CE-317 GIS/RS Application to Civil Engineering
Spring 2011

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- Lecture 01: Introduction to GIS

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Definition 01

- A system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data which are **spatially referenced** to the Earth.
- This is normally considered to involve a spatially referenced computer database and appropriate applications software.

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Definition 02

- Geographic Information System (GIS) can also be defined as:
  - The organized activity by which people
    - Measure aspects of geographic phenomena and processes;
    - Represent these measurements, usually in the form of a computer database, to emphasize spatial themes, entities, and relationships;
    - Operate upon these representations to produce more measurements and to discover new relationships by integrating disparate sources; and
    - Transform these representations to conform to other frameworks of entities and relationships.

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Definition 02

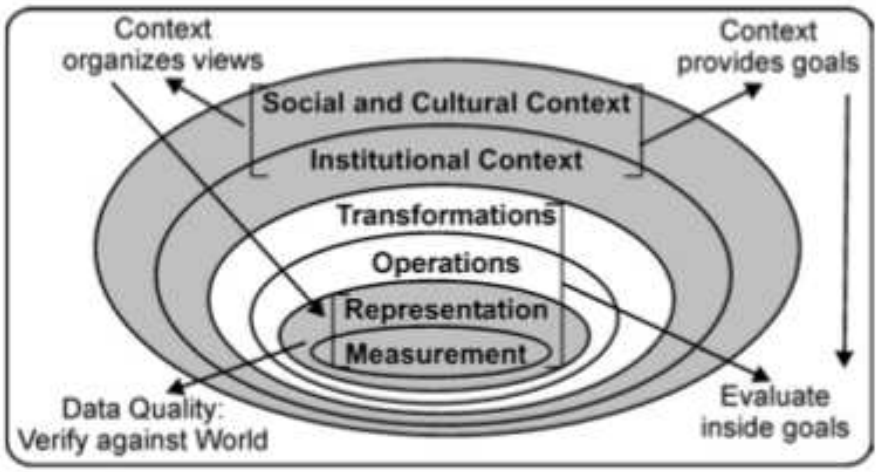

Figure 1.4: GIS framework.

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Definition 03

- A definition quoted in William Huxhold's Introduction to Urban Geographic Information Systems:
- '. . . The purpose of a traditional GIS is first and foremost spatial analysis. Therefore, capabilities may have limited data capture and cartographic output. Capabilities of analysis typically support decision making for specific projects and / or limited geographic areas. The map data-base characteristics (accuracy, continuity, completeness, etc.) are typically appropriate for small-scale map output. Vector and raster data interfaces may be available. However, topology is usually the sole underlying data structure for spatial analysis.'

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Definition 04

- C. Dana Tomlin's definition, from Geographic Information Systems and Cartographic Modeling:
- 'A geographic information system is a facility for preparing, presenting, and interpreting facts that pertain to the surface of the earth.'

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Definition 05

- This is a broad definition . . . a considerably narrower definition, however, is more often employed.
- In common parlance, a geographic information system or GIS is a configuration of computer hardware and software specifically designed for the acquisition, maintenance, and use of cartographic data.

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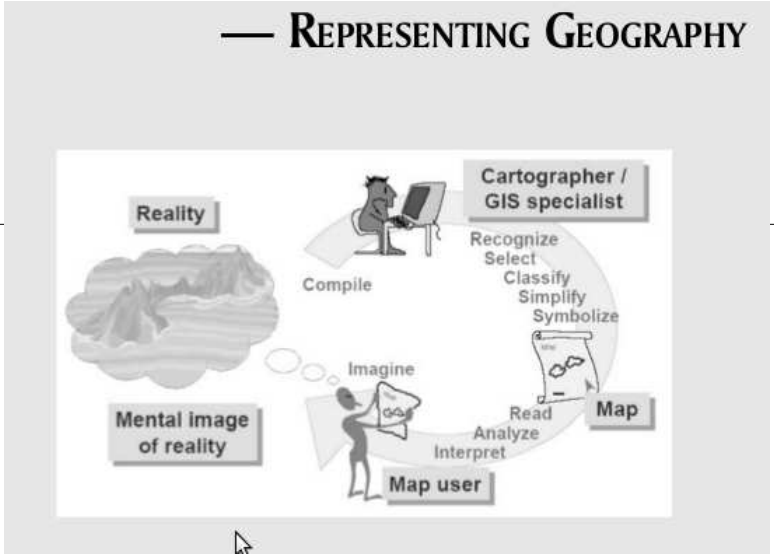
GIS Scope



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GIS Integrating Technology

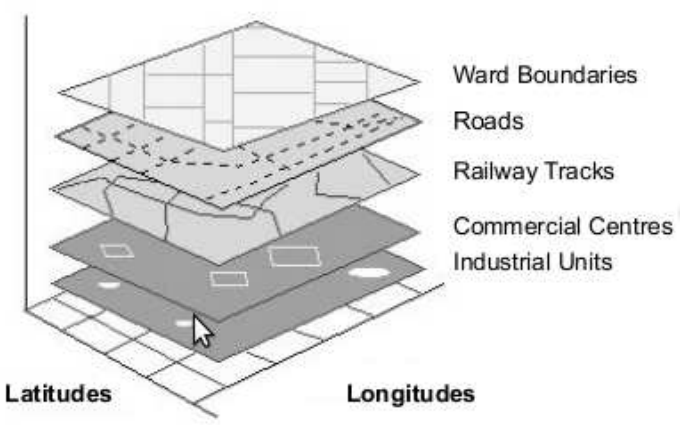

Figure 1.5: GIS: an integrating technology.

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GIS Integrating Technology

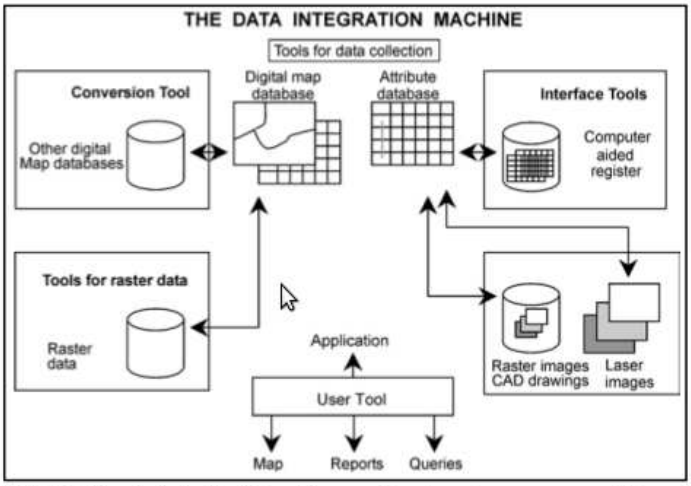

Figure 1.12: GIS is a typical data integration machine. It receives, process and transmits data.

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Why GIS Important

Box 2: Definitions of GIS and the groups who find them useful.

A container of maps in digital form	the general public
A computerized tool for solving geographic problems	decision makers, planners
A spatial decision support system	managers, operations researchers
A mechanized inventory of geographically distributed features	utility managers, resource managers
A tool for revealing what is otherwise invisible in geographic information	scientists, investigators
A tool for performing operations on geographic data that are too tedious if performed by manual methods	resource managers, planners, GIS experts

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CONTRIBUTING DISCIPLINES

- GIS is science of Spatial Information and it is called enabling technology
  - Geography
  - Cartography (concerns with the display of spatial information)
  - Remote Sensing
  - Photogrammetry
  - Surveying
  - Statistics
  - Computer Science
  - Mathematics

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Some Important Areas Where GIS is Being Used Are:

- Different Streams of Planning: Urban planning, housing, transportation planning architectural conservation, urban design, landscape planning etc.
- Street Network Based Application: It is an addressed matched application, vehicle routing and scheduling: location, development and site selection and disaster planning.
- Natural Resource Based Application: Management and environmental impact analysis of wild and scenic recreational resources, flood plain, wetlands, aquifers, forests, and wildlife.

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Some Important Areas Where Gis is Being Used Are:

- View Shed Analysis: Hazardous or toxic factories siting and ground water modeling. Wildlife habitat study and migration route planning.
- Land Parcel Based: Zoning, sub-division plans review, land acquisition, environment impact analysis, nature quality management and maintenance etc.
- Facilities Management: Can locate underground pipes and cables for maintenance, planning, tracking energy use.

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Application potential of GIS

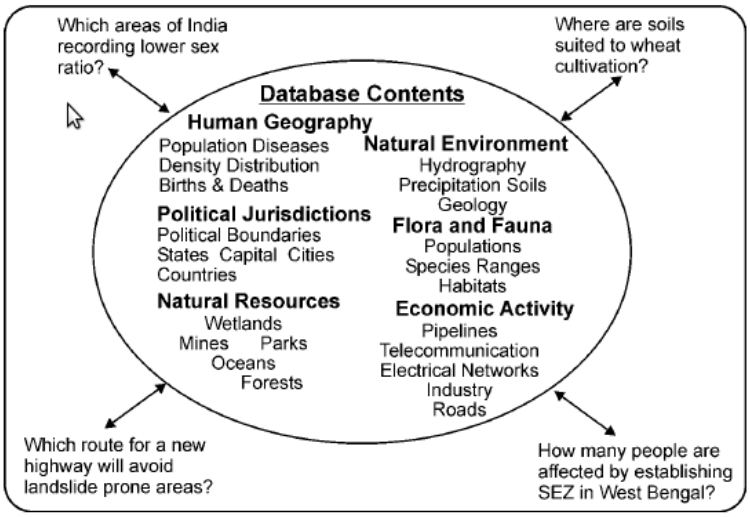

Figure 1.6: Application potential of GIS for geographical studies.

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COMPONENTS OF GIS

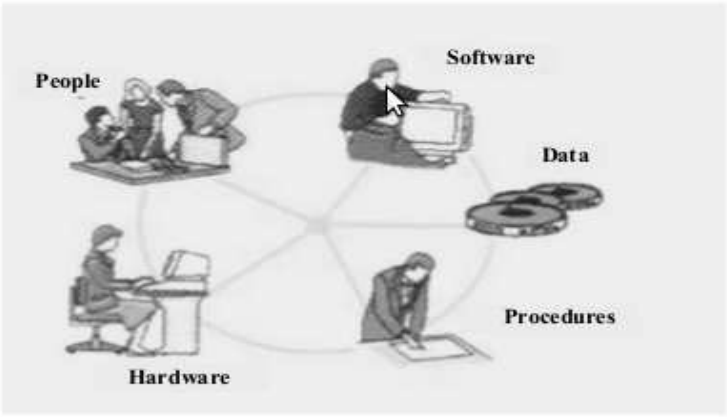

Figure 1.7: Six basic components of GIS.

Note: The sixth component is the Network Shown in Yellow Connecting Line

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Function of Hardware and Software in GIS

- The hardware and software functions of a GIS include:
  - Compilation
  - Storage
  - Updating and changing
  - Management and exchange
  - Manipulation
  - Retrieval and presentation
  - Acquisition and verification
  - Analysis and combination

Defining a Map & Cartography

- According to the International Cartographic Association, a map is a representation, normally to scale and on a flat medium, of a selection of material or abstract features on, or in relation to, the surface of the Earth.
- The term ‘map’ is often used in mathematics to convey the notion of transferring information from one form to another, just as cartographers transfer information from the surface of the Earth to a sheet of paper.
- Cartography is very much a process of abstraction in which features of the real world are generalized or simplified to meet the demands of the theme and audience.

Map Types

- There are two map types; i.e.,
    1. Topographic
    2. Thematic

1. Topographic map: These maps are a reference tool, showing the outlines of selected natural and man-made features of the Earth, often acts as a frame for other information.
    - 'Topography' refers to the shape of the surface, represented by contours and/or shading, but topographic maps also show roads and other prominent features.

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Map Types

2. Thematic map: These maps are a tool to communicate geographical concepts such as the distribution of population densities, climate, land use etc.
    - Thematic maps are important in GIS.
    - An area class map shows zones of constant attributes, such as vegetation, soil type, or forest species.
    - The boundaries are different for each map as they are determined by the variation of the attribute being mapped, e.g., breaks of soil type may occur independently of breaks of vegetation.

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GIS & Mapping Components

- A GIS contains these four components:
  - a. Input
  - b. Database
  - c. Analysis
  - d. Output
- In contrast, a mapping (cartographic) system can be described in three components:
  - Input
  - Map design
  - Output

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Information on Digital Map

- 03 Types of Information is displayed on Digital Map:
  - Geographic information, which provides the position and shapes of specific geographic features.
  - Attribute information, which provides additional non-graphic information about each feature.
  - Display information, which describes how the features will appear on the screen.

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Q & A

- Thanks