# GEOSPATIAL / GEOGRAPHIC INFORMATION SYSTEMS (GIS)

## UNIT - 3
## DATA INPUT, VERIFICATION, STORAGE & OUTPUT

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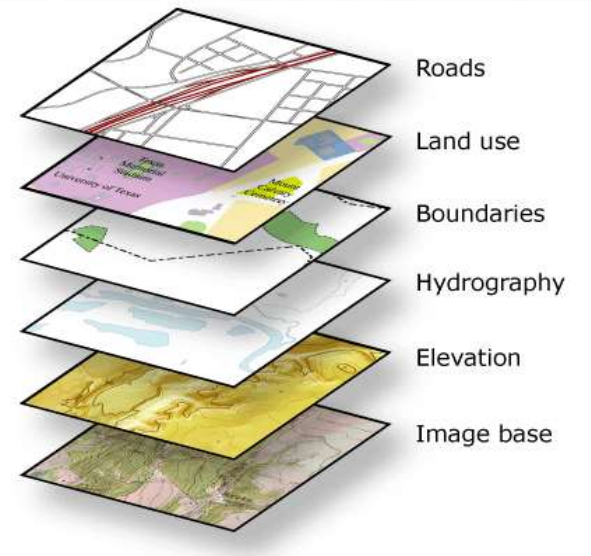
# GIS Unit - 3

- **Data Input, Verification, Storage and Output:** Spatial Data Input Processes and Devices (Sources of data, - Different Types of Data Entry methods, viz., Manual input, Run length code, Digitization, Automated Scanning, etc. – Vector to Raster conversion – Raster to Vector conversion - Input devices) - Entry of non-spatial data – Linking of Spatial & Non-spatial data – Data Verification (Errors of different types) – Correction (Rubber Sheet Transformation, Bilinear interpolation, Cubic Convolution, etc.) – GIS capabilities for Data correction – Data output (Types of Output, GIS Capabilities for output, Output devices).

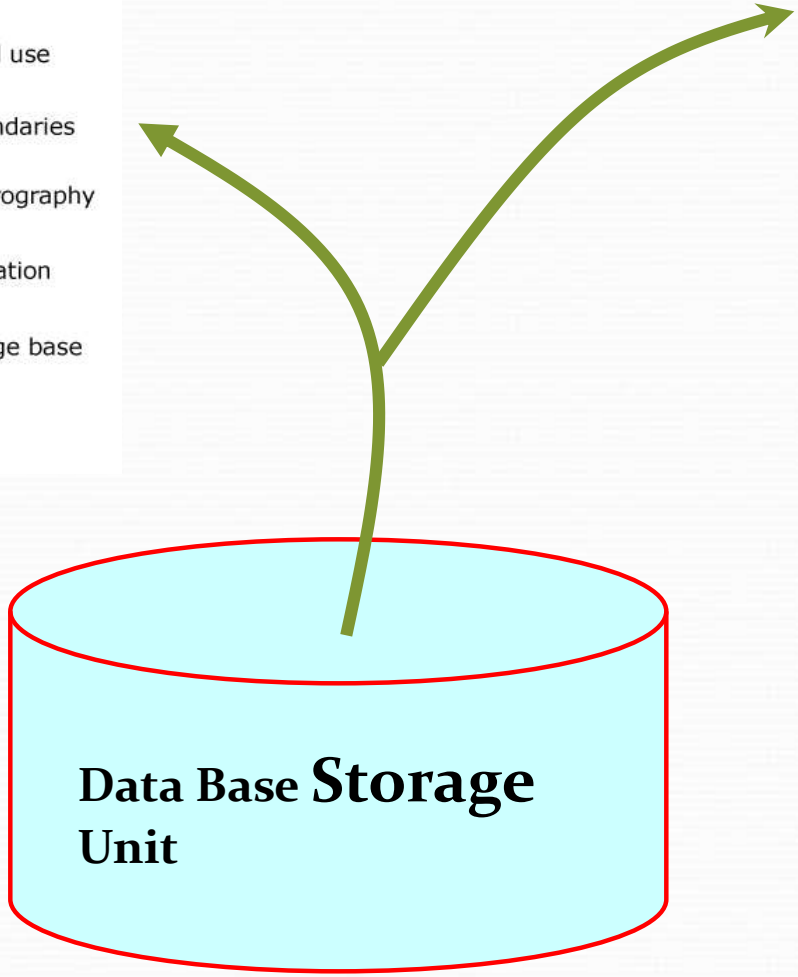
# GIS Can hold large amount of geospatial data / maps

## Geospatial data / maps




## Non spatial / Attribute data /

| | BLOCK_NAME | BK_AREA | SALI_AREA | PERCENTAGE | SALINITY_TYPE |
|---|---|---|---|---|---|
| 2 | AGASTESWARAM | 97755036.16 | 47651257.35 | 48.75 | COASTAL SALINE SOIL |
| 3 | ALWARTHIRUNAGARI | 314587693.28 | 13483201.16 | 4.29 | COASTAL SALINE SOIL |
| 4 | ARANTANGI | 646979186.79 | 19699964.93 | 3.60 | COASTAL SALINE SOIL |
| 5 | ARIMALAM | 362442584.63 | 39056.26 | 0.01 | COASTAL SALINE SOIL |
| 6 | AVUDAIYARKOIL | 317311588.56 | 124505284.05 | 39.24 | COASTAL SALINE SOIL |
| 7 | BHUVANAGIRI | 198728518.35 | 26522096.91 | 13.35 | COASTAL SALINE SOIL |
| 8 | CHENNAI | 173276620.57 | 116210289.56 | 67.07 | COASTAL SALINE SOIL |
| 9 | CHITHAMUR | 266707327.11 | 82036036.70 | 30.76 | COASTAL SALINE SOIL |
| 10 | CUDDALORE | 301090086.77 | 23434921.02 | 77.83 | COASTAL SALINE SOIL |
| 11 | GUMMIDIPOONDI | 418223625.80 | 198466820.60 | 47.46 | COASTAL SALINE SOIL |
| 12 | KADALADI | 801377568.81 | 518714069.26 | 64.73 | COASTAL SALINE SOIL |
| 13 | KANDAMANGALAM | 233537210.04 | 3561928.61 | 1.53 | COASTAL SALINE SOIL |
| 14 | KEELAYUR | 173072950.20 | 9080648.32 | 5.25 | COASTAL SALINE SOIL |
| 15 | KEERAPALAYAM | 123066986.35 | 50184462.65 | 40.78 | COASTAL SALINE SOIL |
| 16 | KILLIYOOR | 27797205.53 | 975230.86 | 3.51 | COASTAL SALINE SOIL |
| 17 | KOLLIDAM | 272680537.73 | 465289.90 | 0.17 | COASTAL SALINE SOIL |
| 18 | KOTTUR | 321190978.64 | 437663.63 | 0.14 | COASTAL SALINE SOIL |
| 19 | KURINJIPADI | 403874698.25 | 102104013.42 | 25.28 | COASTAL SALINE SOIL |
| 20 | KURUNTHENCODE | 150643684.38 | 76575441.17 | 50.83 | COASTAL SALINE SOIL |
| 21 | LATHUR | 378322678.78 | 227214144.85 | 60.06 | COASTAL SALINE SOIL |
| 22 | MANAMELKUDI | 187969286.34 | 90731336.29 | 48.27 | COASTAL SALINE SOIL |
| 23 | MANDAPAM | 221958482.90 | 221958446.74 | 100.00 | COASTAL SALINE SOIL |
| 24 | MARAKKANAM | 423770925.09 | 169722836.96 | 40.05 | COASTAL SALINE SOIL |
| 25 | MINJUR | 459693083.78 | 452608481.54 | 98.46 | COASTAL SALINE SOIL |
| 26 | MUNCHIRAI | 167408797.71 | 123207679.80 | 65.74 | COASTAL SALINE SOIL |
| 27 | MUTHUPETTAI | 372762749.08 | 275672726.32 | 73.95 | COASTAL SALINE SOIL |
| 28 | NANARKOIL | 265298425.88 | 5883174.16 | 2.21 | COASTAL SALINE SOIL |
| 29 | OTTAPIDARAM | 789995082.30 | 58580178.42 | 7.42 | COASTAL SALINE SOIL |
| 30 | PARANGIPETTAI | 232530511.68 | 202813776.86 | 87.22 | COASTAL SALINE SOIL |
| 31 | PATTUKKOTTAI | 414210092.49 | 142415280.27 | 34.38 | COASTAL SALINE SOIL |
| 32 | PONDI | 304809120.44 | 168067160.76 | 55.14 | COASTAL SALINE SOIL |
| 33 | PUZHAL | 134592930.49 | 77617267.23 | 57.61 | COASTAL SALINE SOIL |
| 34 | RADHAPURAM | 308678174.69 | 151774863.02 | 49.01 | COASTAL SALINE SOIL |
| 35 | RAJAKKAMANGALAM | 147954170.04 | 88595022.01 | 59.89 | COASTAL SALINE SOIL |



# DATA INPUT

4.2.1 ENTERING SPATIAL DATA

4.2.2 ENTERING NON SPATIAL DATA

4.2.3 LINKING SPATIAL DATA TO NON SPATIAL DATA

# Data Sources for GIS

Field surveys

Collecting latitude and longitude coordinates with a Global Positioning System (GPS) receiver.

BOTH SPATIAL & NON-SPATIAL DATA



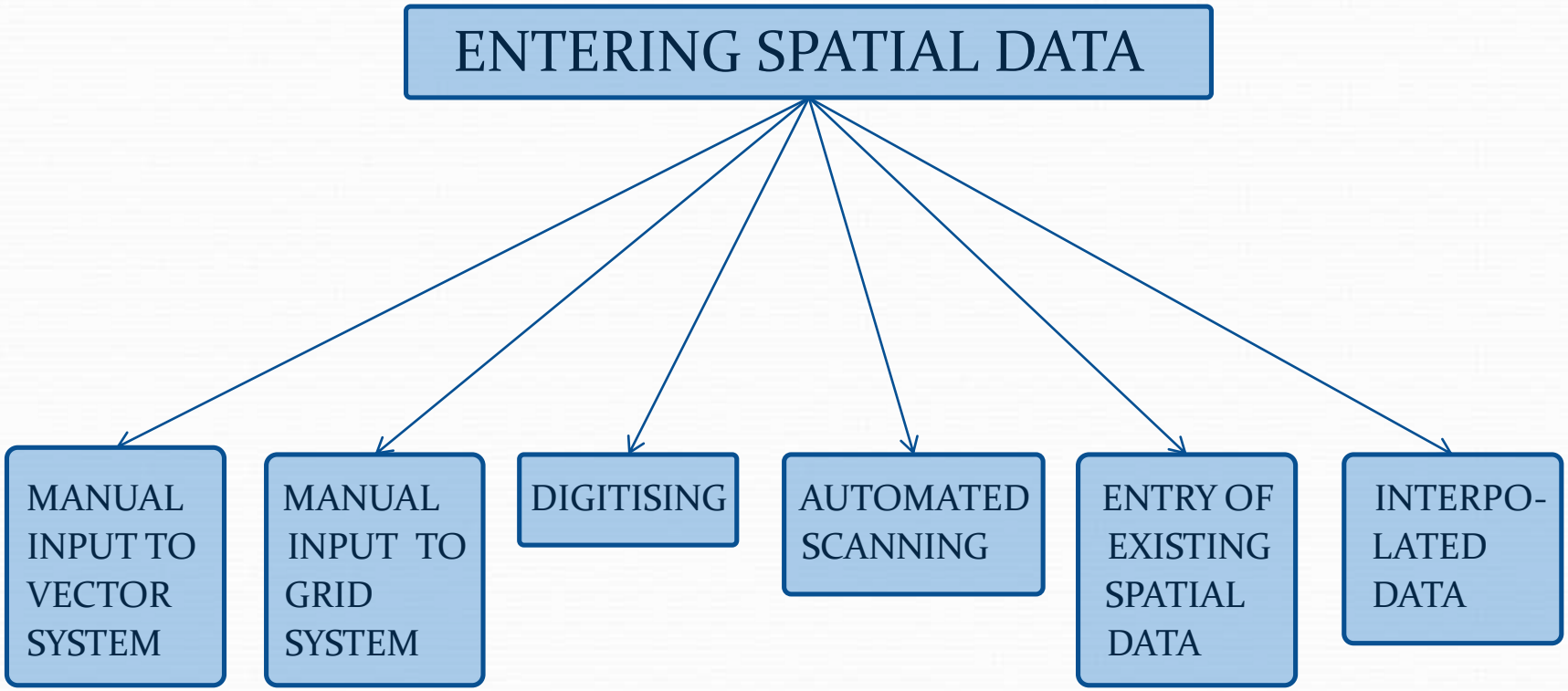
Remote sensing data

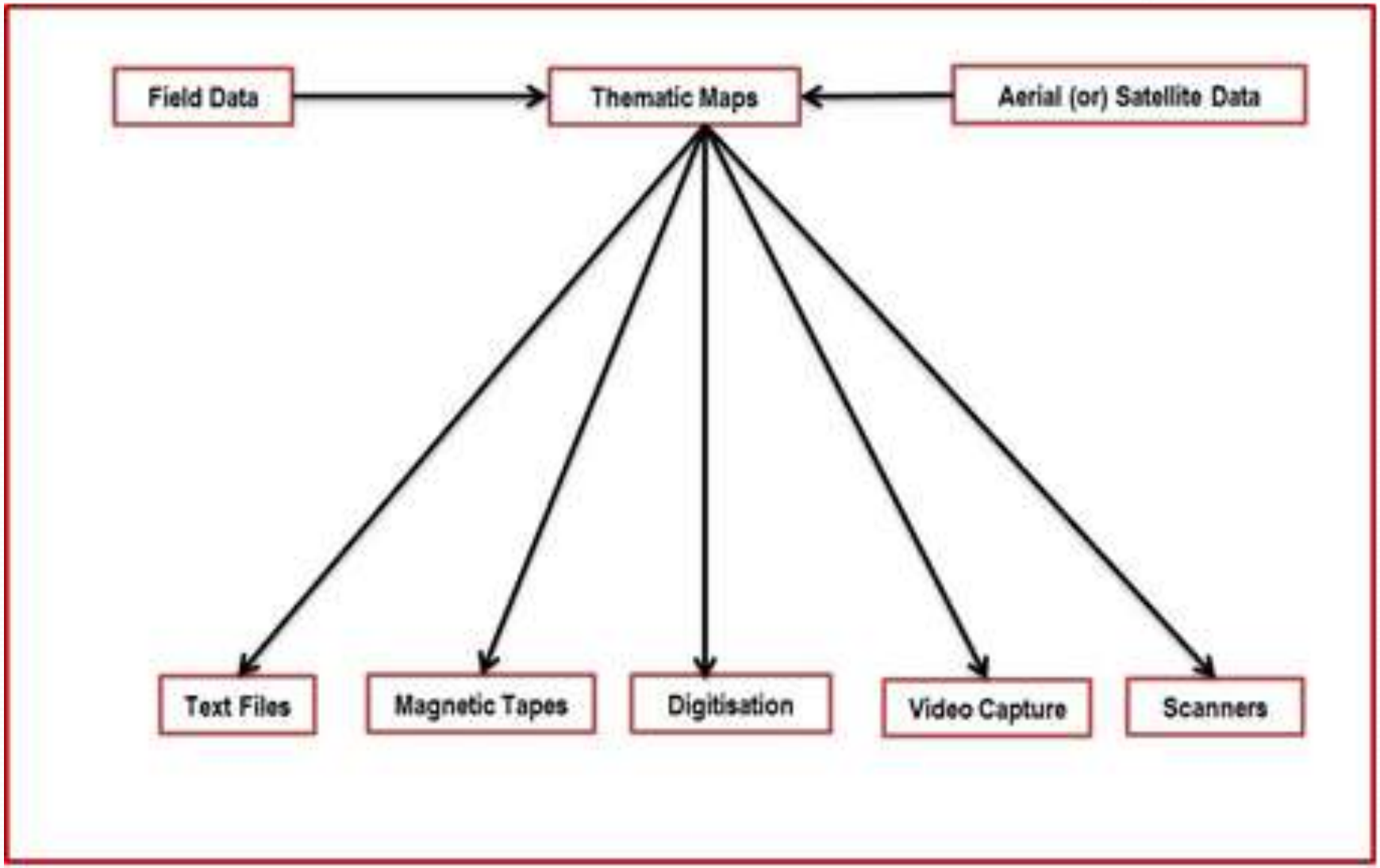

Digital data files

Collateral or Secondary data collection

Literatures & References

# ENTERING SPATIAL DATA

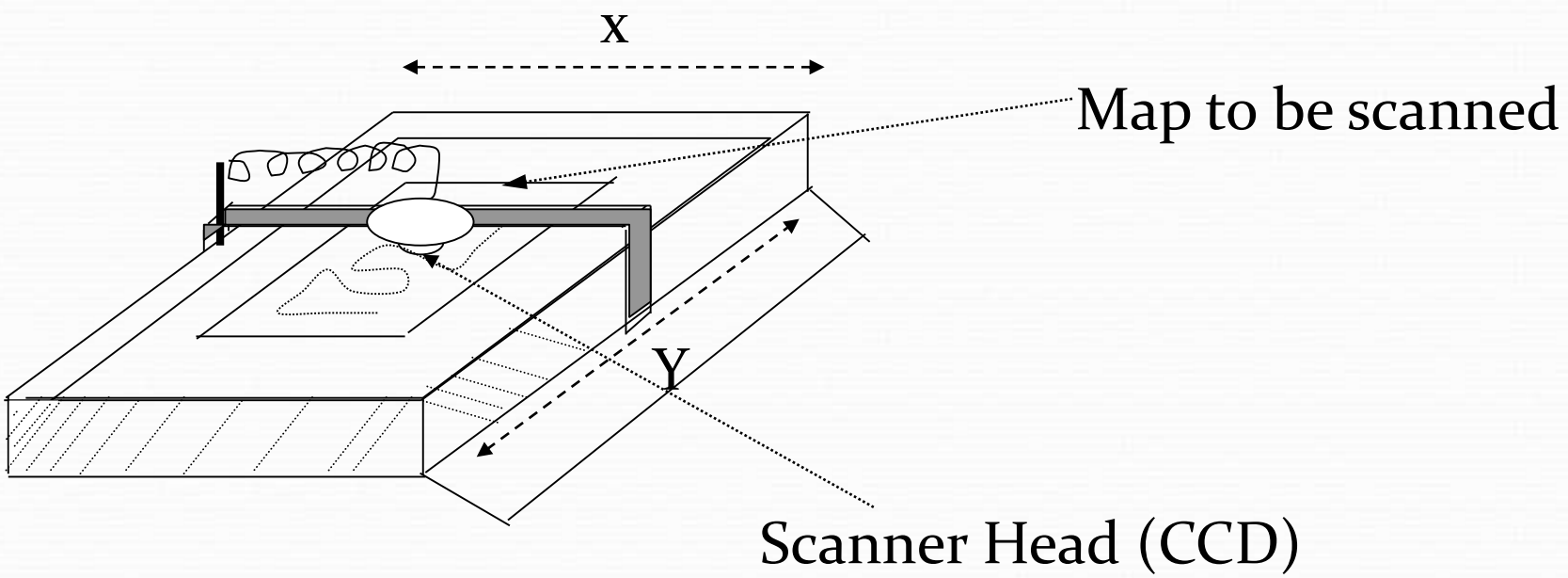



Field Data
Thematic Maps
Aerial (or) Satellite Data
Text Files
Magnetic Tapes
Digitisation
Video Capture
Scanners

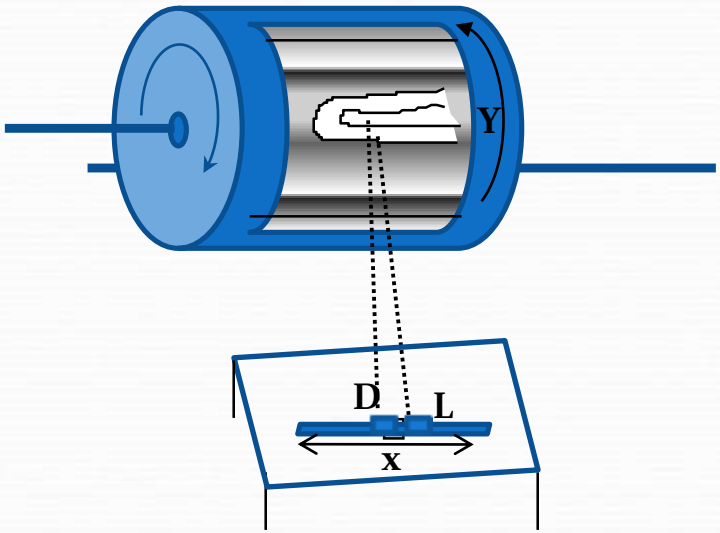
# Data Entry in GIS

- Digitization using digitizer board
  - Stream mode & Point mode
- Onscreen digitization
  - Scanning
  - Georeferencing
  - Digitization
  - Projection
- Manual entry of  series of X,Y data
- Automated Scanning

# AUTOMATED SCANNING
## Flat bed Scanner

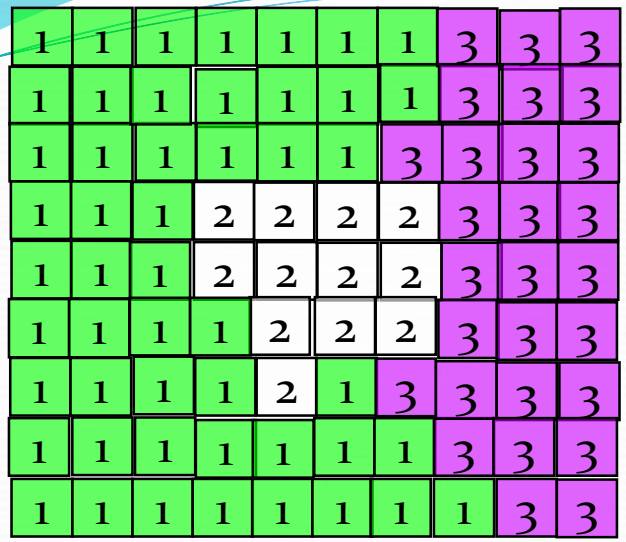


# Drum Scanner

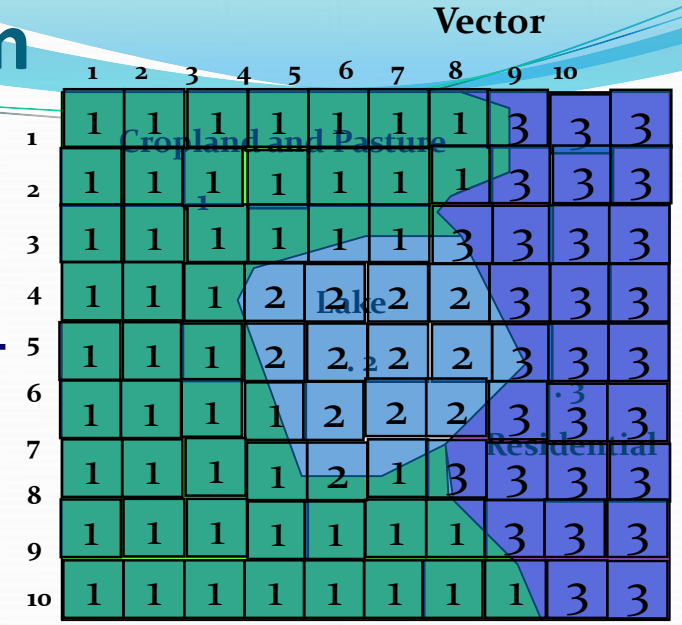



L – Laser beam
D – Detector
X – Direction of movement of laser source and Detector over a sliding bar
Y – Direction of scanning of map pasted over rotating Drum

# GIS Data Conversion

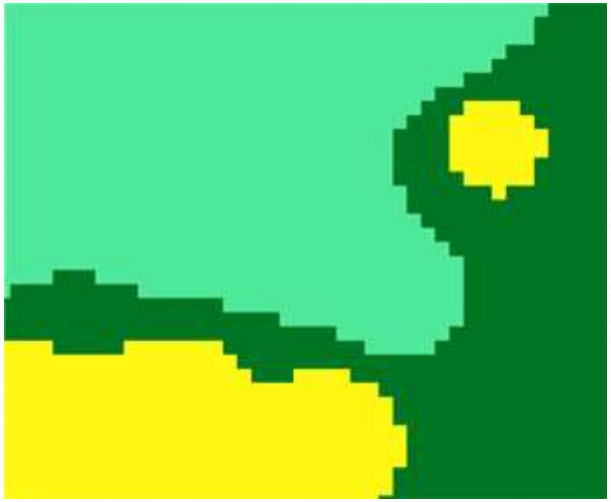


Rasterization

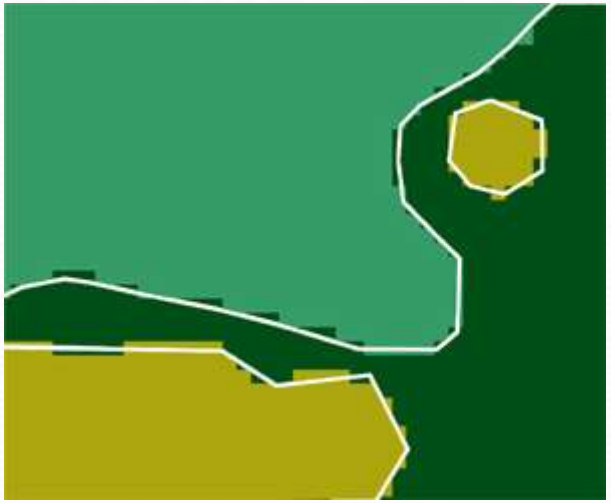



Consist arrays of cells in a grid pattern

Raster (Pixel size = 5mm x 5mm)



Vectorization



Tracing the changes in attribute values as boundaries of polygons

# GIS HARDWARE

SCANNER

DIGITIZER

TYPING

INPUT

PC

WORKSTATION NETWORK

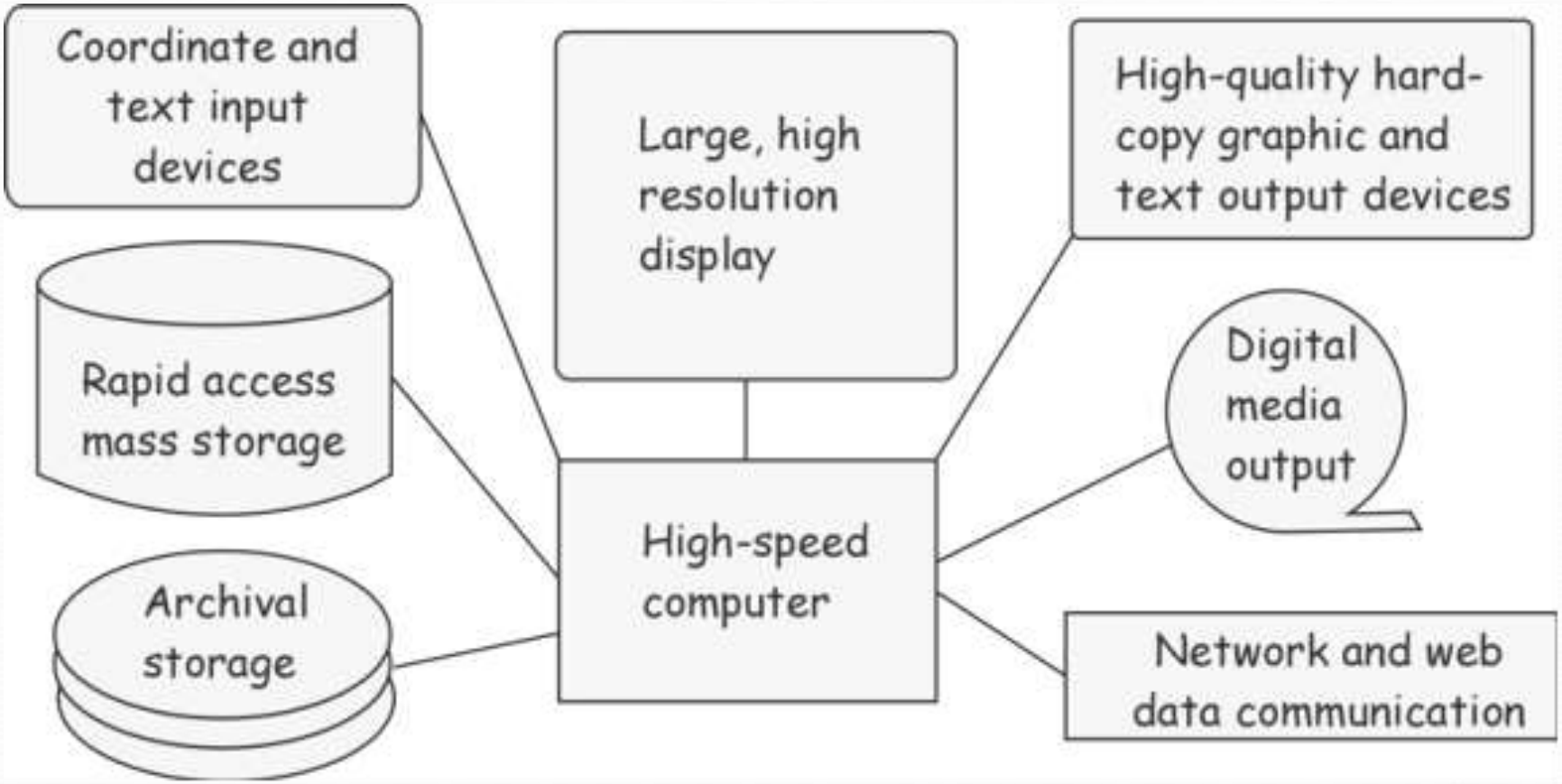
DATA MANAGEMENT

DIGITAL DATA

PRINTER

PLOTTER

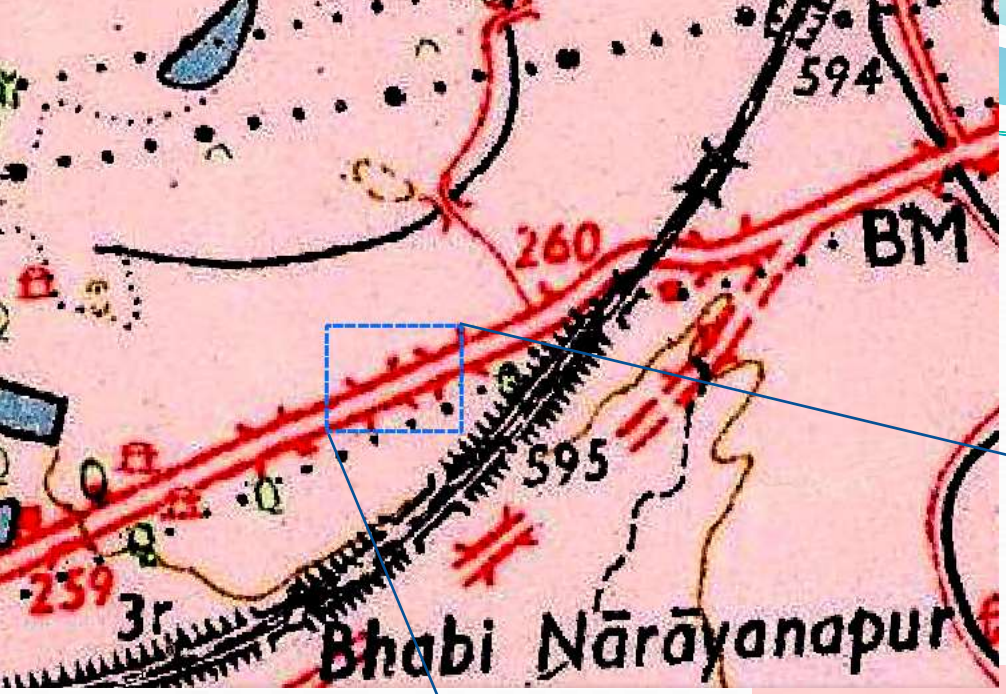
OUTPUT




**General-purpose and specialized GIS hardware components**

# Thinning Algorithm

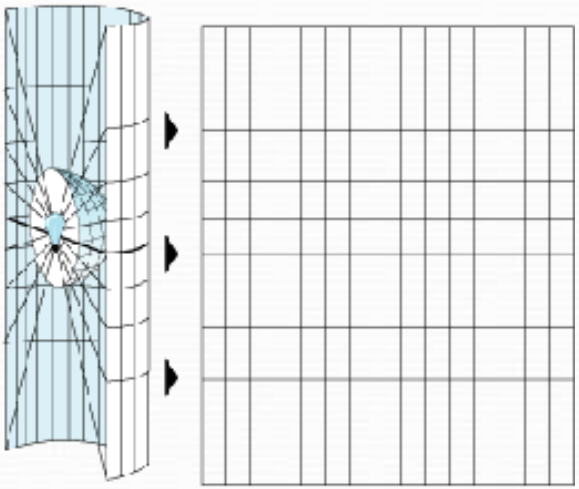
- The features seen in the scanned topos / maps must contain several rows of pixels representing the shape and size of them as depicted using various symbols
- For example, NH roads might have been scanned as a series of 5 adjacent pixels aligned in a row can be seen while it is zoomed to a maximum extent.
- Now, the GIS program consisting of algorithm which can identify the number of pixels occupied along the width of the required feature and find out the median pixel in each row all along the entire length of the feature
- Fix nodes at the centers of these pixels and finally
- Connect them to make it as boundary or linear feature or as polygon as per the conditions.

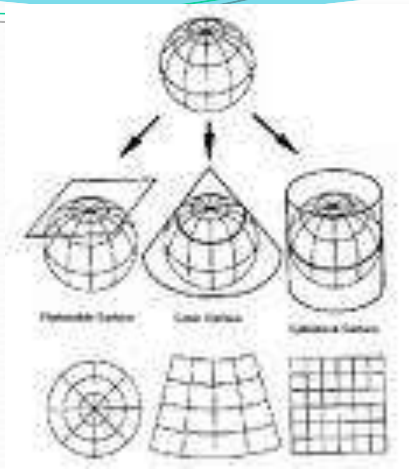


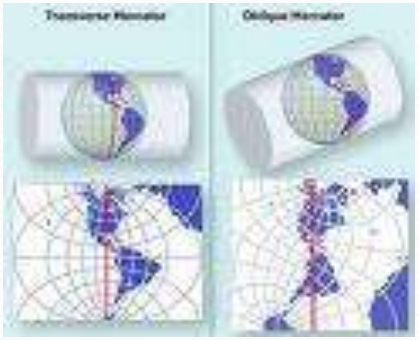

19 pixels are representing the red coloured double line symbol for NH in this area.

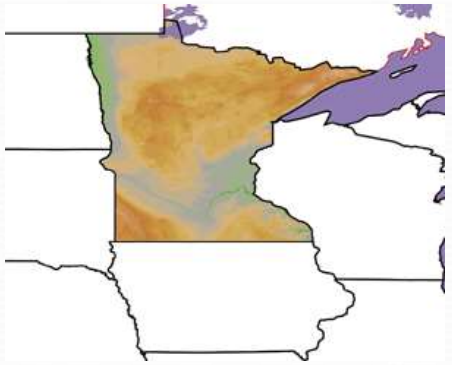
Thinning Algorithm - The median pixel along the width of this NH is falling in 10th pixel will be identified and a node will be inserted in its center position in each row and finally all the nodes will get connected to get vector feature of NH in GIS.

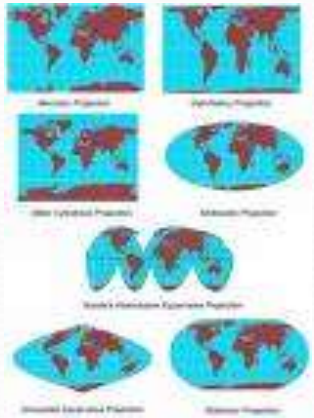
# Map Projection

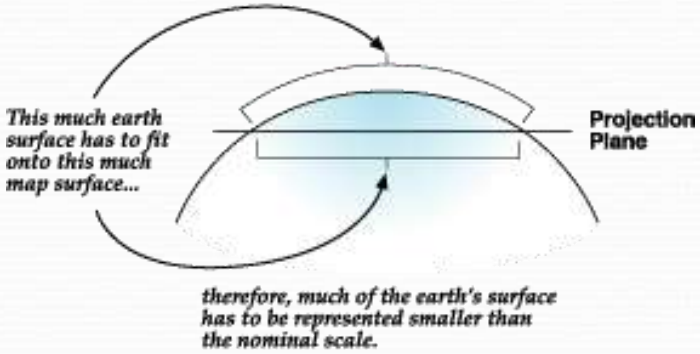


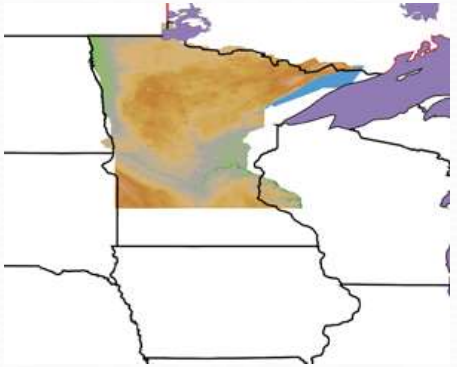










# Map Projection …contd…

## A. MAP RECTIFICATION USING GROUND CONTROL POINTS (GCP's)

- RAW DIGITAL DATA ARE EITHER IN DIGITIZER BOARD UNIT OR DISPLAY SCREEN UNIT
- UPDATE THEIR CO-ORDINATE VALUES WITH DECIMAL DEGREES

DD = (DEGREE + (MINUTE / 60) + (SECONDS / 3600))

## B. PROJECT THEM TO THE REQUIRED PROJECTION SYSTEM

**DETAILS REQUIRED:**

1. **INPUT DETAILS**

   PROJECTION TYPE – GEOGRAPHIC

   UNITS – DD

2. **OUTPUT DETAILS**

   PROJECTION TYPE (EXPECTED) – POLYCONIC …etc....

   UNITS – METERS

3. **CENTRAL MERIDIAN IN DD**

   (MAX – MIN LONGITUDE/2)

4. **LATTITUDE OF PROJECTIONS ORIGIN IN DD**

   LAT. @ BOTTOM LEFT CORNER OF MAP

5. **DATUM PLANE**

6. **FALSE EASTING & FALSE NORTHING**

# Linking of Spatial and Aspatial data

- Entry of Spatial and Non-spatial data
- Check for accuracy and errors
- Add / Identify Unique Identifier in both Attribute Tables (PAT / AAT / PAT / DBMS Tables / Spread Sheets)
- Choose the method for providing linkage between them
  - One to One
  - One  to Many
  - Many to One
  - Many to Many
- Choose ‘Join’ option when ‘One-to-One’ relation exists
- Choose ‘Relate option for others

# GIS Database Management

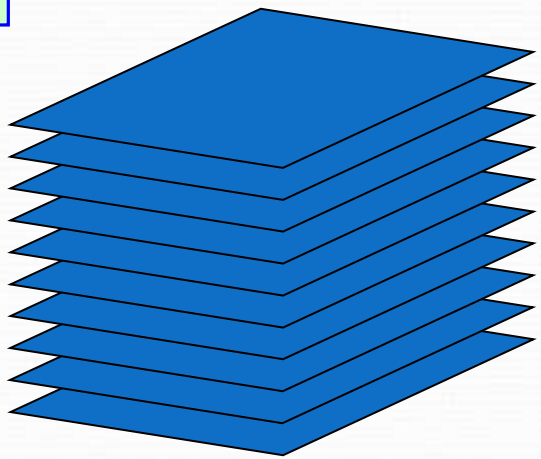
**Spatial Data**

**Non Spatial Data**

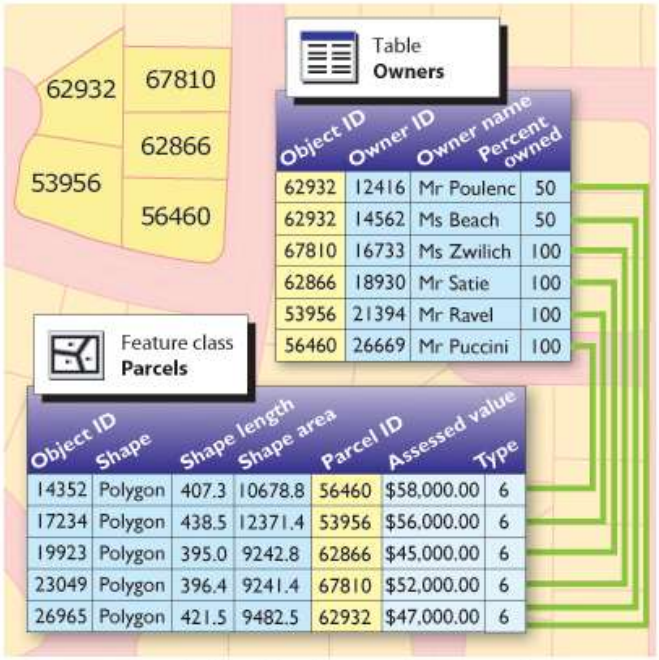
**Unique Identifier (Unique Id)**

**Provide Link using 'Join & Relate' methods**

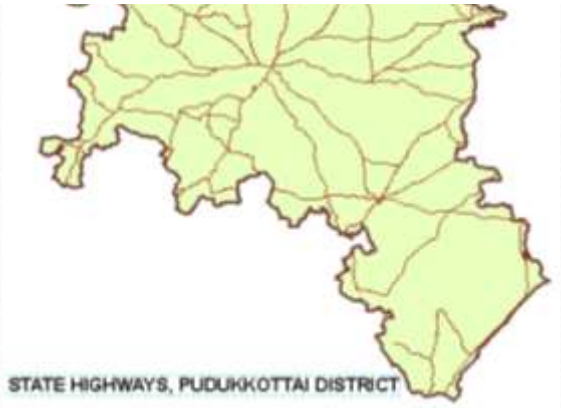
**Preferential display of map**



- National Highway
- State Highway
- District Road
- Panchayat Road
- Unmetalled Road
- Cart Track
- Pack Track




**Unique Identifier / (Unique Id) – is an unique value (as alphabets or numbers or alpha-numeric values) used as identifier for spatial objects and / or records and to retrieve them quickly by providing linkage between them.**



# DATA VERIFICATION IN GIS

**ERRORS ARISES DURING ENCODING AND INPUT OF SPATIAL / NON-SPATIAL DATA**

i) SPATIAL DATA IN WRONG PLACE

ii) SPATIAL DATA ARE DISTORTED

iii) SPATIAL DATA ARE IN WRONG SCALE

iv) SPATIAL DATA ARE INCOMPLETE OR DOUBLE

v) SPATIAL DATA LINKED TO A WRONG NON SPATIAL DATA

vi) SIMILAR ERRORS IN NON SPATIAL DATA

## i) SPATIAL DATA IN WRONG PLACE

Mislocation of spatial data – minor error to gross spatial location errors

Minor - due to careless digitizing
- wrong data entry in item/field or in lab.
- due to GPS errors

Gross - due to data origin

# Sources of possible errors

1. Obvious sources of error
   i. Age of the data
   ii. Areal coverage-partial or complete
   iii. Map scale
   iv. Density of observations
   v. Relevance
   vi. Format
   vii. Accessibility
   viii. Cost
2. Errors resulting from natural variations or from original measurements
   1. Positional accuracy
   2. Accuracy of content-qualitative and quantitative
   3. Sources of variation in data
      1. Data entry faults
      2. Data output faults
      3. Observer bias
      4. Natural variation

1. **Errors arising through processing**
    1. Numerical errors in the computer
    2. Limitations of computer representations of numbers
    3. Faults arising through topological analyses
    4. Misuse of logic
    5. Problems associated with map overlay
    6. Classification and generalization problems
    7. Methodology
    8. Class interval definition
    9. Interpolation

# Error types in Vector Data

**Points** - Un-labeled Points, Multi-labeled Points
Missing Points, Multiple Points

**Lines** - Overshoots, Undershoots, Missing Lines/Arcs, Un-labeled Lines, Multi-labeled Lines, Missing Lines, Multiple Lines

**Polygons** - Sliver polygons, Dead ends, Gaps, Weird Polygons, Floating Polygons, Un-labeled Polys, Multi-labeled Polys Missing Polys, Multiple Polygons

# GIS CAPABILITIES FOR DATA VERIFICATION

- **Rubber sheet transformation and warping**
  - Keeping the faulty digitized map as an elastic sheet that can be stretched in all directions so as to correct point positions by linking vectors of accurate base map.
  - A number of points on the faulty map are linked by vectors to the correct positions on the base map
  - The rubber sheeting algorithms stretch and compress the faulty map until the linking vectors have shrunk to zero length and the tie points are registered with each other.
  - Now, values are calculated for all the other points on the faulty map and relocated correctly.

# Data verification

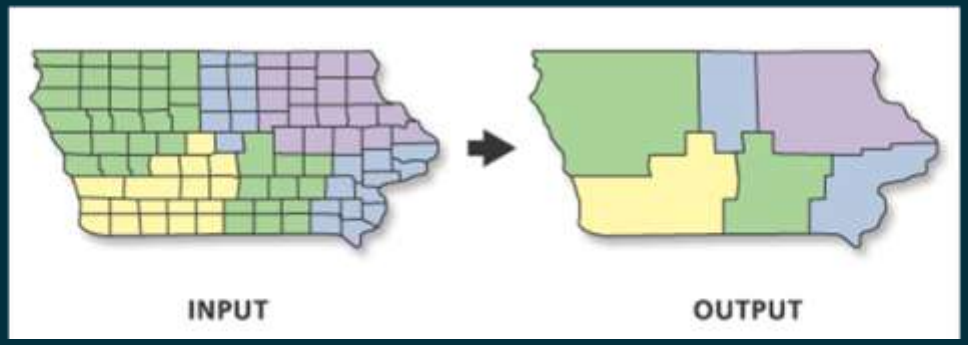
- Comparative checking physically over light table with transparent/transluscent/thin paper hardcopy of the digitized map in the same scale as that of the original map and mark the
  - Missing data
  - Locational errors
  - Multiple entry
- Generate topology – Build Topology options
  - Utilizing topology rules
  - Locate and Display errors like, Node errors, Dangle errors-(overshoots), Pseudo-nodes, open polygons(undershoots),

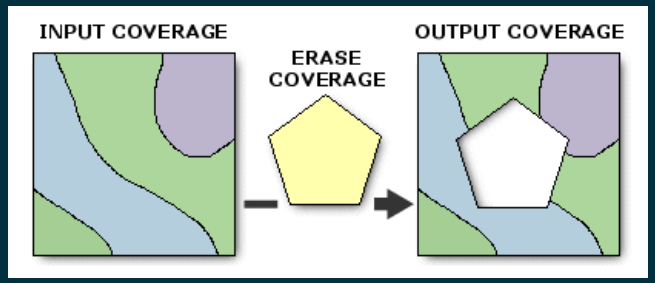
## GIS CAPABILITIES FOR DATA VERIFICATION …contd…

- ADD / DELETE / CHANGE – interactive editing of the alignment, length, text, text font and attributes of graphic entities
- MOVE / ROTATE – To a new position
- STRETCH / RECTIFY – adjust co-ordinates to fit a true base
- TRANSFORM SCALE, PROJECTION
- ZOOM / WINDOW
- CLIP, UPDATE
- JOIN / EDGE MATCH – map continuity
- POLYGON OVERLAY & MERGE
- 3D PROJECTION – Block diagram
- Raster to vector, Vector to Raster
- GENERALIZATION & SMOOTHING
- DATA RETRIEVAL & REPORTING

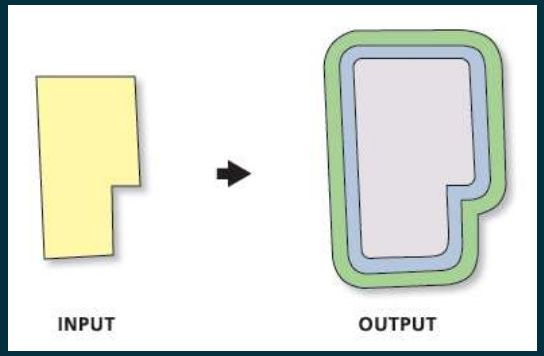
# Data Preprocessing and Postprocessing capabilities

## Classification/Grouping , Regrouping,/Reclassification

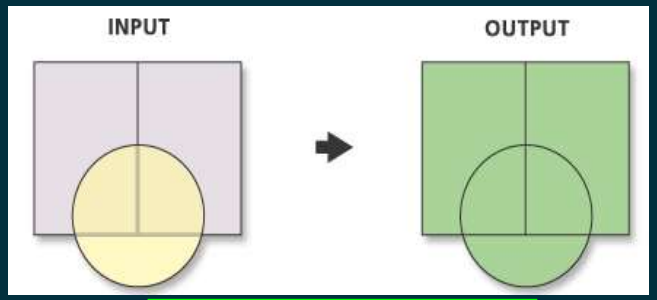


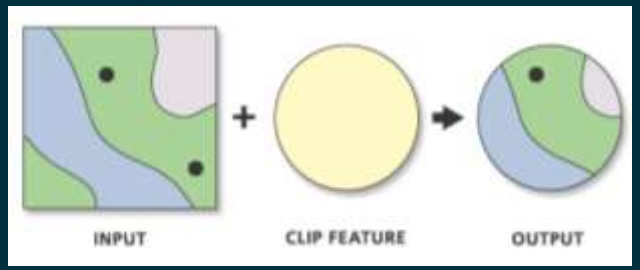

**ERASE**



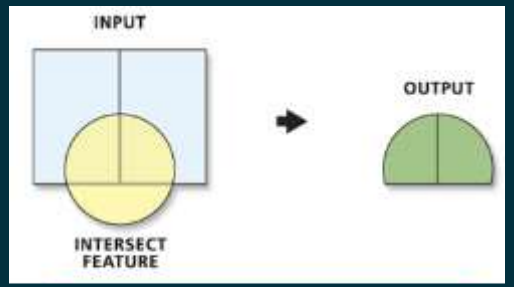

**BUFFER**




**UNION**



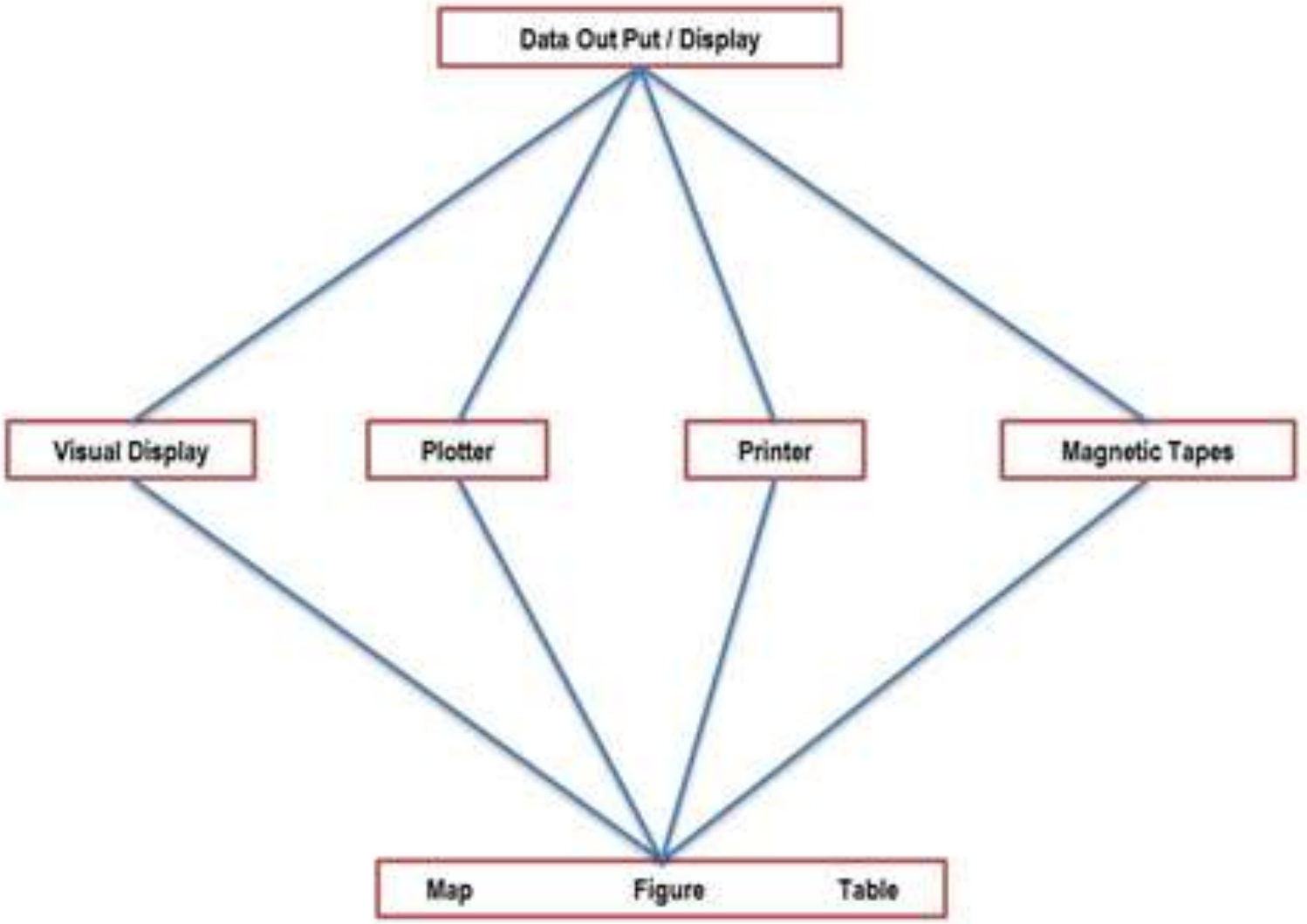

**INTERSECT**



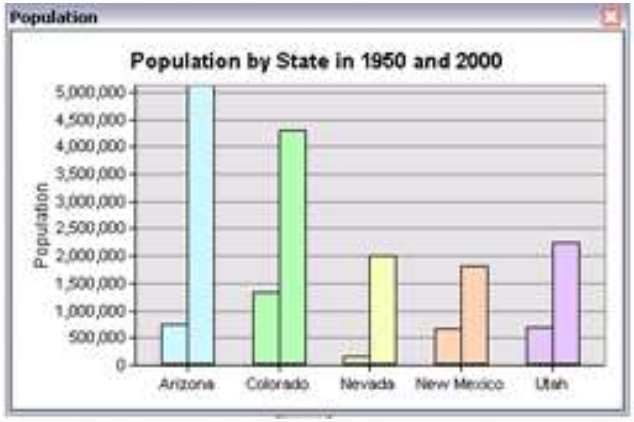

**CLIP**

# GIS OUTPUT CAPABILITIES

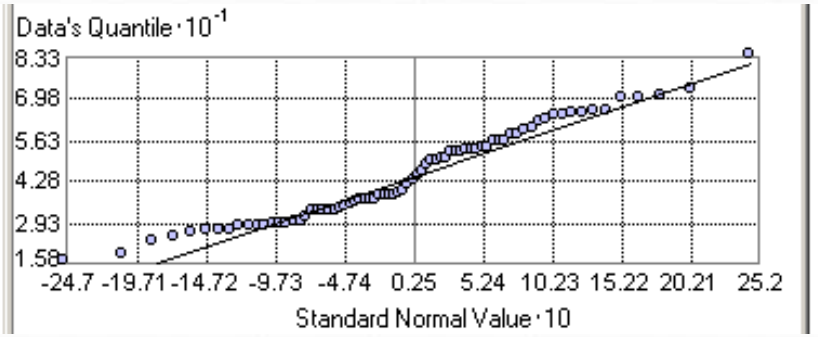
- ➔SIMPLE DISPLAY
- ➔ALL CARTOGRAPHIC LAYOUT OPTIONS
- ➔SCALE, STYLE & COLOR CHANGE
- ➔INCLUDE GRAPHS, PHOTOS, ETC.
- ➔3D DISPLAY
- ➔OVERLAY OF MANY THEMES
- ➔LIVE MAPS & INTERACTIVE MAPS
- ➔PLOTTER / PRINTER O/P, WEB DISPLAY


Data Out Put / Display
Visual Display
Plotter
Printer
Magnetic Tapes
Map
Figure
Table

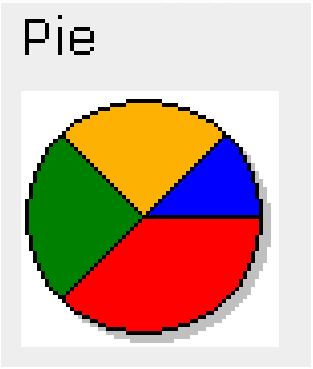
# GIS can display in the form of Charts, Histograms, 3D visualized output, DEM, etc,.

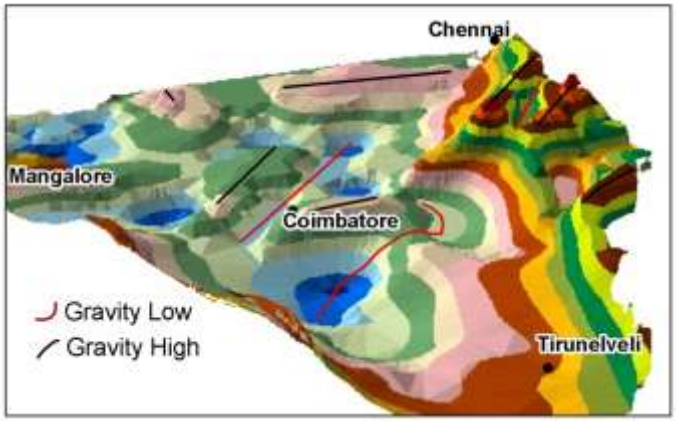



Charts

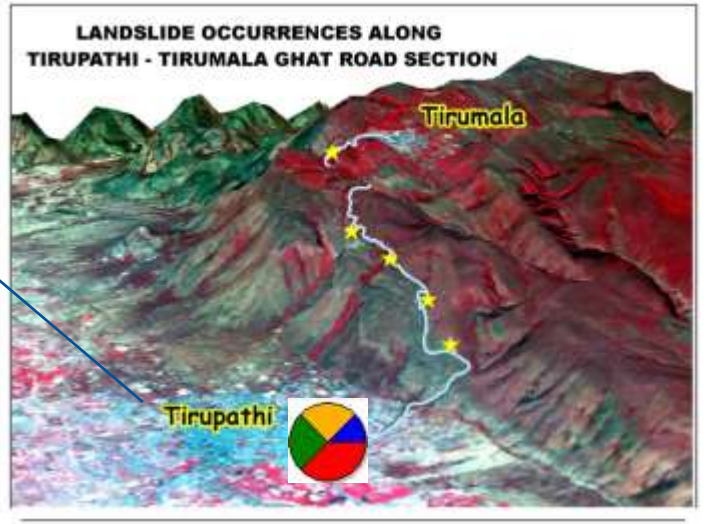



Histograms




3D IMAGE




DIGITAL ELEVATION MODEL(DEM)

# Functions commonly provided by GIS Software

| Date Entry | Analysis |
|---|---|
| ▪ Manual coordinate capture<br>▪ Attribute capture<br>▪ Digital coordinate capture<br>▪ Data import | ▪ Spatial query<br>▪ Attribute query<br>▪ Interpolation<br>▪ Connectivity<br>▪ Proximity and adjacency<br>▪ Buffering<br>▪ Terrain analyses<br>▪ Boundary dissolve<br>▪ Spatial data overlay<br>▪ Moving window analyses<br>▪ Map algebra |
| **Editing** | |
| ▪ Manual point, line and area feature editing<br>▪ Manual attribute editing<br>▪ Automated error detection and editing | |
| **Data Management** | **Output** |
| ▪ Copy, subset, merge data<br>▪ Versioning<br>▪ Data registration and Projection<br>▪ Summarization, data reduction<br>▪ Documentation | ▪ Map design and layout<br>▪ Hardcopy map printing<br>▪ Digital graphic production<br>▪ Export format generation<br>▪ Metadata output<br>▪ Digital map serving |