The Bellman Ford Algorithm

Description In this assignment, you are asked to implement the Bellman-Ford Algorithm which solves the single-source shortest-paths problem. See Chapter 24.1. More specifically, you are given as input a directed graph $G = (V, E)$ with weight $w(u, v)$ on each edge $(u, v) \in E$ along with a source vertex $s \in V$. Edges may have negative weights.

Input structure The input will have the following format. The first integer refers to the number of vertices, i.e. $|V|$. The second integer is the number of edges, i.e. $|E|$. Vertices are indexed by 0, 1, ..., $|V| - 1$. Then, three numbers $u, v, w(u, v)$ appearing in each line refer to an edge (u, v) with weight $w(u, v)$. Vertex 0 is the source vertex.

Output There are two cases:

Case (i) The first case is when there is no negative-weight cycle reachable from s. In this case you must output TRUE in the first line, followed by the shortest distance from s to each vertex. More precisely, you must output TRUE, $\delta(0, 0)$, $\delta(0, 1)$, ..., $\delta(0, |V| - 1)$, one per line. Recall that $\delta(u, v)$ denotes the shortest distance from u to v. If a vertex v is not reachable, output INFINITY in place of $\delta(0, v)$.

Case (ii) Otherwise, you must output FALSE.

See examples below for some possible cases of input and output. For using the included Makefile script, your source code file's name must be "BellmanFord.cpp".

Examples of input and output

Input

```
6
10
0 1 6
1 2 5
1 3 -4
1 4  8
2 1 -2
3 0 2
3 2 7
3 4 9
4 0 7
5 2 5
```

Output

```
TRUE
0
6
9
```

```
2
11
INFINITY
```

Input

```
6
11
0 1 6
1 2 5
1 3 -4
1 4  8
2 1 -2
3 0 2
3 2 7
3 4 9
3 5 -14
4 0 7
5 2 5
```

Output

```
FALSE
```

Testing your code Your execution file name must be "BellmanFord.exe". Use Grade10 to test your program.

Submission As usual, before the posted deadline, submit a .zip or zipped tar archive of your program through the assignments page of CatCourses. Please use your UCMNetID as the file-name for the zipped archive. Be careful since CatCourses assigns a timestamp and strictly enforces the assignment deadline. Recall that submission alone is not enough, you must present your work to your TA before submission.

Important Reminder Never change the grading scripts of the files under the "testfiles" folder. If you do so, it will be considered as SERIOUS CHEATING.