

GIS 310 – Advanced GIS
First Semester Test

4 March 2009

Time: 2 Hours

Question 1:

Name and discuss the entity types that can be used to represent geographical phenomena in a GIS model.

POINTS:

- Example: tree, house, weather station,
- Has NO spatial dimensions
- Has location
- (X1,Y1)
- Represented by: symbols
 - Don't indicate length or breath of the feature.
- Used:
 - Too small at given scale
 - Location of events

LINES:

- One dimensional feature
- Only has length - NO width, but can have weights
- Beginning and an end
- (X1,Y1) (X2, Y2)
- Represented by: line symbols
- Linear features
 - Real – roads, streams
 - Artificial – administrative, property boundaries

POLYGONS

- Enclosed area,
- 2D feature with at least 3 sides
- Has perimeter & area
- (X1,Y1) (X2, Y2) (X3, Y3) (X1,Y1)
- Represented by: polygons
 - boundary lines and fills can vary
- Generally aerial features:
 - Parcel of land, fields, political districts

SURFACES

- 2 or 3 dimensional
- At any location \diamond measurement or value
- Quantitative or qualitative
- A continuous entity

(X1, Y1, Z1)(Xn, Yn, Zn)

- Where X1, Y1 = Location
- Z1 = measure or value
- Infinite set of points?
- Represented by: TINs; DEMs;
- Rainfall, elevation, distance, pollution etc
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NETWORKS

- Extension of lines
- Set of interconnected lines
- Models the flow of objects
 - Example: Traffic, river system, drainage system, telephone network, electricity network etc.

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Question 2:

Illustrate how the following entities will be represented in a topological vector model and in a quad tree model. Compare the advantages and disadvantages of the raster and vector data models.

(Only do the top half of the raster image for the quad tree)

TOPOLOGICAL VECTOR MODEL

POINT

Points	X	Y
1	2	2,2
2	2.2	2
3	1.8	1.4

LINES:

Nodes	X	Y
N1	0.5	1.1
N2	3	4.5

Line	Begin Node	End Node
L1	N1	N2

POLYGONS:

Nodes:

Node	X	Y
n1	0.9	5.6
n2	1.9	5,6
n3	1.9	4.5
n4	1.9	3.3
n5	0.2	3.3
n6	0.2	4.5

Arcs:

Arc	Begin node	End node	Left Poly	Right Poly
a1	n1	n2	-	P1
a2	n2	n3	-	P1
a3	n3	n4	-	P2
a4	n4	n5	-	P2
a5	n5	n6	-	P2
a6	n6	n1	-	P1
a7	n6	n3	P1	P2

Polygon	Arcs
P1	a1, a2, a7, a6

P2	a7, a3, a4, a5
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QUAD TREE

Level 1	Level 2	Level 3	Entity
0			Present
1			Present
	10		Absent
	11		Absent
	12		Present
		120	Absent
		121	Present
		122	Present
		123	Present
	13		Present
		130	Present
		131	Absent
		132	Absent
		133	Absent

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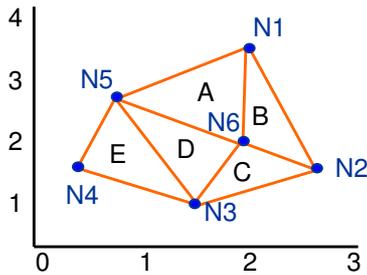
Question 3:

Discuss and illustrate the use of TIN models in a GIS. Refer to the construction of the model and the data structure.

- Vector **RELATED** model used to represent terrain heights:
 - Triangulated Irregular Network (TIN Model)
- Very useful for irregularly spaced points
- Data points are connected to form triangles
- Triangles do not overlap
- Tin surfaces are created by performing delaunay triangulation of the points
- Smallest triangle is formed from any three points
- Lines from one triangle does not cross the lines from another triangle
- Identify the convergent circle for a set of 3 points
- Each triangle is a surface and assumed to have a constant degree of slope

TIN Data Structure

- Stored in a topological structure:



Node	Coord
N1	x1y1z1
N2	x2y2z2
N3	X3y3z3
N4	X4y4z4
N5	X5y5z5
N6	x6y6z6

Triangle table	Adjacent
A	BD
B	AC
C	BD
D	ACE
E	D

Triangle table	Node
A	N1, N5, N6
B	N1, N2, N6
C	N2, N3, N6
D	N3, N5, N6
E	N3, N4, N5

Advantages:

- They incorporate the original sample points
- Variable densities of triangles means it is an efficient way of storing surface representations
- Easy to calculate elevation, slope, aspect and line of sight

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Question 4:

Explain the difference between the data layer view used by most GIS data models and the Object Orientated model.

Layer view:

- ▶ Each variable can be conceptualised as a layer
 - each layer captures the variation of one variable over the surface of the earth

OO:

- ▶ OO approach provide:
 - Spatial entities with intelligence
 - Does not see the earth as points lines and polygons but each real world entity as an object
 - Enhance the potential for modelling relationships
 - Allows the implementation of truly dynamic spatial models

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Question 5:

Explain why levels of measurement are important when capturing data for the use in a GIS. Name the permissible arithmetic operations for each of the levels.

1. Knowing the level of measurement helps you decide how to interpret the data from that variable

2. Knowing the level of measurement helps you decide what statistical analyses are appropriate on the values that were assigned
- Nominal - Counting
 - Ordinal - Greater than or less than operations
 - Interval - Addition and subtraction
 - Ratio - Multiplication and division

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Question 6:

You need to obtain the following data for the use in a GIS project:

Forest areas (in raster format)

Roads (in vector format)

Population density (in vector format)

Explain the data collection techniques and data capturing methods that you will use to obtain the data for the use in a GIS. Also indicate whether the capturing methods are primary or secondary methods.

Data Set	Collection Technique	Method	Type
Forest areas	Digital remote sensing Aerial photographs	Data Transfer	Primary
	Scanned Maps	Digitising	Secondary
Roads	GPS Surveying	Data Transfer	Primary
Population density	Survey (Census Data)	Data Transfer	Secondary

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TOTAL [60]