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

1   Write a Java program that outputs the 10,001ˢᵗ prime number. Provide comments which explain how the algorithm works.

[20 marks]

2   Write a Java program that uses a stack to check if an inputted String is a palindrome or not (i.e. a word that reads the same forwards as backwards, such as 'radar'). Write the Java Stack class for it to use. 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 single-ended doubly-linked list and deletes every third link, starting with the deletion of the head. 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, preferably in O(nlogn) time, by length, or alphabetically where strings have the same length. Provide comments which explain how the algorithm works. For example, the set of strings below would be sorted as follows:

```
pear
plum
apple
grape
mango
melon
banana
orange
```

[20 marks]

5   Write a Java program that uses a Monte Carlo algorithm to calculate the probability that next week's lottery draw won't have any consecutive pairs of numbers. Six numbers are drawn from 1 to 45. Provide comments which explain how the algorithm works.