

Computer Networks

Computing Shortest Paths with Dijkstra (§5.2.2)



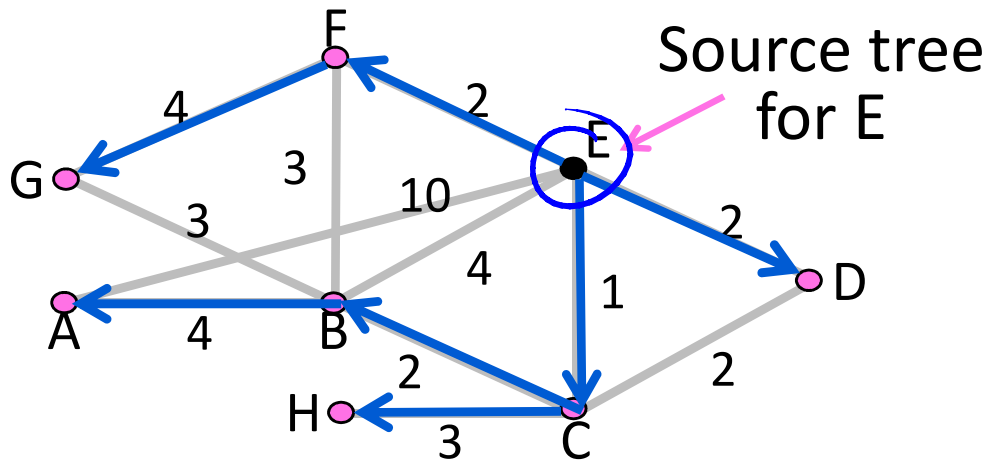
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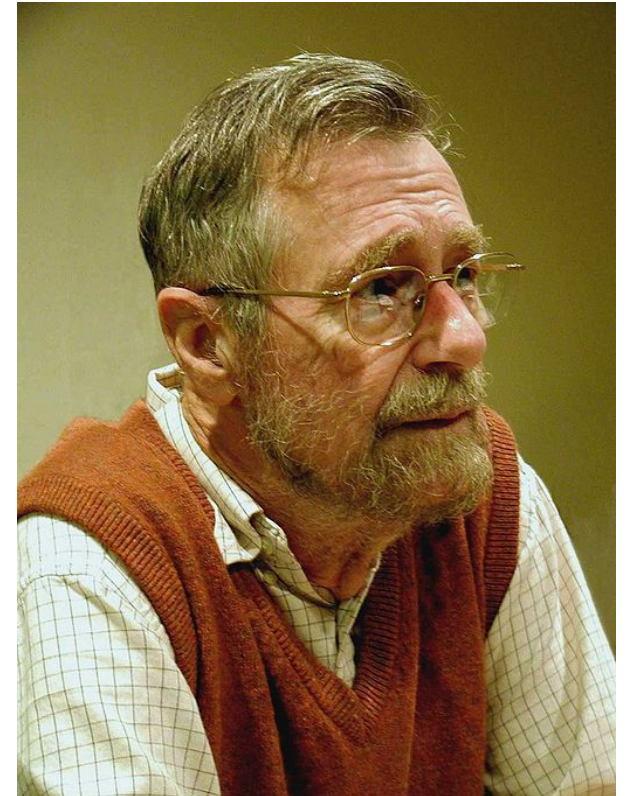
Topic

- How to compute shortest paths given the network topology
 - With Dijkstra's algorithm



Edsger W. Dijkstra (1930-2002)

- Famous computer scientist
 - Programming languages
 - Distributed algorithms
 - Program verification
- Dijkstra's algorithm, 1959
 - Single-source shortest paths, given network with non-negative link costs



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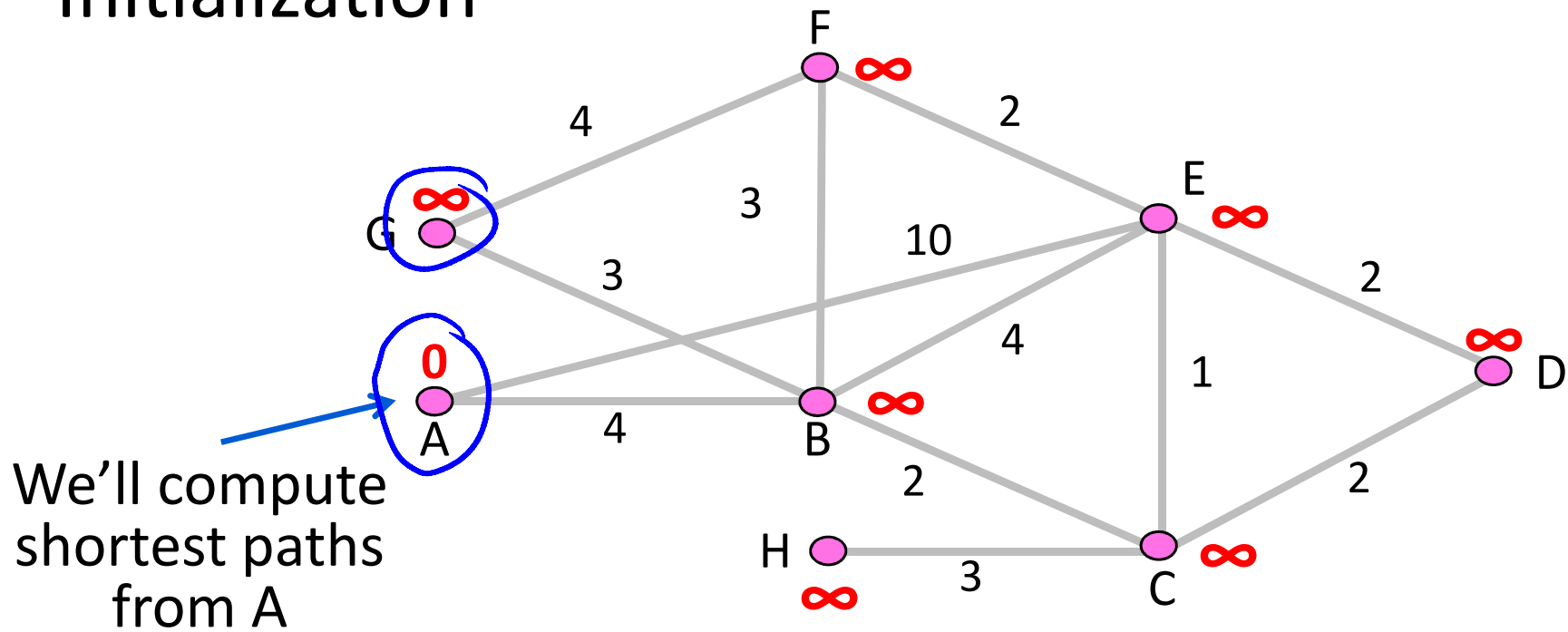
Dijkstra's Algorithm

Algorithm:

- ~~✗~~ Mark all nodes tentative, set distances from source to 0 (zero) for source, and ∞ (infinity) for all other nodes
- ~~✗~~ While tentative nodes remain:
 - Extract N, a node with lowest distance
 - Add link to N to the shortest path tree
 - Relax the distances of neighbors of N by lowering any better distance estimates

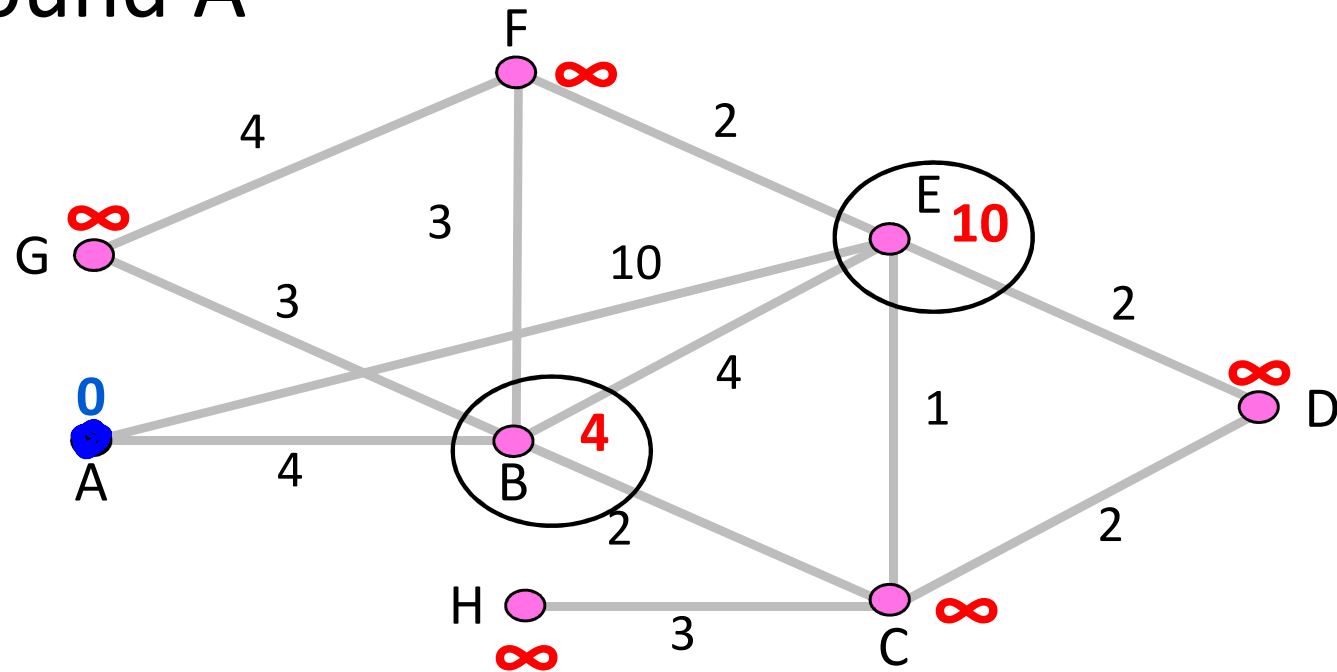
Dijkstra's Algorithm (2)

- Initialization



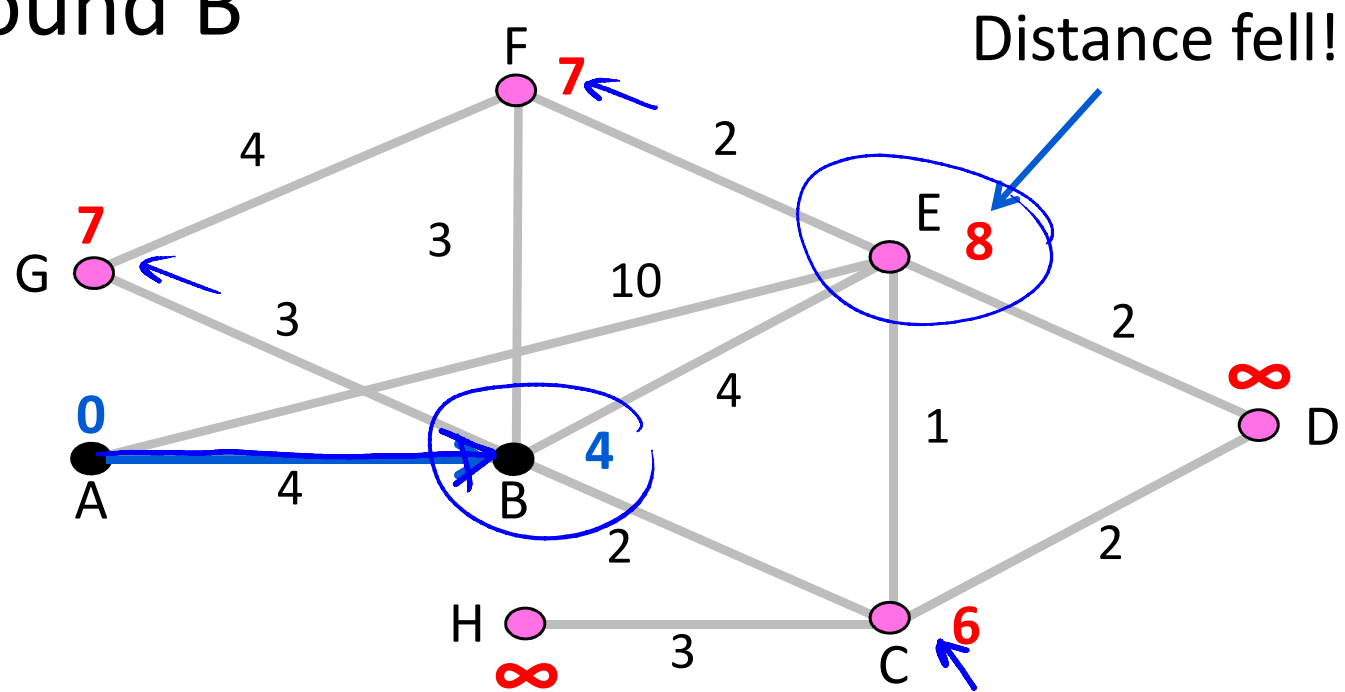
Dijkstra's Algorithm (3)

- Relax around A



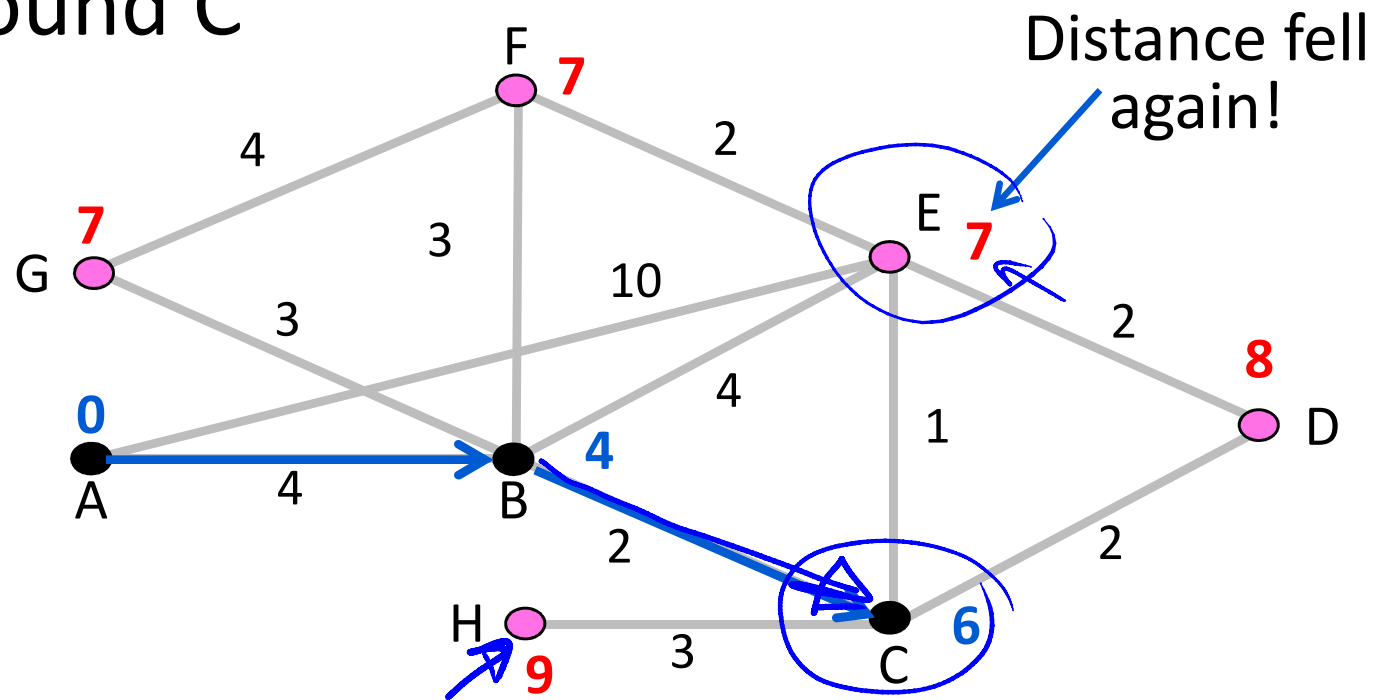
Dijkstra's Algorithm (4)

- Relax around B



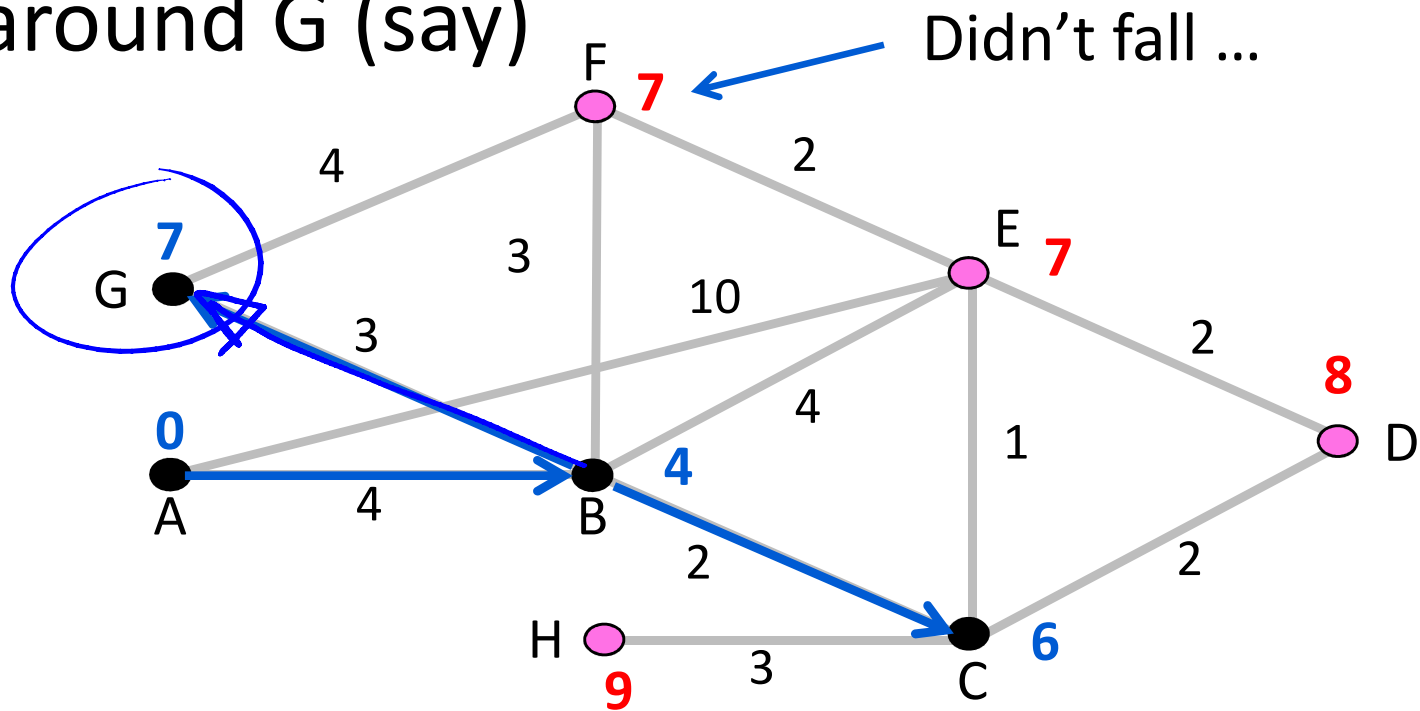
Dijkstra's Algorithm (5)

- Relax around C



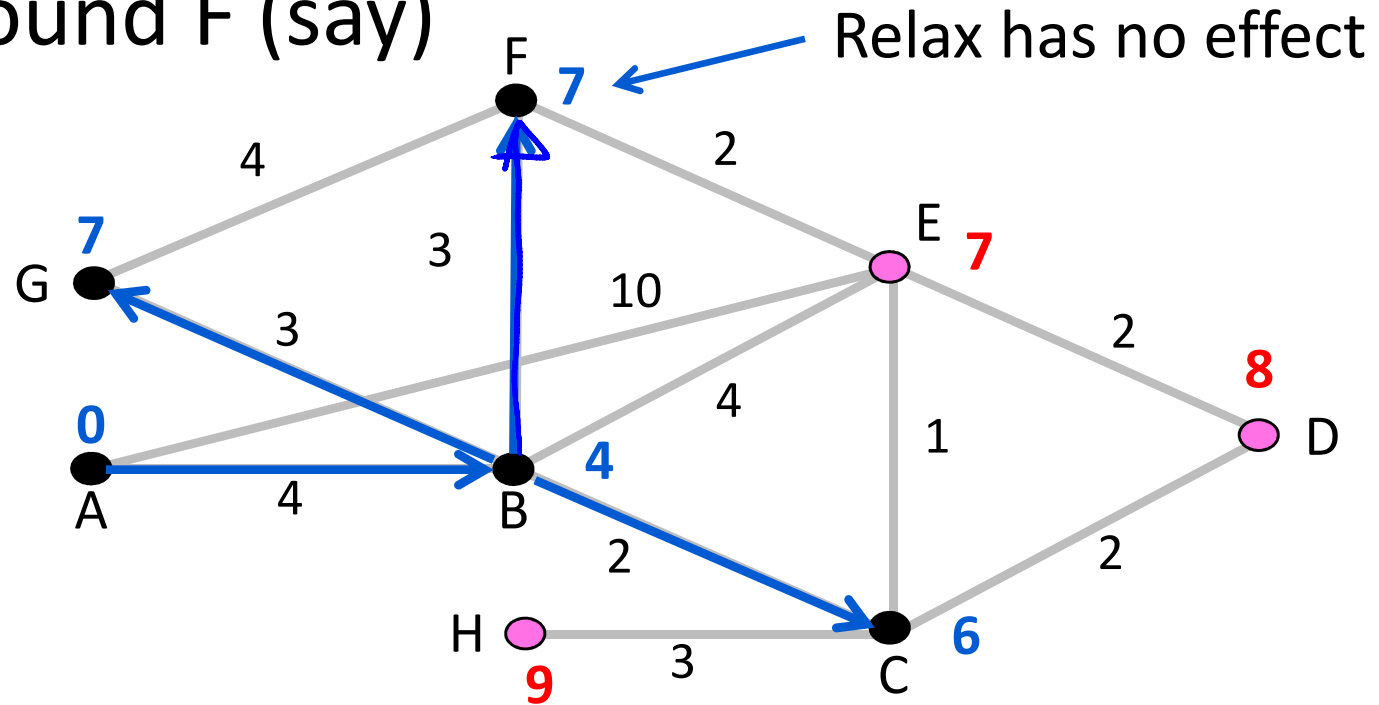
Dijkstra's Algorithm (6)

- Relax around G (say)



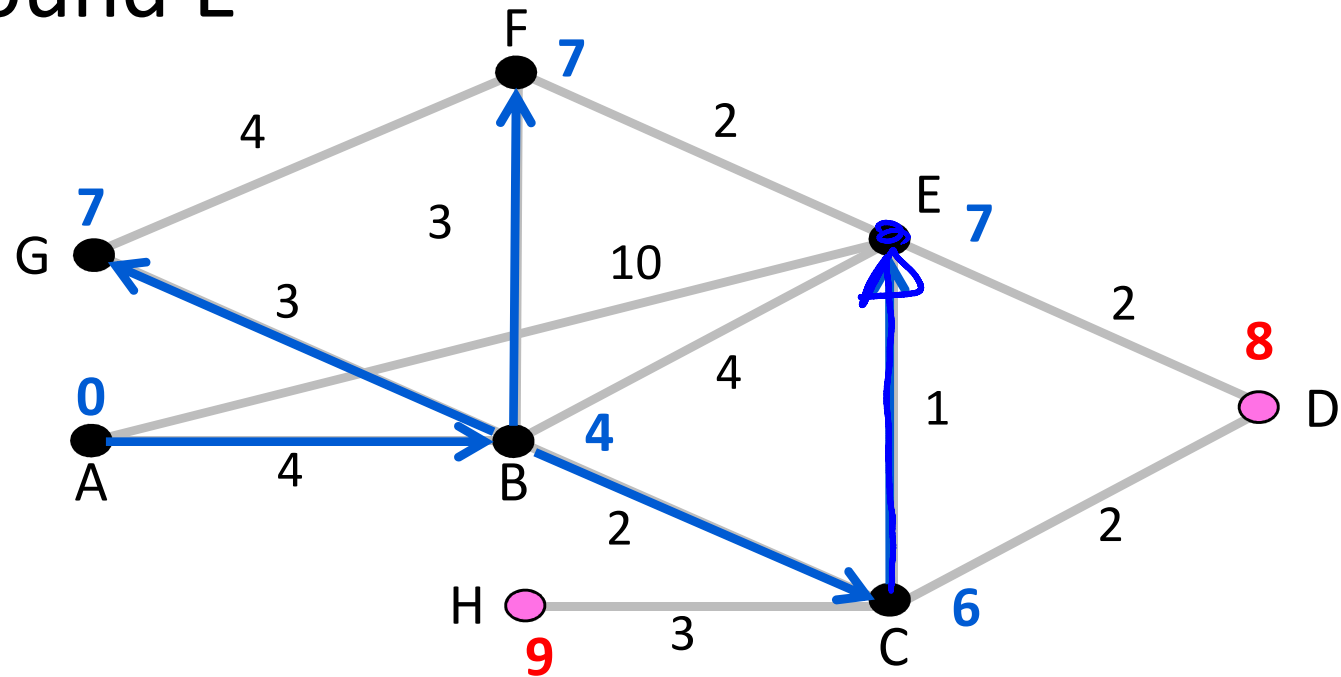
Dijkstra's Algorithm (7)

- Relax around F (say)



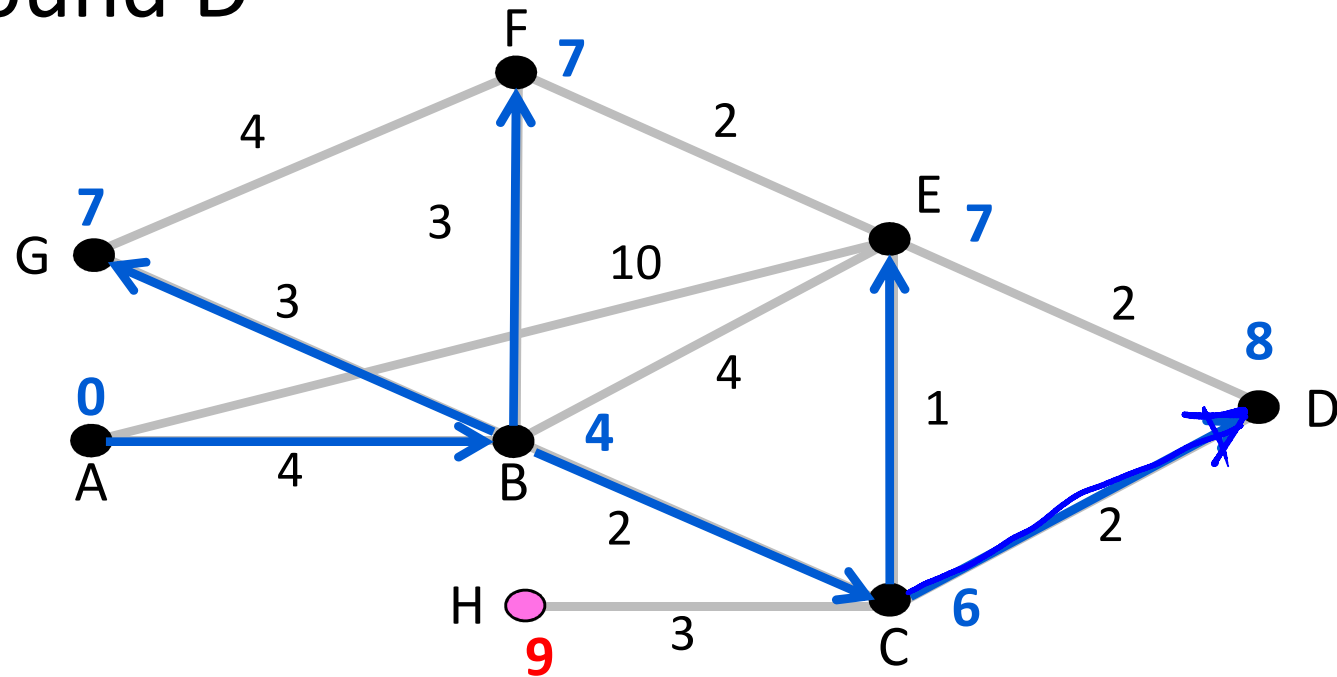
Dijkstra's Algorithm (8)

- Relax around E



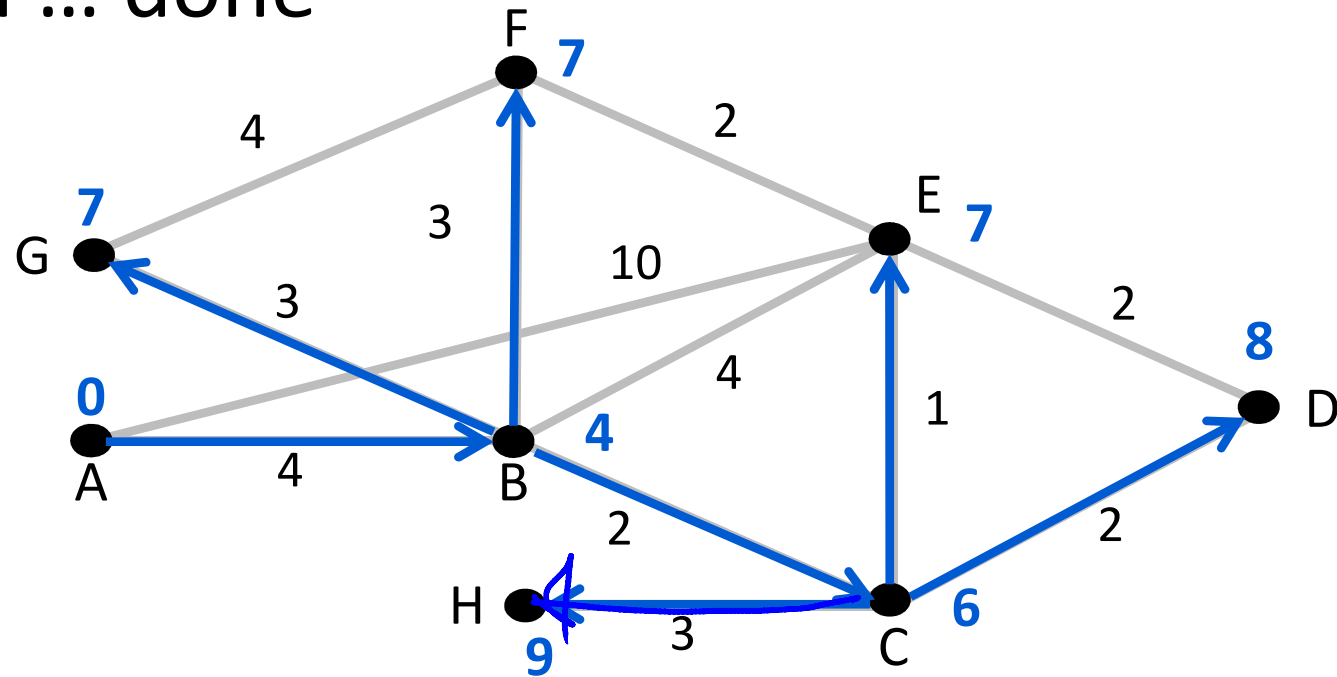
Dijkstra's Algorithm (9)

- Relax around D



Dijkstra's Algorithm (10)

- Finally, H ... done



Dijkstra Comments

- Finds shortest paths in order of increasing distance from source
 - Leverages optimality property
- Runtime depends on efficiency of extracting min-cost node
 - Superlinear in network size (grows fast)
- Gives complete source/sink tree
 - More than needed for forwarding!
 - But requires complete topology

END

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