

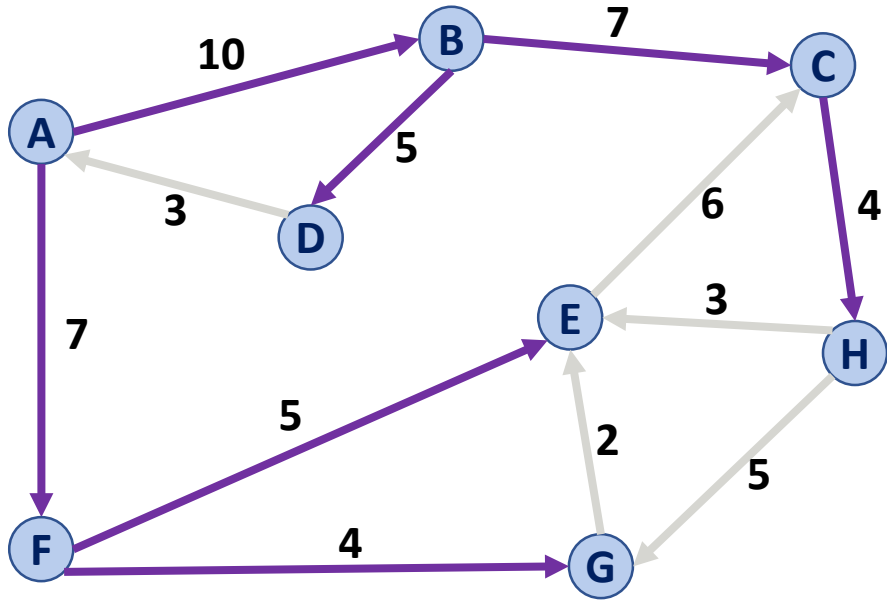
CS 225

Data Structures

December 7 – Dijkstra's Algorithm Analysis

Wade Fagen-Ulmschneider

Dijkstra's Algorithm (SSSP)

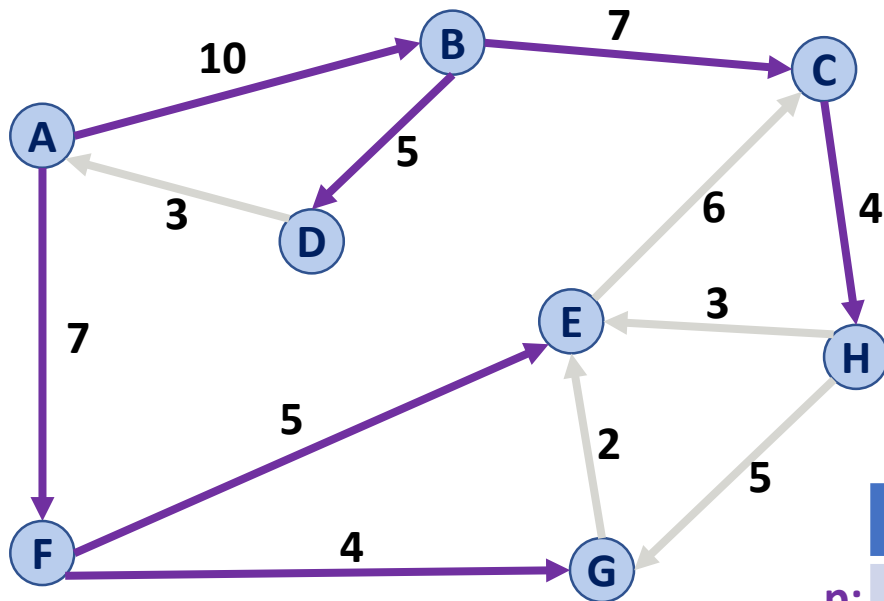


```
DijkstraSSSP(G, s):
```

```
6  foreach (Vertex v : G):
7    d[v] = +inf
8    p[v] = NULL
9  d[s] = 0
10
11  PriorityQueue Q // min distance, defined by d[v]
12  Q.buildHeap(G.vertices())
13  Graph T        // "labeled set"
14
15  repeat n times:
16    Vertex u = Q.removeMin()
17    T.add(u)
18    foreach (Vertex v : neighbors of u not in T):
19      if cost(u, v) + d[u] < d[v]:
20        d[v] = cost(u, v) + d[u]
21        p[v] = u
```

Dijkstra's Algorithm (SSSP)

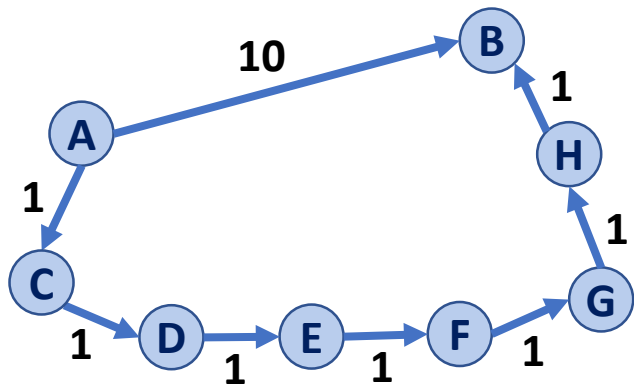
Dijkstra gives us the shortest path from our path (single source) to **every** connected vertex!



	A	B	C	D	E	F	G	H
p:	--	A	B	B	F	A	F	C
d:	0	10	17	15	12	7	11	21

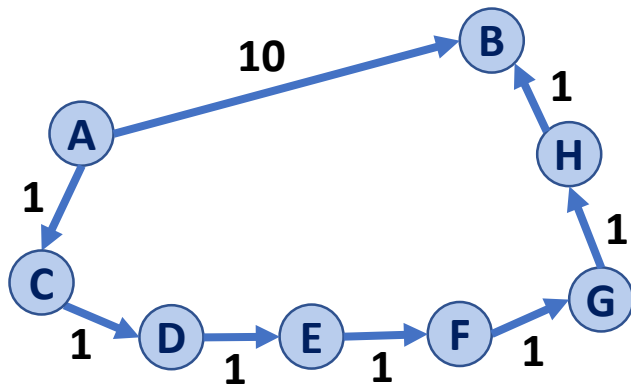
Dijkstra's Algorithm (SSSP)

Q: How does Dijkstra handle a single heavy-weight path vs. many light-weight paths?



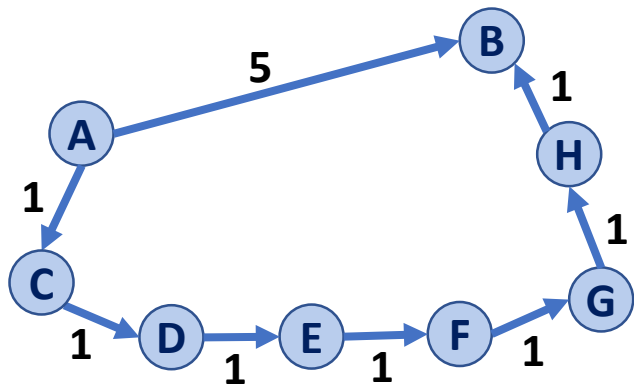
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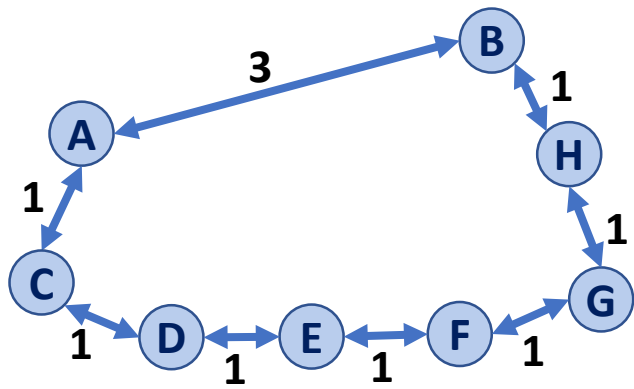
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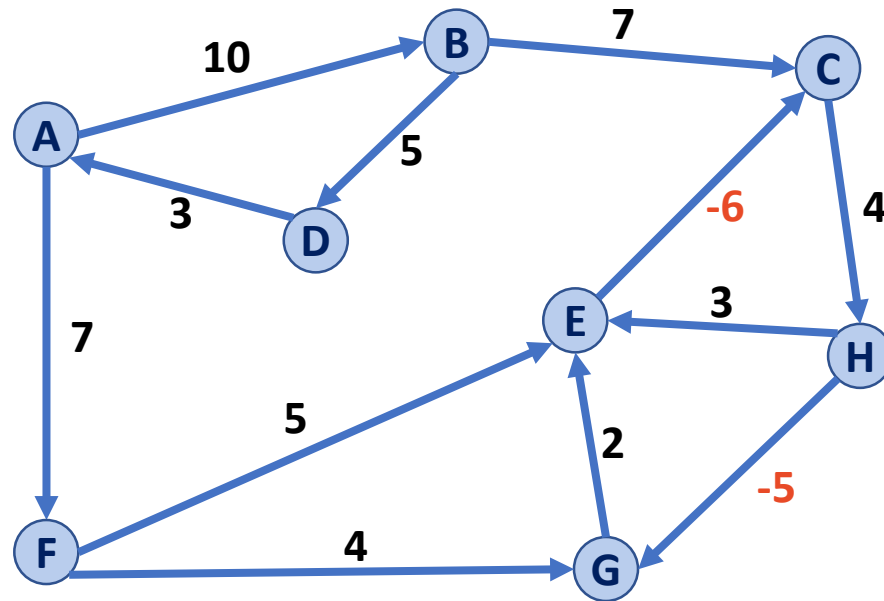
Dijkstra's Algorithm (SSSP)

Q: How does Dijkstra handle undirected graphs?



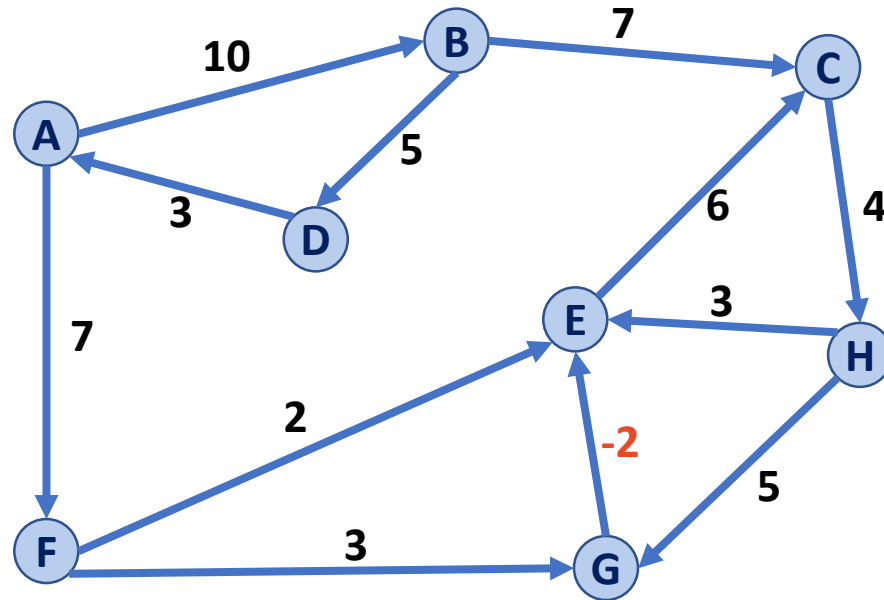
Dijkstra's Algorithm (SSSP)

Q: How does Dijkstra handle negative weight cycles?



Dijkstra's Algorithm (SSSP)

Q: How does Dijkstra handle negative weight edges, without a negative weight cycle?



Dijkstra's Algorithm (SSSP)

What is Dijkstra's running time?

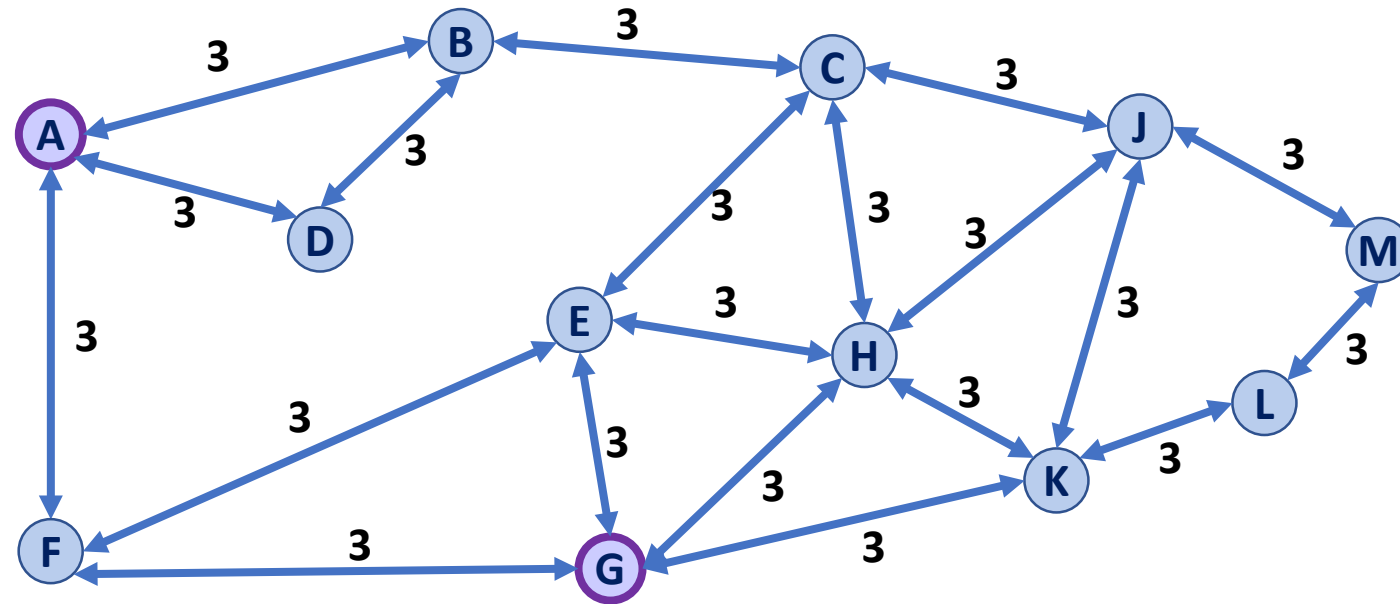
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16      Vertex u = Q.removeMin()
17      T.add(u)
18      foreach (Vertex v : neighbors of u not in T):
19          if cost(u, v) + d[u] < d[v]:
20              d[v] = cost(u, v) + d[u]
21              p[v] = m
22
23  return T
```

Landmark Path Problem

Suppose you want to travel from **A** to **G**.

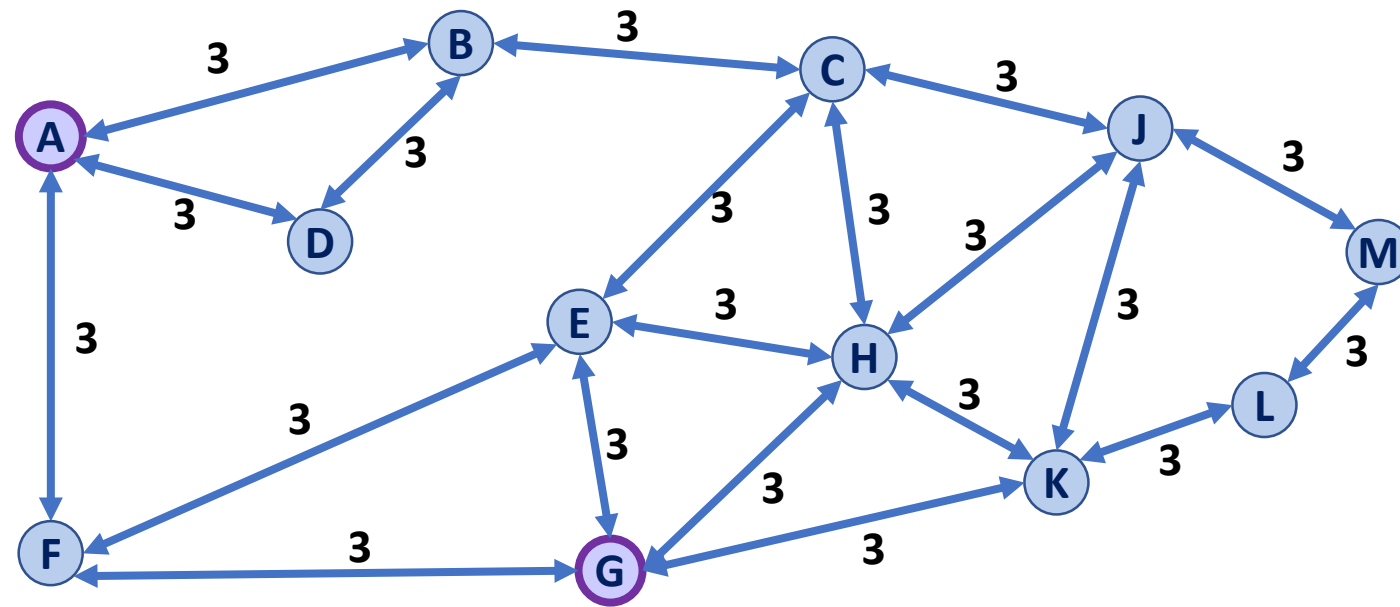
Q1: What is the shortest path from **A** to **G**?



Landmark Path Problem

Suppose you want to travel from **A** to **G**.

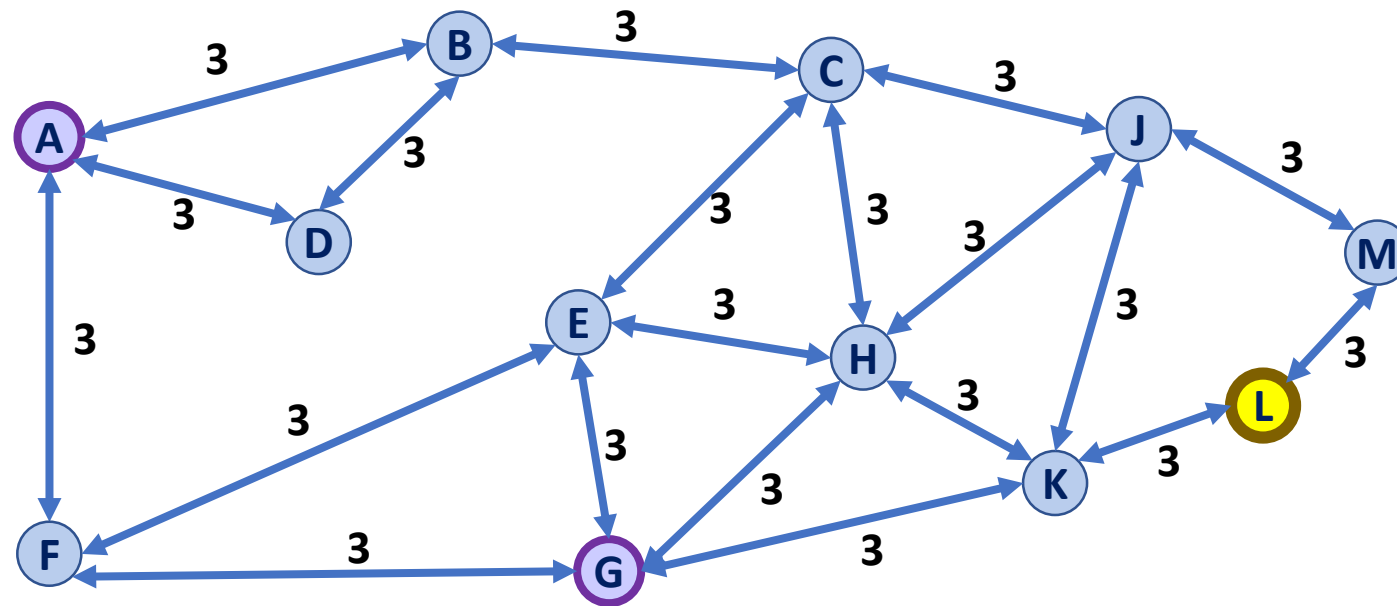
Q2: What is the fastest algorithm to use to find the shortest path?



Landmark Path Problem

In your journey between **A** and **G**, you also want to visit the landmark **L**.

Q3: What is the shortest path from **A** to **G** that visits **L**?

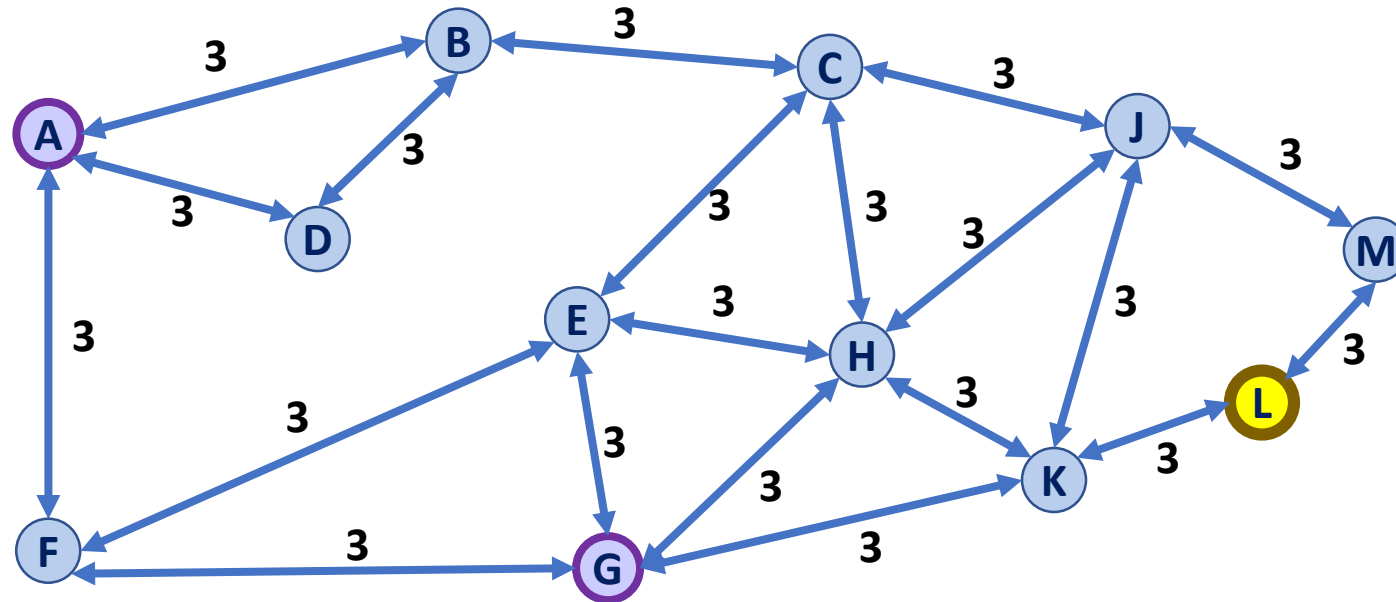


Landmark Path Problem

In your journey between **A** and **G**, you also want to visit the landmark **L**.

Q4: What is the fastest algorithm to find this path?

Q5: What are the specific call(s) to this algorithm?





ICES

Thank you for an amazing semester!