CMPU 1014

S211/104

DUBLIN INSTITUTE OF TECHNOLOGY
KEVIN STREET DUBLIN 8

BSc. (Honours) Degree in Computing

Year 1

Semester 2 Examinations 2013/2014

Introduction to Algorithms

Dr. D. Lillis
M. Mc Hugh

Friday 16th May 4.00 p.m. – 6.00 p.m.

Answer THREE questions out of FOUR.

All questions carry equal marks.

Each student will be awarded a bonus of 1 mark

Question 1

a) Define what is meant by the term algorithm, and explain why they are important in computing? Write down 4 properties that any algorithm should have. Explain what is meant by the term *complexity* of an algorithm?

(11 marks)

b) Explain how a 1D array can be used to store a list of numbers a_1 , a_2 , ...,a_{n-1}, a_n. Given an array A of size n, write down a pseudocode to compute the maximum, minimum and the sum of the elements in the array, and to print them out.

```
process_array(A, n, max, min, sum)
```

(15 marks)

c) Given an array A with N elements: A[0], A[1],...,A[N-1], draw a flowchart to read N and the N elements into the array, and compute the maximum and minimum elements and print out both of them.

(7 marks)

Question 2

a) Define what is meant by the terms (i) *singly-linked list* and (ii) *a doubly-linked list*. Give 2 advantages of using a linked-list, and 1 advantage of using an array to implement an algorithm for a given problem.

(8 marks)

b) Write down pseudocode, with the help of diagrams, to do the following operations on a linked-list, with *head* being the head-pointer to the list.

i) Add a node at the *head* of the list.

ii) Check if a linked-list with pointer *head* is empty.

(10 marks)

c) Write down pseudocode, with the help of a diagram, to print all the data (integers) stored in a linked-list. You are given the head of the list, *head*. The algorithm should be of the form `printlist(head)`. Explain briefly *each* line of pseudocode.

(15 marks)

Question 3

a) Write down the definition of a *queue* data structure. Describe clearly using **pseudocode** the two algorithms for *enqueing* and *dequeing* elements on a queue that is implemented using a linear array of size qmax.

(11 marks)

b) Explain what is meant by a stack data structure. With the help of a stack, evaluate the following expressions given in postfix form, showing the stack contents after each operation:

(i) 3 2 4 * + 9 +

(ii) 2 4 + 7 1 – *

(10 marks)

c) Write down the pseudocode for the `push(stack, item)` and `pop(stack)` functions for a stack implemented using an array with `size` elements.

(12 marks)

Question 4

a) List clearly all the steps of the Bubble Sort algorithm for sorting an array A of size n. Show how this algorithm sorts the following array in increasing order, by showing the sequence of values after *each* pass through the array:

6 4 2 5 3 1

(12 marks)

b) The Insertion Sort algorithm is a simple algorithm to sort an array. Write down clearly, in English or pseudocode, the steps involved in this algorithm, and how it differs from the Bubble Sort.

(10 marks)

c) In terms of the array size n, what is the complexity of each of the algorithms in (a) and (b) above using big-O notation? If the Bubble Sort method takes 1 second to sort a random array with 100 elements, approximately how long will it take if the array has 200, 300, 400 elements respectively? Show clearly how you compute your answers.

(11 marks)