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THE NATIONAL UNIVERSITY OF IRELAND

NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II, SUMMER EXAMINATIONS 1999

Second University Examination in Arts

CT218 PROGRAMMING

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Time Allowed: 3 Hours

Answer five (5) Questions

Answer at least two (2) Questions from each section.

Please use a separate answer book for each section.

Section A

Q1 (a) Describe the Insertion Sort algorithm, giving an analysis of its performance.

(b) Implement insertion sort in the programming language of your choice.

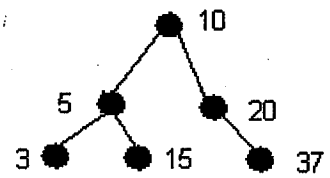
(c) Some algorithms, e.g. Merge Sort, require an auxiliary data structure. Explain.

(d) Describe Merge Sort giving an analysis of its performance, and an example of how it works.

(e) Describe the Binary Search algorithm. Your answer should include an analysis of its performance.

Q2 (a) What are the properties of a Tree structure? Use a diagram to illustrate your answer.

(b) Given the following Binary Search Tree, insert nodes with the following key values (in the order given): 4, 35, 20, 8, 0



(c) Delete the following nodes in the order given: 20, 8

(d) Which traversal method is the most appropriate if you are searching for the **minimum** value in a BST? Explain your answer.

(e) Which traversal method is the most appropriate if you are searching for the **maximum** value in a BST? Explain your answer.

(f) What is a balanced tree structure and why is it useful?

(g) Define an AVL tree.

Q3 A farmer has N fields. Each field is planted with one of three crops: corn, hay, or beans. The farmer wants a data structure to record the following information for each field:

- The day of the year the field was planted (a number in the range 1 to 365)
- The crop planted in the field
- the day of the year the field was harvested

The farmer plans to define a structure named `Field` to hold information about one field and to use an array of `Fields` of length N to store information about each of the N fields.

(a) In the programming language of your choice, implement an appropriate data structure that represents `Field`.

(b) Give reasons for your choice of data structure.

(c) Using the data structure you choose to represent `Field`, what best characterises the time needed to print all information about the k^{th} field?

(d) Describe the O Notation. Your answer should discuss what it is, what it describes, why it is useful, etc. Use examples to illustrate your answer if necessary.

(e) Briefly describe the Stack ADT and the Queue ADT.

(f) Using the programming language of your choice, implement **one** of the following:

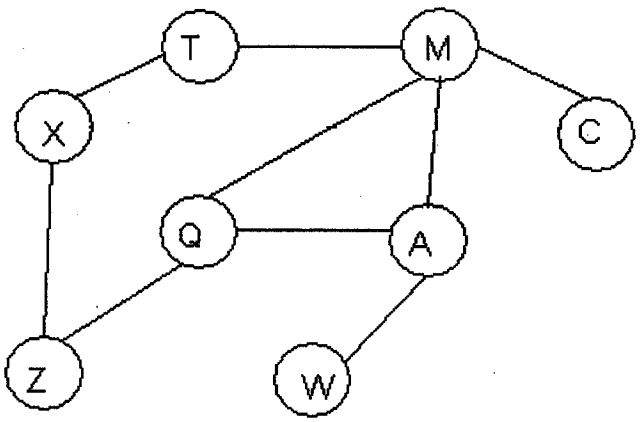
- the `push` operation for a stack
- the `insert` operation for a queue

Q4 (a) Given the following graph, show how the graph can be represented using

(i) an Adjacency Matrix, and

(ii) an Adjacency List.

Mention the disadvantages, if any, of using an Adjacency Matrix. How does an Adjacency List improve on an Adjacency Matrix?



(b) Explain how a state space is represented by the four-tuple (N, A, S, GD). In this context, what is a solution path?

(c) In relation to searching a graph, discuss the breadth-first search and depth-first search algorithms. What factors need to be considered when choosing between depth-first search and breadth-first search?

(d) What is a Spanning Tree? What is the MST Property? What are the 2 fundamental MST algorithm types?

Q5 (a) What is the UML and why is it important?

(b) Explain the essential properties that define an object-oriented programming language.

(c) What is the difference between an object-oriented programming language and an object-based programming language?

(d) What is a programming paradigm?

Section B

Q.6. (i) What is the difference in VB between an *event procedure* and a *general procedure*? Give examples of when you would use each of these two types of procedures.
(ii) Present a VB application which uses a listbox to store the names of business contacts. It should include functionality for adding and deleting items from the list. In addition, it should disallow the entry of a particular business contact into the list more than once.

Q.7. (i) Explain the difference in VB between a user activated event and a non user activated event. When would you use a form's Load event?
(ii) Present a VB application which provides three scollbar controls and a large text box. The three scollbars should represent the red, green, and blue (RGB) components of the background colour of the text box. Whenever the user moves any of the scollbars, the text box's colour should be updated accordingly.

Q.8. (i) Explain the following types of errors that can occur in VB: syntax errors, run-time errors, and logic errors. Explain the terms Debug Window, Break Mode, and Breakpoint. Outline the general structure of a procedure that incorporates run-time error handling.
(ii) What is the *common dialog* control used for? Write the VB code necessary to (a) use a common dialog control to allow the user to select a colour, (b) apply that colour to the *ForeColor* property of a text box.

Q.9. (i) Describe the use of the VB Data Control for manipulating external database files.
(ii) Present a VB program that uses a data control to connect to a table in a database which has the following fields: Name, Address, Date_of_Birth, Salary. When it starts up, the program should automatically populate a listbox with the names of the employees stored in the table.

Q.10. Answer <u>four</u> of the following short questions (with examples/ code fragments where appropriate):
(a) Explain these VB terms: Access keys, the Tab Order, and the Focus.
(b) What causes the *keypress* event of a *text box* to occur, and what is its *KeyAscii* argument used for?
(c) Describe the Object Linking and Embedding (OLE) technology.
(d) What is Visual Basic for Applications (VBA)? Describe the process of "macro recording" followed by code editing using VBA in Excel or Word.
(e) Present a simple VB alarm clock application (with 1 programmable alarm).
(f) Present a VB application whose form receives pairs of mouse clicks and which draws boxes on the form: a pair of mouse clicks should be used to delimit the opposite corners of a box. (Hint: use the form's MouseDown event).