Bharathidasan University

Tiruchirappalli – 620 023, Tamil Nadu

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

Course : MTIGT0501

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

Unit-5 : DATA ANALYSIS & SPATIAL MODELLING

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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 outputgeneration
- 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, use of topology) – 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, Fly-thru models, Anaglyph stereo images) - 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 - Post-processing of analysed outputs – 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.

Text Books:

1. Burrough, P.A 1986: Principles of Geographical information Systems for Land Resources Assessment, Clarandone Press, Oxford.
2. Kang - Tsung Chang, Introduction to Geographic Inf`ormation System, MC Graw Hill, Boston. 2002.

References:

1. Campbell, J 1984: introductory Cartography, Printers Hall Englewood Cliffs, N.J
2. Dent B.D 1985: Principles of Thematic Map Design, Addition - Wesley, Reading, Mass.
3. Freeman, H and GG.Pieroni 1980: Map Data Processing, Academic Press, New York.
4. Monmonier, M.A 1982: Computer Assisted Cartography - Principles and Prospects, Prentice Hall, Englewood Cliffs, NJ

Additional References for further readings:

1. Tomlinson, R.F Calkins, H.S and D.F.Marble 1976: Computer Handling of Geographic Data, UNESCO, Geneva.
2. 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:

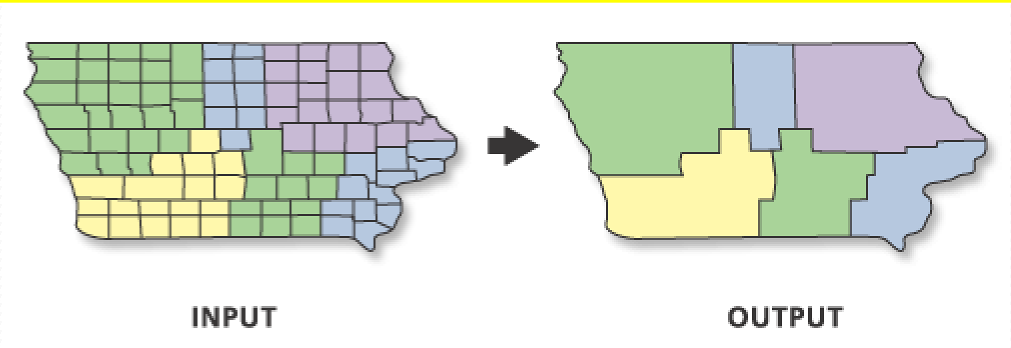
1. Understand the basic concepts and virtues of this important tool providing various platforms to handle Geospatial data
2. Gain basic ideas to generate, group, store Geospatial data in effective data structures
3. Develop skills on manipulation, 3D visualization, Spatial Analysis and Spatial Modeling.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

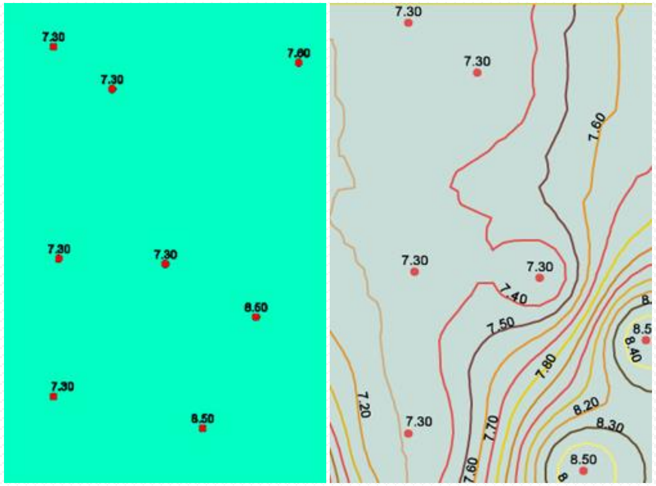
Unit-5

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 - Post-processing of analysed outputs– Net work analysis. **12 Hrs.**

GIS DATA PREPARATION / PRE-PROCESSING FOR ANALYSIS

Data Classification/Grouping , Regrouping,/Reclassification, Generalization, Buffering, Conversion of data formats, indexing, Assigning Ranks and Weightages, Numerical spatial database generation, Data tandardization





DISSOLVE

MERGE

UPDATE

CALCULATE RASTER ……

Classification Methods

Classifying the ranges of values of a single continuous variables

The different types of making class intervals are:

• **Exogenous class intervals** – according to threshold values that are relevant to, but not derived from the data set under study

- Fail to resolve the variations in any specific area
- If exogenous intervals are derived from qualitative class definitions, they may not be unique and may in fact overlap

- **Arbitrary class intervals**
  - chosen without any clear aim in mind
  - very often the intervals are irregularly spaced and
  - Chosen without a proper examination of the data

- **Idiographic class intervals**
  - chosen with respect to specific aspects of the data set
  - They include methods that attempt to divide the data into multi-modal groupings
  - Using 'Natural Breaks', their location,
  - Objective comparison is difficult – not exactly followed from dataset to dataset

- **Serial class intervals**
  - have limits that are direct mathematical relation to one another.
  - intervals are chosen independent of the characteristics of the particular dataset,
  - then the results from different samples or datasets will be strictly comparable
    - **Normal percentiles** – class intervals subdivide a normal distribution with mean μ and standard deviation, with classes centred on the mean
    - **Equal arithmetic intervals** with no variation in class width, such as are normally used for elevation contours
    - **Equal intervals** on reciprocal, trignometric, geometric, or logarithmic scales – used when original data are not normally or rectangularly distributed

DATA SORTING And PERFORMING STATISTICAL OPERATIONS

Data Sorting

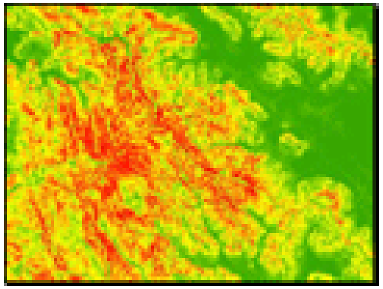
Mean, Mode, Std. Deviation, Correlation, Factor analysis, Multivariate analysis, Multiple Regression analysis, etc.

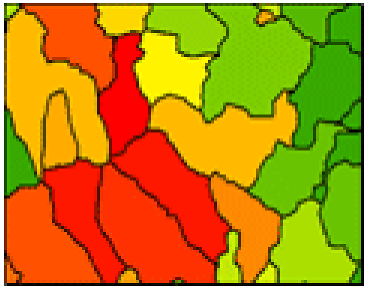
In order to perform statistical analysis in GIS, it is necessary to have samples of uniform length (equal number of samples) for all the thematic maps.

Hence, it would be better to convert the vector data to Raster format for statistical analysis.

DATA CONVERSION

Raster ⇄ Vector





GIS ANALYSIS

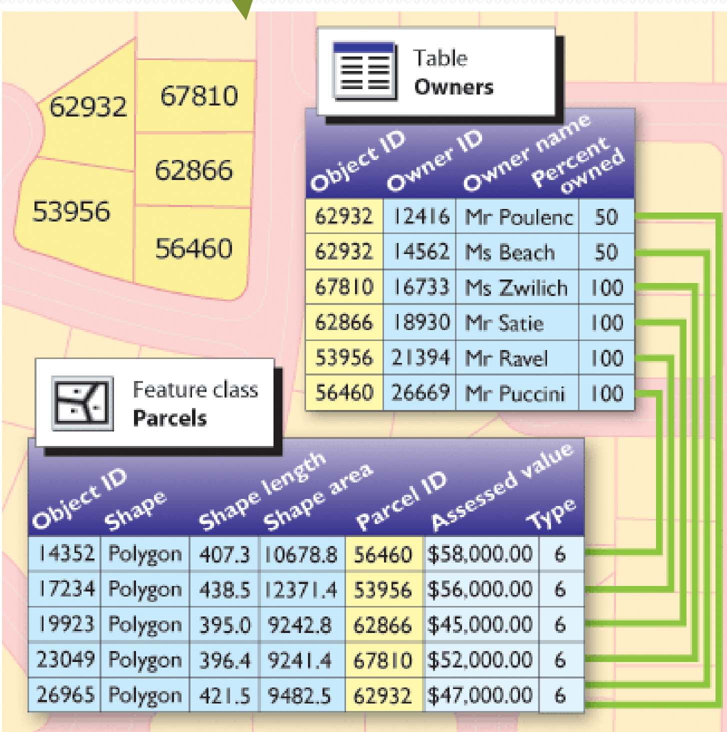
- GIS has the analysis capabilities ,that is not available with CAD
- Operates on Topology, spatial and/or non-spatial aspects combined
- The user can interactively work for getting the results
- Analysis capabilities range from
  - Retrieving subsets of information
  - up to univariate,
  - multivariate statistical and
  - spatial analysis using neighbourhood functions using interpolate methods
- Spatial modelling
- Simulation programs

Spatial Data

Unique Identifier (Unique Id)

Non Spatial Data

Provide Link using 'Join & Relate' methods



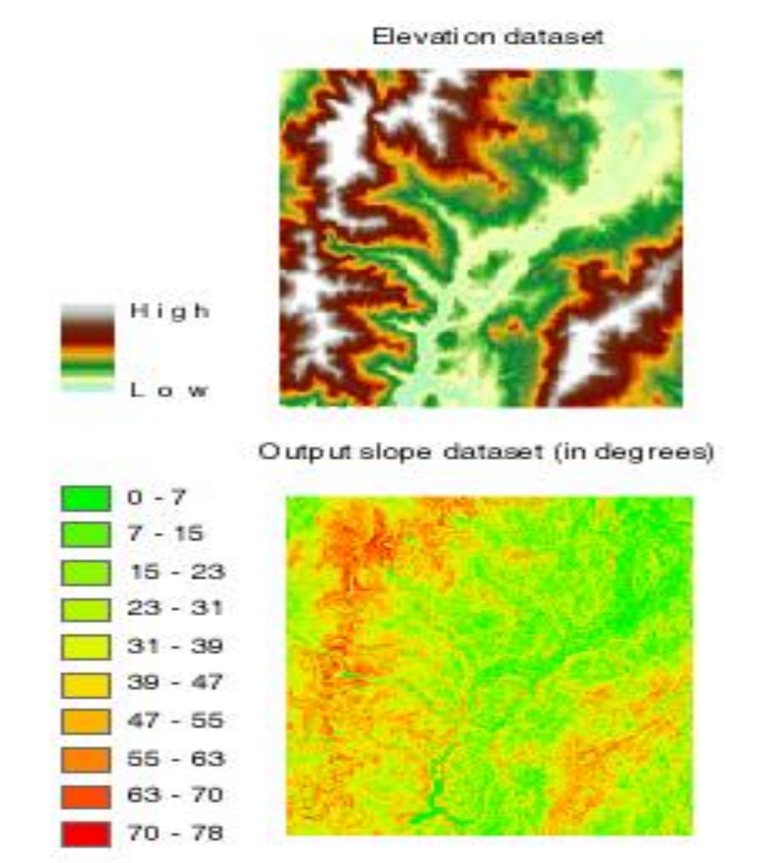
Object ID	Owner ID	Owner name	Percent owned
62932	12416	Mr Poulenc	50
62932	14562	Ms Beach	50
67810	16733	Ms Zwilich	100
62866	18930	Mr Satie	100
53956	21394	Mr Ravel	100
56460	26669	Mr Puccini	100

Object ID	Shape	Shape length	Shape area	Parcel ID	Assessed value	Type
14352	Polygon	407.3	10678.8	56460	$58,000.00	6
17234	Polygon	438.5	12371.4	53956	$56,000.00	6
19923	Polygon	395.0	9242.8	62866	$45,000.00	6
23049	Polygon	396.4	9241.4	67810	$52,000.00	6
26965	Polygon	421.5	9482.5	62932	$47,000.00	6

- It is necessary to establish a link between database and output that provides answer in different forms – maps, tables, figures, etc. using "**Unique_Identifier**"
- That link is any function used to convert data from one or more input maps into an output / **Action Plan** map
- Define the database – nature of geodatabase – **vector** / **raster**, and whether it contains **points**, **lines**, **polygons** & **associated attributes**, having **same projection**

GIS Data Analysis ...contd...

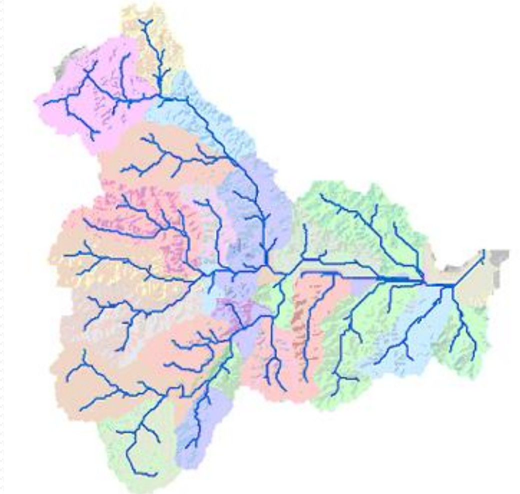
SLOPE ANALYSIS



Slope Categories – DEGREES , ASPECT, LENGTH

Intervisibility Analysis, etc.

DRAINAGE ANALYSIS



Delineation of Drainages,

Flow Direction, Flow Accumulation

Flow Length,

Demarcation of drainage basins,

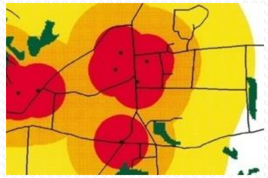
Runoff estimation,

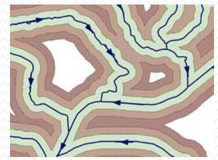
Quantum of soil erosion, etc.

Hydrological Modeling

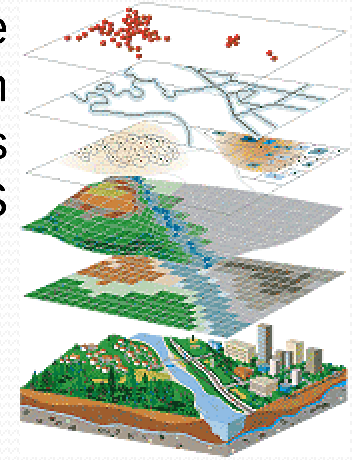
GIS Data Analysis & integration

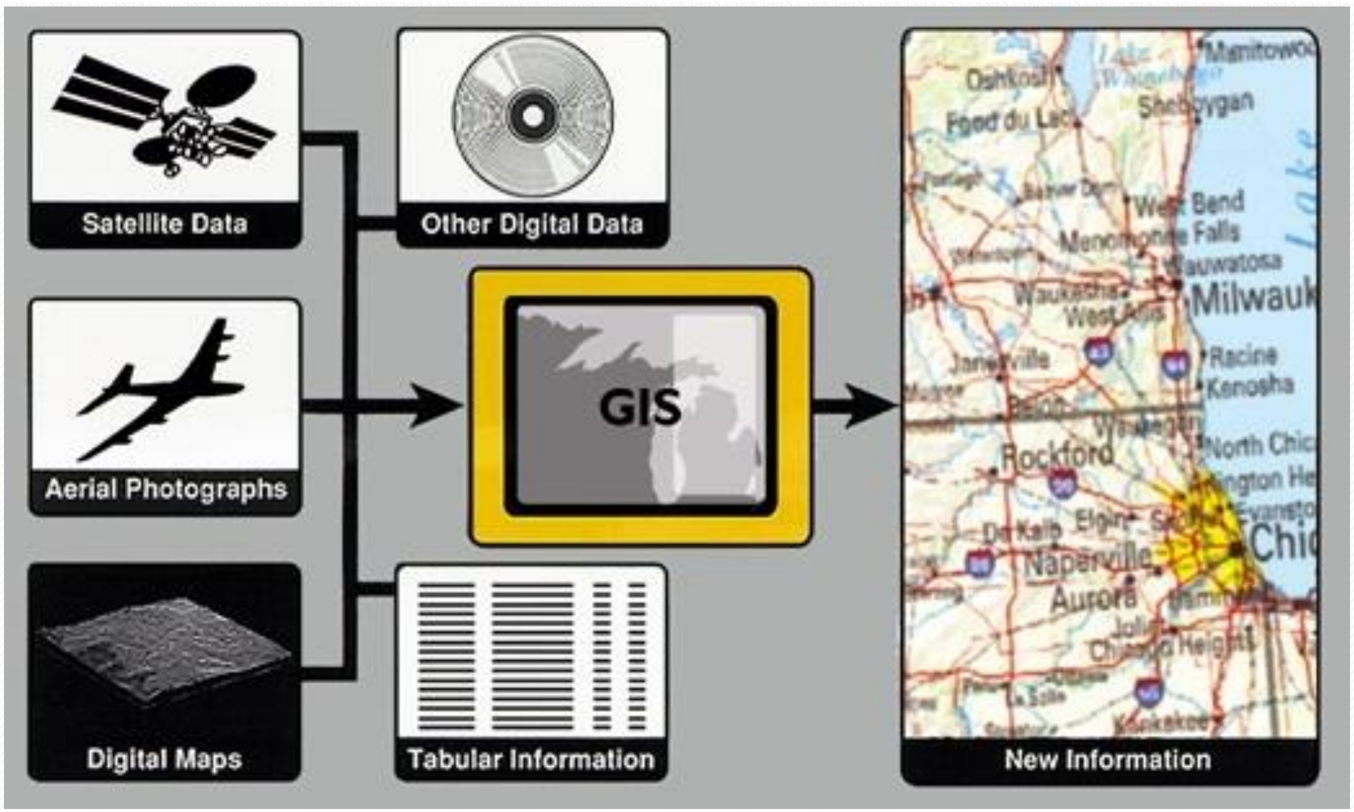
- Performing overlays
- Creating buffers
- Calculating statistics
- Merging datasets

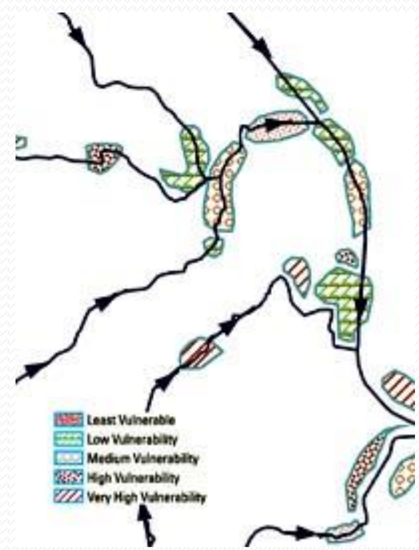




Data integration is the linking of information in different forms through a GIS







GIS OVERLAY – INTEGRATION OF SPATIAL LAYERS

- **Spatial integration (union / intersection) of multiple layers having :**
  - **Single feature attribute** –Resulted with unique polygons having positive / inducing / vulnerable polygons - useful for further planning - prioritization (Union) and direct implementation (Intersection);
  - **Binary feature attributes** – Resulted with both +ve and –ve polygons – useful to know the parameter which are not potential / not loaded / not vulnerable or safe polygons / sites – so as to improve / develop their property to achieve the target / reduce vulnerability as minimum as possible – mitigation
  - **Multiple feature attributes** – complex but gives useful detaile information about the parameters involved.

GIS Can do many operations / Analysis like add, subtract, multiply, divide, square, buffer, corridor, integrate multiple layers, etc.

GO BACK

Raster Based Addition

InRaster1

1	1	2	2	2
3	1	3	4	4
3	3	2	4	4
3	2	2	1	4
3	2	2	1	1

\+

InRaster2

3	3	1	2	2
2	3	1	1	1
2	4	3	3	1
2	2	3	4	4
1	2	1	1	4

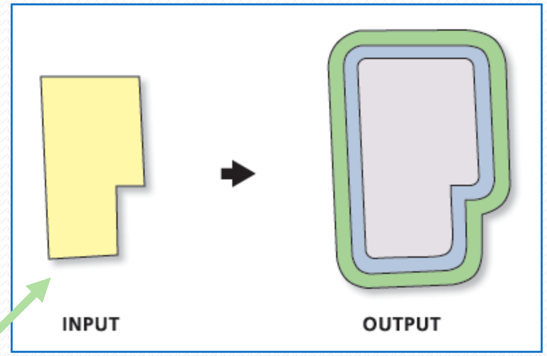
=

OutRaster

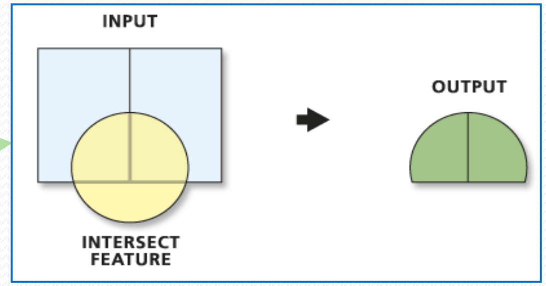
4	4	3	4	4
5	4	4	5	5
5	7	5	7	5
5	4	5	5	8
4	4	3	2	5

InRaster1 + InRaster2 = OutRaster

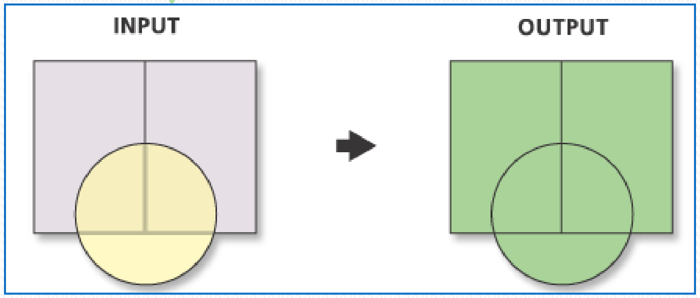
Vector Based Layer Integration



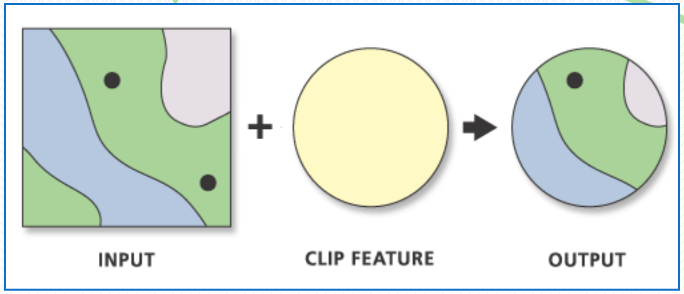
BUFFER



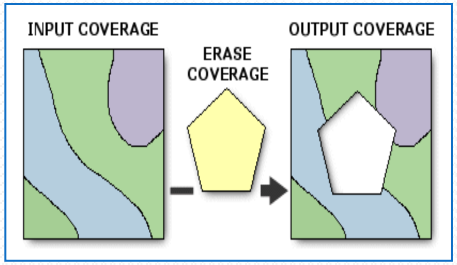
INTERSECT



UNION



CLIP



ERASE

Simple Data Retrieval

- **Boolean logic**
- **Reclassification and display**
- **Boolean operations with two or more maps**

Boolean logic

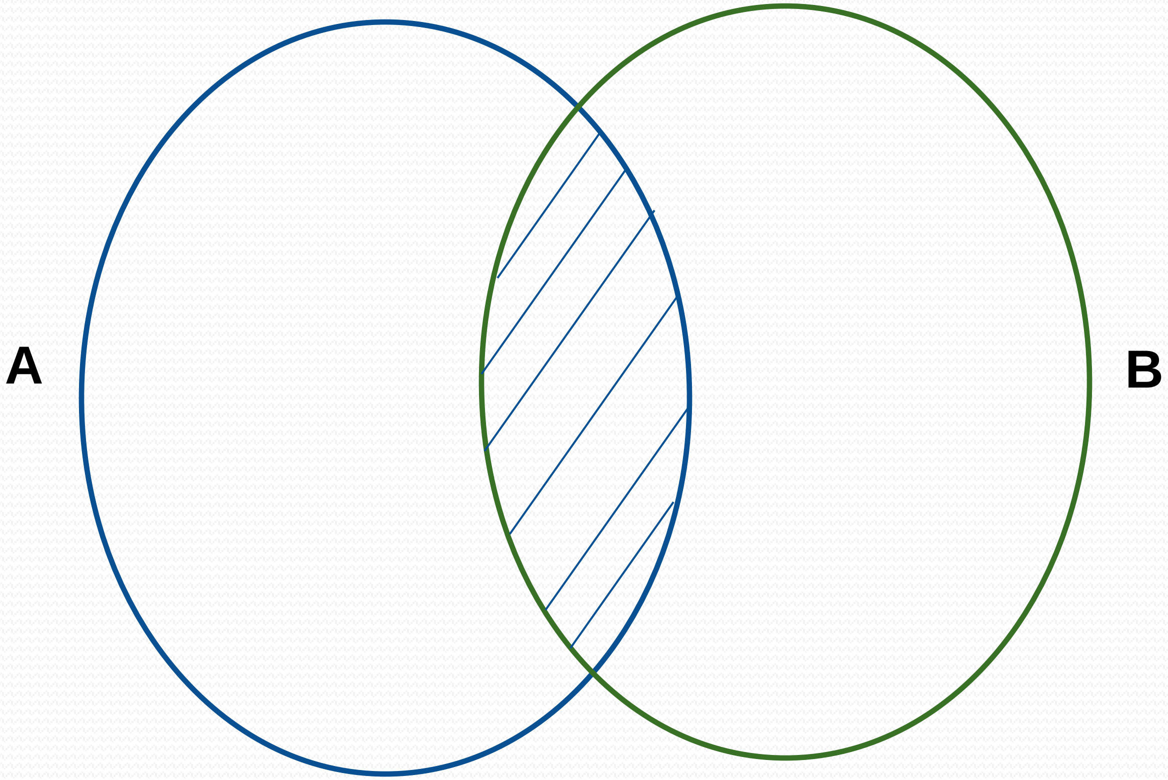
- Retrieve data by using the rules of Boolean logic to operate on the attributes and spatial properties
- Operators are : AND, OR, XOR, NOT
- The particular condition is 'true' or 'false'
- Visual portray of Boolean logic is in the form of 'Venn diagrams'
- A is the set of items having attribute 'a' and B is the set of items having attribute 'b', then the statements

A **AND** B, A **OR** B, A **XOR** B, A **NOT** B,

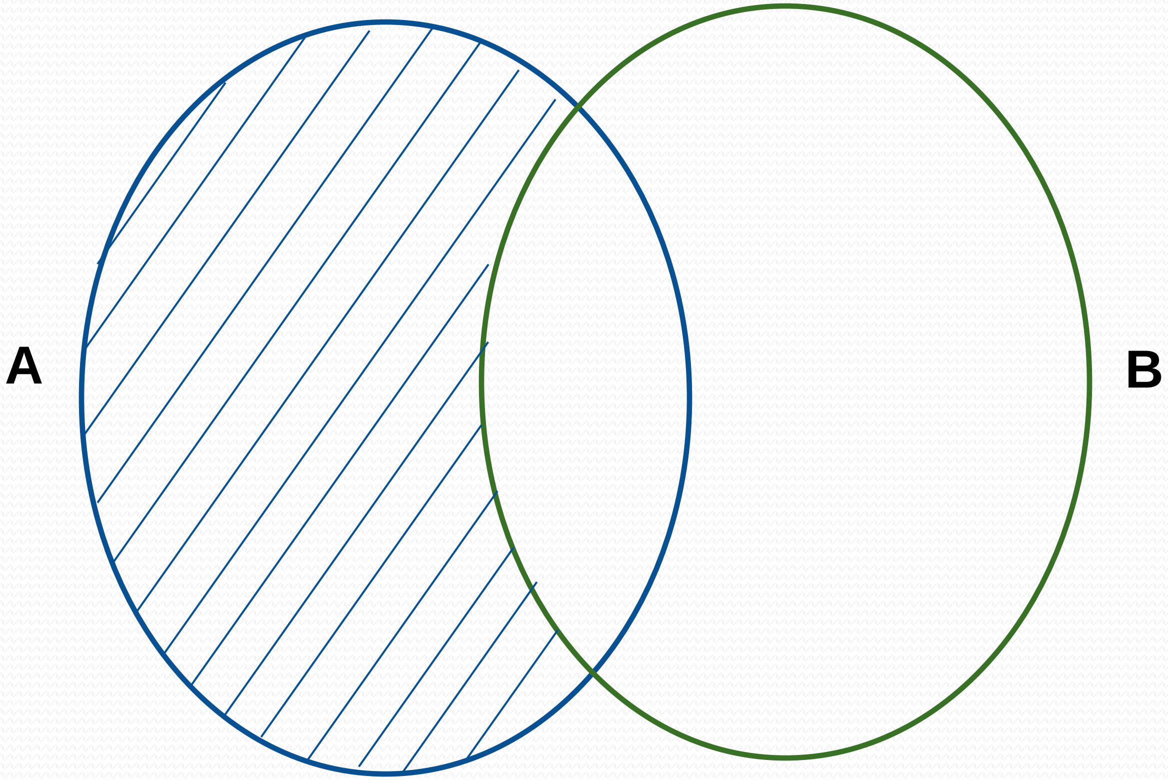
(A **AND** B) **OR** C, A **AND** (B **OR** C)

will return items that have attribute combination covered by the **shaded portions** respectively.

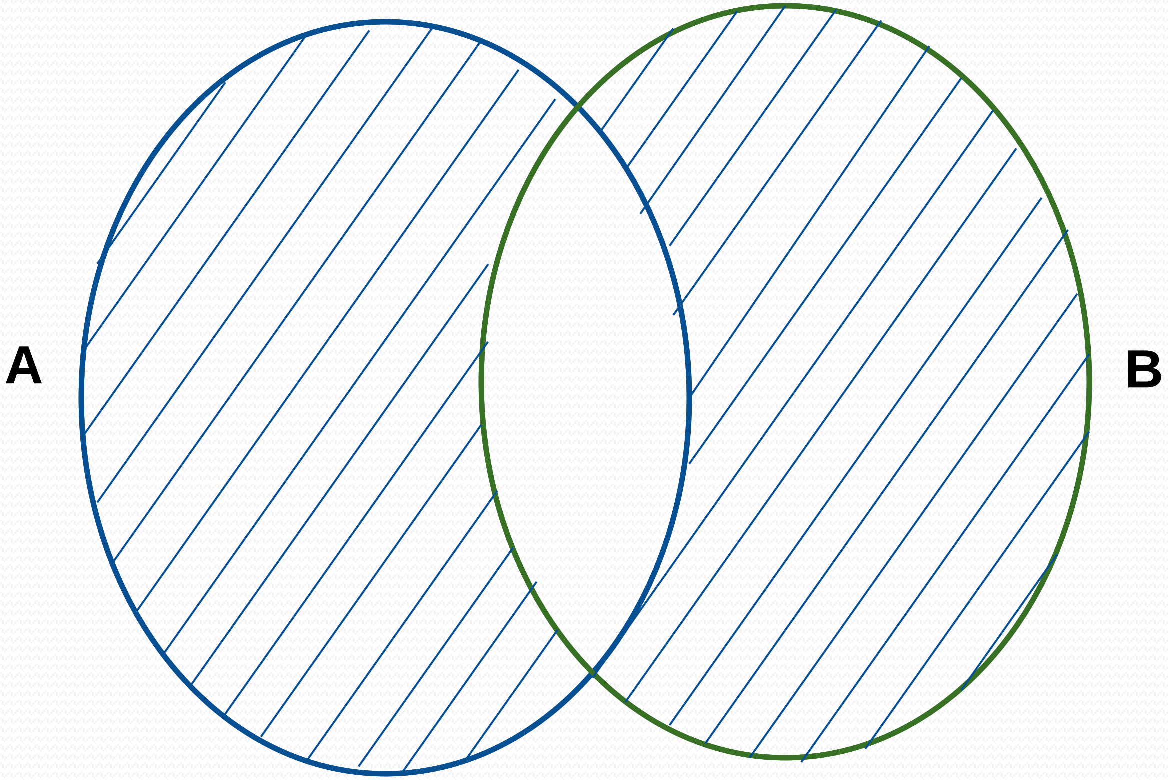
- On the basis of priority of AND with respect to OR
- Parentheses are usually used to represent the order of evaluation
- More complicated searches involve the shapes of areas, the properties of the boundaries of areas or the neighbouring areas. For e.g.,
  - All areas of woodland bordering urban areas
  - All open areas that have a particular shape and area bounded by hedgerow (a row of bushes)



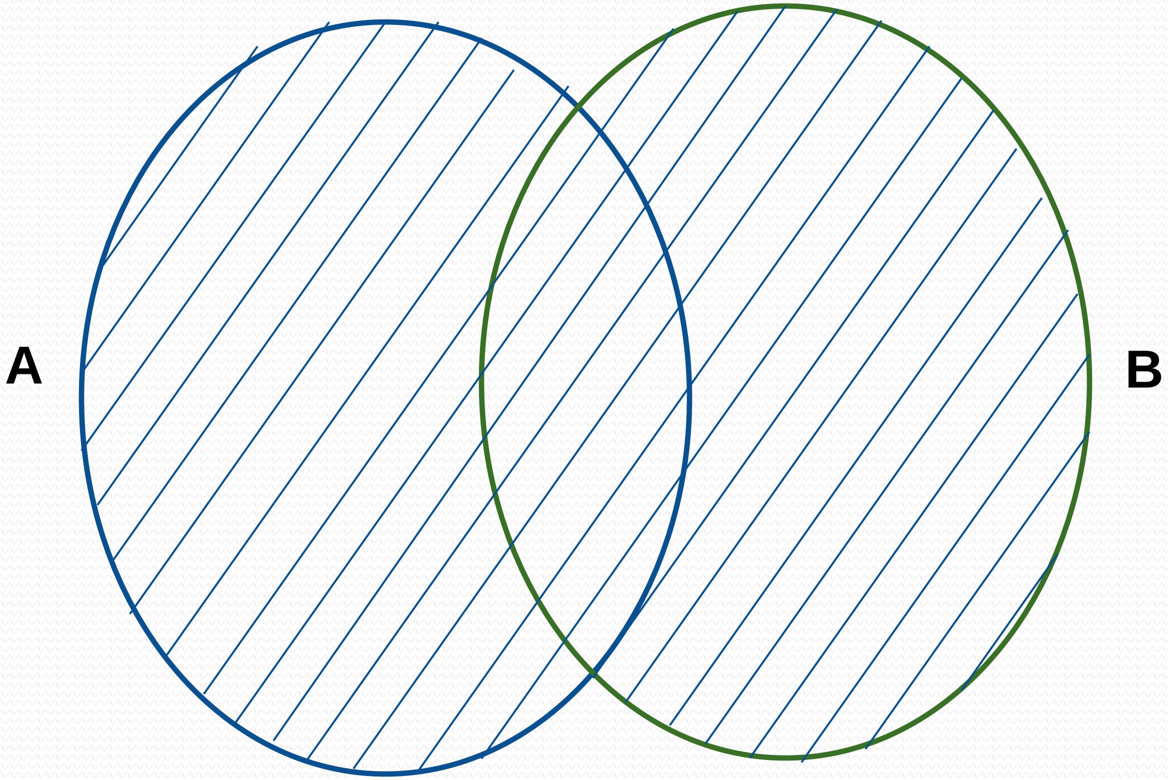
A AND B



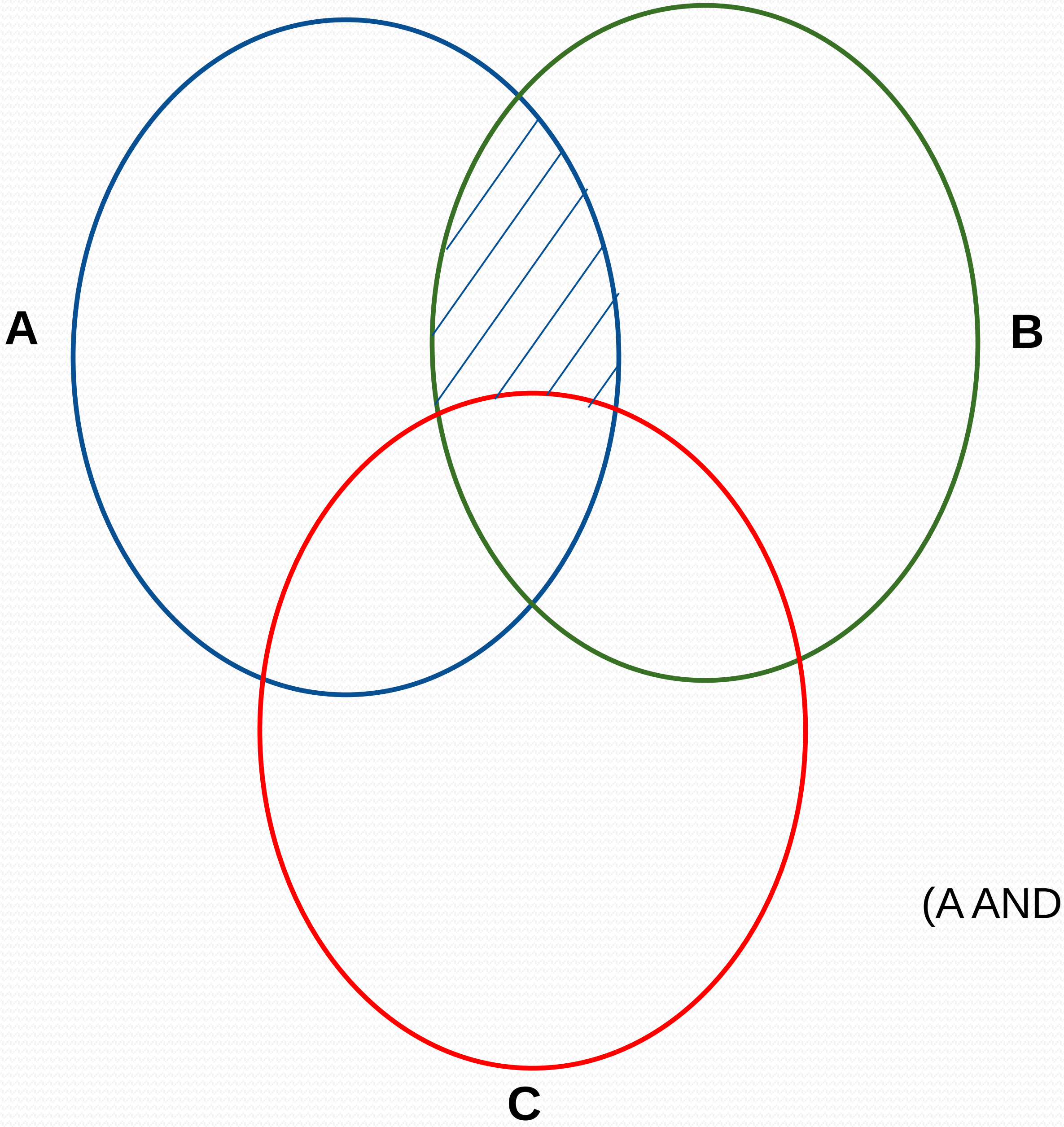
A NOT B



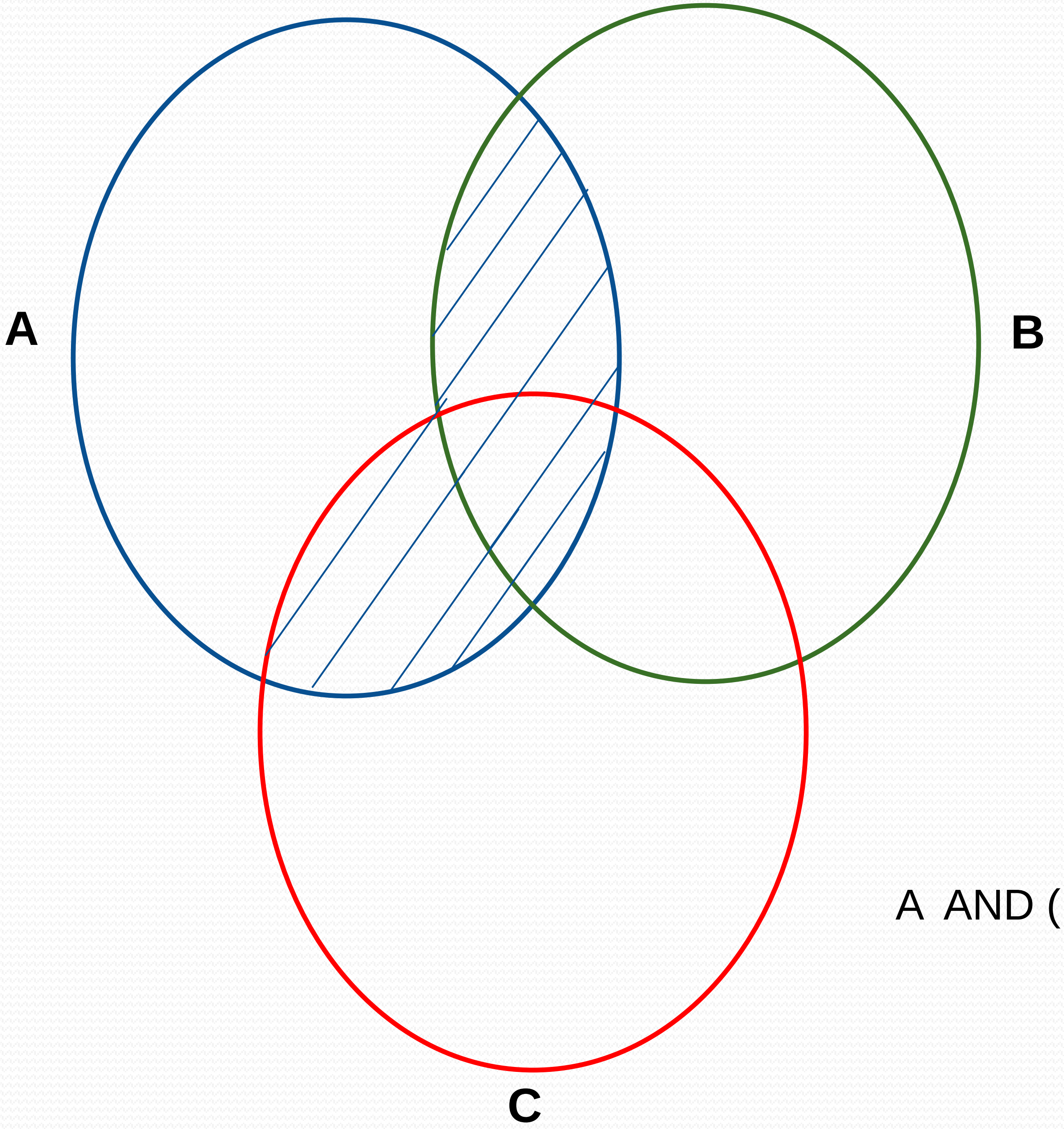
A XOR B



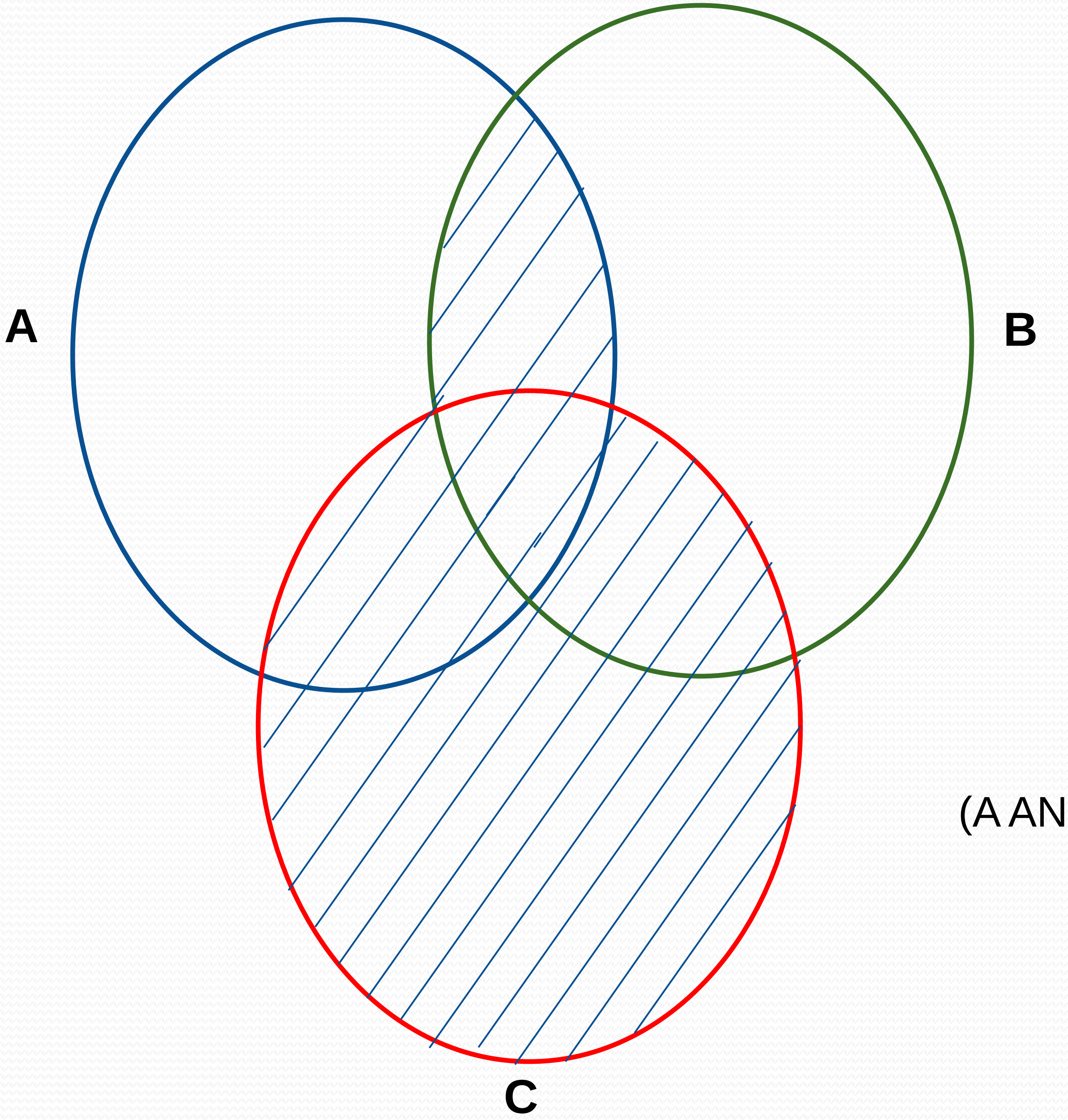
A OR B



(A AND B) NOT C



A AND (B OR C)



(A AND B) OR C

Cartographic modeling

- The procedure of using map algebraic techniques such as mathematical operation –i.e., Layer Addition, to build models for spatial analysis and represent the real world earth system processes in GIS environments is known as Cartographic modeling.

- The method offers benefits that can improve modeling efficiency and demonstrate model reliability.

- Because GIS relies largely upon spatial data, original inputs as well as intermediate output layers can be shown in map form, which in turn permits visual determination that the modeling steps are moving toward a logical end point.

- Cartographic models can take three forms (**descriptive, prescriptive** and **normative**).

- **Descriptive models** are used to characterize position and form, or to synthesize spatial relationships and establish spatial association, suitability, and possibly determine if relationships are hierarchical (Tomlin, 2013).

- Descriptive models can be transformed into **prescriptive models** by focusing attention on one particular factor, examining the range of parameters that could be modified to meet a specific objective.

- **Normative models** are not covered here but could be achieved by transforming the prescriptive model so as to limit the choice of parameter values in accordance with existing regulations and policies in place in the county.

- In addition, it would be possible to add steps to the model to assign weights to each criterion and then compute a score for each biogas site reflecting how close is its location to optimality (i.e., the highest scored site would be established as most optimal for these criteria).

- Weights could be chosen in accordance with established regulations to bring the model closer to normative status.

Advantages of Cartographic modeling :

- Easy for programming
- Simple operations are involved and hence it is a simple model
- Quick completion of the task in GIS
- Customization of several tedious steps – works are completed easily
- Can improve modeling efficiency and demonstrate model reliability.

Disadvantages of Carto modeling:

- Restricted to certain software modules
- Error handling is needed
- Limits with the size of the layers / coverages

Cartographic Modeling using Natural Language Commands

- **Useful for the programmers and those who willing to type commands**
- **Simple terms are used as "commands" to perform the GIS works. For e.g,.**
  - **Buffer Point <input layer> buffer distance**
  - **Intersect <Input layer> <intersect Layer>**
  - **Classify <input layer> No. of classes required; method (e.g.,Equal, natural breaks…)**

- **All the sequences of commands can be listed in a Run Model text box and the commands can be executed by providing the required inputs through interactive method.**
- **Typographical errors are not allowed – this includes unnecessary spaces, special codes / marks…**
- **SML – Simple Macro Language; AML – Arc Macro Language were the modules of DOS versions of ArcInfo s/w.**

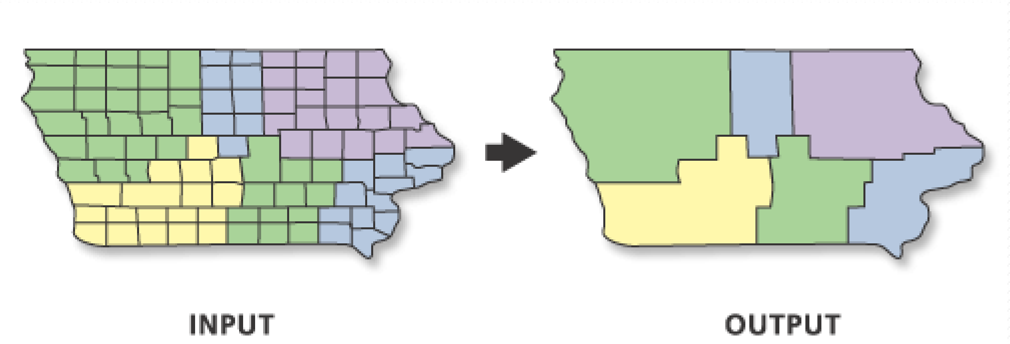
Reclassification / Post – Processing and display

- After the retrieval of required data, reclassification is necessary
- So that redisplay of the retrieved data can be done which will exactly reflect the user's perception
- The similar polygons in adjacent places / boundary shared polygons having same codes / values / attributes,
- Then Dissolving has to be done
- Then, recompute the polygon structure again

Due to the multiple fractionated classes of polygon groups with 1000's of feature combinations in each, it is important to provide clarity to represent the output.

Similar to processing of data prior to analysis, post processing of out put is also necessary.

Data Classification/Grouping , Regrouping,/Reclassification



Finally using option like,

DISSOLVE

MERGE

UPDATE

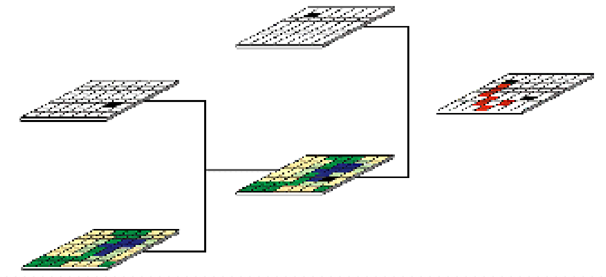
CALCULATE RASTER ……

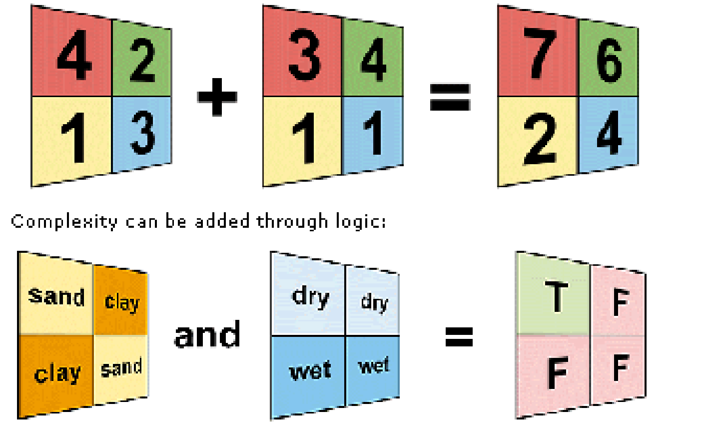
Simplified user friendly outputs can be presented.

GIS Modeling

- A model is a representation of reality.
- Due to the inherent complexity of the world and the interactions in it, models are created as a simplified, manageable view of reality.
- Models help to understand, describe, or predict how things work in the real world.

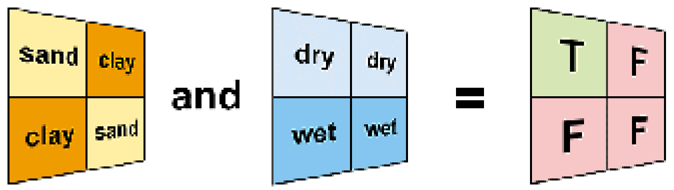
- **Binary model**
- **Process model**
- **Index model**
- **Regression model**
- **…**
- **…**





GIS MODELLING …CONTD…

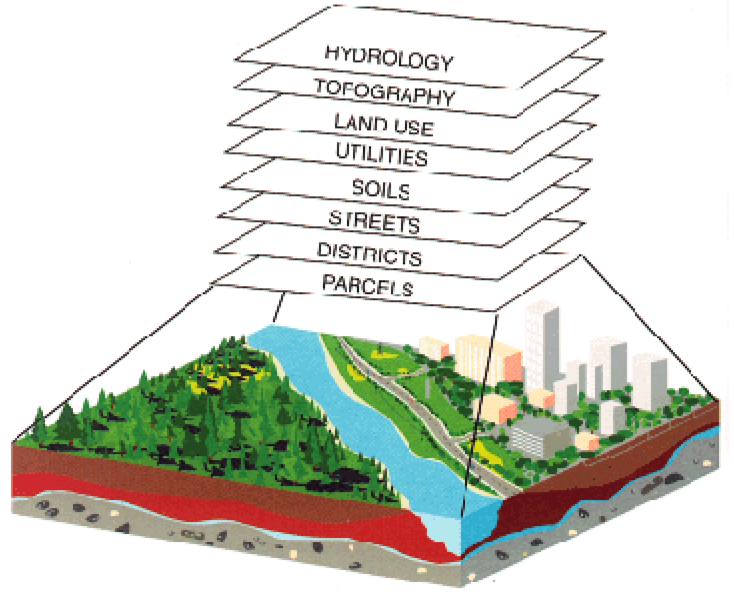
Binary Model



Yes / No, True / False, 1 / 0, etc.

Back

Process Model



Lookup Table (LUT)

Combined Attribute table containing the values / classes available from the both thematic layers involved in GIS integration.

1st **Thematic Map** / Layer having 3 classes – e.g. Thickness of Top soil (TTS) High, Moderate & Low

+

2nd **Thematic Map** / Layer having 3 classes – e.g. Water level (WL) - Deep, Moderate & Shallow

	TTS-H	TTS-M	TTS-L
WL-D	DH	DM	DL
WL-M	MH	MM	ML
WL-S	SH	SM	SL

In Binary model, Thematic layers can be classified with only two classes, Yes - No. In this case, once the GIS integration is performed then, the number of combined classes in the resultant layers can be easily determined by a simple formula,

$$N_{rc} = 2^n - 1 \; ,$$

Where,

n = no. of layers having Y/N classes involved in GIS integration analysis.

N_{rc} = resultant number of classes

GIS Integration of **Two layers** in binary model

	TTS-1	TTS-0
WL-1	1 1	1 0
WL-0	0 1	0 0

	SLP-1	SLP-0
1 1	1 1 1	1 1 0
1 0	1 0 1	1 0 0
0 1	0 1 1	0 1 0
0 0	0 0 1	0 0 0

GIS Integration of **Three layers** in binary model

First step of GIS integration in Binary model will result 3 + 1 (1-unwanted) classes.

In the **Second step** of GIS integration, 7 +1(unwanted) classes are resulted.

$$N_{rc} = 2^3 – 1$$

	GEM-1	GEM-0
1 1 1	1 1 1 1	1 1 1 0
1 0 1	1 0 1 1	1 0 1 0
0 1 1	0 1 1 1	0 1 1 0
0 0 1	0 0 1 1	0 0 1 0
1 1 0	1 1 0 1	1 1 0 0
1 0 0	1 0 0 1	1 0 0 0
0 1 0	0 1 0 1	0 1 0 0
0 0 0	0 0 0 1	0 0 0 0

Similarly, for the GIS Integration involving **Four layers** in binary model will result into (**2^4 – 1**) = **15** + 1 (1-unwanted) classes.

Network Analysis / Model

- **Network** – Consists of connected linear features
  - E.g. Road, Railway, Bicycle paths, Streams & Shorelines.
- **Dynamic Segmentation**
  - A data model that is built upon lines of a network and allows the use of real-world co-ordinates with linear measures such as mileposts
  - To link linearly referenced data such as accidents & pavement conditions to geographically referenced road network
- For this, the networks need to be segmented and labelled by inserting nodes in proper locations
- For both **NW/DS** - Appropriate attributes are to be collected as per the real-world applications and entered in computer for 'Linking'.
  - For e.g., to use road network for Path Finding / Resource Distribution, etc., - we need the following attributes:

- Travel time
- Impedance at turn
- One-way streets
- Linear measures – to be added with arcs and nodes of the network – can be directly linked to road segments.

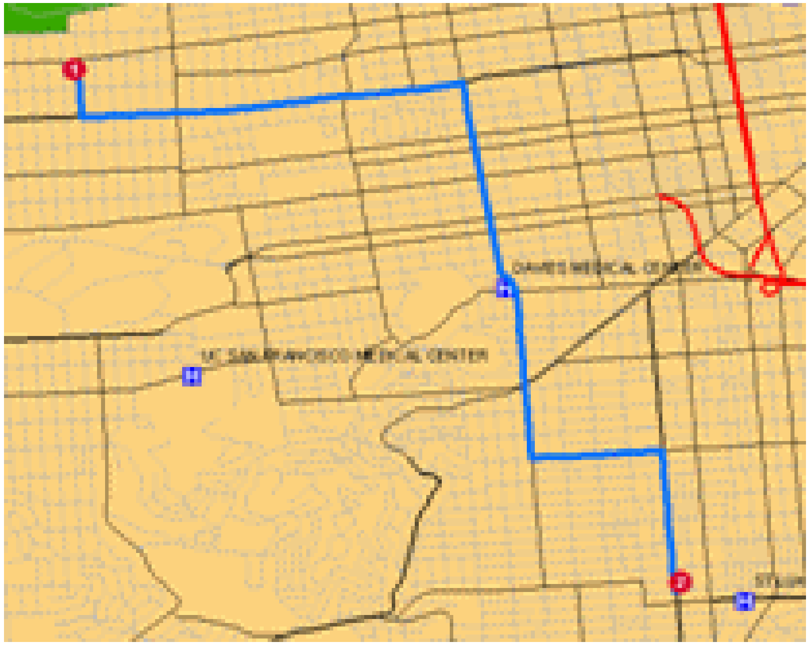
- 1. **Network** – is a line coverage, which is topology based and has the appropriate attributes for the flow of objects such as traffic.
  - Linear Feature + Attribute data, such as
    - Impedance values assigned to
      - network links – link impedance
      - Turns – turn impedance
    - One-way streets and
    - Overpasses and under passes.

Link impedance

- A link refers to a segment separated by two nodes in a road network

NETWORK ANALYSIS

Link impedance is the cost or resistance or constraints of traversing a network link, which can be the time it takes to travel from one node to another.



Route Identification

Involves, the direction of travel (turn) with link node attributes, connecting nodes to the destination, length of the line segments and impedances.

NETWORKS AND APPLICATIONS

Networks are simple. They are comprised of two fundamental components**,** ***edges*** *and* ***junctions.***

Edges are **streets, transmission lines, pipe** and **stream reaches.**

Junctions are **street intersections, fuses, switches, service taps,** and the **confluence of stream reaches.**

Edges connect at junctions.

Railroad schedules its trains to efficiently link with intermodal container trucks.

- A **parcel delivery service** optimizes its package delivery on a street system.

- An electric utility locates where **power outages** originate based on telephone calls received from affected customers.
- An environmental agency analyzes water samples collected from streams to trace **contaminant flow**.
- A regional transportation agency uses **traffic data** to plan **future highway construction**.
- A school district finds **optimum bus routes** to pick up children and deliver them to school.
- A driver uses a mapping system with a GPS receiver mounted in the car to find the **best way to get to a destination**.

THE GEOMETRIC NETWORK

A **geometric network** is a collection of features that comprise a connected system of ***edges*** *and* ***junctions.***

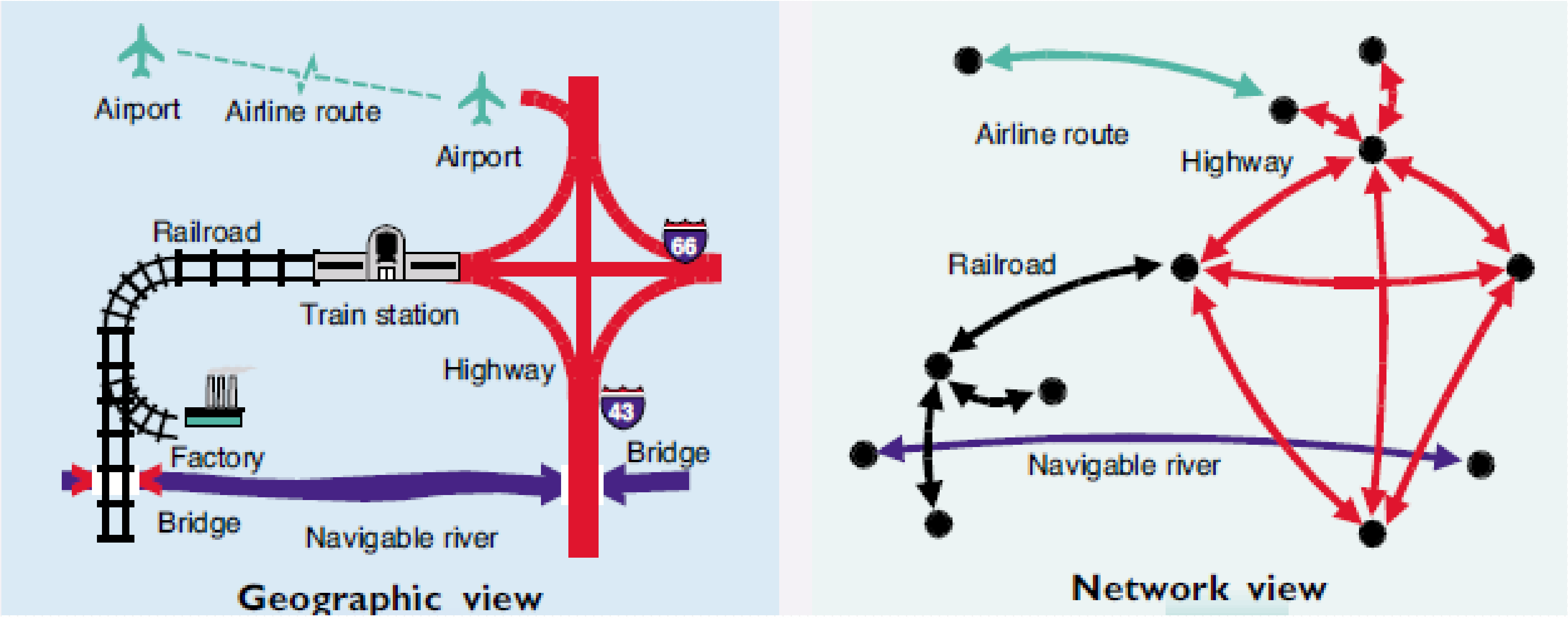
An ***edge*** *has* ***two junctions*** *and a junction* can be connected to any number of edges.

Network features: simple junction feature, complex junction feature, simple edge feature, or complex edge feature.

THE LOGICAL NETWORK

Like a geometric network, a **logical network** is a collection of connected **edges** and **junctions**.

The key difference is that a logical network does not have coordinate values.

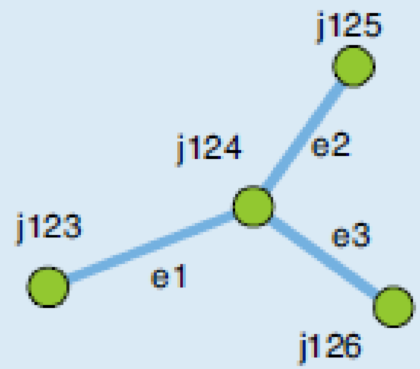

Airport
Airline route
Airport
Railroad
Train station
Highway
66
43
Factory
Bridge
Bridge
Navigable river
Geographic view
Airline route
Highway
Railroad
Navigable river
Network view

HOW FEATURES CONNECT

The center-piece of a logical network is the connectivity table, which describes how network elements are connected.

For every junction in the network, the connectivity table lists the adjacent junctions and edges — junctions at the other end of the connected edge.

Geometric network



Junction feature table

id	geometry
j123	
j124	
j125	
j126	

Edge feature table

id	geometry
e1	
e2	
e3	

A geometric network contains the features that participate in a network. Feature classes contain either edge features or junction features.

Logical network

Connectivity table

Junction	Adjacent junction and edge		
j123	j124, e1		
j124	j124, e1	j125, e2	j126, e3
j125	j124, e2		
j126	j124, e3		

A logical network contains the connectivity of the network. The connectivity table lists all the adjacent junctions to a given junction, along with the edge that connects them.

CONNECTIVITY RULES

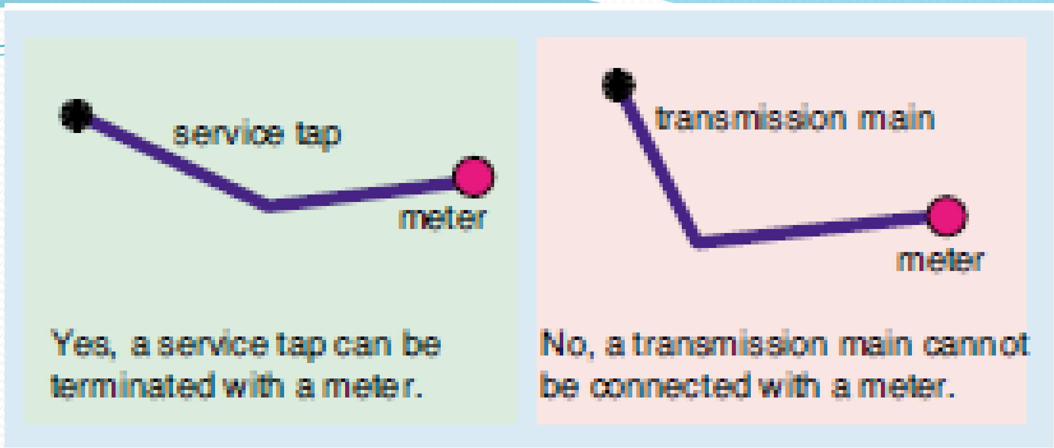
In most networks, not all edges can connect to all other junctions. Also, not all edges can connect to all other edges through a specified junction.

For example, a hydrant lateral in a water network can connect to a hydrant, but not to a service lateral.

Similarly, a 10-inch transmission main can only connect to an 8-inch transmission main through a reducer.

Edge–junction rule

This rule constrains which types of junctions can connect to a type of edge.

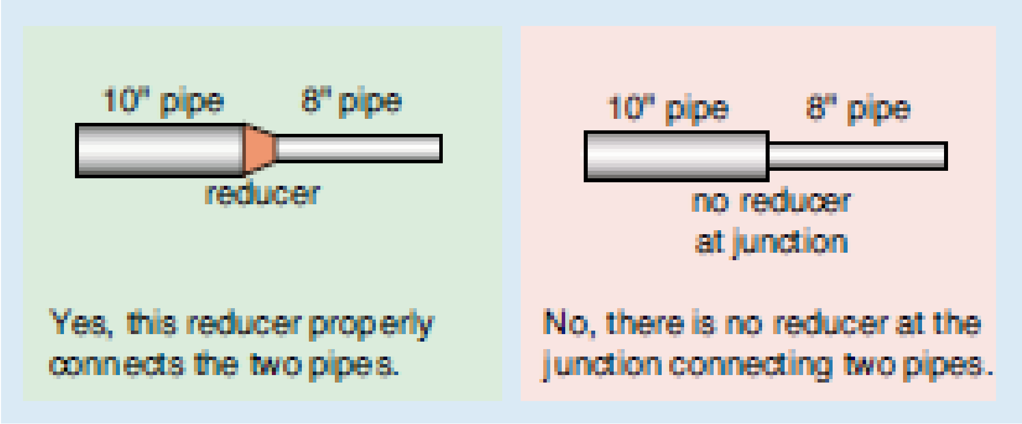


Meters can only connect to **low-voltage lines.**

Edge–edge rule

This rule establishes which combinations of edge types can connect through a given junction.

Two pipes of different diameters can be connected only through a properly sized **reducer**.

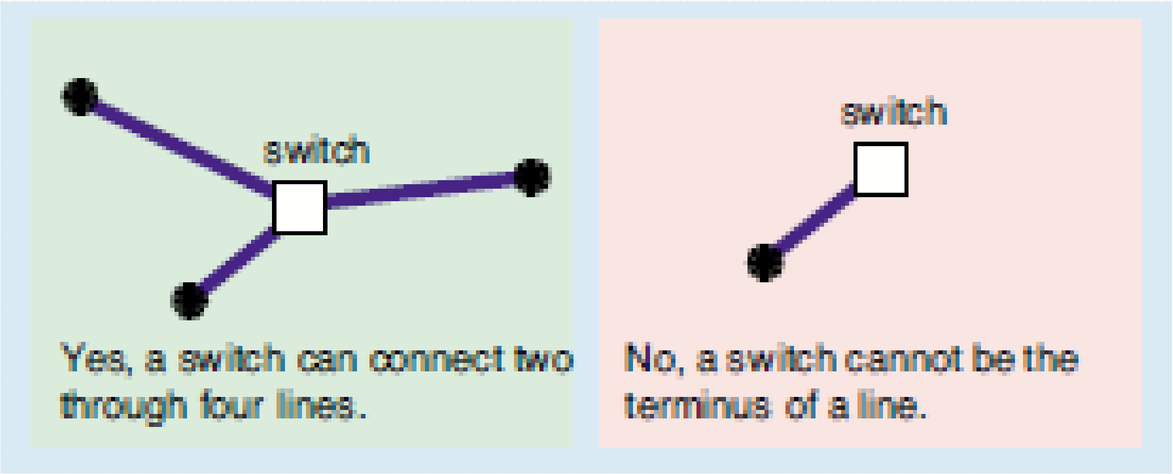


Edge–junction cardinality

This rule lets you restrict the count (cardinality) of edges that connect at a junction.

A certain type of switch might be designed to accept between two and four lines.

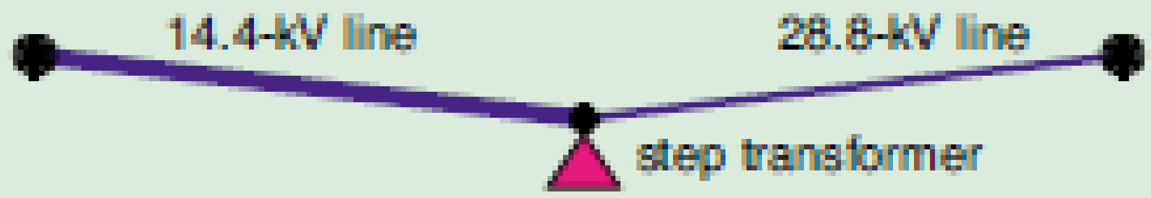
Precisely define the acceptable range of lines that can be connected at a junction.



Default junction type

When you connect one type of edge to another, you can specify a default junction type to be inserted.

When a 14.4-kV line is added to an end-junction of a 28.8-kV line, a step-down transformer with the correct electrical ratings is assigned to the junction



When you connect a 14.4-kV electric distribution line to a 28.8-kV line, a properly sized transformer can be automatically inserted.

NETWORK FLOW

Networks are of two type: utility network and transportation network.

In a *transportation network*, depends on the need will be changed "will of their own."

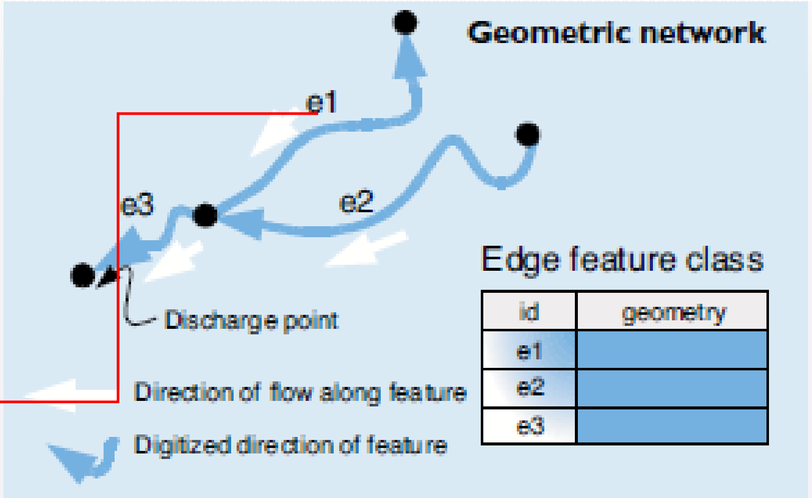
In a *utility network*, the commodity that flows through the network—water, electricity, oil—has no will of its own.

The network imposes flow direction by its configuration of sources, sinks, and switches

Logical network

Edge element table

Feature class	Feature ID	Sub-ID	Element ID	Flow direction
1	e1	1	10	Against
1	e2	1	11	With
1	e3	1	12	With



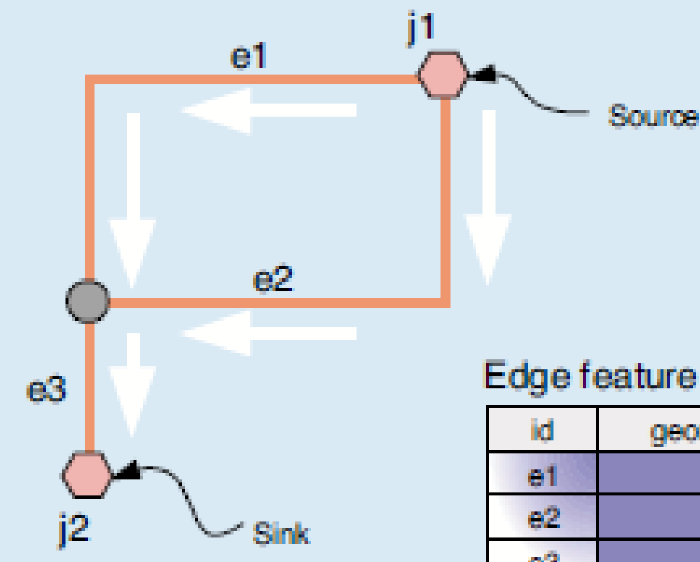
SOURCES AND SINKS

In a utility network, sources and sinks are used in determining flow direction.

Source is a junction from which a commodity flows, such as a well-head pump.

Sink is a junction where all commodity flow terminates, such as a wastewater treatment plant.

Geometric network



Edge feature class

id	geometry
e1	
e2	
e3	

Flow junctions feature class

id	Ancillary role	geometry
j1	Source	
j2	Sink	

Junction features can have an ancillary role of source, sink, or neither. The role is stored in an attribute of the feature class, which is accessed by the establish flow direction method.

DISABLED FEATURES

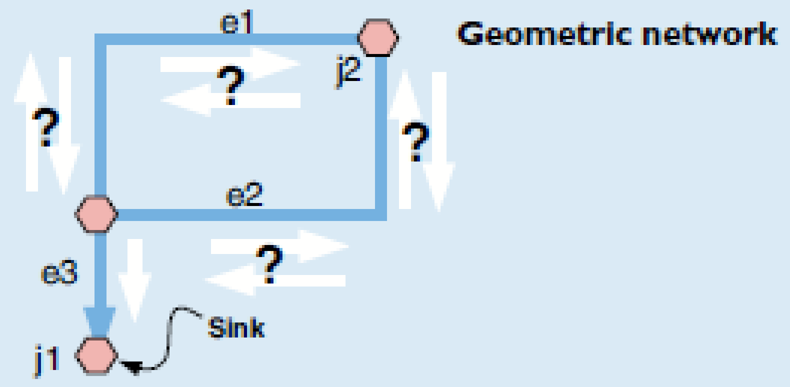
All features participating in a network have an enabled/disabled state.

Nothing flows into or out of the feature.

Disabled features are useful for representing open electrical switches or closed valves.

INDETERMINATE FLOW

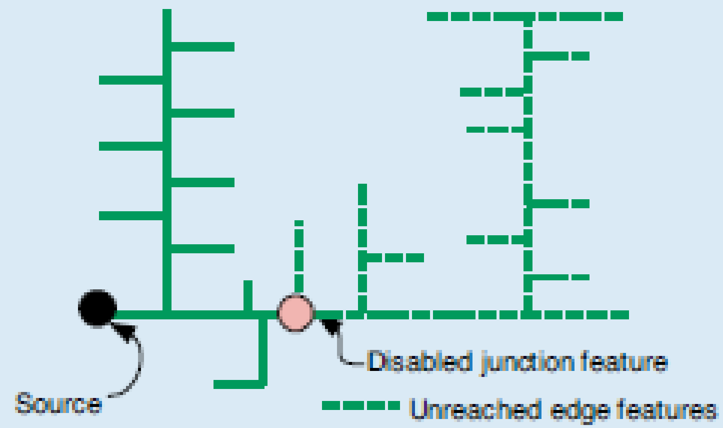
Indeterminate flow occurs when the established flow direction method cannot determine in which direction, commodities flow in a network.



It may not be possible to determine the direction of flow given a configuration of sources, sinks, and enabled features. In this example, it is impossible to determine the flow through edges e1 and e2 because they form a cycle. Changing junction j2 to a source would break the cycle.

UNINITIALIZED FLOW

When a flow is isolated because the edges are disconnected from the rest of the network (that has flow), flow is said to be uninitialized.



When establishing flow direction, edge features may be unreached because they are disconnected from the rest of the network. In this example, the unreached edges are disconnected because one of the junction features–a valve–is disabled.

Point operations in GIS analysis include:

Point Statistics

- calculates an output raster based on the values of input point features within a specified neighbourhood. The output raster value for each cell is a function of the input point features.

Point-in-Polygon

- A topological overlay procedure that determines if points are within polygons. Points are assigned the attributes of the polygons they fall within.
- In Geographic Information Systems (GIS), **regional operations** are a type of zonal operation that examines groups of cells that share a similar value or feature type.
- A region is a group of connected cells within a zone.
- The number of cells in a region can be unlimited.

- **Region Group**: This tool identifies unique connected regions of cells in an input raster.
- **Zonal Statistics**: This tool calculates statistics for each zone, such as the percentile, range, or standard deviation.
- Examine groups of cells that have similar features or values, such as land parcels, water bodies, or soil types.
- **Local operations:** Examine a single target cell. For example, a mathematical transformation to each cell in a raster can be applied to change the values.
- **Focal operations:** Examine the relationship between a target cell and its surrounding cells. A kernel, or window, defines the neighbourhood shape and dimension.
- **Global operations:** Examine the entire areal extent of the dataset.

Neighbourhood processing : An algorithm visits each cell in an input raster and calculates a statistic for the cells in the specified Neighbourhood shape around it.

- Eg. Buffer, interpolation and link analyses.

Minimum Distance Model

Euclidean distance

- This tool measures the distance from each cell to the nearest source in a straight line. Eg. to find the nearest hospital for an emergency flight or to plan a hiking trip.

Calculate Distance Band from Neighbour Count

- This tool evaluates minimum, average, and maximum distances for a specified number of Neighbours. It helps to determine an appropriate distance band value for analysis.

Distance Allocation

- This tool calculates the least accumulative cost distance to the nearest source, while accounting for surface distance and horizontal and vertical cost factors.
- Distance analysis is a fundamental part of most GIS applications.
- It can be used for a variety of tasks, including calculating distance, distance accumulation, and connecting locations.
- When calculating distance, it's important to consider factors that can alter the straight-line distance, such as barriers and surface distance.
- For example, a river, cliff, highway, or building can prevent you from traveling directly from one location to another.

Maximum Covering Model (P-median model)

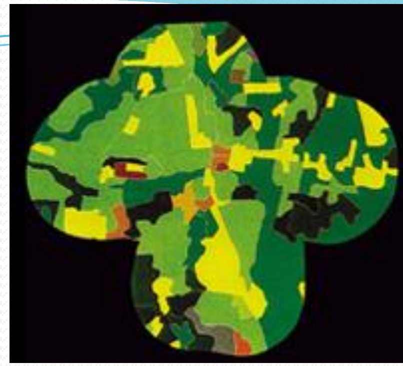
- Finds the best locations for facilities to maximize the number of demand points covered with 3 aspects like, **Demand points** (within the critical distance of a facility), **Demand weights** (allocated to the nearest facility within the impedance cutoff of multiple facilities) and **Nodes** (weighted according to the demands generated at the nodes).
- The p-median model can be used in a GIS environment to solve problems such as **facility location, spatial analysis** and **transit facility allocation**:
- **Facility location**: The p-median model can be used to determine the location of facilities to minimize the average distance from the population to their nearest facility.
- **Spatial analysis**: The p-median model can be used for spatial analysis in a GIS environment.
- **Transit facility allocation**: The p-median model can be used to allocate transit facilities.

Urban Transportation Planning Model

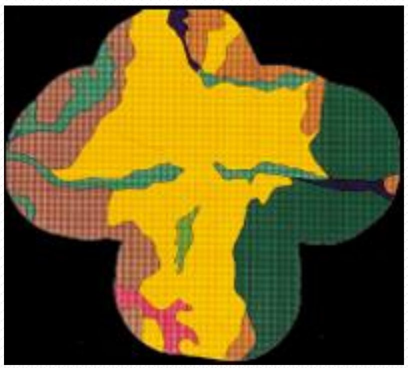
- **Analyze traffic patterns:** GIS can help identify areas prone to congestion and analyze traffic patterns.
- **Plan routes:** GIS can help plan routes for public transportation.
- **Understand mobility patterns:** GIS can help understand why certain mobility patterns take place and how residents relate to the current infrastructure.
- **Improve landuse estimates:** GIS can help improve land-use estimates, which can lead to improved travel demand estimation.
- **Identify weaknesses:** GIS can help identify weaknesses in the manual overlay process.
- **Share data:** GIS can help streamline data sharing by enabling coordinated data exchange.

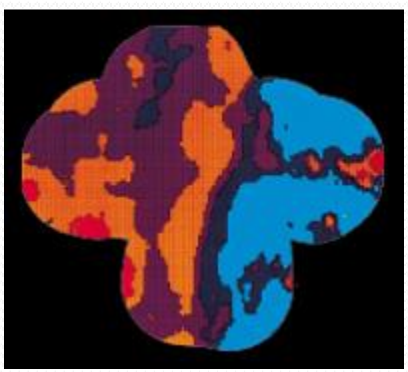
Identification of Potential groundwater well sites

Land use and land cover data for the area bounded by a half-mile buffer zone around the water company service area.



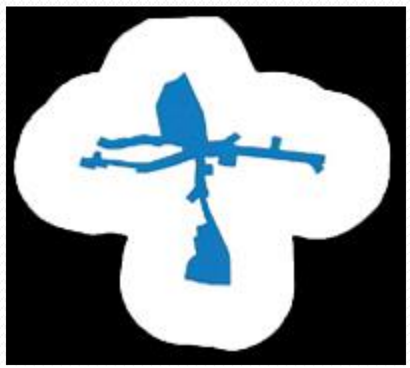
Map of surficial geology of the water service area

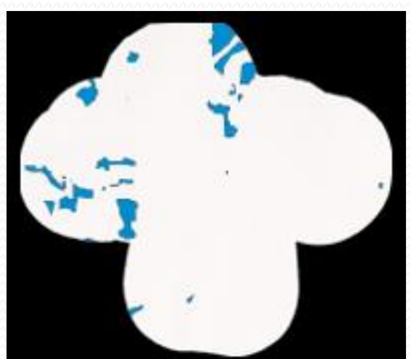




A bedrock elevation subtracted from water level elevation by a GIS to show the thickness of water-saturated sediment

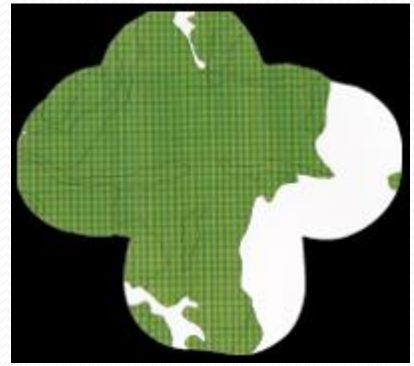
A half-mile buffer zone drawn around the service area



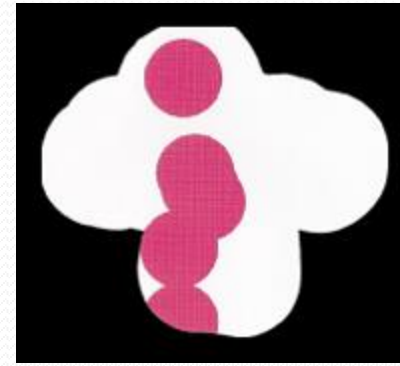


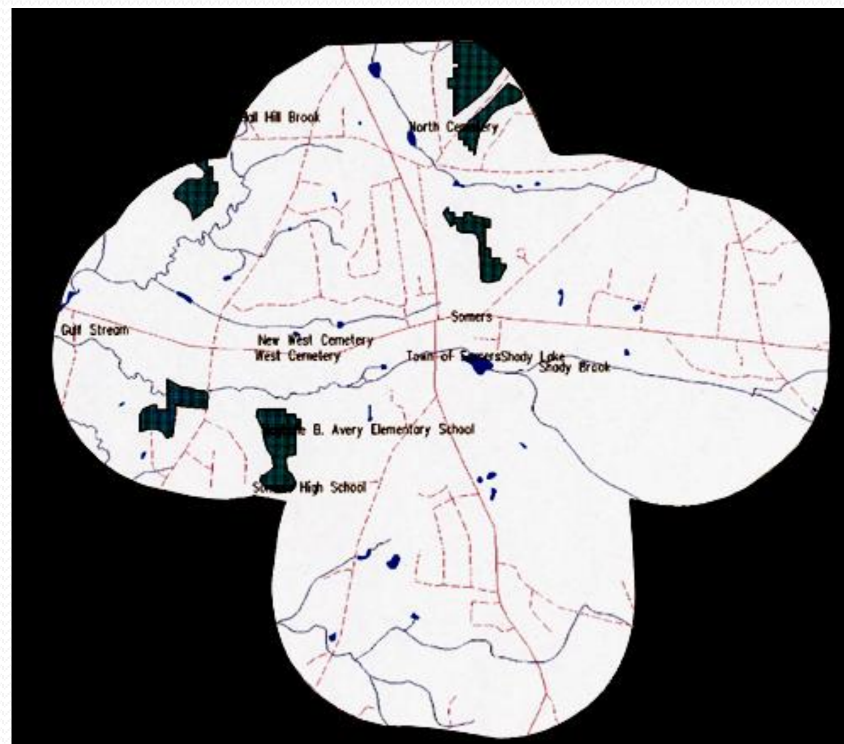
Potential sites with saturated thickness of sediments greater than 40 feet.

Selection areas of sand and gravel from the map of surficial geology

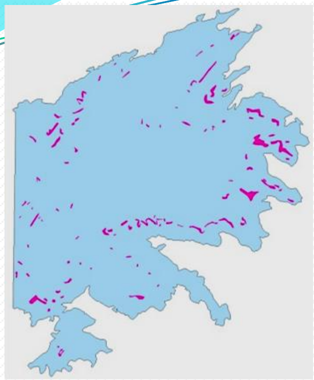


Buffer zones of 500 meters are drawn around the point sources of pollution.

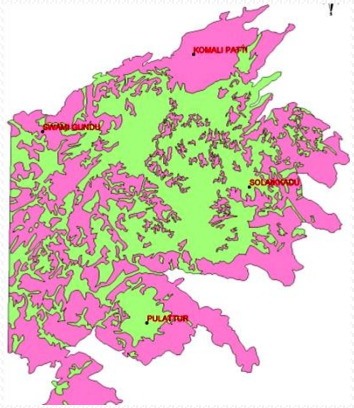




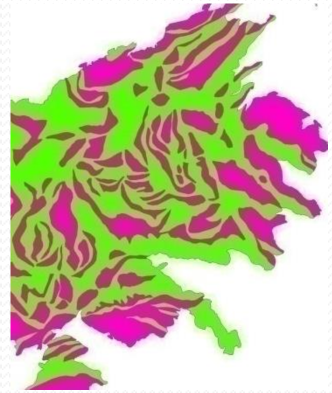
LANDSLIDE HAZARD ZONATION AND INDUCING PARAMETER IDENTIFICATION



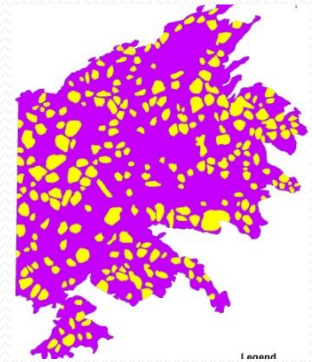
Mapping of Escarpments



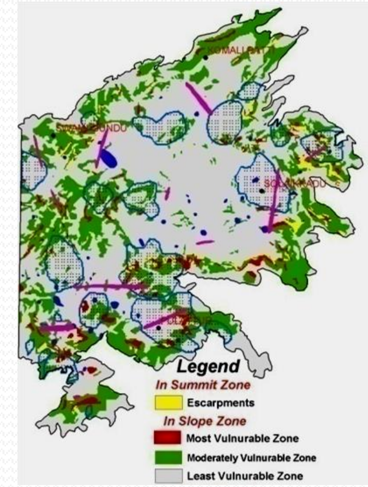
Identification of Active slope areas



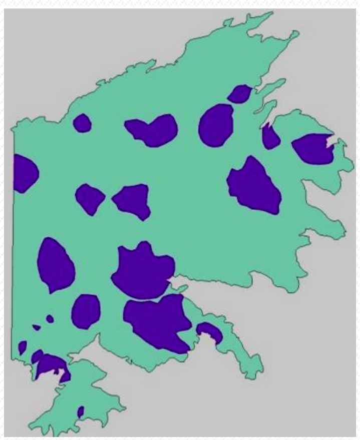
Interpretation of dip & obsequent slopes



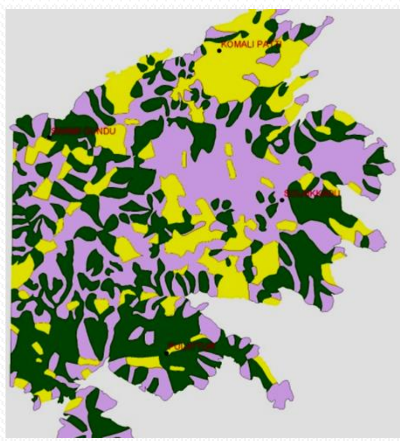
Map out dissected slopes



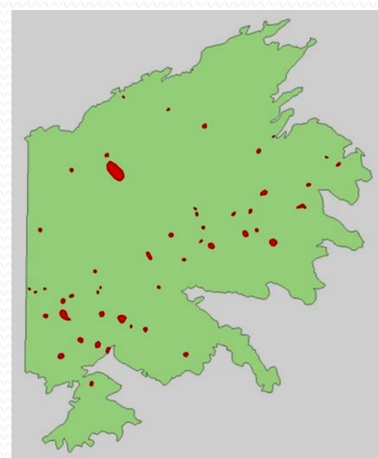
Landslide Hazard Zones



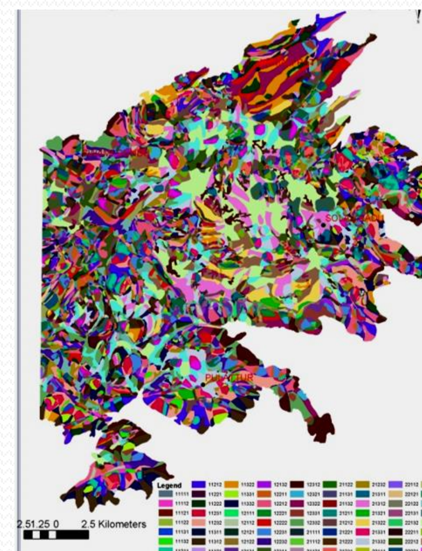
Zones of dendritic drainages



Filter out Convex & plain slopes



Buffer out sensitive toes



Landslide inducing parameters

UNIT-6

Unit-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.

Advancements & Recent Trends of GIS

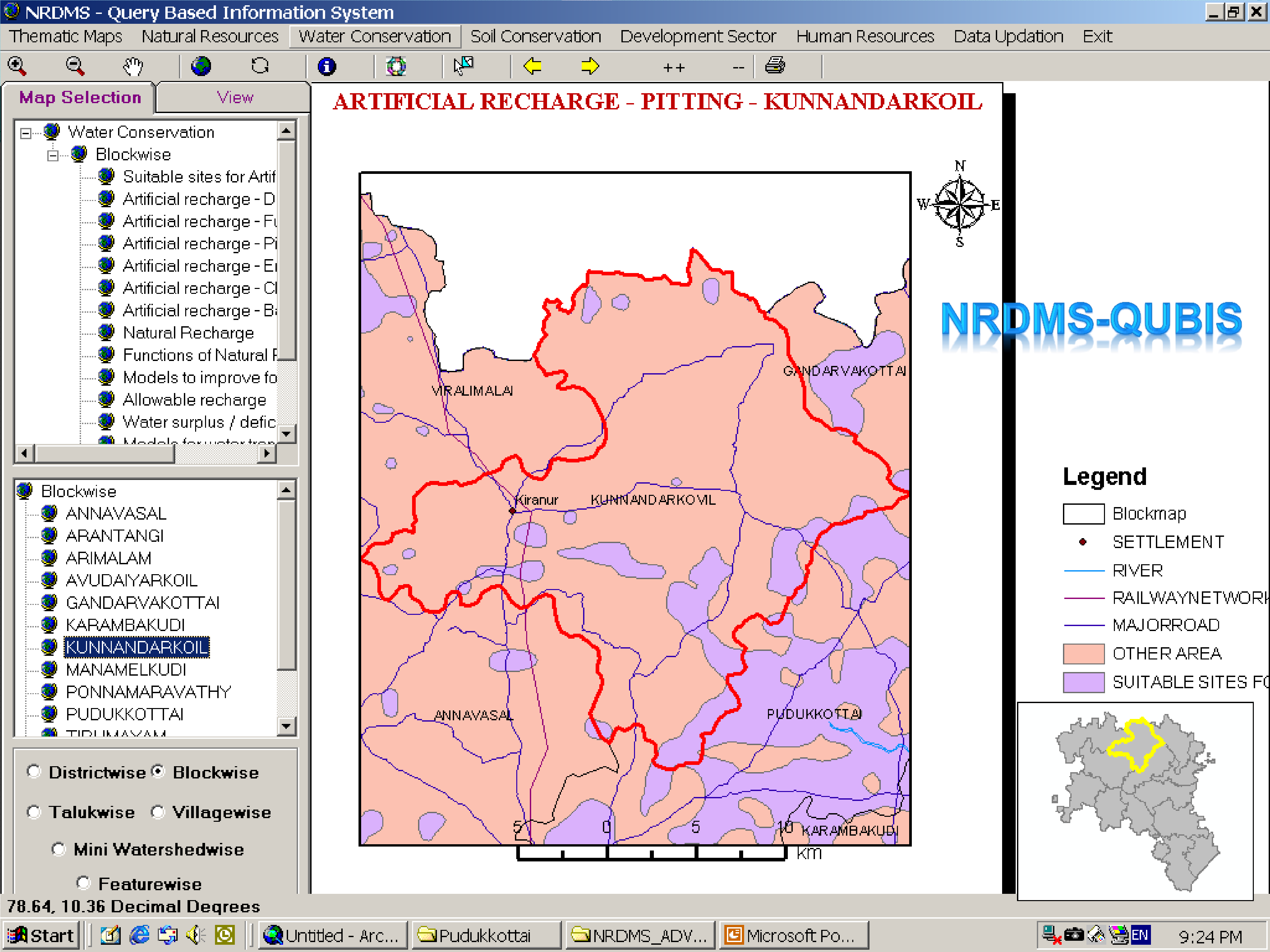
- GIS has got a large number of vistas and advanced virtues
- Apart from many, GIS can perform a lot of sophisticated spatial operations.
- Integrate data from various sources – RS, GPS, CAD, AM/FM, etc.
- Provide support for making decisions with a set of procedures in a problem solving environment.

CUSTOMIZATION IN GIS (Dev. 1)

- Consist of easy user interface (GUI)
- User friendly environment
- Reduces multiple time taking steps
- Hiding operations
- Easy to modify
- No need to train the user

SPATIAL INFORMATION RETRIEVAL SYSTEM (Dev. 2)

- Customized GIS package
- Assists the user to retrieve the spatial data easily and quickly
- User oriented Built-in queries for easy retrieval (Query Based Information Retrieval System – QBIRS / QUBIS)
- Displays attribute data spatially by creating a link (Relate)


NRDMS - Query Based Information System
Thematic Maps
Natural Resources
Water Conservation
Soil Conservation
Development Sector
Human Resources
Data Updation
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View
Water Conservation
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Artificial recharge - Fu
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Artificial recharge - Ba
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GANDARVAKOTTAI
KARAMBAKUDI
KUNNANDARKOIL
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PUDUKKOTTAI
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Blockwise
Talukwise
Villagewise
Mini Watershedwise
Featurewise
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SPATIAL DECISION SUPPORT SYSTEM (SDSS) (Dev. 3)

- An interactive computer based system,
- designed to support the user
- in achieving a higher effectiveness of decision making
- while solving a semi structured spatial decision problem

AUTOMATED SPATIAL DECISION SUPPORT SYSTEM (ASDSS) (Dev. 4)

USER SIDE INPUTS

- User need to help the system to locate the data sets
- Select the model / ready made methodology
- Give the conditions, if necessary, then

ASDSS does the job of

- Self extrapolating the data sets
- Generating the databases
- Self analyzing the databases,
- Generating action plans maps, tables, reports,
- Forewarn the users with suggestions, etc.

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https://www.fema.gov

FEMA

Navigation

Search

Languages

Hurricane Matthew

Find up-to-date resources and information on the federal response to Hurricane Matthew

Urban Search & Rescue Teams

As floodwaters from Hurricane Matthew continue to rise, we deployed some of the country's bravest & finest into those waters to help impacted communities.

Louisiana Flood Recovery

7:21 PM
10/23/2016

federal emergency manag × | FEMA Flood Map Service (×

https://msc.fema.gov/portal/

FEMA

FEMA Flood Map Service Center : Welcome!

Navigation

Search

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- MSC Search All Products
- MSC Products and Tools
  - Hazus
  - LOMC Batch Files
  - Product Availability
- MSC Frequently Asked Questions (FAQs)
- MSC Email Subscriptions
- Contact MSC Help

Looking for a Flood Map?

Enter an address, a place, or longitude/latitude coordinates:

Enter an address, a place, or longitude/latitude coordin | Search

Looking for more than just a current flood map?

Visit **Search All Products** to access the full range of flood risk products for your community.

About Flood Map Service Center

The FEMA Flood Map Service Center (MSC) is the official public source for flood hazard information produced in support of the National Flood Insurance Program (NFIP). Use the MSC to find your official flood map, access a range of other flood hazard products, and take advantage of tools for better understanding flood risk.

FEMA flood maps are continually updated through a variety of processes. Effective information that you download or print from this site may change or become superseded by new maps over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet

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10/23/2016


Thank you
For your kind cooperation
Patient listening & Learning GIS
Let us enjoy using GIS more efficiently & effectively…