

LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 7

LEFEL 7

EXAMINATION PERIOD
JULY 2023

CYFNOD ARHOLIADAU
GORFFENNAF 2023

MODULE CODE: ACCA7003
OO PROGRAMMING

TIME: 2 HOURS

ANSWER 3 OUT OF 4 QUESTIONS.
ALL QUESTION CARRY EQUAL MARKS

Equipment or materials required –Approved Calculators

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QUESTION ONE

- a) An algorithm has a running time, R_t given by:-

$$R_t = n^2 + n + 3$$

where n is the number of items input into the algorithm. Using “big-O” notation, state the computational complexity of this algorithm and explain your answer.

[6 marks]

- b) Use pseudocode to illustrate programming structures that have complexity $O(1)$, $O(n)$ and $O(n^2)$ and explain your answers.

[9 marks]

- c) The following table records the execution time of 3 C++ functions, Func1(), Func2() and Func3(). Each of these functions has been timed (in milliseconds) when processing a range of data arrays containing data of size 3000 data elements, 6000 data elements, 12000 data elements, 24000 data elements and 50.000 data elements.

	Data size in array elements				
	3000	6000	12000	24000	50,000
Func1()	5.0ms	19.5ms	81.3ms	324.5ms	1390.5ms
Func2()	150.1ms	150.7ms	150.9ms	150.7ms	150.3ms
Func3()	10.0ms	19.8ms	41.0ms	83.0ms	160.0ms

Table Q1.

For each function, sketch a graph in your answer book showing the relationship between time and data size. From this graph, or from the table Q1 above, estimate the time complexity of each function using Big O notation.

[10 Marks]

Please Turn Over

QUESTION TWO

- a) Explain the difference between static memory allocation and dynamic memory allocation in the context of data structures.

[4 marks]

- b) Explain with the aid of a diagram the term “node based linked list.” Identify essential operations required manage this data structure. Provide reasons for your choices in your answer.

[7 marks]

- c) Using the ideas of dynamic memory allocation and the concept of a list node, describe using pseudo-code a detailed algorithm for a function that will add an item from a double linked list. In your answer comment on any potential problems associated with your implementation.

[10 marks]

- d) Given a dynamic linearly linked list explain how it can be modified to implement a stack.

[4 marks]

Please Turn Over

QUESTION THREE

- a) Describe the stack and queue data structures including, with arguments for their inclusion, essential operations that are performed on each structure.

[10 marks]

- b) Provide an algorithm that implements an iterative depth first search using a stack data structure. Analyse this algorithm and hence state its space and time complexity.

[8marks]

- (c) Apply your algorithm to the graph of figure Q3, showing the contents of the stack after each iteration of the loop. Explain how your depth first search algorithm might be modified to perform, instead, a breadth first search.

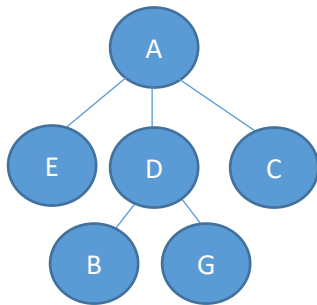


Figure Q3

[7 marks]

QUESTION FOUR

- a) Show by means of a diagram how a binary search tree would be constructed given the following list of unordered numbers:

50, 20, 14 30, 18, 80, 85, 7

Give you reasons for the placement of each value.

[6 marks]

- b) Using the binary tree generated in part a), perform a post-order traversal of the tree writing down the data read in the order in which the nodes are visited (ensure you indicate which is the first node visited in your answer). Repeat this process using an in-order and pre-order traversal.

[12 marks]

- c) Demonstrate with the aid of program code or pseudo code the process required to delete the number 14 from the binary tree.

[7 Marks]

Diwedd/End