# INTRODUCTION TO GIS
## Overview, History and concepts of GIS

### CONCEPTS OF GIS

- Geographic Information System is a computerized system that facilitates collection, analysis and presentation of geo referenced or spatial data.
- GIS involves working with positional data that makes use of Earth's surface as a reference.
- GIS application is the tool that allows the user to create interactive queries, analyze spatial information, edit data in maps and present the results in an interactive manner.

### HISTORY OF GIS

- The term Geographic Information System was first used by Roger Tomlinson in his paper "A Geographic Information System for Regional Planning" in 1968.
- In 1960, the first operational GIS was developed in Canada by Federal Department of Forestry and Rural Development. It is known as Canada Geographic Information System (CGIS).
- In 1964, Laboratory for Computer Graphics and Spatial Analysis was formed at Harvard Graduate School of Design. The theoretical concepts on spatial data analysis were developed.
- By late 1970's, two public domain GIS systems known as MOSS and GRASS GIS were in development.
- By early 1980's, Environmental System Research Institute (ESRI), Computer Aided Resource Information System (CARIS) and Earth Resource Data Analysis System (ERDAS) emerged as commercial vendors of GIS software.
- In 1986, Mapping Display and Analysis System (MIDAS) was released as a first Desktop GIS product.
- In 1990, MIDAS was renamed as MapInfo for Windows operating system.
- By the end of 20th century, users started exploring GIS data over the Internet.

## STAGES OF GIS

### 1. DATA PREPARATION AND ENTRY:

- It is the first phase for GIS.
- The study phenomena is decided.
- All the geographic data related to the geographic phenomena under study are collected.
- The collected geographic data are then prepared by converting into the format that can be entered into the GIS system.

### 2. DATA ANALYSIS:

- It is the second phase of GIS.
- The collected data are reviewed and analyzed to discover hidden patterns within them.
- It includes various geographic data mining techniques.

### 3. DATA PRESENTATION:

- It is the final phase of GIS.
- The results obtained from the analysis phase are presented to the users of the GIS application.
- The results should be presented in efficient and understandable way.

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## FUNCTIONS OF GIS

### 1. INTEGRATED REPRESENTATION OF GEOGRAPHIC DATA

- The geographic data are represented in the easy and understandable manner.
- GIS makes use of various tools to represent the data in the form of point, line, polygon, topography.
- The collection of all of these representation provides the integrated view of the collected data.

### 2. SPATIAL ANALYSIS AND VISUALIZATION

- GIS is responsible to analyze the collected geographic data.
- Such analysis is helpful to determine the patterns within the data.
- GIS is also responsible to visualize the data using 2D and 3D visualization technique so as to present the analysis results to the users in efficient way.

### 3. GEOGRAPHIC DATA STORAGE AND MANAGEMENT

- GIS is also responsible to store and manage the collected geographic data and obtained patterns or information.
- Such collection may lay roadmap to produce a new informative map of interest.

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## Purpose and benefits of GIS

### PURPOSE OF GIS

- It allows to record a base map with a geospatial referencing system along with additional layers of other information.
- It provides statistical and analytical tools to analyze the recorded information.
- It facilitates visual representations of analyzed data that is used to reveal patterns and trends.

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### USES OF GIS

- GIS is used to provide a visual representation of data in a mapped format from the stored data in a database
- It is used for proximity analysis. Proximity analysis is an analytical technique that is used to define the relationship between a specific location and other locations that are linked in some way.
- GIS is used for buffering, a technique to indicate the sphere of influence of a given point.
- It is used to selecting a group of unrelated points on a theme matching a set of criteria. Such groups are called clusters.
- It is used for location analysis. Location analysis is used to identify a location for a new retail outlet.

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# Scope and Application Areas of GIS

## 1. Facilities Management (large scale and precise maps and network analysis are used)

- Locating underground pipes and cables
- Planning facility maintenance
- Telecommunication network services
- Energy use tracking and planning

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## 2. Environment and Natural Resources Management (Medium or small scale maps and overlay techniques in combination with aerial photographs and satellite images are used)

- Suitable study for agricultural cropping
- Management of forests, agricultural lands, water resources, etc
- Environmental impact analysis
- Disaster management and mitigation
- Waste facility site location

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## 3. Street Network (Large or medium scale maps and spatial analysis are used)

- Car navigation
- Locating houses and streets
- Site selection
- Transportation planning

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### 4. Planning and Engineering (Large and medium scale maps and engineering models are used)

- Urban planning
- Regional planning
- Route location of highways
- Development of public facilities

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### 5. Land Information System (Large scale cadastre maps or land parcel maps and spatial analysis are used)

- Cadastre administration
- Taxation
- Zoning of land use
- Land acquisition

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## Functional components of GIS

### Building Blocks of GIS

- A working GIS integrates five major components. They are as follows:
1. Hardware
2. Software
3. Data
4. People
5. Method

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### Hardware:

- It refers to the computer in which GIS will operate.
- It includes devices ranging from centralized computer servers to standalone desktop computers.

## Software:

- GIS software provides the necessary tools and functions needed to perform various GIS operations such as storing, analyzing and representing the geographic data.
- The components of the GIS software are as follows:
1. Tools for input and manipulation of geographic information
2. Database management system
3. Tools for geographic query, analysis and visualization
4. Graphical user interface to access available tools

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## Data:

- Data is the most important component of GIS.
- The geographic data are collected from various sources such as in-house collection or purchase from data providers.
- GIS is responsible to integrate the spatial data with other data as per the necessity of the application.
- Database management system is used to store, organize and manage spatial data.

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## People:

- The people involved in GIS technology can be classified as developers and users.
- Developers are responsible to develop plans and implement the plans so as to apply spatial data to the real world problems.
- Users are responsible to use the technology so as to make their daily life better.

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**Methods:**

- Each GIS application has its own functionality.
- Each GIS is designed as per the predefined plan and business rules, which are the models or methods of the GIS, which are unique to each organization.

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## Importance of GPS and remote sensing data in GIS

### Role Of GPS

- GPS stands for Global Positioning System.
- It is the satellite based technology that is used to collect the geographic information about the Earth.
- GPS technology is used in data collection phase of Geographic Information System.
- GPS helps to collect data about the position of the objects in the spatial space.
- It helps to provide the spatial data, which is the most important part of the GIS.
- Proper integration of GPS and GIS helps in inexpensive method of spatial data collection, that is further processed and analyzed by GIS for providing valuable geographic information.

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### ROLE OF REMOTE SENSING

- Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object.
- It makes use of satellite or aircraft-based sensor technology.
- It helps to collect data by detecting and classifying the objects on Earth.
- It is based on signal emission and reflection.
- Remote sensing is called active if a signal emitted by a satellite or sensor and the object reflects it, which is again detected by the sensor.
- Remote sensing is called passive if a sensor detects the reflection of sunlight from the object.
- It makes possibility of collecting spatial data of dangerous and inaccessible areas.