com), which offers GeoMedia
- Manifold Systems (www.manifold.net), which offers Manifold Enterprise Edition.
- MapInfo (www.mapinfo.com), which offers MapInfo

These companies target a number of markets, including education, manufacturing, shipping, retailing, security, and telecommunication. Most sales to libraries have been made by vendors that are value added retailers for these six companies. The value added includes

consulting to libraries, databases of particular use to libraries, training, and the alternative of hosted service. The names of the value added retailers can be obtained by contacting these companies.

The vendor that had the largest number of library customers as of the first quarter of 2009 was CIVIC Technologies (www.civictechnologies.com). It has exhibited at both the ACRL and ALA conferences. Most of its success has been with academic libraries, but it has sold both its Business Decision and Library Decision to public libraries. The former is a tool that a library can offer to local businesses that cannot afford to invest directly in GIS. The latter is a planning and management toolkit that helps a library get a clear picture of the service area by mapping the demographics of the user population. .

The operating system environment for standalone systems typically is Windows XP or Windows Vista; the operating system environment for server-based systems typically is Windows Server 2008 or UNIX.

Costs

Hardware and system software for a single desktop workstation is a minimum of $3,500. A server and five desktop workstations will cost a minimum of $18,000.

Applications software ranges from as little as $395 to tens-of-thousands of dollars. The lowest price is offered by Manifold. The company offers only applications software and an instruction manual, not customization, maps, databases, or training. The highest price is a multi-module server version of the ESRI product with the add-on of customization, maps, specialized databases, and training. The price is less per concurrent user when a multi-user version is purchased. .

Data used in GIS often includes U.S. government data, especially that available from the U.S. Geological Service (www.usgs.gov and key in "digital geospatial data") and the U.S. Census Bureau (www.census.gov). These two government agencies are not the only ones to offer spatial data; more than 80 percent of all government data has a spatial component. Depending on the amount of data required, prices can range from a few hundred dollars to many thousands.

The most widely used government source is TIGER (Topologically Integrated Geographic Encoding and Reference} from the U.S. Census Bureau. The URL is www.census.gov/geo/www/tiger/index.html. [Do not confuse www.tiger.com, the URL of a commercial firm, with the U.S. Census Bureau's URL].

There are also commercial sources of census data. These are often easier to break apart into packages of various sizes. Geolytics (www.geolitics.com) offers a 12-disk package containing the entire 2000 census at $1,695 for the country or $795 for a single state. Expanding the collection to include the 1970, 1980, and 1990 censuses increases the price to $2,995 for the country and $1,495 for a single state. The latter product includes software for converting data from previous census to the 2000 boundaries so that an apples-to-apples comparison can be made. Given the amount of redistricting that is done, such functionality is very useful.

Staffing for GIS is a challenge. It takes the assistance of a well trained technician to maintain a complex system and one or more librarians who are skilled in the use of the software—a skill that comes not only from training in the software, but also from regular use of the software and the data sources. There are few people in libraries that are qualified at this time; therefore, a library may need to train members of its own staff.

GIS training is offered by many community colleges and universities. It is also available online. The largest online program is operated by ESRI, the dominant vendor in the GIS software market. Their course, which costs $125, begins with an overview of basic image and

remote sensing science concepts. It then presents six modules:

- Understanding imagery and image analysis
- Accessing and displaying image data
- Rectifying and "mosaicing" images
- Extracting and classifying features
- Image analysis
- Applying the image analysis extensions

The reason for presenting the outline is to illustrate how much there is to learn. The training course is only the beginning.

Understandably, patrons find it difficult to utilize GIS without assistance. Even with a required two-hour course in the basics of GIS, one library reported that the typical user usually consults a librarian several times during the course of a single 30 to 60-minute session. A librarian may be occupied full-time by as few as five users. If a library decides to limit its role to providing hardware, software, and data, it should be prepared for complaints. One way of ameliorating the complaints is to provide information about GIS training opportunities in the community.

Coordinating With Local Government

Many local governments, both municipal and county, have GIS programs. Public libraries should, therefore, coordinate their efforts with any that may be underway in their jurisdictions.

Sources of Information

The vast majority of the articles in the professional literature are out of date. With rare exception, articles published more than five years ago should be ignored, not only because of

their age, but because the deal almost exclusively with GIS in academic institutions. The best single source is to be found at www.gis.com; however, realize that the site is sponsored by ESRI, the largest vendor in the GIS software industry.

Wikipedia, the free online encyclopedia, has a very good 22-page article on GIS, including its history, the software components, techniques, and its future. The URL is http://en.wikipedia.org/wiki/GIS.

There is an excellent GIS portal available at www.gisportal.com. It organizes more than 1,000 Web sites that deal with GIS into broad categories. One of the categories is governmental Web sites.

The University of Edinburgh's Department of Geography and the Association of Geographic Information (UK) have created an alphabetic index of useful GIS Web sites. The URL is www.geo.ed.ac.uk/home/gishome.html. While it takes time to find sites on a specific aspect of GIS, it is worth it because many good sites are included that are not available through the portal mentioned in the previous paragraph.

Not to be overlooked are state library agencies and local colleges and universities. Many offer consulting services and some have undertaken GIS projects on behalf of public libraries.

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