Batch:D-2 **Roll No.:** 16010122151

Experiment No. 3

Title: Implement spatial data analysis in QGIS

Course Outcome:

CO2 Apply the data analytics in the field of geospatial system

Books/ Journals/ Websites referred:

QGIS Version 3.38-Vector Data Code File-World.shp

(Students should write)

Resources used:

(Students should write)

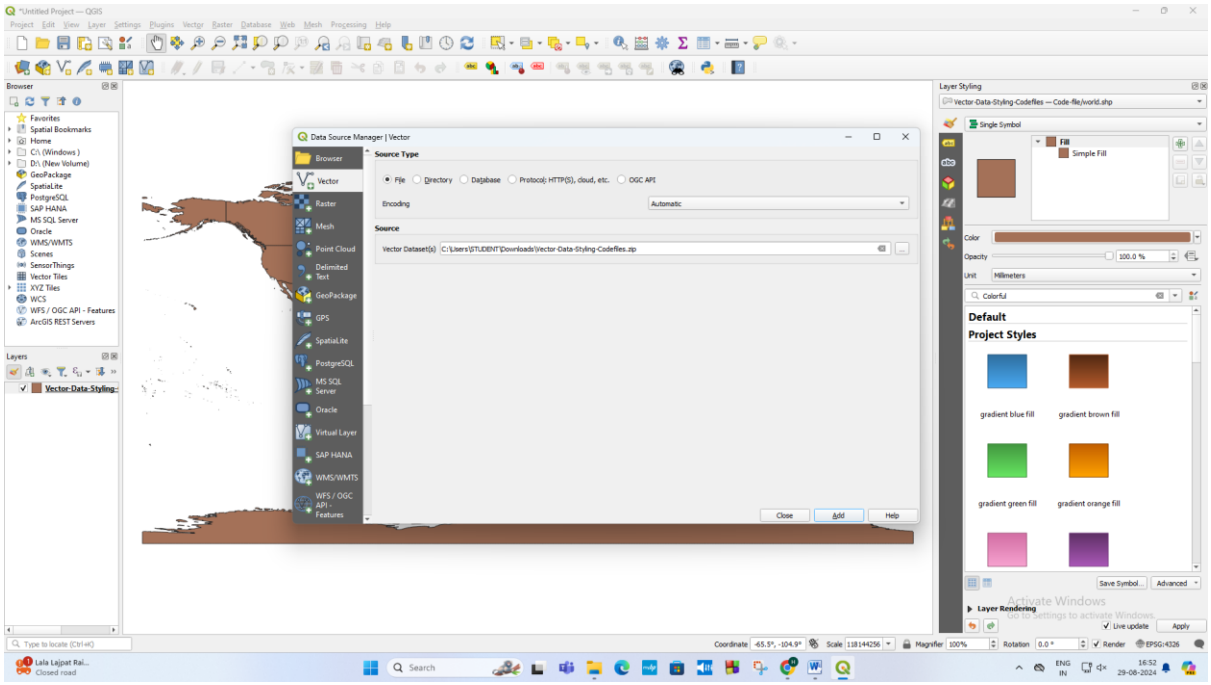
Algorithm: Spatial Data Analysis

Spatial Data type: Vector Data

Step 1: Load Your Vector Data

Open QGIS.

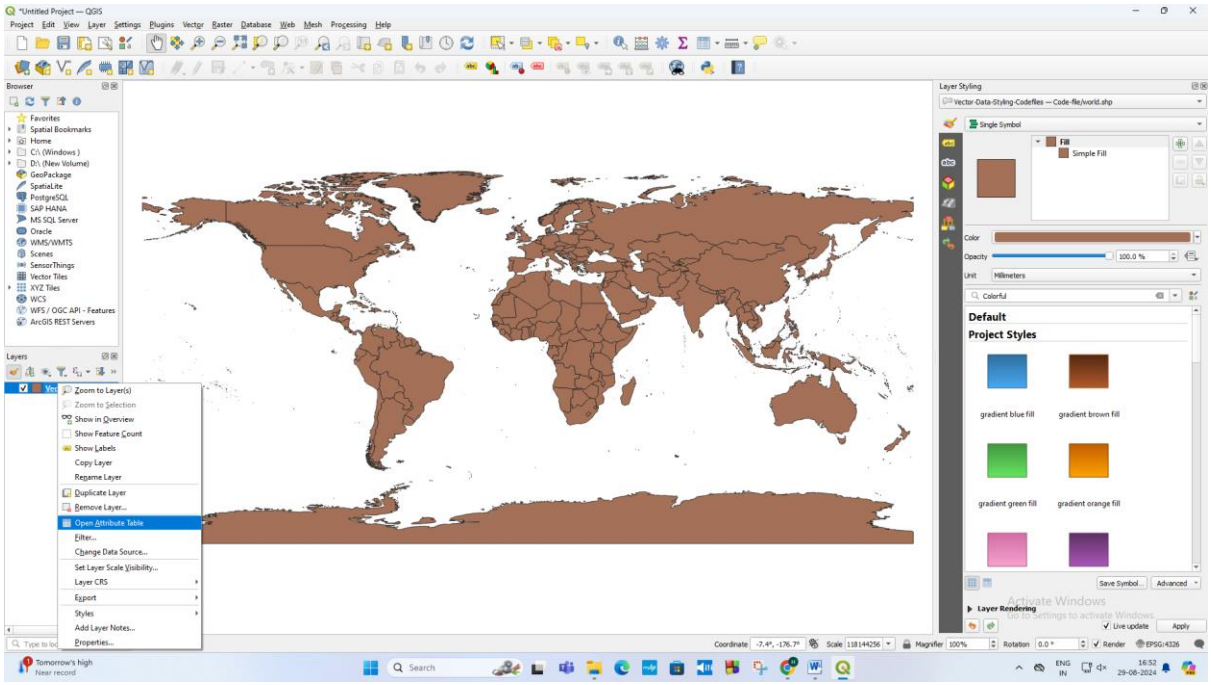
Add your vector layer: Go to Layer > Add Layer > Add Vector Layer... and browse to your shapefile or other vector data.



Step 2: Open the Attribute Table

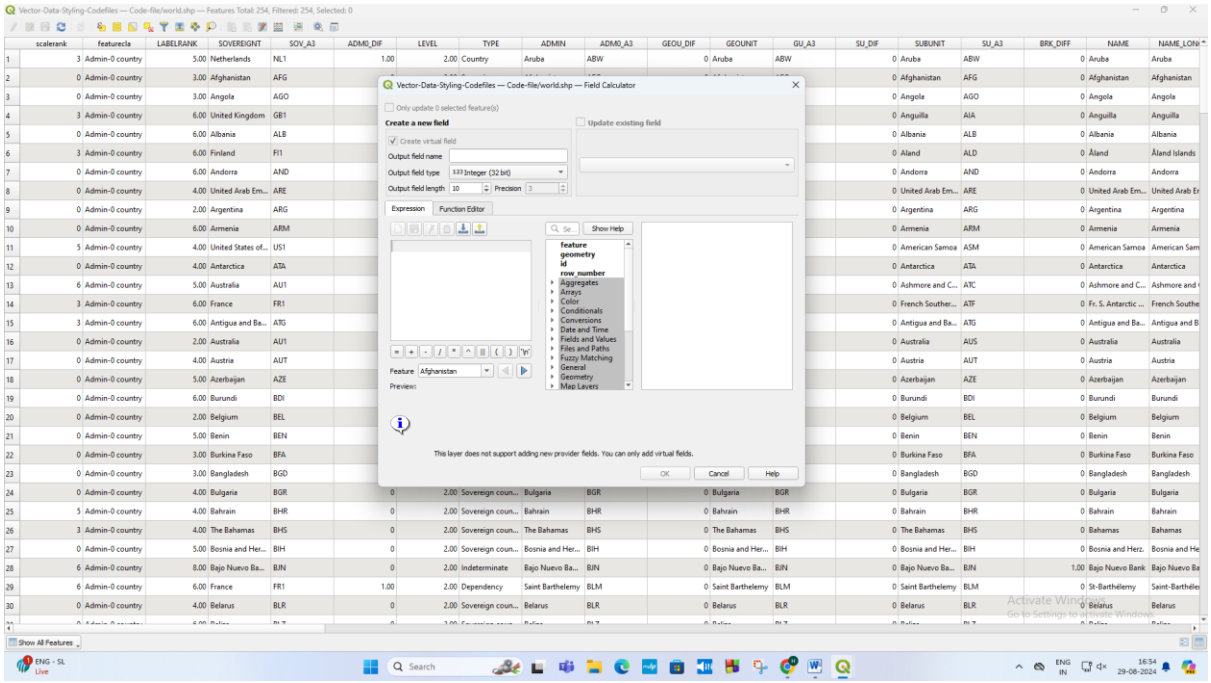
Right-click on the layer in the Layers panel.

Select Open Attribute Table.



Step 3: Add a New Field for Calculations

In the attribute table, click on the Field Calculator icon (it looks like an abacus).



Step 4: Calculate Area

In the Field Calculator dialog:

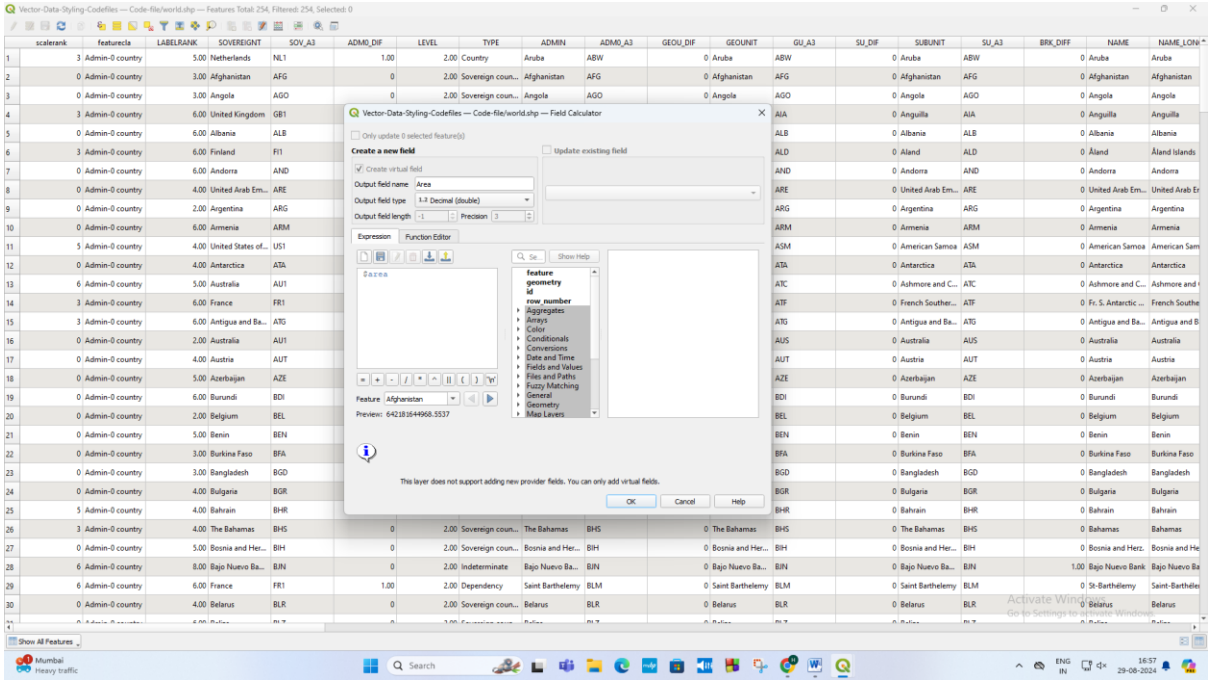
Check the option Create a new field.

Enter a name for the new field (e.g., "Area").

Set the output field type to Decimal number (real).

In the Expression field, enter the following expression to calculate the area in square meters:

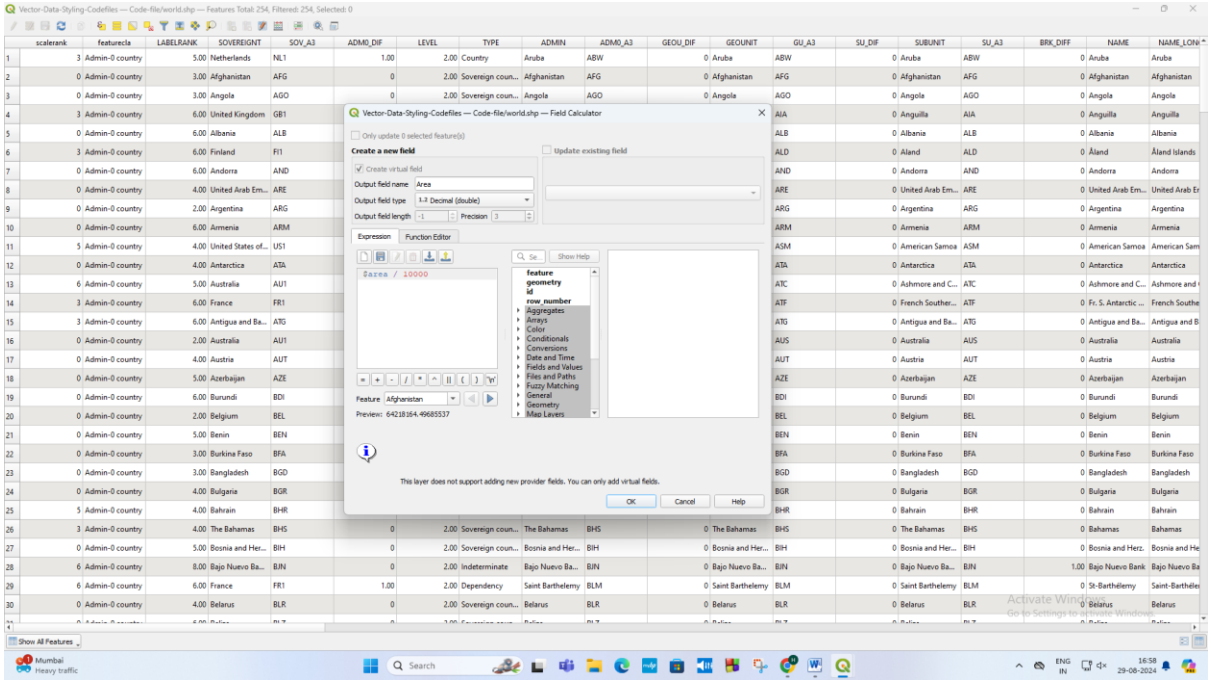
$area



To get the area in hectares:

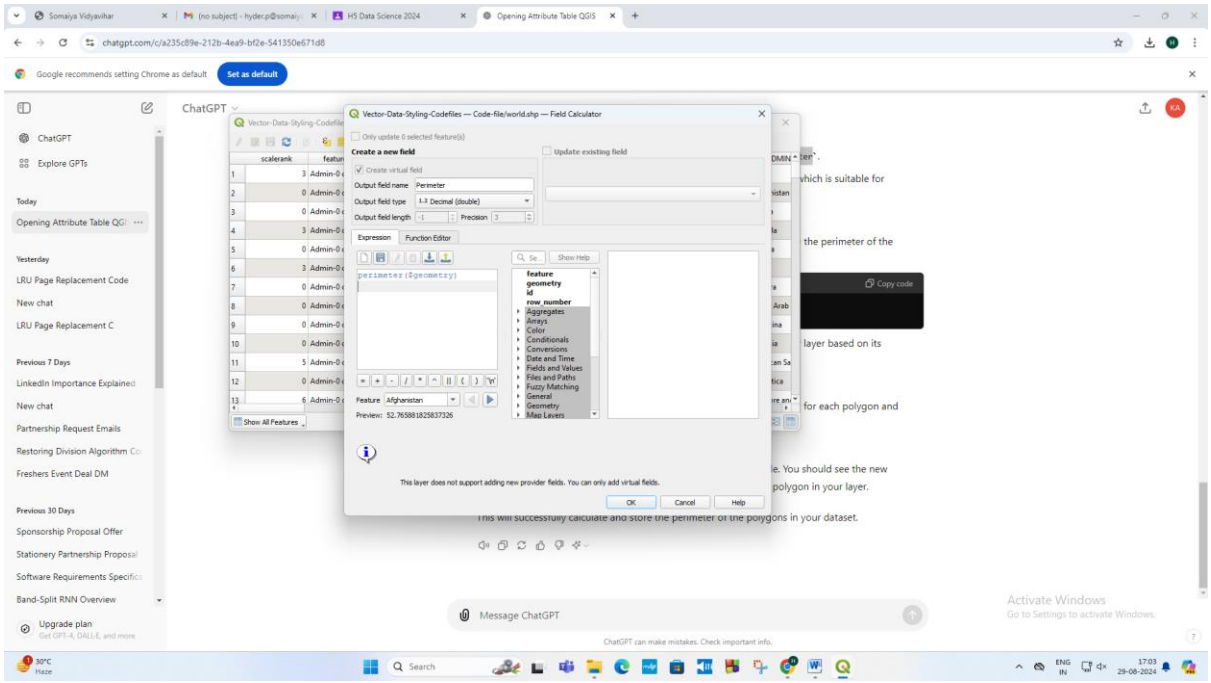
$area / 10000

Click OK to create the new field and calculate the areas.

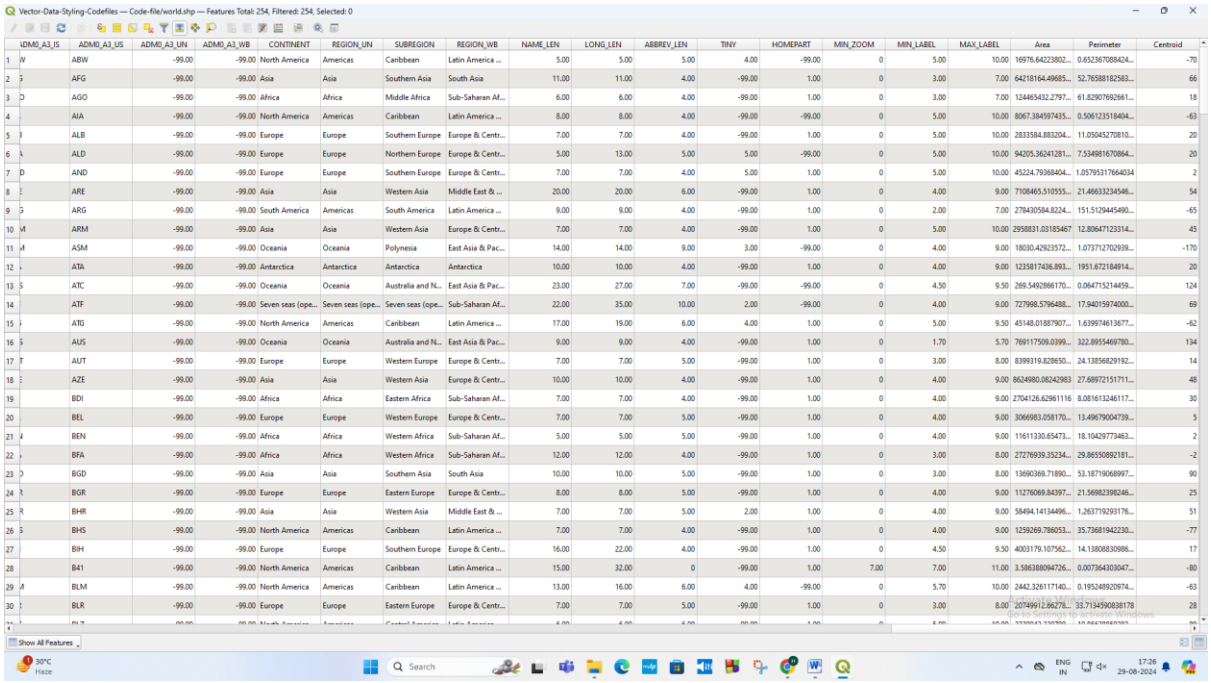


Step : Calculate Perimeter (for polygons):

perimeter($geometry)



Task: To work on other geometric properties like centroid using different expressions in the Field Calculator.



We can see Area, Perimeter,

Platform used by the student: QGIS

Following points should be written by students

Different Geometric Properties used in spatial data analysis.

Key geometric properties commonly used in spatial data analysis:

1. **Length:**
   - Used to measure the distance of linear features, such as roads or rivers.
2. **Area:**
   - Measures the surface area enclosed by polygon features, such as land parcels or lakes.
3. **Centroid:**
   - The central point of a feature, used to find the geometric center of polygons or to position labels.
4. **Bounding Box (Envelope):**
   - The smallest rectangle that can contain a feature, useful for simplifying spatial queries and calculations.

5. **Distance:**
    - Measures the shortest distance between features, such as point-to-point or point-to-line distances.

Conclusion (Students should write in their own words):

Learned how to use field Calculator, used field Calculator to make Area, Perimeter, Centroid

Post lab questions:

Q.1 What are different geometric properties used in spatial data analysis on vector data with expression?

Ans) Key geometric properties used in spatial data analysis on vector data.

1. **Area**
    - **Expression**: $area
    - **Description**: Computes the area of polygon features. Useful for determining the size of features like land parcels or lakes.
2. **Perimeter**
    - **Expression**: $perimeter
    - **Description**: Measures the perimeter (boundary length) of polygon features. Essential for understanding the extent of boundaries.
3. **Length**
    - **Expression**: $length
    - **Description**: Calculates the length of line features. Important for analyzing features such as roads, rivers, or utility lines.

4. **Centroid Coordinates**
    - **X-Coordinate Expression**: x(centroid($geometry))
    - **Y-Coordinate Expression**: y(centroid($geometry))
    - **Description**: Provides the X and Y coordinates of the centroid (geometric center) of polygon features. Useful for placing labels or central point analysis.
5. **Bounding Box**
    - **Minimum X-Coordinate Expression**: $xmin
    - **Maximum X-Coordinate Expression**: $xmax
    - **Minimum Y-Coordinate Expression**: $ymin
    - **Maximum Y-Coordinate Expression**: $ymax
    - **Description**: Gives the coordinates of the bounding box (envelope) that contains the feature. Useful for spatial queries and extent analysis.
6. **Distance to Another Feature**
    - **Expression**: distance($geometry, geometry(get_feature('another_layer', 'id', 'your_id')))
    - **Description**: Calculates the distance from a feature to another feature or layer. Essential for proximity analysis and spatial relationships.

Q.2 What are different geometric properties used in spatial data analysis on raster data with expression?

Ans) Key geometric properties used in spatial data analysis on raster data

1. **Cell Size**
    - **Description**: The dimensions of each cell in the raster grid. This defines the spatial resolution of the raster data, with smaller cell sizes providing higher resolution and more detail.
2. **Raster Extent**

- **Description**: The spatial extent of the raster layer, including the minimum and maximum X and Y coordinates. This indicates the geographic area covered by the raster data.

3. **Slope**
   - **Description**: Measures the steepness or incline of the terrain. This is derived from the rate of change in elevation values in a digital elevation model (DEM). Slope analysis helps in understanding terrain variability and landform characteristics.
4. **Aspect**
   - **Description**: Indicates the compass direction that the slope faces. This property helps in understanding the orientation of terrain and is useful for applications like solar exposure analysis.
5. **Hillshade**
   - **Description**: Simulates the effect of sunlight on the terrain to visualize the 3D relief of the landscape. It helps in enhancing the visualization of elevation changes and terrain features by simulating how light and shadow would interact with the surface.

Q.3 What is spatial data analysis and write its advantages.

Ans) **Spatial data analysis** involves examining geographic data to reveal patterns, relationships, and trends associated with specific locations on Earth. It is performed using Geographic Information Systems (GIS) and includes tasks like mapping, overlay analysis, proximity analysis, and pattern recognition.

Advantages of Spatial Data Analysis

1. **Enhanced Decision-Making**:
   - **Advantage**: Provides valuable insights for informed decisions by visualizing spatial relationships.
   - **Example**: Helps urban planners make zoning and infrastructure decisions.
2. **Identification of Spatial Patterns**:
   - **Advantage**: Reveals patterns and trends, such as clustering of events.

- **Example**: Identifies disease hotspots for epidemiologists.

3. **Improved Resource Management**:
   - **Advantage**: Optimizes the allocation and use of resources.
   - **Example**: Assists environmental managers in monitoring natural resources.
4. **Enhanced Visualization**:
   - **Advantage**: Converts complex data into understandable maps and charts.
   - **Example**: Businesses use heatmaps to target marketing efforts.
5. **Spatial Problem Solving**:
   - **Advantage**: Solves spatially-related problems through modeling and analysis.
   - **Example**: Optimizes traffic routes to reduce congestion.