

SuperMario

Difficulty level: intermediate

Keywords

- Graph theory
- Undirected graphs
- Kruskal's algorithm

Problem description

You are playing “Super Mario 3D World” with your Nintendo Switch. At the moment, you are in World 1, where some Mega Mushrooms, or “Power Ups”, are scattered around, and Mario can reach them by cutting down some bushes that obstruct his way.



To pass the current level, you must have Mario collect all the Mega Mushrooms by making the minimum number of cuts. Which trees need to be cut?

Tasks

1. Solve the problem by applying Kruskal's algorithm.
2. Now consider the following variant of the problem: in addition to having to minimize the number of shrubs to be cut to reach all the mushrooms, Mario will also have to try to keep as much energy as possible. In fact, every time he chooses to go down a street and cut the shrubs present there, Mario makes an effort and consumes energy, in the form of *stars*.

Together with the shrubs, the map below also shows the stars required to cross a road. If there are no stars on one side, then the energy consumption required to cross it is 0. As before, to pass the level, Mario will have to



collect all the Mega Mushrooms by making the minimum number of cuts AND consuming as few stars as possible:

- (a) Which and how many trees will you have to cut in this case?
- (b) Is the solution obtained the same or different from the one obtained previously?