18BGE66S - Fundamentals of GIS

[Syllabus Unit IV:-. GIS modules: Network, TIN, DTM, DEM and Trends in GIS.]

NETWORK ANALYSIS

Network is a series of interconnecting lines along which there is a flow of data, objects or materials.

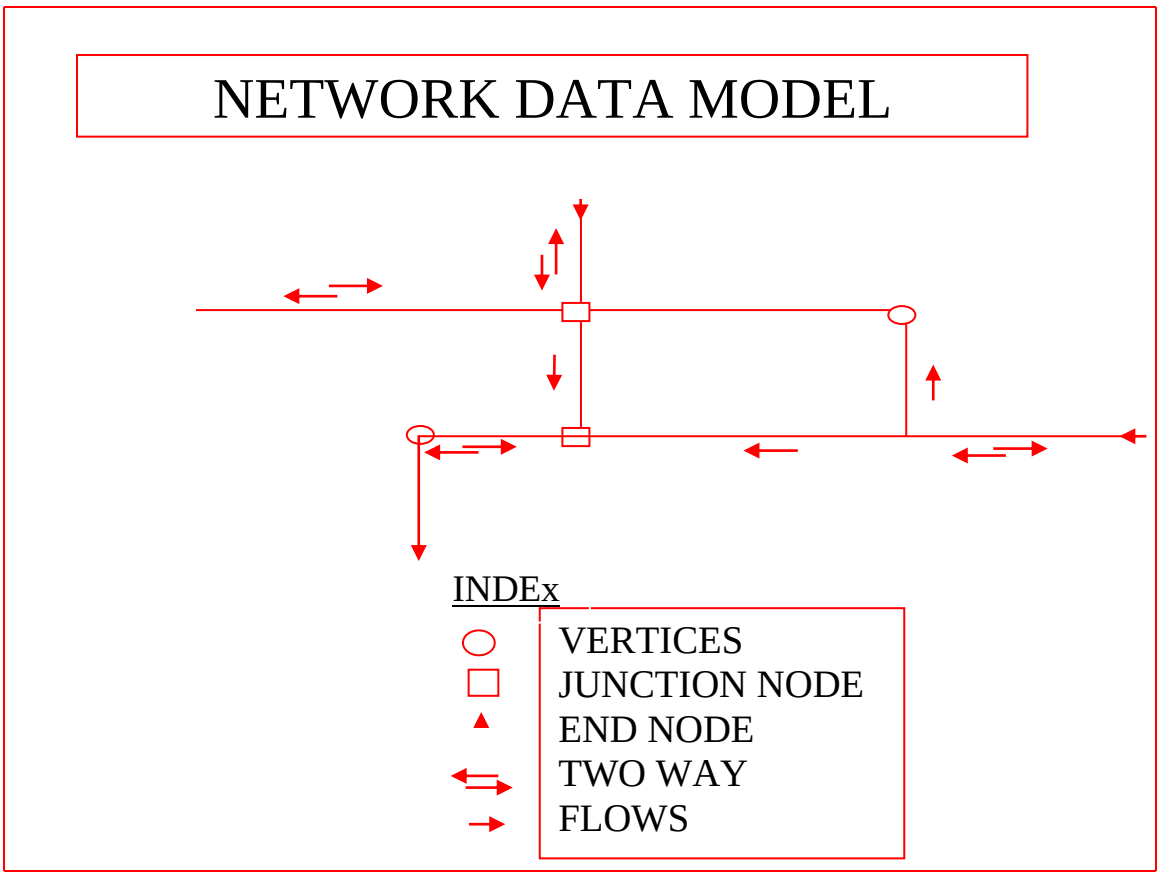
NETWORK MODELLING

- It is an abstract representation of the components and characteristic of their real world counterparts.
- It is defined as a line graph, which is composed of links representing linear channels of flow and nodes representing their connections.
- The network takes the form of edges connecting pairs of nodes can be junctions and edges can be segments of a road or a pipeline.
- In the network model the arc became network links representing the roads, railways, and air routes of transport network, the power line cable &pipe lines of the utilities networks and the rivers and streams of hydrological systems. the nodes in turn become network nodes, stops and centers.

NETWORK DATA MODEL

Network data models becoming increasingly relevant to use a data model where a transportation network can be encoded, stored, retrived. modified, analyzed and displayed. Obviously, Gis have received a lot of attention over this issue since they are among the best tools to store and use network data models. Network data models are an implicit part of many GIS.

There are essentially adaptations of the vector data model and for this reason raster Gis are generally not very good at network analysis. the vector network model is made up of the same arc and node elements as any other vector data model but with addition of special attributed in the above figure.



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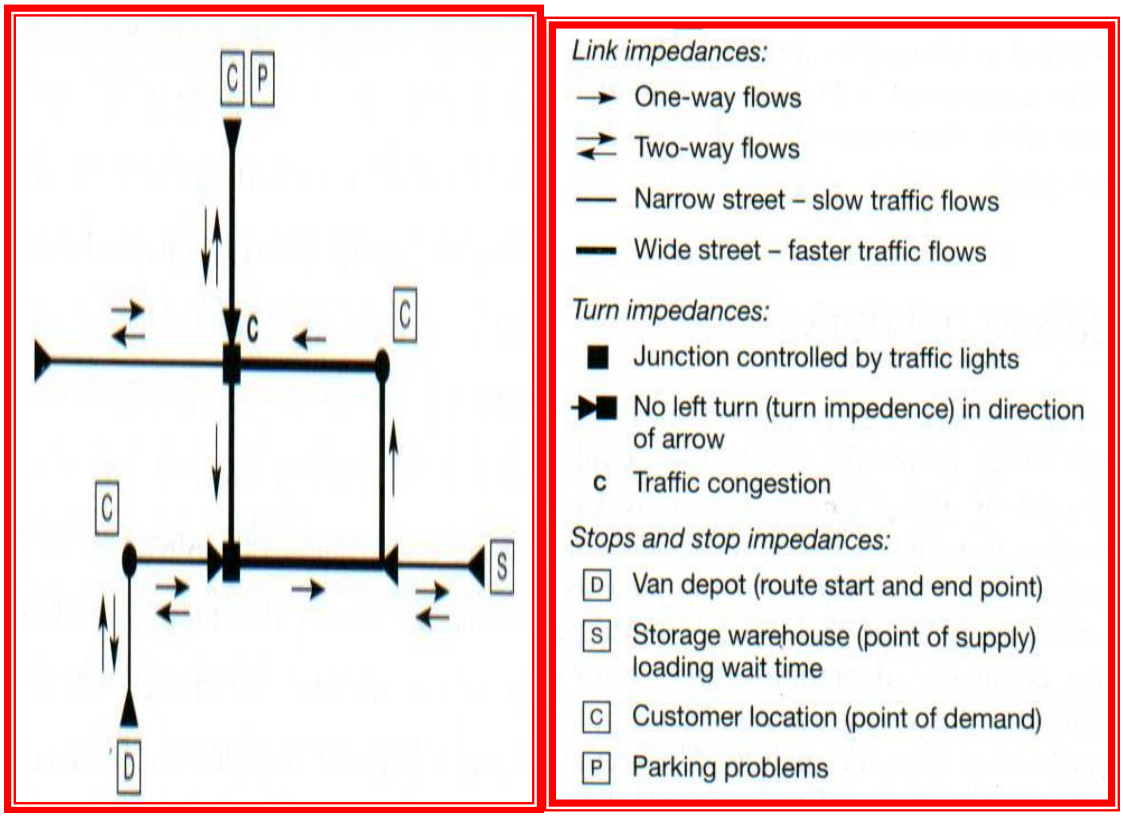
TWO KEY CHARECTERISTICS OF NETWORKS ARE:

1 **Impedance**
2 **supply and demand**

Impedance

- Impedance is the cost associated with traversing a network link, stopping, turning or visiting a center.
- Link impedance may be the time it takes to travel from one node to another along a network link.
- Turn impedance is also important and may be represented by the cost of making a particular turn.
- Impedance values are very important in determining the outcome of route finding, allocation and spatial interaction operation.

LINK, TURN, STOP IMPEDANCE AFFECTING THE JOURNEY OF A DELIVERY VAN



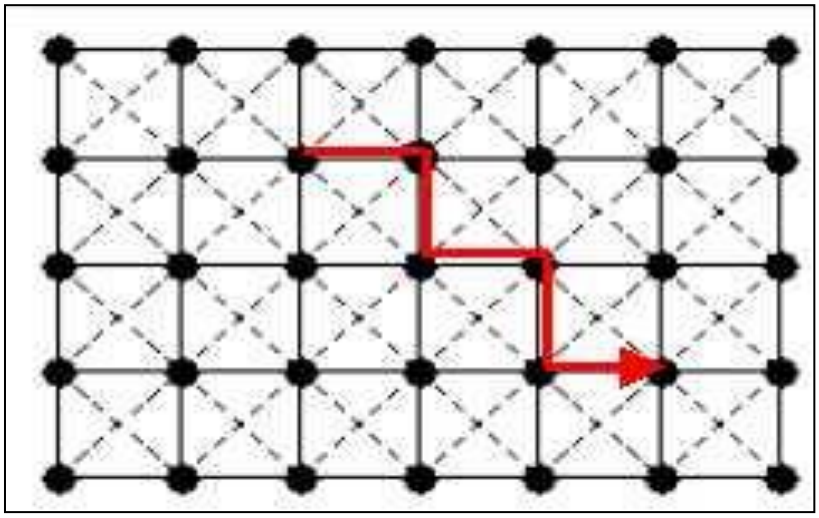
Supply and demand

- Supply is the quantity of a resource available at a center that is available to satisfy the demand associated with the links of a Network.
- Correct topology and connectivity are extremely important for network analysis.
- Digital networks should be good topological representations of the real world network.

NETWORK MODELLING IN RASTER GIS

In a raster GIS the grid cells only approximate the exact shapes of the lines in the network. The line and node attributes must be stored as a separate layer for each attribute. As a result, a network using a raster model normally consists of a vast number of layers. Since the grid has a given resolution, the cells will only approximate the exact length of the network.

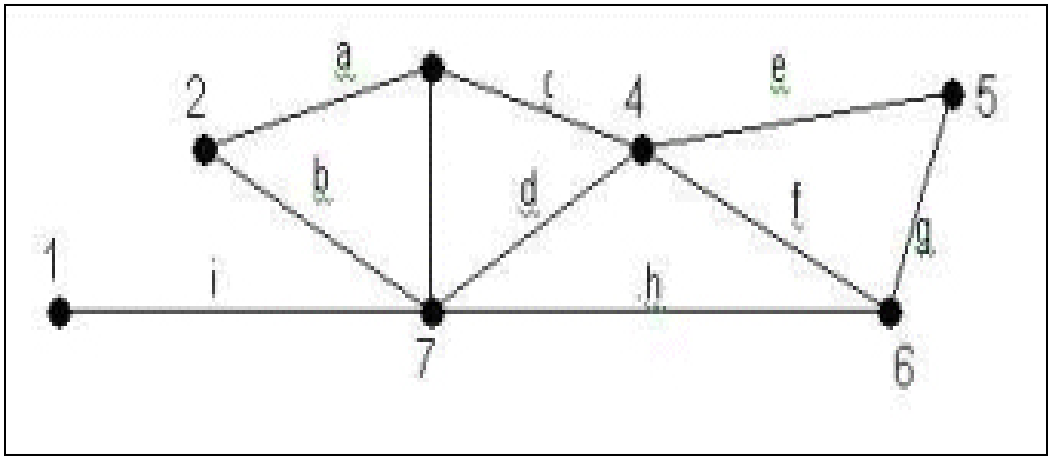
Tracing a path from cell to cell in raster GIS
generates a zigzag path instead of a straight line.



NETWORK MODELLING IN VECTOR GIS

A network in vector GIS takes the form of edges (or arcs) connecting pairs of nodes (or vertices). Nodes can be junctions and edges can be segments of a road. For a network to function as a real-world model, an edge will have to be associated with a direction and with a measure of impedance, determining the resistance or travel cost along the network.

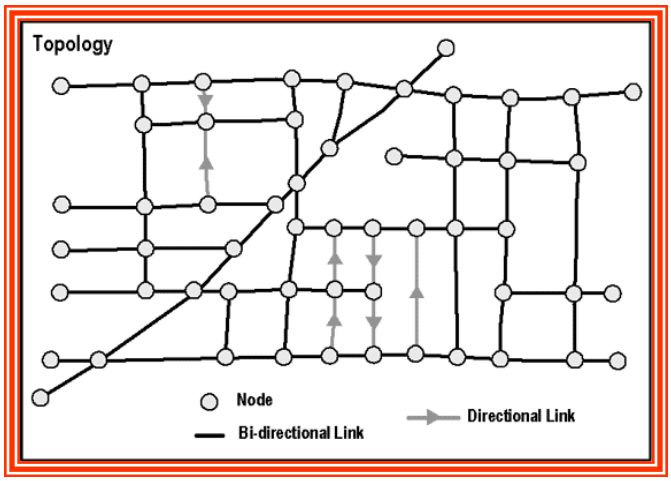
Network representation in vector Gis: nodes (numbers) and arcs (letters)



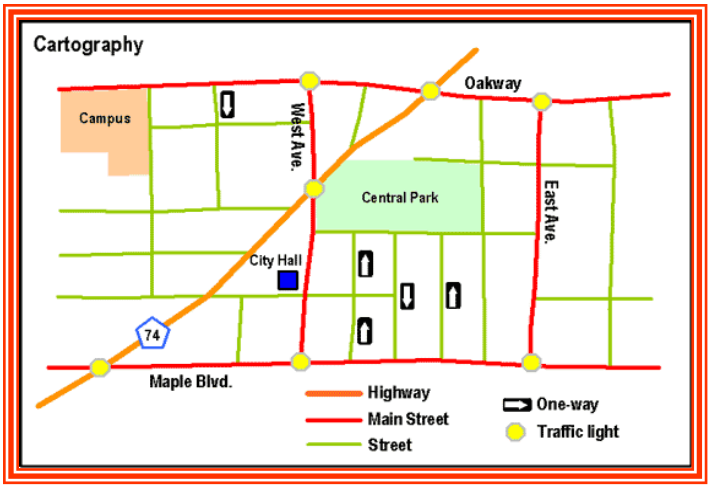
There are four basic application areas of network data models

1. Topology
2. Cartography
3. Geocoding
4. Routing and assignment

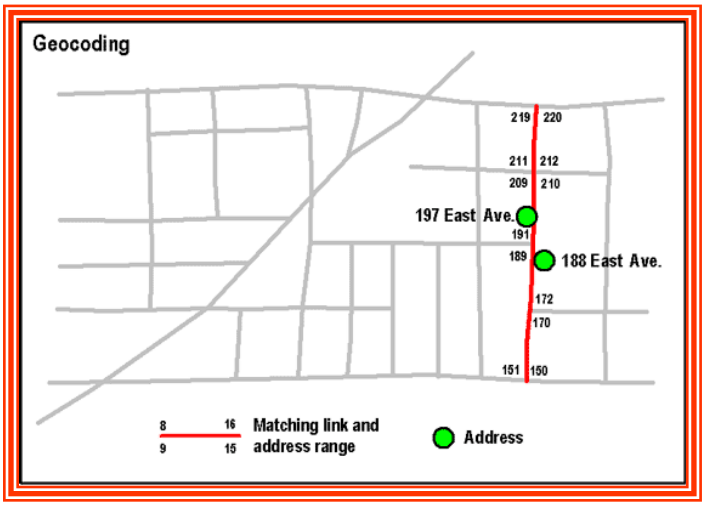
Topology of a Network Data Model



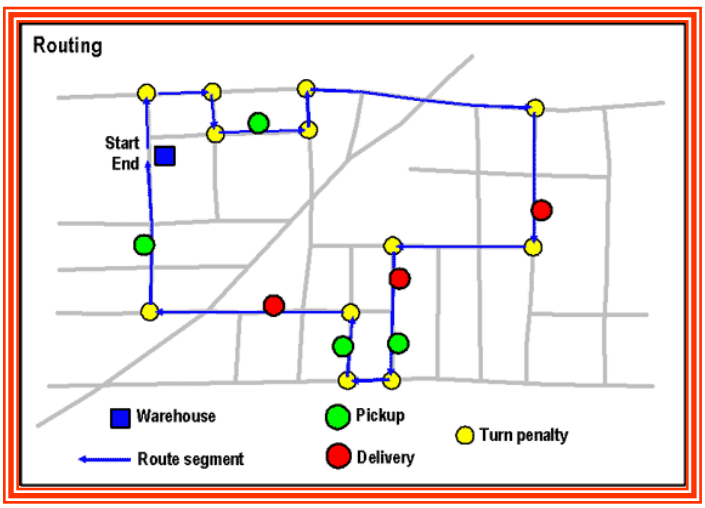
Cartography of a Network Data Model



Geocoding in a Network Data Model



Routing in a Network Data Model



NETWORK MODELING TECHNIQUES

It has been well developed in today's GIS.however to date its major applications have been in the areas of

- Transportation modelling
- Urban and facilities management
- Resource allocation
- Infrasture planning
- Environmental management
- Surface modelling
- Drainage networks

TIN

TIN is a set of adjacent, non-overlapping triangles computed from irregularly spaced points, with x, y horizontal coordinates and z vertical elevations.

Advantages

- Can capture significant slope features (ridges, etc)
- Efficient since require few triangles in flat areas.
- Easy for certain analyses: slope, aspect, volume.

Disadvantages

- Analysis involving comparison with other layers difficult.

TINs – are the most useful method for representing a continuous surface in a vector GIS system. – data sets comprising any combination of contours, breaklines and point elevations (either DEM or massed points) can be combined as input to create a TIN

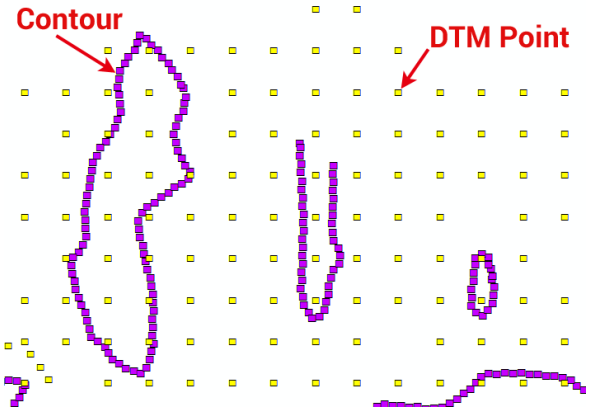
- TINS are especially useful for analytical purposes
- Good model for representing surfaces
- Slope and aspect easily derived
- Simplify the calculation of surface area and volume TIN as a Storage Method

Digital Terrain Model (DTM)

Over the recent years various datasets have been collected. This can be serve different purposes in general, spatial data represents of reality. When used in a GIS environment, can create various landscape scenarios are able to visualize them in two dimensional, three dimensional or even four dimensional.

In some countries, a DTM is actually synonymous with a DEM. This means that a DTM is simply an elevation surface representing the bare earth referenced to a common vertical datum. In the United States and other countries, a DTM has a slightly different meaning. A DTM is a

vector data set composed of regularly spaced points and natural features such as ridges and break lines. A DTM augments a DEM by including linear features of the bare-earth terrain.
DTMs are typically created through stereo photogrammetry like in the example above. For example, contour lines are in purple. The DTM points are regularly-spaced and characterize the shape of the bare-earth terrain.



In the image, you can see how the DTM is not continuous and that it's not a surface model. From these regularly-spaced and contour lines, you can interpolate a DTM into a DEM. A DTM represents distinctive terrain features much better because of its 3D breaklines and regularly spaced 3D mass points.

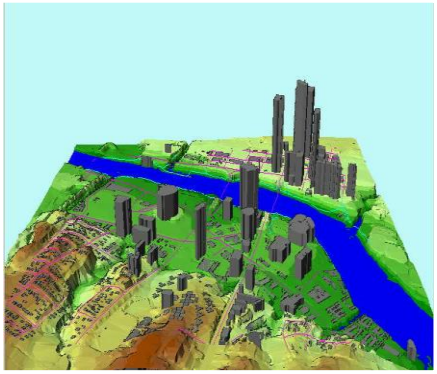
MODELLING THE THIRD DIMENSION

- In the real world all the features are seen exactly on 3D
- In terms of its display capabilities the computer screen is a two-dimensional display device even though the use of clever graphics it is possible to stimulate the appearance of the third dimension.
- In GIS the only medium for 3D is the display of computer screen. To produce system capable of representing the complexities of the real world, we need to portray the third dimension in more than a visual way.
- To produce system capable of representing the complexities of the real world. we need to portray the third dimension in more than a visual way.
- The representation of the third dimension of an entity can also help us model the form of entity and associated spatial process. the 3D is an integrated part of GIS tool box.
- Worboys (1995) describes how the simple raster grid cell an e extended into 3D representation; known as a voxel is that it is unable to record topological information .worboys suggests that the solution to this problem lies in extending the vector approach by using constructive. Solid geometry to create 3D objects such as cubes, spheres and cylinders.

TWO DIMENSIONAL MAP

THREE DIMENSIONAL MAP

THREE DIMENSIONAL MAP WITH Z COORDINATES



Modern trends in GIS

- Better Understanding, Integration, Application and Manipulation of GIS Data with other Fields to Develop New Technologies/Software's and Features.
- Use Of Digital Data, Modern GIS Technologies Use Digital Form Data, Data Creation
- Increase In Dimensions:- Historic 2-D maps change into contemporary 3-D maps, Along with longitude and latitude, vertical component i.e. elevation or depth is also included.
- 3d View of a city showing buildings And Features such as roads, parks Etc
- Integration of GISAnd Multimedia, Multimedia GIS allows to incorporate not only spatial-temporal geographic information in image format but also multimedia geographic information in descriptive texts, scanned photographs, graphics, digital sound and video.
- Integration of GIS & Remote Sensing:- Remote sensing stored data in raster format while GIS stored data in vector format, but now modeling Is done by merging these two types of data.
- Integration of GIs and Web: - Non-professional GIS users gain easy and fast access to location analyses data to assist in their day-to-day work.
- GIS And Virtual Reality:- 3D and 360º panoramic scenes are reconstructed from multiple image pairs.
- MOBILE GIS:- MOBILE GIS extends indoor GIS manipulation to outdoor work to collect, modify, measure the spatial data.
