

Geographic Information Systems Highlights @ NYU

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From the first days of computational research, the geographic nature of most data was at issue and often contributed to the results. Statistical researchers' first analyses of spatial data occurred in the 1960s and used programming languages like Fortran. Then, in the 1980s, specialized programs, such as ArcInfo,¹ provided the tools researchers needed to answer the questions inherent in spatial data. (See <http://www.esri.com/company/about/history.html> for historic details.)

At New York University, statistical research technologists within Information Technology Services and one of its predecessor organizations, the Academic Computing Facility, have been supporting research employing Geographic Information Systems (GIS) for almost two decades. NYU researchers doing GIS work in the late 1980s under the University's first ArcInfo license may remember that the software was run on Archimedes, an SGI minicomputer.

GIS software enables maps and spatial data to be created, stored, and studied using PCs and servers. Any file with addresses or a latitude/longitude field—Census data, for example—begs for spatial visualization or analysis (see the figure on p. 24). And today, mapping applications can be used over the Web. Using contemporary web-based GIS

software, MapQuest-like interfaces can be designed and published by university researchers.

Digital maps can be thought of as layers of data associated with points, lines, and polygons. For example, we could create a layer in which lines represented city streets and a street name was associated with each of these lines. This would be a street layer, and we would have created it using a vector model, one of the models used in creating map layers.

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To create a layer using the raster model, a checkerboard-like grid would be laid over a map, and each square within the grid would have a data value measuring an attribute associated with that square, such as its population count.

Together, the layers make up the map. Using GIS software, we edit, manage, and analyze these layers and compose them into thematic maps.

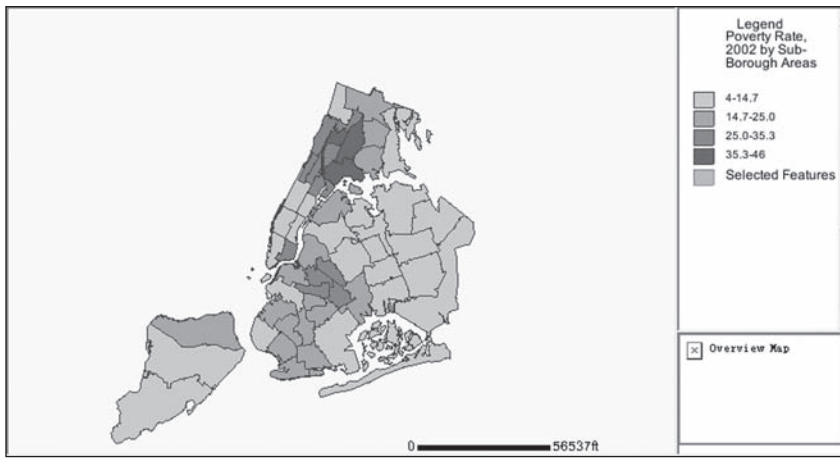
For example, if one layer consists of streets (a vector-model layer, as described above) and another layer is population, when they are put together, or overlaid, the grid population layer might color the street map, so that highly populated areas are darker than lightly populated ones, making up a simple thematic map.

But GIS software can do more than store maps and data. These high-level languages are rich with tools. Tasks that researchers need to perform in order to answer a range of research questions have been made into functions. There are functions that select corridors along a street. I could create a mile-wide corridor along a street and select the people living there. I could study what educational services are needed by that population. Or, I could use the corridor function to find all streets that pass through high-population areas. Another function, Geocoding, takes a list of addresses and locates them on a street map. This is often used to create a layer with specific types of facilities, for example, a layer of subway stations created from a list of the street intersections where the stations are located.

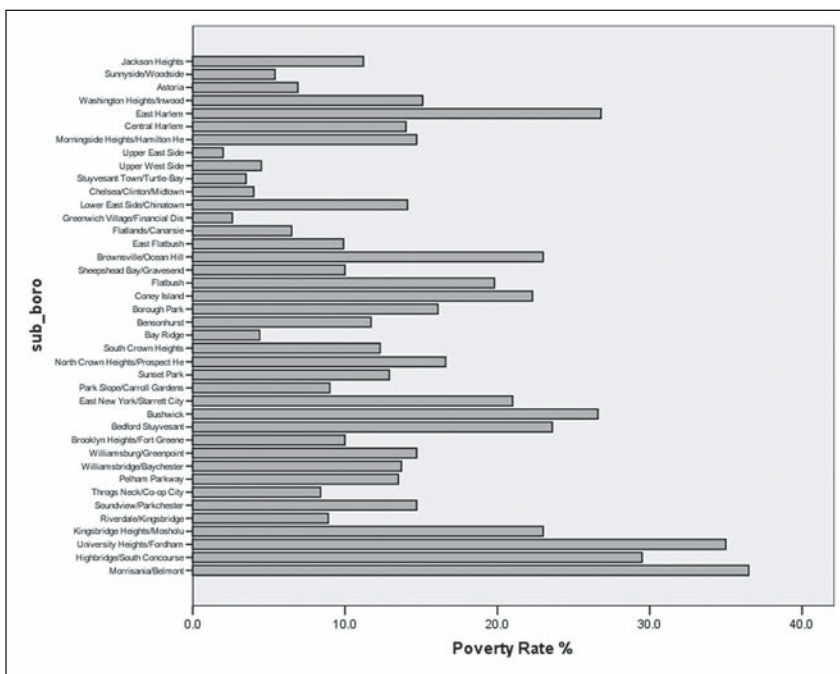
GIS SOFTWARE @ NYU

The GIS software available through ITS can be classified as proprietary software that NYU/ITS has

1. Created by the Environmental Systems Research Institute (ESRI), ArcInfo is a complete, extensible desktop Geographic Information System (GIS). See <http://www.esri.com/software/arcgis/arcinfo/> for more information.



A map of NYC poverty data by zip code from the NYCHANIS ArcIMS application, compared with a less intuitive tabular depiction of the same data.



purchased from a vendor, and Open Source software, which is free. Applications may also be classified as workstation- or web-based. Most GIS work is performed at a workstation, and includes such activities as preparing a data layer to visualize as a thematic map or doing layout work for printing by choosing colors for different regions. In other cases, one could share a Web application with other members of a project team. These advanced web-based applications involve the use of “front-end” server software, in addition to the GIS tools described above, with which the underlying “maps”

are created. Advanced GIS applications may also use spatial database software available at the ITS Faculty Technology Services Center.

Proprietary Software

Two workstation-based, proprietary GIS software packages are available at the ITS Statistics and Mapping Computational Lab: MapInfo, from Principia Products, and ArcGIS, from ESRI.

MapInfo is a good teaching resource, completely sufficient for introductory courses with mapping projects and most research applications. NYU has a University-wide

license that allows faculty to use the software in developing their skills or creating courses. Their students may also install copies of the MapInfo software to use while taking the course.

ArcGIS, which is also used for introductory course work and research, is considered by many to be the more sophisticated of these two packages. Under the University’s ArcGIS license, NYU students and researchers may take online courses from ESRI Virtual Campus that provide an introduction to GIS and address such specific tasks as labeling, annotation, and creating legends, as well as advanced topics like spatial and network analysis. Integrated with ArcGIS is ArcSDE, server software enabling the use of relational database tools like Oracle and DB2 to store and manage mapping data and serve spatial data to ArcGIS applications and other members of the ESRI GIS software suite.

At NYU, these tools have been used in a range of research applications. The NYC Housing and Neighborhood Information System is one of the rich and exciting web-based GIS applications developed at NYU. Created by the Furman Center for Real Estate and Urban Policy, a joint research center of the School of Law and the Robert F. Wagner Graduate School of Public Service, this freely accessed website (<http://www.nychanis.com/NYU/NYCHANIS/>) enables a visitor to interactively select New York City neighborhood data—population, demographics, housing, mortgages, taxes, and more—to create maps and data sets (see figures at left). This complex system uses a GIS web server application (ArcIMS), ArcGIS, and a geodatabase, all of which are products available to NYU researchers at the ITS Faculty Technology Service’s Statistics and Mapping Computational Lab.

Open Source Software

The ITS Faculty Technology Services (FTS) Center staff also have experi-

ence using open source GIS software. GRASS (Geographical Resources Analysis Support System) is the largest free software Geographical Information System. GRASS was an early entry in the field, originally programmed by the U.S. Army Construction Engineering Research Laboratory (USA-CERL) in 1982 as a tool for land management and environmental planning. QGIS (Quantum GIS) is another all-purpose GIS supported at the FTS Center.

These systems are used in conjunction with other open source tools, the front- and back-ends to complex GIS applications. MapServer is an open source development environment for constructing spatially enabled web applications. PROJ.4 is a cartographic projections library. PostGIS adds support for geographic objects to the PostgreSQL object-relational database.

Many advanced open source GIS extensions are available on computers at the ITS Statistics and Mapping Computational Lab, along with additional mapping resources and consultation and support in the use of GIS.

Sources of Data

The New York State GIS Data Sharing Cooperative is a group of governmental entities and not-for-profit organizations (NYU included) that have executed Data Sharing Agreements for the purpose of

improving access to GIS data among members. All New York State agencies are mandated to join the Cooperative.

Most of the data available through the Cooperative's archives is from New York state, county, or city agencies. Boundaries, tax parcels, imagery, and political, education, health, and other data and maps are available. See <http://nysgis.state.ny.us/> for a full list of the archive's contents.

GeoLytics' CensusCDs simplify the creation of map data sets with imbedded census data. ITS Faculty Technology Services has obtained the 1970 through 2000 collection. It is available for your academic research with an academic library license. See <http://www.geolytics.com/> for more information on this value-added Census data collection, and see <http://www.nyu.edu/its/pubs/connect/spring04/pdfs/lopresti.pdf> for an overview of this complex subject.

HELP & ADDITIONAL INFORMATION

ITS Faculty Technology Services hosts clinics in GIS and open source software each semester. Subscribe to the Statistics Forum to receive email notifications about the times and topics of these clinics and other ITS statistical and GIS offerings. To subscribe, send a blank email message from your preferred email account to: subscribe-statistics@forums.nyu.edu, or subscribe through the Forums

channel in NYUHome (<http://home.nyu.edu>). If you have questions about GIS resources at NYU, stop by the ITS Statistics & Mapping Computational Lab within the ITS Third Avenue North Lab (<http://www.nyu.edu/its/labs/third.html>) or send email to the author of this article: frank.lopresti@nyu.edu.

These related *Connect* articles may also be of interest:

- Lopez, Antonio. "GIS on the World Wide Web." *Connect: Information Technology at NYU*. Summer 1998. <http://www.nyu.edu/its/pubs/connect/archives/98summer/lopezgis.html>.
- Lopez, Antonio. Why is ArcGIS an Improvement? *Connect: Information Technology at NYU*. Spring 2003. http://www.nyu.edu/its/pubs/connect/spring03/lopez_ArcGIS.html.
- LoPresti, Frank, and Yekaterina Bolotnaya. ArcIMS, Internet Map Server. *Connect: Information Technology at NYU*. Spring 2001. <http://www.nyu.edu/its/pubs/connect/archives/01spring/LoPrestiArcIMS.html>. (ArcIMS can be used for developing web-based mapping applications.)

Frank LoPresti is a Senior Faculty Technology Specialist at ITS' .edu Services who specializes in research methods, statistics, and mapping.

In Memoriam: Antonio Lopez

ITS Faculty Technology Services GIS and statistics staff, and all who knew him, regret the passing of Wagner graduate, Antonio Lopez. Over the past 10 years, Antonio was a major contributor to NYU's efforts in these areas. During his student years at NYU's Robert F. Wagner Graduate School of Public Administration and at Hunter College, Antonio served as a lab consultant for ITS. While at the Metropolitan Transit Authority (MTA) as a Senior Planner, Antonio developed an MTA/NYU cooperation in GIS, which included his attendance as consultant to the Friday Mapping Clinics, articles for *Connect* (several of which are referred to in this issue's article on GIS), and his arrangement of student internships. Antonio Lopez will be greatly missed.