DUBLIN INSTITUTE OF TECHNOLOGY

DT228 BSc. (Honours) Degree in Computer Science

Year 1

DT282 BSc. (Honours) Degree in Computer Science (International)

Year 1

SUMMER EXAMINATIONS 2014/2015

ALGORITHM DESIGN AND PROBLEM SOLVING [PROG1210]

MS. ANDREA CURLEY
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FRIDAY 15TH MAY   1.00 P.M. – 3.00 P.M.

TWO HOURS

ANSWER QUESTION (1) AND *ANY TWO* OF QUESTIONS (2), (3), (4).

QUESTION (1) IS WORTH **40** MARKS.

QUESTIONS (2), (3), (4) ARE WORTH **30** MARKS EACH.

1. (a)   i.   Write the recursive algorithm for finding a number in an **ordered** list.

(6 marks)

        ii.   Illustrate the call stack using [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11], where the number that is being searched for is **3.**

(4 marks)

        iii.   What is the complexity (Big O) of the algorithm in 1(a)(i)? Explain your answer.

(4 marks)

(b)   i.   Describe briefly how the *Selection Sort* algorithm works.

(4 marks)

        ii.   Write the pseudo-code for the *Selection Sort.*

(6 marks)

        iii.   Make at least one change to this algorithm to improve its efficiency.

(4 marks)

        iv.   Using the list [1, 2, 4, 3], highlight exactly how it is more efficient.

(4 marks)

        v.   What is the complexity (Big O) of the algorithm described in 1(b)(i)? Explain your answer.

(2 marks)

(c)   i.   What steps are involved in the *Quick Sort* algorithm?

(4 marks)

        ii.   What is the complexity (Big O) of the algorithm described in 1(c)(i)? Explain your answer.

(2 marks)

2. (a)

    i.   What are the advantages and disadvantages of using a *Binary Search Tree*?

                    (6 marks)

    ii.   Draw a *Binary Search Tree* with the following numbers

                19, 6, 8, 11, 4, 13, 5, 27, 43, 49, 31, 25

                    (6 marks)

    iii.   What is the height of a *Binary Search Tree* with 16 elements?

                    (3 marks)

    iv.   Write the algorithm for searching the tree for a specific value.

                    (5 marks)

    v.   Write a recursive algorithm that will return the minimum value in the tree.

                    (5 marks)

    vi.   Write a recursive algorithm that will return the maximum value in the tree.

                    (5 marks)

3. (a)

i. Draw a flowchart for the following the tree-drawing algorithm.

Size 4 tree					Size 3 tree			
Line		Spaces	Asterisks		Line		Spaces	Asterisks
1	▼	3	1		1	▼	2	1
2	★▼★	2	3		2	★▼★	1	3
3	★★★★★	1	5		3	★★★★★	0	5
4	★★★★★★★	0	7		4	▼	2	1
5	▼	3	1					
		size - line	2*line - 1				size - line	2 * line - 1

Trunk spacing is always size - 1

(10 marks)

ii. What is the complexity (Big O) of the algorithm described in 3(a)(i)? Explain your answer.

(2 marks)

(b)

i. Write a recursive algorithm (in pseudo code), which provides a solution to the *Tower of Hanoi* problem.

(10 marks)

ii. What is the complexity (Big O) of the algorithm in 3(b)(i)? Explain your answer.

(2 marks)

(c)

Write a Haskell function findMin that calculates the minimum of a list of integers. Then show how findMin [3, 4, 1, 5, 2] would be evaluated.

(6 marks)

4. (a) The *Merge Sort* algorithm is illustrated below. Nine function calls are made (1-9).

    i.   Write the *Merge Sort* algorithm in pseudo code.

                      (8 marks)

    ii.   State the actual function call made with appropriate parameters.

                      (9 marks)

    iii.   State the order of the function calls made.

                      (6 marks)

    iv.   What is the complexity (Big O) of the algorithm described in 4(a)(i)? Explain your answer.

                      (4 marks)

    v.   What is the actual complexity when there are four numbers, which need to be sorted, such as the example below? Explain your answer.

                      (3 marks)