OLLSCOIL NA hÉIREANN MÁ NUAD

THE NATIONAL UNIVERSITY OF IRELAND MAYNOOTH

JANUARY 2015 EXAMINATION

CS210

Algorithms & Data Structures 1

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Time allowed: 2 hours

Answer all five questions

All questions carry equal marks

This is a sample exam paper.

The structure is different to previous years in that all the data structures and algorithms are presented in terms of programming problems.

The reasoning behind this adjustment is that these are the kinds of questions that students are getting in interviews. The old style exam paper offered marks for questions that were not realistic.

The first thing that companies ask in an interview for a software engineering position is to write a piece of code on the whiteboard.

The exam style has been updated to reflect what employers actually expect.

The exam places more emphasis on skill and less emphasis on rote learning. If you know how to program you don't have to study.

The code should be clean and neat, so use rough-work first if necessary. Explain everything in English as well.

You get marks for clarity. Other people will need to understand your code, so it needs to look good.

[20 marks]

1   Write a Java program that outputs the quantity of prime numbers under an input number *n* which is inputted by the user. For example, if the user inputs 10, then the program outputs 4. Provide comments which explain how the algorithm works.

[20 marks]

2   Write a Java program that prints the integers from 1 to 100. But for multiples of three print "Fizz" instead of the number and for the multiples of five print "Buzz". For numbers which are multiples of both three and five print "FizzBuzz". Provide comments which explain how the algorithm works.

[20 marks]

3   Write a Java method that takes in a reference to the head of a double-ended doubly-linked list and reverses it. Provide comments which explain how the algorithm works.

[20 marks]

4   Write a Java method that takes in an array of strings and sorts them by the number of unique characters in each string. Provide comments which explain how the algorithm works.

[20 marks]

5   Write a Java program that takes in an array of ints and finds the maximum contiguous subsequence sum, given an input length *n*. For example, for the following array, where *n* = 3 and the array is {-5 -1 2 -3 0 -3 3} the best possible sum of at least length 3 would be 0, where the subsequence is the last three elements (0, -3, 3). Provide comments which explain how the algorithm works.