# Introduction to GIS

**Muhammad Ali**
Research Associate
GIS/RS Lab Incharge

# **** G. I. S ****

- **Geographic?**
  - Reality
  - Spatial location, scale, and time
- **Information?**
  - Data and meaning of data
  - Collections of facts, knowledge base, personal or collective value
- **Systems?**
  - Computers and methods
  - Physical and conceptual entities or networks
- **Science?**
  - Knowledge, System of Knowledge

# What is GIS……?????

*Cower (1988) defines GIS as "a decision support system involving the integration of spatially referenced data in a problem solving environment".*

**According to Aronoff (1989) defines GIS as**

**"a computer-based system that provides four sets of capabilities to handle georeferenced data:**

**i) data input**

**ii) ii) data management (data storage and retrieval)**

**iii) iii) manipulation and analysis**

**iv) iv) data output."**

## What is GIS (Aronoff, 1993)

"A system for the input, management, analysis and output of spatial data Information"

**A GIS usually contains;**

A computer based system, allow data entry, data management, analysis, and representation of Geographically referenced data

## INPUT

- Data from Maps
- Tabular Data
- Field Data
- Other database
- A
- B
- C
- D
- **Remote Sensing**

## Geographic Information System

### Data Base Management System

Collection & Input → Storage, Retrieval ↔ Manipulation & Analysis → Output

## OUTPUT

- Maps
- Statistics
- Reports
- Other database

Decision makers

# GIS stores related map features as separate map themes


Spatial Overlay

Combined Themes

The beauty of GIS
(Layer by layer analysis)

**Advantage:**
**e.g. Integration of data from different sources to a single Georeferenced Platform for spatial analysis.**

# Data concept in GIS

**Raw fact which is collected from specific environment for specific requirements**

# Data

**Data** in everyday language is a synonym for information therefore often used indiscriminately.
But in the exact sciences there is a clear distinction between data and information because they both have a specific meaning.

Data can be described as different observations and measurement which are collected and stored and can be organized .

Data may relate to **reality**, or to **fiction** as in a fictional movies.
Data about reality consists of propositions . A large class of practically important propositions are measurements or observations of a variable.
Such propositions may comprise numbers, words or images.

# Information

when data is organized then it becomes **information.**
**Information** is data which is used in answering queries or solving a problem. Digitizing a large number of maps provides a large amount of data after hours of painstaking work, but the data can only render useful information if used in analysis.

**Information** it is the context in which data is taken from the real world and then entered into a system. Then after processing (i.e. gathering, manipulating and organizing ), that data in a way that adds to the knowledge of the receiver.

# SOURCES OF DATA

1.Primary data sources:
(Direct Data Acquisition)
Like Field survey, observations and GPS surveys etc.

2. Secondary data sources:
(Indirect Data Acquisition)
Digitizers, Scanners, available Statistical data, charts, tabular data, maps, satellite imageries (RS) , GPS data, reports, and research papers etc.

# TYPES OF DATA

1. Geographic data
   (Spatial data) i.e each feature has a location on earth surface
   Map features: point, line, polygon, Electric pole, road, soil type)

2. Attribute data
   (Non-spatial data, non-geographic data)
   Properties of map features e.g. name of city, road, river, land use type,)

# Spatial data types

**Features of the earth surface are also called as Geo-Objects**
**(Geo-objects (processes or phenomena, things) occupy space)**

## Types of Geo-objects

1. **Natural geo-objects**
   Discrete spatial entities recognizable in the real world
   Examples: river channels, forests, mountains

2. **Imposed geo-objects**
   Artificial or man-made spatial entities
   Examples: property boundary, Built-up areas, fields

# Modeling the real word

Geological process

Surveys
Paper Maps
Air Photos
Satellite images

Computer representation (GIS)

Geo-objects Model

Real world

Simulation world

Spatial data can be considered to be a collection of spatially referenced features that acts as a model of reality.
There are two important components of spatial data;

- Geographic position
- Attributes or properties

In other words
- spatial data (where is it?)
- attribute data (what is it)

# Computer Representation of Spatial Data

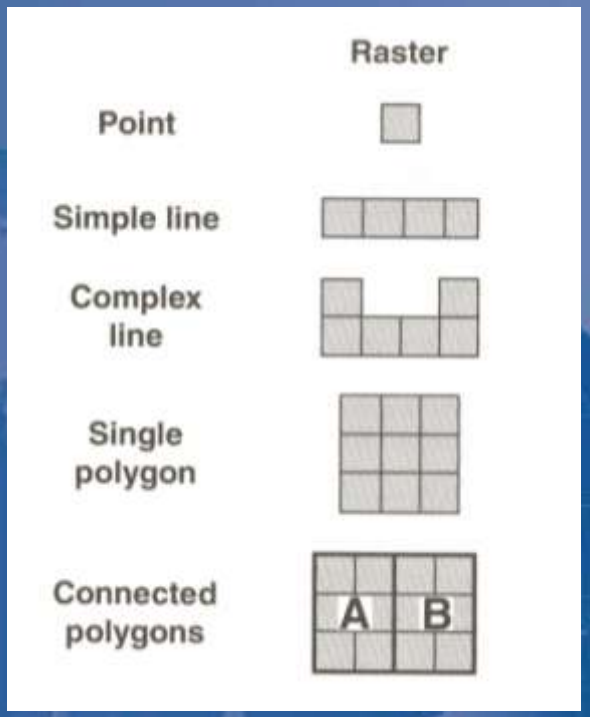
## Computer Representation of Spatial Data

The human eye is highly efficient at recognizing shapes and forms, but the computer needs to be instructed exactly how spatial patterns should be handled and displayed.

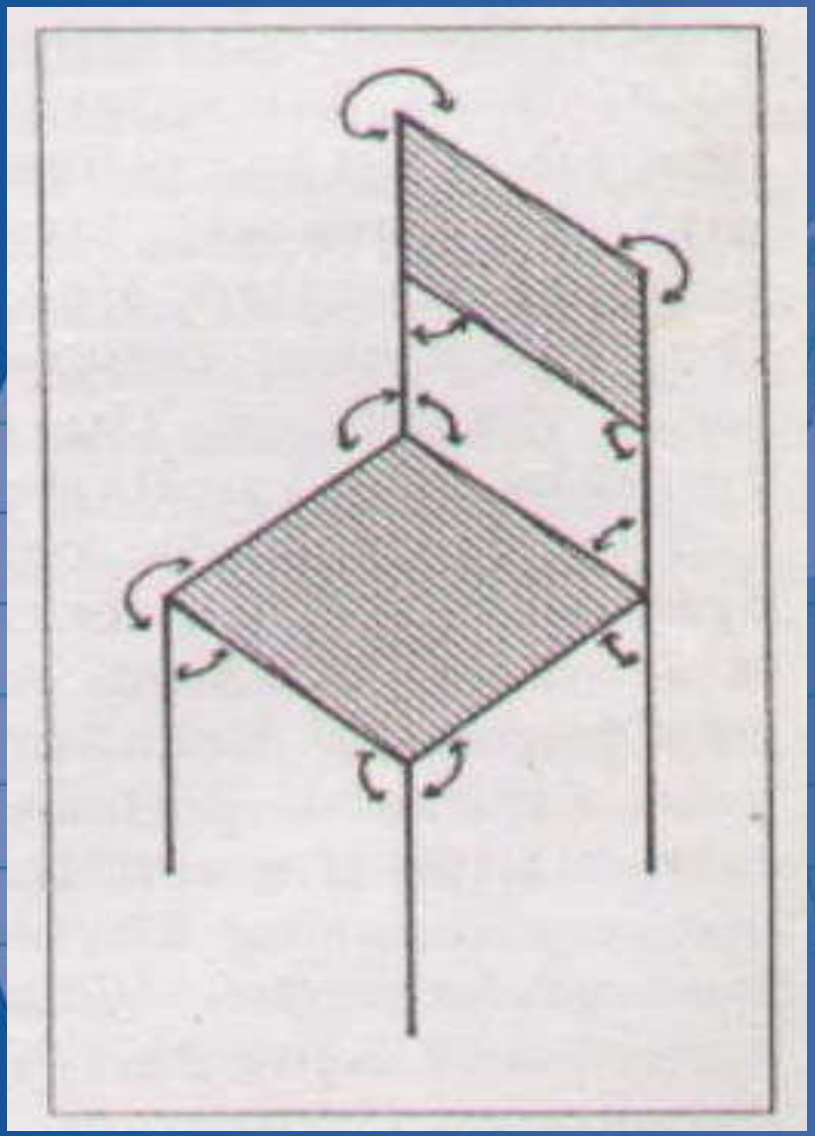
Essentially there are two contrasting but complementary ways of representing data in the computer that we shall refer to as explicit and implicit ways of describing spatial entities.

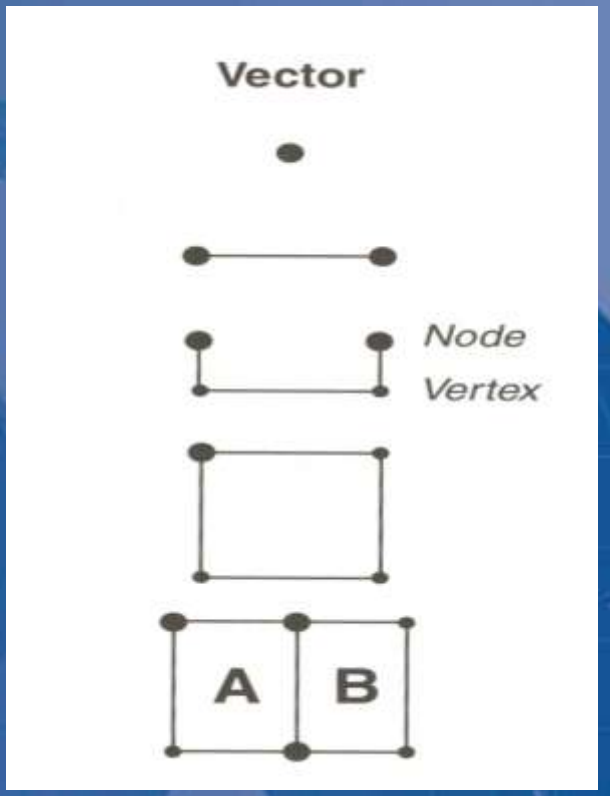
GIS uses primarily two spatial data models

- Raster data model
- Vector data model




**A spatial data model that uses a grid and cells to represent the spatial variation of a feature – Raster data.**

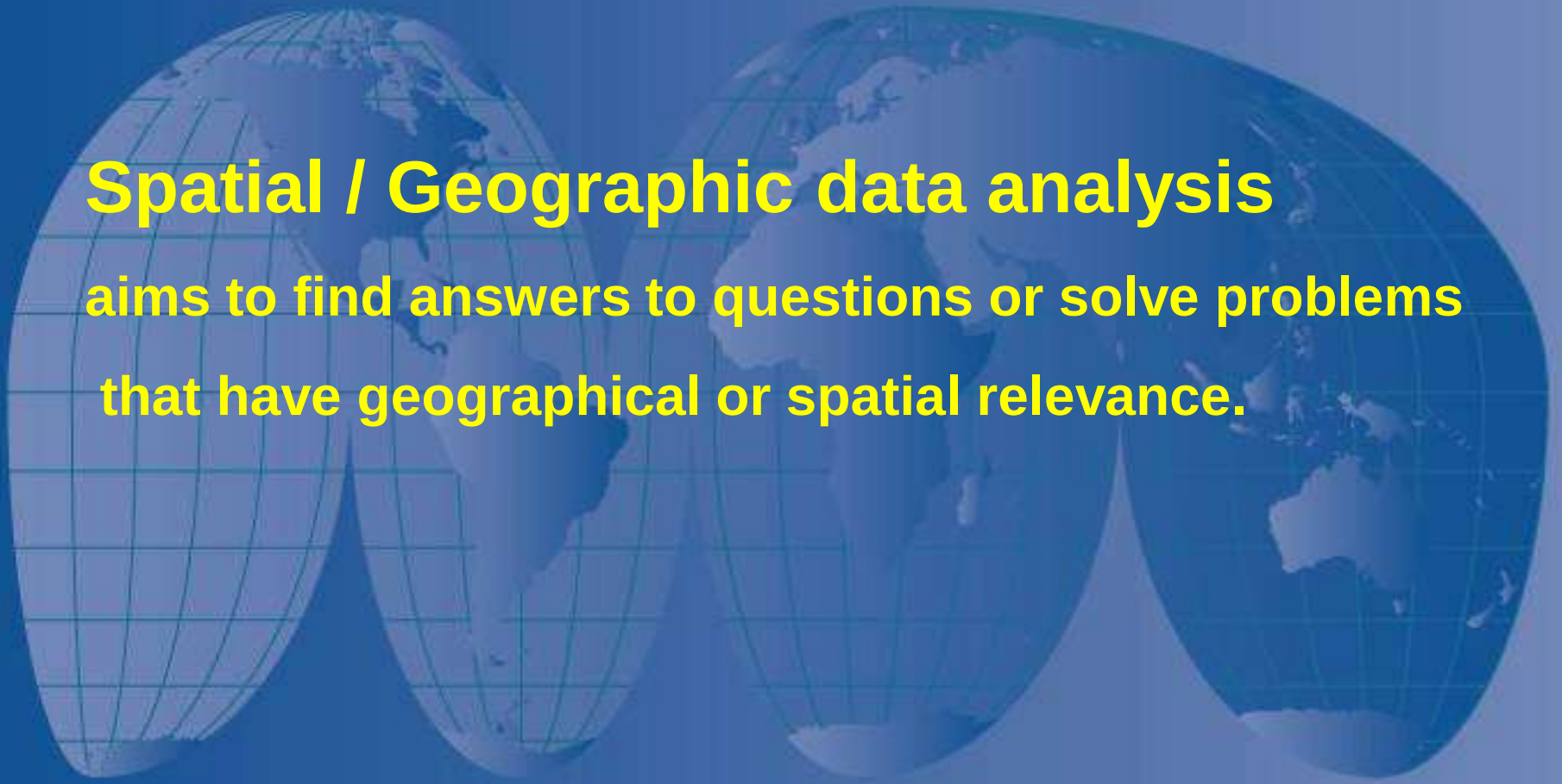





**Vector format has points, lines, polygons that appear normal, much like a map.**

# Spatial Analysis

## or Geographic Analysis



# Spatial / Geographic data analysis

**aims to find answers to questions or solve problems that have geographical or spatial relevance.**

- ✓ **Heart of GIS**
- ✓ **Distinguishes a GIS from other information systems**
- ✓ **Allows to study real world processes by developing and applying models**
- ✓ **The analysis function uses spatial and non-spatial data to answer questions about real world**
- ✓ **Results of Analysis can be communicated by maps, reports or both i.e output.**

**The objective of Spatial/Geographic analysis is to transform data into useful information to satisfy the requirements or objectives of decision Makers.**

**For instance…….**

**Where is the most suitable site for waste disposal?**

**Which areas are not prone to landslides?**

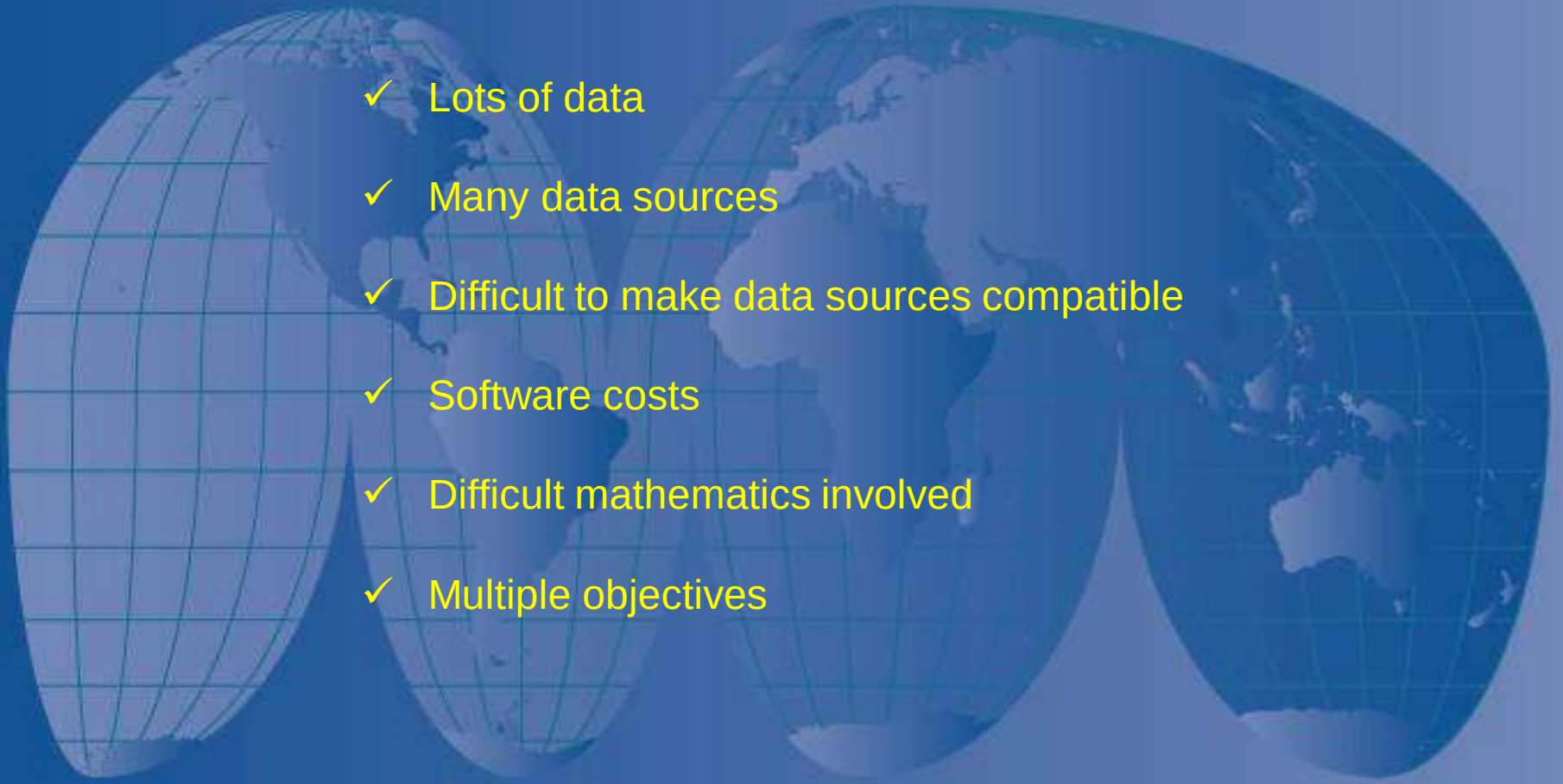
**Which areas will be submerged underwater upstream of a new dam?**

**Where are the best exploration targets for gold deposits?**

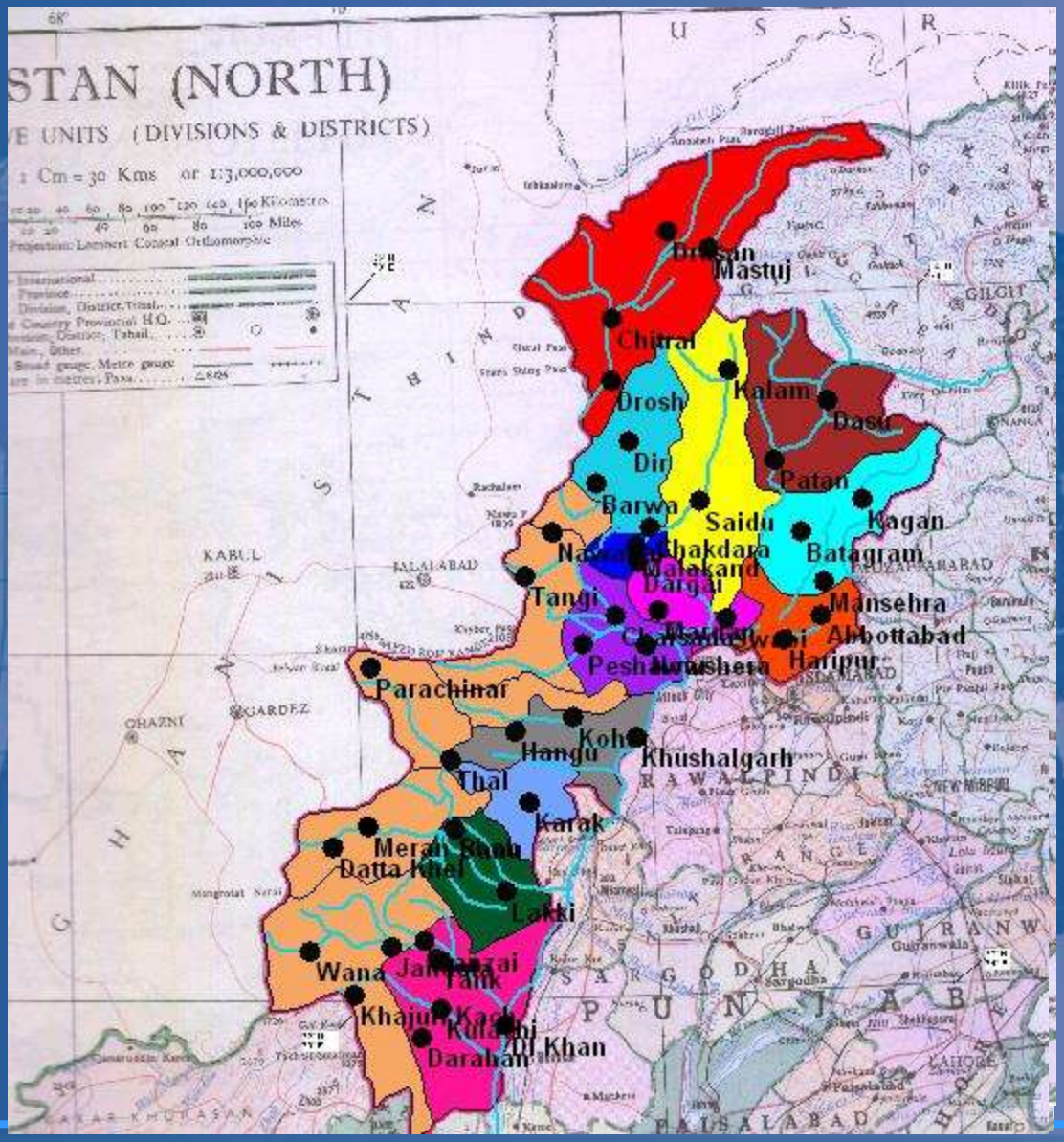
The range of analysis procedures can be subdivided into the following categories :

- ✓ **Database Query**
- ✓ **Overlay operations**
- ✓ **Proximity Analysis (Buffering)**
- ✓ **Network Analysis**
- ✓ **DEM, DTM (Surface analysis)**
- ✓ **Statistical & Tabular Analysis**

# Difficulties of Geographic/spatial Analysis



- ✓ Lots of data
- ✓ Many data sources
- ✓ Difficult to make data sources compatible
- ✓ Software costs
- ✓ Difficult mathematics involved
- ✓ Multiple objectives


STAN (NORTH)
UNITS (DIVISIONS & DISTRICTS)
1 Cm = 30 Kms or 1:3,000,000
U S S R
Chitral
Drosh
Dir
Barwa
Saidu
Kalam
Dasu
Patan
Kagan
Batagram
Mansehra
Abbottabad
Haripur
Tangi
Parachinar
Hangu
Thal
Karak
Khushalgarh
Lakki
Wana
Khajuri Kach
Darahan
KABUL
GARDEZ
GHAZNI
RAWALPINDI
LAHORE
FAISALABAD


The End *****