Problem W. Prim's (MST) : Special Subtree

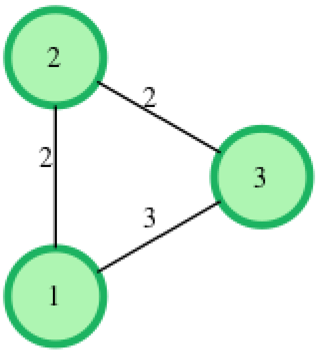
OS Linux

Given a graph which consists of several edges connecting its nodes, find a subgraph of the given graph with the following properties:

- The subgraph contains all the nodes present in the original graph.
- The subgraph is of minimum overall weight (sum of all edges) among all such subgraphs.
- It is also required that there is **exactly one, exclusive** path between any two nodes of the subgraph.

One specific node S is fixed as the starting point of finding the subgraph using Prim's Algorithm.
Find the total weight or the sum of all edges in the subgraph.

Example
$n = 3$
$edges = [[1,2,2],[2,3,2],[1,3,3]]$
$start = 1$



Starting from node 1, select the lower weight edge, i.e. $1 \leftrightarrow 2$, weight 2.

Choose between the remaining edges, $1 \leftrightarrow 3$, weight 3, and $2 \leftrightarrow 3$, weight 2.

The lower weight edge is $2 \leftrightarrow 3$ weight 2.

All nodes are connected at a cost of $2 + 2 = 4$. The edge $1 \leftrightarrow 3$ is not included in the subgraph.

Function Description

Complete the *prims* function in the editor below.

prims has the following parameter(s):

- *int n:* the number of nodes in the graph
- *int edges[m][3]:* each element contains three integers, two nodes numbers that are connected and the weight of that edge
- *int start*: the number of the starting node

Returns

- *int:* the minimum weight to connect all nodes in the graph

Input Format

The first line has two space-separated integers n and m, the number of nodes and edges in the graph.

Each of the next m lines contains three space-separated integers u, v and w, the end nodes of $edges[i]$, and the edge's weight.
The last line has an integer $start$, the starting node.

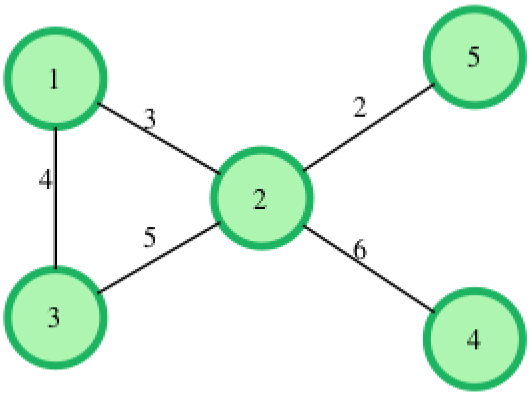
Constraints

$2 \leq n \leq 3000$
$1 \leq m \leq (n * (n-1))/2$
$1 \leq u, v, start \leq n$
$0 \leq w \leq 10^5$
There may be multiple edges between two nodes.

Input	Output
5 6 1 2 3 1 3 4 4 2 6 5 2 2 2 3 5 3 5 7 1	15

Explanation 0

The graph given in the test case is shown as :



- The starting node is 1 (in the given test case)

Applying the Prim's algorithm, edge choices available at first are :

$1 \rightarrow 2$ (**WT. 3**) and $1 \rightarrow 3$ (**WT. 4**) , out of which $1 \rightarrow 2$ is chosen (smaller weight of edge).

Now the available choices are :

$1 \rightarrow 3$ (**WT. 4**) , $2 \rightarrow 3$ (**WT. 5**) , $2 \rightarrow 5$ (**WT. 2**) and $2 \rightarrow 4$ (**WT. 6**) , out of which $2 \rightarrow 5$ is chosen by the algorithm.

Following the same method of the algorithm, the next chosen edges , sequentially are :

$1 \rightarrow 3$ and $2 \rightarrow 4$.

Hence the overall sequence of edges picked up by Prim's are:

$1 \rightarrow 2 : 2 \rightarrow 5 : 1 \rightarrow 3 : 2 \rightarrow 4$

and the total weight of the MST (minimum spanning tree) is : $3 + 2 + 4 + 6 = 15$