**Problem**

Given this map calculate the minimum cost of travelling from point 1 to all points.

A diagram of a diagram

Description automatically generated

**Solution**

This involves using the Bellman Ford Algorithm. In short, you want to calculate the cost associated with reachin one point given a chosen path and apply the same concept to all other points but the cath is you can not use one route say 12 more than once.

The way to go about it is to first envision a box above each point where you will insert and update the cost associated to reaching that point. At first assume that the values are infnity for all points. Since we start from 1 let’s say that we take the route 12. At this point you might want to make a list of all direct routes and start to cross the ones you used (e.g., the rout 12 would be now crossed). The cost of taking this route from point 1 to 2 is 2. So now that 2 is less than infinity you update the cost associated with reaching that point. Moving on, let’s say we take the route 24. We now take the cost of reachin point 2 and add to it the cost of taking the rout leading to 4. The result is 1. Now update the box above point 4 with this cost of 1 associated to reaching point 4. Next let’s go to 5. We take route 45, add to the initial cost of reachin 4 the cost of reaching 5 by starting from 4. This is 1+0 and so the cost of reaching 5 is 1. You only care about the cost of reaching the point where you are plus the cost of travelling to another point. In the beginning notice that I didn’t add anything in addition to the route’s cost when I started from 1 and went to 2. That is because 1 was the starting point and so the cost of arriving at 1 is 0. By now you should know what to do to arrive at all points and accurately calcualte the minimum cost of doing so. The caveat is that the costs in the box update. For, example let’s resume from 5, where we were.

Let’s now go to 2 by using route 5We now calcualte the cost of reaching 2 which is the cost of reachin 5 that is 1 plus the cost of the route which is -1. This gives us 0. But whait I second, we already have a 2 in the box. Now what? Well, you update the value. Now it is 0 because there is such a route that I can take to point 2 that would cost me nothing. Now you are equipped with everytning to complete the map. At the end add all the values in the boxes above each point. That is the minimum cost of reaching all points.

Bear in mind that this is a simplified example and in order to be sure of reachin the most optimal value you have to repeat the process but by taking the routes in a different order. If a map has n points then the number of iterations needed to ensure optimal values is n-1.

In this case all the iterations will give the same result of 11 so **11** is the optimal value.

**Answer: 11**