



## Introduction to GIS - 1

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## Introduction to Geographic Information Systems

- ☞ Text: *Getting Started With Geographic Information Systems* by Keith C. Clarke. Prentice Hall: Upper Saddle River, NJ. (1997).
- ☞ Lecture Materials of Prof. Maidment and his colleagues in Texas A&M Univ.
- ☞ Internet



## Topics

- ☞ An overview of GIS
- ☞ How GIS data are captured, stored, retrieved, analyzed & displayed
- ☞ Where to go for more information
- ☞ GIS software and its functionality
- ☞ How to use a basic GIS (ArcView and Idrisi)



## What is a GIS?

*What in the world is a "GIS"?*

—Item on the Internet's  
[comp.infosystems.gis](http://comp.infosystems.gis) FAQ.

*GISs are simultaneously the telescope, the microscope, the computer, and the Xerox machine of regional analysis and synthesis of spatial data.* (Ron Abler, 1988)



## Where Did GIS Come From?

- ☞ GIS is built upon knowledge from geography, cartography, computer science and mathematics.
- ☞ Geographic Information Science is a new interdisciplinary field built out of the use and theory of GIS.



## Defining GIS

- ☞ Different definitions of a GIS have evolved in different areas and disciplines.
- ☞ All GIS definitions recognize that spatial data are unique because they are linked to maps.
- ☞ A GIS at least consists of a database, map information, and a computer-based link between them.



## Spatial and non-spatial data

Bicycle Parts

Part No.	Quant.	Desc.	Crimes during 1995		
			Date	Location	Type
1034161	5	Wheel spoke	1/22	123 James St.	Robbery
1051671	1	Ball bearing	1/24	22 Smith St.	Burglary
1047623	6	Wheel rim	2/10	9 Elm St. #4A	Assault
1021413	2	Tire	2/13	12 Fifth Avenue	Breaking & Entering
1011210	3	Handlebars			

Figure 1.1 Two databases. A database contains columns (attributes) and rows (records). The bicycle parts list on the left is not spatial. The parts could be located anywhere. The list of crimes on the right is spatial because one of the attributes, the street address, locates the crimes on a map. This list could be used in a GIS.



## Definition 1: A GIS is a toolbox

*"a powerful set of tools for storing and retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes"*

(Burrough, 1986, p. 6).

*"automated systems for the capture, storage, retrieval, analysis, and display of spatial data."* (Clarke, 1995, p. 13).



## Definition 2: A GIS is an information system

*"An information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, a GIS is both a database system with specific capabilities for spatially-referenced data, as well as a set of operations for working with the data"* (Star and Estes, 1990, p. 2).



## Map Overlay

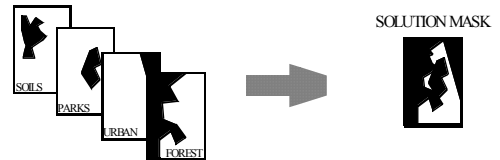


Figure 1.3 Map overlay as presented in *Design with Nature* by Ian McHarg. Each transparent layer map "blacked out" areas excluded as unsuitable locations.



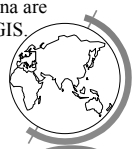
## Duecker's 1979 definition (p. 20) has survived the test of time.

*"A geographic information system is a special case of information systems where the database consists of observations on spatially distributed features, activities or events, which are definable in space as points, lines, or areas. A geographic information system manipulates data about these points, lines, and areas to retrieve data for ad hoc queries and analyses"* (Duecker, 1979, p. 106).



## The Feature Model

- ☞ Duecker's definition uses the feature model of geographic space.
- ☞ The standard feature model divides a mapped landscape up into features, that can be points, lines, or areas.
- ☞ Using a GIS involves capturing the spatial distribution of features by measurement of the world or of maps.
- ☞ Almost all human activity and natural phenomena are spatially distributed, so can be studied using a GIS.
- ☞ A GIS uses map features to manage data.



## The Feature Model

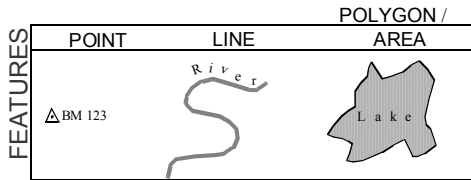


Figure 1.2 The Feature Model: Examples of a point feature (elevation bench mark), a line feature (river) and an area feature (lake)



## Duecker (ctd)

- ☞ A GIS is flexible enough to be used for adhoc query and analysis.
- ☞ A GIS can do analysis, modeling and prediction.



## Definition 3: GIS is an approach to science

- ☞ Geographic Information Science is research both *on* and *with* GIS.

*"the generic issues that surround the use of GIS technology, impede its successful implementation, or emerge from an understanding of its potential capabilities."*

(Goodchild, 1992)



## A Brief History of GIS

- ☞ GIS's origins lie in thematic cartography.
- ☞ Many planners used the method of map overlay using manual techniques.
- ☞ Manual map overlay as a method was first described comprehensively by Jacqueline Tyrwhitt in a 1950 planning textbook.
- ☞ HcHarg used blacked out transparent overlays for site selection in *Design with Nature*.



## A Brief History of GIS (ctd)

- ☞ The 1960s saw many new forms of geographic data and mapping software.
- ☞ Computer cartography developed the first basic GIS concepts during the late 1950s and 1960s.
- ☞ Linked software modules, rather than stand-alone programs, preceded GISs.
- ☞ Early influential data sets were the World Data Bank and the GBF/DIME files.
- ☞ Early systems were CGIS, MLMIS, GRID and ~~ENR~~ ENR.
- ☞ The Harvard University ODYSSEY system was influential due to its topological arc-node (vector) data structure.



## A Brief History of GIS (ctd)

- ☞ GIS was significantly altered by (1) the PC and (2) the workstation.
- ☞ During the 1980s, new GIS software could better exploit more advanced hardware.
- ☞ User Interface developments led to GIS's vastly improved ease of use during the 1990s.



## Sources of Information on GIS

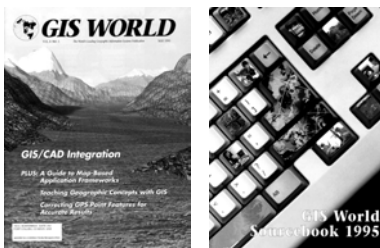
- ☞ The amount of information available about GIS can be overwhelming.
- ☞ Sources of GIS information include journals and magazines, books, professional societies, the World Wide Web, and conferences.
- ☞ GIS has Web Home pages, network conference groups, professional organizations, and user groups.
- ☞ Most colleges and universities now offer GIS classes in geography departments.



## GIS Resources: Conferences



## GIS Resources: Glossies



## Major GIS-Only Journals

- ☞ International Journal of Geographical Information Systems
- ☞ Geographical Systems
- ☞ Transactions in GIS
- ☞ Geo Info Systems
- ☞ GIS World



## Specialty Journals

- ☞ Business Geographics
- ☞ GIS Law
- ☞ GrassClippings
- ☞ GIS Asia/Pacific
- ☞ GIS World Report/CANADA
- ☞ GIS Europe
- ☞ Mapping Awareness



## Regular GIS Papers

- ☞ Annals of the Association of American Geographers
- ☞ Cartographica
- ☞ Cartography and GIS
- ☞ Computer, Computers, Environment, and Urban Systems
- ☞ Computers and Geosciences
- ☞ IEEE Transactions on Computer Graphics and Applications
- ☞ Photogrammetric Engineering and Remote Sensing



## Occasional GIS papers

- ☞ Cartographic Perspectives
- ☞ Cartographica
- ☞ Journal of Cartography
- ☞ Geocarto International
- ☞ IEEE Geosciences
- ☞ International Journal of Remote Sensing
- ☞ Landscape Ecology
- ☞ Remote Sensing Review
- ☞ Mapping Science and Remote Sensing
- ☞ Infoworld



## Popular Distribution Magazines

- ☞ Business geographics
- ☞ Geo info systems
- ☞ GIS law
- ☞ GIS world
- ☞ GPS World
- ☞ Mapping awareness/Mapping awareness and GIS in Europe.



## Proceedings of Conferences

- ☞ AUTOCARTO International Symposium on Automated Cartography.
- ☞ GIS/LIS. Sponsored by AAG, ACSM, AM/FM, ASPRS, URISA. Held every year.
- ☞ International Advanced Study Symposium on Topological Data Structures for Geographic Information Systems.
- ☞ Proceedings International Symposium on Spatial Data Handling. IGU Commission on GIS.
- ☞ SSD Advances in spatial databases



## Professional Organizations

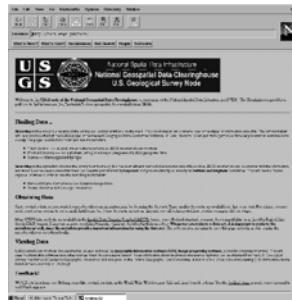
- ☞ AM/FM International Automated Mapping and Facilities Management.
- ☞ AAG: The Association of American Geographers.
- ☞ ACSM: American Congress on Surveying and Mapping.
- ☞ ASPRS: American Society for Photogrammetry and Remote Sensing.
- ☞ NACIS: North American Cartographic Information Society.
- ☞ URISA: Urban and Regional Information Systems Association.



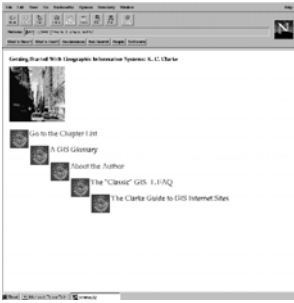
## WWW Resources: USGS



## WWW Resources: NSDI



# WWW Resources: Textbook Pages



# Clarke GIS Internet Guide



# CSG: Guide to Student Awards, Fellowships and Internships

