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\* Because of the time constraint, we can grade only once – after the hard deadline.

## The Bellman-Ford Algorithm

In this assignment, you are asked to implement the Bellman-Ford Algorithm which solves the single-source shortest-paths problem. 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** The input has the following format. There are two integers on the first line. The first integer represents the number of vertices,  $|V|$ . The second integer is the number of edges,  $|E|$ . Vertices are indexed by  $0, 1, \dots, |V| - 1$ . Each of the following  $|E|$  lines has three integers  $u, v, w(u, v)$ , which represent an edge  $(u, v)$  with weight  $w(u, v)$ . Vertex 0 is the source vertex.

**Output** The output falls into two possible cases.

Case (i): There is no negative-weight cycle reachable from  $s$ . In this case, you must output TRUE on the first line, followed by the shortest distance from  $s$  to each vertex in the graph. More precisely, you must output TRUE,  $\delta(0, 0)$ ,  $\delta(0, 1)$ ,  $\dots$ ,  $\delta(0, |V| - 1)$ , 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): There is a negative-weight cycle reachable from  $s$ . You must output FALSE.

### Examples of input and output

Input 1

```
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 1

```
TRUE
0
6
9
2
11
INFINITY
```

Input 2

```
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 2

```
FALSE
```

Note that every line is followed by an enter key.

See the lab guidelines for submission/grading, etc., which can be found in Files/Labs.