NATIONAL UNIVERSITY OF SINGAPORE

FACULTY OF ENGINEERING

EXAMINATION FOR

(Semester I: 2011-2012)

CE5310 - HYDROINFORMATICS

Nov/ Dec 2011 - Time allowed: 2.5 hours

INSTRUCTIONS TO CANDIDATES

1. This examination paper contains **FOUR(4)** questions and comprises **THREE(3)** printed pages.
2. Answer ALL **FOUR(4)** questions.
3. All questions carry equal marks.
4. This is a "**CLOSE BOOK**" examination.

Question 1 [20 marks]

1.1 Database Design

- State the advantages of storing the measurements data in a database (e.g., MySQL) rather than several spreadsheet (e.g., Microsoft Excel) files.

[5 marks]

- Design a database for managing measurements data from NUS Kent Ridge experimental catchment consisting of date, time, rainfall intensity, water level and flow rate in canal leavig the catchment. List the attributes and their data types (e.g., Varchar, date, time, datetime, int, real)

[6 marks]

1.2 SQL queries:

- Write a create table command for **one** of the tables that you designed in the previous question.

[3 marks]

- Write a SQL query that finds out: the water level measurements on Aug 9, 2011 taken at 10:45 am.

[3 marks]

- Write a SQL query that finds out: the average flow rate in August of 2011.

[3 marks]

Question 2 [20 marks]

a) Explain a few reasons -in the context of hydroinformatics system - a need for deterministic models such as 1D hydraulic models or 2D hydrodynamic models?

[6 marks]

b) What are the three main issues that might affect the design of computational deterministic models?

[6 marks]

c) Why are most 1D hydraulic model computational schemes based on the implicit time-marching schemes rather than the explicit schemes?

[4 marks]

d) What are the main issues in modeling a tropical urban rainfall-runoff catchment such as Singapore?

[4 marks]

Question 3 [20 marks]

3.1 a) Why are coordinate systems important in GIS? [4 marks]

b) What is a shapefile? [4 marks]

3.2 On 16 June 2010 and 5 July 2011 heavy rains caused brief flooding of parts of Orchard Road, the main shopping street in Singapore. The flooding affected traffic and some basements shops and car parks were flooded, causing several millions of dollars of damage. A GIS can be used to analyse the flooding and support decision making for projects to avoid future flooding.

a) The following data layers could be used in the GIS: i) flood water extent, ii) buildings, iii) canals and iv) water level meters. For each of these layers give the most appropriate data type, the feature type (if relevant), and possible attributes.
[4 marks]

b) Assume that in addition to the data layers in question 3.2 a) you also have a data layer representing elevation. Describe the analysis that is required to find out which buildings can potentially be flooded based on distance to canals, elevation and past flooding.
[8 marks]

Question 4 [20 marks]

Sketch artificial neural network consisting of 3 neurons in input layer and 1 neuron in output layer as well as 1 hidden layer with 5 neurons. Assume full connectivity (all neurons in input layer connected to all neurons in hidden layer; all neurons in hidden layer connected to all neurons in output layer):

4.1 How many weights are involved in such articifial neural network? [2 marks]

4.2 Write pseudo algorithm for back-propagation algorithm. [8 marks]

4.3 Describe purpose of training, cross-validation and testing data sets in context of artificial neural networks [5 marks]

4.4 In some cases values in testing data set are larger than values used in training data set. What sort of problem, if any, would you expect in such situation? How would you deal with it? [5 marks]

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