Geographic Information System

Lecture 9

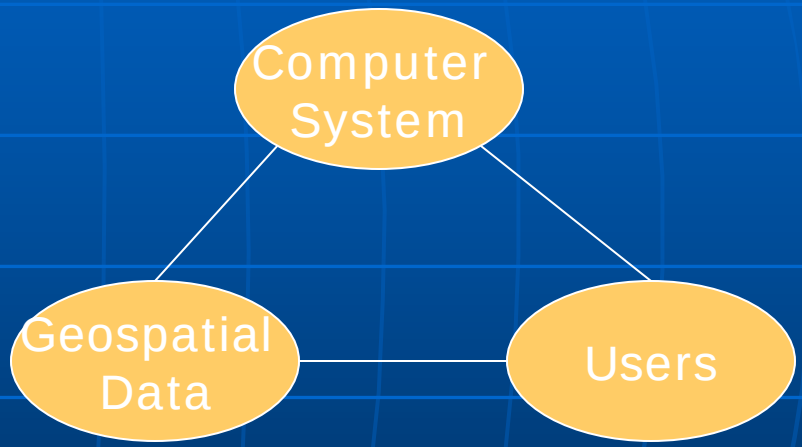
15-11-2018

What is GIS

- Information System for Space Related Data
- Information System = Database System
- Definition
  - Geographic Information System (GIS) is defined as an information system that is used to input, store, retrieve, manipulate, analyze and output geographically referenced data or geospatial data, in order to support decision making for planning and management of land use, natural resources, environment, transportation, urban facilities, and other administrative records.

Key Component of GIS

- Computer:
  - Hardware, Software for capturing, storing, processing, and Analysis, and display etc.
- Geospatial Data
  - Maps, Arial Photos, Satellite Images, Statistical Tables etc.
- Users
  - For Design of Standards, for analysis, updating and implementation



Basic Geographical Concepts

- Spatial Object:
  - Delimited Geographical areas, with a number of different kind of associated attributes
- Point:
  - A spatial object with no area. A key attribute is its geodetic location. Many Attributes can be associated with a Point
- Line:
  - A spatial object, made up of a connected sequence of points. Lines have no width, thus a specified location will be on one side of a line or other, but never on a line.
- Nodes:
  - Special kinds of points showing start, end and junction of line segments.
- Polygon:
  - A closed Area. Simple Polygons are undivided areas, while complex polygons are divided into areas of different characteristics.
- Chains:
  - Special kinds of line segments, which corresponds to a portion of the bounding edge of polygon.

Basic Geographical Concepts

- Scale:
  - Ratio of distance on map (or image) to their true length on the earth's surface
  - Large Scale: A scale is relatively large, if the area or length represented on map (or image) is large
  - Small Scale: A scale is relatively small, if the area or length represented on map (or image) is small
  - e.g.

    1:10,000 is large scale as compared to 1:100,000.

Basic Geographical Concepts

- Resolution
  - Refers to minimum size of the element which we can distinguish on a map.
  - For Raster Maps, it is size of cell
  - For Maps, it is
    = (Area/No of elements)^0.5
  - Higher the resolution, more information are available.
  - RESEL=Resolution Element
- Attributes:
  - Pertinent (important) information of geospatial data.
    e.g. if a line is representing a road through geographic data (Lat., Long. or Easting , Northing), then its helping information such as width, condition, name, metaled or un-metaled etc. are its attributes.
  - Only those attributes should be selected/acquired which might be required in the analysis.

Key Activities of Planners, Scientists and Resource Managers

- 4 - Ms
  - Measure
  - Map
  - Monitor
  - Model

These 4-key activities can be enhanced by use of GIS

GIS Functional Elements

- Acquisition
  - digitizing, editing, topology building, projection transformation, format conversion, attribute assignment etc.
- Pre-Processing
  - Analogue to digital
  - Conversion of units
- Management
  - Data archival, databases (hierarchical model, networking model, relational databases etc.)
- Manipulation and Analysis
  - Buffering, overlay, connectivity operations etc.
- Output (Product Generation)
  - Thematic maps, 3D birds eye view, scaled maps etc

Why a GIS

- Old Records/maps are poorly maintained
- Poorly Updated
- Inaccurate
- No Sharing
- No data retrieval service for maps

Benefits of GIS

Once a GIS is implemented, following benefits are expected:

- Better Maintained data
- Standard format
- Easy revision,
- Easy updation
- Easy Units conversion
- Easy to share
- Easier to search, analyze and represent
- Many value added products
- Enhance productivity of staff
- Time and Money saved
- Better Decision making

GIS Elements

The questions that a GIS can answer:

- What is it?
- Where is it?
- How has it changed?
- Which data are related to it?
- What if?

GIS Software

- ESRI: ARC/INFO, ARC VIEW, ARC GIS
- Intergraph: MGE
- Grass Information Centre: GRASS*
- Clark University: IDRISI
- AUTODESK: ARC MAP
- ILWIS: Integrated Land and Water Information System.

http://grass.osgeo.org/

http://www.clarklabs.org/products/idrisi-taiga.cfm

GIS as a Multi-Disciplinary Science

Combination of following traditional sciences

- Geography
- Statistics
- Cartography
- Remote Sensing
- Photogrammetry
- Computer Science
- Operation Research
- Mathematics
- Surveying
- Civil Engineering
- Geodesy
- Urban Planning
- Environmental Engineering, etc.

Alternate Names of GIS

- Land Information System (LIS)
- AM/FM-Automated Mapping and Facilities Management
- Environmental Information System (EIS)
- Resource Information System (RIS)

GIS Is now becoming independent DISCIPLINE in the name of GEOINFORMATICS, or GEOSPATIAL INFORMATION SYSTEM.

Areas of GIS Applications

- Facilities Management
  - e.g. PTCL, SNGPL, Irrigation, WASA, for: locating on-ground and underground acilities e.g. pipes and cables)
- Environmental and Natural Resource management
  - suitable lands for crops, management of forests, EIA, Disaster Management etc.
- Street Network
  - Car Navigation, locating houses and streets, rescue services etc.
- Planning and Engineering
  - DAMS, Power Projects, urban planning, regional planning
- Land Information System
  - Board of Revenue, taxation, zoning, land acquisition.

GIS and DSS

- GIS is usually an important component of modern Decision Support Systems
- DSS components:
  - Data Base
  - Statistical Analysis
  - Numerical Model
  - Input and output facility

USE OF GIS as DSS

Thanks