Maynooth University
National University of Ireland Maynooth

OLLSCOIL NA hÉIREANN MÁ NUAD

THE NATIONAL UNIVERSITY OF IRELAND MAYNOOTH

AUTUMN 2016 EXAMINATION

CS210

Algorithms & Data Structures 1

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Time allowed: 2 hours

Answer all four questions

All questions carry equal marks

[20 marks]

1 Write a Java program given the following specification and provide comments which explain how your algorithm works.

Problem Statement
The goal is to read in a list of integers into an array and output the one which occurs most frequently. If there are two or more values that occur most frequently then choose the one which is lower.

Input Format
The first line contains *N*, the number of inputs. The second line contains *N* integers, $a_0, a_1,...a_{N-1}$, separated by a space.

Output Format
The mode, that is, the number which occurs most frequently in the list.

Constraints
$1 \leq N \leq 1000$
$-1000 \leq a_i \leq 1000$

Sample Input
7
15 18 3 2 -5 6 2 6

Sample Output
2

[20 marks]

2 Write a Java program given the following specification and provide comments which explain how your algorithm works.

Problem Statement
Use a **priority queue** to sort a sequence of numbers. You must write your own Priority Queue class. The numbers are inserted into the priority queue, which assigns higher numbers higher priority. The numbers are then removed in a sorted order.

Input Format
The first line contains *N*, the number of inputs. The second line contains *N* integers, $a_0, a_1,...a_{N-1}$, separated by a space.

Output Format
A line of sorted integers, from higher to lower, with each integer separated by a space.

Constraints
$1 \leq N \leq 1000$
$-1000 \leq a_i \leq 1000$

Sample Input
5
8 2 7 5 9

Sample Output
9 8 7 5 2

[20 marks]

3 Write a Java method that takes in a Linked List object (double-ended and doubly-linked) and deletes the first half of the linked list. If there is an odd number of links then the middle link should also be deleted. The method then returns the Linked List object. Provide comments which explain how your algorithm works.

[20 marks]

4 a) Identify the output that the following Java code produces and explain your reasoning clearly. [10 marks]

```
public class Recursion{
    public static void main(String[] args){
        System.out.println(method(3));
    }

    public static int method(int number){
        if (number > 30){
            return 7;
        }
        System.out.println("hello");
        return method(number + 7) - 8;
    }
}
```

b) Identify the output that the following Java code produces and explain your reasoning clearly. [10 marks]

```
public class BitManipulation{
    public static void main (String[] args){
        System.out.println((7&11)<<7);

    }
}
```