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Data Structures 2270

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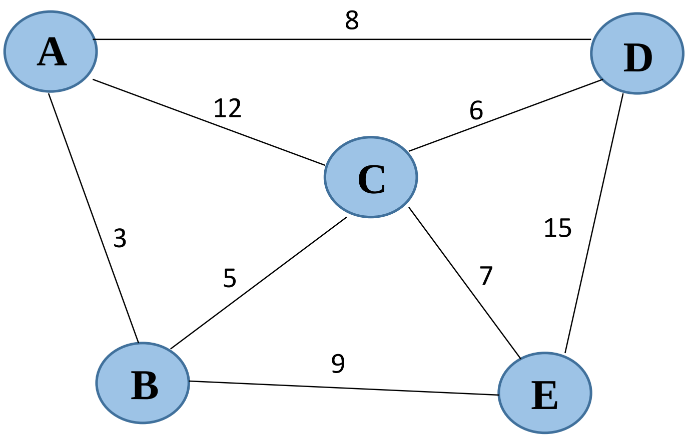
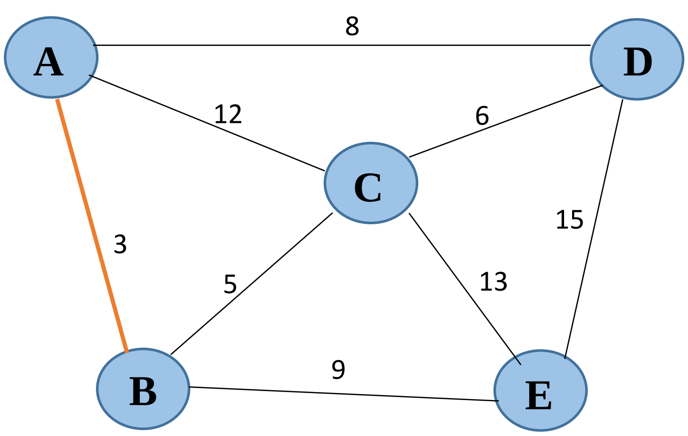
Data Structures Final Project

Sometime in the distant future, in an imaginary scenario, the clean water supply of the world has diminished and become extremely scarce. The U.S government has decided to distribute its remaining clean water to its major cities through a network of water pipes buried underground. However, it wants to distribute the water in the most efficient and least expensive way possible. To do this, it must first take in to account the distances between all the different cities which are in the same regions and find the pathway that goes through all of them in the least-costly way.

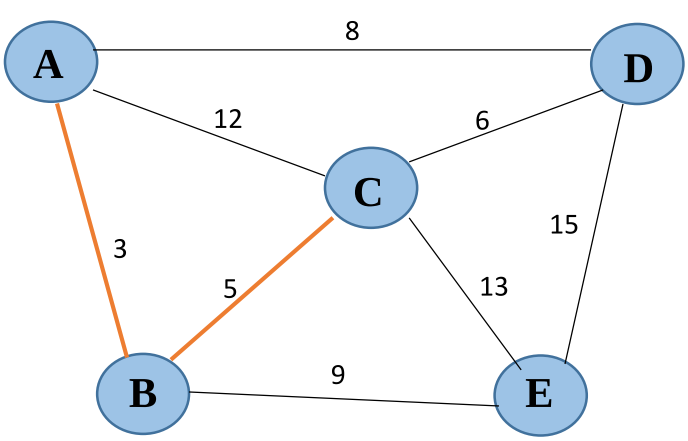
One of the best ways to tackle a problem such as this is to use the concept of minimum spanning trees (MST). We can treat a map that shows all of the major cities in America as a graph structure in mathematics and computer science, and each city can be a vertex of the graph while the distance between two cities – as well as the length of the water pipe in between two cities - can be the edges of the graph. A MST will help us in this case because it will give us the shortest pathway through all of the cities which is going to be the least expensive pathway. In order to find the MST of the graph, we are going to need to implement one of the algorithms needed to find the MST. The two most popular algorithms are Kruskal's algorithm and Prim's algorithm. In this project, we will be implementing Kruskal's algorithm.

So, for example, let's say we have the following graph:

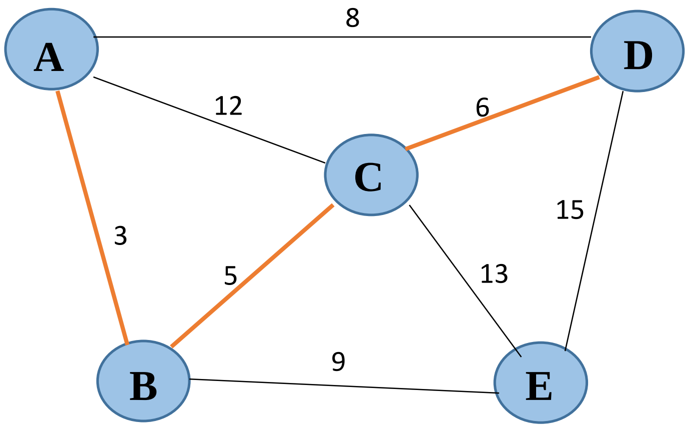




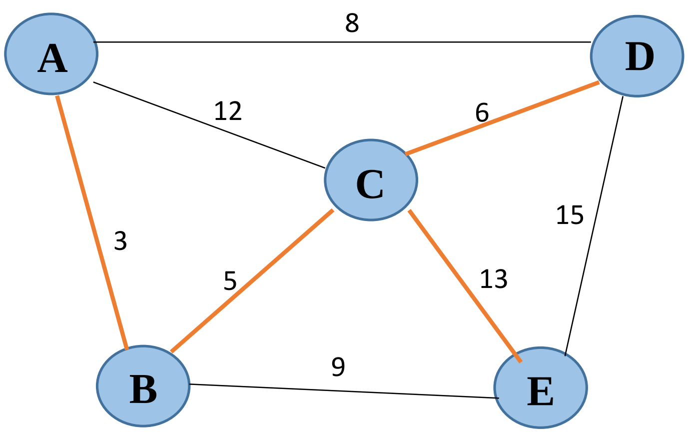
The first step of Kruskal's algorithm is to pick the edge with the least weight. In this case, it's the edge with the weight of 3 (shown on the left in red).



Next, we again pick the edge with the least weight from the remaining edges, which is the edge that has a weight of 5.



We continue to choose the next smallest edge in the graph that doesn't make a complete loop. This time, it is the edge with the weight of 6.



Finally, we pick the edge that has a weight of 13 as our last edge. We do not pick 8 or 9 because even though those edges are smaller than 13, they form closed loops, and if we have a closed loop, we will not have a spanning tree. This resulting spanning tree on the left is our minimum spanning tree.