Middle East Technical University
Department of Computer Engineering

CENG 140

Spring '14

Take Home Exam 1

REGULATIONS

Due date: 14 April 2014, Monday, 23:55
(Not subject to postpone)

Submission: Electronically. You will be submitting your program source code written in a file which you will name as `the1.c` through the cow web system. Resubmission is allowed (till the last moment of the due date), The last will replace the previous.

Team: There is **no** teaming up. The take home exam has to be done/turned in individually.

Cheating: This is an exam: all parts involved (source(s) and receiver(s)) get zero+parts will be subject to disciplinary action.

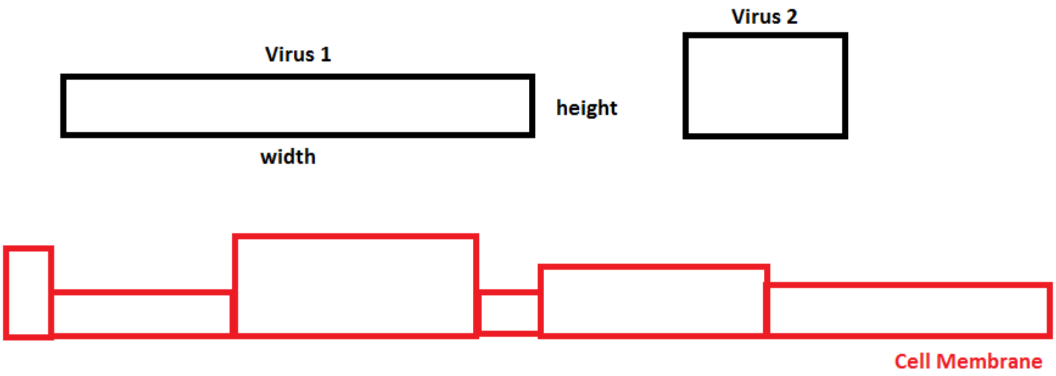
Disclaimer: The story of THE1 below is completely fictional. Some of the biological statements are not scientifically correct.

INTRODUCTION

The membrane of human cells is the first line of defense against pathogens, such as viruses. Cell membranes of a cell are initially thin, defenseless structures, but may grow stronger as a response to virus attacks. Although cell membranes are circular structures, in this assignment, we will assume that they stretch from left to right as a linear structure. Cell membranes may have variable thickness in different positions on the membrane and the viruses that are longer than the cell thickness may successfully penetrate the cell. The cell uses the following strategy to react to viruses: whenever a part of the cell membrane is penetrated by a virus of height h, the part of the cell membrane in that region thinner than h is grown to the thickness h, sufficient to stop an identical virus attack in the future.

The cell membrane can be frequently attacked by viruses. In this assignment, we assume that each virus has a specific width and height (see the figure below) and attacks the membrane on some interval equal to its width. The virus has a fixed height, but may continue to attack the cell in different places at different times by moving left or right with a constant speed. In order to repel virus attacks, the cell membrane must have a height of at least h all along the interval attacked by a virus of height h. If even a short stretch of the membrane is thinner than h, the virus will penetrate the membrane at this point and succeed. Note that even a successful virus attack does not damage the cell membrane. After the attack, every attacked fragment of the cell membrane that was thinner than h is grown to a thickness of h, in other words, the cell membrane grows in the minimal way that would have stopped the attack.

Viruses tend to attack the cell membrane repeatedly (for a fixed number of times for each virus) by moving left or right at some constant speed and attack in some predefined constant time intervals. Assuming that initially the cell membrane has a thickness of 1 unit at all places, and given the full description of all the viruses that attack the cell membrane, your job is to determine the final state of the cell membrane after all virus attacks are finished.



PROBLEM

You will be given the right boundary of the cell membrane as a positive integer, r. The left boundary of the cell will start at position 0. A number of virus descriptions are also provided by specifying for each virus, v_i, 1) the width, w_i, 2) the height, h_i, 3) the minute of the first attack, t_i, 4) the position of the first attack, p_i, 5) the speed (in units/minute) (negative for viruses that go left and positive for viruses that go right), s_i, 6) attack interval (in minutes), a_i, and 7) number of attacks, n_i. All the values are provided as integers. You will ignore virus attacks that are outside the cell membrane boundaries. The position of the first attack, p_i indicates the position of the left leg of the virus. In other words, the cell membrane interval $[p_i, p_i + w_i - 1]$ is attacked first by virus v_i.

In this assignment, write a C program that takes cell membrane and virus descriptions as input from the standard input and outputs the final state of the cell membrane as a list of thickness values from left to right.

SPECIFICATIONS

- The first line of the input contains the right boundary of the cell membrane, r, $100 \leq r < 100000$.
- The second line of the input contains the number of viruses that attack the cell membrane, k, $1 \leq k \leq 100$.
- Each of the following k lines contains virus descriptions separated by spaces, in the following format:

  $w_i\ h_i\ t_i\ p_i\ s_i\ a_i\ n_i$

  with $1 \leq w_i, h_i \leq 100$,
  $1 \leq t_i \leq 1000$,
  $p_i \geq 0$,
  $|s_i| \leq 1000$,
  $a_i \geq 1$,
  and $0 < n_i \leq 100$.
- Your output should be a single line output of $r + 1$ integers separated by single spaces, indicating the thickness values of the cell membrane from position 0 to position r.
- There will be no erroneous input.
- Do not beautify your output. The grading of your output will be done by a program which will be expecting an input 100% complying with the specifications.

SAMPLE INPUT AND OUTPUT

INPUT:

```
20
2
3 4 2 5 1 2 2
5 2 5 10 -1 3 3
```

OUTPUT:

```
1 1 1 1 2 4 4 4 4 4 2 2 2 2 2 1 1 1 1 1 1
```

The first virus attacks twice at minutes 2 and 4. The first attack hits positions 5, 6, 7 on the membrane. Then the virus moves 2 units to the right in 2 minutes, with 1 unit/minute speed and makes its second attack at positions 7, 8, 9 on the membrane. After these attacks, the thickness of the membrane grows to 4 units at these attacked positions. The second virus attacks three times at minutes 5, 8, and 11. The first attack hits the interval [10,14]. The virus moves left with speed -1 units/minutes and the second attack hits the interval [7,11]. The last attack hits the interval [4,8].