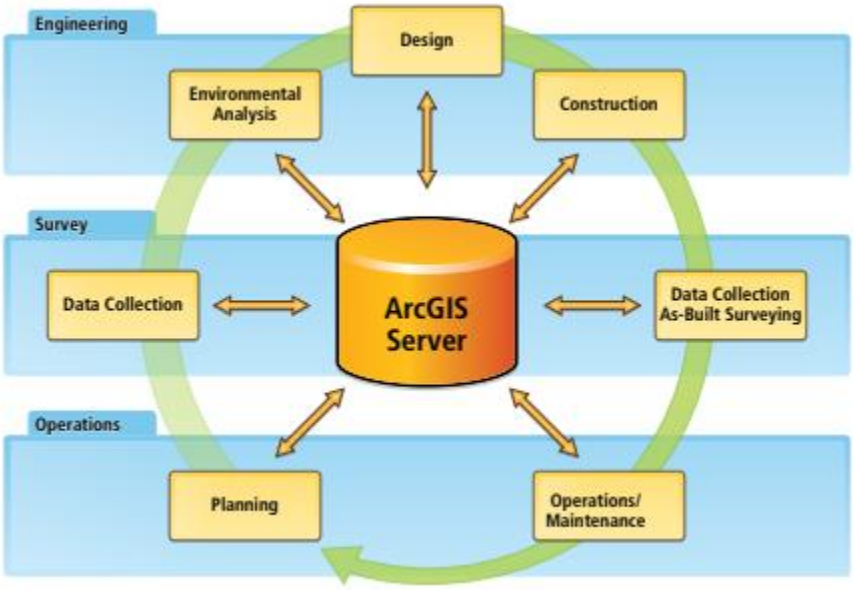
1. (a)Definition from Page 1 and notes given in the class. Application of GIS in civil engineering: Geographic information system (GIS) technology provides the tools for creating, managing, analyzing, and visualizing the data associated with developing and managing infrastructure.



1. (b)Pg. 3 and 4 from notes.

2. (a)

Data acquisition

As data acquisition or data input of geospatial data in digital format is most expensive and procedures are time consuming. In GIS, the data sources for data acquisition should be carefully selected considering the application and scale.

The following data sources are widely used:

Analog maps
- Elevation, soil, landuse, climate, etc.

Aerial photographs
- DEM, landuse (Urban)

Satellite image
- Landuse (regional), vegetation, temperature, DEM

Ground survey with GPS
- Detailed information

Reports and publications
- Attributes, statistics

2. (b)The basic data type in a GIS reflects traditional data found on a map. Accordingly, GIS technology utilizes two basic types of data. These are:

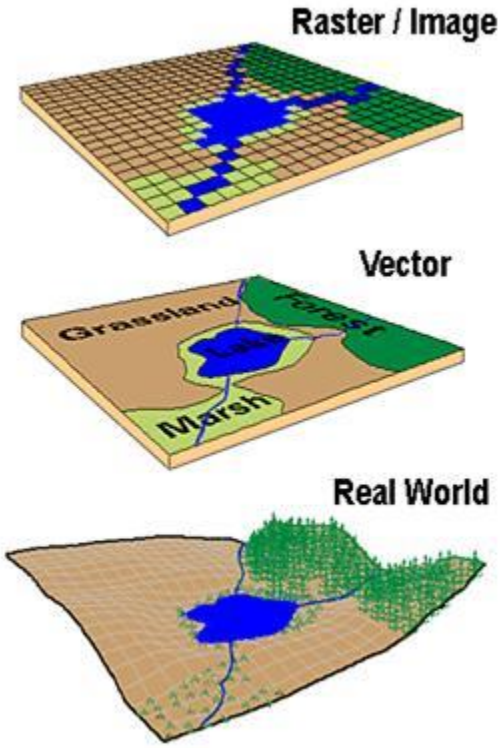
Spatial data	describes the absolute and relative location of geographic features.
Attribute data	describes characteristics of the spatial features. These characteristics can be quantitative and/or qualitative in nature. Attribute data is often referred to as tabular data.

All spatial data models are approaches for storing the spatial location of geographic features in database.

Traditionally spatial data has been stored and presented in the form of a map. Three basic types of spatial data models have evolved for storing geographic data digitally. These are referred to as:

- **Vector**;
- **Raster**;
- **Image**.

The following diagram reflects the two primary spatial data encoding techniques. These are vector and raster. Image data utilizes techniques very similar to raster data, however typically lacks the internal formats required for analysis and modeling of the data. Images reflect *pictures* or *photographs* of the landscape.



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

The tabular model is the manner in which most early GIS software packages stored their attribute data. The next three models are those most commonly implemented in database management systems (DBMS). The object oriented is newer but rapidly gaining in popularity for some applications. A brief review of each model is provided.

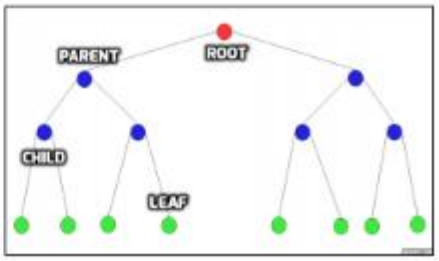
3. (a) Elements of fixing location on earth: (spatial reference system)
    - Ellipsoid: shape
    - GCS : coordinates
    - Datum : origin and orientation or frame of reference
        - PCS: Projection of 3D to 2D
3. (b) From notes "unit 2 coordinates system "
4. (a) Resolution is the smallest difference between adjacent positions that can be recorded. It also refers to the number of pixels in an image. Resolution also limits the minimum size of feature that can be stored. The physical size of a **pixel** depends on how you've set the **resolution** for the display screen. Different types of resolution are:
    a. Spatial resolution
    b. Temporal resolution
    c. Radiometric resolution
    d. Spectral resolution

scale can be expressed as the ratio or proportion between a distance on the maps or imagery and the actual distance on the ground or land surface. It is a ratio that could represent any unit of measurement and this ratio is called the Representative Fraction (RF). While Resolution refers to the ability to distinguish the smallest visible objects on a photograph. Resolution is a result of the combination of film type and the camera lens system.

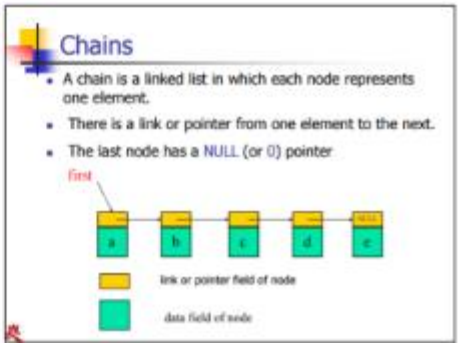
4. (b)

Computer fundamentals in GIS

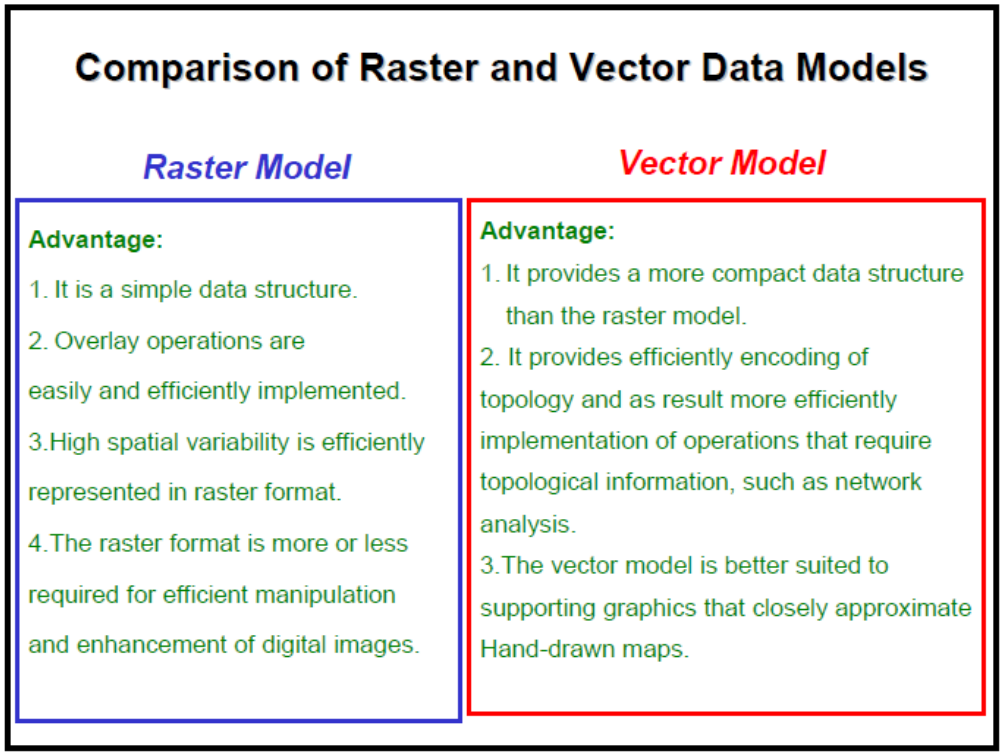
- Data structure : file organisation in operating system memory
- Data sturucture types: Linked lists, chains and binary tree
- A **binary tree** is a rooted tree which is such that all nodes have **at most 2 children.**

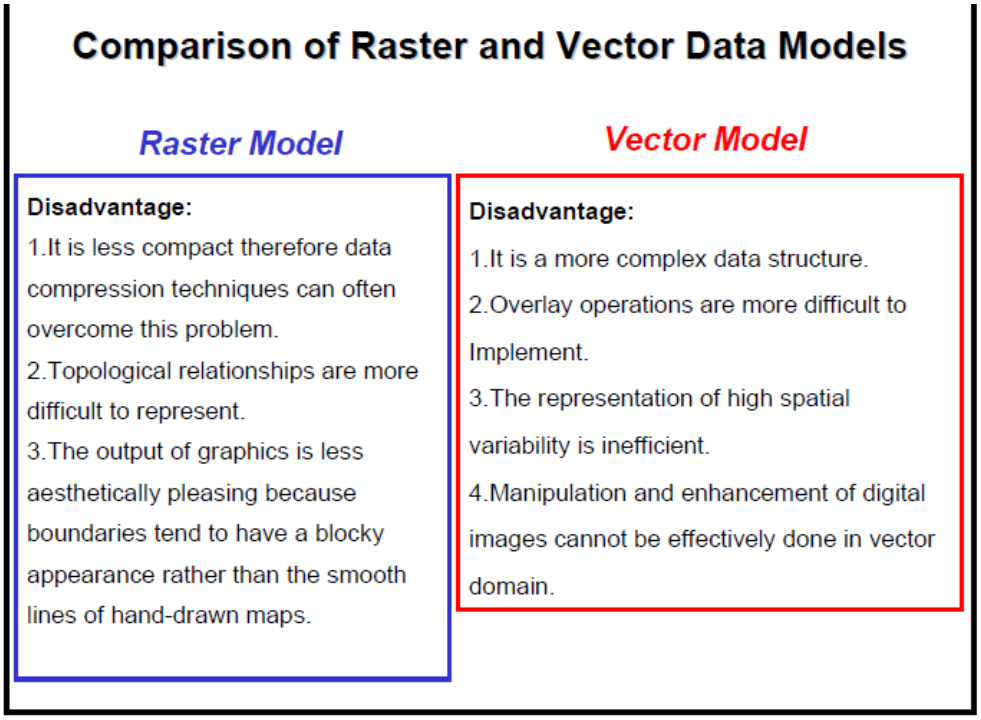


- Each bead connected to the next through a link
- Can change the order of the beads by changing the link/connection
- Bead ~ Data
- Linked beads ~ Linked list of data
- Changing links is useful in sorting
- Need not use additional temporary spaces as in array sorting



5. (a)(i)





5. (a)(ii) A projected coordinate system (**PCS**) is defined on a flat, two-dimensional surface. Unlike a **GCS**, a **PCS** has constant lengths, angles, and areas across the two dimensions. A **PCS** is always based on a **GCS** that is based on a sphere or spheroid.
5. (b)(i)..(2)
5. (b)(ii)..(1)