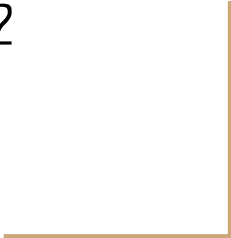# Programming, Problem Solving, and Algorithms

CPSC203, 2023 W2
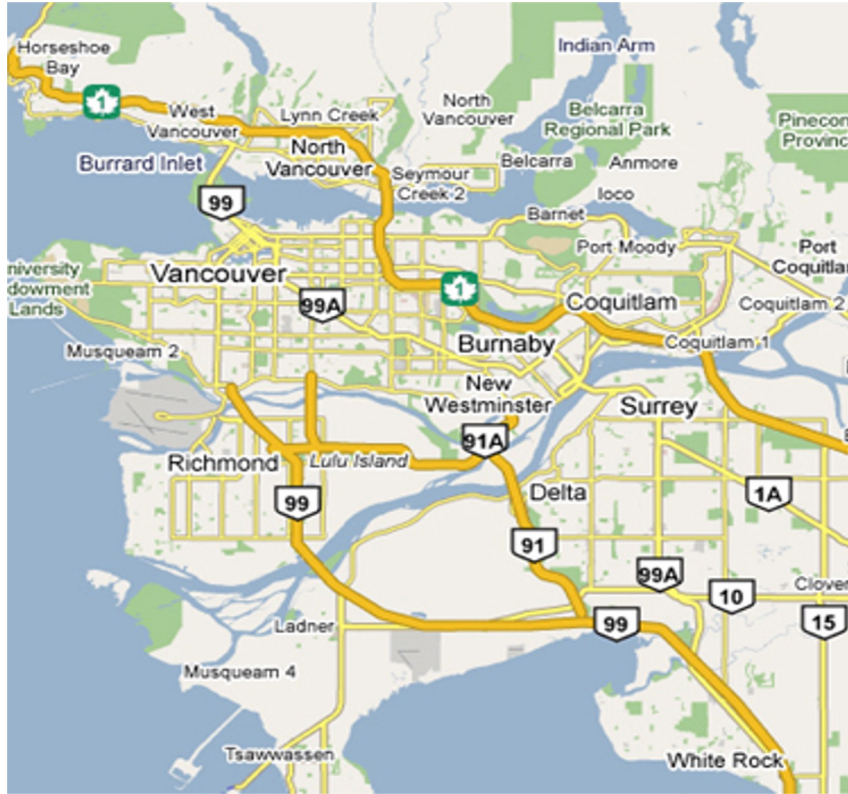
Announcements

- TBD

Today's Plan...

1. Announcements! (10 mins)

2. Weekly Videos Review/Questions (20 mins)

3. Single Source Shortest Path (40 mins)

# Slides from the Assigned Videos

Single Source Shortest Path

Given a start vertex (source) s, find the path of least total cost from s to every vertex in the graph.
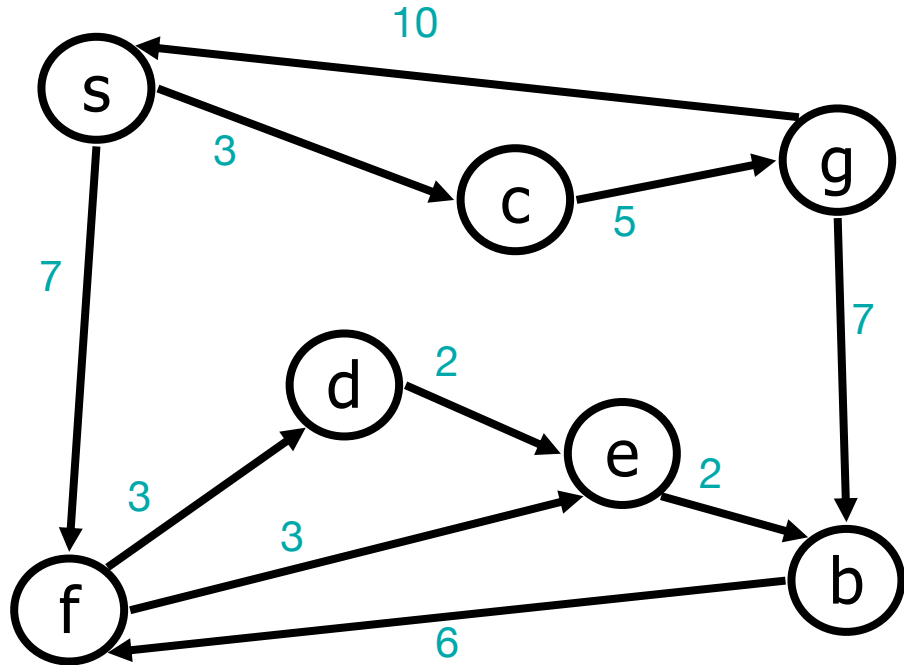
Single Source Shortest Path

Input: directed graph G with non-negative edge weights, and a start vertex s.

Output: A subgraph G' consisting of the shortest (minimum total cost) paths from s to every other vertex in the graph.
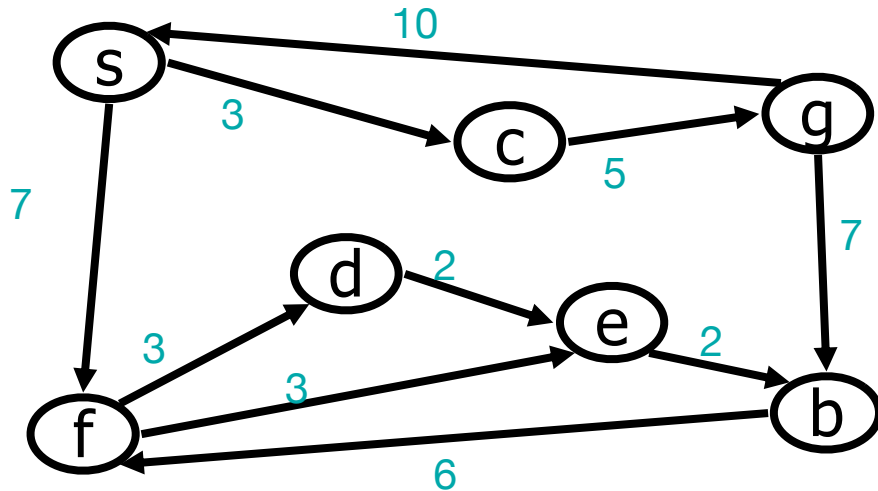
Dijkstra's Algorithm (1959)

Single Source Shortest Path

Given a source vertex s, we wish to find the shortest path from s to every other vertex in the graph.

Initialize structure:

Repeat these steps:

1. Label a new (unlabelled) vertex v, whose shortest distance has been found

2. Update v's neighbors with an improved distance

Single Source Shortest Path

Initialize structure:

1. For all v, d[v] = "infinity", p[v] = null

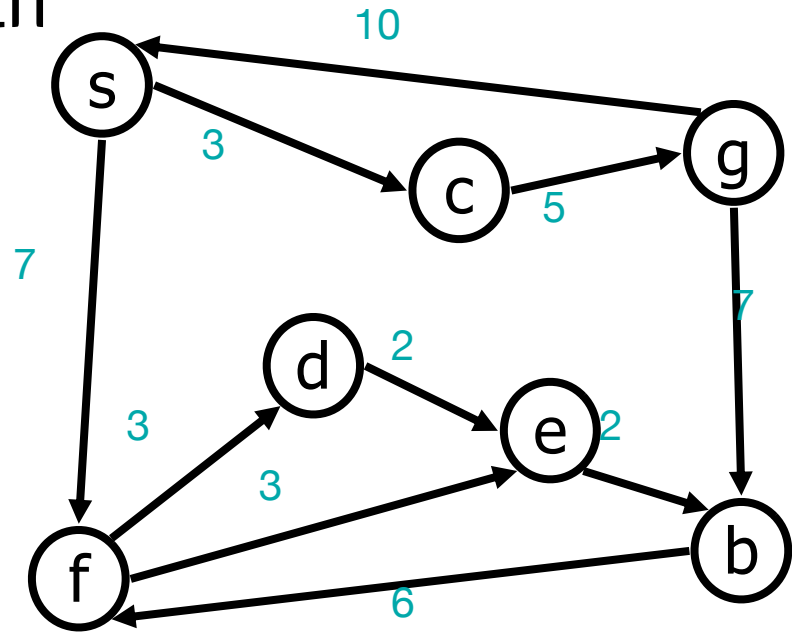2. Initialize source: d[s] = 0

3. Initialize priority (min) queue

Repeat these steps n times:

- Find minimum d[] unlabelled vertex: v

- Label vertex v

- For all unlabelled neighbors w of v,

    If (_____ < d[w])
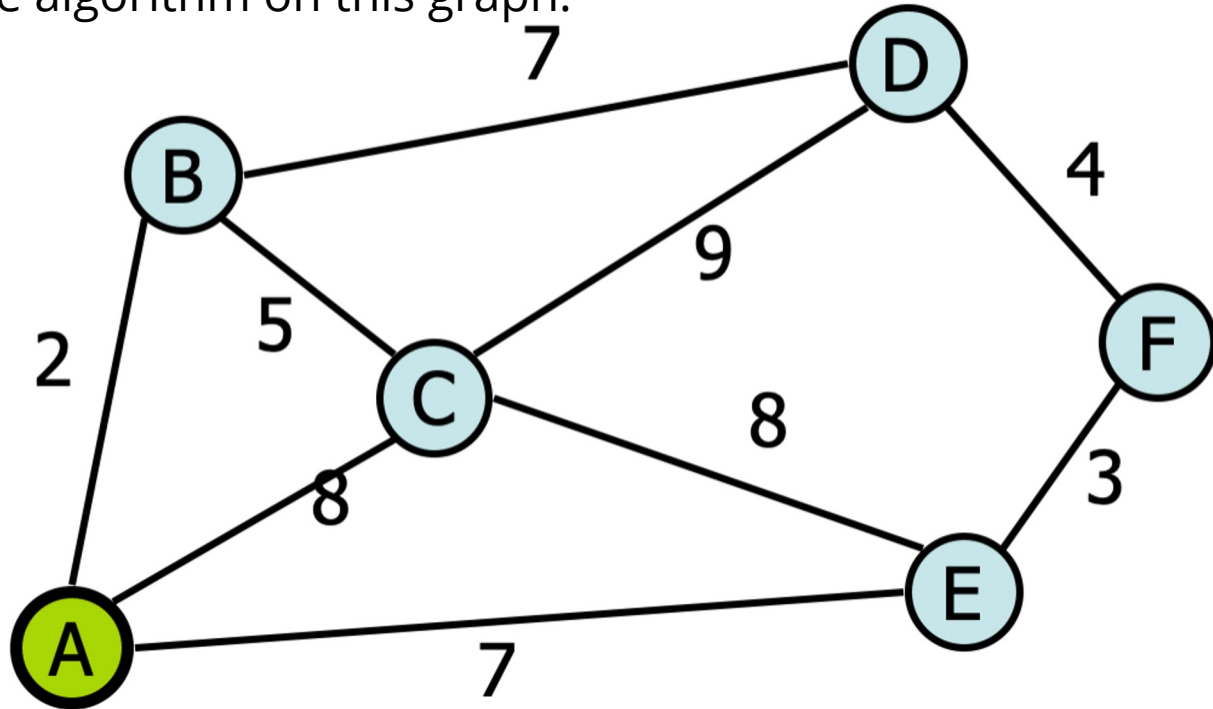
        d[w] = _____

        p[w] = v

Your Turn...

Execute the algorithm on this graph:

Dijkstra's Algorithm

How is this algorithm similar to BFS/DFS?

_____

_____

How is this algorithm different from BFS/DFS?

_____

_____

Initialize structure:

1. For all v, d[v] = "infinity", p[v] = null
2. Initialize source: d[s] = 0
3. Initialize priority (min) queue
4. Initialize set of labeled vertices to Ø.

Repeat these steps n times:

- Find & remove minimum d[] unlabelled vertex: v

- Label vertex v

- For all unlabelled neighbors w of v,

    If cost(v,w) < d[w]

        d[w] = cost(v,w)

        p[w] = v

Resources…

REALLY great example: https://www.youtube.com/watch?v=wsSEKm-rU6U

OSMNX reference: https://github.com/gboeing/osmnx-examples/tree/master/notebooks

Tutorial:
https://gist.github.com/psychemedia/b49c49da365666ba9199d2e27d002d07