Maynooth University
National University of Ireland Maynooth

OLLSCOIL NA hÉIREANN MÁ NUAD

THE NATIONAL UNIVERSITY OF IRELAND MAYNOOTH

JANUARY 2022 EXAMINATION

CS210

Algorithms & Data Structures 1

Dr. J. Timoney, Dr. P. Maguire

Time allowed: 2 hours

Answer ALL four questions

All questions carry equal marks

[25 marks]

1 2520 is the smallest number that can be divided by each of the numbers from 1 to 10 without any remainder. Write a Java program that outputs the smallest positive number that is evenly divisible by all of the numbers from 1 to 20. Include comments that explain your code clearly. [25 marks]

[25 marks]

2 Two integers are coprime if the only positive integer that divides into both of them is 1. In other words, the greatest common divisor of two coprime numbers is 1. Write a Java program that uses a Monte Carlo simulation to determine the probability that two randomly selected numbers will be coprime with each other. Include comments that explain your code clearly. [25 marks]

[25 marks]

3 Write a Java program that manipulates a priority queue according to given insert and remove commands, and then outputs the string that is in the middle of the priority queue. Include comments that explain your code clearly. [25 marks]

If there is an even number of strings in the queue, thus two middle strings, the program should output the one which is nearest the front. If a remove command is issued for an empty queue nothing should happen.

The way that priority is settled is by the number of vowels in a word. If a word has more vowels, then it has higher priority. If two words have the same number of vowels, then the higher priority word is the one that has been in the queue the longest.

Sample Input

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

Sample Output

to

[25 marks]

4 Write a Java program that sorts a long list of words using a special ordering. The first input line is an int representing the total number of words, followed by a word on each line. All the words should be sorted by the total sum of all the ASCII values of each character in the word. The words that are outputted first should be those with the lowest ASCII sum. For example, the ASCII value for 'a' is 97, while that for 'n' is 110, so the word "an" has an ASCII sum of 207. Because this total is relatively low, “an” should be one of the first words to be outputted. [25 marks]

Words that have the exact same ASCII sum (e.g., "dog" and "god") should be sorted in REVERSE alphabetical order (so "god" would be outputted before "dog" since it's nearer the end of the dictionary).

State the complexity of your program using **Big O notation**. The more efficient it is, the better. Include comments that explain your code clearly.

Sample Input

```
10
one
two
three
four
five
six
seven
eight
nine
ten
```

Sample Output

```
one
ten
six
two
nine
five
four
eight
three
seven
```