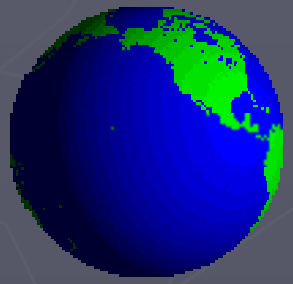
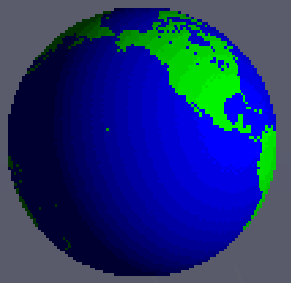
Introduction to GIS



Dr. Pranjit Kr. Sarma
Assistant Professor
Department of Geography
Mangaldi College

Mobile: +91 94357 04398

What is a GIS



- a system for input, storage, manipulation, and output of geographic information.

- a class of software.

- GIS combines software with hardware, data, a user, etc., to solve a problem, support a decision, help in planning.

What is GIS

GEOGRAPHIC
(deals with spatial or geographic features)

INFORMATION
(deals with data spatial or non spatial)

SYSTEM
(deal with the integration of elements)

Evolution of GIS

- revolution in **information technology**
  - Computer Technology
  - Remote Sensing
  - Global Positioning System (GPS)
  - Communication Technology
- rapidly **declining cost** of computer hardware
- enhanced **functionality** of software

GIS Historical Development

History of GIS

GIS, would not exist without geography and cartography. The contributions made by information and systems' development, in conjunction with the advancement in computer technology, have made GIS a powerful analytical tool.

The GIS technology has evolved from geography and geo-type disciplines. Cartographic map production can be taken as the first type of manual GIS. However, at a later stage, many other fields, such as civil engineering, computer cartography, photogrammetry, remote sensing, global positioning systems, database management systems, earth sciences, and so on have influenced the development of GIS and made it a truly interdisciplinary technology.

Canada was the pioneer in development of geographic information systems as a result of innovations dating back to the early 1960s. Much of the credit goes to Roger Tomilson for the early development of GIS. Although the field of GIS has been around for the last 25 years, the real potentials have become apparent only since the late 1980s.

Objective of GIS

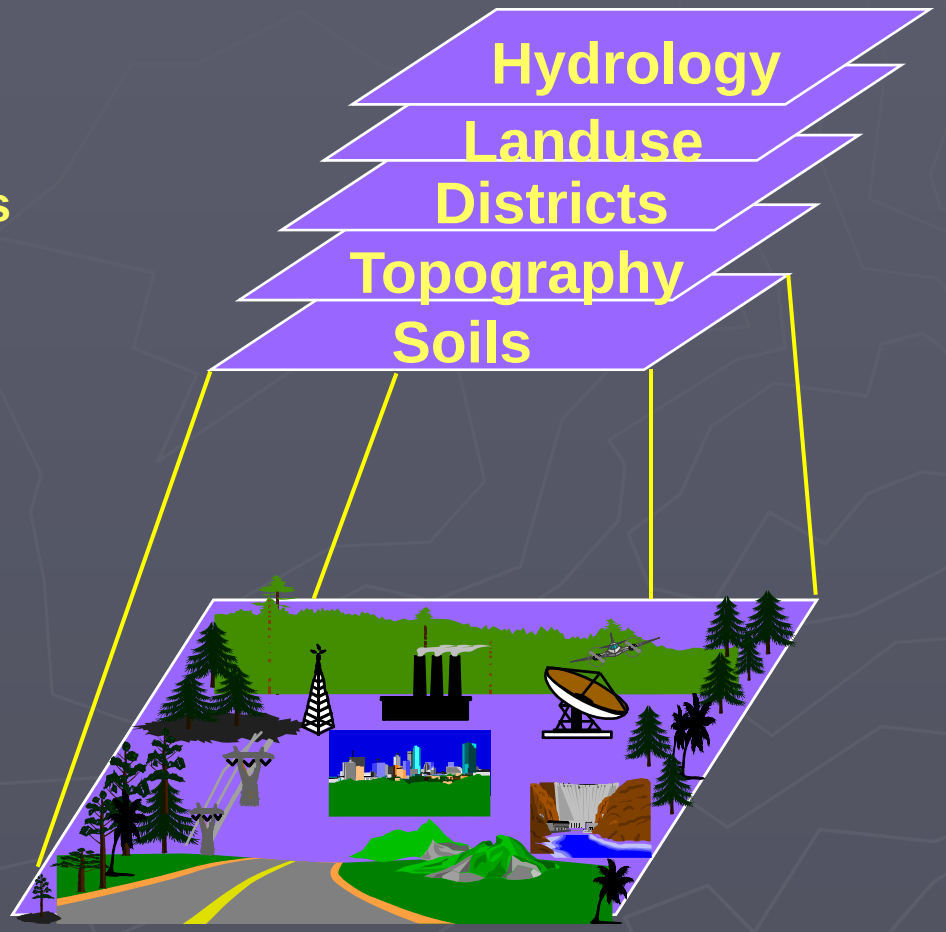
The main objective of geographic information systems is to help and assist in decision-making processes for the management and effective conservation of natural resources. Basic facts about location and the quantity and availability of natural resources are indispensable for more rational planning and intelligent development of natural resources.

Why GIS?

- **70% of the information includes some geographical facts in the decision-making process**
- **Ability to assimilate divergent sources of data both spatial and non-spatial (attribute data)**
- **Visualization impact**
- **Sharing of information**
- **Analytical capability in a spatial context**

GIS

A computer-based system capable of holding and using data describing places on the earth's surface

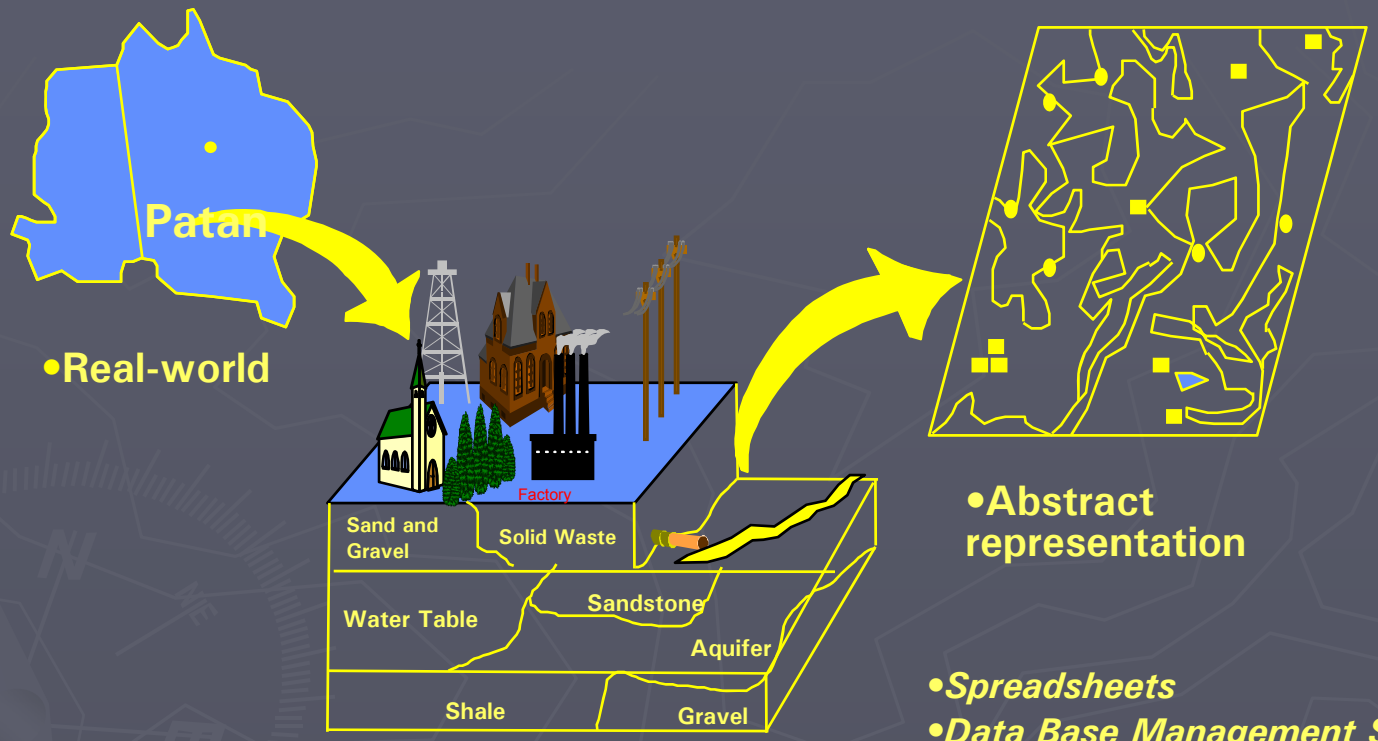


The real world consists of many geographies which can be represented as a number of related data layers.

GIS IS NOT THE DECISION MAKING TOOL

GIS IS SUPPORTING TOOL FOR DECISION MAKERS

Handling Geographic Information



•Real-world

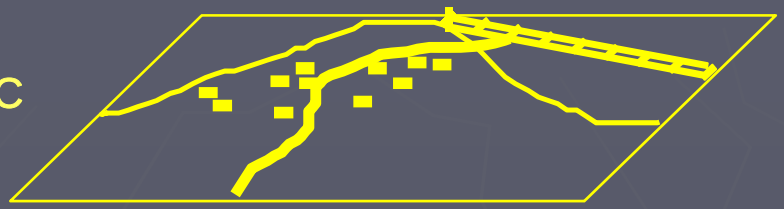
•Geographic features

•Abstract representation

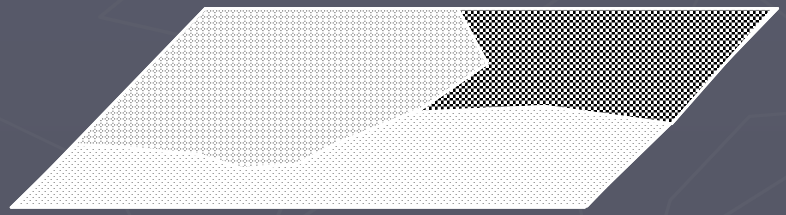
- *Spreadsheets*
- *Data Base Management Systems*
- *Computer Aided Design (CAD)*
- *Cartographic Packages*
- *Photogrammetrical Software*
- *Image Processing Software*

Maps and Spatial Data

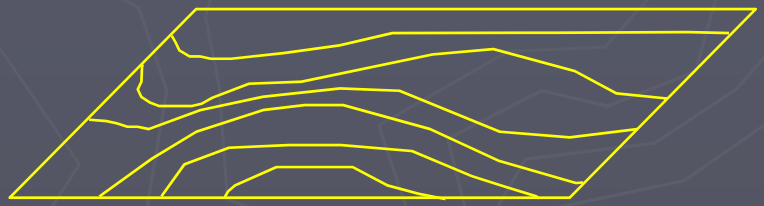
TOPOGRAPHIC



ZONAL



ISOLINE



REAL-WORLD

Questions a GIS can answer

Thus far, GIS have been described in two ways: i) through formal definitions, and ii) through the technology's ability to carry out spatial operations, linking data sets together. One can also, however, distinguish GIS by listing the types of questions the technology can (or should be able to) answer. If one considers a particular application carefully, there are five types of question that sophisticated GIS can answer.

Location What is at...?

The first of these questions seeks to find what exists at a particular location. A location can be described in many ways, using, for example, place name, post code, or geographic reference such as longitude/latitude or x and y.

Condition Where is it...?

The second question is the converse of the first and requires spatial data to answer. Instead of identifying what exists at a given location, one may wish to find location(s) where certain conditions are satisfied (e.g., nonforested section of at least 2,000 square metres in size, within 100 metres of a road, and with soils suitable for supporting buildings).

Trends — **What has changed since...?**

The third question might involve both of the first two and seeks to find the differences (e.g., in land use or elevation) within an area over time.

Patterns — **What spatial pattern exists...?**

This question is more sophisticated. One might ask this question to determine whether landslides are mostly occurring near streams. It might be just as important to know how many anomalies there are that do not fit the pattern and where they are located.

Modelling — **What if...?**

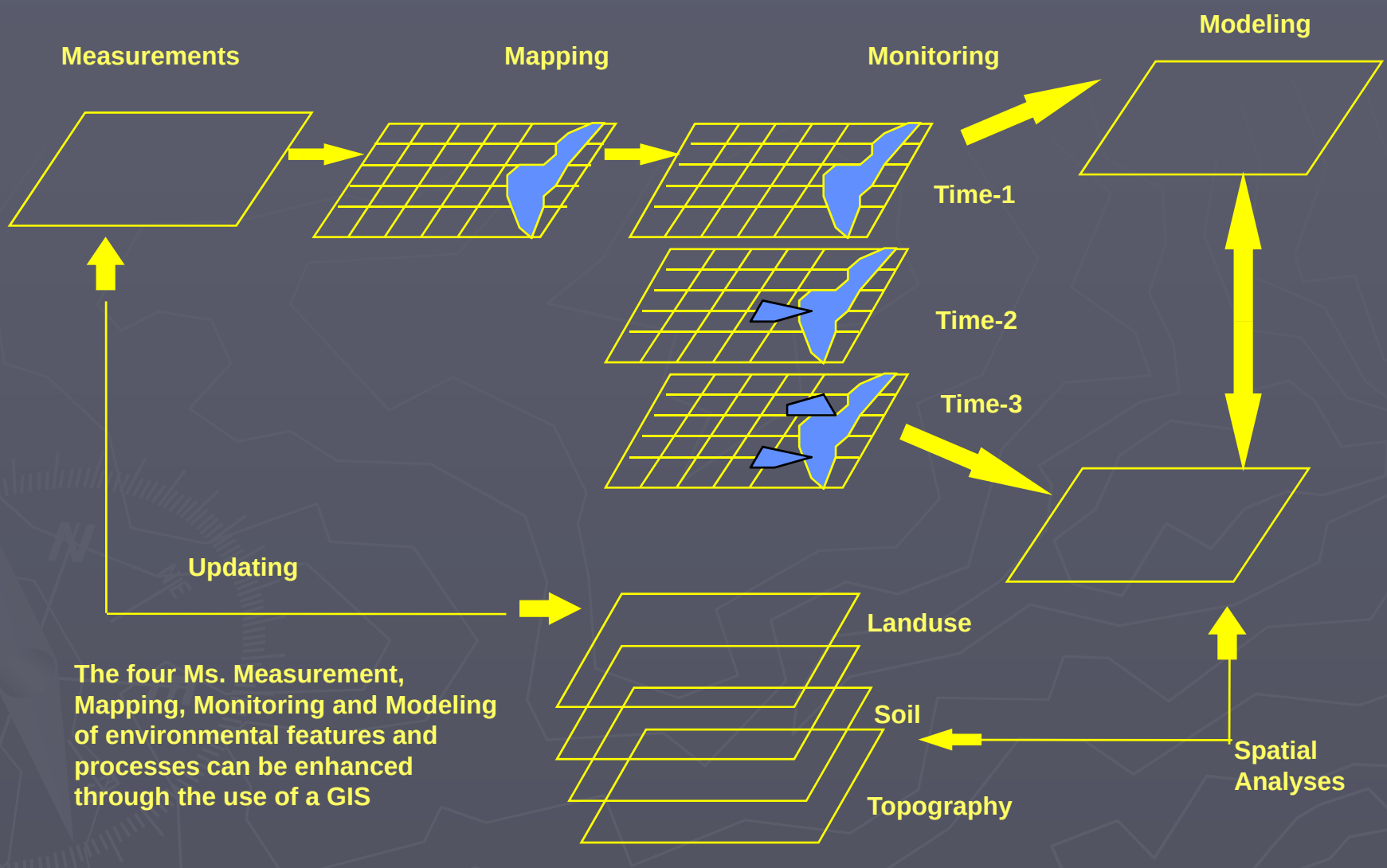
"What if.." questions are posed to determine what happens, for example, if a new road is added to a network or if a toxic substance seeps into the local groundwater supply. Answering this type of question requires both geographic and other information (as well as specific models). GIS permits spatial operation. For example:

Aspatial questions: Asking “What's the average number of people working with GIS in each location?” is an aspatial question - the answer doesn't require the stored value of latitude and longitude; nor does it describe where the places are in relation to each other.

Spatial questions: “How many people work with GIS in the major centres of Brahmaputra Valley”, or “Which centres lie within 10 kilometres of each other?”, or “What's the shortest route passing through all of these centres?” These are spatial questions that can only be answered using latitude and longitude data and other information such as the radius of the earth. Geographic Information Systems can answer such questions.

GIS is not simply a computer system for making maps, although maps on different scales are created in different projections and with different colours. GIS provide a truly analytical tool. The major advantage of GIS technology is that it facilitates identification of spatial relationships between map features.

FOUR Ms



The four Ms. Measurement, Mapping, Monitoring and Modeling of environmental features and processes can be enhanced through the use of a GIS

GEOGRAPHIC INFORMATION SYSTEM

The Four Ms

Geographic Information Systems are a means of integrating data acquired at different scales and times, and in different formats.

Measurements :	Observe and measure the environmental and topographical parameters.
Mapping :	Develop maps which portray characteristics of the earth.
Monitoring :	Monitor changes in space and time.
Modelling :	Model alternatives of actions and processes.

These key activities can be enhanced through the use of information systems technologies, and in particular, through the use of GIS.

Geographic Information Systems have the potential for improving our understanding of the world around us.

CAUTIONS !

The work we can do with a GIS is clearly dependent on the quality of data it contains. Therefore, care must be taken to understand the potential sources and relative magnitudes of errors which may occur when gathering and processing spatial data. In addition, one must be cautious of the potential for misinterpretation of the information output from a GIS.

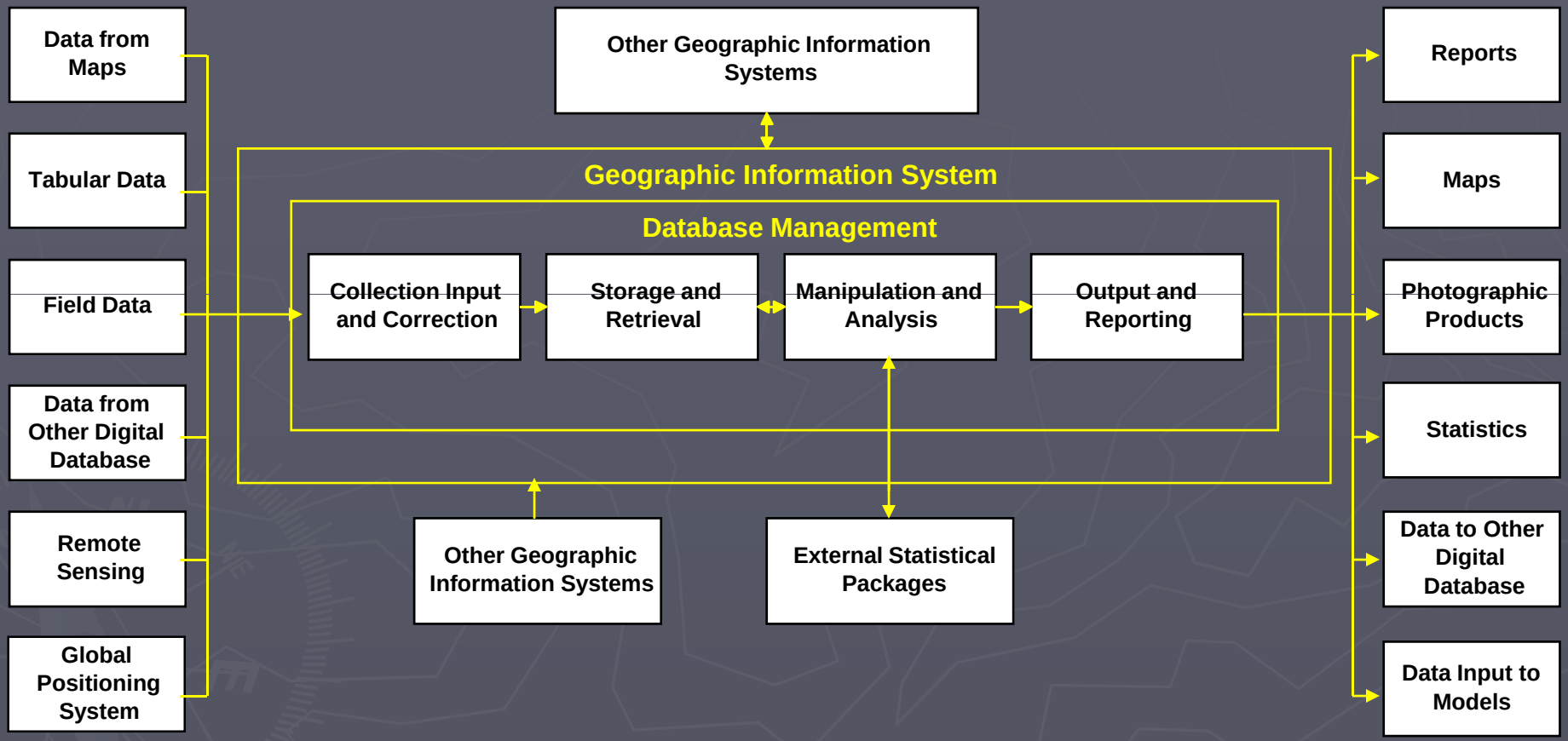
Four Major GIS Functions

- data capture
  - graphic data: digitized, converted from existing data
  - attribute data: keyed-in, loaded from existing data files
- data storage and manipulation
  - file management
  - editing
- data analysis
  - database query
  - spatial analysis
  - modeling
- data display
  - maps
  - reports

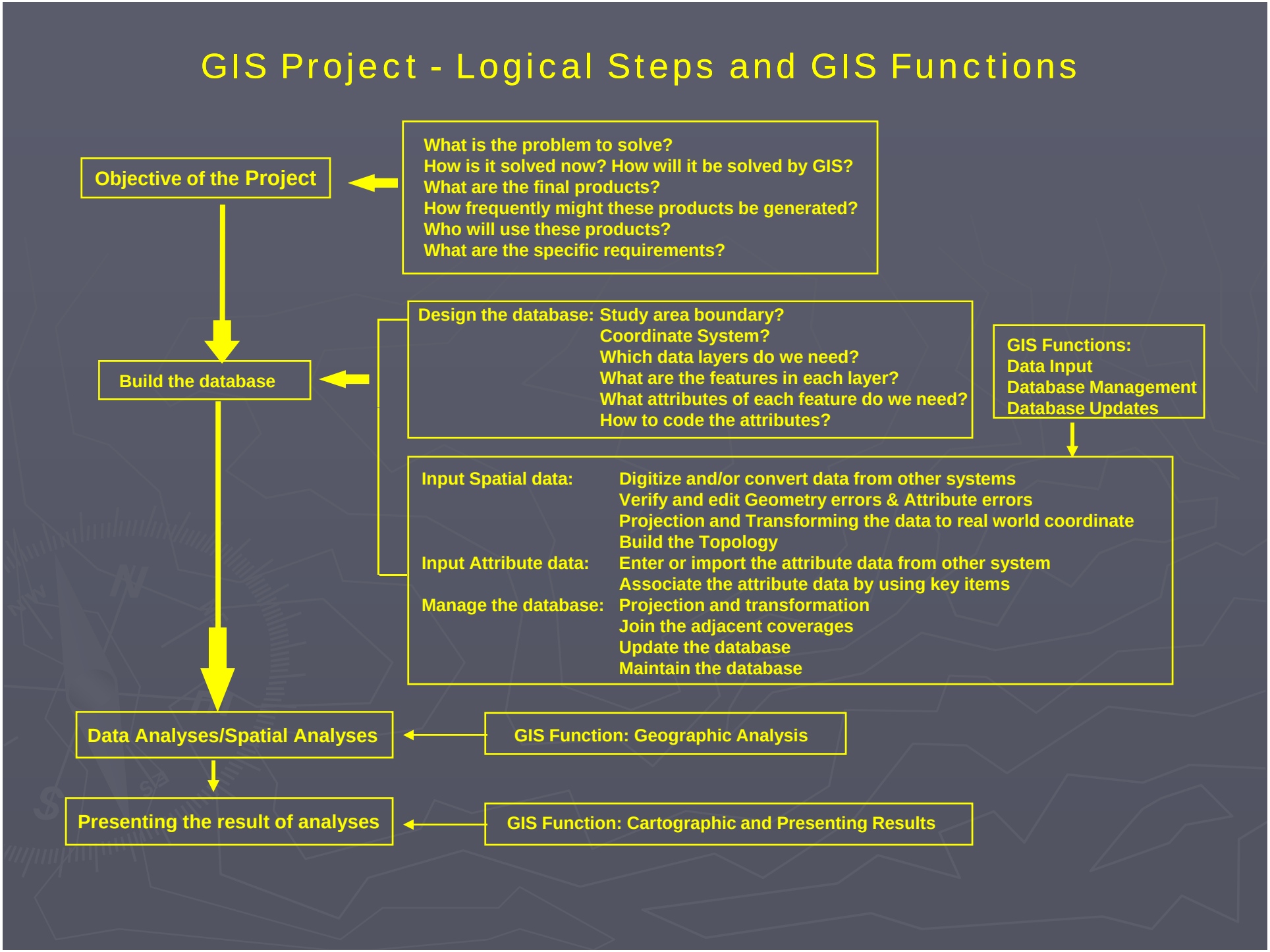
Functions of GIS

- Display on the screen.
- Edit, Change, Transform Geographical Data.
- Measure distances, areas
- Combine maps of the same area together.
- Keep inventories of what is where.
- Judge the suitability of areas for different purposes.
- Help user make decisions about places, plan
- Make prediction about the future. etc.

Principal Components and Functions of an Ideal GIS



GIS Project - Logical Steps and GIS Functions



GIS Functions

Maintenance and Analyses of the Spatial Data

- Format Transformations
- Geometric Transformation
- Transformations between Map Projections
- Edge Matching
- Editing of Graphic Elements
- Line Coordinate Thinning & Spline
- Vector to Raster Conversion
- Raster to vector Conversion
- Resampling, Pixel duplication, Pixel Thinning
- Subsetting by polygon or a rectangular window

Maintenance and Analyses of the Attribute Data

- Attribute Editing Functions
- Attribute Query Functions
- Attribute Relationship Functions
- Assigning new attributes
- Creating attributes based on selected region
- Importing Database files of different formats

The Planning Process