GIS DATA MODEL AND STRUCTURING

Dr. Md. Akhtar Hossain
Professor
Department of Fisheries, University of Rajshahi

Entity: Represents objects or things to be included in the database

Attribute: Represents the characteristics or measurements to be recorded for the entities

Data model: Formal specification for the entities, their attributes and all relationships between the entities for GIS.

GIS data can be modelled in three ways namely vector, raster and hybrid or integrated GIS

Vector GIS: is characterized by the sequential points or vertices to define a linear segment. Such vertex consists of an X coordinate and a Y coordinate. Vector GIS includes point, line and polygon data. The data structure of vector GIS cane be of two types

Topographic data structure: having spatial relationships between the features

CAD (computer aided drafting) data structure: having no spatial relationships between the features

Point data

- Defined as a single x, y coordinate used to describe a geographic feature
- It is the simplest type of spatial object
- Choice of entities which are represented as points depends upon the scale of the map/study. On a large scale (small area) building can be encoded as a point location whereas on a small scale map (large area) cities can be encoded as point location

Line data

- The line is made of ordered set of coordinates linked in a chain to represent the shape and length of a feature such as a road
- Vector lines are often referred to as arcs and consists of a string of vertices terminated by a node (i.e., identifies the start or end of a line)

Feature networks

- Infrastructure networks
- Transportation networks- highways and railroads
- Utility networks- gas, electric, telephones etc.

Attributes

- Length of road
- Direction of traffic
- Volume of traffic
- Number of trains

Node attributes: presence of traffic light, name of streets etc.

Types of nodes

1. True node: Located at the intersection of three or more arcs and forming the junction between the arcs.
2. Pseudo node: Located between two arcs linked together.
3. Dangling node: Located at the end of one arc defining it's end point and not linked to another arc.

Polygon data:

- An area completely bounded by one or more arcs
- Polygons have shape and area characteristics
- Each polygon is associated with one label point that relates to an attribute table
- There are several types of areas that can be represented by polygons
    1. Environmental or natural resource zones (Forest, wet land, urban soil types etc.)
    2. Land records (Land use, ownership, tax information etc.)
    3. Different types of holes and islands.

Raster GIS:

- Displays, locates and stores graphical data by using a matrix or grid of cells (pixels)

- Each cell or pixel has discrete attribute data

- Raster models usually have more layer for forest cover, soil type, land use, wetland habitat etc.

- Data analysis is usually easy to program and quick to perform but network linkages are difficult to establish.

Pixel:

- The spatial data area is divided into rows and columns defining a smallest unit as pixel

Model	Advantages	Disadvantages
Vector	Accurate geographic location is maintained	Location of each vertex need to be stored explicitly
	Effective operations for network analysis	Spatial analysis within polygon is impossible
Raster	Facilitates the integrating of two data layers	Network linkages are difficult to establish.
	Data analysis is usually easy to program and quick to perform	

Hybrid/Integrated model:

- It is often difficult to compare GIS software that use different data models.

- Some packages utilize vector structure for data input, editing and display but convert to raster structure for any analysis.

- Some other provides both integrated vector and raster analysis techniques.

- Intergraded model is most desirable providing greatest flexibility for data manipulation and analysis.

Data Structuring

1. Defining area of the application
2. Tasks
   - a Administrative and operational
   - b Planning
   - c Dissemination of information
3. Requirements
   - a Requirements and needs for standardised map products
   - b Requirements and needs for standardised map reports
4. Criteria for assigning priorities- object types with their attendant attributes should be entered into the data base
5. Identification and definition of object types; and required and optional attributes
6. Geometric representation
   - a Vector representation
   - b Raster representation

7 Relation between objects
   - a Composition of objects
   - b Locations of objects
   - c Affiliations of objects
   - d Neighbours of objects

8 Quality assurance
   - a Geometrical accuracy
   - b Attribute accuracy
   - c Geometrical resolution
   - d Consistency of linking between geometric data and attribute data
   - e Currentness