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UNIVERSITY OF PRETORIA  
Departement Geografie, Geoinformatika  
en Meteorologie  
Department of Geography, Geoinformatics  
and Meteorology



## GIS 310

**Eksamen / Examination**  
GIS

**Interne Eksaminator/Internal Examiner**  
G. D. BREETZKE

**Eksterne Eksaminator/External Examiner**  
MS I. S. J. NETTERBERG

TYD / TIME:  
180 MIN

DATUM / DATE:  
9 JUNIE/JUNE 2007

PUNTE / MARKS  
150

### INSTRUKSIES / INLIGTING INSTRUCTIONS / INFORMATION

Answer all the questions.  
*Beantwoord al die vrae.*

#### Multiple-choice questions

[20]

1. In the world of GIS, another term for the property of connectivity is:
  - a) proximity
  - b) neighborhood
  - c) topology
  - d) Boolean identity
  - e) location
  
2. By definition a GIS must include:
  - I) A subsystem for data reporting and product generation
  - II) A method for data storage, retrieval, and representation
  - III) A method for storing demographic information
  - IV) A method for scanning maps to produce raster files
  - V) Data analysis functions
  - VI) A means for the input of spatial and non-spatial data
  - a) I, II, V and VI
  - b) III and IV
  - c) I and II
  - d) I, III and VI
  - e) All of the above

3. Examples of non-obvious errors in data sources:
  - a) loss of small polygons
  - b) map scale
  - c) numerical errors
  - d) format
  - e) density of observations
  
4. During database development, locational information may be input into a GIS using the following techniques:
  - I) photogrammetric digitising
  - II) manual digitising
  - III) standardising geographic naming conventions
  - IV) typing coordinates at a keyboard
  - V) adding map annotations to map overlays
  - VI) creating data directories
  - a) I, II and IV
  - b) I, II, and III
  - c) III and IV
  - d) I, II, IV and VI
  - e) I, III and VI
  - f) All of the above
  
5. The advantages of Standard Query Language (SQL) include which of the following in relation to GIS databases?
  - I) It uses a pseudo-English style of questioning
  - II) It is widely used.
  - III) It is simple and easy to understand.
  - IV) It is good at handling geographical concepts
  - a) I, II and IV
  - b) II, III and IV
  - c) I and II
  - d) All of the above
  
6. Which of the following might be considered as the fourth dimension in GIS?
  - a) Space
  - b) Scale
  - c) Location
  - d) Time
  
7. Raster A is a geologic map of Gauteng; raster B is a map of water table elevations. The type of z values in raster A are \_\_\_\_\_ whereas those in B are \_\_\_\_\_ data.
  - a) Ratio, Interval
  - b) Interval, Ordinal
  - c) Ordinal, Nominal
  - d) Nominal, Ratio
  - e) Ratio, Ordinal

8. Which of the following may be considered key problems when using GIS to model spatial processes?
- I) Matching model complexity with process complexity
  - II) Avoiding making assumptions
  - III) Displaying model results in the context of other datasets
  - IV) The availability of data for model validation
  - V) The implementation of the model within the GIS
  - VI) The quality of the data used
- a) I, II, III, IV
  - b) II, III, IV, V, VI
  - c) V and VI
  - d) I, IV, V and VI
  - e) II, IV, V, and VI
  - f) All of the above
9. I wish to fit a surface to several hundred, widely spaced water level measurements. Knowing that water tables are typically smoothly varying surfaces, an appropriate technique for interpolation is:
- a) Inverse distance weighting
  - b) Spline
  - c) A first order polynomial function
  - d) Co-kriging
  - e) Indicator kriging
10. Trend surface analysis is an example of a \_\_\_\_\_ interpolator
- a) Stochastic, global, gradual
  - b) Deterministic, global, gradual
  - c) Stochastic, local, abrupt
  - d) Deterministic, local, gradual
  - e) Difficult

True or False

[10]

- 1. A keyboard cannot be used to digitise maps, only to enter attribute information
  - 2. Layers or levels in a GIS can be used to highlight logical relationships among geographic features
  - 3. An accurate measurement may be imprecise
  - 4. One thing that distinguishes GIS from CAD is that a GIS can read all standard GIS file formats.
  - 5. Kriging is an example of a global, exact, stochastic interpolator
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### Short questions

[50]

1. How might the Modifiable Areal Unit Problem (MAUP) and ecological fallacy affect communities within a data analysis case study? (4)
2. Where can I get GIS data? Name three public or private institutions that offer GIS data in South Africa and state what kind of data is available from them. (6)
3. The four best known scales of measurement for geographic data are the nominal, the ordinal, the interval and the ratio scale.
  - a) Give an example of a choropleth map with data on the nominal scale.
  - b) Give an example of a choropleth map with data on the ratio scale.
  - c) Give an example of an isoline map with data on the ratio scale. (6)
4. How many times is the common boundary between two adjacent polygons recorded in:
  - a) the spaghetti data model
  - b) the arc-node model (2)
5. Choose 5 of the 10 terms below and define with a sentence or three. (10)
  - Rubber-sheeting
  - Relational operators
  - Allocating modelling
  - Bench-marking
  - Fuzzy boundary
  - Trend surface analysis
  - Joint Photographic Experts Group
  - Error tagging
  - Network valency
  - Convolution
6. Calculate the value of cell F6 if a 5x5 kernel is applied using the following filters: (10)

	1	2	3	4	5	6	7	8	9	10
A	2	3	2	5	9	1	6	4	2	5
B	5	4	5	6	2	3	2	1	2	2
C	2	2	3	3	5	4	2	6	2	4
D	5	5	5	4	4	4	5	3	5	4
E	6	6	5	5	4	5	4	4	4	5
F	4	4	5	5	4	1	3	5	3	2
G	2	3	4	2	3	3	3	2	3	5
H	4	4	5	2	5	6	3	2	2	1
I	3	3	5	3	5	1	5	5	5	1
J	4	4	4	4	4	2	5	5	6	2

- a) Min filter
- b) Modal filter
- c) Diversity filter
- d) Max filter
- e) A 3X3 Laplacian filter
- f) A 5X5 Laplacian filter

7. (Answer 3 of the following): (12)

- Name and briefly describe 'heads-up' digitising
- Discuss the difference between classification and reclassification
- How do resolution and scales of measurement influence raster overlay operations?
- Identify the four uses of spatial interpolation

Long questions: [45]

- Differentiate between the four different **categories** of point-based interpolation methods. Provide examples and diagrams if necessary. (12)
- What is the South African Geo-Information Science Standards Generating Body (SGB)? What do they do and how do they function? (8)
- Calculate the area of the Quadtree polygon (A) below (10)

						<b>B</b>	
	<b>A</b>						
<b>B</b>							

NOTE: *Dimension of pixel = 1km\* 1km*

HINT: Structure your answer according to the following table.

Leaf	Level	Area Weight

4. Reproduce the observation points below to answer the following questions.

- a) Construct a Triangle Irregular Network (TIN) from the set of given points (2)
- b) Construct a 20 metre contour isoline from the TIN model (6)
- c) Describe the process that you followed in order to construct the contour isolines (2)



5. Schematically depict the difference between volume preserving and non-volume preserving areal interpolation (5)

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Essay [25]

Explain and compare the techniques of “Thiessen polygons”, “inverse distance weighting” and “kriging”

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TOTAL: 150 marks