2	**Creating and Managing Vector Data: Adding vector layers, setting properties, formatting, calculating line lengths and statistics**
3	**Exploring and Managing Raster data: Adding raster layers, raster styling and analysis, raster mosaicking and clipping**
4	**Making a Map, Working with Attributes, Importing Spreadsheets or CSV files Using Plugins, Searching and Downloading OpenStreetMap Data**
5	**Working with attributes, terrain Data**
6	**Working with Projections and WMS Data**
7	**Georeferencing Topo Sheets and Scanned Maps** **Georeferencing Aerial Imagery** **Digitizing Map Data**
8	**Managing Data Tables and Saptial data Sets: Table joins, spatial joins, points in polygon analysis, performing spatial queries**

Practical 2 :Creating and Managing Vector Data:

1) **Adding vector layers, setting properties, formatting**
2) **calculating line lengths and statistics**

AIM: To create a map of your surrounding area using vector data model (points, lines and polygons)

Steps to implement Vector data:-

- Go to the **Project** tab in your GIS software.
- Click on **"New Project"** to start a fresh workspace.
- Navigate to the **Layer** tab.
- Under **Create Layer**, select **"New Shapefile Layer"**.
- Provide a **file name** with the **".shp"** extension.
- In **Geometry Type**, choose one of the following:
    - **Polygon**
    - **Line**
    - **Point**
    - **Multipoint**
- In the **New Field** box, enter a name of your choice (replacing the default "Name") and click on **"Add to Field List"**.
- Click **OK** to create the shapefile layer.
- Begin drawing your desired feature (area, line, or point) based on the geometry type selected.
- The newly created layer will appear in the **Layer Panel** on the left side of the screen.
- To **format the layer**, right-click on it in the Layer Panel and select **Properties**.
- In the Properties window, you can:
    - Add **Labels**
    - Change **Colours**
    - Adjust **Symbology** and other styling options

For Calculating Line Lengths Statistic

1) **Add Vector Layers:**
    a. Go to **Layer** > **Add Layer** > **Add Vector Layer**.
    b. Select **“Indian_railway.shp”** and **“indian_administrative.shp”** files.
2) **Calculate Route Lengths:**
    a. Right-click **Indian_railway** layer > **Open Attribute Table** > **Open Field Calculator**.
    b. Set **Output Field Name:** route_len, **Type:** Decimal Number.
    c. In **Expression** box, enter: $length/1000 and select **Geometry**.
    d. Click **OK** and **Save Edits**.
3) **Generate Line Length Statistics:**
    a. Go to **Vector** > **Analysis Tools** > **Basic Stats for Fields**.
    b. Set **Input Layer:** Indian_railway, **Field:** route_len, then click **Run**.
4) **Symbolize the Railway Layer:**
    a. Open **Indian_railway** properties and style it using the route_len field.

Practical 3 : Exploring and Managing Raster data:

Adding raster layers, raster styling and analysis, raster mosaicking and clipping

Exploring and Managing Raster Data

a) Adding Raster Layers

1. **Open Menu:** Select **Layer → Add Layer → Add Raster Layer**.
2. **Select Dataset:** Choose the **GPW v3 dataset** (Population Density Grid, ASCII format, for 1990 & 2000).
    - Path:
        - *1990:* `Prac-02\A\DATA\gl-gpwv3-pdens_90_ascii_one\glds90ag60.asc`
        - *2000:* `Prac-02\A\DATA\gl-gpwv3-pdens_90_ascii_one\glds00ag60.asc`
3. **Set CRS:**
    - Open **Project → Properties** or use the right-corner shortcut.
    - Go to **CRS**, select **WGS 84 EPSG: 4326**, and press **OK**.

b) Raster Styling & Analysis

1. Convert the raster layer from grayscale to color:
    - Select **glds90ag60.asc** from the **Layer Pane**.
    - Open **Properties** (right-click or double-click the layer).
    - Go to **Symbology** and apply changes.
2. Repeat the same steps for **glds00ag60.asc**.

1. Compute Population Change

- Open **Raster → Raster Calculator**.
- Enter the expression:

```
graphql
gid500ag60@1 - gids90ag60@1
```

- Set output file location & name, then press **OK**.

2. Remove Old Layers

- Remove **gid500ag60.asc** and **gids90ag60.asc**.

3. Style the Difference Layer

- Double-click **pop-diff layer** → Open **Properties → Symbology**.
- Set **Render Type:** *Single Band Pseudo Color*.
- Set **Interpolation:** *Discrete*.
- Remove all classifications and add new ones as needed.
- Press **OK** to apply changes.

Raster Mosaicking and Clipping

Mosaicking combines multiple raster images into a single dataset. When overlapping occurs, different methods can be applied:

- **First/Last:** Retains data from the first or last dataset.
- **Blend/Mean:** Best for continuous data, using weighted or average values.
- **Min/Max:** Useful for discrete data, selecting the smallest or largest value.

Raster Mosaicking and Clipping

1. Load Raster Images

- **Go to: Layer → Add Layer → Add Raster Layer**.
- **Select TIFF files:**
  - `FAS-India1-2018249-terra-367-2km-tif`
  - `FAS-India2-2018249-terra-367-2km-tif`
  - `FAS-India3-2018249-terra-367-2km-tif`
  - `FAS-India4-2018249-terra-367-2km-tif`
- Click **Open**, then in **Data Source Manager → Raster**, click **Add**.

2. Merge Raster Layers

- **Go to: Raster → Miscellaneous → Merge**.
- **Select all layers** and press **OK**.
- **Set output file location & name:**
  - Save as: "`GIS-Workshop/Practical/Prac-2/C/Merge-Files.tif`"
- Press **Run**, then close the **Merge** window.

3. Final Adjustments

- **Deselect individual layers** in the layer pane, keeping only the merged raster file.
- **Add Vector Layer:**
  - **Go to: Layer → Add Vector Layer**.
  - Select: `GIS-Workshop\Practicals\Prac-2\C\India Admin Boundry\IND_adm0.shp`.

Practical 4 :- Making a Map, Working with Attributes, Importing Spreadsheets or CSV files Using Plugins, Searching and Downloading OpenStreetMap Data

GIS Mapping, Data Import, and OSM Integration

1. Creating a Thematic Map

- **New Map:** Go to **Project → Print Layout (New)** → Add a title → Press **OK**.
- **Add Map: Add Item → Add Map** → Adjust properties in **Item Properties → Map 1 → Layers**.
    - Enable **Lock Layers & Lock Style** to prevent changes.
- **Insert Image: Add Item → Add Picture** → Adjust placement & rotation.
- **Inset Map: Add Item → Add Picture** → Highlight an area on the main map.
    - Enable **Frame** and **Draw Overview** in **Item Properties → Overviews**.
- **Customize Layout:**
    - **Title: Add Item → Add Label** → Set text (e.g., "Mumbai Map"), font size, and color.
    - **Legend: Add Item → Add Legend** → Uncheck **Auto-update**, adjust labels.
    - **Scale Bar: Add Item → Add Scale Bar**.
    - **Additional Labels: Add Item → Add Label** (HTML rendering enabled).
- **Export Map: Layout → Export as Image/PDF** → Save & open the file.

2. Importing CSV/Spreadsheet Data

- **Go to: Layer → Add Layer → Add Delimited Text Layer**.
- **Select File:** Choose `sample.csv` from the data folder.
- **Press ADD**, then close the window.

3. Using Plugins in QGIS

- **Enable Core Plugins: Plugins → Manage and Install Plugins** → Check desired plugins.
- **Install External Plugins:**
    - **Go to: Not Installed** tab or **Install from ZIP**.
    - Enable **Experimental/Deprecated Plugins** if needed.
    - Click **Install** → Access via **Plugins → [Plugin Name]**.

4. Searching & Downloading OpenStreetMap (OSM) Data

- **Install Plugins:**
    - **Plugins → Manage and Install Plugins** → Add **OpenLayers** & **OSM Search**.
- **Load OSM Map:**
    - **Web → OpenLayer Plugin → OpenStreetMap**.
    - If an error occurs, **Project Properties → CRS → Check "No projection"**.
- **Search for Places:**
    - **View → Panels → OSM Place Search** → Enter location (e.g., *Mumbai*).
    - **Double-click** or **Zoom** to view the location

Practical 5 :- Working with attributes, terrain Data

1. Working with Attributes

- **Start a new project → Layer → Add Layer → Add Vector Layer**.
- Select:

  `ne-lom-populated_places-simple.zip`

- **Open Attribute Table** (Right-click on layer → Open Attribute Table).
- **Filter Data:**
  - Click **"Select features using expression"**.
  - Enter: `pop_max > 100 AND pop_max < 10000`.
  - Selected places appear in a different color.
  - Use **Deselect Button** to reset.

2. Terrain Data & Hill Shade Analysis

- **Load Raster Layer:**
  - **Layer → Add Raster Layer** → Select:

    `100 060-e_20101117gmted-mea 300 tif`

  - Darker areas = lower altitudes, Lighter areas = higher altitudes.
  - **Zoom to Mt. Everest** (`27.9881°N, 86.9253°E`).

2.1 Clipping Raster Layer

- **Go to: Raster → Extraction → Clip Raster by Extent**.
- Select:
  - **Use Canvas Extent** (or manually define an area).
  - Set output file name & location → **Press RUN**.
- **Keep only clipped raster layer**, deselect original.

2.2 Contour Line Generation

- **Go to: Raster → Extraction → Contour**.
- Set:
  - **Contour Interval:** `100m`.
  - **Output File:** Select name & location.
  - **Check "Add output file to project"**.
- **Press RUN** → Contour layer appears.
- **Label Contour Lines:** Use `ELEV` field.
- **Sort Data:** Right-click Contour Layer → **Open Attribute Table** → Sort by `ELEV`.

2.3 Export to Google Maps

- **Copy Contour Layer → Layer → Save As**.
- Set format to **Keyhole Markup Language (KML)**.
- **CRS:** WGS 84 EPSG: 4326.
- Open the saved **KML file** in Google Maps.

2.4 Hill Shade Analysis

- **Install Plugin: Plugins → Install Georeference GADL**.
- **Go to: Raster → Analysis → Hill Shade**.
- Set:
    - **Input Raster Layer**, **Output Filename & Location**.
- **Press RUN** → Close **Hill Shade Window**.
- **Apply Raster Styling** for visualization.

Practical 6 :- Working with Projections and WMS Data

Working with Projection & WMS Data

1. Setting Up Projection

- **Start a new project → Layer → Add Layer → Vector Layer**.
- Select:

  `ne_10m_admin_0_countries.zip`

- **Reproject Layer:**
  - **Layer → Save As** → Format: **ESRI Shapefile**.
  - Set **CRS**: **North America Albers Equal Area Conic (EPSG: 102008)**.
  - Choose output folder & file name → **Press OK**.
  - **Deselect the original layer**, keep the projected layer visible.

2. Adding Raster Layer

- **Layer → Add Layer → Add Raster Layer**.
- Select:

  `Miniscale (Standard) R17.tif`

  (Path: `GIS Workshop Practicals\Prac 05\DATA\minisc_gb\data\RGB_TIF compressed\Miniscale_(standard)-R17.tif`)

- The raster layer appears **misaligned** from Great Britain.

3. Correcting Projection

- **Open Layer Properties → CRS**.
- **Search & Select: British National Grid (EPSG: 27700)**.
- **Processing takes time**; once completed, the **vector layer aligns perfectly with the raster layer**, covering the United Kingdom.

Practical 7 :- Georeferencing & Digitizing in GIS

A. Georeferencing Topo Sheets & Scanned Maps

1. **Start a New Project**
   - **Layer → Add Vector Layer** → Select:

     `GIS Workshop | Manual | Prom 06/IND_adm0:shy`

   - Zoom into **Mumbai region**.
2. **Install & Open Georeferencer GDAL**
   - **Plugins → Manage & Install Plugins** → Ensure **Georeferencer GDAL** is enabled.
   - **Raster → Georeferencer** → **File → Open Raster**.
   - Select:

     1870-southern-india-3975-3071-600.jpg

   - **Settings → Transformation Settings**:
     - **Transformation Type**: Thin Plate Spline
     - **Resampling**: Nearest Neighbour
     - **Target CRS**: Everest 1830 datum (EPSG:4044)
     - **Output Raster Name & Location** → Check **Load in QGIS when done** → **Press OK**.
   - **Edit → Add Point** → Add control points.
   - **Settings → Transformation Settings** → Press **Run**.
   - **File → Start Georeferencing**.
   - Adjust **raster transparency** in **Layer Properties**.

B. Georeferencing Aerial Imagery

1. **Install OpenStreetMap Plugin**
   - **Web → OpenLayer Plugin → OpenStreetMap**.
   - **Project → Properties → CRS** → Set **EPSG:3857**.
   - **View → Panels → Select OSM Place Search**.
   - Search **"Gateway of India"** → Zoom in.
2. **Load & Georeference Image**
   - **Raster → Georeferencer** → **File → Open Raster**.
   - Select:

     `Gateway Imagery.tif`

   - **Edit → Add Points** → Select control points.
   - **Settings → Transformation Settings** → **File → Start Georeferencing**.
   - Observe **aerial image aligned with OSM**.

C. Digitizing Map Data

1. **Load & Optimize Raster**
   - **Layer → Add Raster Layer** → Select:

     `Christchurch Topo50 map-tif`

- **Right-click → Properties → Pyramids Tab**.
- Select all resolutions → **Build Pyramids → OK**.

2. **Set Digitizing Options**
   - **Settings → Options → Digitizing Tab**.
   - Set **Default Snap Mode**: Vertex & Segment → **Press OK**.
3. **Create & Edit Spatialite Layer**
   - **Layer → Add Spatialite Layer**.
   - **Create Database**:

     ```
     GIS-Workshop/Practicals/Prac-06/MySpatialDataBase.sqlite
     ```

   - **Layer Name**: Digitized Road
   - **Geometry Type**: Line
   - **CRS**: EPSG:4167 - NZGD 2000
   - Add **"Name" & "Class" fields** → **Load Layer**.
4. **Digitizing Features**
   - **Toggle Editing → Add Feature**.
   - Click to add vertices → Right-click to end.
   - **Layer Properties → Style Tab** → Set appropriate style.
   - **For Polygon Features:**
     - Select **Digitized Garden Layer** → **Toggle Editing → Add Polygon Feature**.
     - Draw two gardens as polygons.
   - **Save & Finalize Digitized Features**.

Final Notes:

- **Points, Lines, and Polygons** can be digitized using the same process.
- **Label & Style features** using **Layer Properties** for a visually clear map.

Practical 8 :- Managing Data Tables and Saptial data Sets: Table joins, spatial joins, points in polygon analysis, performing spatial queries

A Table Joins

Datasets

- **tl_2013_06_tract.zip**: It's a map layer of Census Tracts in California for the year 2013.
- **ca_tacts_pop.csv**: A CSV file containing population data for census tracts in California.
- **ca_tacts_pop.csvt**: This is a companion to the CSV, which helps define data types for each column (text, integer, float, etc.).

Steps :

- Load the shapefile (vector layer)
- Load the CSV file (delimated text layer)
- Perform the Join
- Right-click the shapefile → Click Properties
- Go to the Joins tab
- Click the "+" to add a join
    - Join layer: Your CSV
    - Join field: The ID field in the CSV (Geo_id2)
    - Target field: The matching field in the shapefile (Geoid)
- Click OK
- Go to properties >symbology>graduated>value : D001, mode : equal interval
- Click OK

Spatial Joins

Datasets

- Nybb.shp (vector layer)
- Oem_nursinghome.shp (vector layer)

Steps

- First add both the vector layer
- Go to vector tab>data managements tool >add attribute by location
- Base layer : nybb.shp and join layer :oem_nursinghome.shp
- Fields to add :click on "select all" then click on next
- In next page join type : one to one and then run the fil
- Then right click on generated join layer and click on attribute table

Points in polygon analysis

Datasets

- Earthqauakedatabase (delimited text layer)
- Countries.zip (vector layer)

Steps

- Add both layer
- Goto to vector tab>Analysis tool >count point in p[olygon
- Polygon layer :countries & point layer : earthquake
- Save the file and run it

Spatial queries

Data sets

- Populated_people.shp (vector layer)
- River_lakes.shp (vector layer)

Steps

- Add both layer
- Change its crs by going on properties tab > crs > search “54032” and select it
- Go to vector tab > geoprocessing tool > buffer >input layer : river_lake & distance : 0.02 and then run it
- Go to vector tab >research tool > select by location > select feature : buffered and then run it