# GIS – Basics-Vector and Raster Data

# What is GIS

- A geographic information system is a computer-based tool for mapping and analyzing things that exist and events that happen on earth.

# GIS

- Spatial reference
- Integrates technologies
- Process rather than a software; decision making

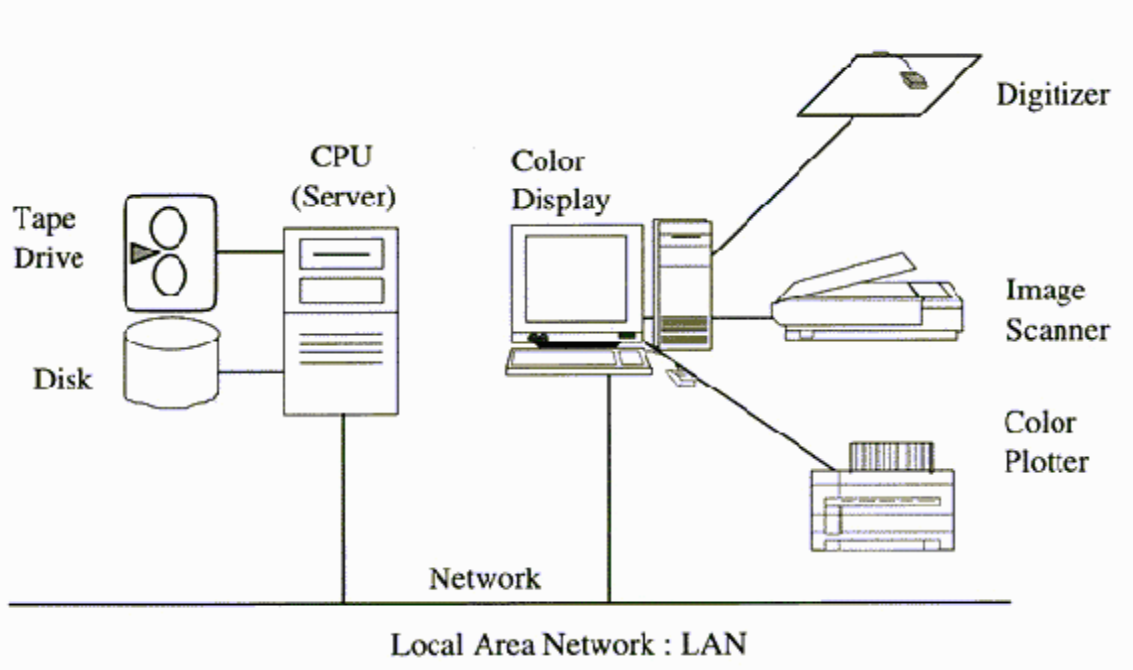
# Components of GIS

- Hardware
- Software
- Data
- People
- Methods

# Hardware

- Computer on which GIS operates
- Centralised computer servers
- Desktop computers
- Networked configurations
- WebGIS

# Hardware


Digitizer
CPU
(Server)
Color
Display
Tape
Drive
Image
Scanner
Disk
Color
Plotter
Network
Local Area Network : LAN

# Software

- Tools for input and manipulation of geographic information
- DBMS
- Tools that support geographic query, analysis and visualization
- A graphical user interface (GUI) for easy access to tools

# Data

- Most important
- Geographic data / tabular
- Collected / purchased

# People

- Planners / Engineers
- End users

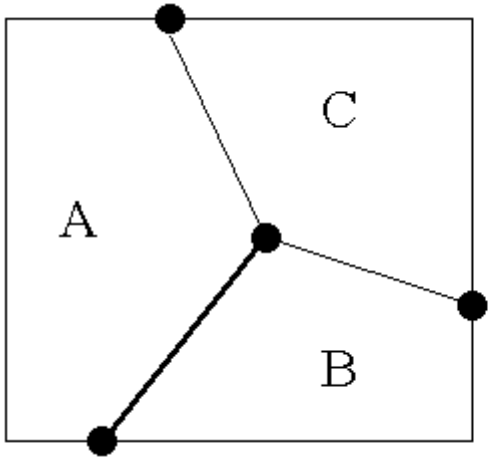
# Methods

- Well designed plan and business rules
- Models and operating practices unique to each organization.

# Data Model and Structure

- represents a set of guidelines to convert the real world (called entity) to the digitally and logically represented spatial objects consisting of the attributes and geometry.
- Vector model
- Raster model

# Data Model and Structure




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| A | A | A | A | A | C | C | C | C | C |
| A | A | A | A | A | C | C | C | C | C |
| A | A | A | A | A | A | C | C | C | C |
| A | A | A | A | A | A | C | C | C | C |
| A | A | A | A | A | B | B | C | C | C |
| A | A | A | A | B | B | B | B | B | C |
| A | A | A | B | B | B | B | B | B | B |
| A | A | B | B | B | B | B | B | B | B |

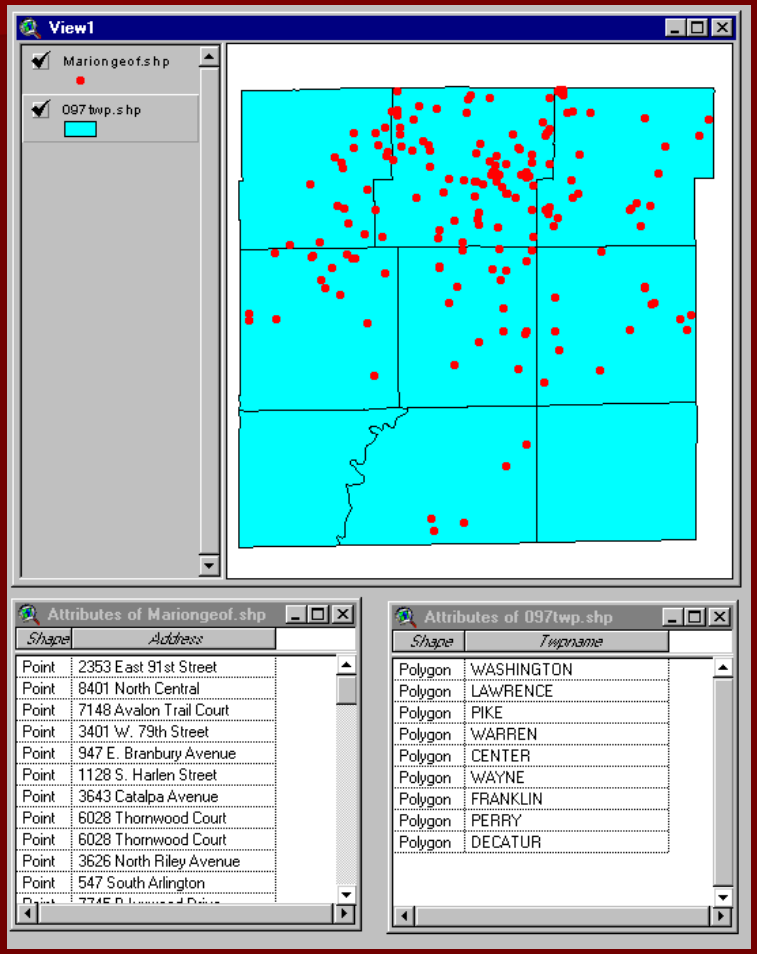
**Vector model**

**Raster model**

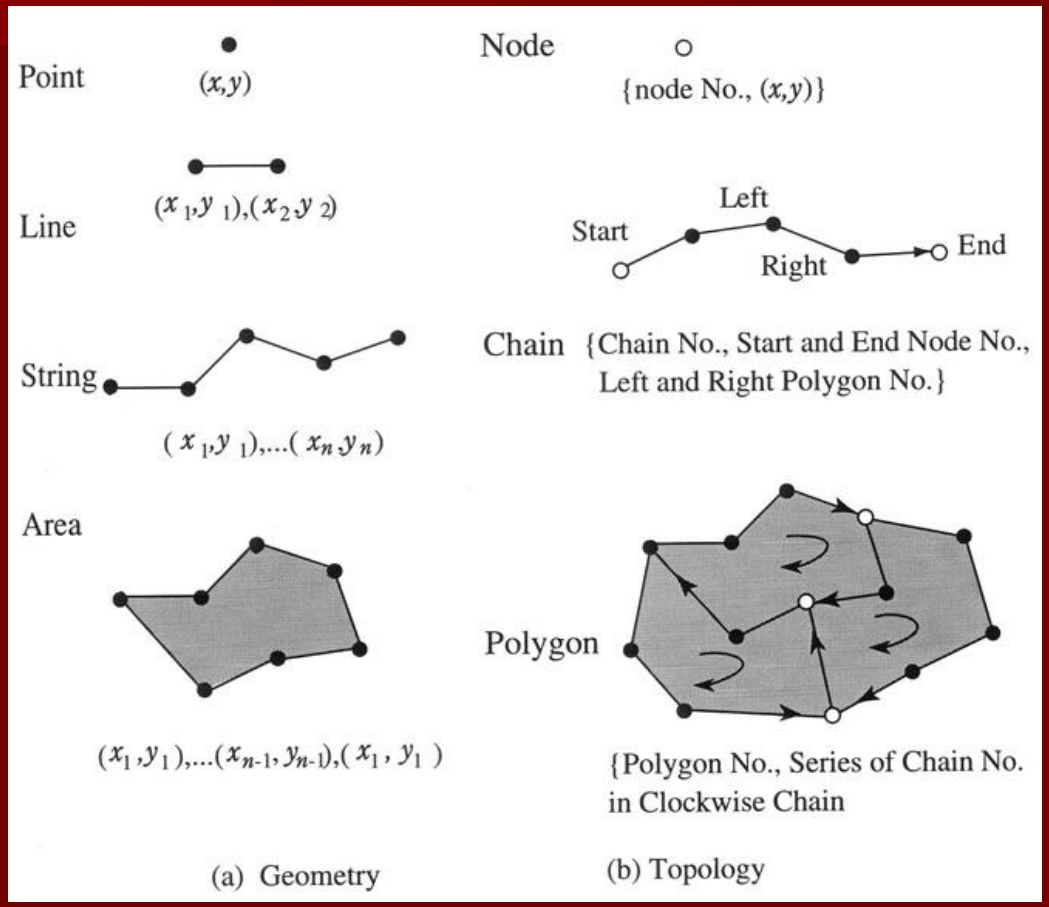
# Vector model

- Vector model uses discrete points, lines and/or areas corresponding to discrete objects with name or code number of attributes.
- Do not necessarily fill space
- Not all locations space need to referenced in the model
- More compact
- More complex data structure

# Vector model

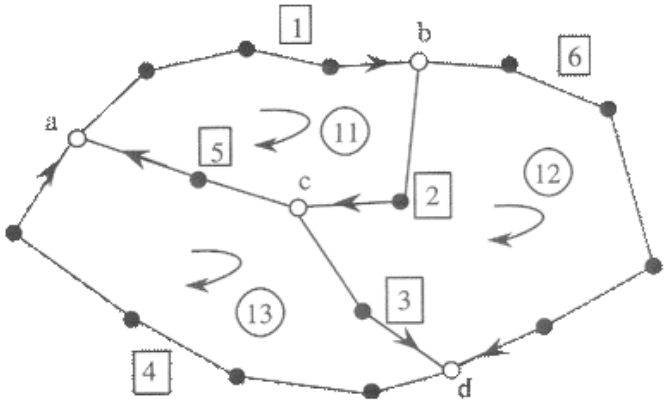


# Vector model




**Geometry and topology of vector data**

# Vector model




**Chain Geometry**

| Chain | Start Coordinates | | End |
|---|---|---|---|
| 1 | $(X_a, Y_a$ | $(X, Y)$ ..... $(X, Y)$ | $(X_b, Y_b)$ |
| 2 | $(X_b, Y_b$ | $(X, Y)$ ..... $(X, Y)$ | $(X_c, Y_c)$ |
| ⋮ | ⋮ | ⋮ | |
| 6 | $(X_b, Y_b$ | $(X, Y)$ ..... $(X, Y)$ | $(X_d, Y_d)$ |

**Topology of Polygon**

| Polygon | Chain |
|---|---|
| 11 | 1,2,5 |
| 12 | -2,6,-3 |
| 13 | 4,-5,3 |

**Topology of Node**

| Node | Chains |
|---|---|
| a | 1,-5,-4 |
| b | -1,2,6 |
| c | -2,3,5 |
| d | -3,4,-7 |

**Topology of Chain**

| Chain | From | To | Left Polygon | Right Polygon |
|---|---|---|---|---|
| 1 | a | b | 0 | 11 |
| 2 | b | c | 12 | 11 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| 6 | b | d | 0 | 12 |

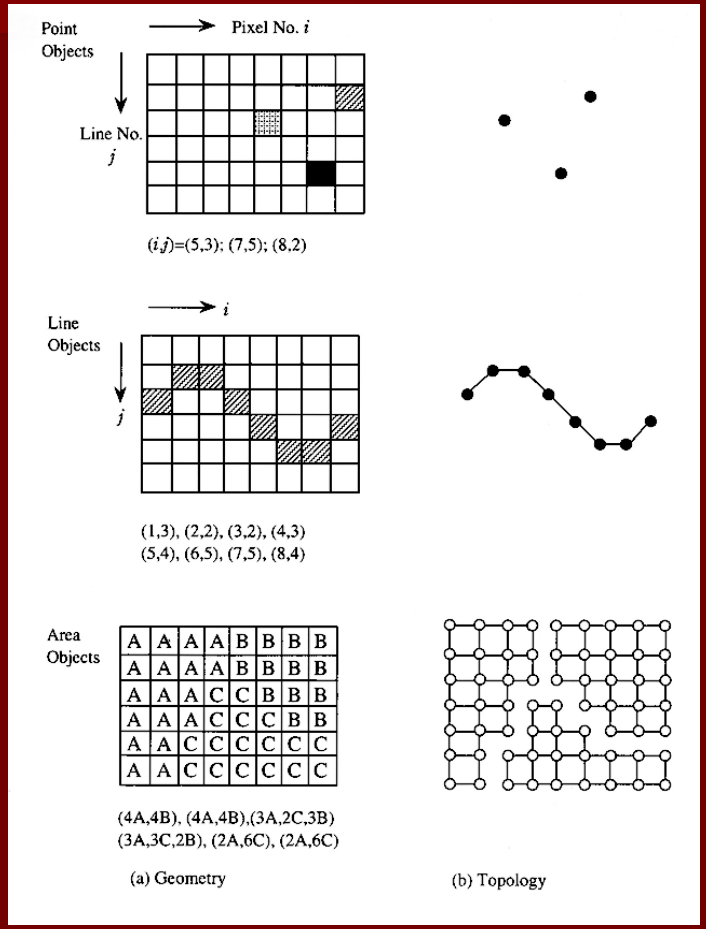
**Building topology**

# Raster model

- Entire area into grid of cells in sequence
- Simple data structure
- Less compact
- High spatial variability efficiently represented
- Digital images - manipulation

# Raster model

# Raster model

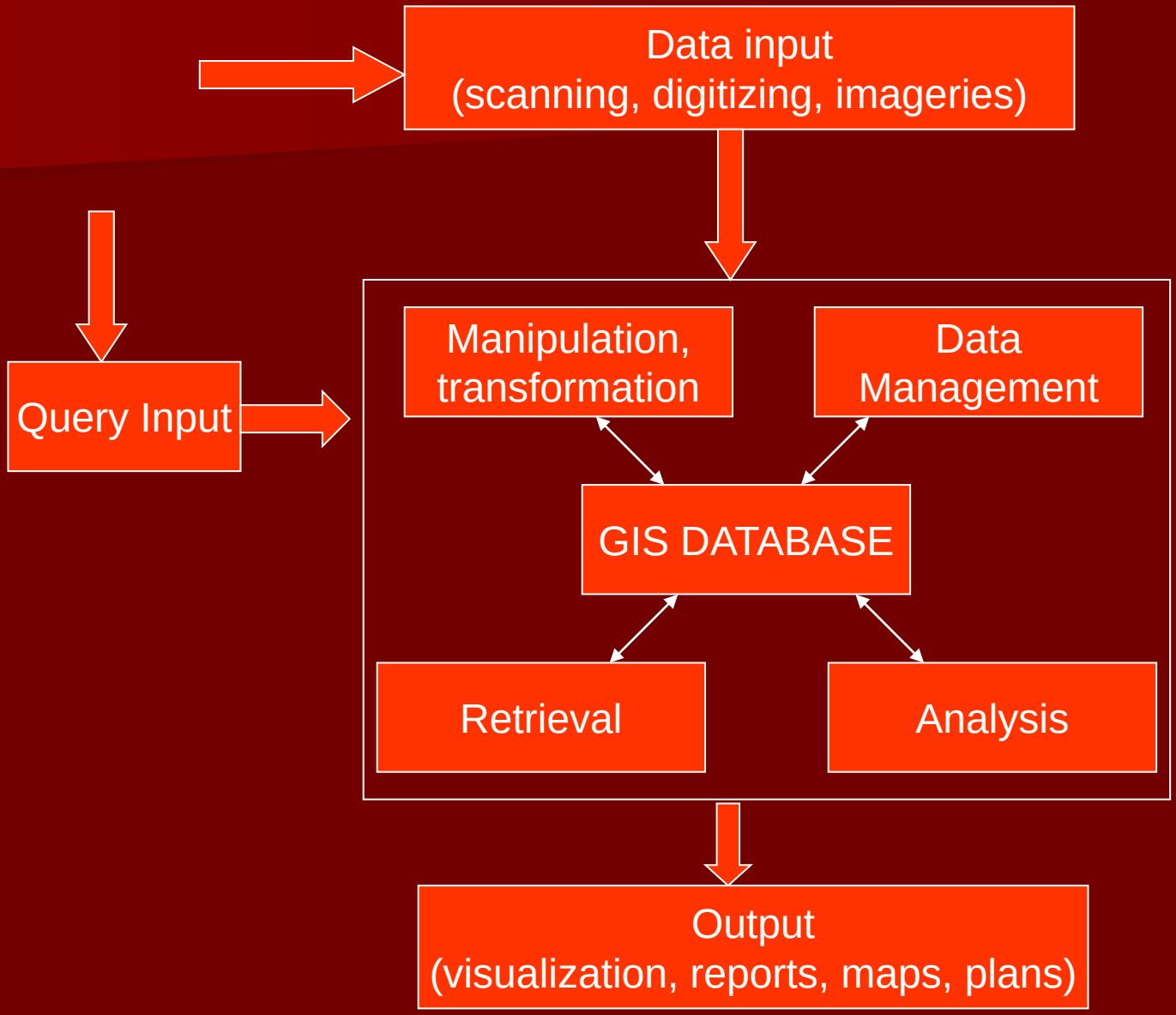



**Geometry and topology of raster data**

# GIS functionality

- A system of hardware, software and procedures designed to support the capture, management, manipulation, analysis, modelling and display of spatially-referenced data for solving complex planning and management problems

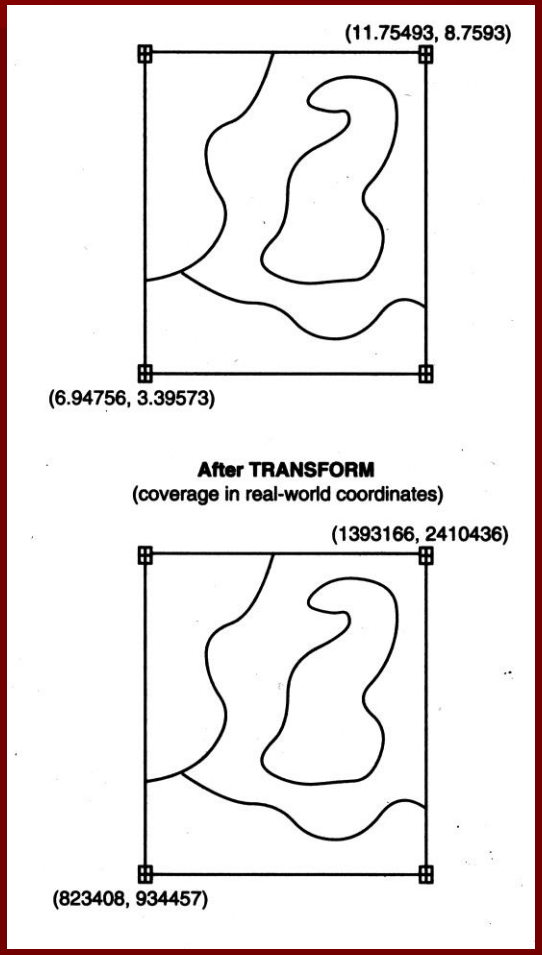
# Major tasks performed by GIS



# Geo-referencing data

- Capturing data
  - Scanning: all of map converted into raster data
  - Digitising: individual features selected from map as points, lines or polygons
- Geo-referencing
  - Initial scanning digitising gives co-ordinates in inches from bottom left corner of digitiser/scanner
  - Real-world co-ordinates are found for four registration points on the captured data
  - These are used to convert the entire map onto a real-world co-ordinate system

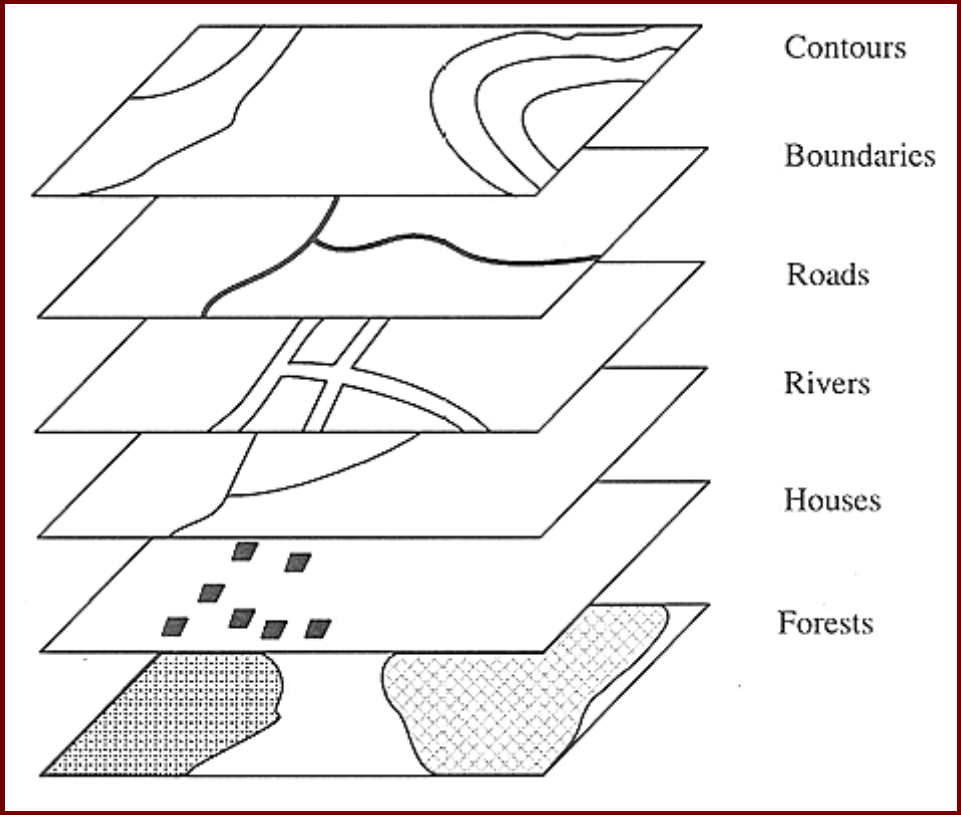
# Example of geo-referencing



# Layers

- Data on different themes are stored in separate “layers”
- As each layer is geo-referenced layers from different sources can easily be integrated using location

# Layers



# Advantages of GIS

- Exploring both geographical and thematic components of data in a holistic way
- Stresses geographical aspects of a research question
- Large volumes of data
- Integration of data from widely disparate sources
- Allows a wide variety of forms of visualisation

# Limitations of GIS

- Data are expensive
- Learning curve on GIS software can be long
- Shows spatial relationships but does not provide absolute solutions
- Origins in the Earth sciences and computer science. Solutions may not be appropriate for humanities research