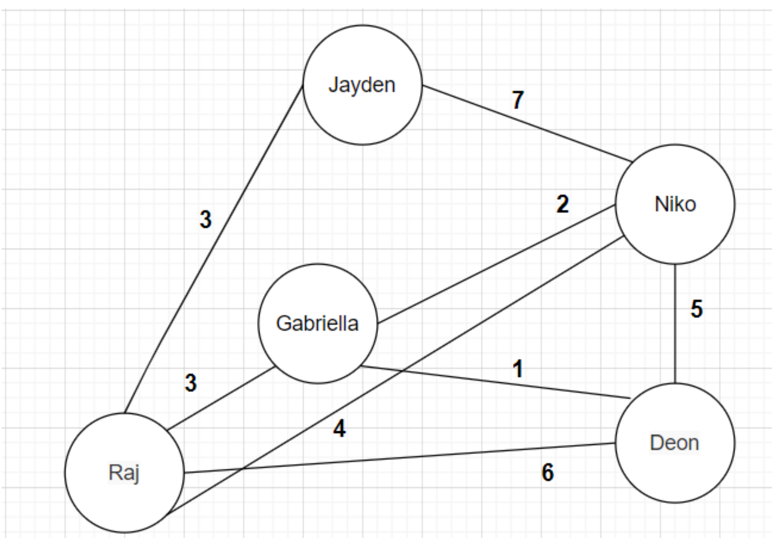
1. Write a problem from a real-world scenario that can be solved using concepts and definitions of graph theory. X
2. Solve your problem in at least one way. X
3. In your responses to peers, **solve the problems of at least two peers**, and **contrast your solution method** with others who have solved the same problems. Make sure to include follow-up questions whenever possible in your responses. X

Hello everyone,

1. Graph theory can be applied to problems of disease transmission (Cornell University, 2014). Using a graph, we can represent members of a group as nodes and their social connections as edges. The weight of an edge indicates the strength of a connection. I would like to share an example of how to identify the shortest path of a disease being transmitted through a group of interconnected individuals from Jayden to a randomly selected person of the group.

Undirected graph of a social network



2. We can solve this problem with Dijkstra's algorithm. The algorithm allows us to find the shortest path between one graph node and another given the node is reachable. The steps (Joshi, 2017) are illustrated as follows:
    a. Begin at the starting node/vertex.

b. When selecting a new node to visit, select the node with the smallest weight from your current node.
c. Once the new node is visited, for each of the neighboring nodes, check the cost of the distance (sum the edges from the starting node to the neighbor node).
d. If we find that a distance to a node is less than a known distance, we update the shortest distance found for that node.

For this problem, I decided to find the shortest path for Deon. Below I used a table (Joshi, 2017) to keep track of the known distances from Jayden as I traverse through the problem.

I start at Jayden and compare the weights of his edges: Niko (7) and Raj (3). The smaller weight is of course 3, so I navigate to Raj. Next I check the cost of the distance from Jayden to each of Raj's neighboring nodes: Jayden-Raj-Gabriella (3 + 3 = 6) and Jayden-Raj-Deon (3 + 6 = 9). Here I find a distance from Jayden to Deon and update the shortest distance on record. To ensure that I have found the shortest distance, I exhaust all other pathways and find that the shortest path to Deon is in fact Jayden-Raj-Gabriella-Deon (3 + 3 + 1 = 7).

Vertex	Shortest Distance from Jayden	Previous Vertex
Jayden	0	N/A
Niko	7	Jayden
Raj	3	Jayden
Gabriella	6	Raj
Deon	~~9~~ 7	Gabriella

Thanks,
Lauren Alexandra

References

Cornell University. (2014, September 15). *Graph Theory Applied to Disease Transmission*.

https://blogs.cornell.edu/info2040/2014/09/15/graph-theory-applied-to-disease-transmission

Joshi, V. Price, D. (2017, October 16). *Finding The Shortest Path, With A Little Help From Dijkstra*. Medium. https://medium.com/basecs/finding-the-shortest-path-with-a-little-help-from-dijkstra-613149fbdc8e

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Respond to D

Hi, Lauren.

Your explanation is very straightforward.

It caused me to wonder if the same method by using the shortest distance and the associated cost could be used to solve other problem types? I can see that it might be applied to identifying the most advantageous supplier to use amongst a group of suppliers to provide your business with parts or supplies.

Respond to the bold

Hi David,

I haven't encountered this problem before! The way you applied the solution to a graph in terms of transitioning between states is quite perceptive. I especially enjoyed your illustration of the states and inverse conditions.

Lauren

Then do 2 more responses (solve 2 problems).

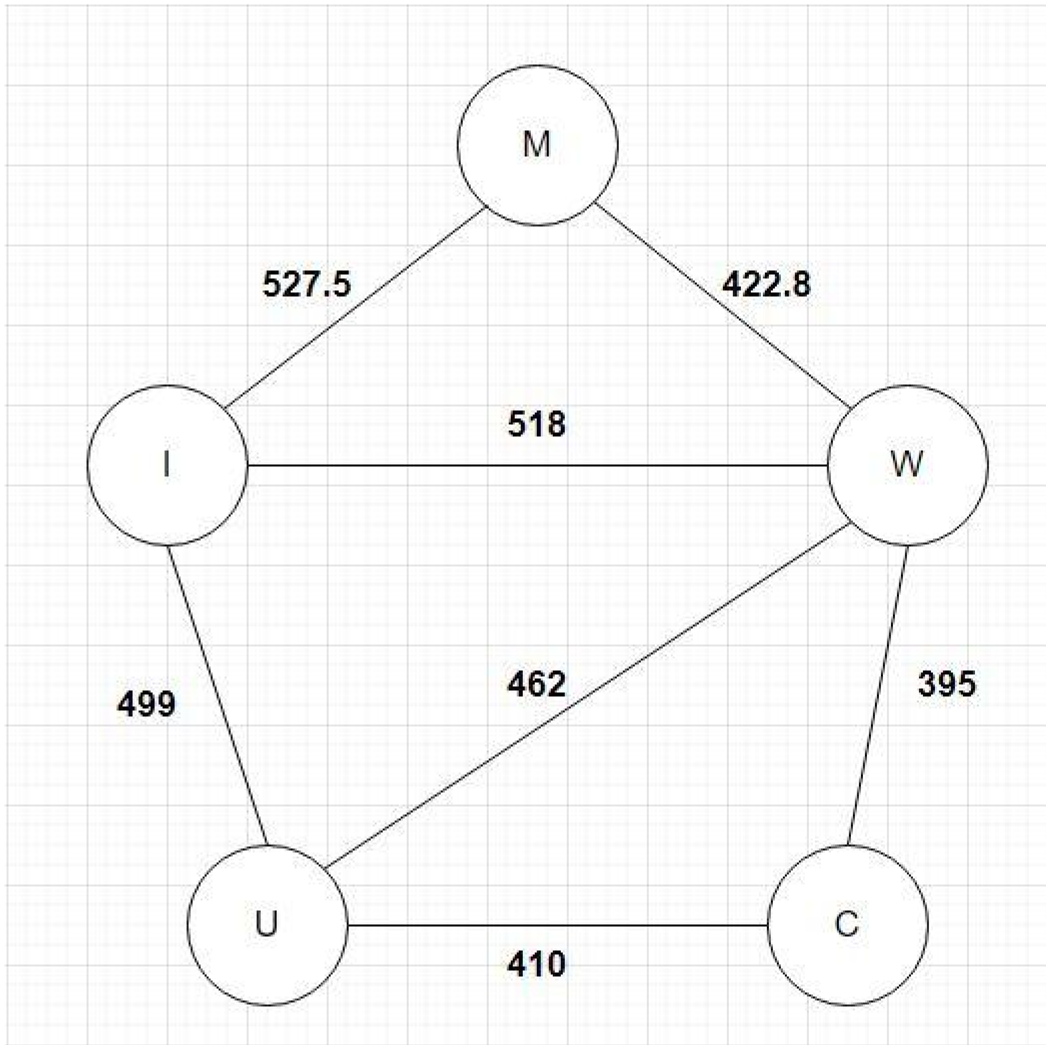
In your responses to peers, solve the problems of at least two peers, and contrast your solution method with others who have solved the same problems:

Dijkstra’s Algorithm

Solve Muataz then Tyrus with Dijstrka. Compare your method to how they solved the problem. Table helped me because etc.

Hi Muataz,

I decided to solve your problem by relying on Dijkstra’s algorithm. I modified the graph by adding weights to the edges. I selected weights based on the miles between each state capitol using Google Maps.



I started at Montana and compared the weights of its edges: Idaho (527.5) and Wyoming (422.8). The smaller weight is 422.8, so I navigate to Wyoming. Next I check the cost of the distance from Montana to each of Wyoming's neighboring vertices: Montana-Wyoming-Utah (422.8 + 462 = 884.8) and Montana-Wyoming-Colorado (422.8 + 395 = 817.8). Here I find a distance from Montana to Colorado so I update the shortest distance on record. To ensure that I have found the shortest distance, I then exhaust all other pathways to Colorado and find that the shortest path is indeed Montana-Wyoming-Colorado.

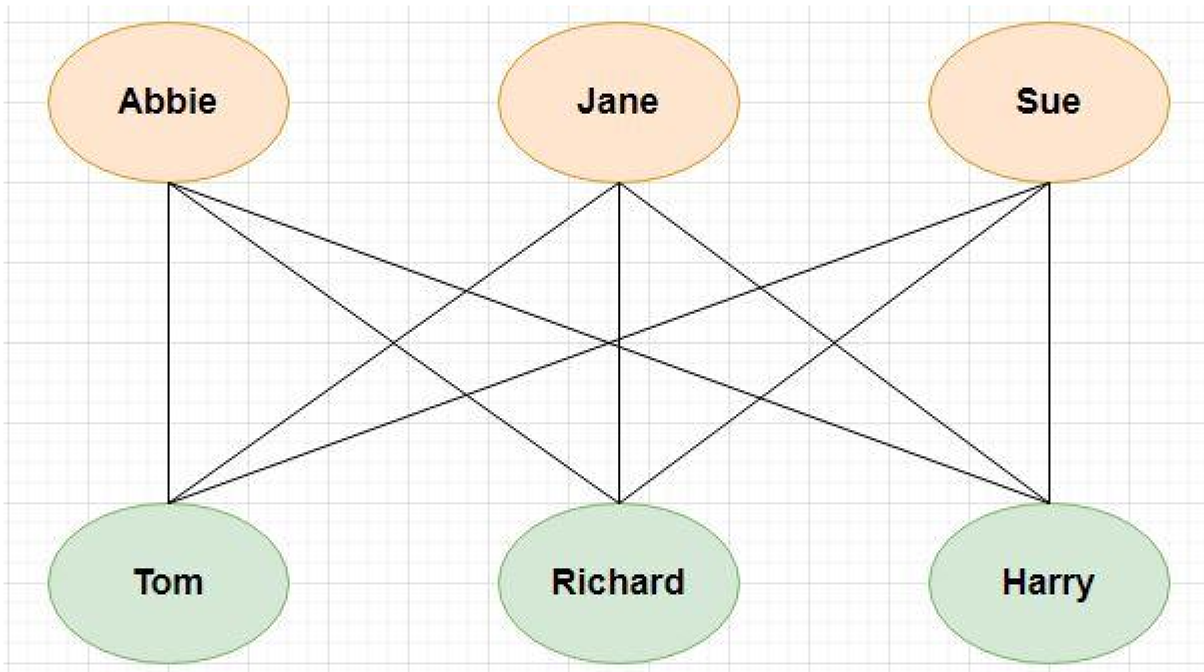
Your approach of adding an edge if a border exists is a straightforward and apt solution and also doesn't require identifying starting and ending locations of paths.

Lauren

Hi Tyrus,

I realized that your problem can be illustrated as a bipartite graph where the vertices belong to two independent sets and every edge connects a vertex in one set to the other set (Levin, 2020).

A = {Abbie, Jane, Sue} and B = {Tom, Richard, Harry} can be graphed as follows:



If we denote the vertices of set A as m and set B as n, where $m = 3$ and $n = 3$, we can calculate the number of edges as mn and thus the number of dances, 9.

Both graphs work for this problem as it requires multiplying the edges either way.

Lauren

References:

Levin, O. (2020). *Discrete Mathematics: An Open Introduction*. http://discrete.openmathbooks.org/dmoi3/frontmatter.html