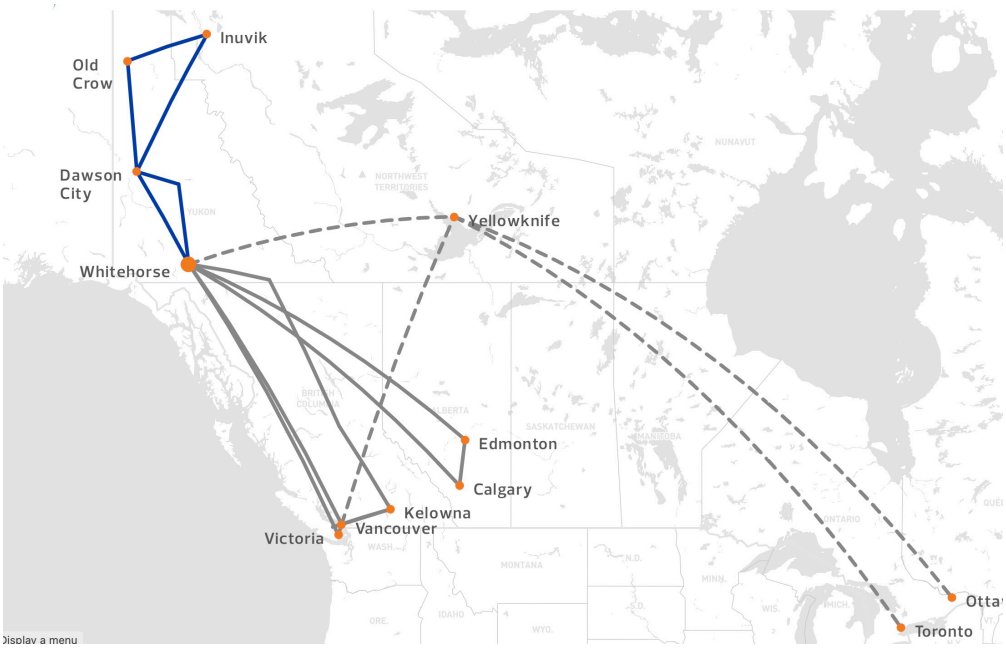
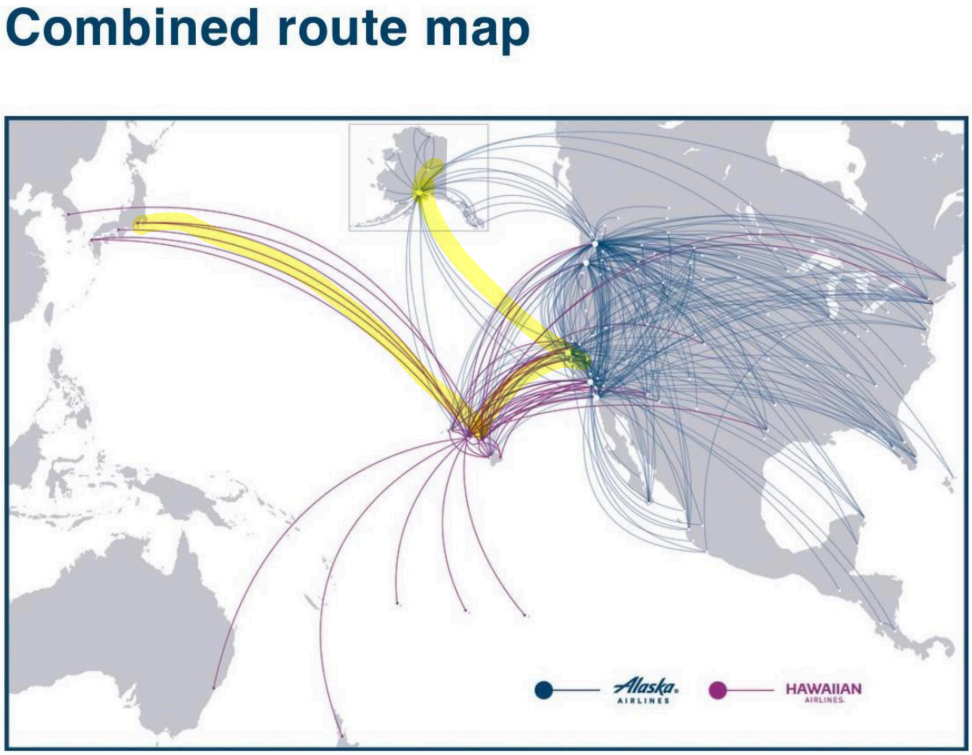
MATH F113X: Dijkstra's Algorithm

Air North Route Map



Find the shortest route from Old Crow to Victoria

Alaska and Hawaii Airlines Combined Route Math



from Fairbanks to Tokyo?

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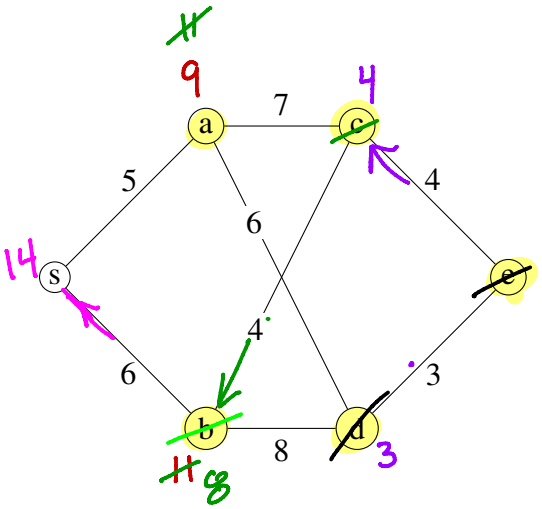
Dijkstra's Algorithm

input: a graph with distances (weights) on the edges, a starting vertex, say s and end ending vertex, say e
output: the length of the shortest path between s and e
rough strategy: Starting with the ending vertex, work your way back to the starting vertex keeping track of the shortest path **thus far.**
Steps:

1. Mark the ending vertex with a distance of zero and label it as **current**.
2. Let v be the current vertex. For every vertex w with an edge to v **that has not already been visited**, calculated the distance to e through v and mark w with this distance **unless its present distance is smaller.**** (This is called the tentative distance to e.)
3. Mark the current vertex as visited. We never look at this vertex again.
4. Identify the **un-visited** vertex with the smallest distance to e. Mark it as current and return to step 2. You know when to stop when vertex s is labeled as current.

** If you keep track of which current vertex assigns a minimum distance, you can recover the shortest path itself, not just the length.



vertex	current/ visited	**tentative** minimum distance to e	preceding vertex
s		14	b
a	c	9	d
b	e v	~~11~~ 8	~~d~~ c
c	e v	4	e
d	e v	3	e
e	e v	0	

Length of the shortest path from s to e: 14

Find the shortest path from s to e **using the last column in the table.**

s b c e

FYI: s a d e also has length 14 ... but it's not given by the algorithm.

Think of another application of Dijkstra's Algorithm. It must include: vertices, weights of edges, and the meaning of a ~~minimum weight spanning tree~~. shortest path.

Vertices: actors
edges: between actors if they have been in the same movie.
shortest path: Kevin Bacon index.