What is GIS?

- A geographic information system (GIS) is a computer-based tool for mapping and analyzing geographic phenomenon that exist, and events that occur, on Earth.

- GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps.

- These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies.

- Map making and geographic analysis are not new, but a GIS performs these tasks faster and with more sophistication than do traditional manual methods.

What is GIS?

- Overall, GIS should be viewed as a technology, not simply as a computer system.
- In general, a GIS provides facilities for data capture, data management, data manipulation and analysis, and the presentation of results in both graphic and report form, with a particular emphasis upon preserving and utilizing inherent characteristics of spatial data.
- The ability to incorporate spatial data, manage it, analyze it, and answer spatial questions is the distinctive characteristic of geographic information systems.

GIS Subsystems.

A GIS has four main functional subsystems. These are:

- a data input subsystem;
- a data storage and retrieval subsystem;
- a data manipulation and analysis subsystem; and
- a data output and display subsystem.

GIS Subsystems.

- A **data input** subsystem allows the user to capture, collect, and transform spatial and thematic data into digital form.
- The data inputs are usually derived from a combination of hard copy maps, aerial photographs, remotely sensed images, reports, survey documents, etc.
- The **data storage and retrieval** subsystem organizes the data, spatial and attribute, in a form which permits it to be quickly retrieved by the user for analysis, and permits rapid and accurate updates to be made to the database.
- This component usually involves use of a database management system (DBMS) for maintaining attribute data.

GIS Subsystems

- The **data manipulation and analysis** subsystem allows the user to define and execute spatial and attribute procedures to generate derived information.
- This subsystem is commonly thought of as the heart of a GIS, and usually distinguishes it from other database information systems.

- The **data output** subsystem allows the user to generate graphic displays, normally maps, and tabular reports representing derived information products.

GIS Subsystems

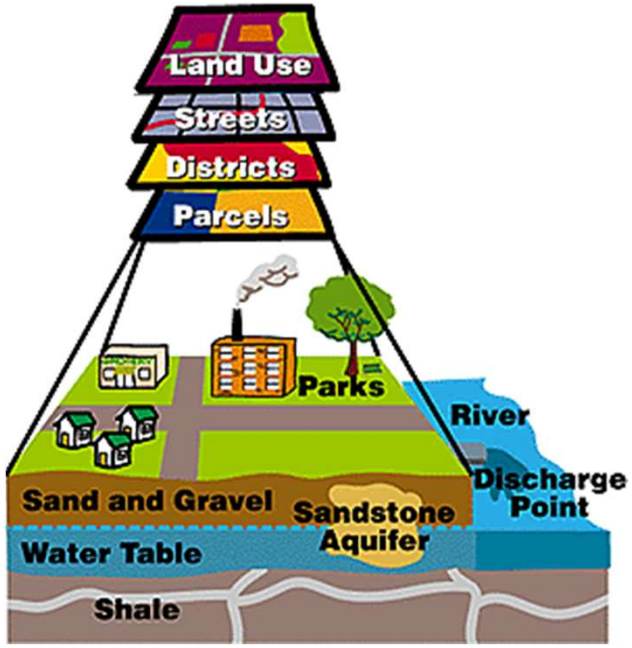
- It is important to understand that the GIS is not a new invention. In fact, geographic information processing has a rich history in a variety of disciplines.
- In particular, natural resource specialists and environmental scientists have been actively *processing* geographic data and promoting their techniques since the 1960's.
- Today's generic, geographic information system, is distinguished from the geo-processing of the past by the use of computer automation to integrate geographic data processing tools in a friendly and comprehensive environment.

Components of A GIS

Components of A GIS

- **Hardware** is the computer system on which a GIS operates. Today, GIS software runs on a wide range of hardware types, from centralized computer servers to desktop computers used in stand-alone or networked configurations.
- GIS **software** provides the functions and tools needed to store, analyze, and display geographic information.
- **Data is** Perhaps the most important component of a GIS. A GIS can integrate spatial data with other existing data resources, often stored in a corporate DBMS. This integration is a key functionality afforded by GIS.
- **People** in GIS are those who manage the system and develop plans for applying it to real world problems. GIS users range from technical specialists who design and maintain the system to those who use it to help them perform their everyday work.
- **Methods** help GIS to operate according to a well-designed implementation plan and business rules, which are the models and operating practices unique to each organization.

GIS Data Model

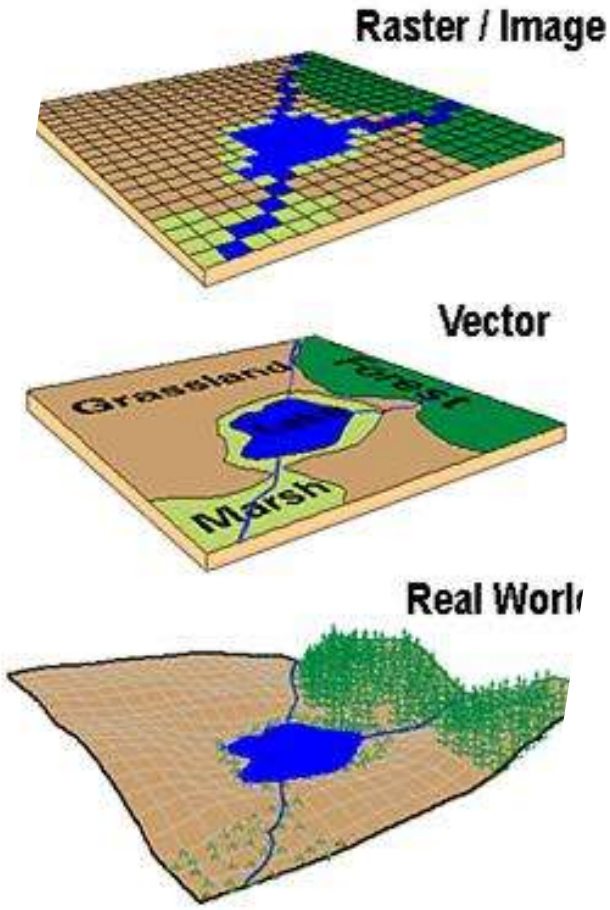


- A GIS stores information about the world as a collection of thematic layers that can be linked together by geography.
- This simple concept has proven valuable for solving many real-world problems from tracking delivery vehicles to modeling global atmospheric circulation.
- The thematic layer approach allows us to organize the complexity of the real world into a simple representation to help facilitate our understanding of natural relationships.

GIS Data Types

- GIS technology utilizes two basic types of data. These are:
  - Spatial Data: Which describes the absolute and relative location of geographic features.
  - Attribute Data: which describes characteristics of the spatial features. These characteristics can be quantitative and/or qualitative in nature. Attribute data is often referred to as tabular data.
- The coordinate location of a forestry stand would be spatial data, while the characteristics of that forestry stand, e.g. cover group, dominant species, height, etc., would be attribute data.
- Other data types, in particular image and multimedia data, are becoming more prevalent with changing technology.
- Depending on the specific content of the data, *image data* may be considered either spatial, e.g. photographs, animation, movies, etc., or attribute, e.g. sound, descriptions, narration's, etc.

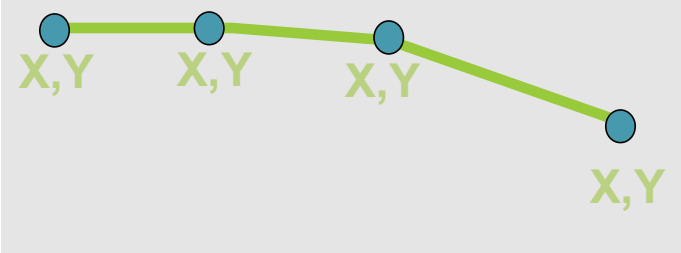
Special Data Models



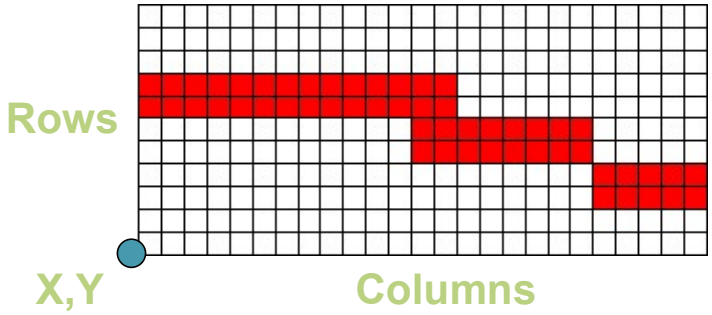
- Three basic types of spatial data models have evolved for storing geographic data digitally. These are referred to as:
  - Vector
  - Raster
  - Image

Spatial Data models

- Vector formats
  - Discrete representations of reality

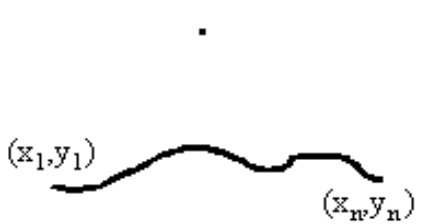


- Raster formats
  - Use square cells to model reality



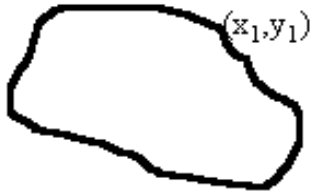
Reality
(A highway)

Vector Data Format



A point (x,y)

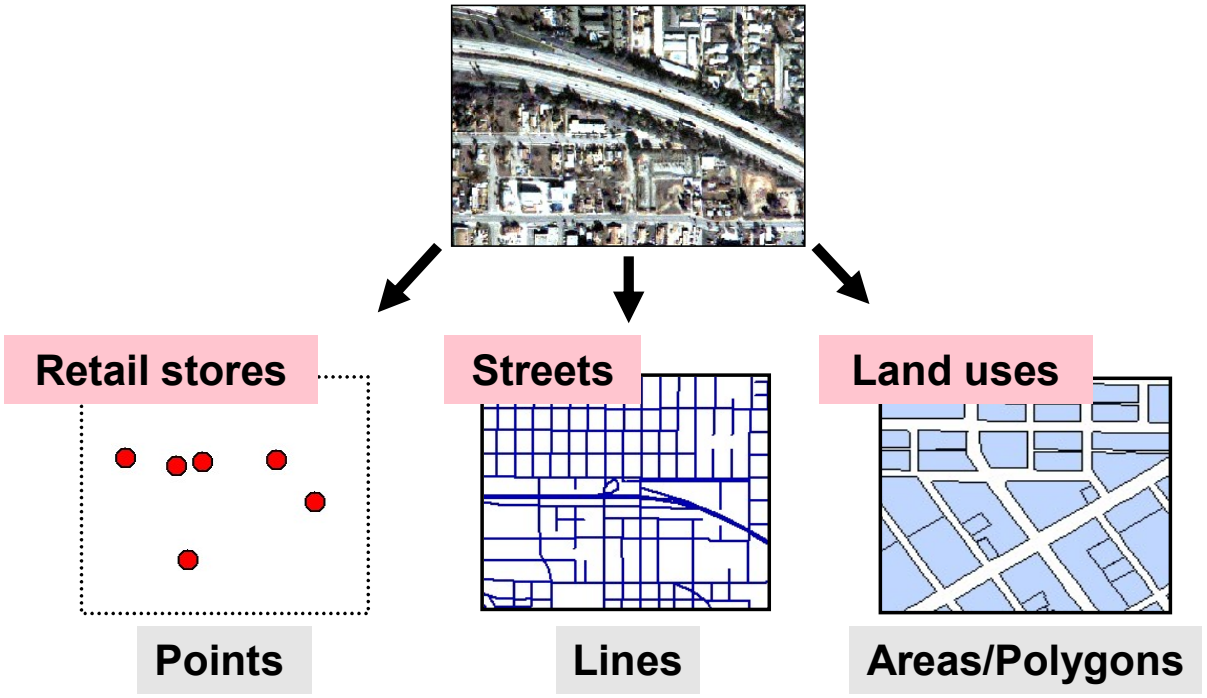
A line $(x_1,y_1; x_2,y_2;x_3,y_3; \ldots x_{n-1},y_{n-1};x_n,y_n)$
x_1,y_1 and x_n,y_n are called nodes; the other points are called vertices



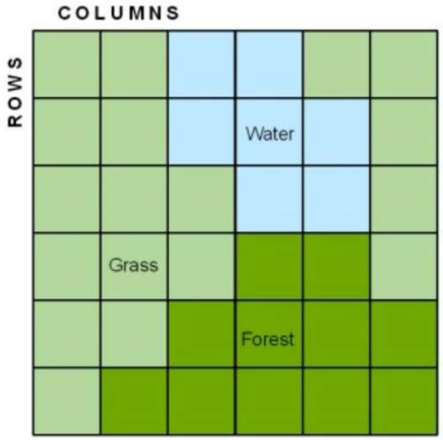
An area $(x_1,y_1; x_2,y_2;x_3,y_3; \ldots x_n,y_n;x_1,y_1)$
x_1,y_1 is called a node; the other points are called vertices

Representing features in vector data

- Real-world entities are abstracted into three basic shapes



Raster data Format



- Areas broken into ‘pixels’ or cells Each cell contains data
- Good at representing
  - dense data
  - land cover
  - Elevation

Vector versus Raster presentation

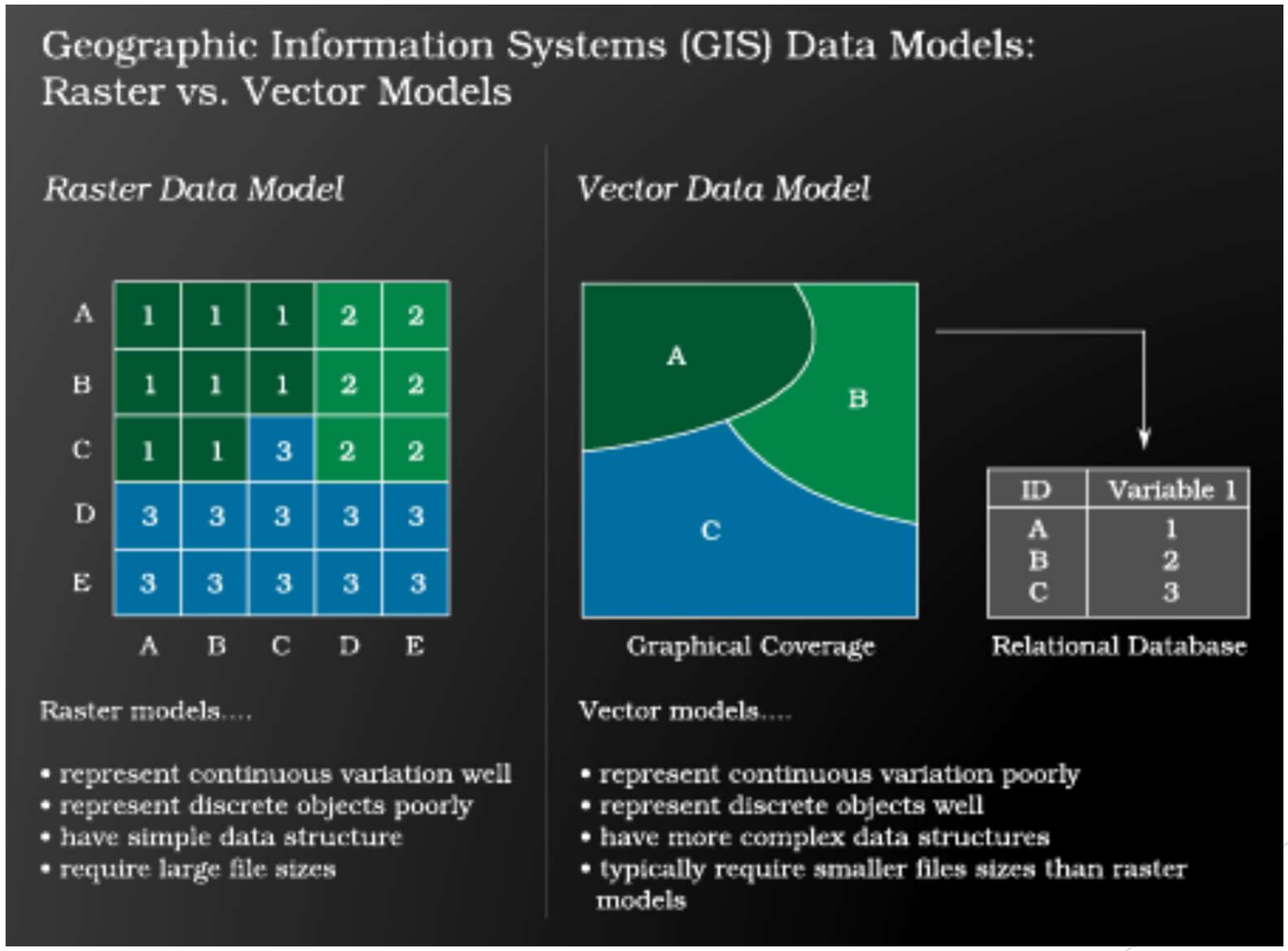


Image Data Type

- Image data is most often used to represent graphic or pictorial data.
- Most often, image data is used to store remotely sensed imagery, e.g. satellite scenes or orthophotos, or ancillary graphics such as photographs, scanned plan documents, etc.
- Image data is typically used in GIS systems as background display data.
- Typically, this data must be converted into a raster format (and perhaps vector) to be used analytically with the GIS.

Attribute data Model

- A separate data model is used to store and maintain attribute data for GIS software.
- These data models may exist internally within the GIS software, or may be reflected in external commercial Database Management Software (DBMS).
- A variety of different data models exist for the storage and management of attribute data. The most common are:
  - Tabular
  - Hierarchial
  - Network
  - Relational
  - Object_oriented

Connecting spatial with attribute data

- Single feature class
- Attributes stored in dBASE table