GIS and remote sensing

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Introduction to GIS

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What is GIS ?

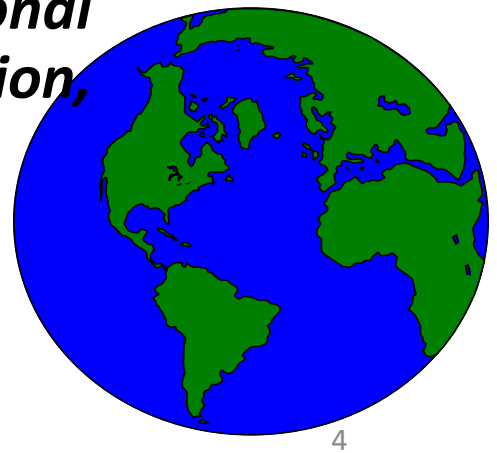
An Information System that is used to input, store , retrieve, manipulate, analyze and output geographically referenced data or geospatial data, in order to support decision making for planning and management of land use, natural resources, environment, transportation, urban facilities, and other administrative records

WHAT IS G – I - S ?

GEOGRAPHIC *implies that locations of the data items are known, or can be calculated, in terms of Geographic coordinates (Latitude, Longitude)*

INFORMATION *implies that the data in a GIS are organized to yield useful knowledge, often as coloured maps and images, but also as statistical graphics, tables, and various on-screen responses to interactive queries.*

SYSTEM *implies that a GIS is made up from several inter-related and linked components with different functions. Thus, GIS have functional capabilities for data capture, input, manipulation, transformation, visualization, combinations, query, analysis, modelling and output.*



GIS Terminology:

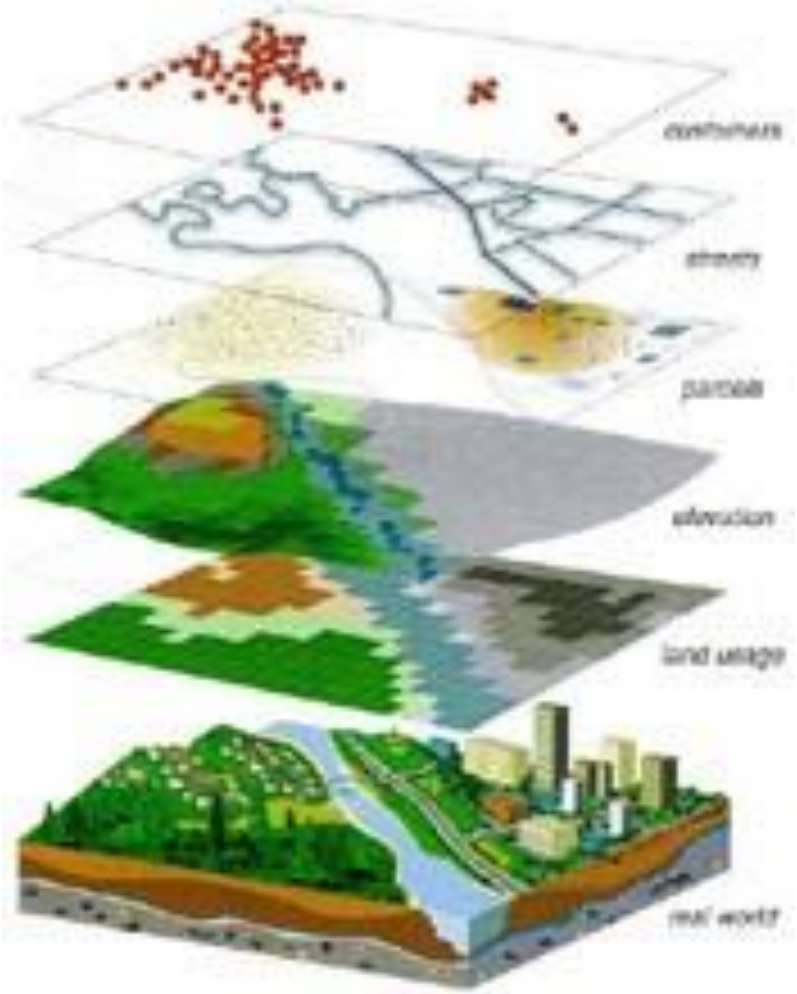
- Geographical Information System
- Geographical Information Science
- Geoinformatics
- Geomatics
- Spatial information system
- Geospatial systems
- Geospatial information engineering
- Land information system

What GIS can do?

What GIS can do	Real world Problems
Identification	*Where ?*
Locate	*What is there?*
Trends	*What if ?*
Patterns	*What has changed ?*
Optimum path	*What relations exists between ?*
Models	*What is the best route?*

What Analysis GIS can do ?

- ✓ Simple Query
- ✓ Spatial Querying
- ✓ Single Layer Operation
- ✓ Multiple- Layer Operations
- ✓ Spatial Modeling
- ✓ Surface Analysis
- ✓ Network Analysis
- ✓ Point Pattern Analysis
- ✓ Grid Analysis



GIS Software

The most popular GIS software packages are:

- ESRI (ArcGIS, ArcView 3.0)
- MapInfo
- IDRISI
- Manifold
- Inter Graph Geo Media
- Small World
- GRASS
- MS MapPoint
- ERDAS Imagine
- ILWIS
- ER Mapper
- JTMaps (India)
- ENVI

Technologies that support GIS

- Remote Sensing
- Photogrammetry
- GPS (Global Positioning System)
- Digital cartography
- CAD
- Surveying, Mapping

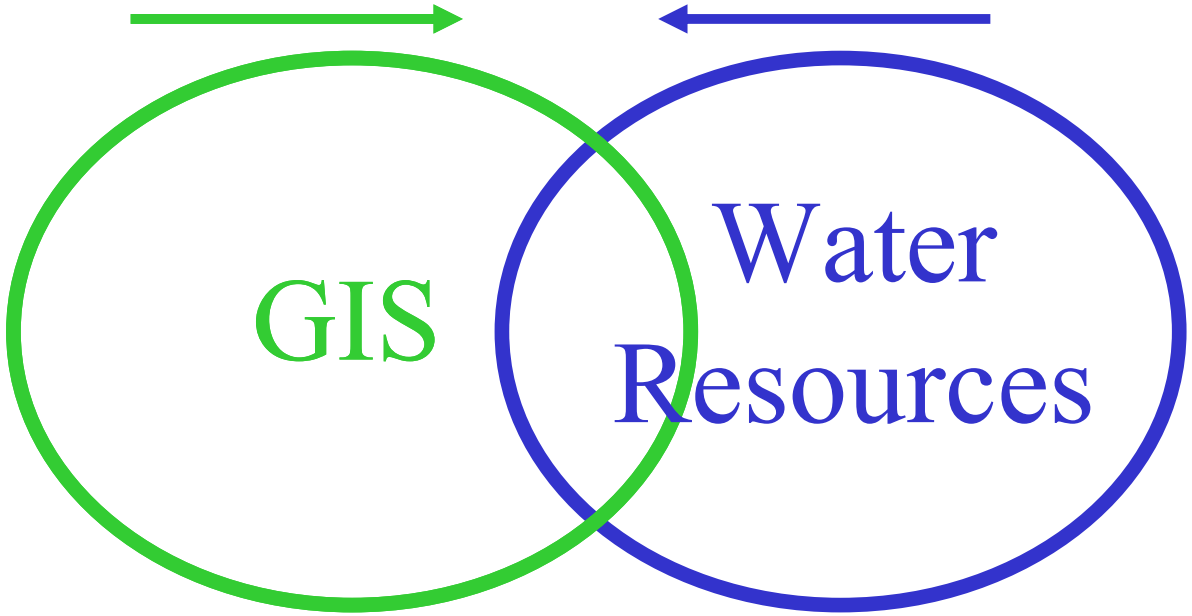
A Career in GIS

GIS careers include responsibilities such as

- **Cartographic design**
- **Data analysis**
- **Computer programming**
- **Database administration**
- **Project management**
- **System administration**
- **Careers in GIS can also encompass business development, managerial, and administrative roles.**

Position	
GIS Developer	GIS Data Specialist
GIS Engineer	GIS Mapping Technician
GIS Analyst	GIS Mapping Assistant
Geospatial Analyst	GIS Business Analyst
GIS Project Manager	GIS Programmer
Jr.Gis Associate	Geographer
ArcGIS Developer/Programmer	Cartographic designer
GIS Applications Developer	Database administrator.
Entry level (GIS digitisers)	GIS MANAGER
Research Associate (R.A.)	Project Fellow
Scientist	

The relationship



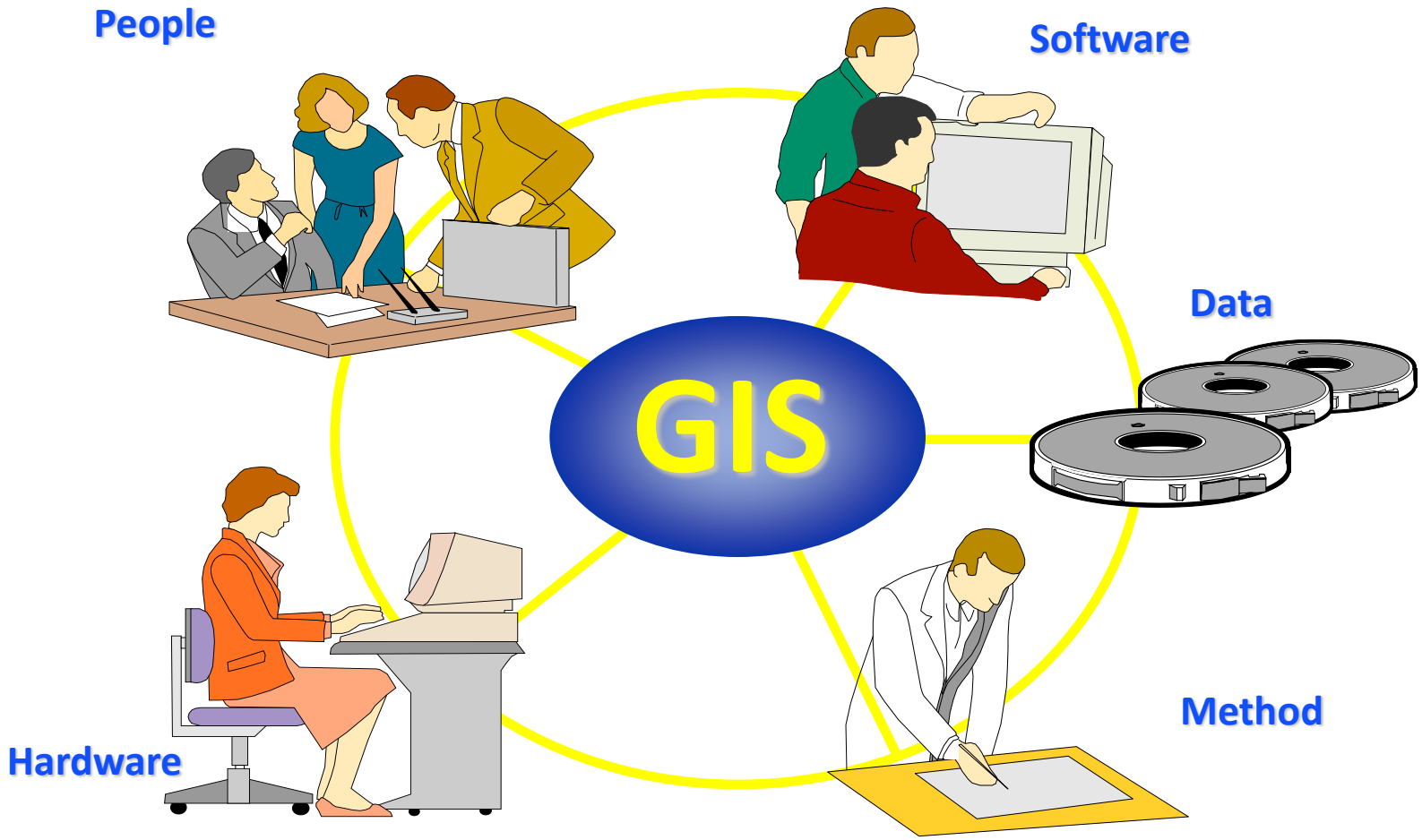
Bringing together these two communities by using a common geospatial data model

Components of GIS

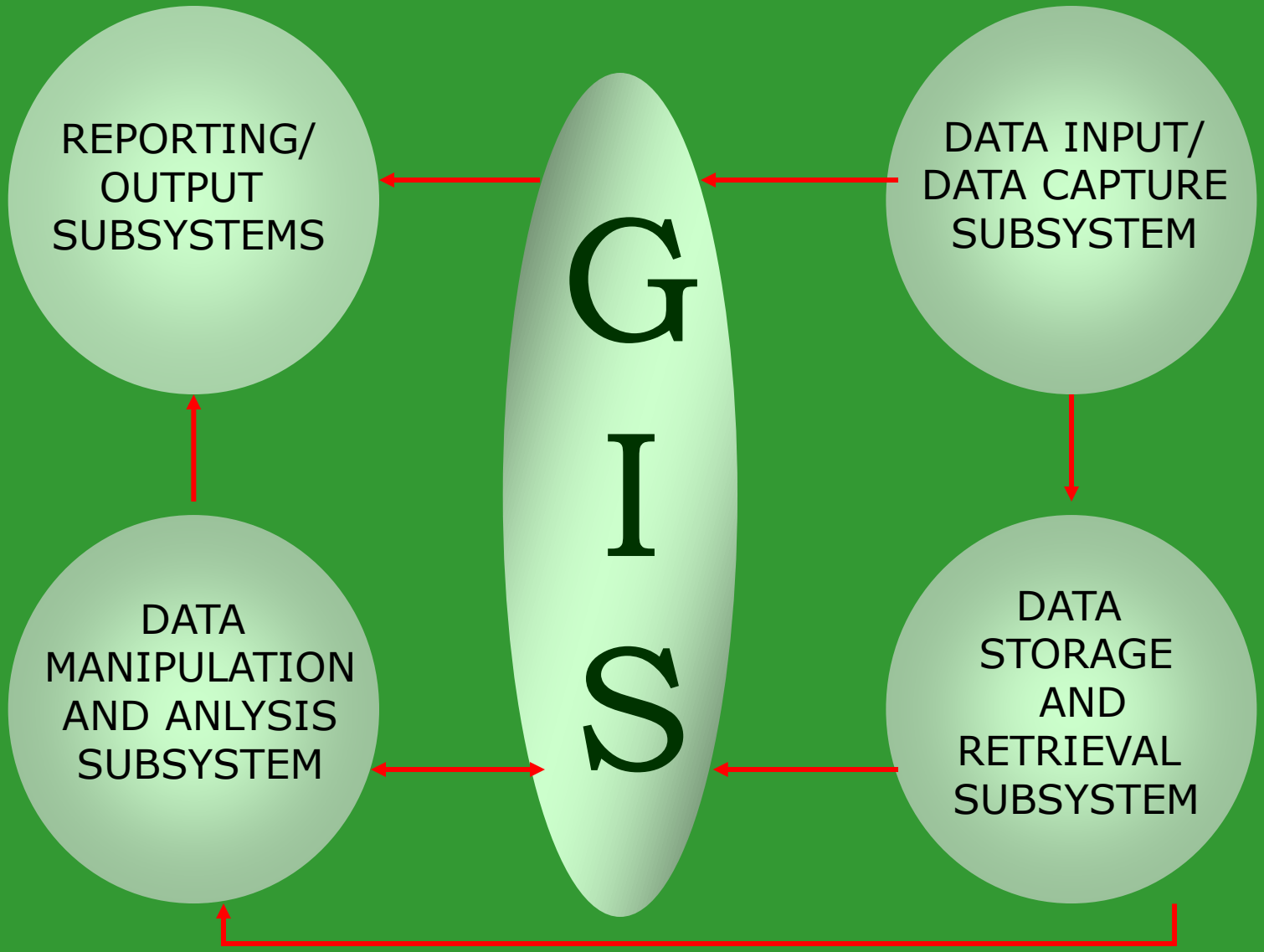
- Key components of GIS are:
  - Computer system, geospatial data, and users

- Sources of geospatial data are:
  - Digitized maps, aerial photographs, satellite images, statistical tables, and other related documents

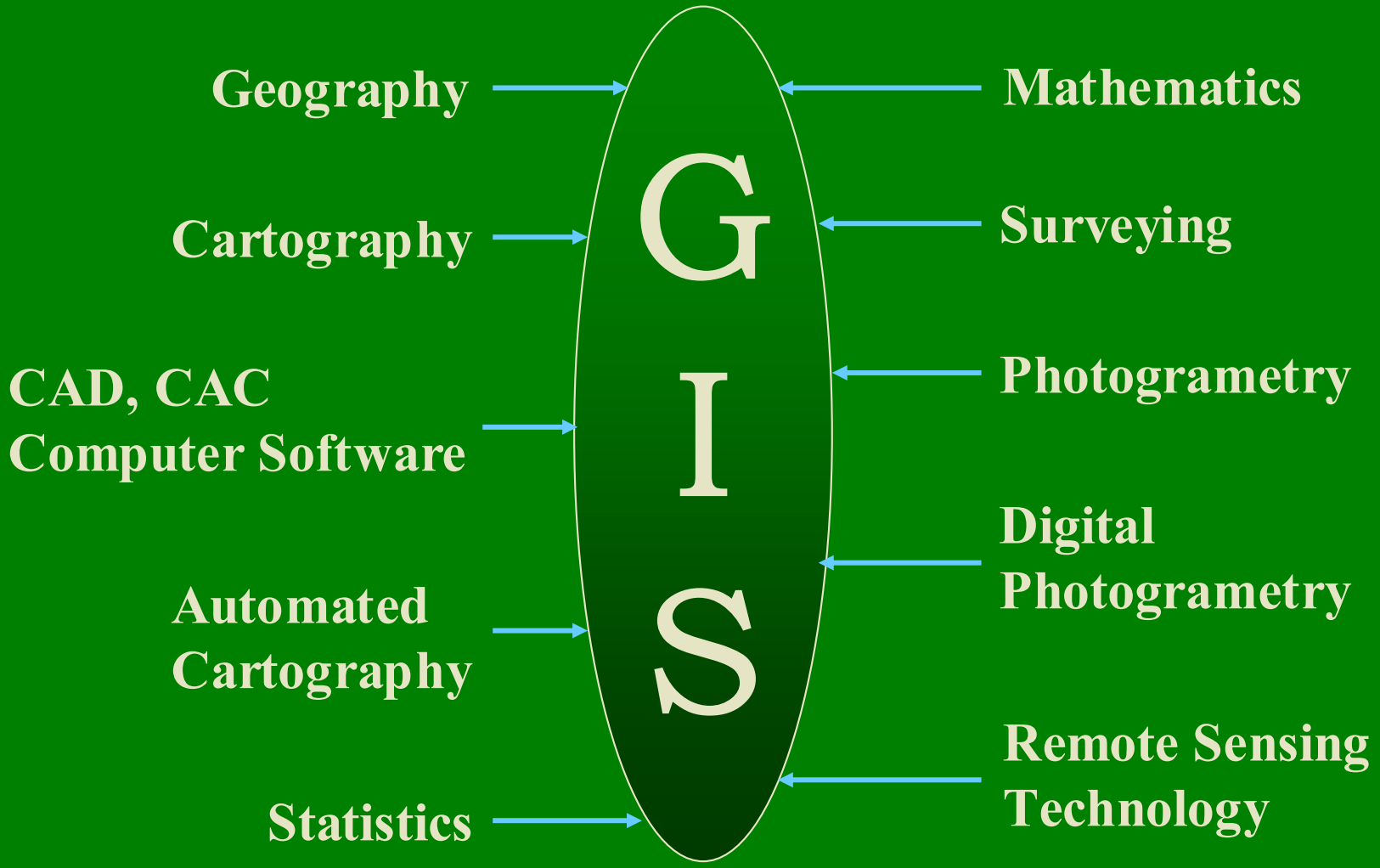
Elements of GIS:



GIS Architecture



Contribution Disciplines



Why GIS is needed ?

Common problems of handing geospatial information:

- Geospatial data are poorly maintained.
- Maps and statistics are out of date.
- Data and information are inaccurate.
- There is no data retrieval service.
- There is no data sharing.

Benefits once GIS is implemented

- Geospatial data are better maintained in a standard format.
- Revision and updating are easier.
- Geospatial data and information are easier to search, analysis and represent.
- More value added product.
- Geospatial data can be shared and exchanged freely.
- Productivity of the staff improved and more efficient.
- Time and money are saved.
- Better decision can be made.

GIS Versus Manual Works

Maps	GIS	Manual works
Storage	**Standardized and integrated**	**Different scales on different standard**
Retrieval	**Digital Database**	**Paper Maps, Census, Tables**
Updating	**Search by Computer**	**Manual Check**
Overlay	**Very Fast**	**Expensive & Time consuming**
Spatial Analysis	**Easy**	**Complicated**
Display	**Cheap & Fast**	**Expensive**

Basic Functions of GIS

Functions	Sub-functions
Data Acquisition and prepossessing	**Digitizing, Editing , Topology Building, Projection Transformation, Format Conversion etc.**
Database Management and Retrieval	**Data Archival, Hierarchical Modeling , Network Modeling, Relational Modeling, Attribute Query, Object-oriented Database etc.**
Spatial Measurement and Analysis	**Measurement operations, Overlay operations, connectivity Operations etc.**
Graphic output and Visualization	**Scale Transformation, Generalization, Topological Map, Statistical Map etc.**

GIS as Multidisciplinary Science

- Geography
- Cartography
- Remote Sensing
- Photogrammetry
- Surveying
- Geodesy

- Statistics
- Operations Research
- Computer Science
- Mathematics
- Civil Engineering
- Urban Planning

Relations of Traditional Disciplines with GIS

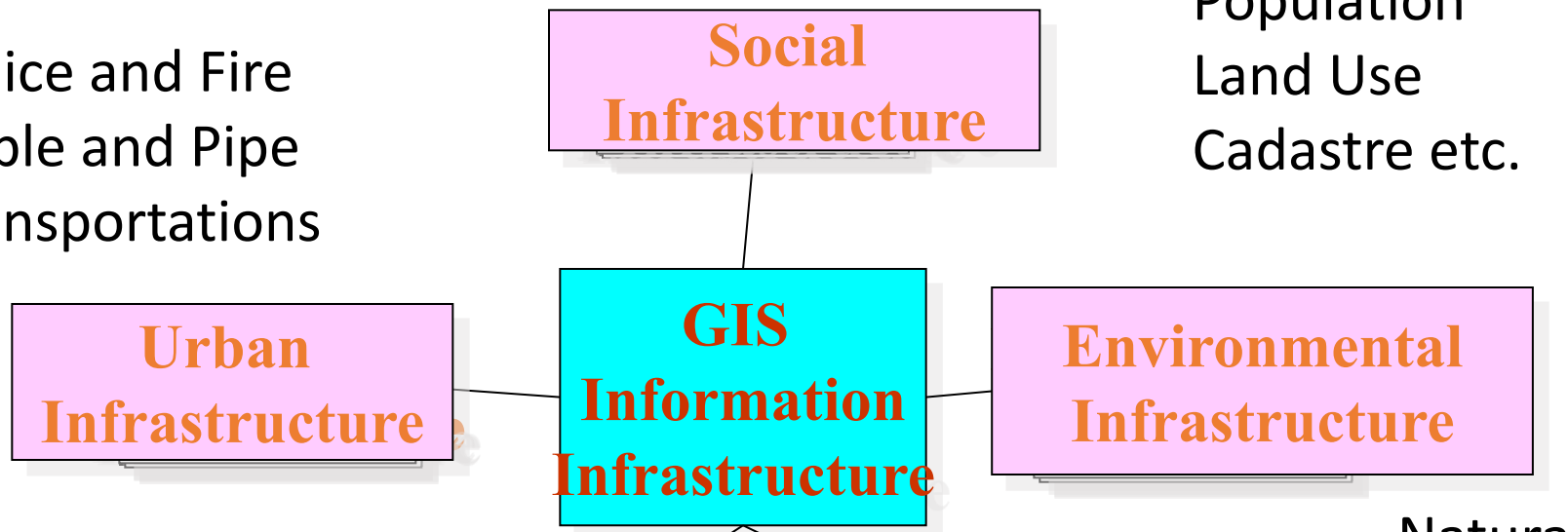
Table 1.4 Relations of Traditional Disciplines with GIS

Discipline	Functions of GIS								
	Data Acquisition	Mapping	Pre-processing	Data Structure	Data Base	Spatial Analysis	Modeling	Display	Application
Geography		○				○			○
Cartography	○	○						○	○
Remote Sensing	○	○						○	○
Photogrammetry	○	○						○	○
Surveying	○	○							
Geodesy		○							
Statistics			○		○	○			
Operations Research						○	○		
Computer Science			○	○	○	○	○	○	
Mathematics				○		○	○		
Civil Engineering						○	○		
Urban Planning						○	○		○

Area of GIS Applications

Area	GIS Applications
Facilities Management	**Locating underground pipes & cables, planning facility maintenance, telecommunication network services**
Environmental and Natural Resources Management	**Environmental impact analysis, disaster management and mitigation**
Street Network	**Locating houses and streets, car navigation, transportation planning**
Planning and Engineering	**Urban planning, regional planning, development of public facilities**
Land Information	**zoning of land use, land acquisition**

GIS Information Infrastructure



Police and Fire
Cable and Pipe
Transportations

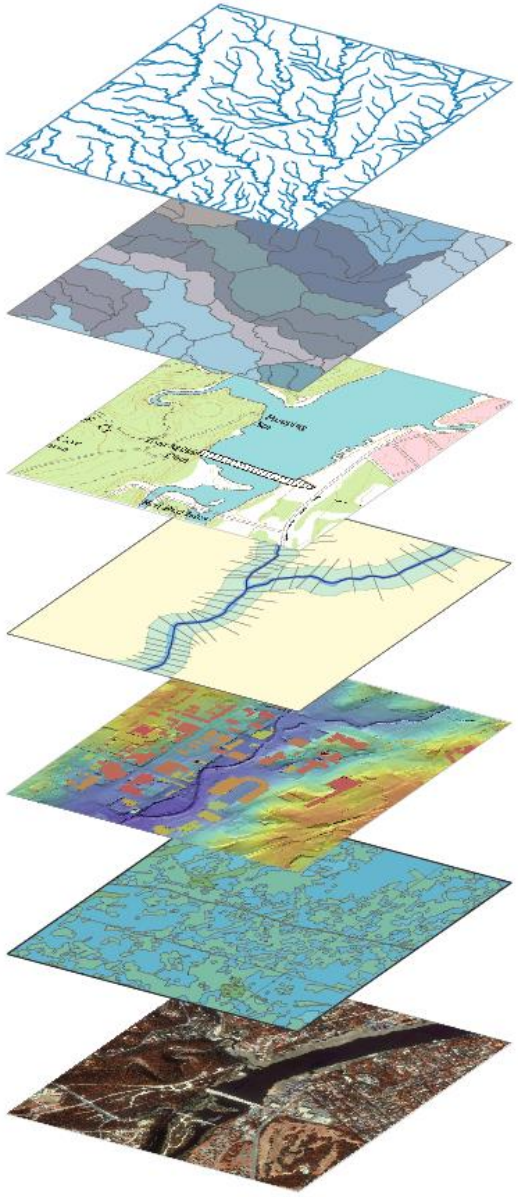
Population
Land Use
Cadastre etc.

Marketing
Banking
Car Navigations etc.

Natural Resources
Pollution
Disaster etc.

Basic knowledge
Computer assisted education

Data Model



Streams

Drainage Areas

Hydrography

Channels

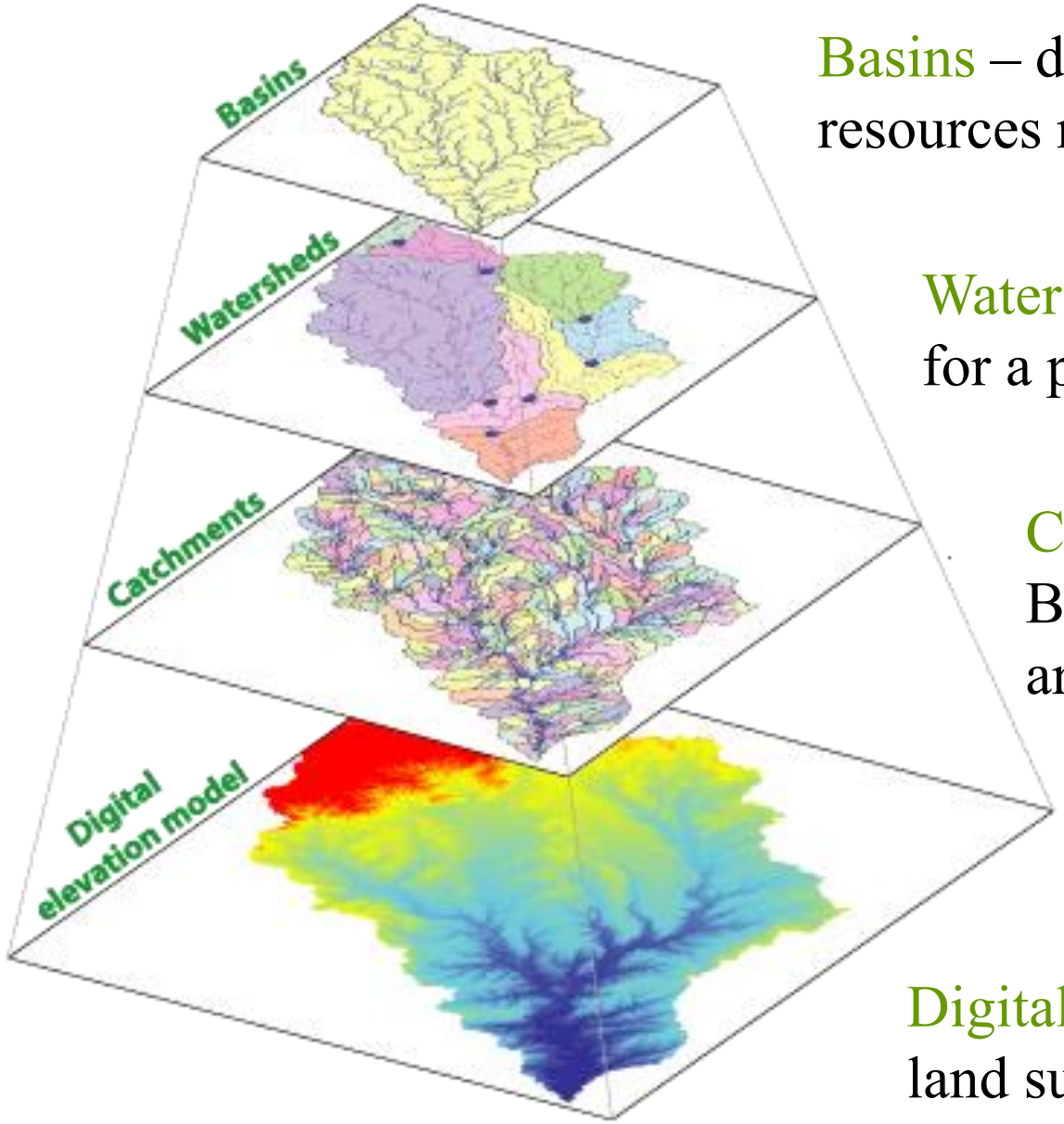
Terrain Surfaces

Rainfall Response

Digital Orthophotos

Data Model Based on Inventory

Scales of representation of Drainage Systems



Basins – drainage areas for water resources management

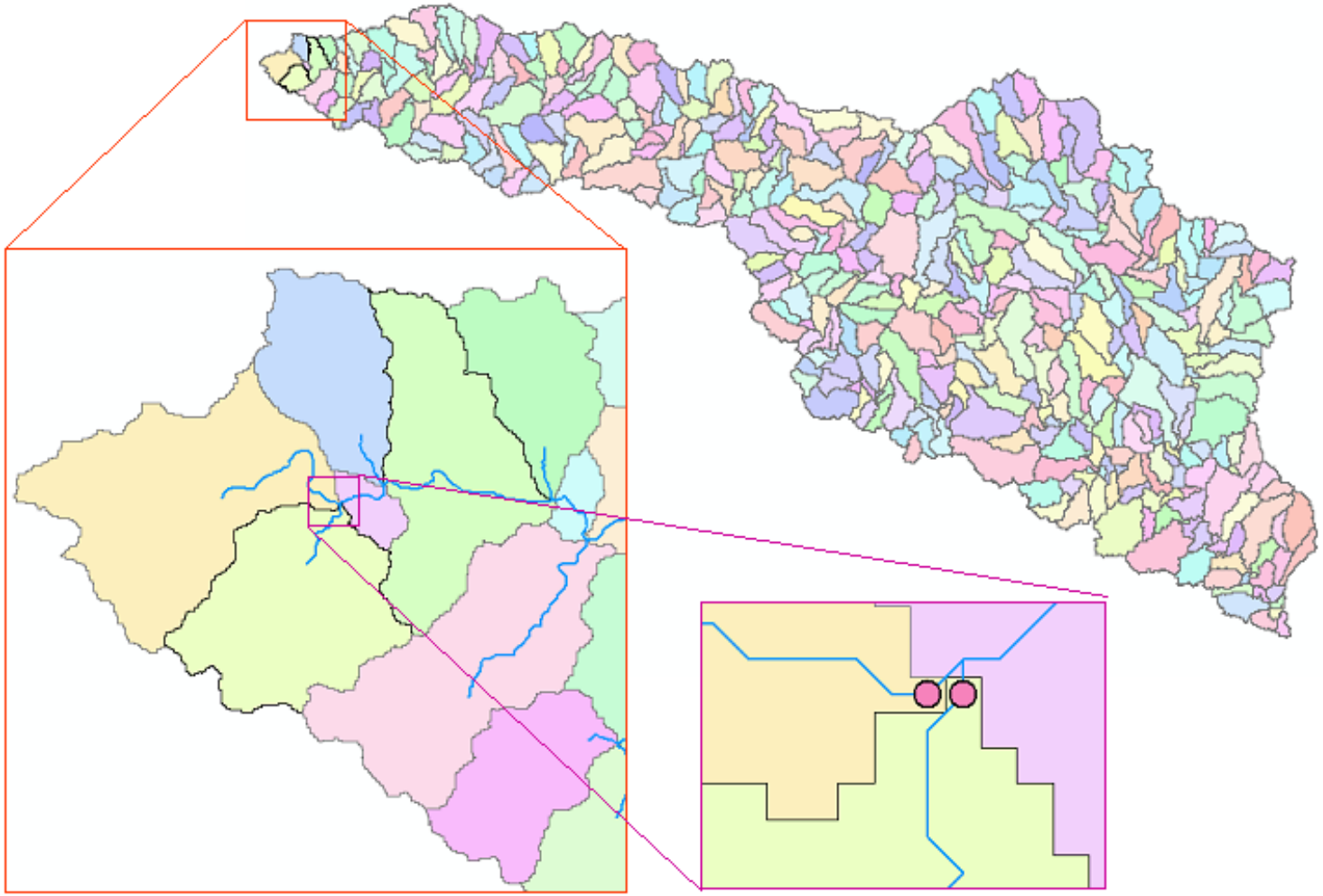
Watersheds – subdivision of Basin for a particular hydrologic purpose

Catchments – subdivision of Basin into elementary drainage areas by physical rules

Digital Elevation Model – land surface terrain grid cells

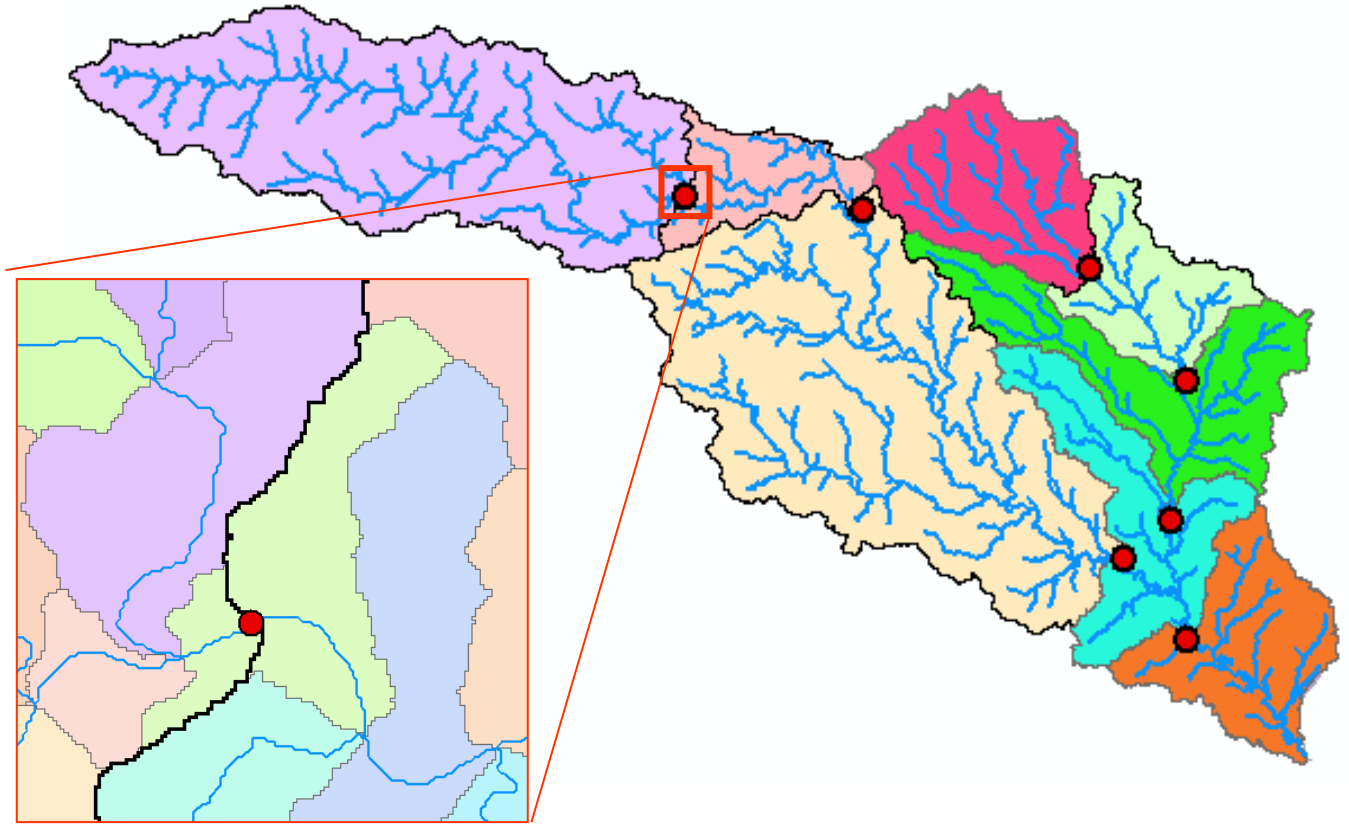
Drainage Systems

Catchments, Drainage Lines and DrainagePoints



Drainage Systems

Catchments Subdivided at Watershed Outlet



Classification of Geospatial Data

- Graphical data (called geometric data)
- Attributes (called thematic data)

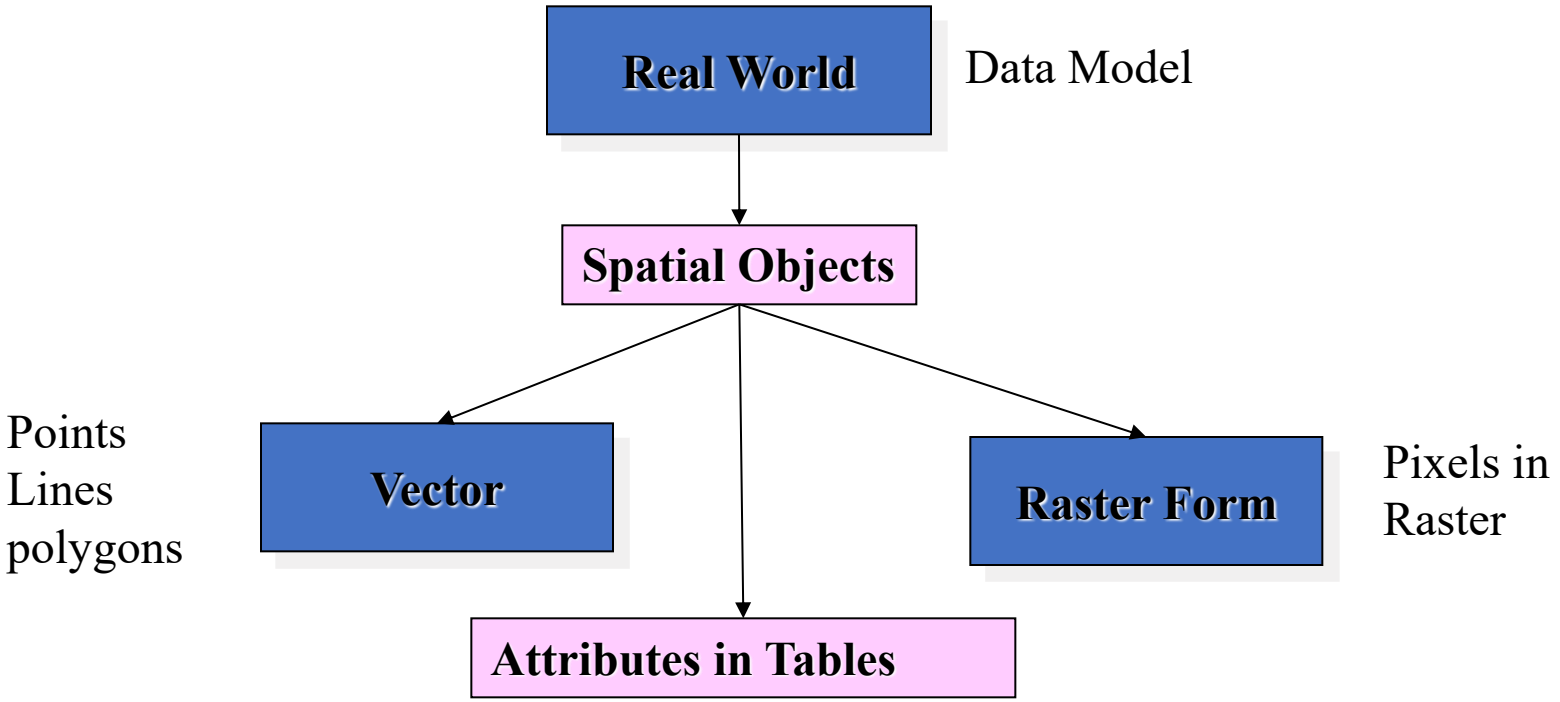


Figure: Concept of Geospatial Data

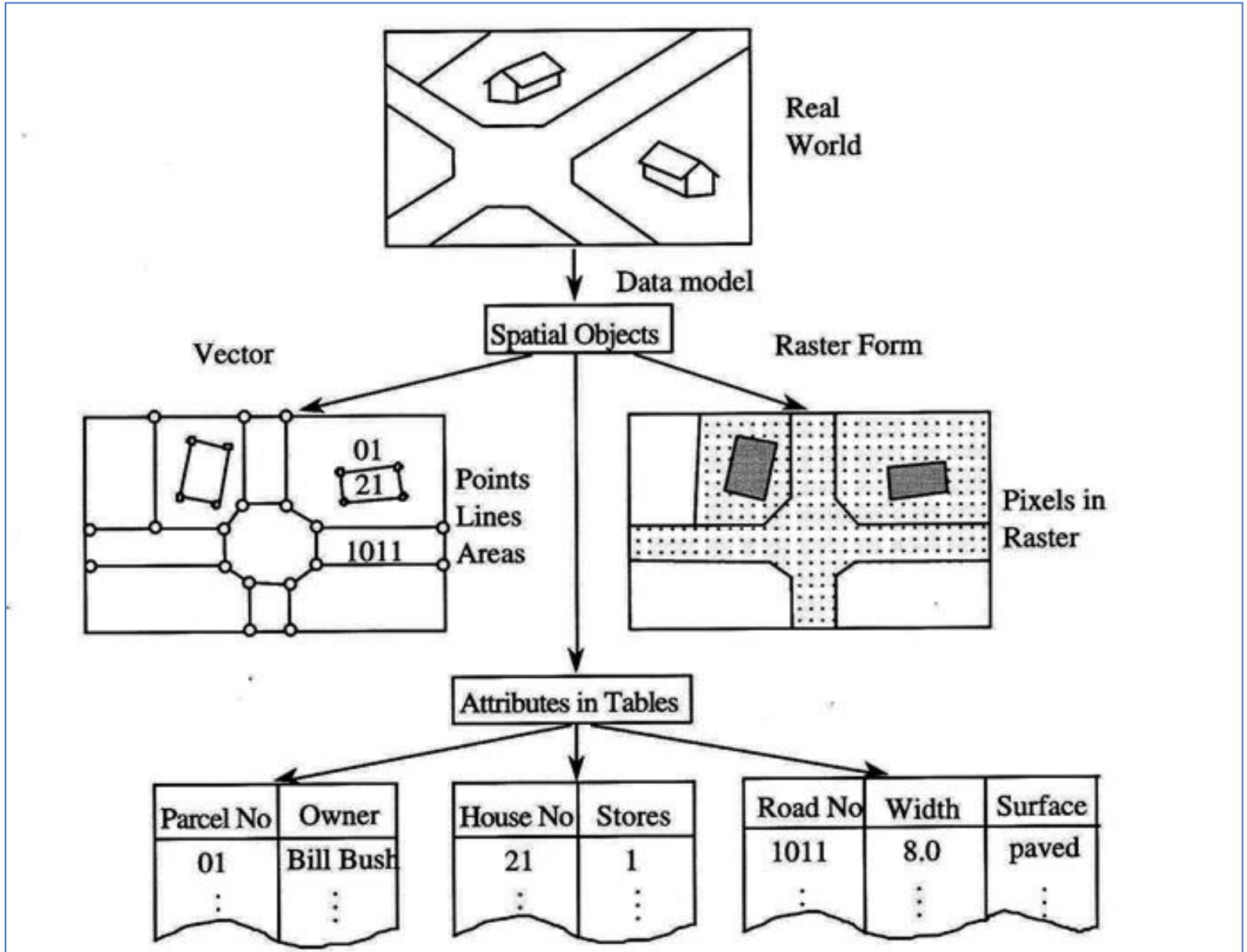
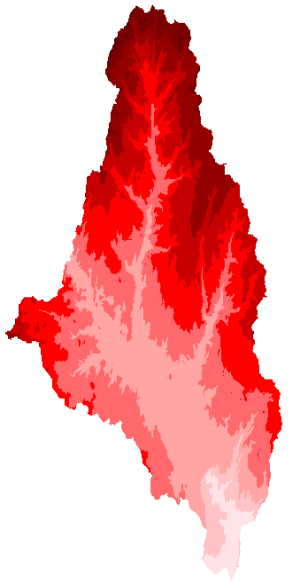
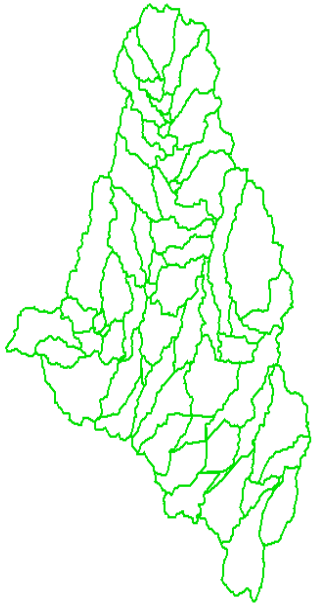


Figure 1.2 Concept of Geospatial data

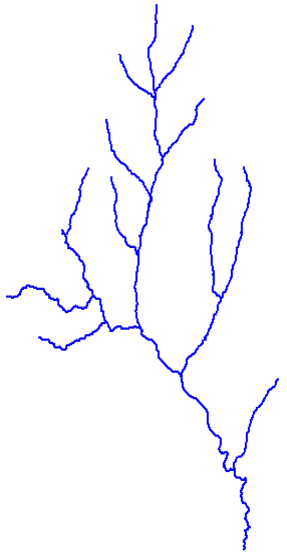
How do we combine these data?



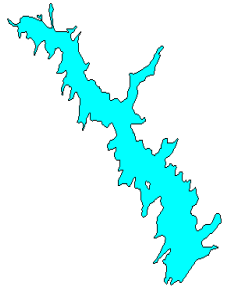
Digital Elevation Models



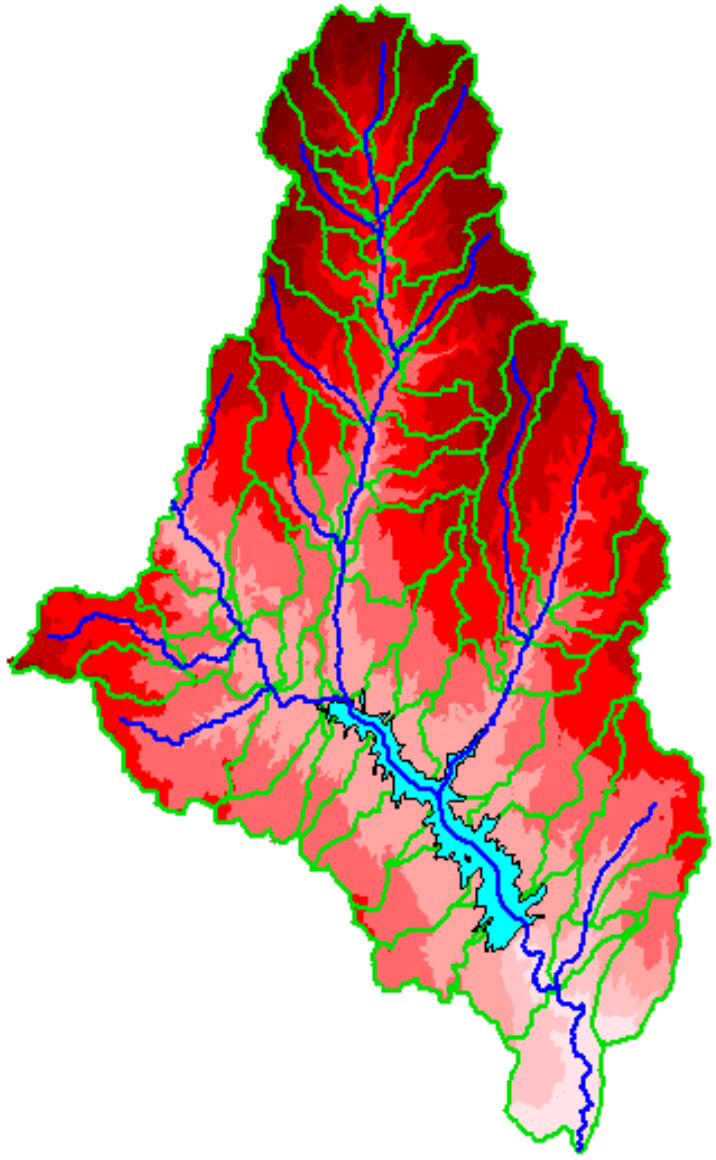
Watersheds



Streams

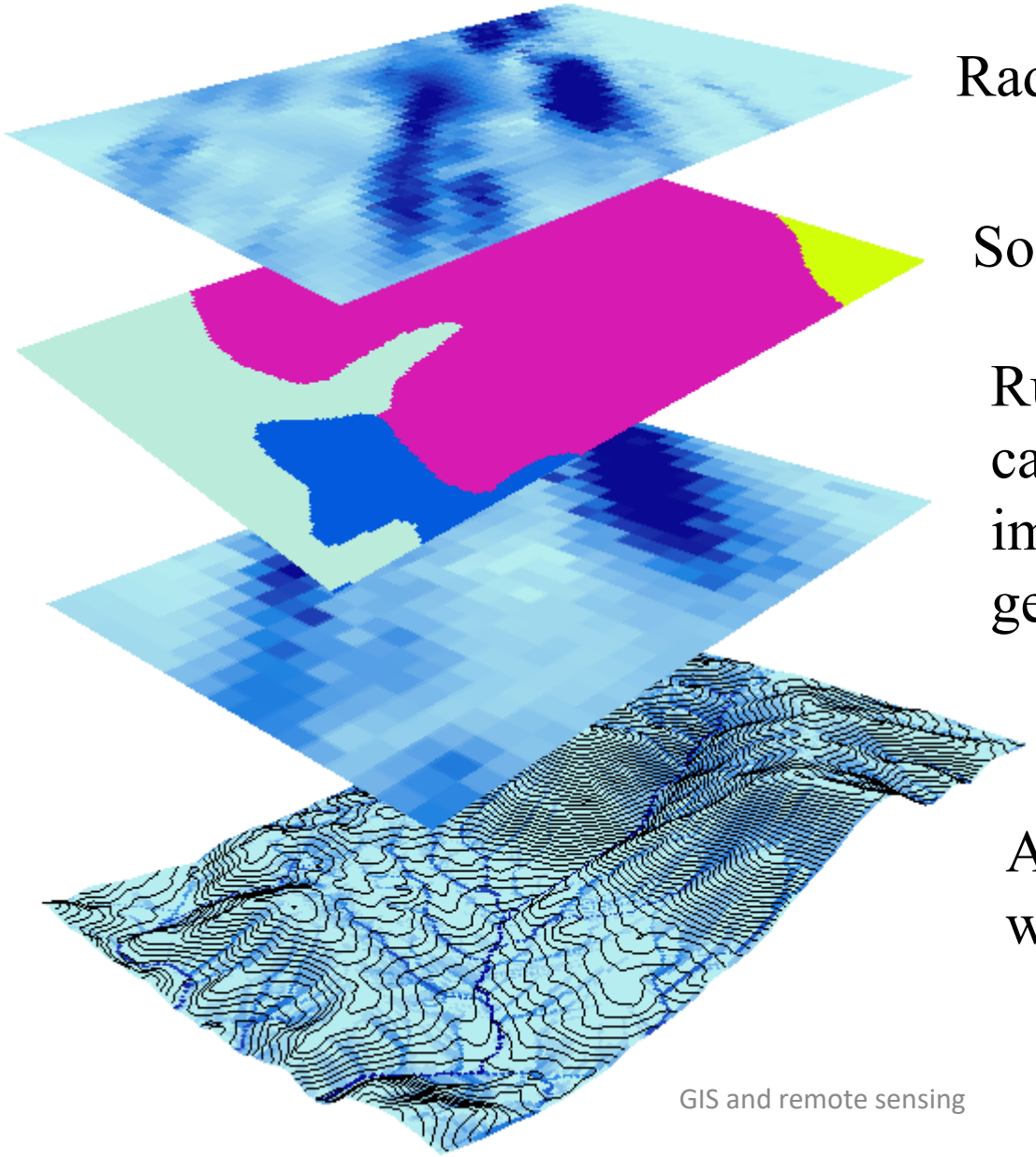


Water bodies



An integrated raster-vector database

Cell based discharge mapping flow accumulation of generated runoff



Radar Precipitation grid

Soil and land use grid

Runoff grid from raster calculator operations implementing runoff generation formula's

Accumulation of runoff within watersheds


ANY
QUESTIONS?