

(Basic concepts of Geographic Information Systems)

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Management

Topic to be covered

- ➤What is GIS and its definition, Why GIS?
- Components and Hardware requirement
- System concepts, Coordinate systems , Projection system
- >Type of data in GIS Spatial and non spatial data

Files and data formats

➢ Data Model and Management: Spatial, Thematic, and Temporal dimensions of Geographic Data, Conceptual, objectoriented and logical data model.

➢ Raster and Vector Data Model, Raster versus Vector, advantages and limitation.

Data compression-Spatial analysis, Data retrieval, Query, Overlay, Vector and Raster data analysis,

- Digital Elevation Model
- Sources of errors

> Types of errors - Elimination – Accuracy

>Attribute data management and Meta Data concept



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Decisions

(Geographic Information Systems)

Structure of talk

- **1**. Define GIS and related terms
 - Geographic Information
 - GIS as:
 - a type of software
 - a set of tools
 - an approach to analysis
 - Geographical Information Science (GISc)
- 2. Data in GIS
 - Spatial and attribute
 - Geo-referencing data
 - Raster and vector
 - Layers of data
- 3. Querying a GIS database
- 4. Integrating data with GIS

Geographical Information (GI)

- Information that refers to a location on the Earth's surface
 - Has both a spatial and a thematic component
 - Census data
 - Hospitals admissions data
 - Relief data (e.g. from contours)
 - Information on transport networks
 - A text about a specific place (eg. Kasinagar's description of Odisha, during the Malaria)
 - A photograph or painting of a building

Geographical Information Systems (GIS)

- 1. GIS: A type of software
 - A computer system that allows us to handle information about the location of features or phenomena on the Earth's surface
 - Has all the functionality of a conventional DBMS plus much of the functionality of a computer mapping system
 - GIS as a DBMS that allows us to explicitly handle the spatial
 - Common examples:
 - ArcView
 - ArcGIS
 - MapInfo

Geographical Information Systems (2) 2. GIS: A tool-kit

- Manipulate spatially:
 - Calculate distances and adjacencies
 - Change projections and scales
 - Integrate disparate sources
- Analyse spatially:
 - Quantitative analysis
 - Exploratory spatial data analysis
 - Qualitative analysis
- Visualise data:
 - -Maps!
 - Tables, graphs, etc.
 - Animations
 - Virtual landscapes

Geographical Information Systems (3)

- 3. Approach:
 - Explore the database:
 - In conventional ways
 - AND geographically
 - Allows us to think about the implications of location
 - Allows us to think holistically
 - Should not be restricted by vendor-provided functionality
 - Should be used imaginatively taking into account :
 - the advantages and limitations of geographical information

Geographical Information Science (GISc)

- Deals with making appropriate or best use of geographical information
- Closely related to GIS but is not application specific
- Examples
 - Analysis techniques
 - Visualisation techniques
 - Algorithms for geographical data

GIS—What it is?

- Geographic/Geospatial Information
 - information about places on the earth's surface
 - knowledge about "what is <u>where</u> when"

(Don't forget time!)

- GIS--what's in the S?
 - Systems: the technology
 - Science: the concepts and theory
 - Studies: the societal context

Geographic Information Technologies
Global Positioning Systems (GPS)

- a system of earth-orbiting satellites which can provide precise (100 meter to sub-cm.)location on the earth's surface (in lat/long coordinates or equiv.)
- Remote Sensing (RS)
 - use of satellites or aircraft to capture information about the earth's surface
 - Digital ortho images a key product (map accurate digital photos)
- Geographic Information Systems (GISy)
 - Software systems with capability for input, storage, manipulation/analysis and output/display of geographic (spatial) information

GPS and RS are sources of input data for a GISy. A GISy provides for storing and manipulating GPS and RS data.

Defining Geographic Information Systems (GIS)

- The *common ground* between information processing and the many fields using spatial analysis techniques. (Tomlinson, 1972)
- A powerful *set of tools* for <u>collecting</u>, <u>storing</u>, <u>retrieving</u>, <u>transforming</u>, <u>and displaying spatial</u> <u>data</u> from the real world. (Burroughs, 1986)
- A computerized *database management system* for the capture, storage, retrieval, analysis and display of spatial (locationally defined) data. (NCGIA, 1987)
- A *decision support system* involving <u>the *integration* of</u> <u>spatially referenced data in a problem solving</u> <u>environment</u>. (Cowen, 1988)

- the common theme is obviously spatial--that is to say, referced to the earth's surface
- --Tomlinson: very general 'common ground'
- --Burroughs: 'tool box', but how linked together?
- --NCGIA 'DBMS' for spatial data, but also adds the concept of process--capture, store, analyze and display
- --Cowen: adds (1) decision support/solve problem perspective and (2) integration

An Inelegant Definition for GISy

A system of integrated computer-based <u>tools</u> for endto-end <u>processing</u> (capture, storage, retrieval, analysis, display) of data using <u>location on the</u> <u>earth's surface</u> for interrelation in support of <u>operations management, decision making,</u> <u>and science.</u>

- set of integrated tools for spatial analysis
- encompasses end-to-end processing of data
 - capture, storage, retrieval, analysis/modification, display
- uses explicit location on earth's surface to relate data
- aimed at decision support, as well as on-going operations and scientific inquiry

GIS

- •Art, science, engineering and technology associated with answering geographical questions
- •Geologist: pattern of earthquake?
- •Hydrologist: pattern of pollutant spread?
- •Climatologist: change in ozone hole?
- •Politician: population of a particular constituency?
- •Forester: spread of forest fire?
- >All of these are concerned with the geographical pattern and processes on earth's surface

Why GIS ?

- > To inventory and monitor resources
- > To test the sensitivity of our analysis
- ➤ assumptions
- To simulate potential impacts of management alternatives
- To make the map the 2nd time, the 50th time, the 100th time...

GEOGRAPHIC INFORMATION SYSTEM



Components of GIS •Computer hardware

- -CPU
- -Data storage devices
- -Display devices
- -Printing devices

Software Modules

- -Data input and verification : Data structure
- –Data storage and data base management
- –Data analysis and cartographic modeling(Data transformation and manipulation)
- -Interaction with the user(Data out put and presentation)

GIS System Architecture and Components



Work flow process of GIS

Data input and verification

Entering spatial data

- -Manual input to a vector system
- -Manual input to a grid system
- -Digitizing
- -Automated scanning
- •Entering the non-spatial associated attributes
- Linking spatial and non-spatial data
- -Special programs
- -Procedures
- Format conversion
- Data reduction and generalization
- •Error detection and editing
- Merging of points into lines and lines into polygons
- •Edge matching
- Rectification/registration
- Interpolation
- Photo-interpretation

FUNCTIONS OF GIS

What is it.....?

≻This is a location based question, which seeks to find out what exists at a particular location.

Where is it....?

≻It is a conditional question.

What has changed.....?

This question identifies geographic occurrences or trends that have changed or area in processes of changing.
What spatial pattern exist.....?

Relational question, which analyses the spatial relationship between object of geographic features.
What if.....?

≻Model-based question

Roots of GIS

- •As data analysis and display tools: beginning of use of computers to handle and analyze mapped data
- •As map-making tool: automation of map making (digital cartography)
- •Architecture and environmentally sensitive planning (groundwater, vegetation, soils)
- •Urban and demographic roots: automation of national population census
- •Remote sensing: combine information from Remote Sensing with other information (Raster GIS)

Types of data

Two types of data are stored for each item in the database

1.Spatial data:

- Says *where* the feature is
- Co-ordinate based
- Vector data discrete features:
 - Points
 - Lines
 - Polygons (zones or areas)
- Raster data:
 - A continuous surface
- 2. Attribute data:
 - Says *what* a feature is
 - Eg. statistics, text, images, sound, etc

What Data is in Your GIS?

- What features do you map?
- What attributes do you need to collect data on?
- What attribute values can you give the attribute?

What makes data spatial?

