



Bharathidasan University

Tiruchirappalli – 620 023, Tamil Nadu

6 Yr. Int. M.Tech. Geological Technology and Geoinformatics

Course : MTIGT0501

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

**Unit-3 : Data Input, Verification, Storage and
Output**

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Professor, Department of Remote Sensing

Course Objectives:

- To learn the basics and concepts of GIS
- To know the components and importance of GIS
- To study the capabilities of GIS in input, verification, analysis, modelling and output generation
- To understand the importance of manipulation and their applications
- To learn the methods of spatial data analyses, simulation and modelling aspects.

MTIGT0501: GEOGRAPHIC INFORMATION SYSTEMS

--- 3 credits

- 1. Basics of GIS:** Definition - Usefulness of GIS - Components of GIS - Computer Hardware, Software Modules and Organizational Context of GIS. **6 Hrs.**
- 2. Data Structure:** Data Structure in GIS - Types of Data (Points, Lines and Polygons)- Data Base Structures (Raster Data Structures and Vector data Structures) - Data Conversion, (Vector to Raster and Raster to Vector). **6 Hrs.**
- 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). **12 Hrs.**
- 4. Methods of Spatial Interpolation and Digital Elevation Model:** Spatial Interpolation: Basic Principles of Interpolation – Methods of Interpolation (Interpolation by Joining Boundaries, viz., Simple vector maps, Theisson polygons) – Global Methods of Interpolation, Local Interpolation (Trend Surface Analysis) – Local Interpolation (Splines) - Optimal Interpolation (Kriging).
Digital Elevation Modeling: Need for Three Dimensional Models - Methods of DEM - Products of DTM (Contour Maps, Shaded Relief Map, Maps Related To Slopes, Line of Sight Maps, Drainage Analysis, Volume Estimation, etc.) - Usefulness of DEM/DTM. **12 Hrs.**
- 5. Data Analysis and Spatial Modeling:** Simple data retrieval – Data retrieval through Boolean Logic – Map Overlaying and Cartographic Modeling (Two layers, Multiple layers, Binary, Index, Regression, and Process Models) – Overlay analysis, Capabilities (Point Operations, Regional Operations, Neighbourhood Operations) – Buffering – Cartographic Modeling using Natural Language Commands – Advantages and disadvantages of Carto modeling – Net work analysis. **12 Hrs.**
- 6. Current Contours: (Not for Final Exam, only for Discussion):** Recent advancements in GIS; Application of GIS in automation, decision making and query building processes in Geological Technology; Modules and capabilities of QUGIS, GRAM++, IDRISI GIS software.

1. Burrough, P.A 1986: Principles of Geographical information Systems for Land Resources Assessment, Clarandone Press, Oxford.
2. Kang - Tsung Chang, Introduction to Geographic Information System, MC Graw Hill, Boston. 2002.
3. Avery, T.V, Interpretation of Aerial Photography Burgass, Publishing Company.
4. Gautham, N.C 1970: Urban Landuse Study Through Aerial Photo interpretations Techniques, Pink Publishing House, Mathura.
5. American Society of Photogrammetry, 1983: Manual of Remote Sensing (2nd Edition), ASP Falls Church, Virginia.
6. Campbell, J 1984: introductory Cartography, Printers Hall Englewood Cliffs, N.J
7. Dent B.D 1985: Principles of Thematic Map Design, Addition - Wesley, Reading, Mass.
8. Freeman, H and GG.Pieroni 1980: Map Data Processing, Academic Press, New York.
9. Monmonier, M.A 1982: Computer Assisted Cartography - Principles and Prospects, Prentice Hall, Englewood Cliffs, NJ
10. Tomlinson, R.F Calkins, H.S and D.F.Marble 1976: Computer Handling of Geographic Data, UNESCO, Geneva.
11. Grame F. & Bonham – Carter; Geographic information Systems for Geoscientists; Modelling with GIS, Pergamon.

Course outcomes:

After the successful completion of this course, the students are able to:

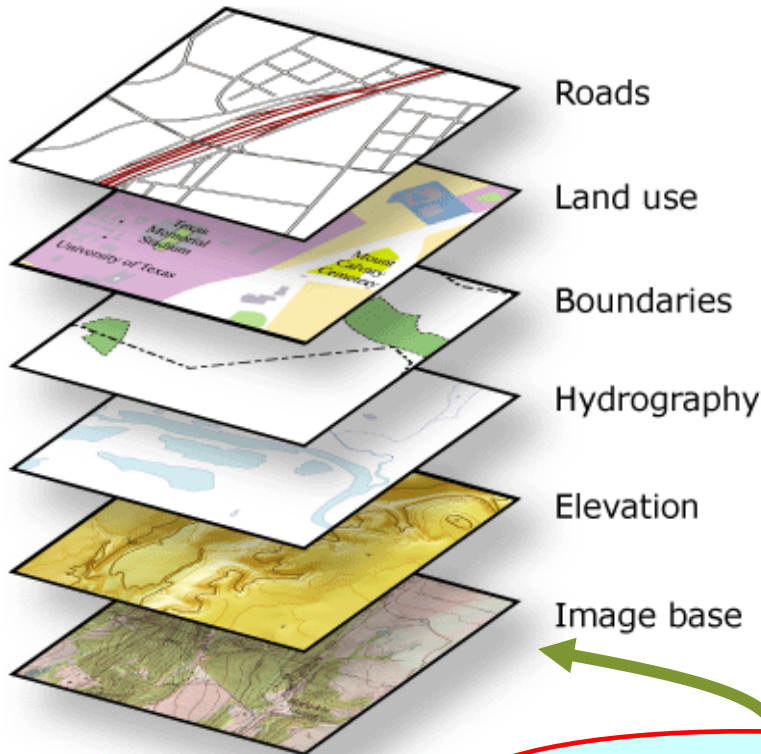
1. Understand the basic concepts and virtues of this important tool providing various platforms to handle Geospatial data
2. Gain basic ideas to generate, group, store Geospatial data in effective data structures
3. Develop skills on manipulation, 3D visualization, Spatial Analysis and Spatial Modeling.
4. Handle Geologic problems Geospatially in GIS platform independently.

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). **12 Hrs.**

GIS Can hold large amount of geospatial data / maps

Geospatial / Spatial data / maps



Aspatial / Non spatial / Attribute data

	A	B	C	D	E
1	BLOCK_NAME	BK_AREA	SALI_AREA	PERCENTAGE	SALINITY_TYPE
2	AGASTISWARAM	97755036.16	47651257.35	48.75	COASTAL SALINE SOIL
3	ALWARTHIRUNAGARI	314587683.28	13483201.16	4.29	COASTAL SALINE SOIL
4	ARANTANGI	546979186.79	19699964.93	3.60	COASTAL SALINE SOIL
5	ARIMALAM	382442584.63	38056.28	0.01	COASTAL SALINE SOIL
6	AVUDAIYARKOIL	317311598.56	124505284.05	39.24	COASTAL SALINE SOIL
7	BHUVANAGIRI	198728518.35	26522056.91	13.35	COASTAL SALINE SOIL
8	CHENNAI	173276620.57	116210285.58	67.07	COASTAL SALINE SOIL
9	CHITHAMUR	266707327.11	82036026.70	30.76	COASTAL SALINE SOIL
10	CUDDALORE	301090086.77	234349321.02	77.83	COASTAL SALINE SOIL
11	GUMMDIPOONDI	418232625.80	198485820.68	47.46	COASTAL SALINE SOIL
12	KADALADI	801377568.81	518714059.26	64.73	COASTAL SALINE SOIL
13	KANDAMANGALAM	233537210.04	3561928.61	1.53	COASTAL SALINE SOIL
14	KEELAIYUR	173072850.20	9083648.32	5.25	COASTAL SALINE SOIL
15	KEERAPALAYAM	123066985.35	50184462.65	40.78	COASTAL SALINE SOIL
16	KILLIYOOR	27797205.53	975230.88	3.51	COASTAL SALINE SOIL
17	KOLLIDAM	272680537.73	465285.90	0.17	COASTAL SALINE SOIL
18	KOTTUR	321190878.64	437653.63	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	221958448.74	100.00	COASTAL SALINE SOIL
24	MARAKKANAM	423770925.99	169722836.98	40.05	COASTAL SALINE SOIL
25	MINJUR	459683083.78	452608481.54	98.46	COASTAL SALINE SOIL
26	MUNCHIRAI	187408797.71	123207679.80	65.74	COASTAL SALINE SOIL
27	MUTHUPETTAI	372762749.08	275672726.32	73.95	COASTAL SALINE SOIL
28	NAINARKOIL	265298425.88	5869174.18	2.21	COASTAL SALINE SOIL
29	OTTAPIDARAM	789985062.30	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	168067150.78	55.14	COASTAL SALINE SOIL
33	PUZHAL	134550930.49	77517267.23	57.61	COASTAL SALINE SOIL
34	RADHAPURAM	309678174.59	151774863.02	49.01	COASTAL SALINE SOIL
35	RAJAKKAMANGALAM	147554170.04	86895022.01	58.89	COASTAL SALINE SOIL



3.1 DATA INPUT

3.1.1 ENTERING SPATIAL DATA

3.1.2 ENTERING NON SPATIAL DATA

3.1.3 LINKING SPATIAL DATA TO NON SPATIAL
DATA

Field surveys



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

**BOTH
SPATIAL
& NON-
SPATIAL
DATA**



Remote sensing data

Data Sources for GIS



Digital data files



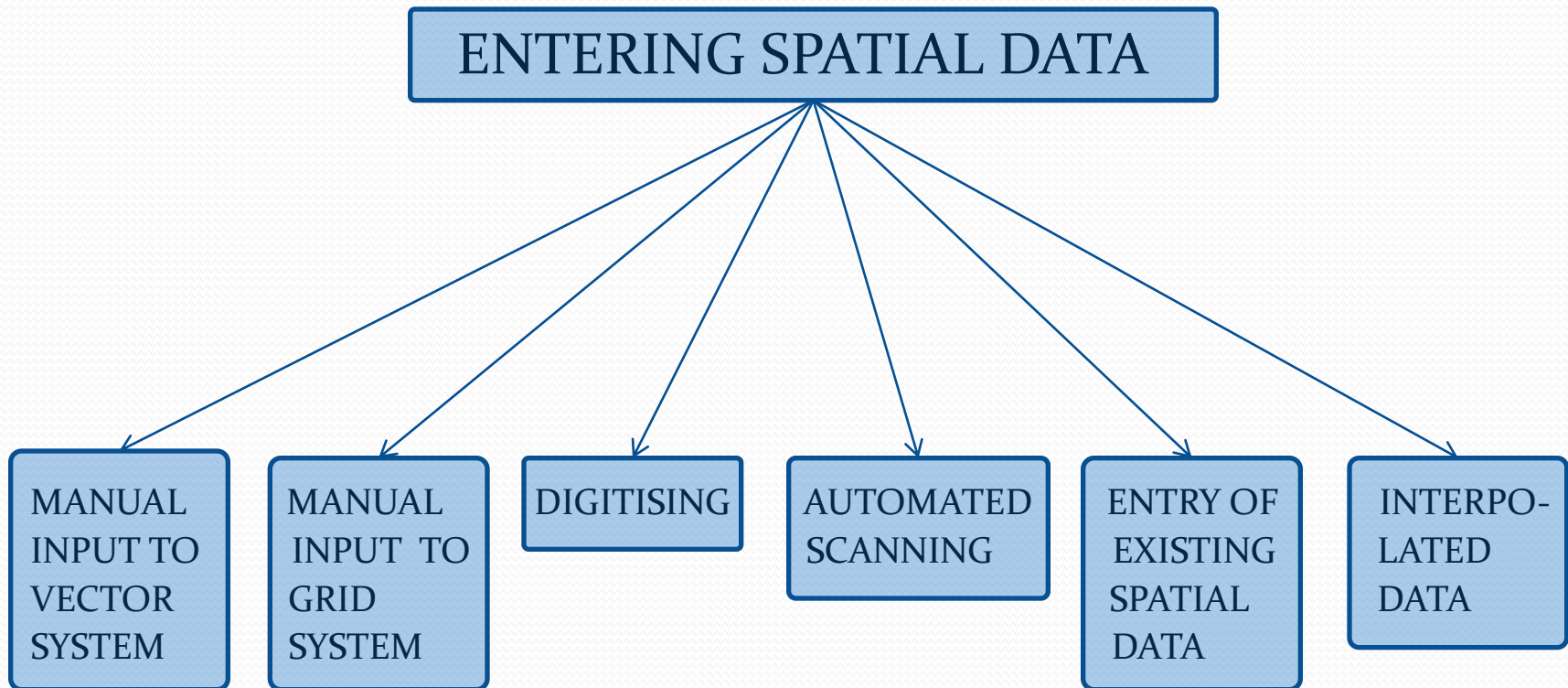
**Collateral or Secondary
data collection**



Literatures & References



ENTERING SPATIAL DATA



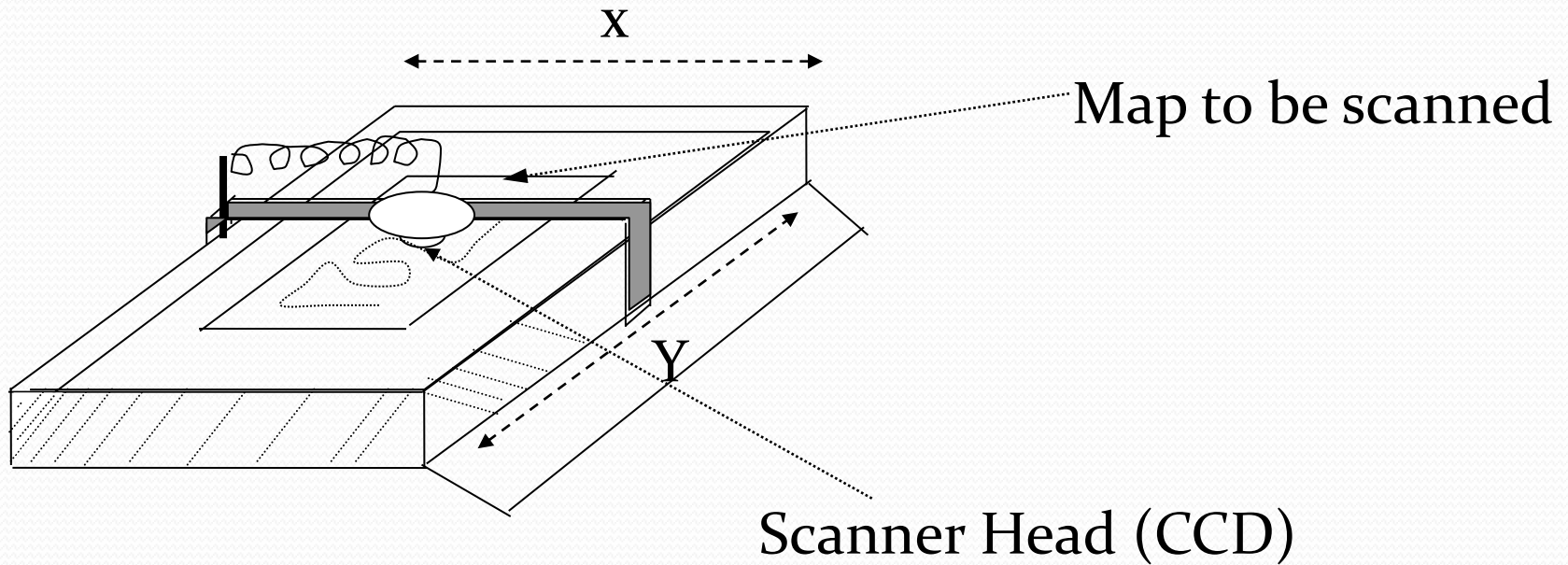
Data Entry in GIS

- Digitization using digitizer board
- Onscreen digitization
 - Scanning – Automatic / Semi-Auto.
 - Geo-referencing
 - Digitization &
 - Projection
- A straight line can be digitized by inserting two nodes only, i.e., with a starting/from node, and finish with an end/to node. Otherwise, the 3rd and the other extra nodes will **deform the shape** of the straight line feature.
- An acute curvature has to be digitized with many no. of nodes.
- Manual entry of series of X,Y data
- Entry of existing spatial data using .txt, .dbf, .xls files.

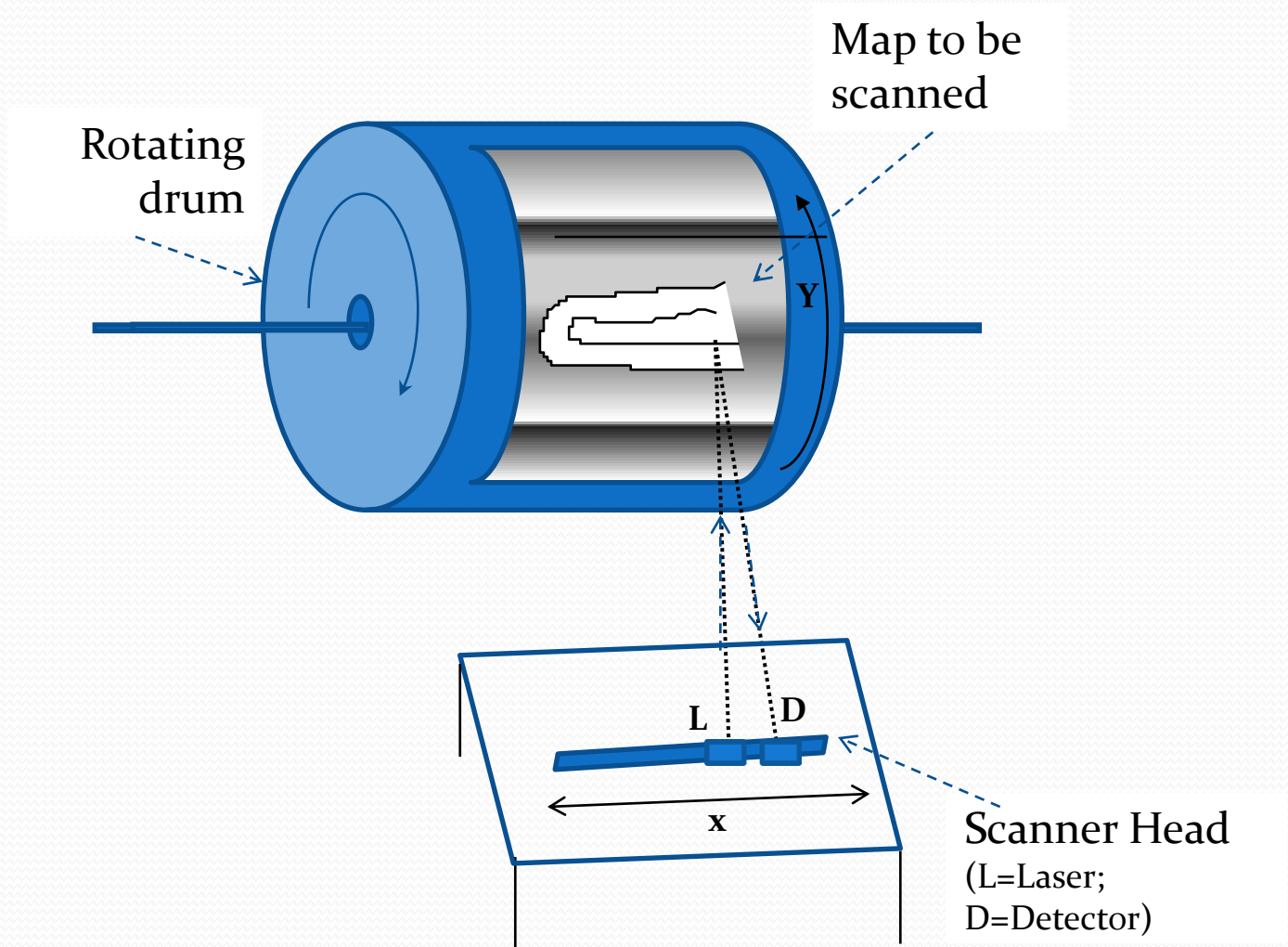


AUTOMATED SCANNING

Flat bed Scanner

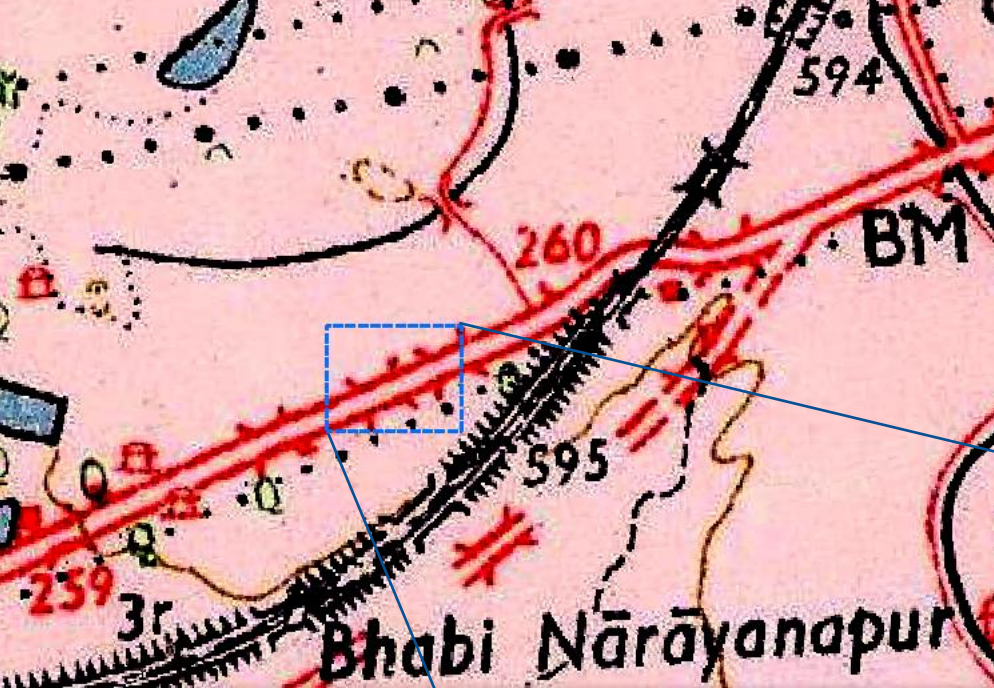


Drum Scanner



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.

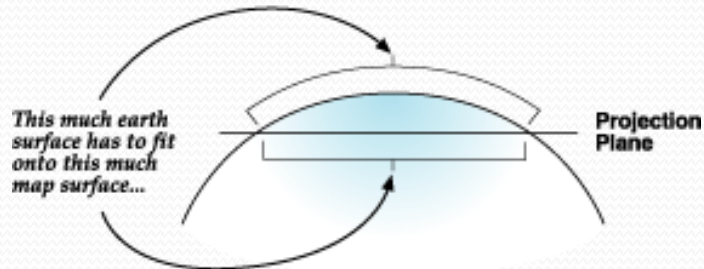
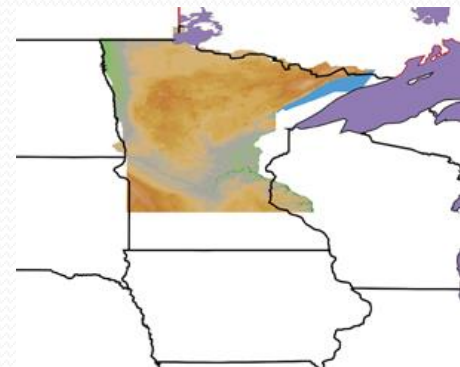
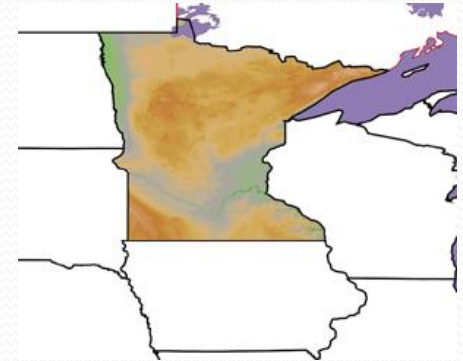
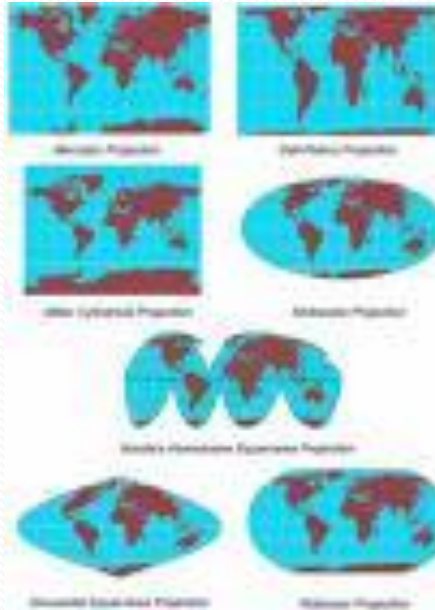
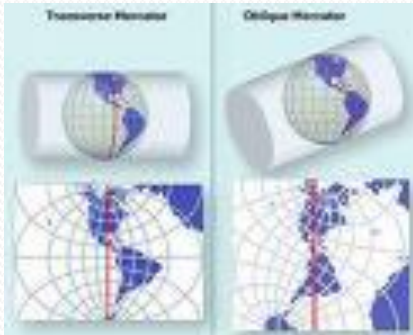
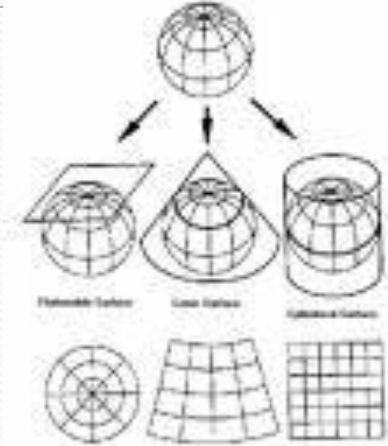
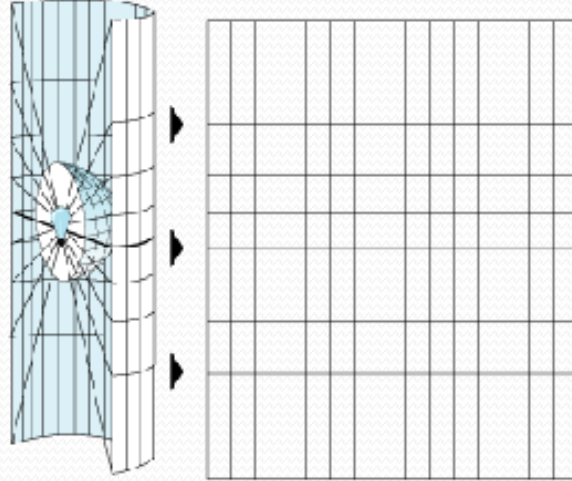


19 pixels are representing the red coloured double line symbol for NH in this area.

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



This much earth surface has to fit onto this much map surface...

therefore, much of the earth's surface has to be represented smaller than the nominal scale.

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

$$DD = (\text{DEGREE} + (\text{MINUTE} / 60) + (\text{SECONDS} / 3600))$$

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

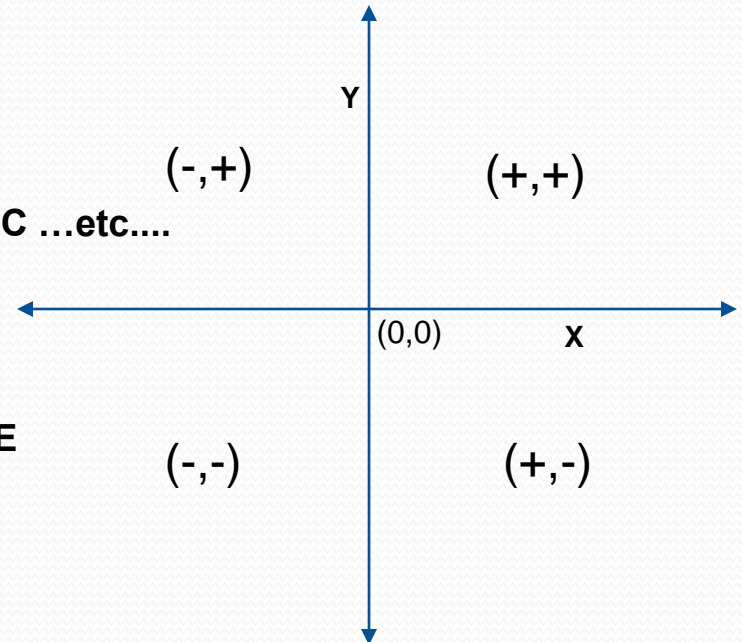
$(\text{MAX} - \text{MIN LONGITUDE}/2) + \text{MIN. LONGITUDE}$

4. LATITUDE OF PROJECTIONS ORIGIN IN DD

LAT. @ BOTTOM LEFT CORNER OF MAP

5. DATUM PLANE

6. FALSE EASTING & FALSE NORTHING



GIS Database Management

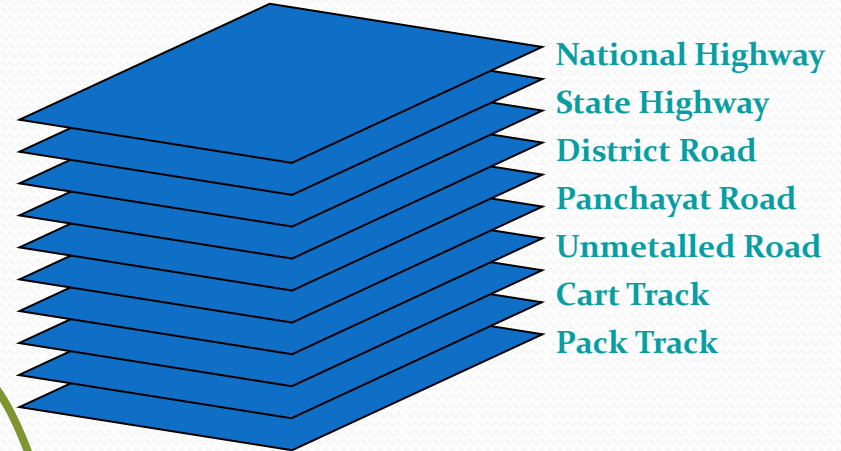
Spatial Data

Non Spatial Data

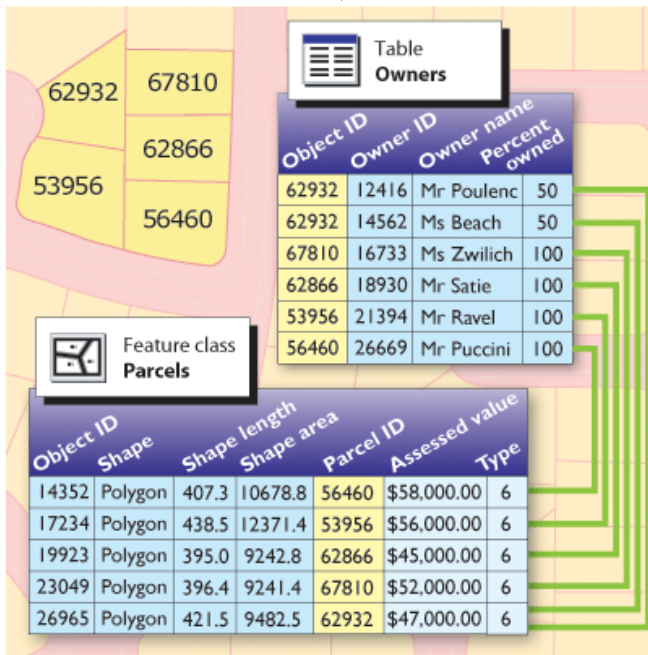
Unique Identifier (U_ID) /
Feature Identifier (F_ID) /
Label-ID / Object-ID / Parcel-ID...

Provide Link using 'Join / Relate'
methods

Preferential display / retrieval
of a Layer



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

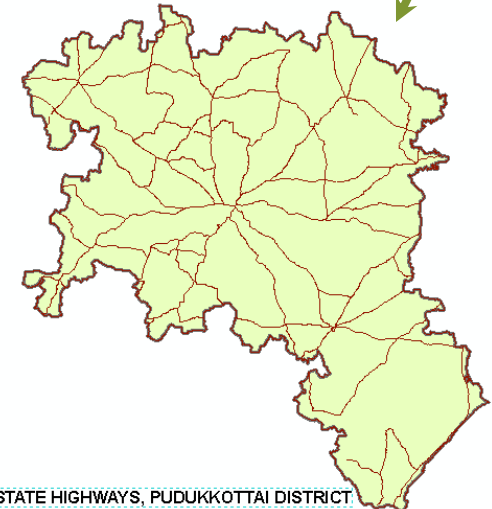


What are the data linking
methods?

One to One = "Join"

One to Many
Many to One
& Many to Many } = "Relate"

State Highways of Pudukkottai District
Tamil Nadu, India



STATE HIGHWAYS, PUDUKKOTTAI DISTRICT

DATA VERIFICATION, DATA QUALITY ANALYSIS & SOURCES OF ERRORS

Decisions... to identify and acquire QUALITY products...



What to discuss...

- **Factors affecting data quality**
- **Sources of errors**
- **Types of GIS errors**
- **Methods to deal with errors**

TERMINOLOGY – Used in assessing data quality

- **Data Quality** – Refers to how good the data are. Degree of excellence.
Overall fitness or suitability of data for a specific purpose or is used to indicate data free from errors and other problems.
- **Error** – is a departure/deviation from the correct data value.
- **Data Accuracy** – The extent to which a measured data value approaches its true value. Data Accuracy Standard by ASPRS (American Society for Photogrammetry and Remote Sensing, in terms of RMS error = $\pm 16.7'$ for 1:20,000, $\pm 2'$ for 1:2400 scale maps.
- **Data precision** – The recorded level of detail.
- **Bias** – Refers a consistent / regular / constant error. A systematic variation of data from reality
- **Resolution** – The size of the smallest features captured in the data.
- **Generalization** – The degree of simplification when drawing a map.
- **Completeness** – The degree to which data are missing.
- **Compatibility** – It indicates the reasonable usage of two data sets together.
- **Data Consistency** – The commonality of same methods of data capture, storage, manipulation and editing, when adopted to generate database to ensure compatibility.
- **Applicability** – The suitability of a particular data set for a particular purpose.

Development of computer methods for handling spatial data

- **Computer cartography**
 - Computer cartography (digital mapping) is the generation, storage and editing of maps using a computer.
- **Spatial statistics**
 - Initially, developments were in areas such as measures of spatial distribution, three-dimensional analysis, network analysis and modeling techniques.
- **CAD**
 - Computer-aided design (CAD) is used to enter and manipulate graphics data. Traditional users of CAD used for the production, maintenance and analysis of design graphics.
- **GIS**
 - Geospatial information system on natural, physical and human resources and hazards having all data handling facilities with automation and customization.
- **SDSS**
 - Spatial Decision Support System – Automated GIS functionality loaded with raw data, cooked data, information and maps which are ready to directly use by the users. Moreover, it provides options to build new methodology to analyze data with update, edit and other functions of GIS.

What type of error?



Causes of errors in spatial data

- i. Accuracy of content**
- ii. Instrument / measurement errors:** accuracy (ex. During altitude measurement or soil samples, usually related to instruments)
- iii. Computational errors:** precision (ex. To what decimal point the data is represented?)
- iv. Human error:** error in using instruments, selecting scale, location of samples
- v. Data model representation errors**
- vi. Errors in derived data**

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**

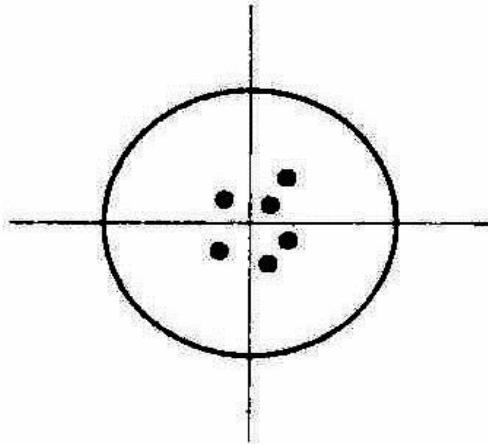
2. Errors resulting from natural variations or from original measurements

- 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**

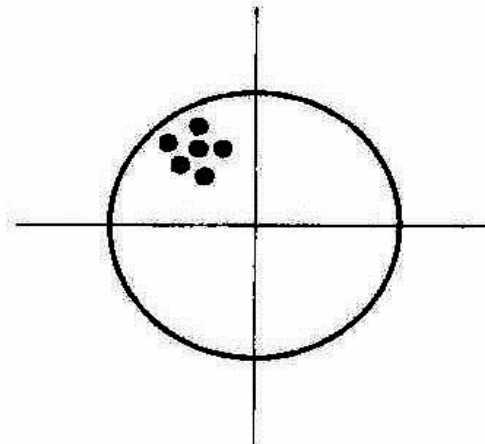
Factors affecting the quality of Geospatial data

- **Currency / Age of data** – Time series-different times and up to date
- **Completeness** - Areal coverage
- **Consistency** - Map scale and resolution, relevance, standard descriptions
- **Accuracy and Precision** - Density of observations, positional accuracy, attribute accuracy-qualitative and quantitative, topological accuracy, lineage-when, by whom, how?
- **Data Accessibility** - Data formats, data exchange and Interoperability, Cost and copyright
- **Sources of errors in data** – Data entry and output faults, Choice of original data model, Natural variation and uncertainty in boundary location, topology, observer bias, processing-Numerical errors in the computer, computer limitation in number precision
- **Sources of errors in derived data and in the results of modelling and analysis** – Problems associated with map overlay, classification and generalization problems, choice of analysis model, misuse of logic, error propagation, method used for interpolation.

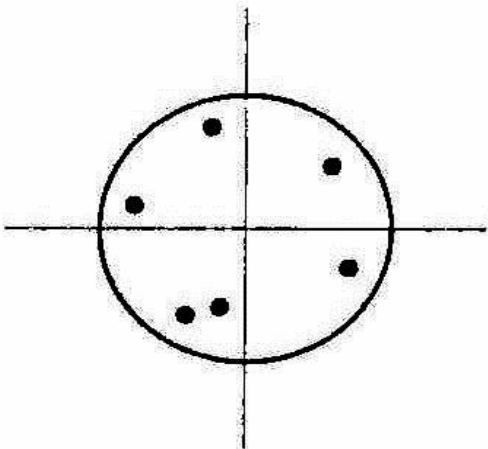
Errors during collection of data



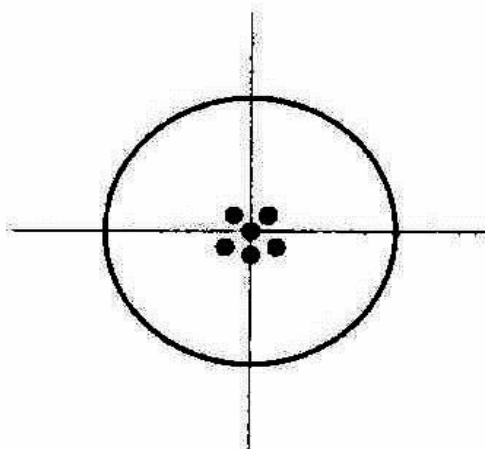
(a) Accurate
imprecise



(b) Inaccurate
precise



(c) Inaccurate
imprecise



(d) Accurate
precise

DATA VERIFICATION IN GIS

Sources of possible errors

1. ERRORS ARISES DURING ENCODING AND INPUT OF SPATIAL / NON-SPATIAL DATA - Errors in source data for GIS

- Survey data can contain errors due to mistakes made by people operating equipment, or due to technical problems with equipment.
 - Remotely sensed, and aerial photography data could have spatial errors if they were referenced wrongly, projected wrongly, and mistakes in classification and interpretation would create attribute errors.
- a) SPATIAL DATA IN WRONG PLACE
 - b) SPATIAL DATA ARE DISTORTED
 - c) SPATIAL DATA ARE IN WRONG SCALE
 - d) SPATIAL DATA ARE INCOMPLETE OR DOUBLE
 - e) SPATIAL DATA LINKED TO A WRONG NON SPATIAL DATA
 - f) SIMILAR ERRORS IN NON SPATIAL DATA

Sources of possible errors ...contd...

a) 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 field or in lab
- due to GPS errors
-

Gross - due to data origin

b) SPATIAL DATA ARE DISTORTED

Due to shrinkage, improper rectification, improper projection

2. Errors arising from our understanding and modeling of reality

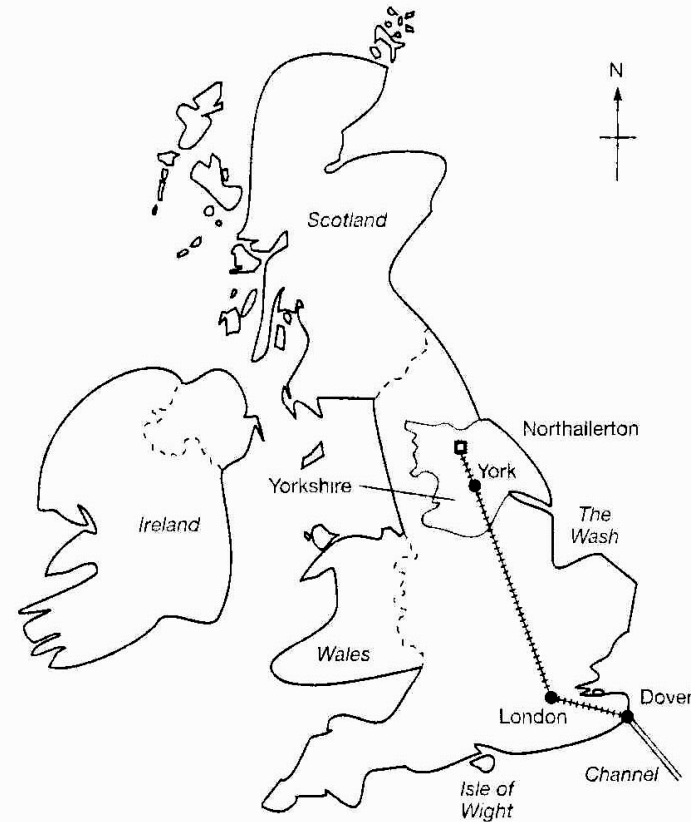
- The different ways in which people perceive reality can have effects on how they model the world using GIS.
- Mentally prepared maps to be personal, fragmentary, incomplete and frequently erroneous.
- In all cases, distance and shape would be distorted in inconsistent ways and the final product would be influenced by the personality and experience of the 'cartographer'.

Errors through Perceptions or reality – mental mapping ...contd...

Map prepared by person 1

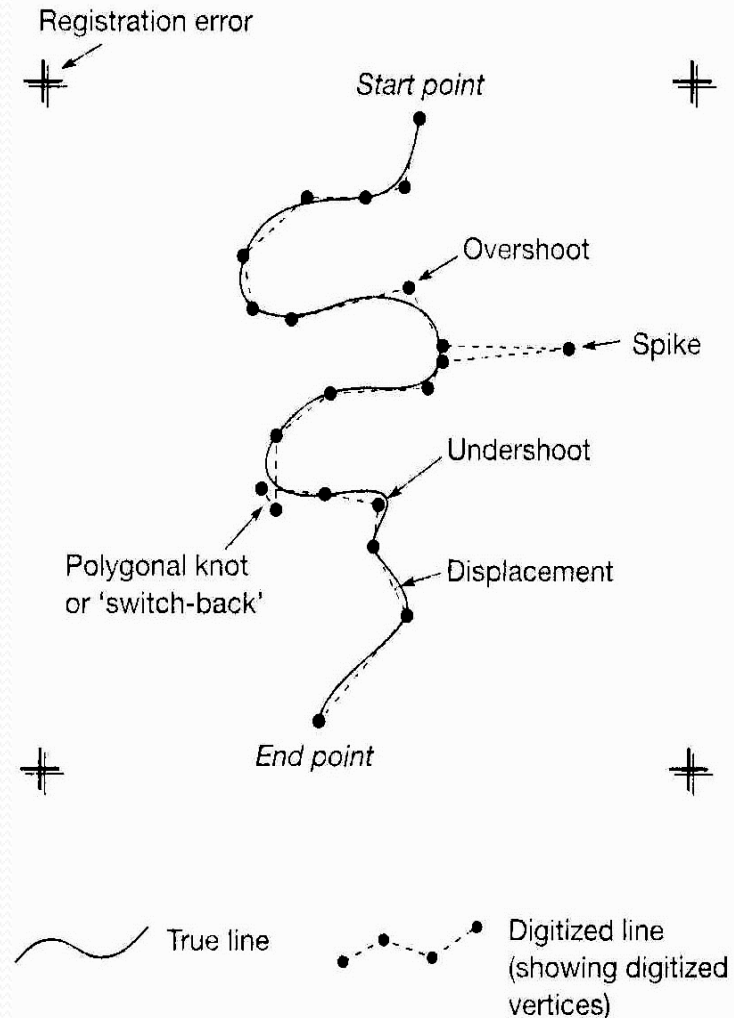


Person 2



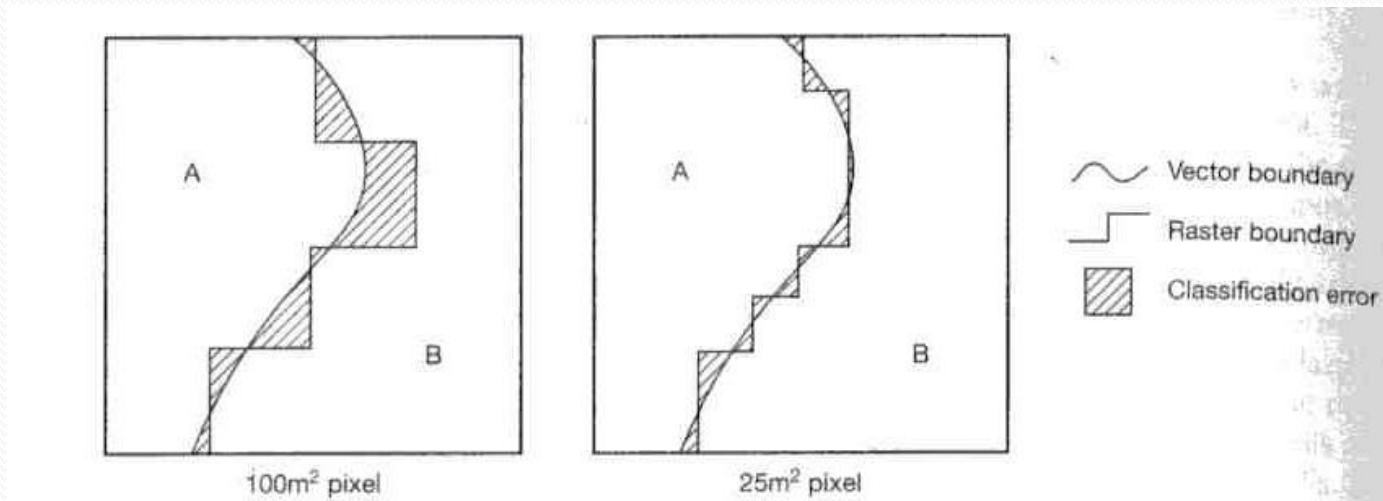
3. Operational errors introduced during manual digitizing – data encoding

- **Psychological errors:** Difficulties in perceiving the true center of the line being digitized and inability to move the cursor cross-hairs accurately along it;
- **Due to Mental / Physical Tiredness:** Double digitization / incomplete / missing / wrong entry of spatial and nonspatial / linking of feature.
- **Physiological errors:** It results from involuntary muscle spasms that give rise to random displacement.
- **Line thickness:** The thickness of lines on a map is determined by the cartographic generation employed.
- **Method of digitizing:** Point mode and stream mode.



4. Errors during data editing and data conversion

- -Non-Topological errors in vector GIS
 - Double / wrong digitization of point, line, polygon, etc.
- - Errors During Data conversion

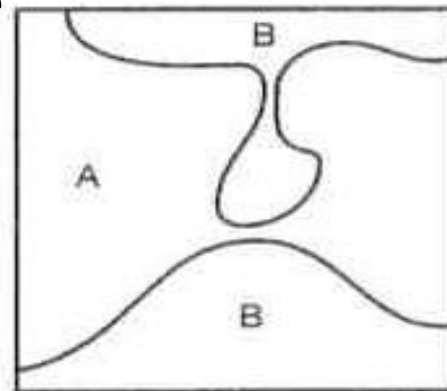


...Contd ... Rasterization errors

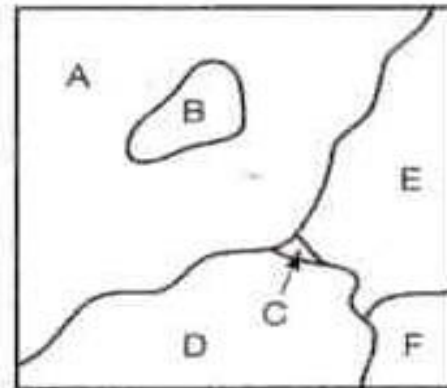
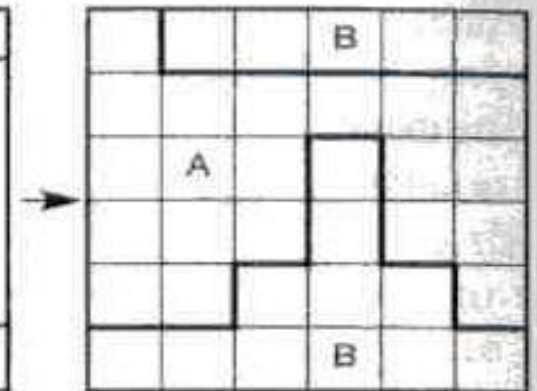
Vector to raster conversion can cause an interesting assortment of errors in the resulting data. For example

- Topological errors
- Loss of small polygons
- Effects of grid orientation
- Variations in grid origin and datum

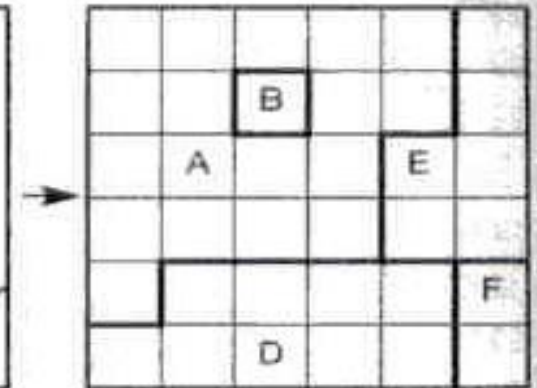
Topological error in vector GIS: (a) loss of connectivity and creation of false connectivity (b) loss of information



(a)



(b)



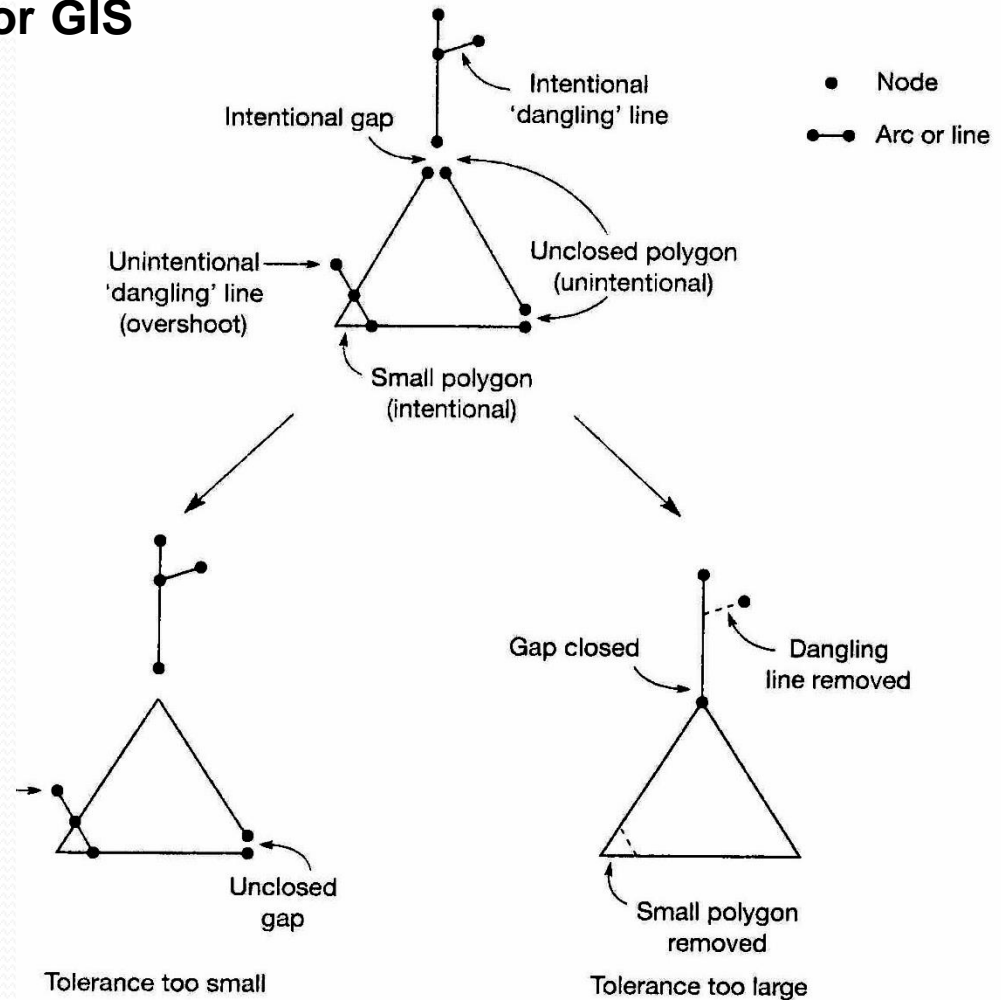
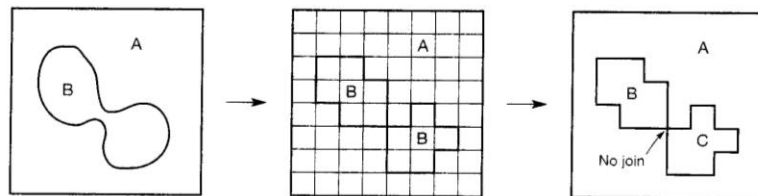
What happened to 'C'?

5. Topological Errors in data

-Topological errors in vector GIS

(a) Effects of tolerance on topological cleaning

(b) Topological ambiguities in raster to vector



6. Errors arising through processing / analysis

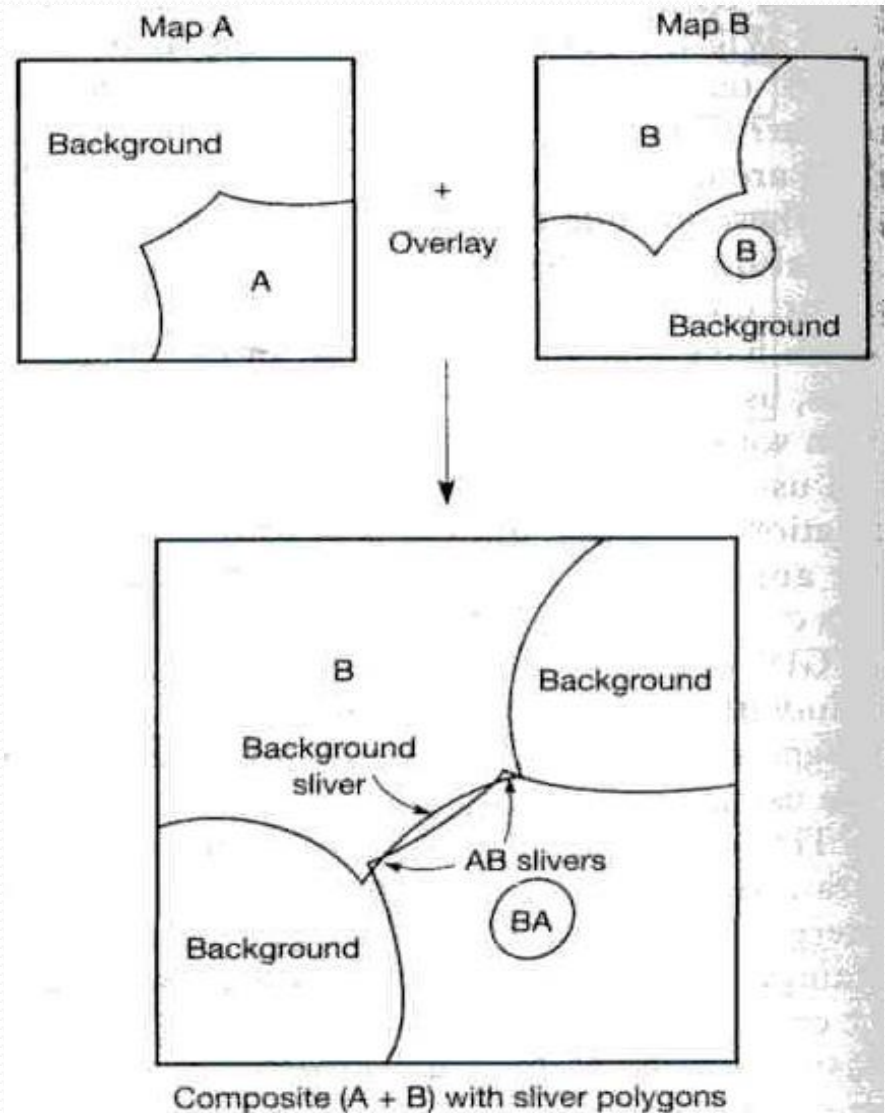
1. Numerical errors in the computer
2. Limitations of computer representations of numbers
3. Faults arising through topological analyses
4. Misuse of logic
5. Problems associated with map overlay
6. Classification and generalization problems
7. Methodology
8. Class interval definition
9. Interpolation

Errors during data processing...contd...

- GIS operations that can introduce errors include the classification of data, aggregation or disaggregation of area data and the integration of data using overlay technique.
- Where a certain level of spatial resolution or a certain set of polygon boundaries are required,
- Data sets that are not mapped with these considerations may need to be aggregated or disaggregated to the required level.

Error due to Analysis...contd...

- Attribute error result from positional error (such as the missing 'hole' feature in map A that is present as an island in map B). If one of the two maps that overlaid contains an error, then a classification error will result in the composite map (polygon BA).

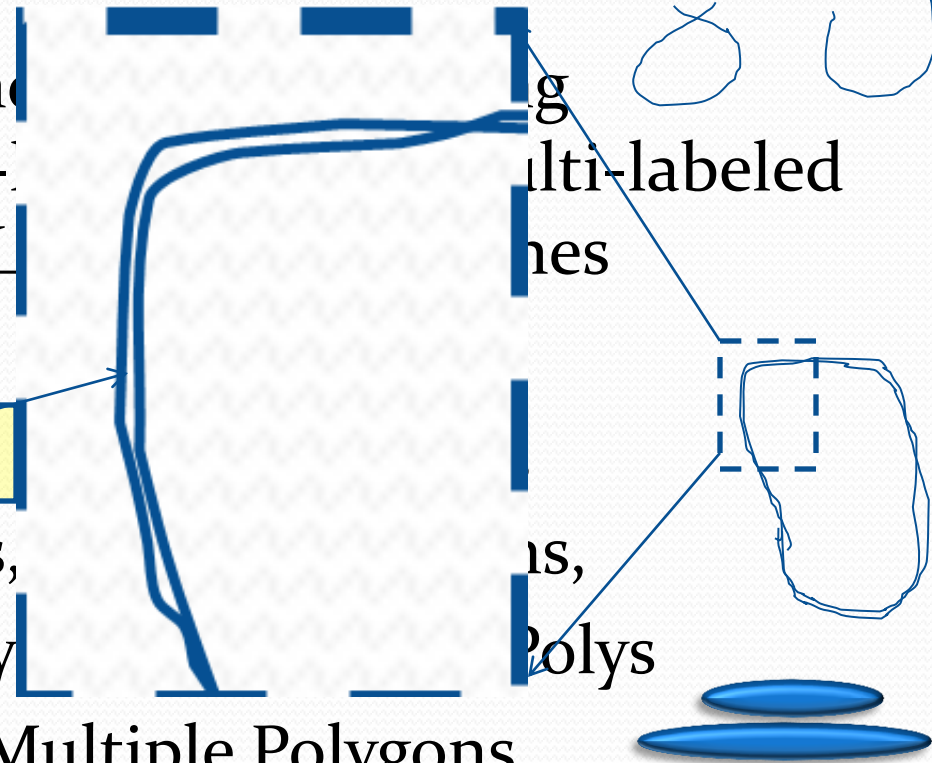


Error types in Vector Data

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

Lines - Overshoots, Un-closed Lines, Multi-labeled Lines, Missing Lines

Polygons - Sliver polygons, Weirid Polygons, Un-labeled Polygons, Missing Polys, Multiple Polygons



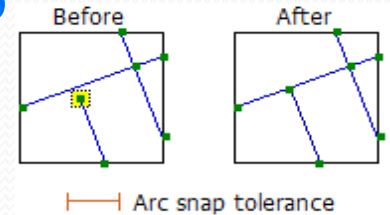
Methods to deal with errors

- Initial data: Control quality of measurement, develop standards, prevent human error.
- Data models: select correct data models based on experience or model appropriateness, reduce errors during conversion from one to another.
- Build Topology properly – Geometrical properties of spatial features such as Containment, Adjacency, and Connectivity.

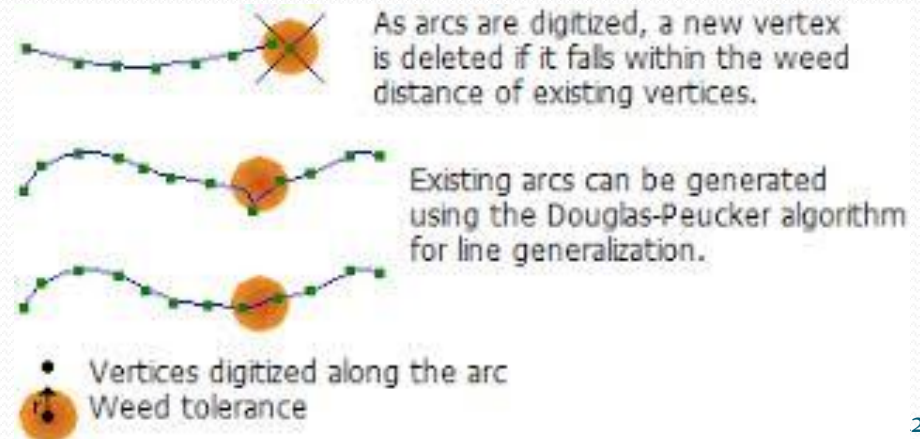
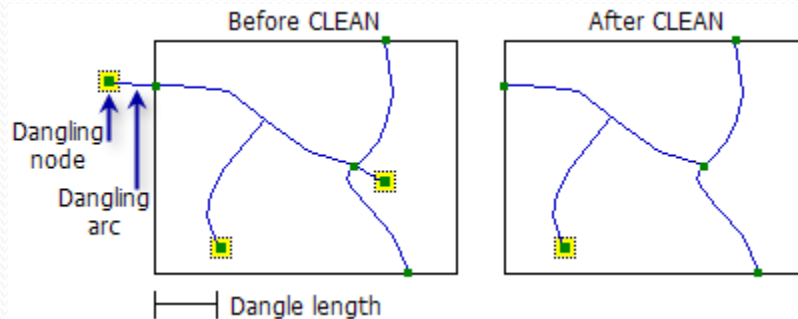
Finding and modeling errors in GIS

- Checking for errors
 - Probably the simplest means of checking for data errors is by visual inspection.
 - Various statistical methods can be employed to help pinpoint potential errors.
 - Estimating degree of an error helps in controlling and correcting errors
 - Use topological relations to find and locate errors
 - Maintain the ASPRS standard of data quality : RMS error should be less than 5%.

Editing topological errors



- Properly define Dangle length, Fuzzy tolerance, Snap tolerance – to remove dangles,
- Use Flip, Select to remove wrong arc directions and duplicate lines.
- Editing using Topology Rules -25 rules to remove the topological errors easily for the entire data sets at a single stretch.

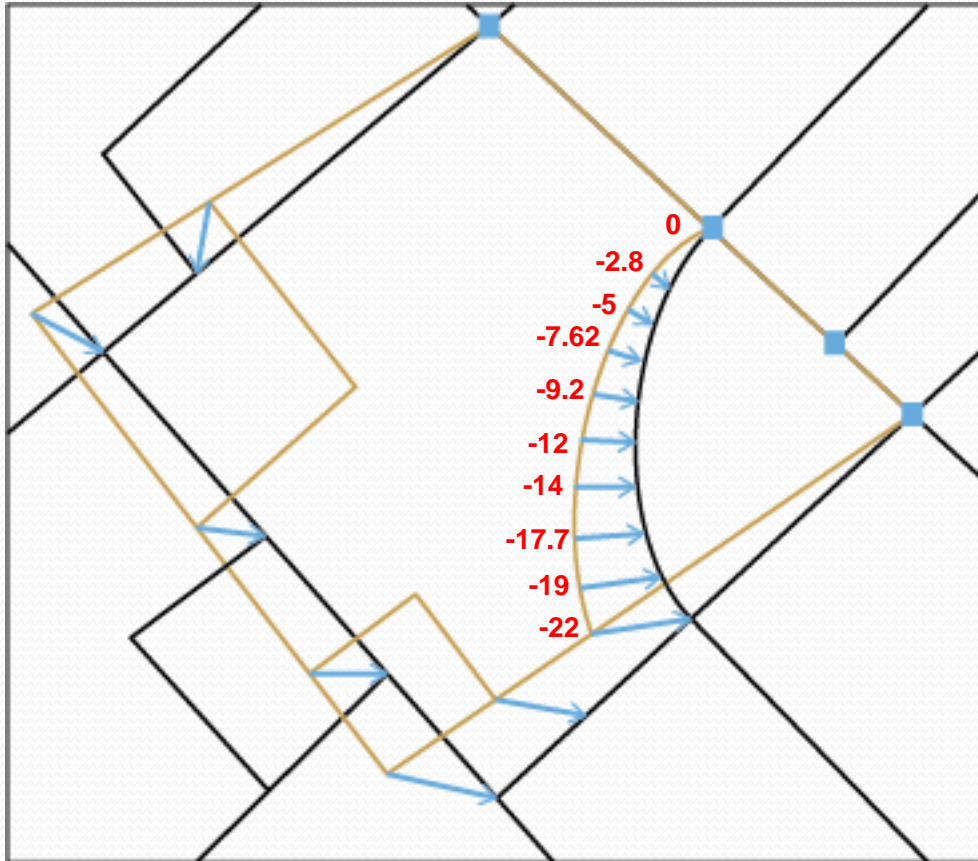


Editing of Non-topological errors

- **Extend/Trim lines**
- **Delete / Move features**
- **Reshaping features**
- **Split lines and polygons**
- **Merge features**
- **Buffer, union, intersect features**
- **Copy, put, get features in other maps – to avoid slivers due to integration**
- **Edge matching**
- **Line simplification and**
- **Line smoothing.**

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.



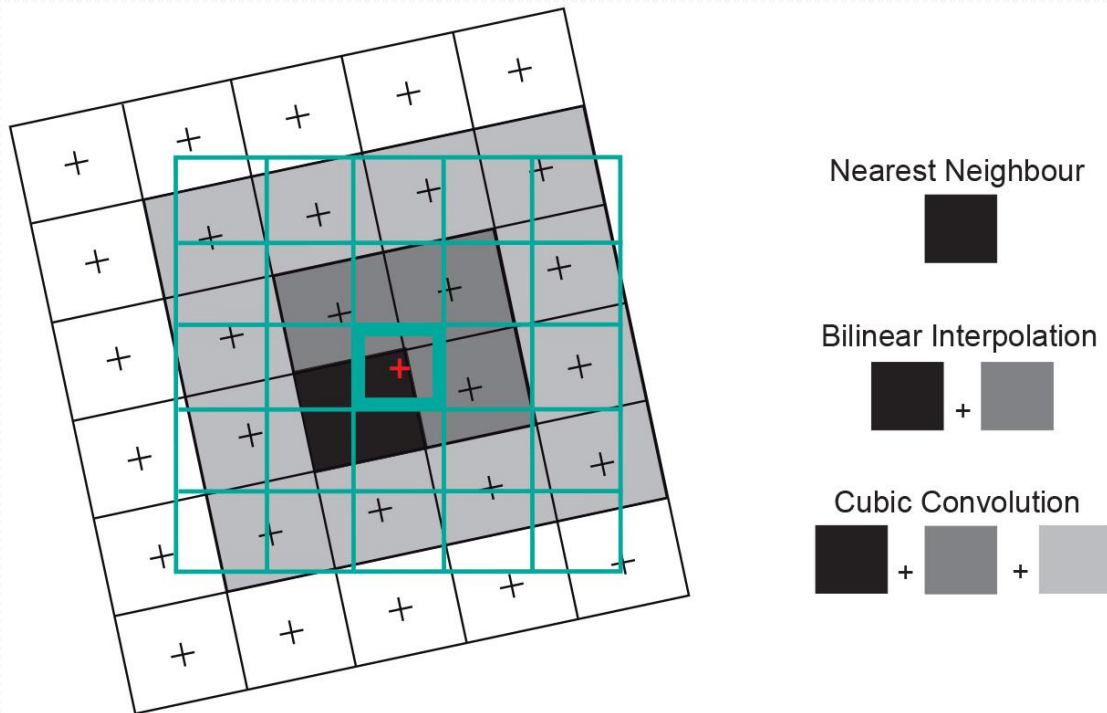
- Source feature
- Target feature
- Line as regular rubbersheet link
- Point as identity rubbersheet link

Search distance

Bilinear interpolation & Cubic Convolution

- Both are simple interpolation methods by resampling techniques for continuous data sets with no discernible boundaries used to calculate new pixel values.
- **Bilinear interpolation** - Uses a weighted average of the attributes of four surrounding pixels to calculate the output value.
- Two-dimensional interpolation along horizontally and vertically and produces a smoother surface than cubic convolution.
- **Cubic convolution** - Uses a weighted average of the 16 nearest input cell centers to calculate the output value.
- It fits a smooth curve through the points to find the value, which can change the values of the input and cause the output value to be outside of the range of input values.

- Cubic convolution tends to sharpen the edges of the data more than bilinear interpolation and does an excellent job of smoothing continuous data.



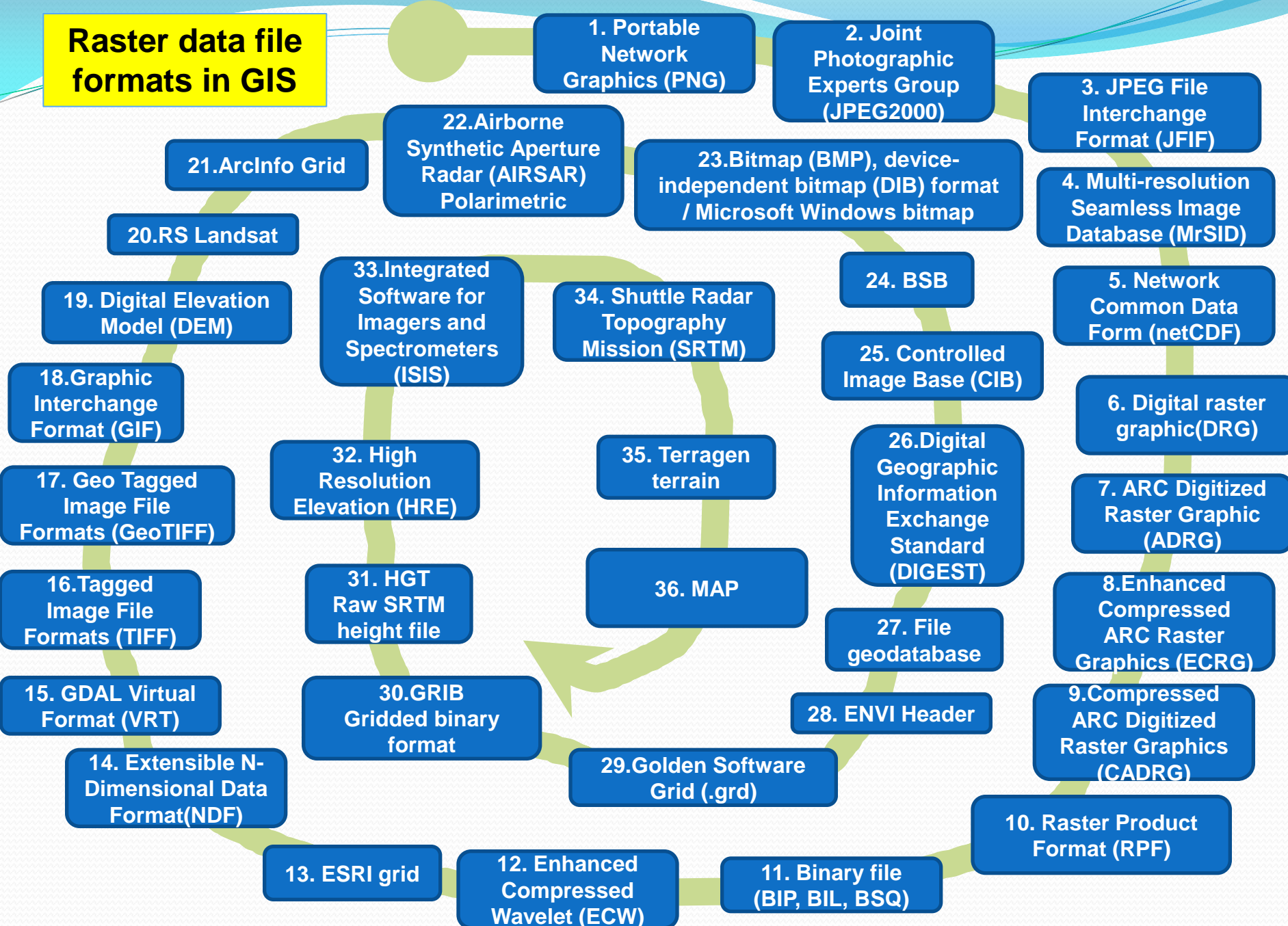
Ref.: <https://lfb.itc.utwente.nl/498/concept/81586>

Data verification

- Comparative checking physically over light table with transparent/translucent/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),

- 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

Raster data file formats in GIS



Vector data file formats in GIS

1. Shapefiles

2. ArcInfo Coverage

3. E00 ArcInfo Interchange

4. Spatial Database engine (ArcSDE)

5. Digital Line Graph (DLG)

12. Geograph y Markup Language (GML)

13. SpatiaLite

6. GeoJSON

11. ESRI TIN

17. SOSI is stands for Samordnet Opplegg for Stedfestet Informasjon (Coordinated Approach for Spatial Information).

18. MapInfo TAB format

14. OSM (OpenStreetMap)

16. National Transfer Format (NTF)

15. Scalable Vector Graphics

10. Vector Product Format (VPF)

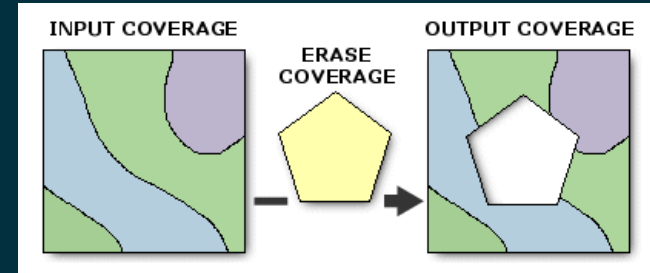
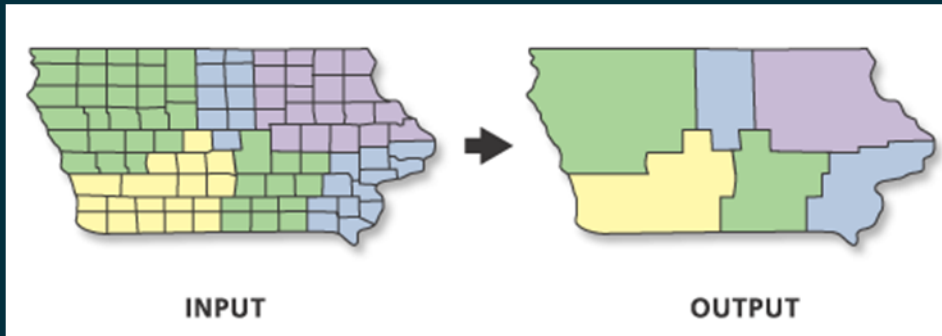
9. TIGER - Topologically Integrated Geographic Encoding and Referencing

8. Keyhole Markup Language (KML)

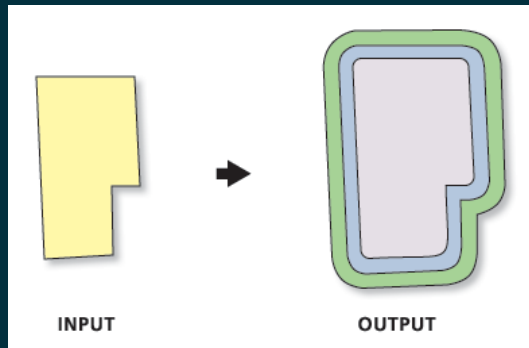
7. AutoCAD Drawing Interchange File (DXF)

Data Preprocessing and Postprocessing capabilities

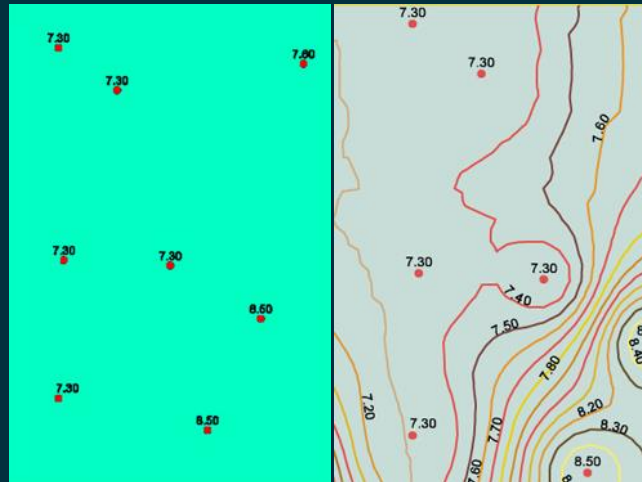
Classification/Grouping, Regrouping, /Reclassification



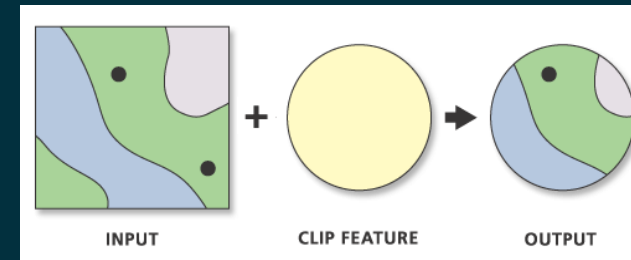
ERASE



BUFFER



**Interpolate points to lines
- Continuous surfaces**



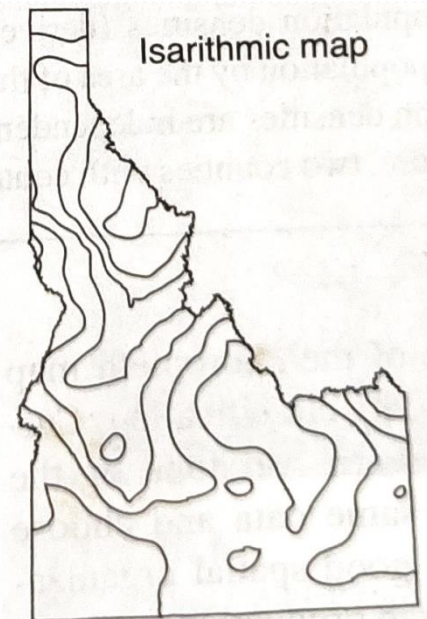
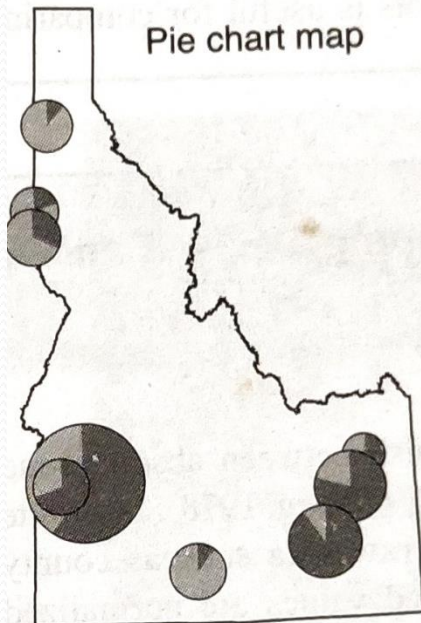
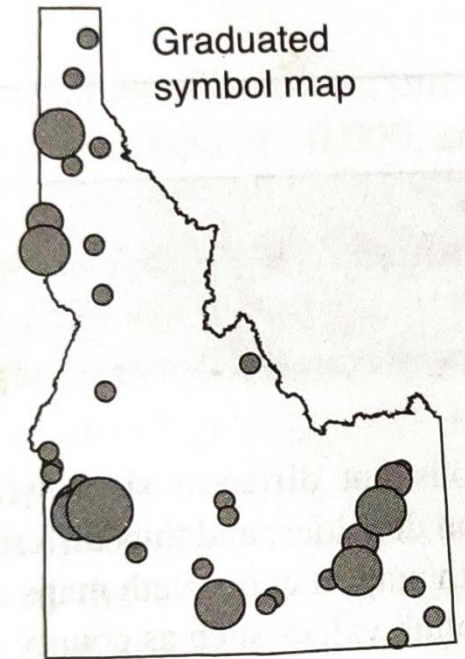
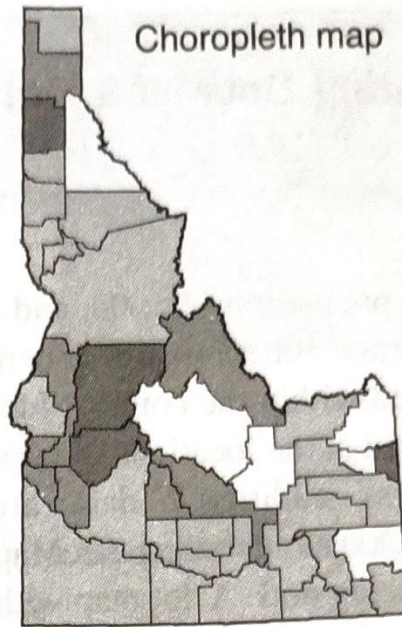
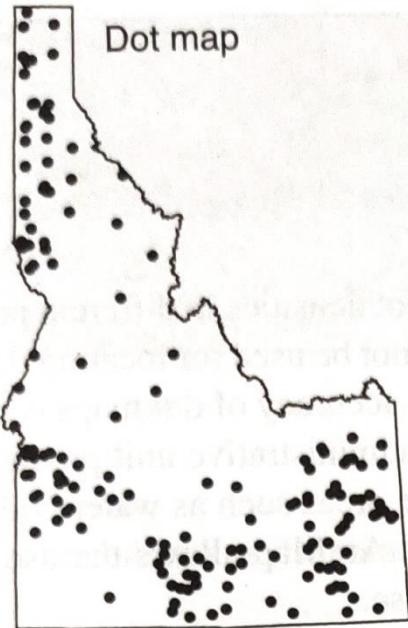
CLIP

Data type conversion - Nominal to Notional
Data format Conversion
Data Standardization, Normalization

Dissolve
Merge
Update
Identity
Interpolate...

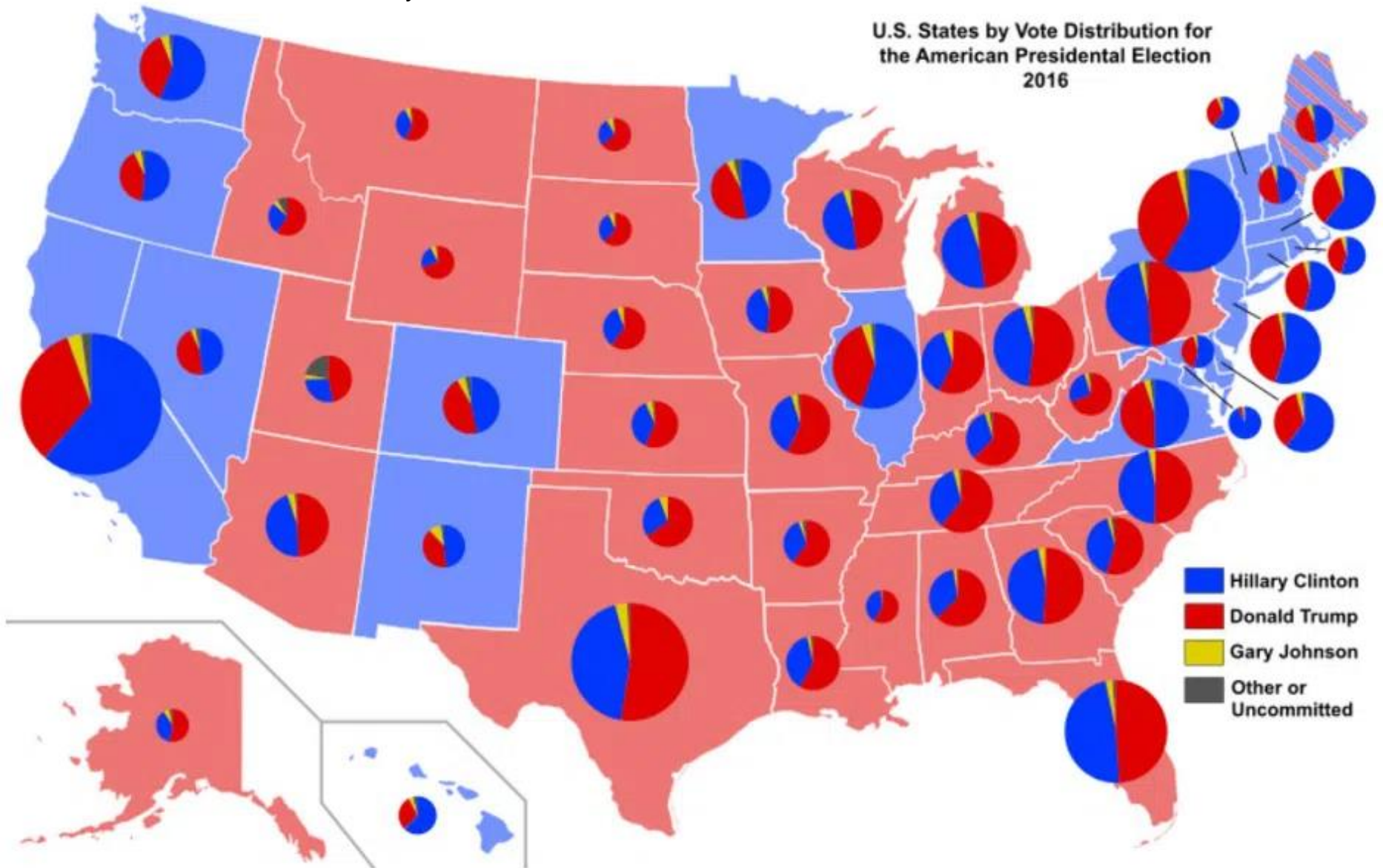
GIS OUTPUT CAPABILITIES

- SIMPLE DISPLAY - CARTOGRAPHIC LAYOUT OPTIONS
- CARTOGRAPHIC ELEMENTS - SCALE, LEGEND, TITLE, SUBTITLE, NORTH ARROW...
- STYLE & COLOUR CHANGE (COLOUR RAMP – MONO COLOUR RAMP-CHROMA, DOUBLE COLOUR RAMP, ,MULTI COLOUR RAMP, TEXTURE, COLOUR SYMBOL, SHAPE, VALUE, PATTERN, HUE...)
- INCLUDE LOCATION MAP – KEY MAP, MAP INSET, GRAPHS, PHOTOS, ETC.
- DOT MAP, CHOROPLETH MAP, DASYMETRIC MAP, GRADUATED COLOUR MAP, GRADUATED SYMBOL MAP, PROPORTIONAL SYMBOL MAP, CHART MAP, FLOW MAP, ISARITHMIC MAP
- CLASSIFIED DISPLAY OF DATA – EQUAL INTERVAL, EQUAL FREQUENCY, MEAN AND STANDARD DEVIATION, NATURAL BREAKS, USER DEFINED
- 3D DISPLAY – FLY-THRU MODEL, FENCE DIAGRAM, STACKED LAYERS ...
- OVERLAY OF MANY THEMES
- LIVE MAPS & INTERACTIVE MAPS
- PLOTTER / PRINTER O/P, WEB DISPLAY
- QUBIS – QUERY BASED INFORMATION (MAP) RETREIVAL SYSTEM
- SDSS – SPATIAL DECISION SUPPORT (MAP) SYSTEM - ON-TIME / STRATEGIC MAPS

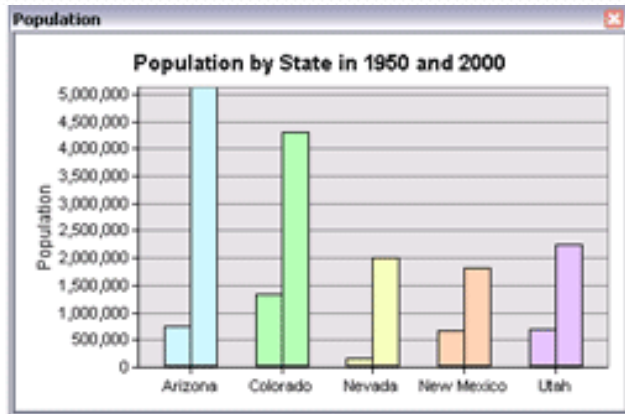


Dasymetric map (from Greek δασύς dasýs 'dense' and μέτρο méτρο 'measure')

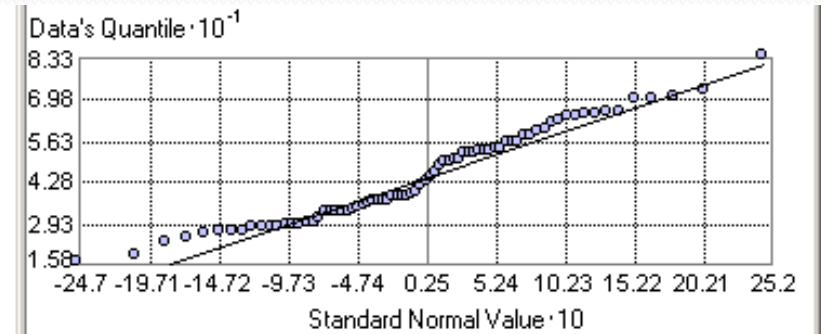
- For e.g.,
1. Groundwater level in Tiruchirappalli Blocks (2018 isolines based dasymetric map)
 2. U.S. States by vote distribution for the American Presidential Election -2016



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

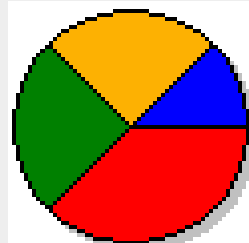


Charts

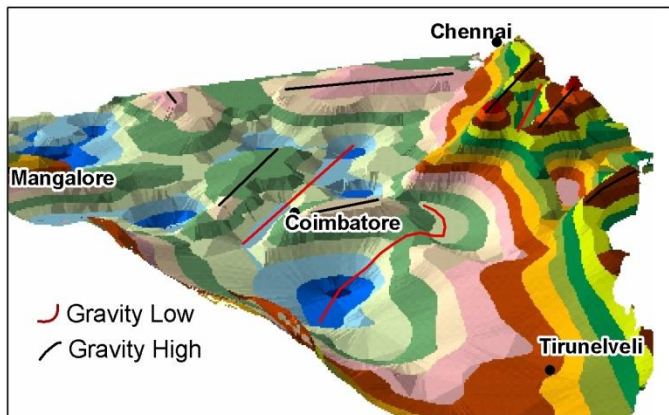


Histograms

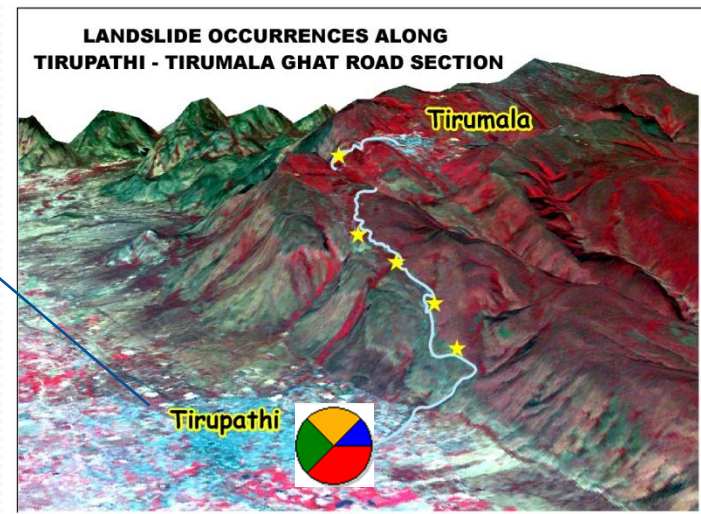
Pie



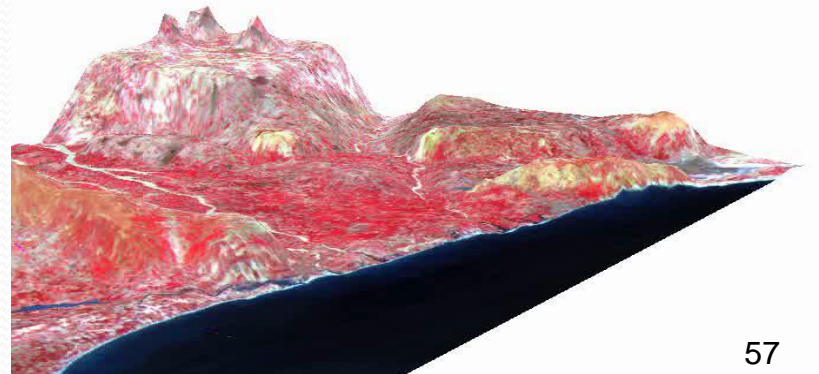
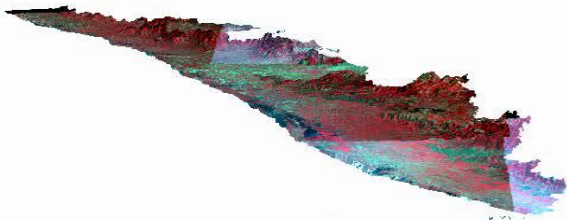
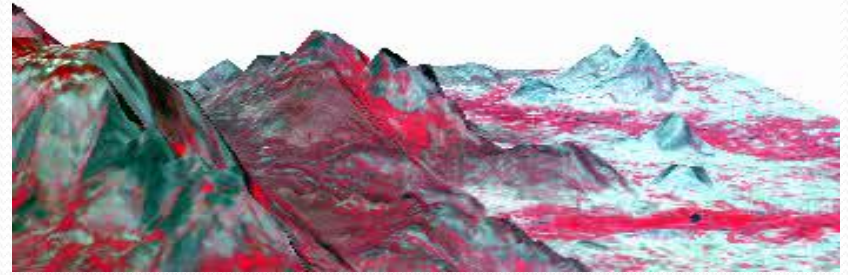
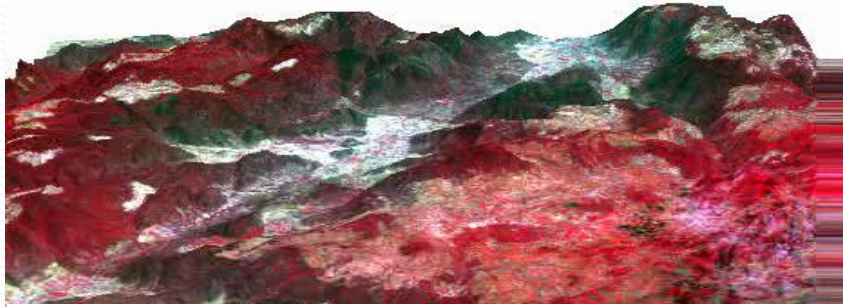
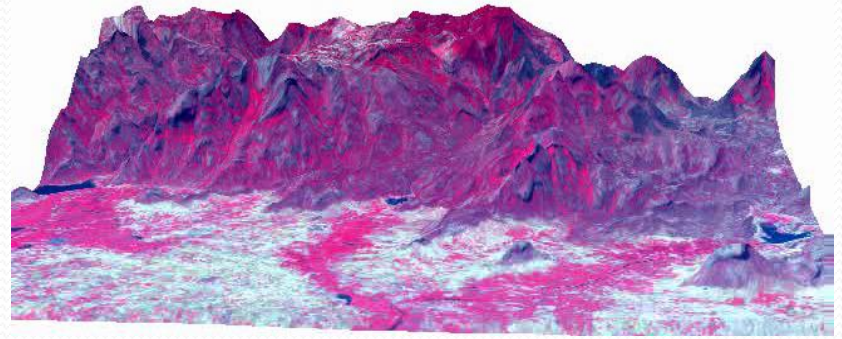
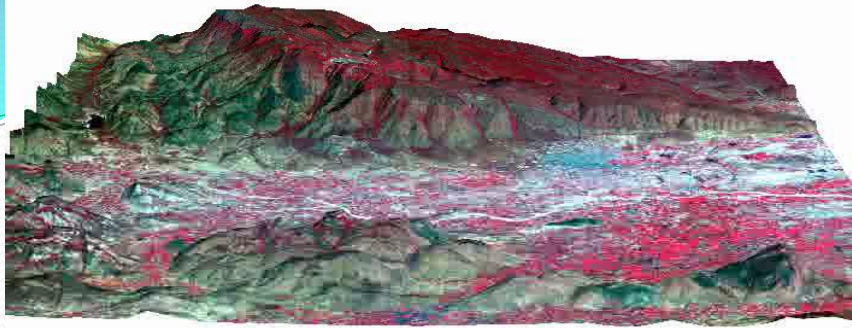
UNIT – IV
GIS Data Manipulation & DEM

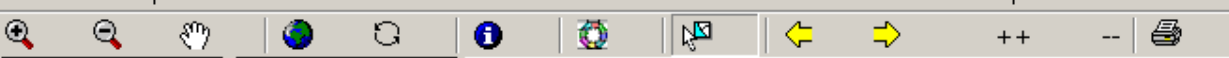


3D IMAGE



DIGITAL ELEVATION MODEL(DEM)

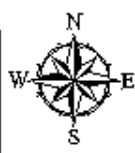
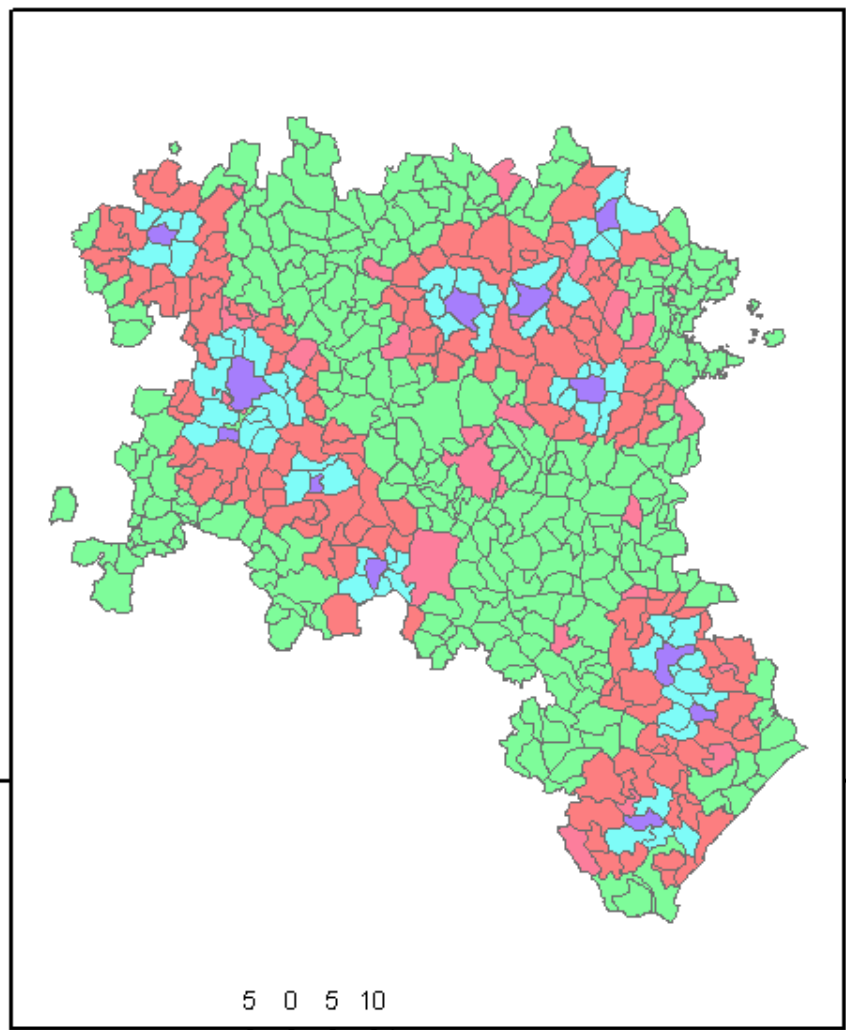




Map Selection View

- ital Availability - Block Prima
- ailable
- < 2
- 2 - 4
- > 4
- Overall Availability
- available
- < 3 km
- 3 - 6 km
- > 6 km
- Overall Availability and Reachability
- rs

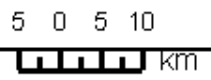
Health Sector - Hospital Availability - Block Primary Health Centre Unavailable - Overall Availability and Reachability



- Legend**
- < 3 km
 - > 6 km
 - 3 - 6 km
 - 0

0°0'N

10°0'N



- Districtwise Blockwise
- Talukwise Villagewise
- Mini Watershedwise
- Featurewise

Problem Selection Statistics

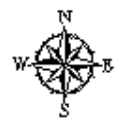
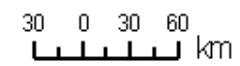
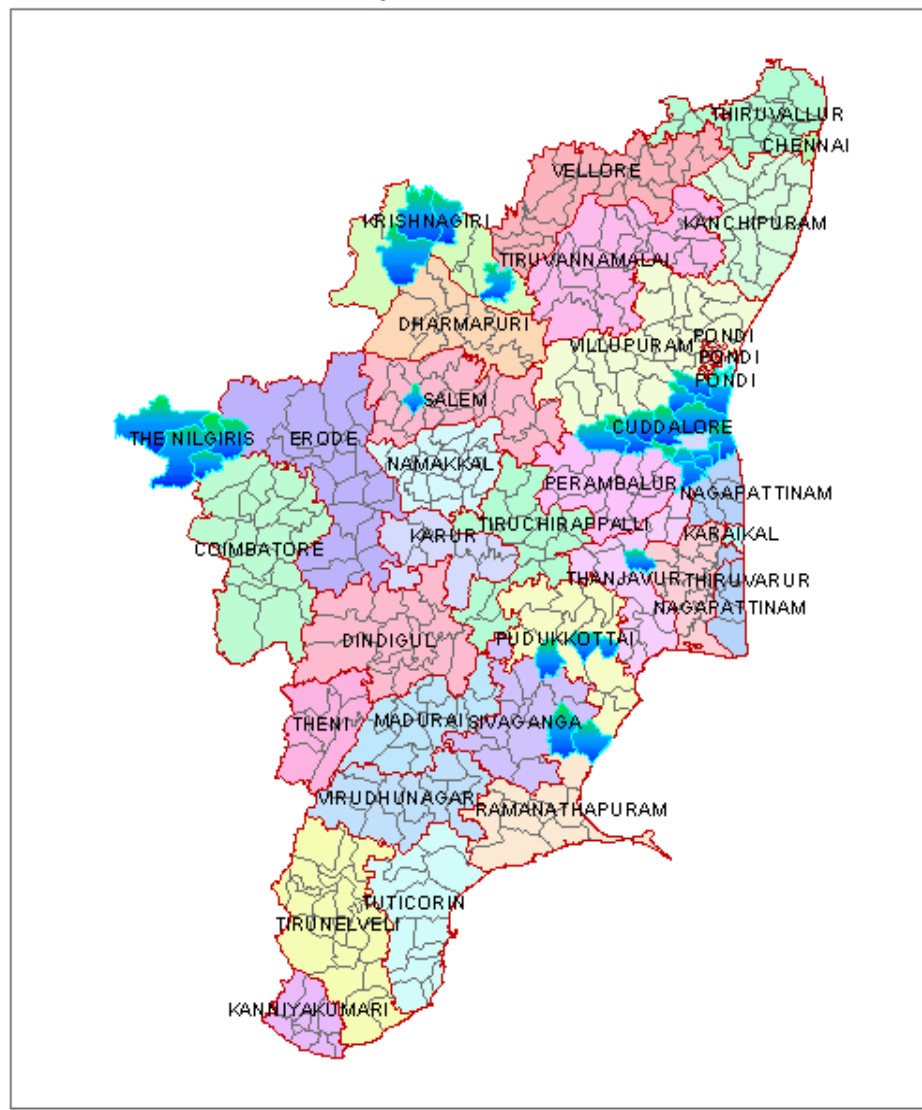
- Natural Disasters Secto
 - Problems
 - Seismicity
 - Floods
 - Severity in Grade
 - VERY LOW
 - LOW
 - MODERATE**
 - HIGH
 - VERY HIGH
 - Over all Sever
 - Level of S&T Inter
 - Agency invloved
 - Landslides
 - Tsunamis
 - Cyclones (last 25 ye
 - Coastal Erosion
 - Drought

Blockwise Retrieval for

- Entire State
- Districtwise

NATURAL DISASTERS SECTOR Floods

Severity in Grades - MODERATE



Severity in Grades

- MODERATE
- TN_DISTRICT