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INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM

By Reshma H. Patil

ABSTRACT:-

The geographical information system (GIS) is Computer system for capturing, storing , querying analyzing, and displaying geospatial data. The hardware and software functions of GIS include data input, data storage, data management (data manipulation, updating, changing, exchange) and data reporting (retrieval, presentation, analysis, combination, etc.). All of these actions and operations are applied to GIS as a tool that forms its database. The paper describes Geospatial data, Spatial data , Attribute data, types of GIS data format i.e. Vector and Raster data, basic operation in GIS ,Integration of GIs with other system such as GPS and Application of GIS.

Key terms: Geographic Information System (GIS), Geospatial data, Spatial data, Attribute data, Vector data, Raster data, Global Positioning System (GPS).

INTRODUCTION:-

Geographical Information System (GIS) is a computer based tool for collecting, storing, transforming, retrieving and displaying spatial data from the real GIS world. GIS provides facilities for data capture, data management, data manipulation, analysis, and the presentation.

Geospatial data are data that describe both the location and the characteristic of spatial features. The GIS provide ability to handle and process geospatial data that separates the GIS from other information system.

GEOSPATIAL DATA

Geospatial data are data that describe both the locations and the characteristics of spatial features. Geospatial data has component of spatial data and attribute data.

1) SPATIAL DATA

Spatial data describes the location of the spatial features on the earth surface, which may be discrete or continuous. Discrete features are individually distinguishable features that do not exist in between observations. They includes points ,lines, areas that are used to represent a district, houses, towns, agricultural fields, rivers, highways, ….

Continuous features are spatial features that exist in between observations. They include Temperature, precipitation, elevation…

GIS represents these spatial features on the earth surface as the map features on the plane surface. This is called as Transformation. It includes two main issues: the spatial reference system and the data model.

Geographic coordinate system defines the locations of the spatial features on the earth surface, contains Longitude and Latitude values. The locations of the map features are based on Plane coordinate system with x and y coordinates. The process of projection transforms the earth spherical coordinate system into plane coordinate system and bridges the two spatial reference systems.

The spatial feature on the earth surface are represented in GIS by using Two Data Model

Vector data model:

Vector data provide a way to represent real world features within the GIS environment. A vector feature has its shape represented using geometry. The geometry is made up of one or more interconnected vertices. A vertex describes a position in space using an x, y and optionally z axis. In the vector data model, features on the earth are represented as:

- A point has a 0 dimension and has only the property of location. A point may also be called a node vertex or 0 cells. Wells, benchmarks are the examples of points features

- Lines / routes is a one dimensional and has the property of length. A line has two end points endpoints in between to mark the shape of the line. The shape of a line may be smooth curve or connection of straight- line segments. A line is also called edge, link, chain or 1-cell. Roads, Lines, Contours lines are the example of the line features.

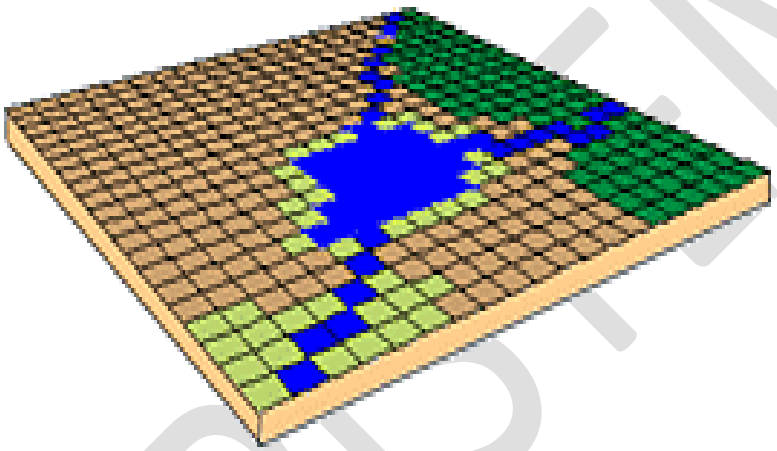
- Polygons / regions has a two dimension has the properties of size and perimeter. Polygon is a closed group of three or more arcs. Examples include timber stands, land parcel, water bodies.

Vector data e.g.: Administrative borders, linear features, Roads, Rivers, Discrete habitat boundaries

Raster data model:

Raster data model uses grid format to represents spatial features on the earth surface. A raster represents continuous features, but for data storage and analysis, a raster is divided into rows and columns and cells. Cells are also called pixel with images. The origin of rows and columns is typically at the upper left corner of the raster. Rows functions as y coordinate and columns as x coordinates and each cell in raster typically defined by its row and column position.

Raster data represent point with single cell, line with collection of contiguous cells Advantage of the raster data model is that it has fixed cell location. Elements of raster data include cell value, cell size, rater bands and spatial reference.



Examples of Raster includes Temperature (air, water) , Air pressure , Soil ph ,Precipitation Raster ,Salinity (Grid) Vector (Feature) Real-world ,Elevation & its derivatives ,Flow ,Direction, distance ,Reflectance (photography/imagery)

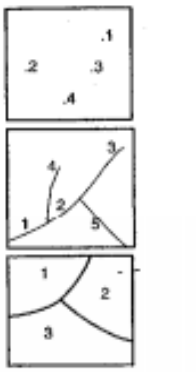
2) **ATTRIBUTE DATA:-**

Attribute data describe the characteristics of spatial features. Attribute data describe the characteristics of the map feature. Attribute data are stored in table's .Each row of a table represents a map feature. Each column represents a characteristic. The object-oriented data model stores both data in a single database, but can distinguish spatial data from attribute data.

For raster data each cell has a value that corresponds to the attribute of the spatial features at that location. A cell is tightly bound to cell value. For vector data, the amount of attribute data to be associated with a spatial feature can vary significantly.

JOINING SPATIAL DATA AND ATTRIBUTE DATA:-

The georelational data model store spatial data and attribute data in separate files. Each map feature has unique label ID as shown in figure. Linked by feature ID, the two sets of data files can be queried, analyzed and displayed. Attribute data are stored in a table called feature attribute table. A row is called a record. A column is called a field.



Point-ID	Item 1	Item 2	. . .
1			
2			
3			
4			

Line-ID	Item 1	Item 2	. . .
1			
2			
3			
4			
5			

Polygon-ID	Item 1	Item 2	. . .
1			
2			
3			

GIS OPERATION:-

SPATIAL DATA INPUT:-

The most expensive part of GIS project is data acquition. The data are entered in GIS project by using existing data or by creating new data. New digital spatial data can be created from satellite images, field surveys, GPs data and text file with x and y coordinates. There are two major approaches for spatial data input to GIS project: manual (digitization) and direct input of digital data. Manual digitizing requires special type of hardware and software. Depending on the details that are required digitizing is costly and time consuming process. Direct accqution of digital data saves manual input time but it required more time to convert data into compatible format. A newly digitized map typically requires editing and geometric transformation Editing removes digitizing errors that are related to the location of the spatial data. Geometric transformation

converts a newly digitized map, which has same physical dimensions as its source map, into a real world coordinate system.

DATA MANAGEMENT

Once spatial data have been entered they must be stored in a format that can be readily retrieved. Each data variable is archived in digital format as a spatially referenced plane in a data base. When registered to one another, these planes form a data bank composed of n layers which can be queried. A common problem for both raster- and vector- based systems at this stage is data storage. A potential solution is to use computer compatible tapes (CCT) or optical laser discs for temporary or permanent data storage. Another solution, for personal computer (PC) based systems, is an interface with a mainframe computer system or workstation fileserver which would allow access to the large volume remote disks for data storage.

DATA DISPLAY

Because the map is effective tool for communicating spatial information, the map making is routine operation of GIS. Maps are derived from data query and analysis and it prepare for visualization, presentation. A map for presentation includes no. of elements: title, subtitle, body, legend north arrow scale bar, border These elements work together to bring spatial information to the map reader. The first step to mapmaking is to assemble map element together and second step is map design. Map design is a creative process that is not replaced by computer code. A poorly designed map can confuse map reader and even distort the information intended by the mapmaker.

DATA EXPLORATION

Data Exploration involves the activities of exploring the general trends in data, taking close look at data subsets, and focusing on possible relationship between datasets. Window based GIS packages is ideal for data exploration, in this when the data from subset is selected it automatically highlight the corresponding features in a graph and a map. This type of interactivity increases the capacity for information processing and synthesis.

DATA ANALYSIS

Data manipulation in a GIS is the process by which data base are queried. An expensive review of data manipulations available on most GIS system can be found in Dangermond (1983). There are various analytical tools for data analysis for vector data these tools includes buffering, overlay, distance measurement, spatial statistics and map manipulation. Common tools for analyzing raster data are traditionally grouped into local, neighborhood, zonal and global operations. This paper discusses only vector and raster data analytical tools.

GIS MODELING

A model simplified representation of a system and GIs modeling refer to the use of GIS and it spatial functionalities in building a model with geospatial data. GIS model grouped under four types: binary, index, regression and process models.

APPLICATION OF GIS

1) GIS occurs in almost every industry. It is used for education, land management, natural Resource management, environmental and aeronautical applications (data on rocks, water, soil, atmosphere, biological activity, natural hazards, and disasters collected for wide range of spatial levels of resolution)

2) GIS used for crime analysis, emergency planning, market analysis and transportation planning. The integration of GIs with Global Positioning System (GPS), remote sensing, and mobile devices has found the application in location based services.

3) GIS also has applications in an area of wildlife habitat analysis, riparian zone monitoring and timber management.

CONCLUSION:-

GIS is technology that can handle and process location and attribute data of spatial features. GIS's has offered improvements over manual approaches in the areas of data management, data organization, and the opportunity for description and modeling of spatial relationships .GIS is a powerful and effective tool for creating intelligent map design. Is integrated with other technologies GIS integrates all kinds of information and applications with a geographic component into one manageable system. Therefore, a benefit of GIS applications is their ability

to integrate and analyze all spatial data to support a decision-making process. A GIS system has to be built up within an organization. The integration capability of GIS technology empowers Organizations to make better and informed decision based on all relevant factors.

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Bio:

Reshma Patil is working as the Assistant Professor in Bharat College of Arts and Commerce, Badlapur. The author can be reached at reshmapatil1592@gmail.com