Maynooth University
National University of Ireland Maynooth

OLLSCOIL NA hÉIREANN MÁ NUAD

THE NATIONAL UNIVERSITY OF IRELAND MAYNOOTH

AUTUMN 2017 EXAMINATION

CS210

Algorithms & Data Structures 1

Dr. S. Flynn, Dr. A. Winstanley, Dr. P. Maguire

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 3 numbers and output the one which is most different from the other two (i.e. the one with the greatest difference from the nearest number to it). If there is no single outlier then output "NA".

Input Format
Each line contains *A*, *B*, and *C* separated by a space.

Output Format
An integer representing the outlier of the three, or “NA” if there is no outlier.

Constraints
$-1000 \leq A,B,C \leq 1000$

Sample Input
6 3 9

Sample Output
NA

[20 marks]

2 Write a Java program given the following specification and provide comments which explain how your algorithm works. Estimate the **Big O complexity** of your program and explain your reasoning clearly.

Problem Statement
The goal is to read in a number of fair coin tosses, and a target number of heads, and output the probability that the target number of heads in a row will be tossed at some point in the sequence, rounded to the nearest percent.

Input Format
An integer *N* for the number of coin tosses, followed on the next line by an integer *H* for the target number of heads.

Output Format
An integer from 0 to 100 representing the percentage probability that *H* heads in a row will be observed at some point during *N* tosses of a fair coin.

Constraints
$0 \leq N \leq 1000$
$0 \leq H \leq 100$

Sample Input
5
3

Sample Output
25

[20 marks]

3 Write a Java program given the following specification and provide comments which explain how your algorithm works. Estimate the **Big O complexity** of your program and explain your reasoning clearly.

Problem Statement
The goal is to read in a list of students and exam scores into an array and output the name of the student with the median score, that is, the one which if you put them all in order would be in the middle. For example the median of 40, 80, 20, 30 and 50 is 40, because if you put them all in order 40 would be the middle value, so output the name of the student who got 40. If there is an even number of students, then output the name of the middle two that comes first in alphabetical order.

Input Format
The first line contains *N*, the number of inputs. This is followed by *N* pairs of names and integers separated by a space, each on a separate line.

Output Format
The name of the student who represents the median.

Constraints
$1 \leq N \leq 1000$
$0 \leq \text{score} \leq 100$

Sample Input
4
Paul 18
Claire 94
David 34
John 25

Sample Output
David

[20 marks]

4 Write a Java program given the following specification and provide comments which explain how your algorithm works. Estimate the **Big O complexity** of your program and explain your reasoning clearly.

Problem Statement
Manipulate a queue according to the given insert and remove commands and then output the string that is in the middle of the queue. If there is an even number of strings in the queue, thus two middle strings, output the one which is nearest the front. If a remove command is issued for an empty queue then nothing should happen.

Input Format
A series of lines involving either INSERT or REMOVE commands. The command INSERT is followed by a space and then the string to insert (e.g. INSERT hello).

Output Format
Output the string that is in the middle of the queue following the given commands. If there are two middle strings, output the one nearest the front. If the queue is empty output "empty".

Constraints
1≤#(commands)≤20
1≤length(string)≤20

Sample Input
INSERT this
INSERT is
INSERT how
INSERT to
REMOVE
INSERT do
REMOVE
INSERT it

Sample Output
to