UC Santa Barbara

GIS Core Curriculum for Technical Programs (1997-1999)

Title
Background: What is GIS?

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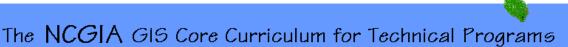
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WHAT IS GIS?

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Context

The unit provides the instructor with a simple overview of GIS. This information is provided in a loose outline form. It can be combined with other "What is GIS" summaries to produce an introductory lecture or activity for GIS courses. This topic is addressed in the beginning of GIS textbooks and can be found in some of the other resources listed below.

Learning Outcomes

- After learning the material covered in this unit, student should be able to provide a general definition for GIS, that includes the two perspectives:

  GIS as an application

  GIS as a type of software

- list some of the application areas of GIS
- provide examples of how GIS is used
- describe topics that will be learned in an introductory study of technical GIS

What is GIS?

- GIS stands for "*geographic information system*"
  - a special kind of information system

TIP (Information systems use computers to work with various types of information. Airlines and travel agents use information systems to make reservations, make changes to them, find out what flights are available, check passengers in for flights, keep track of baggage, etc. Credit card companies use information systems to keep track of purchases, bill users, authorize sales, etc.)

[How about a more robust definition? An example might help?]

- special information about *what is where* on the Earth's surface

- there are many kinds of information
    - numbers

Computers are used to add, multiply, divide, and perform other mathematical and logical operations.

- text

Computers are used as word processors which create, edit, and output text.

Computers are used to send and receive text.

- pictures

Computers are used as image processors.

- lists, tables

Computer spreadsheets are used to organize and manage lists and tabular data.

- sounds

Computers store, play, and, in music synthesizers, create and modify sounds.

- maps and images of the Earth's surface

Computers deal with this type of information in GIS

- why use computers to handle information?
    - It can be easier to store, retrieve, query, manipulate, send, receive, copy, and display various types of information.

Most of these things can be done by hand, but only slowly.

Paper maps are difficult to handle, store, send, receive, copy, and integrate with other maps and information sources.

- GIS makes all of these operations easier for maps and other spatial data.

- today, all kinds of information are being handled in computers
    - It is good to have one place to go for all kinds of information. This utility is increasingly provided by one system, the Internet, which is used to send and receive all kinds of information including maps.

What does a GIS look like?

(i.e., How would I know one if I saw one?)

- There are two distinct meanings of the question "is this a GIS?"
    1. *GIS is a real application*, including the hardware, data, and software needed to solve a problem
    2. *GIS is a type of software* sold by a software developer

TIP (A comparison with out-of-the-box software packages suh as Microsoft Word. There are brands of GIS software, and many of them come in shrink-wrapped boxes like Microsoft products, although the number of users of GIS is much smaller. Nevertheless you might find a simple GIS in a software store like Egghead, and you will certainly find digital maps on CDs for sale.)

Focus on *GIS as an application* first:

- GIS hardware is like that of any other computer (nothing special about the hardware)
    - keyboard, box housing the computer, display monitor (screen), cables, Internet connection

TIP (Note the purposeful omission of a harddrive and CPU. While these are still essential components for most GIS applications, there is a rapid movement towards distributed GIS run over a networks, including the Internet. In this situation, GIS operations may be performed remotely.) [This may not have been what you were trying to imply. Please delete or modify this "TIP" as you will. Delete I think]

- with some extra pieces of hardware
    - maps come in big bits of paper

Especially big printers, plotters to make map output from GIS may be required.

Especially big devices to input data from maps to GIS, such as digitizers and scanners, may be required.

[Note: link word digitizer to CCTP section on digitizing and scanning to scanning section. Same with printers/plotters.]

- but not all GISs will need these

- what's important is the kind of information that's stored
    - information about what is where on the Earth's surface
    - the contents of maps and images

TIP (You'd suspect a computer was being used for GIS because the data stored in it would include maps and images)

- but in addition, a GIS includes the tools to do things with this information
    - special functions that work on geographic information

These include standard functions to:

- graphically display the information on the screen
- edit, change, transform
- measure distances, areas
- combine maps of the same area together

Included functions can be much more sophisticated. They may:

- keep inventories of what is where
- manage properties, facilities
- judge the suitability of areas for different purposes
- help users make decisions about places and develop plans
- make predictions about the future

Since the functions that a GIS can perform are part of its software, we are now into the second meaning listed above - **a GIS is a type of software**

- the user combines the software with his or her data and performs various
  functions
- this software will probably have been supplied by a company that
  specializes in GIS
- the price of the software may be anywhere from $50 to $50,000
- there are many different GIS software vendors
  - some focus primarily on GIS (e.g, ESRI, Idrisi)
  - for others, GIS is one of many markets for their products (Intergraph, AutoDesk)

What is GIS used for?

- Why go to all this trouble and expense?
- Who needs to know what is where?

These are just a few of the most important uses:

- Utility companies
  - includes gas, phone, electric, water, cable TV companies
  - a single company may have
    - hundreds of thousands of customers each with a connection to
      the network
    - thousands of miles of wires, underground pipes
    - transformers, switches, manholes, poles…
    - billions of dollars worth of installed infrastructure
    - thousands of maintenance calls per day
  - a company needs to keep track of all their customers and
    infrastructure by
    - maintaining accurate information about what is where
    - keeping records up to date

- making daily work assignments to crews
- providing information to others

TIP (e.g. If another company wishes to dig up a street,

what are they likely to need to avoid? GIS is used by so-called "one-call" companies that can tell you what you will hit, and who it belongs to, if you plan to dig at a certain location in a street)

- Transportation
  - a state department of transportation needs to
    - store information on the state of pavement everywhere on the state highway network
    - maintain an inventory of all highway signs (one possible use is when the department of transportation is involved in a lawsuit following an accident)
    - analyze data on accidents, look for 'black spots'
  - a traveling salesperson needs
    - a system in the car for finding locations, routes
  - a delivery company, e.g. Federal Express, UPS, needs to
    - keep track of shipments, know where they are
    - plan efficient delivery routes
  - a school bus operator needs to
    - plan efficient collection routes
  - a transit authority needs to
    - know where transit vehicles are at all times

TIP (Studies have shown substantial savings when routes and schedules are managed using GIS. For example, delivery companies have reported savings up to 10%; companies installing TV cable service have reported savings up to 7%) [Link to an example?]

- Farmers
  - increasingly use detailed maps, images to
    - plan crops
    - analyze yields
    - plan efficient application of fertilizers, chemicals

TIP (These techniques are known as "*precision agriculture*".)

- Forestry
  - need to keep track of what timber is growing where
  - need to be able to plan timber harvest
    - to provide for timber needs now, but maintain a healthy forest resource for the future
    - to determine locations of roads, methods of cutting and removing logs, to comply with environmental regulations
  - need to manage forests for many purposes, including recreation

What is there to learn about GIS?

(i.e., What will it take to be an effective user of GIS?)

- defining a GIS project
    - what data will I need?
    - how detailed must the data be?
    - how will the data be manipulated?

- data for GIS
    - where will the data come from?
        - off the Internet
        - from a comercial data provider
        - from a cooperative agency
    - how to search for geographic data
    - creating data from paper maps by digitizing or scanning
    - collecting data in the field including using GPS

- how to build a database
    - there are many different ways
    - data come in different formats

- how to operate a GIS
    - what kinds of GIS are there?
    - finding the right functions
    - how to make a good display or map

- understanding the results
    - what do they tell me about the real world?

What jobs are there in GIS?

Different ways you might specialize in GIS

- the GIS data specialist
    - is an expert in hunting for GIS data
    - knows the Web
    - integrates data from different sources
        - understands different data formats, standards
    - documents and archives data
        - for others to use

- the GIS technician
    - builds GIS databases
        - knows how to input maps and images
    - operates the GIS
        - knows the ins and outs of one or more GISs
        - translates requests into GIS operations

prepares the results

- the system support person
    - knows how to install hardware for GIS
    - knows how to manage computer networks

- the GIS project manager
    - plans the project
        - determines data and software needs
        - selects the best software for the job
    - keeps the project on track
        - works to deadlines
        - keeps within budget

- the software development specialist
    - works for a GIS software developer

- the GIS consultant
    - works for a consulting company or freelances
        - in civil engineering, environmental consulting, market research, forestry, agriculture, real estate, insurance, banking [and????]
    - applies GIS to solve specific problems

Resources
[outdated links have been removed]

1. How do I find out more about GIS?
    - study further in this curriculum

- surf the Web
    - look for some interesting sites that do GIS over the Web

http://www.mapquest.com

http://www.esri.com and try the live demos

- look at the sites of some major GIS software vendors

http://www.esri.com

http://www.intergraph.com

http://www.autodesk.com

- look at some other introductions to GIS

- check the GIS magazines

GIS World

 GIS World Inc

Geo Info Systems

- settle down with a good book; here are some introductions to GIS:

John C. Antenucci and others (1991) *Geographic Information Systems: A Guide to the Technology*. New York : Van Nostrand Reinhold.

Tor Bernhardsen (1992) *Geographic Information Systems*. Arendal, Norway: Viak (but widely available in the US).

Keith C. Clarke (1997) *Getting Started with Geographic Information Systems*. Upper Saddle River, NJ: Prentice Hall.

Michael N. DeMers (1997) *Fundamentals of Geographic Information Systems*. New York: J. Wiley & Sons.

- all of these and many others are obtainable through online GIS 'bookstores':

http://www.esri.com and go to 'shop online'

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