Answer:

(a) Proximity analysis

Proximity analysis is one way of analyzing locations of features by measuring the distance between them and other features in the area. The distance between point A and point B may be measured as a straight line or by following a networked path, such as a street network. For example, in a site selection scenario where a prospect is interested in building a manufacturing plant in the Daytona Beach area, an important consideration might be distance from the interstates and the airport. A GIS user can simply click on the point locations representing the site and the interstate exit ramp or airport to obtain an approximate distance measure. Once the distances are determined, other pertinent information such as water and sewer availability, price per acre, and availability of labor can be analyzed from the database.

(b) Spatial operation

Spatial operation are based on computational algorithms developed in a research field called computational geometry. Computational geometry is a subfield of computer science, which was first advocated by Ian shamos in1986 in his dissertation. Spatial overlay is a spatial operation that puts a map layer on another layer to produce a new layer. This operation is different from visual overlay. Visual overlay displays two layers simultaneously on one device but it does not create new spatial data. Spatial overlay reconstruct the topology of special objects when they are represented by arc node structure.

(c) Terrain analysis

The heart of GIS is the analytical capabilities of the system. What distinguish the GIS system from other information system are its spatial analysis functions. Although the data input is, in general, the most time consuming part, it is for data analysis that GIS is used. The analysis functions use the spatial and non-spatial attributes in the database to answer questions about the real world. Geographic analysis facilitates the study of real-world processes by developing and applying models. Such models illuminate the underlying trends in geographic data and thus make new information available. Results of geographic analysis can be communicated with the help of maps, or both.

The organization of database into map layers is not simply for reasons of organizational clarity; rather it is to provide rapid access to data elements required for geographic analysis. The objective of geographic analysis is to transform data into useful information to satisfy the requirements or objectives of decision-makers at all levels in

terms of detail. An important use of the analysis is the possibility of predicting events in the location or at another point in time.

(d) Network analysis

Arc GIS Network Analyst is an extension to Arc GIS Desktop that helps you conduct network-based spatial analysis. With Arc GIS Network Analyst, you can create applications that build multimodal routes, provide travel directions, look for closest facilities, and create service areas and origin-destination cost matrices.

Arc GIS Network Analyst helps you dynamically model realistic network conditions and solve vehicle routing problems that include turn restrictions, speed limits, height restrictions, and traffic conditions at different times of the day.

Drive-time analysis

Point-to-point routing

Fleet routing

Route directions

Service area definition

Shortest path analysis

Optimum route analysis

Closest facility analysis

Origin-destination analysis

3. a. Explain the data conversion by Digitization.

b. Represent the digitizing errors. (12+4)

Answer:

(a): Data conversion by digitisation:

When beginning a session with a digitising tablet, the user must specify the number of attributes of the map, as well as the map's location on the digitising tablet. Typically, the user will be prompted by the system for information about a map's scale and projection; menus with common choices can help the user to enter this information quickly and accurately. After entering this information and a region of interest. In the process of

converting the data compatible to any GIS, the most important function one should consider is mode of digitisation.

In general there are three types of mode of digitisation

(i) point mode

(ii) line mode

(iii) stream mode.

In point mode, individual locations on the map, such as elevation, benchmarks, road intersections, and water wells can be entered by placing the cursor over the relevant locations and pressing a button.

In line mode, straight line segments, such as short segments along political boundaries and straight road sections are entered by moving the cursor to one end of the line, pressing a button on the cursor then moving the cursor to the other end and pressing a button again. The system automatically converts these two entered points to an appropriate vector.

In stream mode, the location of the cursor on the map surface is determined automatically at equal intervals of time, or after a specified displacement of the cursor. Stream mode is particularly useful when digitising curved line segments, such as the boundaries of waterways. However, in stream mode it is often too easy to create very large data files, since data points entered into the system very quickly.

(b): No answer

4. a. Describe the data conversion by scanning.

b. Write the classification of vector data analysis methods. (10+6)

Answer:

(a): Scanning is the most commonly used method of automatic digitising. Scanning is an appropriate method of data encoding when raster data are required, since this is the automatic output format from most scanning software. Thus scanning may be used as a background raster dataset for the over-plotting of vector infrastructure data, such as, pipelines and cables.

A scanner is a piece of hardware for converting an analogue source documents to a digital raster format. There are two types of scanners,

(i) flatbed scanner and

(ii) rotating drum scanners. The cheapest scanners are small flatbed scanners, and high quality and large format scanners are rotating drum scanners in which the sensor moves along the axis of rotation.

A digital image of the map is produced by moving an electronic detector across the map surface. The size of the map area viewed by the detector and scanning should be processed or edited to improve the quality and convert the raster to vector after online digitisation. The accuracy of the scanned output data depends on the quality of the scanner, the quality of the software used to process the scanned data, and the quality of the scanner, the quality of the software used to process the scanned data, and the quality of the source document. A very important feature that a GIS user should observe after scanning the paper map is the occurrence of splines, which is black appearance on the scanned output. This can be removed by using a process called thinning.

5. a. Explain about spatial data and its models

b. Outline the digital image processing techniques. (10+6)

Answer:

(a): Spatial data and its models: Spatial data structures provide the information that the computer requires to reconstruct the data models in digital form. Although some lines act alone and contain specific attribute information that describes their character, other more complex collections of lines called networks add a dimension of attribute characteristics. Thus not only does a road network contain information about the types of road or similar variables, but it will also indicate that travel is possible only in a particular direction.

This information must be extended to each connecting line segment to advise the user that movement can continue along each segment until the attributes change-perhaps until a one-way street becomes a two-way street. For example, one node might indicate the existence of a stop sign, a traffic signal, or a sigh prohibiting U-turns. All these attributes must be connected throughout the network so that the computer knows the inherent real-world relationships that are being modeled within the network. Such explicit information about connectivity and relative special relation ships is called topology.

(b): Digital image processing techniques:

Once a radiograph has been processed, the image is permanent and further adjustments cannot be made. If the image is too dark or too light, the image has to be repeated. However, this is not the case with digital images. All digital systems employ a stable electronic circuit called a bit, or binary digit. A circuit containing a bit can electronically be switched into two states, off or on. Off is represented by a zero and on is represented by a one. If a shade or color is assigned to the zero and the one then only two colors can be used, black or white. Digital devices used in radiographic imaging must be able to represent more than two colors. To image several shades of gray there must be more than one bit, or multibits.

The number of bits corresponds to the number of gray levels dis-played by a particular system and is calculated as follows: L = 2n where L is equal to the number of gray levels and n the number of bits. For example, an 8-bit unit can display 28 or 256 shades of gray in an image. Since a digital image is made up of pixels, each pixel is assigned a numerical value corresponding to a shade of gray, thus the density and contrast of the image is adjusted by varying the numerical values of each pixel. Human vision can differentiate approximately 32 gray levels, which means that the dynamic range of the X-ray detection system and the human eye do not match. As a result, the computer must be manipulated to show the proper density and contrast of the final image. Most manufacturers treat the raw data with a firmware before the image is displayed. This simply means that the software in the system uses certain algorithms or mathematical computations set by the manufacturer to optimize the image. However, once the image is dis-played, it can be further processed by the operator to change parameters as desired.

6. a. Compare the raster and vector data.

b. Describe the raster data structure. (8+8)

Answer:

(a): Comparison of raster and vector GIS models:

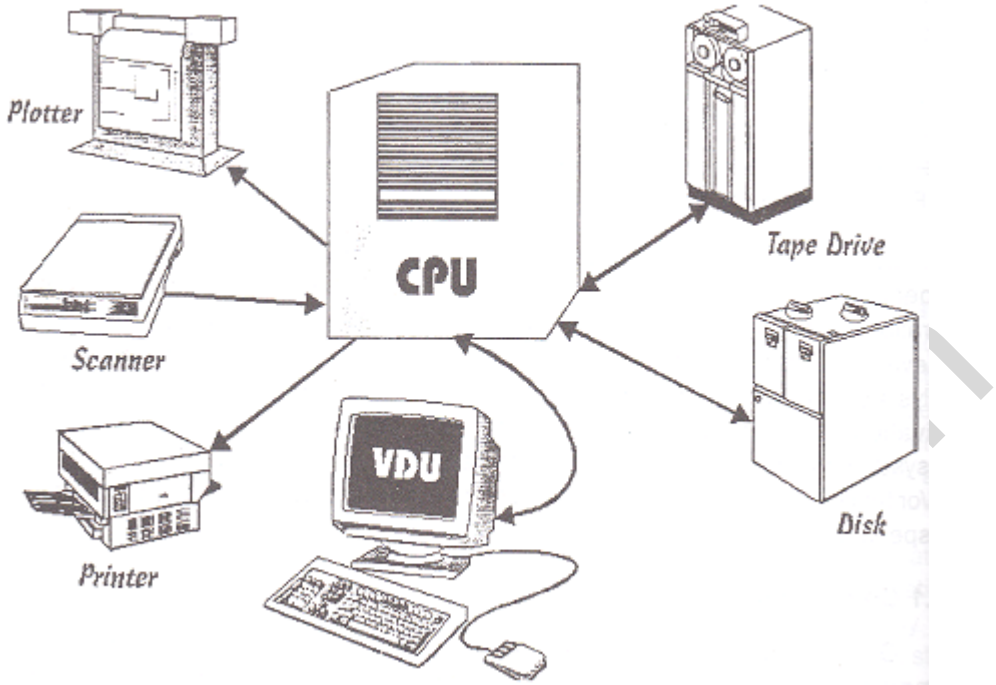
Raster model	**Vector model**
Advantages	**Advantages**
1. It is a simple data structure. 2. Overlay operations are easily and efficiently implemented.	1. It provides a more compact data structure than the raster model.

3. High spatial variability is efficiently represented in a raster format. 4. The raster format is more or less required for efficient manipulation and enhancement of digital images.	2. It provides efficient encoding of topology, and as a result, more efficient implementation of operations that require topological information, such as, network analysis. 3. The vector model is better suited to supporting graphics that closely approximate hand-drawn maps.
Disadvantages	**Disadvantages**
1. The raster data structure is less compact.	1. It is a more complex data structure than a simple raster.
2. Topological relation ships are more difficult to represent.	2. Overlay operations are more difficult to implement.
3. The output of graphics is less aesthetically pleasing because boundaries tend to have a blocky appearance rather than the smooth lines of hand-drawn maps. This can be overcome by using a very large number of cells, but it may result in unacceptably large files.	3. The representation of high special variability is efficient. 4. Manipulation and data enhancement of digital images cannot be effectively done in the vector domain.

(b): Raster data structure: Raster data type consists of rows and columns of cells, with each cell storing a single value. Raster data can be images (raster images) with each pixel (or cell) containing a color value. Additional values recorded for each cell may be a discrete value, such as land use, a continuous value, such as temperature, or a null value if no data is available. While a raster cell stores a single value, it can be extended by using raster bands to represent RGB (red, green, blue) colors, color maps (a mapping between a thematic code and RGB value), or an extended attribute table with one row for each unique cell value. The resolution of the raster data set is its cell width in ground units. Raster data is stored in various formats; from a standard file-based structure of TIF, JPEG, etc. to binary large object (BLOB) data stored directly in a relational database management system (RDBMS) similar to other vector-based feature classes. Database storage, when properly indexed, typically allows for quicker retrieval of the raster data but can require storage of millions of significantly sized records

1. With a neat sketch explain various components of GIS.

Answer:
(a): Components of GIS:



Hard ware components of GIS

Geographical Information Systems have three important components, namely, computer hardware, sets of application software modules, and a proper organizational setup. These three components need to be in balance if the system is to function satisfactorily. GIS run on the whole spectrum of computer system ranges from portable personal computers to multi-user super computers, and are programmed in a wide variety of software packages. Systems are available that use dedicated and expensive work stations, with monitors and disitising tables built in. In all cases, there are a number of elements that are essential for effective GIS operations. These include

(i) the presence of a processor with sufficient power to run the software

(ii) sufficient memory for the storage of large volumes of data

(iii) a good quality, high resolution color graphics screen and

(iv) data input and output devices, like digitisers, scanners, keyboards, printers and plotters.
The general hardware components of a GIS include control processing unit which is linked to mass storage units, such as, hard disk drives and tape drives, peripherals such

as digitizer or scanner, printer or plotter and Visual Display Unit (VDU). Fig shows the major components of GIS.

Terminology of GIS: GIS are decision support computer based systems for collecting, storing, presenting and analyzing geographical special information. These systems are spatially referenced databases giving users the potentiality to control queries over space, and usually through time. GIS is much more advanced than Computer Aided Design (CAD) or any other special data system. The basic output of GIS or special data analysis system is a map. The need to analyze maps to compare and contrast patterns of earth relates phenomena, is confirmed by the long standing tradition of doing so with traditional maps.

Many geographical phenomena are best described scientifically as fields. Good examples are topographic elevations, air temperatures, and soil moisture content. A 2-D field may be defined as any single valued function of location in a 2-D space and discrete fields, with nominal dependent variables. It appears that any geographical phenomenon can be represented either as a field or as a collection of digital objects. For example, a set of states or revenue or administrative units like mandals with in a country would commonly be represented in a GIS as a set of area objects or a set of linear objects that from their boundaries. Fields can be digitally represented by vector approaches, but are often represented by data structures.

2. Discuss various types of Raster GIS models.

Grid:
In this model each grid cell is referenced or addressed individually and is associated with identically positioned grid cells in all other coverages, rather than like a vertical column of grid cells, each dealing with a separate theme. Comparisons between coverages are therefore performed on a single column at a time. Soil attributes in one coverage can be compared with vegetation attributes in a second coverage. Each soil grid cell in one coverage can be compared with a vegetation grid cell in the second coverage. The advantage of this data structure is that it facilitates the multiple coverage analysis for single cells. However, this limits the examination of spatial relationships between entire groups or themes in different coverages.

Imgrid:
To represent a thematic map of land use that contains four categories: recreation, agriculture, industry and residence, each of these features have to be separated out as an individual layer. In the layer that represents agriculture 1 or 0 will represent the presence or absence of crops respectively. The rest of layer will be represented in the same way, with each variable referenced directly. The major advantage of IMGRID is its two-dimensional array of numbers resembling a map-like structure. The binary character of the information in each coverage simplifies long computations and eliminates the need for complex map legends. Since each coverage feature is uniquely identified, there is no limitation of assigning a single attribute value to a single grid cell. On the other side, the main problem related to information storage in an IMGRID