

Introduction to GIS

Introduction to GIS – Quick Reference Notes

1. What is GIS?

- **Definition:** Geographic Information System (GIS) is a computer-based tool that captures, stores, manages, analyzes, and visualizes spatial (location-based) data.
 - **Core Idea:** Combines “**where**” (geography) with “**what**” (attributes) to reveal patterns, relationships, and trends.
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2. Key Components of a GIS

Component	Function	Typical Example
Hardware	Processing power, storage, GPS receivers, plotters, mobile devices	Desktop workstation, field tablet
Software	GIS platforms & extensions for data handling, analysis, mapping	ArcGIS, QGIS, GRASS, MapInfo
Data	Spatial (geometry) + attribute (descriptive) information	Shapefiles, raster images, databases
People	Users, analysts, developers, decision-makers	Cartographers, planners, researchers
Methods/Procedures	Standardized workflows for data acquisition, editing, analysis, and sharing	QA/QC protocols, metadata standards

3. Types of Spatial Data

Data Type	Geometry	Typical Sources	Common Uses
Vector	Points, lines, polygons	GPS surveys, digitized maps, CAD files	Network analysis, parcel mapping
Raster	Grid of cells (pixels)	Satellite imagery, aerial photos, DEMs	Surface modeling, land-cover classification
Tabular (Non-spatial)	Linked via IDs	Census tables, sensor logs	Attribute joins, statistical analysis

Introduction to GIS

4. GIS Data Model Basics

1. **Feature Class** – collection of similar geometry (e.g., all roads as polylines).
 2. **Layer** – visual representation of a feature class with symbology, labeling, and scale settings.
 3. **Geodatabase** – organized storage (file, personal, enterprise) that maintains topology, relationships, and versioning.
 4. **Coordinate Systems**
 - **Geographic (lat/long)** – based on a spheroid/ellipsoid.
 - **Projected** – planar, e.g., UTM, State Plane; preserves distance, area, or shape depending on projection.
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5. Fundamental GIS Operations

Operation	Description	Example
Data Capture	Collecting raw spatial information	GPS field survey, digitizing paper maps
Georeferencing	Aligning raster images to real-world coordinates	Registering a scanned aerial photo
Editing	Adding, deleting, or modifying features	Updating road network after construction
Query & Selection	Retrieve features based on attribute or spatial criteria	Find all schools within 1 km of a river
Overlay	Combine two or more layers to derive new information	Intersect flood zones with residential parcels
Buffering	Create zones at a set distance around features	500 m buffer around highways for noise analysis
Spatial Join	Transfer attributes from one layer to another based on location	Assign census block population to park polygons
Surface Analysis	Derive terrain attributes (slope, aspect, viewshed) from DEMs	Identify suitable sites for solar panels
Network Analysis	Solve routing, service area, and flow problems	Optimize garbage truck routes

Introduction to GIS

Operation	Description	Example
Geostatistics	Interpolate point data to continuous surfaces	Kriging of soil moisture measurements

6. GIS Workflow – Typical Project Cycle

1. **Define Problem