Ch-2-Introduction to GIS & Geographic Phenomena

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Why GIS?

- Around 80% of the information includes some geographical facts in the decision-making process
- Ability to assimilate divergent source of data: both spatial and non-spatial (attribute data)
- Maps, surveys, plans, addresses…
- Visualization impact
- “A picture is worth a thousand words” Chinese proverb
- Spatial data is vital to delivery of service

Why GIS? …cont

- Emergency response (police, fire, flooding…)
- Managing infrastructure (utilities, land, streets…)
- Basic services (mail, transportation, sanitation…)
- Sharing of information
- It allows systematic way of storing spatial data
- Analytical capability in a spatial context

What GIS?

Geographic Information Systems (GIS)

- G – Location based, spatial, geo-referenced
- I – attribute data, spreadsheets
- S – processes, software/hardware, Science

Definition of GIS?

Burrough (1986) defines GIS as

- “a set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purpose.”

Definition of GIS?...cont

Definition of GIS after **Aronoff** (1989)

- A GIS is a *computer-based system* that provides the following *four sets of capabilities* to handle geo-referenced data:

  1. Data capture and preparation
  2. Data management, including storage and maintenance
  3. Data manipulation and analysis
  4. Data presentation

Definition of GIS?...cont

GI-Systems vs. GI-Science

GI-System

- GIS is a *computerized system* that facilitates the phase of data entry, data analysis and data presentation that deals with geo-referenced data.

GI-Science

- The *discipline* that deals with all aspects of the handling of spatial data and geo-information.
- Also called Geoinformatics, Geomatics, and Spatial information science.

A Brief History of GIS...cont

- Geographic information systems (GIS) were devised in the 1960s as computer applications
  - for handling large volumes of information obtained from maps, and
  - for performing operations that would be too tedious, expensive, or inaccurate to perform by hand.
- The Canada Geographic Information System, widely recognized as the first GIS, was built for the purpose of *making vast numbers of calculations of area, reporting the results in tables*.

A Brief History of GIS...cont

- 1963-1977 Innovation
  - Canadian Land Inventory system, Harvard Graphics & S.A. Lab, US Census Bureau, ERTS-1 (Landsat 1)
- 1981-1999 Commercialization
  - ArcInfo, GPS, MapInfo, TIGER, NSDI, MapQuest
  - >7 billion industry, >1 million users

GIS Data

- GIS data can be described by *three data types*
  - Spatial data
    - Geospatial data tells you where it is.
  - Attributes data (None spatial data)
    - Attributes data tells you what it is.
  - Metadata
    - Metadata (data about data) describes both geospatial and attribute data.

GIS Data…cont

Spatial vs. None spatial data

Spatial data*?*

- Any data that is associated with a specific geographic location
- Describes the absolute and relative location of geographic features.
- ***Where it is?***
- **eg.** Soil map, Aerial photography, Remotely sensed imagery, Road networks, Wetlands delineation, Stream gauges, Dam sites, land use/land cover map, Etc…

GIS Data…cont

Non-spatial data?

- Is any data which cannot be explained or associated in terms of position.
- 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.
- ***What it is?***
- **eg.** Human resource and financial data of an organization

Questions a GIS Can Answer

- A GIS allows the user to answer a number of types of questions.
- ESRI (1992) noted that ***a GIS can answer five generic types of questions.***
- These are (in increasing order of complexity):
  - Location Where is it…?
  - Condition What is it…?
  - Trends What has changed since…?
  - Pattern How is it distributed…?
  - Modeling What if…?

Questions a GIS Can Answer…cont

(1) Where is it…? (LOCATION).

- simplest operations in a GIS
- find out what exists at a particular **location.**
- a project manager can use the GIS to determine what vegetation, habitat, soil type, or hydrologic conditions exist at the proposed site.

Questions a GIS Can Answer…cont

(2) What is it…? (CONDITION).

- to locate an area matching a certain set of conditions.
- For example, a manager may wish to determine which areas are most suited for supporting a certain wildlife species.
- He or she may wish to produce a map showing areas with particular vegetation types of a specific size and greater than a critical distance away from recreation activities.
- The GIS is designed to handle such queries in a straightforward and rapid fashion.

Questions a GIS Can Answer…cont

(3) What has changed since...? (TRENDS).

- For instance, there may be interest in quantifying long-term changes to vegetation composition.
- GIS can be useful *for determining long-term changes* to vegetation that may be caused by different types of land use.
- For example, overuse of riparian areas by grazing and off-road vehicles may have caused erosion conditions that altered downstream vegetation composition.
- Such changes may be slow and imperceptible to the observer on the ground, but they can become very apparent when 10 to 20 years of vegetation change is viewed in a GIS.

Questions a GIS Can Answer…cont

(4) What spatial patterns exist? (PATTERNS).

- For example, if nest sites of a particular species are of concern, it may be possible to use the GIS to link these nest sites to other types of information, such as:
  - specific vegetation types,
  - Undergowth conditions,
  - distance from water,
  - topography, etc.

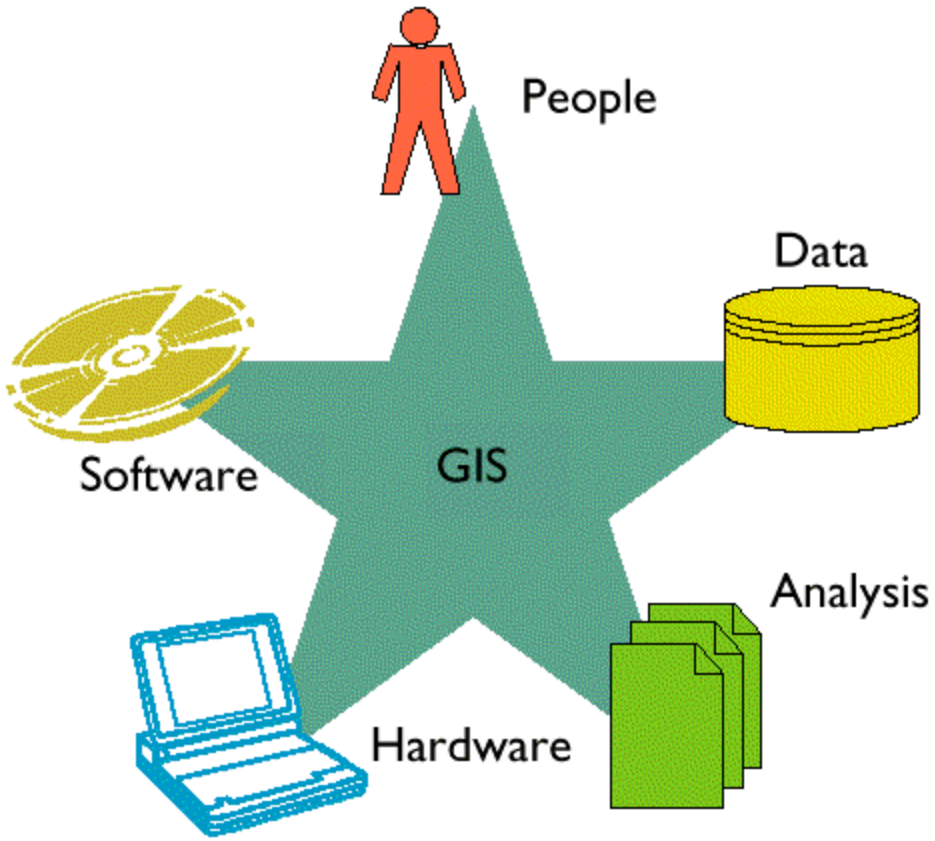
Questions a GIS Can Answer…cont

(5) What if...? (MODELING).

- The ***most complex*** use of a GIS involves tying the GIS to a known set of relationships, scientific laws, etc.,
- to model real-world phenomena.
- **Hydrology, soil loss, and habitat quality** are all examples of geographic phenomena often modeled in a GIS environment.
- it often ***opens the door for both trend and predictive analysis,*** which can prove quite useful in planning operations.

Components of GIS

GIS is an integration of five basic components



Components of GIS

People

- This is the most important component in a GIS.
- People must develop the procedures and define the tasks of the GIS.
- People can often overcome shortcomings in other components of the GIS, but the best software and computers in the world cannot compensate for the incompetence of people.

Data

- The availability and accuracy of data can affect the results of any query or analysis.

Components of GIS

Hardware

- Hardware capabilities affect processing speed, ease of use, and the type of output available.

Software

- This includes not only actual GIS software but also various database, drawing, statistical, imaging, or other software.

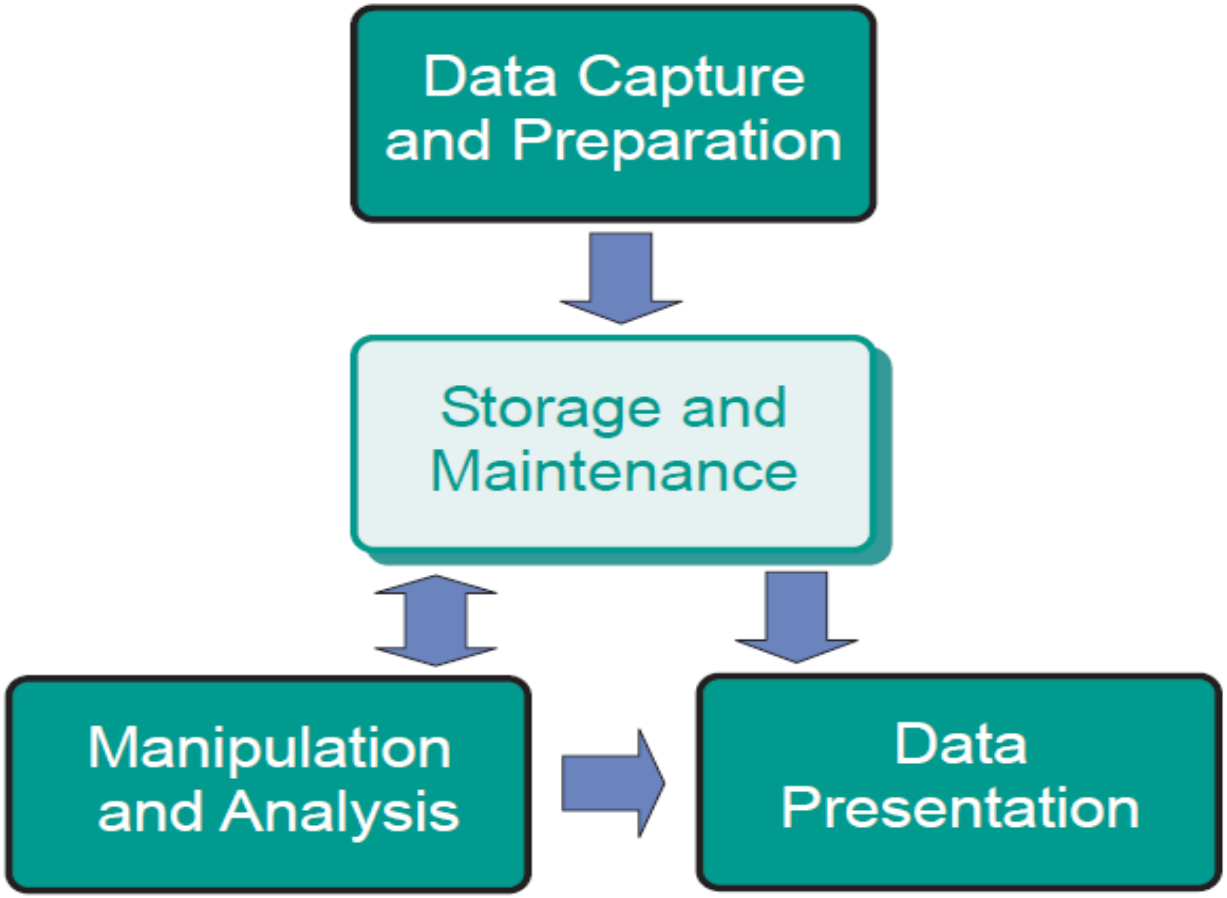
Procedures

- Analysis requires well-defined, consistent methods to produce accurate, reproducible results.

GIS Functional Components

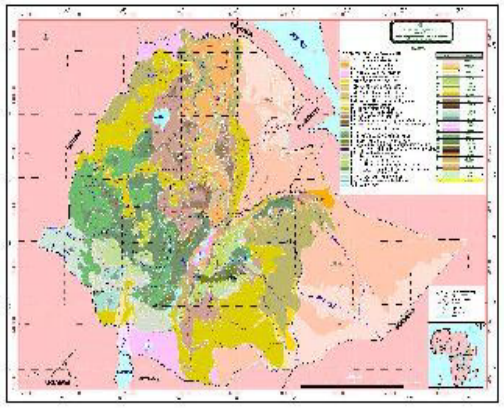
- GIS mainly consists of four functional components, which support key GIS functions.
- These are:
  - Data capture and preparation,
  - Data storage,
  - Data analysis (Query and analysis), and
  - Presentation of spatial data (Data display and output)

GIS Functional Components

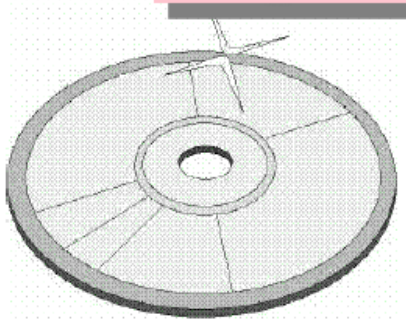


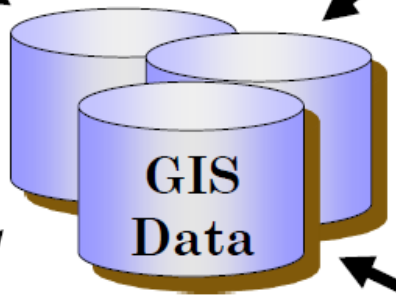
A) Spatial data capture and preparation

Hardcopy maps



Digital data





Coordinates

```
480585.5, 3769234.6
483194.1, 3768432.3
485285.8, 3768391.2
484327.4, 3768565.9
483874.7, 3769823.0
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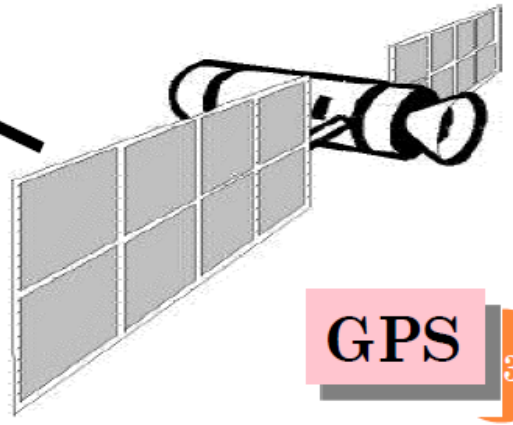
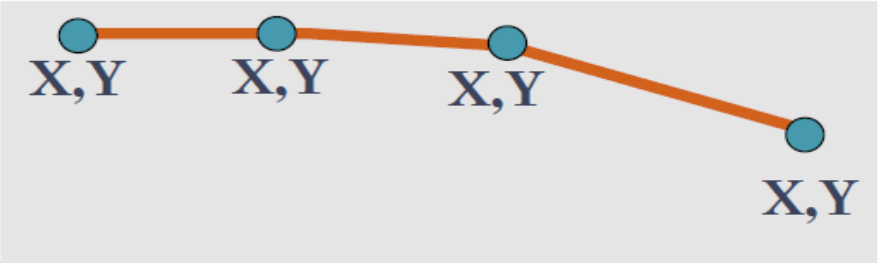


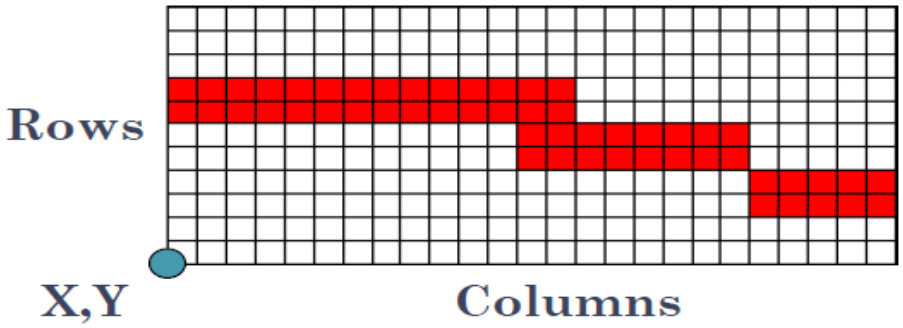
GPS

B. Spatial data storage and maintenance

- **Vector formats**
  - Discrete representations of reality



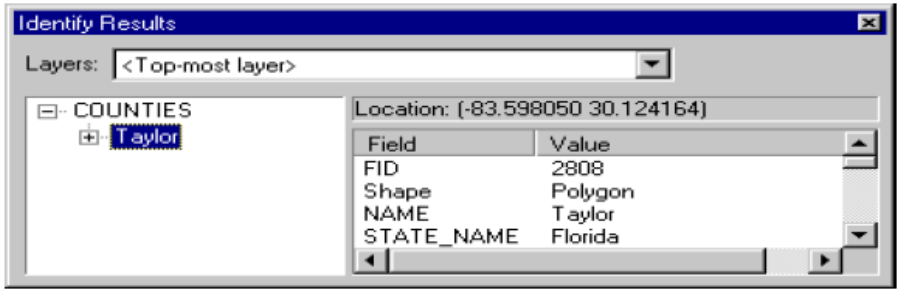
- **Raster formats**
  - Use square cells to model reality

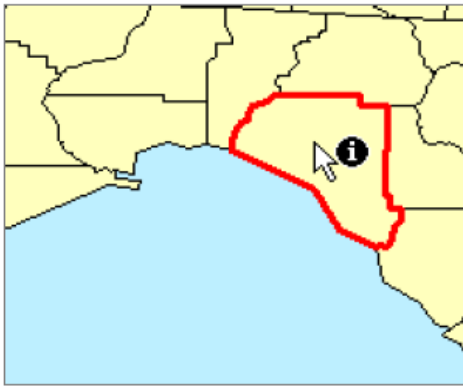


Reality
(A highway)

C. Spatial query and analysis

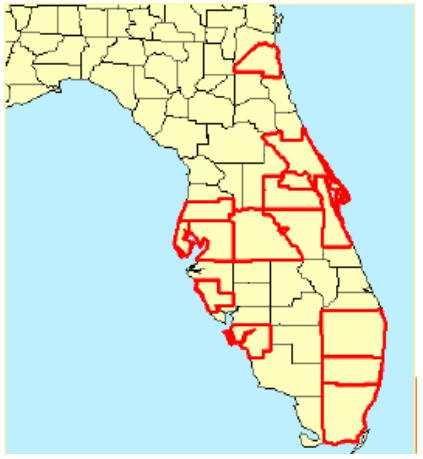
- Identifying specific features





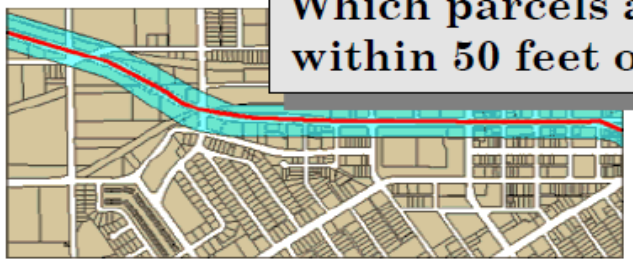
- Identifying features based on conditions

Weredas with a population greater than 300,000

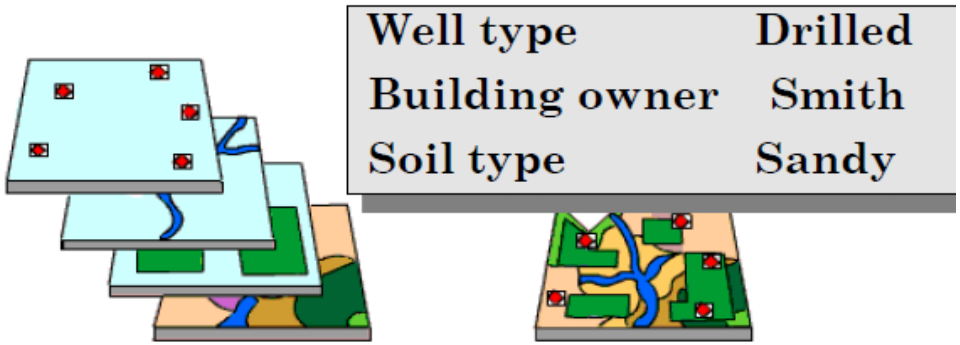


C. Spatial query and analysis…cont

Proximity

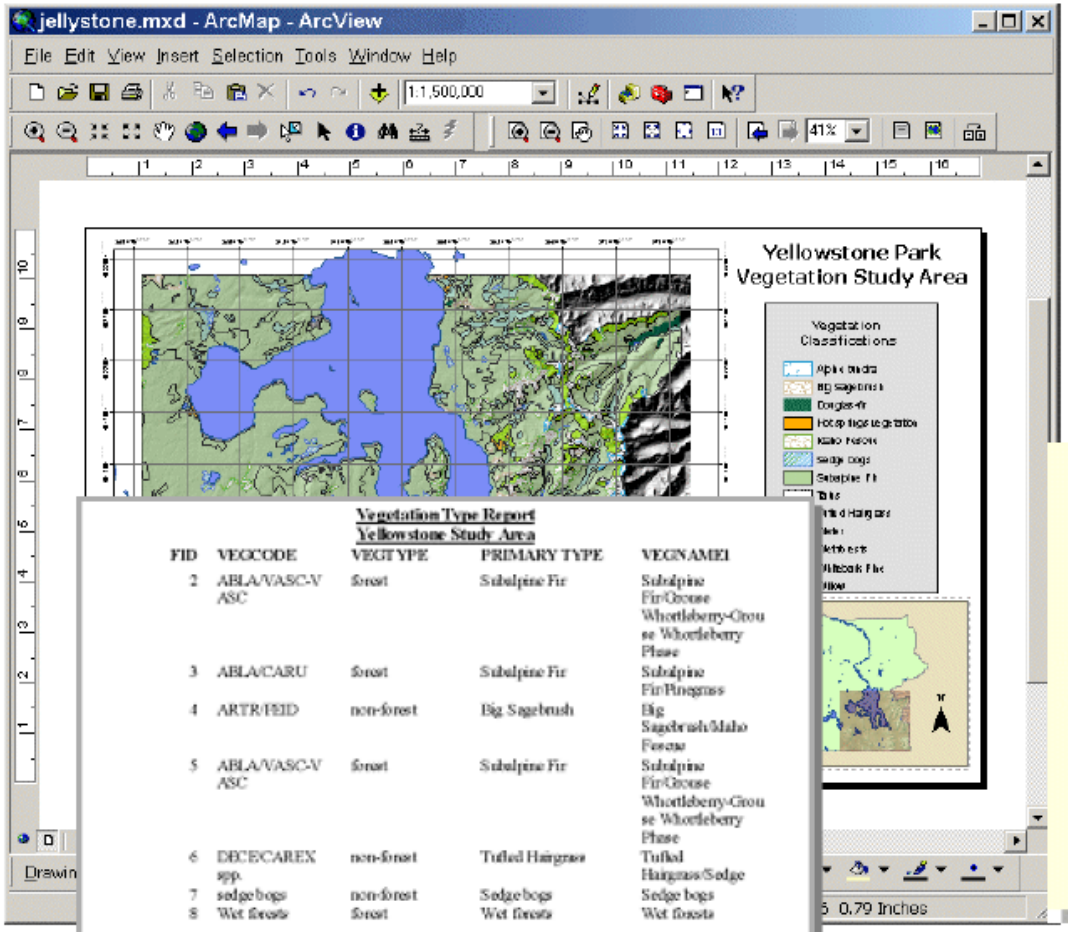


Overlay



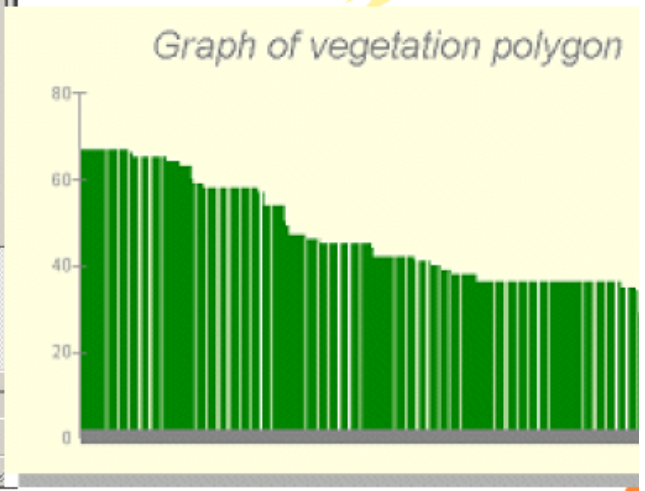
Network

D. Spatial data presentation



Maps

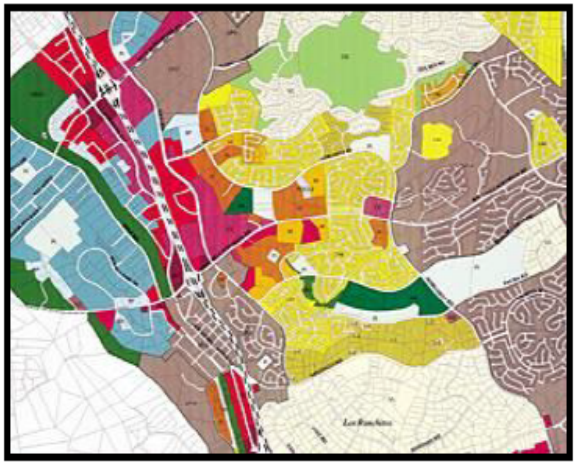
Graphs



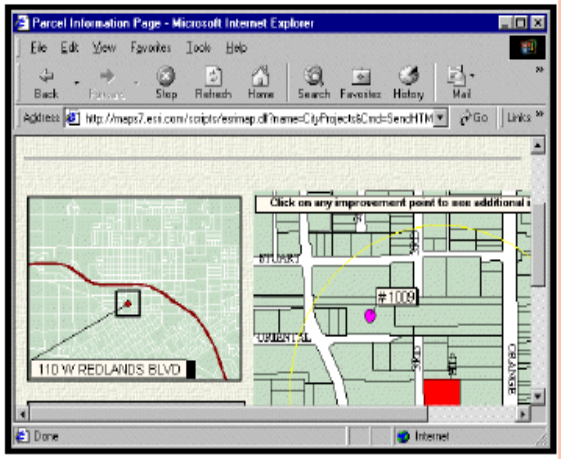
Reports

D. Spatial data presentation…cont

Paper map



Internet



GIS Data

Image

AEZ.jpg

Florida.mxd

Document

Assignments 1 (Individual)

1. Explain the remote sensing process?

2. Write three definitions of GIS taken from books, journals, and/or the World Wide Web.

3. Explain how is spatial information used in environmental applications?

– ***NB: Please include your source (References)***


THANK YOU