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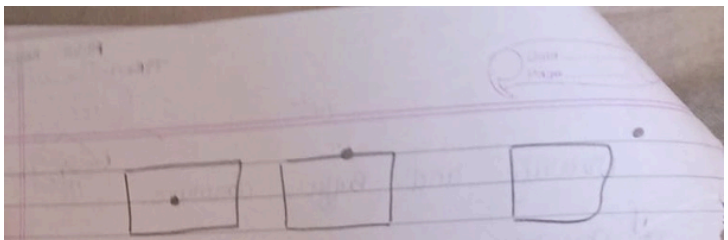
GIS

Overlay and Buffer operations

8. Describe concept of point-in-polygon, line-in-polygon and point in polygon analysis in GIS with real world application

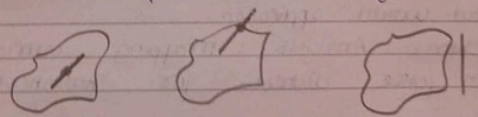
1] Point-in-polygon analysis
This determines whether a given point lies inside, outside or on the boundary of polygon. A point is represented by its coordinates (x,y). Common algorithm used
• Ray Casting Algorithm
A imaginary line is drawn from the point to infinity in any direction. The number of times this ray intersects the polygon boundary is counted. If the count is odd, the point is inside polygon; if even it is outside polygon.

Real-world application
• Crime Analysis: Mapping crimes to neighborhood or police districts for statistical analysis
• Retail Analysis: Identifying whether a customers location falls within a delivery zone
• Utility planning: Verifying if utility lines fall within specific jurisdiction or zone
• Transportation: Checking if public transportation routes lies within specific urban area. Or by connecting the points the roads are made.



2] line-in-Polygon
Line in polygon analysis determines whether a line feature is fully, partially inside or outside the polygon.

Real world application
• Infrastructure
Analyzing which section of roads or railways pass through specific zoning areas
• Environmental impact assessment
Assessing how much of a river flow through a protected wildlife habitat

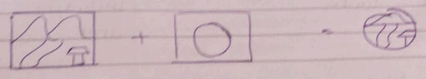


3] polygon-in-polygon
polygon analysis whether one polygon features is fully inside partially inside or outside the polygon
• Land management
Checking if the land parcel overlaps or fall entirely within jurisdictional boundaries

Q.2) How are geoprocessing tool such as clip dissolve and merge

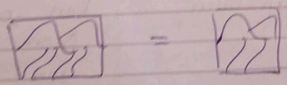
1) Clip Tool

The clip tool extract portion of spatial data by using one dataset using the boundaries of another dataset. It returns only the data within the boundaries of clip area



2) Dissolve tool

The dissolve tool merge adjacent features that share the same attribute value into a single feature. It simplifies dataset by removing boundaries



3) merge tool

Merge tool combines multiple dataset of same input type into single data set. It does not check for overlap

Q.3) Difference between intersection and union operation

Intersection	Union
Returns only the overlapping area as features of input layer	Combines all features from both layers including overlap and non-overlap area
A new layer containing only the shared geometry and attribute of overlapping area	A new layer that contain the geometry and attribute of all features
Creates smaller, refined geometry based on overlap area	Creates larger dataset that combines all geometries from input
Focus on features that are not different	include entire area.
eg: environmental management	eg: land use for farming

Date
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2. difference between Vector data and Raster data

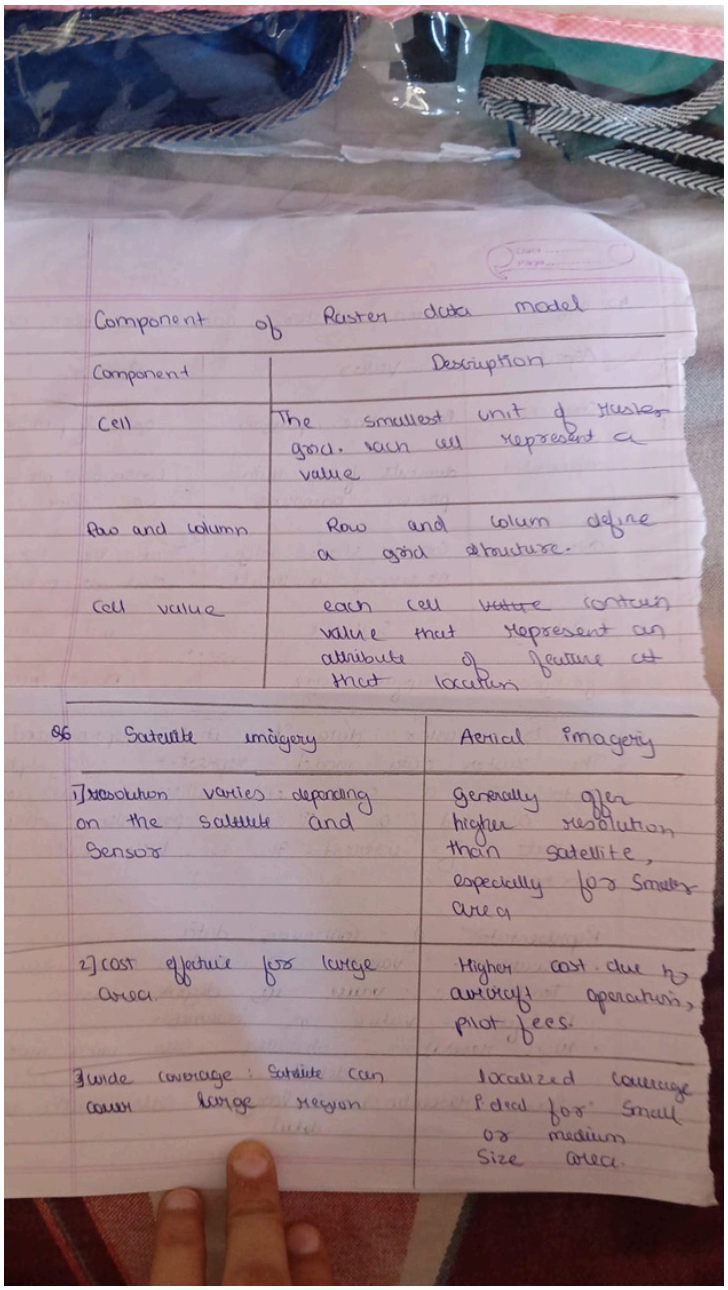
Aspect	Vector	Raster
Structure	Point, line, polygon	grid of pixel, cell
representation	discrete feature with precise boundaries	Continuous phenomena or discrete data
data storage	Compact, stores only necessary coordinate	can be large due to pixel storage
Scalability	Scalable	not scalable
file type	Shapefile, KML	DEM, GeoTIFF

3. what is raster data ? how it is represented.

→ The raster data model represent geographic data as a grid cell, where each cell is assigned a value representing the attribute of interest. It is well suited for continuous data.

Representation of continuous data

- elevation : value in meter above sea
- Temperature : value in degree, celsius
- Rainfall : value in millimeter
- High resolution : smaller cells with more detail
- low resolution : larger cells with less detail



Component of Raster data model

Component	Description
Cell	The smallest unit of raster grid. Each cell represent a value
Row and column	Row and column define a grid structure.
Cell value	Each cell ~~value~~ contain value that represent an attribute of feature at that location

Q6

Satellite imagery	Aerial Imagery
1] Resolution varies depending on the satellite and sensor	Generally offer higher resolution than satellite, especially for smaller area
2] Cost effective for large area	Higher cost due to aircraft operation, pilot fees.
3] Wide coverage: Satellite can cover large region	Localized coverage ideal for small or medium size area.

data availability is often freely available	Tegister subject

7] what is the role of topology in ensuring spatial relationship between vector data feature in GIS?

→ Topology in GIS : ensuring spatial relationship
- Topology in GIS refers to the spatial relationship between geographic features. It's not about the specific coordinate of feature but rather how they are connected and arranged. This is crucial for maintaining data integrity and enabling accurate spatial analysis.

Key role of topology
- Defines spatial relationship : connectivity, containment, adjacency.
- Data quality control : errors detection, data cleaning
- Spatial analysis : network analysis, buffering, overlay analysis

Example : Road network
- Imagin a road network.
1] Road connect at intersection
2] There are no gap or overlap in road segments
3] Street have defined direction longway or two way

8] what is the purpose of hybrid data models.

→ A hybrid data model combines aspects of both vector and raster data models to leverage the strength of each.
- It is designed to overcome the limitation of individual model by integrating there features, making it more versatile for handling complex spatial data and analysis

Purpose :
1] Combining strength
→ vector strength : Accurate representation of discrete features
→ Raster strength : effient representation of continuous data.

2] enhanced spatial analysis
→ supports analysis involving both discrete and continuous phenomena
→ enable overlay operation between vector feature and raster surface.

3] Improved data management
→ facilitates integration of data from different source and format.
→ provide flexibility for storing, querying spatial information

4] Complex modeling and simulation
→ allows for detailed modelling of real-world

process that require both type of data

5] Interoperability
→ support seamless data exchange and compatibility across GIS platform and applica

9] what is buffering in GIS, and how does it enhance proximity-based spatial analysis?
→ Buffering is the process of creating a zone around a spatial feature at a specific dis
· The resulting buffer zone represent an area of influence or proximity around the feature, enabling spatial analysis based on distance relationship
→ · Defining zone of influence.
Buffer create a new boundary to represent the area impacted or influenced by spatial feature
· Buffer helps to identify which spatial feature lie within or outside a specified distance
· Buffer provide insight for planning and decision-making based on proximity.
· Buffer help analyze accessibility and connectivity in transportation and network analysis
· Buffer are critical for evaluating the environmental impacts of features or assessing hazard.

10] what is the role spatial query,
→ Defining spatial Relationship
Spatial query operator help to determine relationship such as:
· intersection = identify feature that overlap
· containment
· Adjacency = finds features that are next to share boundary

2] Proximity Analysis
Identify feature within a certain distance from a point, line or polygon

3] data retrieval & filtering
enable extraction of relevant data subset based on spatial criteria

4] Advanced spatial analyses
Buffering creates zone of influence around features.

By leveraging spatial query operators GIS, users can uncover meaningful pattern, relationship & insight which are crucial for spatial decision making and analysis