Cairo University
Faculty of Engineering
Computer Engineering
Fall 2019

Design and Analysis of Algorithms
Homework 4

DEADLINE Saturday, December 7th 2019, 11:59 PM

<u>Your code should be taking into consideration the following requirements:</u>

1. Implement your code in C++.
2. The grade will be granted based on the running time of your code as well as the correct output.
3. Remember! Plagiarism is not tolerated. Any sign of cheating or plagiarism will be graded as ZERO in this assignment and all other assignments.

<u>Deliverables:</u>

- You will submit your code on SPOJ in the contest sent by email.
- Hint:
  - For a problem that has a time limit of 1 second it is expected that your code runs $O(10^8)$ operations on the maximum input size.
  - If your code is $O(N^2)$ while the maximum N is 10^8 your code will cause a time limit exceeded. If the maximum N is 10^4 your code should be fine.

Requirements:

1. Two Player Game

- In a game with 2 players, both players start the game with **N** coins.
- In each turn a player can choose to do one of two actions A and B.
  - Whenever a player chooses A, he loses **A1** coins and the other player loses **A2** coins.
  - Whenever a player chooses B, if he has a number of coins divisible by 3 the other player loses **B1** coins otherwise both players lose **B2** coins.
- Each player's goal is make the other player reach zero (or below) coins. The player who reaches zero (or below first) loses.
- If both players reach zero (or below) coins together the player who played last loses.
- When the game ends, the losing player gives **T** dollars to the winning player. **T** is the number of turns played. (If player one plays then player 2 plays that is two turns).

Given that both players are perfectly logical players that can reach their optimum solution, find the winning player and the amount of dollars he wins. Player 1 starts first.

The input format will be as follows:

- One line containing **N**, **A1**, **A2**, **B1**, **B2**.

N is between 5 and 10000. A1, A2, B1, B2 are between 1 and 1000 and are always smaller than N. B1 > B2 => A2 > A1.

Output format should be:

- One line containing 2 numbers
  - First number is either 1 or 2 representing who wins
  - Second number is the number of turns needed to win.

Sample Input:

10 1 2 5 3

Sample Output:

1 3

Output explanation:

- Both player start with 10 coins. (10:10)
- Turn 1, player1 does Action A decrementing 1 from his coins and 2 from player 2 coins. (9:8)
- Turn 2, player2 does action B decrementing 3 from both their coins. (6:5)
- Turn 3, player1 does action B decrementing 5 from player's 2 coins. (6:0) (Player 1 one).
- In each turn, since players have perfect logic, each player chooses the choice that maximizes his gain (minimizes the opponent gain).

2. Swimming Team

Hamada is creating a swimming team to compete in the coming corporate games, so Hamada invited **2n** of his friends to a public swimming pool to prepare for the tournament. When they arrived, they had some trainings and exercises and then he held a race between them in order to know each person's stamina.

After the race, Hamada lined his friends up in two equal rows (each row consists of the same number of people). He numbered his friends from 1 to n from left to right in each row. He aims to create a team from his 2n friends, of course not all of them are qualified enough. He is going to choose from left to right and the number (index) of each chosen swimmer will be greater than the index of the last chosen swimmer.

To avoid any biases, Hamada will not choose two consecutive swimmers from the same row. The first student can be chosen among all 2n students and the team can consist of any number of swimmers.

Hamada wishes to choose the team such that the total stamina of the team is as maximum as possible and here comes your job. Your objective is to find the maximum possible total stamina that he can get from a team he chooses given the constraints mentioned above.

The input format will be as follows:

- The first line contains the integer **n**.
- The second line contains **n** integers representing the stamina of each swimmer in the first row.

- The third line contains **n** integers representing the stamina of each swimmer in the first row.
- The value of each input ranges from 0 to 10^8.

Output format should be as follows:

- The maximum possible stamina that can achieved from a team Hamada can choose.

Sample Input:
5
9 3 5 7 3
5 8 1 4 5

Sample Output:
29

3. Monster Killing

Sayed is competing with a friend in a video game, where each of them has a set of weapons and the player who kills their enemies with the minimum number of shots wins.

Your objective is to help Sayed beat his friend by providing the minimum number of shots that would minimize the enemy's health (0) without making it negative. Use greedy approach.

The input format will be as follows:

- An integer N representing the number of monsters in the game.
- The next N lines contains the initial health for each monster.
- The following line is an integer M representing the number of weapons available.
- The following M lines contain the firepower for each weapon.
- The value of each input ranges (N, M, Firepower, Health) from 0 to 10^4.

Output format should be:

- N lines where each line is the minimum number of shots required to kill each monster.

Notes:

- The minimum number of shots should be achieved without wasting your firepower, meaning that you should only use a weapon whose firepower is suitable for the current health of the monster not a weapon with larger firepower even if it was the only choice.

Sample Input:

5
43 39 12 26 16
3
9 8 7

Sample Output:

5
4
1
3
2