CE-317 GIS/RS Application to Civil Engineering
Spring 2011

- Engr. Faisal ur Rehman
- Lecture 05: Sources of GIS Data

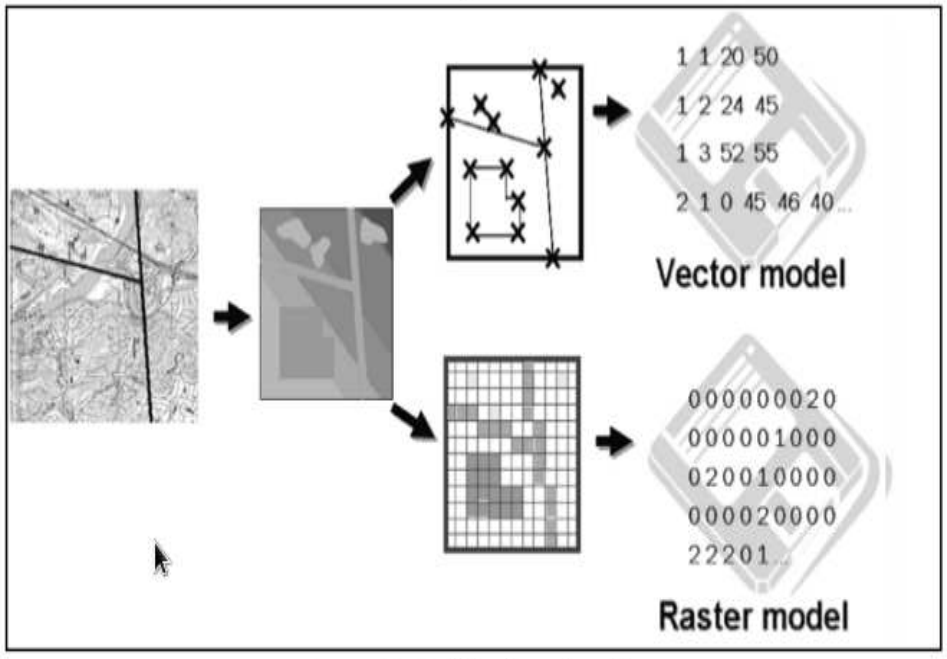

Figure 5.1: Modelling the real world.

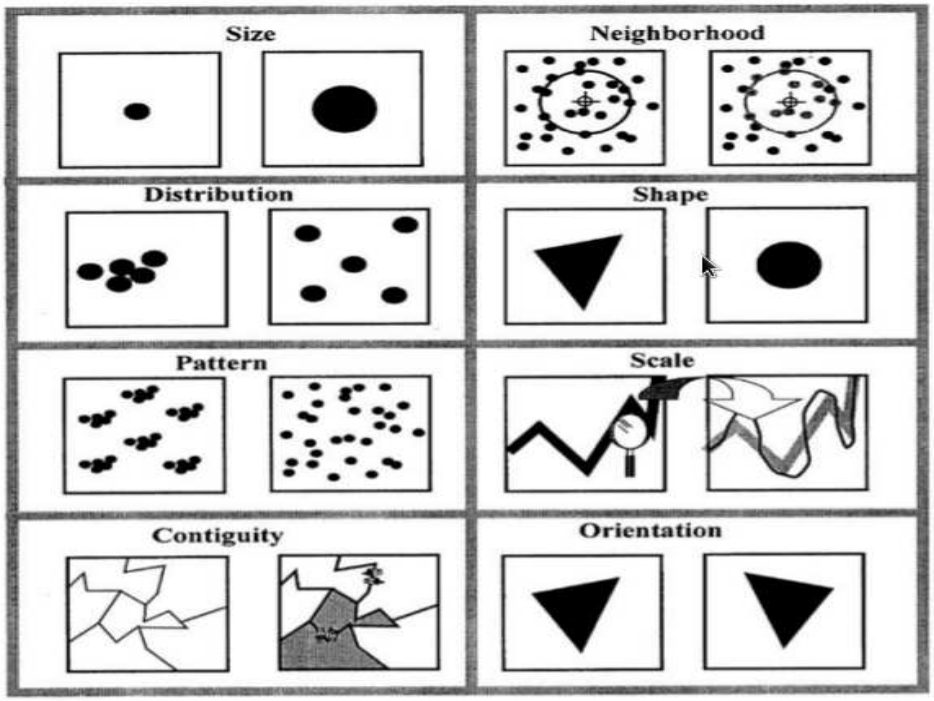

Figure 5.2: Basic properties of geographic features.

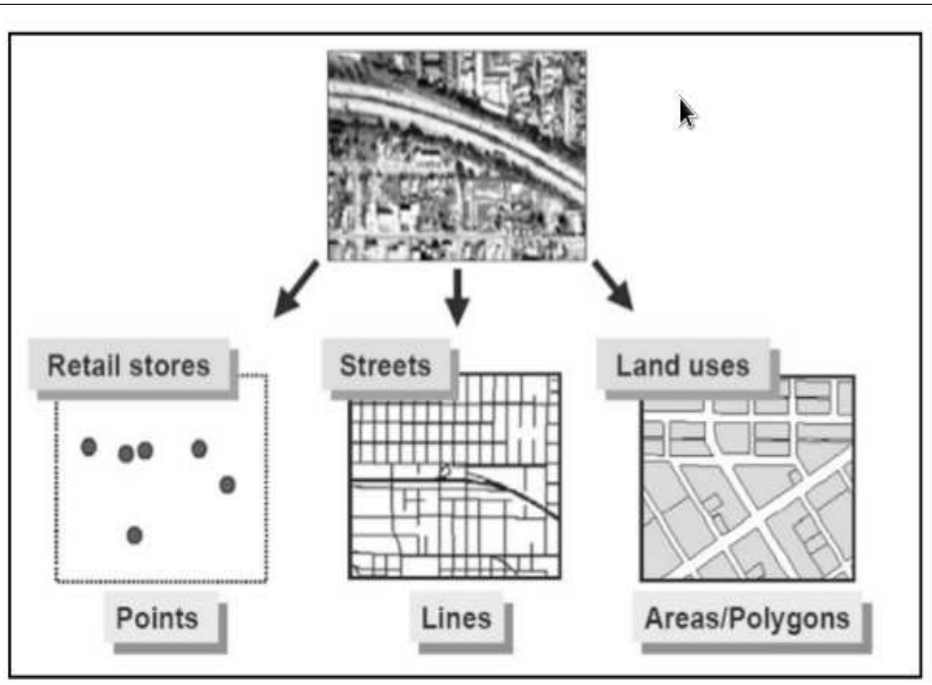

Figure 5.3: Representation of geographic details, point, line and area features.

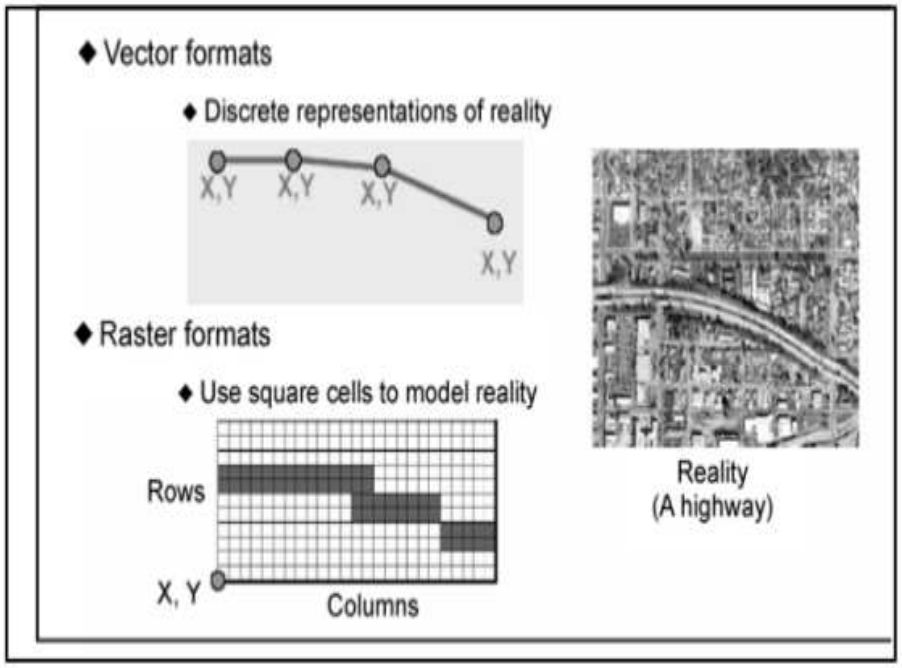

Figure 5.4: Storing of spatial data, vector and raster data formats.

Box 7: Comparison of raster and vector data formats.

Raster Model	Vector Model
Advantages	***Advantages***
• Simple data structure	• Compact data structure
• Easy and efficient overlaying	• Efficient for network analysis
• Compatible with RS imagery	• Efficient projection transformation
• High spatial variability is efficiently represented	• Accurate map output
• Simple for own programming	
• Same grid cells for several attributes	
Disadvantages	***Disadvantages***
• Inefficient use of computer storage	• Complex data structure
• Errors in perimeter, and shape	• Difficult overlay operations
• Difficult network analysis	• High spatial variability is inefficiently represented
• Inefficient projection transformations	• Not compatible with RS imagery
• Loss of information when using large cells Less accurate (although interactive) maps	

Box 8: Choice between raster and vector data

	Raster	Vector
Data Collection	Rapid	Slow
Data Volume	Large	Small
Data Structure	Simple	Complex
Geometrical Accuracy	Low	High
Graphic Treatment	Average	Good
Area Analysis	Good	Average
Network Analysis	Poor	Good
Generalization	Simple	Complex

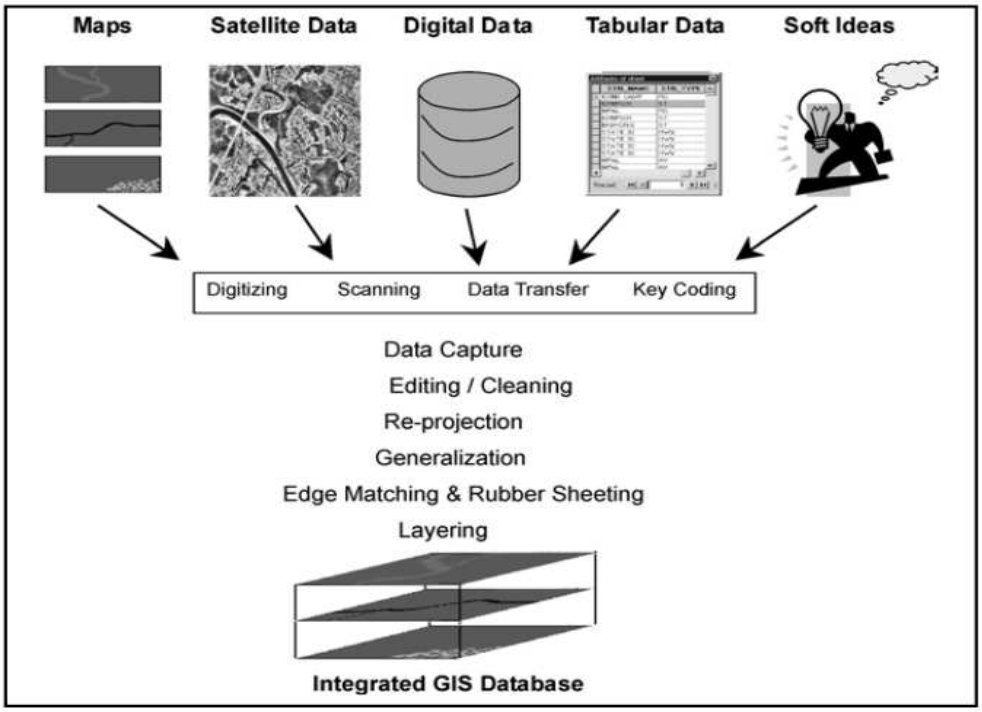

Figure 5.12: GIS data stream.

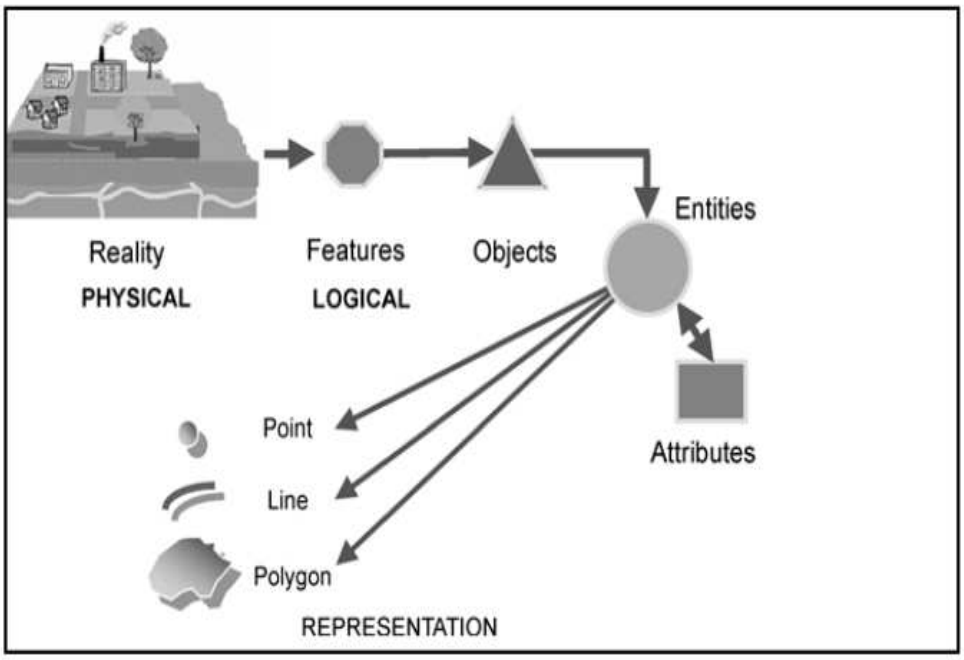

Figure 5.13: Modelling the real world data into GIS.

Box 9: Possible encoding methods for different data sources.

Data source	Analogue or Digital source	Possible encoding method	Examples
Tabular data	Analogue	• Keyboard • Text scanning	• List of school • Education board publications
Map data	Analogue	• Digitizing • Scanning	• Political maps • Historical maps
Aerial photo	Analogue	• Digitizing • Scanning	• Landuse maps • Water bodies
Tabular data	Digital	• Digital file transfer	• Census data
Satellite image	Digital	• Digital file transfer	• Landuse data

Primary Sources

- Typical examples of primary GIS sources include:
  1. raster IRS, SPOT and IKONOS Earth satellite images,
  2. vector building survey measurements captured using a total survey station.

Secondary Sources

- Secondary sources are those that were originally captured for another purpose and need to be converted into a form suitable for use in a GIS project.

- Typical secondary sources include:
  - raster scanned color aerial photographs of urban areas:
  - USGS and IGN paper maps that can be scanned and vectorized.

Box 10: General classification of geographic data.

Source	Raster	Vector
Primary	• Digital aerial photographs • Digital remote sensing images	• Survey measurements • GPS measurements
Secondary	✦ Scanned maps ✦ Photographs ✦ DEM generated from maps	✦ Topographic maps ✦ Toponymy databases (Place names)

Data Collection Work-Flow

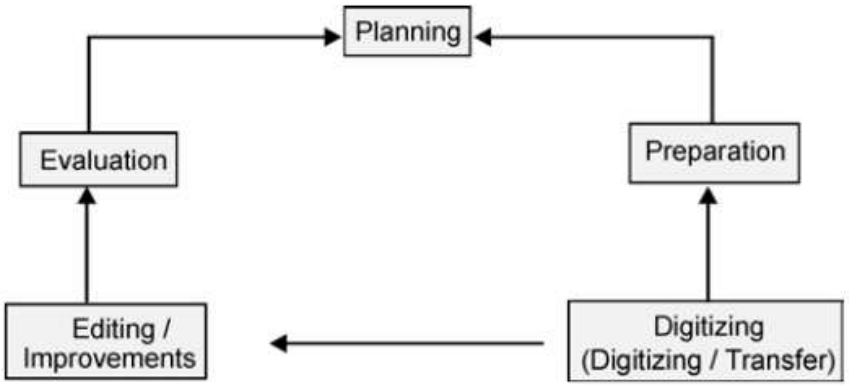

Figure 5.14: Stages in data collection.

Image Resolution

- Image (scene) sizes vary quite widely between sensors – typical ranges include 1000 by 1000 to 3000 by 3000 pixels.
- Satellite remote sensing systems typically provide data with pixel sizes in the range 1 meter – 1 km.
- The cameras used for capturing aerial photographs usually range from 0.1 meter – 5 meters.
- The total coverage of remote sensing images is usually in the range 10 by 10 – 200 by 200 km.

Image Color

- infra red
- panchromatic (black and white)
- multi-spectral cameras/sensors operating in the non-visible parts of the electromagnetic spectrum

Vector Data Capture

- Surveying
- GPS

Secondary Geographic Data Capture

- Secondary sources is the process of creating raster and vector files and databases from maps and other hardcopy documents.
- Scanning is used to capture raster data.
- Table digitizing, heads-up digitizing, stereo-photogrammetry, and COGO data entry are used for vector data.

Secondary Geographic Data Capture

- Flat-bed scanner – A common PC peripheral, it is small and inaccurate.
- Rotating drum scanner – It is expensive and slow but accurate.
- Large-format feed scanner – most suitable for capturing data in GIS. It is quicker, cheaper and accurate.
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Precautions for map scanning in GIS

- Output Quality
- Resolution
- Accuracy
- Georeferencing
- Vectorization

Digitizing

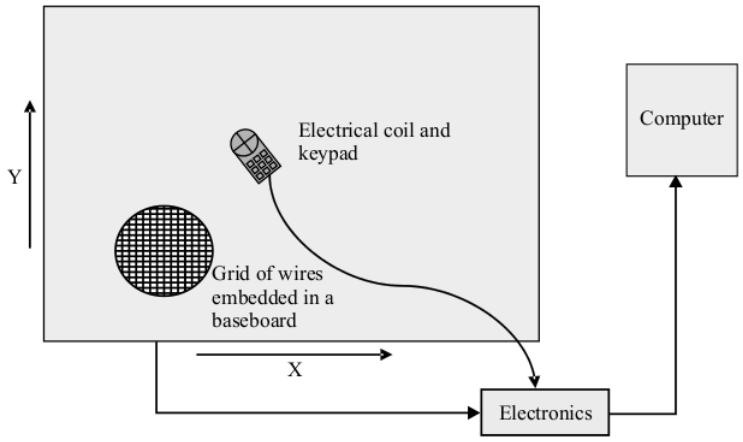

Figure 5.19: The basic components of a digitising tablet.

COGO

- COGO data entry: COGO, a contraction of the term coordinate geometry,
- It is a methodology for capturing and representing geographic data.
- COGO uses survey style bearings and distances to define each part of an object.
- The COGO system is widely used in North America to represent land records and property parcels (also called lots)

Box 13: Some examples of geographic data formats

Vector	Raster (Image)
Automated Mapping System (AMS)	Arc Digitized Raster Graphics (ADRG)
ESRI Coverage	Band Interleaved by line (BIL)
Computer Graphics Metafile (CGM)	Band Interleaved by Pixel (BIP)
Digital Feature Analysis Data (DFAD)	Band Sequential (BSQ)
Encapsulated Postscript (EPS)	Windows Bitmap (BMP)
Microstation drawing file format (DGN)	Device-Independent Bitmap (DIB)
Dual Independent Map Encoding (DIME)	Compressed Arc Digitized Raster Graphics (CADRG)
Digital line Graph (DLG)	Controlled Image Base (CIB)
AutoCAD Drawing Exchange Format (DXF)	Digital Terrain Elevation Data (DTED)
AutoCAD Drawing (DWG)	ERMapper
MapBase file (ETAK)	Graphics Interchange Format (GIF)
ESRI Geodatabase	ERDAS IMAGINE (IMG)
Land Use and Land Cover Data (GlRAS)	ERDAS 7.5 (GIS)
Interactive Graphic Design Software (IGDS)	ESRI GRID file (GRID)
Initial Graphics Exchange Standard (IGES)	JPEG File Interchange Format (JFIF)
Map Information Assembly Display System (MIADS)	Multi-resolution Seamless Image Database (MrSID)
MOSS Export File (MOSS)	Tag Image File Format (TIFF; GeoTIFF)
TIGER/line file: Topologically Integrated Geographic Encoding and Referencing (TIGER)	Portable Network Graphics (PNG)
Spatial Data Transfer Standard/Topological Vector Profile (SDTS/TVP)	

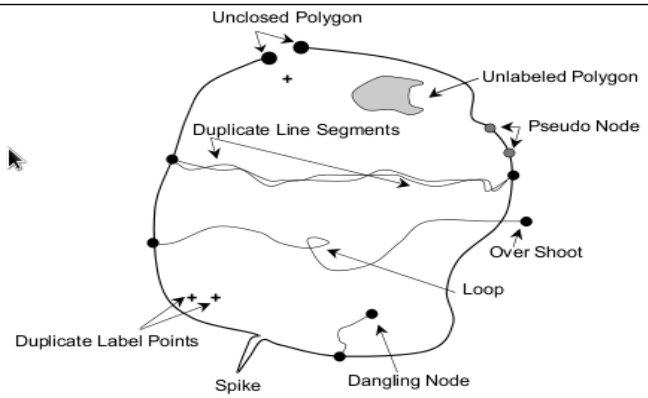

Figure 5.21: Examples of spatial errors.

Box 14: Common spatial errors

Error	Description
Missing entities	Missing points, lines or boundary segments.
Duplicate entities	Points, lines or boundary segments that have been digitized twice.
Mislocated entities	Points, lines or boundary segments that have been digitized at wrong place.
Missing labels	Unidentified polygons.
Duplicate labels	Two or more identification labels for same polygon.
Artifacts of digitizing	Undershoot, overshoot, loops, spikes etc.
Noise	Irrelevant data entry during digitizing or scanning.

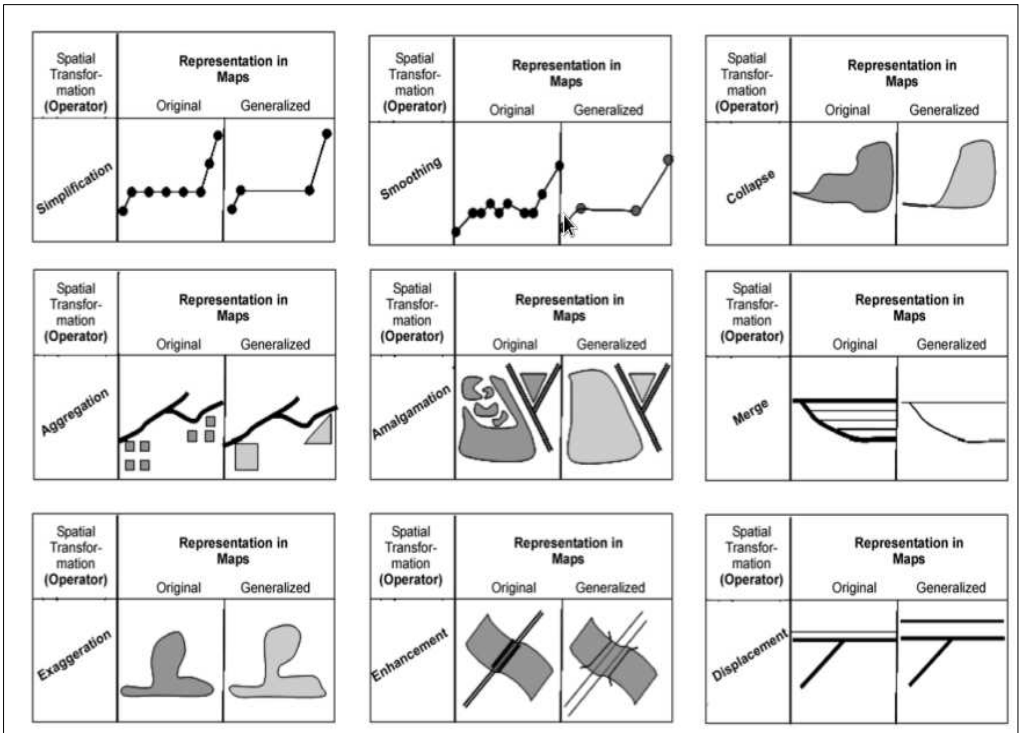

Figure 5.22: Different forms of generalization (Based on McMaster and Shea, 1992).

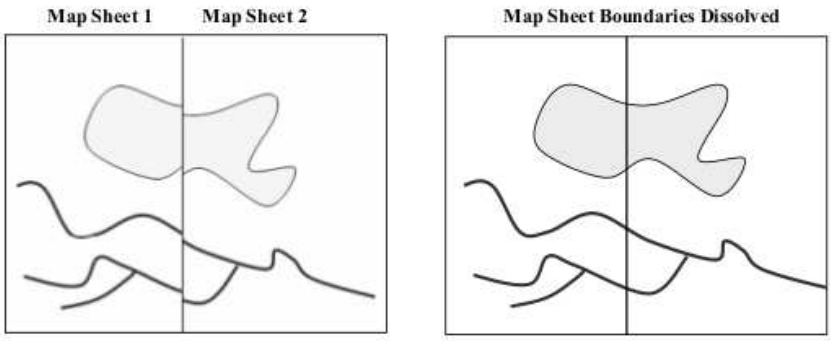

Figure 5.23: Example of edge matching.

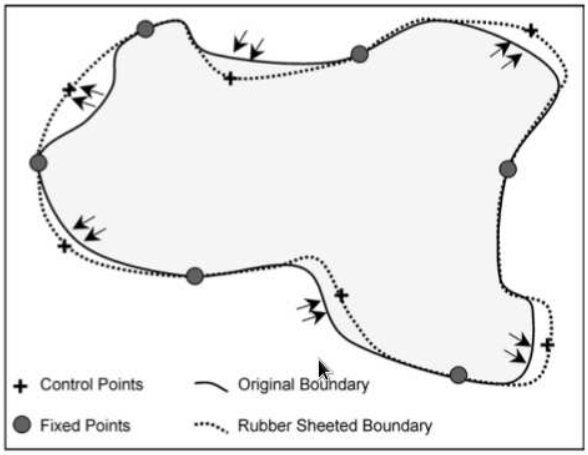

Figure 5.24: Example of rubber sheeting.

Q n A

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