

DSA: Assignment - 2

September 16, 2022

Abstract

In this assignment you will handle different types of data structures like arrays, dictionaries, priority queues, and heaps. For each task, you can download the source code that handles the input and output from Canvas or <https://www.dsacoursevu.or> (DOMjudge) for C++ or Python3. Since it will be used for your grading, we strongly advise you to use it in order for your program to have the correct output.

1 Tasks

1.1 Task 1: Operation of Amsterdam sewage system of sensors (2pt)

You have a network of surveillance sensors at every corner of Amsterdam sewage system. Every sensor reports the covid level in the water. Each day you are tasked to read the readings and report sensor number with the highest rate of covid. Your task is to traverse through the list of sensor values and output the index of the maximum measurement.

Example 1 *The program takes as input: A sequence of measurements: [value,value,..]. The output is the index of the maximum value.*

Input: 2, 43, 21, 457, 321, 23, 9

Output: 3

1.2 Task 2: Custom sensor readings feature (2pt)

Unfortunately one of the sensors is malfunctioning. It reports its value twice each day. Your task is to find the culprit in the data and return the sensor ID of the faulty sensor as output.

HINT: There is a formula to find the only repetitive element in an array of size n with numbers from 1 to $n-1$ in random order in $O(n)$. Think about what you get if you calculate the sum of the array (sensory IDs) subtract $((N - 1) * N/2)$ from this sum with N being the length of the array.

Example 2 *The program takes as input: A sequence of sensor ids and measurements: [id,value;id,value;...]. The output is the duplicated id.*

Input: 6, 215; 2, 655; 9, 988; 8, 34; 7, 9; 1, 192; 4, 7; 3, 26; 5, 965; 8, 34;

Output: 8

1.3 Task 3: Custom sensor readings storage feature (3pt)

The mayor of Amsterdam wants to store the covid levels in the water of for day. He wants to be able give you a date and then get the maximum covid level for that day. Your job is to implement a way to store the input as a data structure so that you can store the readings for each day and easily find the maximum.

The first element in the input is the desired date (e.g., '2022-09-08;'). What follows is a list of triplets, separated with a semicolon ';'. One triplet represents one reading instance with the structure 'date,id,covid level;'. Find the maximum covid level found in the sewage system on the desired date and output the sensor ID and the covid level.

Example 3 *The program takes as input: (string)'yyyy-mm-dd', (int)sensor id, (int)covid level. The expected output is sensor id,covid level.*

Input: 2022-09-08; 2022-09-08, 23, 371; 2022-09-08, 2, 3171; 2022-09-08, 12, 43; 2021-03-21, 4, 129

Output: 2, 3172

1.4 Task 4: Custom sensor readings feature using heap operations (3pt)

The city of Amsterdam wants to store the maximum values of the past few years for research purposes. It is important that the current maximum measured value can be accessed very quickly. One idea to fulfill this requirement is to use a priority queue. Your job is to implement a priority queue with a maximum heap and return again a tuple of the current maximal measurement and its corresponding date when the maximum occurred. Output: date,covid level

Example 4 *The program takes as input: (string)'yyyy-mm-dd', (int)sensor id, (int)covid level. The expected output is: yyyy-mm-dd,covid level.*

Input: 2022-09-08, 23, 371; 2022-09-08, 2, 3171; 2022-09-08, 12, 43; 2021-03-21, 4, 129

Output: 2022-09-08, 3171