How to Pick a GIS

Getting Started With GIS

Chapter 8

Dursun Z. Seker

GISs should, by definition, be capable of performing a key set of functions. we examine six of the most critical functions. Eight GIS packages are introduced, and their functionality discussed.

How to Pick a GIS

Choosing the GIS

- GIS users need to be aware of different GIS software products during system selection and beyond.
- Informed choice is the best way to select the best GIS.

GIS software in 1979

- A historical GIS "snapshot" was the IGC survey conducted in 1979
- In the 1979 survey, most GISs were sets of loosely linked FORTRAN programs performing spatial operations
- Computer mapping programs had evolved GIS functionality

GIS in the 1980s

- spreadsheet was ported to the microcomputer, allowing "active" data
- relational DBMS evolved as the leading means for database management
- single integrated user interface
- degree of device independence
- led to the first true GIS software

Second generation of GIS software

- used graphical user interfaces and the desktop/WIMP model
- Unix workstations integrated GIS with the X-windows GUI
- GISs began to use the OS GUI instead of their own
- PCs integrated GIS with the variants of Windows and other OSs

A functional definition of GIS

- A GIS is often defined not for what it is but for what it can do.
- If the GIS does not match the requirements for a problem, no GIS solution will be forthcoming.
- A GIS may have overcapacity.

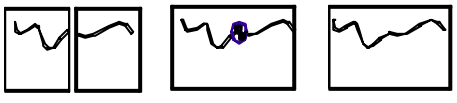
The "critical six" functional capabilities

- data capture
- storage
- management
- retrieval
- analysis
- display

Data capture (1) functions

- digitizing
- scanning
- mosaicing
- editing
- generalization
- topological cleaning

Steps in mosaicing



Disjoint maps Merge & dissolve Rebuild topology

Line generalization

Figure 8.2 Line generalization alternatives. The line (left) can be resampled by retaining every *n*th point (center), or by repeatedly selecting the most distant point from a line between end nodes (right) and redividing the line until a minimum distance is reached, the Douglas-Peucker method.

Topological cleaning

- GIS packages allow “automatic” cleaning of topology, snapping nodes, eliminating duplicate lines, closing polygons, and eliminating slivers.
- lines meet at nodes and map area is covered by polygons without gaps or overlaps

“” the tolerances may eliminate important small features or move the features around in geographic space without accountability

- Affine transformations are plane geometry; they manipulate the coordinates themselves by scaling the axes, rotating the map, and moving the coordinate system's origin.
- In some cases, when no good control is available, maps must be statistically registered together, the statistical method known as *rubber sheeting* or *warping* is used for this.

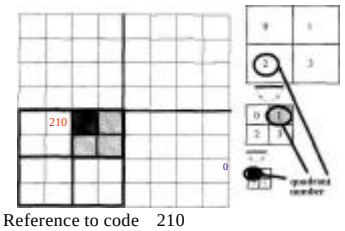
Storage (2) functions

- compression
- metadata handling (exchangeable, searchable)
- control via macros or languages (user-friendliness, (batching) command lines and/or windows within a GUI)
- format support [raster (DEM, GIFF, TIFF, JPEG, PostScript) vector (TIGER, HPGL, DXF, PostScript, DLG]

Compression

- By data structure
  - quad trees
  - run length encoding
- By data format
  - compressed TIF
  - jpeg
- By physical compression
  - digit handling

the quad tree structure



Reference to code 210

Quad trees have been used more in image processing than in GIS

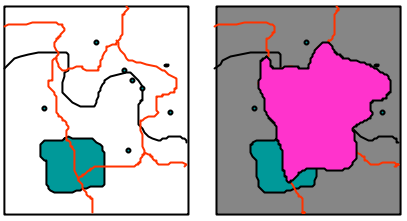
run-length encoding

- Many GIS packages and many industry standard image formats use run-length encoding.
- Method takes a map unit row by row (or column by column). The pixel having same values on a row is coded the starting and ending column numbers. (Row 5 3,3) …

Data management (3) functions

- physical model support (several format)
- DBMS (software capable of storing, retrieving selectively, and reorganising attribute information)
- address matching (TIGER)
- masking
- cookie cutting (*dynamic segmentation*)

Cookie cutting



Data retrieval (4) functions

"...the ability to gain access to a record and its attributes an demand, is in data organisation. Chapter 5"

- locating
- selecting by attributes (if not … not a GIS)
- buffering (point, line, area)
- map overlay (irregular sets)
- Vector systems usually compute a new set of polygons by adding points to and breaking up the existing sets, map algebra (for the raster system)

Map algebra

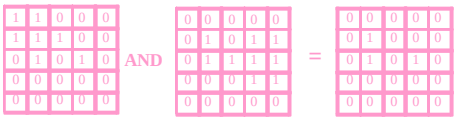
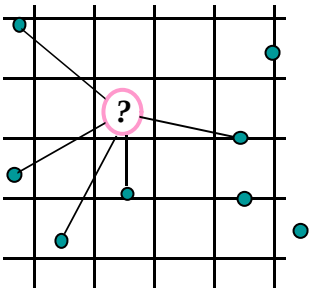


Figure 8.3 Map Algebra in its simplest form, two binary images are ANDed together to give a common area of overlap. Many other operations are possible, such as add, multiply, divide, select maximum, eliminate isolated values, etc.

Data analysis (5) functions

- interpolation
- optimal path selection
- geometric tests
- slope calculation

Interpolation



Data display (6) functions

- desktop mapping
- interactive modification of cartographic elements
- graphic file export

GIS Software and Data Structure

typically raster or vector

potentially TIN, quadtree, object-based...

- ? what the GIS can and cannot do ?
- ? how operations take place ?
- ? what level of error is involved ?
- ? what type of system can be afforded ?
- ? what model is most suitable to a particular application?
- ? what retrieval and analysis functions will be used most?
- ? what level of resolution and error are acceptable ?

Functional capabilities are by-products of data structure

- Raster systems work best in forestry, photogrammetry, remote sensing, terrain analysis, and hydrology.
- Vector systems work best for land parcels, census data, precise positional data, and networks.
- … data's form, accuracy, and suitability for further use.

Vector

- Precision intact
- Used when individual coordinates are important
- More concise spatial description
- Assumes feature model of landscape
- Easy to transform data e.g. map projections

Raster

- Better for field data
- Used by most imaging systems
- Can be compressed
- Easy to display and analyze
- Many common formats
- However, most systems now use both
- Raster layer often backdrop-onscreen editing

The Big Eight

- Form the bulk of operational GIS in professional and educational environments
- There are some significant differences between these “big eight” systems.

GIS Softwares

The focus was on what functional capabilities the typical GIS offer. It should not be forgotten that many GIS features are predetermined by the GIS's particular data structure. At the very least the underlying data structure that the GIS uses, typically raster or vector but potential also TIN or another model. In general, the driving force for the choice of structure should be what type of system can be afforded, but more critically, what model is most suitable to a particular application, what retrieval and analysis functions will be used most, and what level of resolution and error are acceptable.

Some examples where particular structures are favored are extensive land characterization applications such as forestry, where detailed data are not required (favors raster); applications involving irregular polygons and boundary lines, such as political units or census tracts (favors vector).

Choosing the Best 'GIS'

The term best is extremely subjective where GIS is concerned. Some systems have extremely loyal followings that advocate their system over others. A best system implies that one solution is best for all problems, which is of course largely meaningless. The following subset of GIS system, most available commercially, is intended to illustrate the breadth and depth of systems on the market today and some of the major and minor differences between these systems. No endorsement is intended, and the list is provided to further the GIS "consumer 's " education. Research has shown that these packages account for the majority of those used in educational, and many professional, settings. In some cases, different GIS software packages are used in combination or along with other software for statistical analysis, graphical editing, or database management.

Arc/Info

ESRI
Redlands, CA
Arc/Info
Market leader
workstation (mostly)
remarkable functionality
many formats supported
ArcEdit
ArcGRID
ArcPlot
INFO

Arc/Info

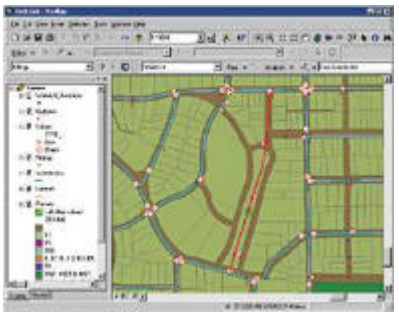
Arc/Info is a long-lived full functions GIS package that has been ported to the microcomputer, the work-station, and the mainframe. Arc/Info is used to automate, manipulate, analyze, and display geographic data and incorporates hundreds of sophisticated tools for map automation, data conversion, database management, map overlay and spatial analysis, interactive display and query, graphic editing, and address geocoding.

Arc/Info

The software includes a relational database interface for integration with commercial database management systems and macro language for developing customized applications called AML (ARC Macro Language). Arc/Info is a generic non application specific approach to geographic information systems, allowing the software to address virtually any geographic application. The software runs both on higher and microcomputers and is available on several Unix workstations and for Windows NT.

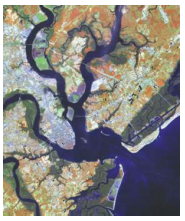
Arc/Info is broadly accepted as a market leader in GIS, with over 30000 people using the software at over 7000 organizations worldwide. Federal, state and local government organisations; businesses; utilities; and universities to address applications in planning cartography, transportation, research, telecommunications, oil and gas, forestry, and many other disciplines use the software.

Arc/Info Applications

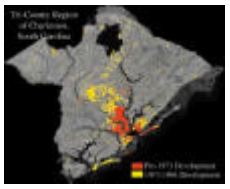


Water Management

Arc/Info Applications



Urban Growth Along South Carolina's Coast



The figure above depicts the change in urban growth between 1974 and 1994 using multispectral satellite imagery.

The figure above is a Landsat Thematic Mapper image of Charleston acquired on February 1994.

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ArcView

Versions 1-3, 3.1
PC Windows
Avenue
Web links
Map Objects
Extensions

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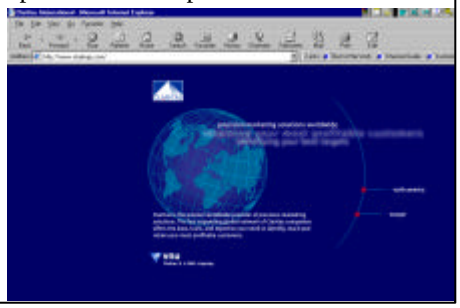
Atlas*GIS

- http://www.stratmap.com/



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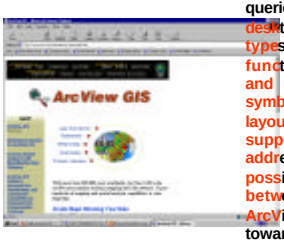
ArcView



ArcView is available for Windows, Macintosh, and a variety of Unix platforms. It is a desktop system for information about geographic space. Support for spatial and tabular queries, "hot links" to other desktop applications and data types, business graphic functions such as charting, bar and pie charts, and map symbolization, desing, and layout capabilities are supported. Gocoding and address matching are also possible. There is compatibility between Arc/Info and ArcView. ArcView being more oriented toward map display than database management.

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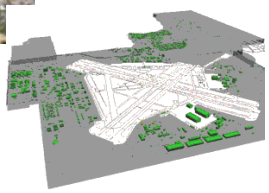
ArcView Applications

Planning the Future of a Former Marine Air Station



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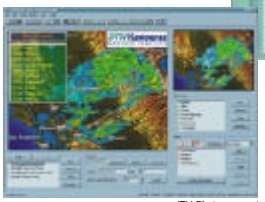
ArcView Applications

Dynamic, On-the-fly Weather Information and GIS Merge



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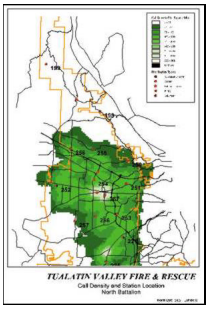
ArcView Applications

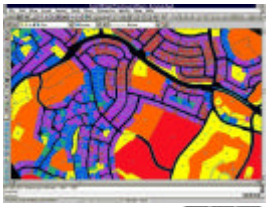
Imagery in Urban Planning



Oregon Firefighters

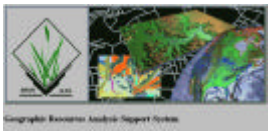
AutoCAD MAP

Windows all versions
SQL DBF Access
Extension to AutoCAD
Menu-based
Massive installed base
Added grid, projection & topology support
DB links good.
3D links good

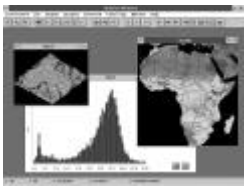


GRASS

First UNIX GIS
Developed by Army Corps of Engineers
UNIX functionality
Many unique functions
Free until recently
Many data sets
Baylor University now supports



IDRISI



Developed at Clark University, Worcester MA
Original in PASCAL, with open code
Development uses a specialty Windows/DOS
Spatial analysis/stats extensions

IDRISI

The IDRISI software system has been developed, distributed, and supported on a not-for-profit basis by the IDRISI Project, Clark University Graduate School of Geography. To date, there are over 15,000 registered users of IDRISI software in over 130 countries, making it the most widely used raster GIS in the world.

IDRISI

IDRISI is designed to be easy to use, yet provide professional-level GIS, image processing and spatial statistics analytical capability on both DOS- and Windows-based personal computers. It is intended to be affordable to all levels of users and to run on the most basic of common computer platforms. Expensive graphics cards or peripheral devices are not required to make use of the analytical power of the system. The system is designed with an open architecture so that researchers can integrate their own modules. IDRISI for Windows, first released in 1995, added a graphical user interface, flexible cartographic composition facilities, and integrated database management system to the analytical toolkit. Special routines for change and time-series analysis, spatial decision support, and uncertainty analysis and incorporation are included. The software comes with a set of tutorial exercises and data that guide the new user through the concepts of GIS and image processing while also introducing the features of IDRISI. The tutorial exercises are appropriate for use in self-training or in classroom settings.

Maptitude

Caliper Corporation
Consultancy
TRANSCAD and GIS+
Many network solutions
Windows
Import/Export
Address matching

Microstation MGE

CAD software with GIS extensions
Intergraph Corp, Huntsville AL
Uses Windows NT
Many parcel applications
Web extensions, server tools etc.

Microstation MGE

Microstation MGE

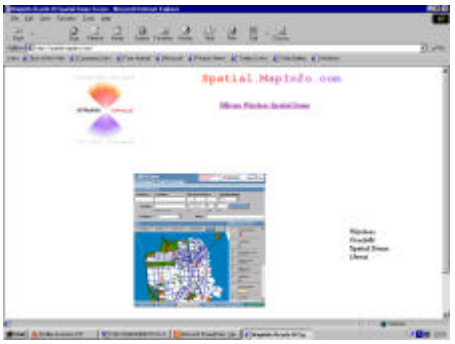
MGE is widely distributed layer-based GIS with a tradition in computer assisted design by the Intergraph Corporation. The software runs on workstations, PCs and under the Windows NT system. An extensive set of add on modules allow users to configure GIS capability around their specific needs. The layered implementation allows efficient storage structures for the geometry and linkages to relational database records. Geographic element is represented in the GIS as features. Features are grouped into the same categories as the maps on which they appear.

For the attribute data, MGE incorporates use of the relational interface system, which facilitates client-server network communication to the relational DBMS so that multiple workstations communicate with the database server simultaneously. MGE contains tools for building and maintaining topologically clean data without the processing and storage overhead of building and maintaining topology. MGE supports the open geodata interoperability specification and the spatial data transfer standard.

MapInfo

Based in Troy, NY
Mapping functions
Limited GIS functionality
Uses Visual Basic
Many applications
Favored for 911, field

MapInfo



MapInfo

MapInfo was one of the first GIS programs to do desktop mapping. The vendor is MapInfo Corporation of Troy, New York. The software is well distributed and has many user groups and a broad variety of applications worldwide. The software runs under DOS, Windows, Macintosh, and on various Unix platforms. While MapInfo's GIS retrieval and analysis functions are fewer than those of full-blown GIS packages, MapInfo includes a link to the Basic programming language via a language called MapBasic. This development environment permits the creation of customized "mapplications", extending MapInfo's built-in functionality and allowing use of a common graphical interface.

MapInfo also supplies information products spanning geographic, economic, political, cultural, and industry application-specific content, each derived from leading worldwide sources to work the software. MapInfo also has an extensive training program, with classes at introductory and advanced levels for MapInfo and MapBasic.

A variety of issues should be considered in system selection:

- cost
- upgrades
- LAN configuration support
- training needs
- ease of installation
- maintenance
- documentation and manuals
- help-line and vendor support
- means of making patches
- workforce

Selecting a GIS can be a complex and confusing process.

- The intelligent GIS consumer should research, select, test, and question systems before purchase.

- Major steps of projects;
  - determine the objectives,
  - build the database,
  - perform the analysis,
  - present of the results.
- Aims are;
  - determine the methods and steps,
  - find out the probable problems that can be encountered ,
  - seek lasting solutions,

Potantial Problems

- Bureaucracy,
- Not up-to-dated map sheets,
- Descriptive data is not updated,
- There is no standard between maps,
- Limitation of softwares,
- Unregistered lands,
- No elevation values,
- Data model.

CONCLUSIONS

- **Accurate/available land information and the nationwide GIS is the key to managing & processing developments in Turkey.**
- **Implementation of both "an information system with definite and determinate purposes" & "an institution responsible for all of the map and cadastre services in the country" is inevitable.**
- **The educational sector conduct basic research, staff and train future generation.**
- **Great care is needed the design of data model.**

Coming next…..

GIS in Action