Introduction to Computer Networks

Shortest Path Routing

(§5.2.1-5.2.2)

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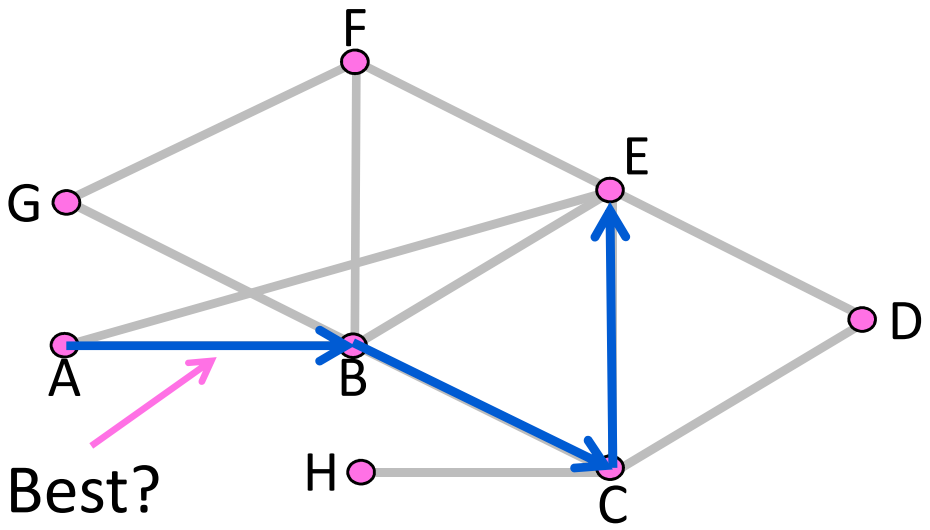
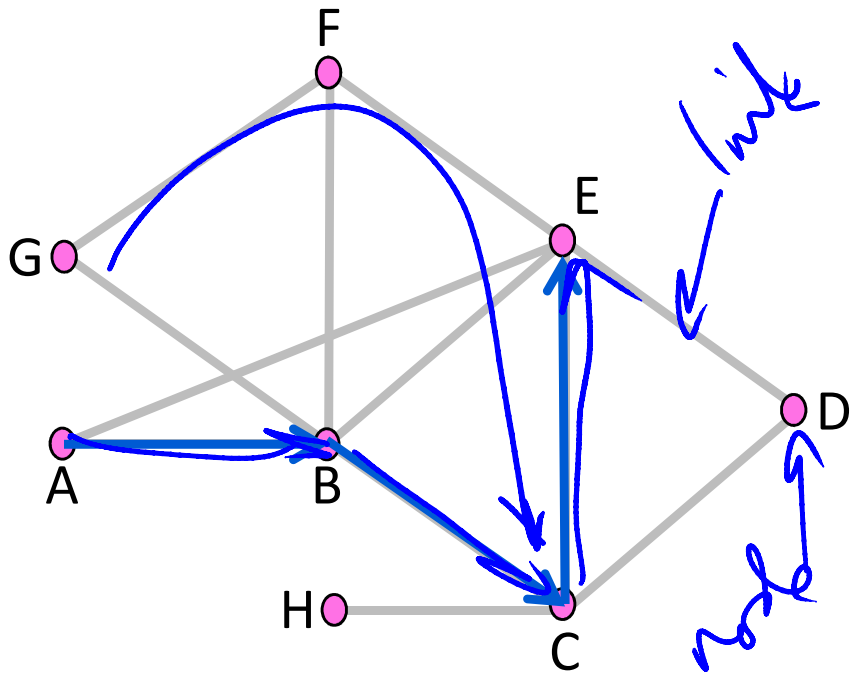
Topic

- Defining “best” paths with link costs
  - These are shortest path routes



What are "Best" paths anyhow?

- Many possibilities:
  - Latency, avoid circuitous paths
  - Bandwidth, avoid slow links
  - Money, avoid expensive links
  - Hops, to reduce switching
- But only consider topology
  - Ignore workload, e.g., hotspots



Shortest Paths

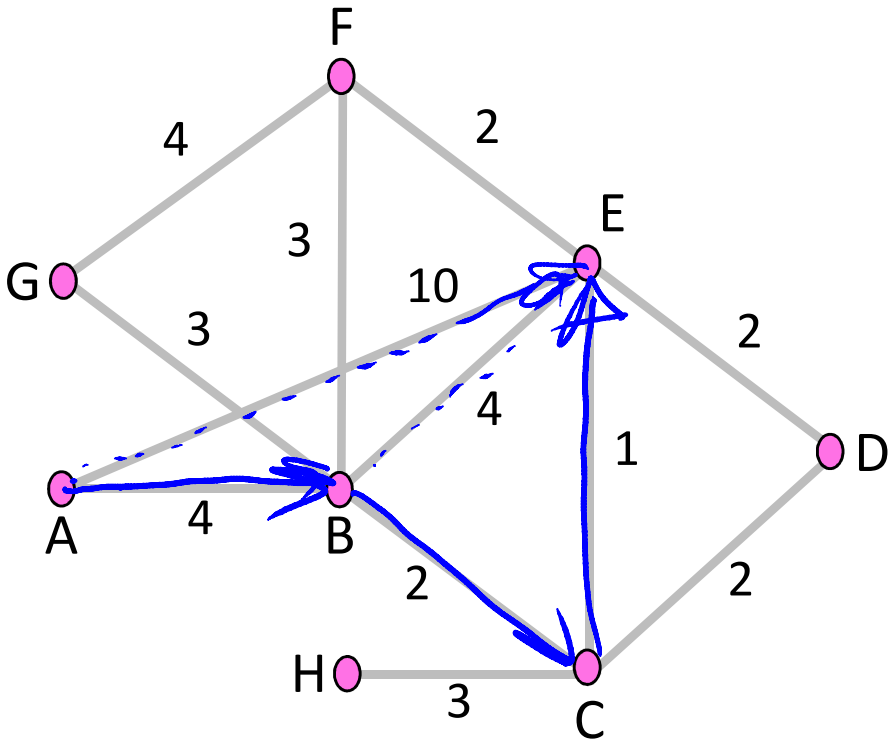
We'll approximate "best" by a cost function that captures the factors

- Often call lowest "shortest"

1. Assign each link a cost (distance)
2. Define best path between each pair of nodes as the path that has the lowest total cost (or is shortest)
3. Pick randomly to any break ties

Shortest Paths (2)

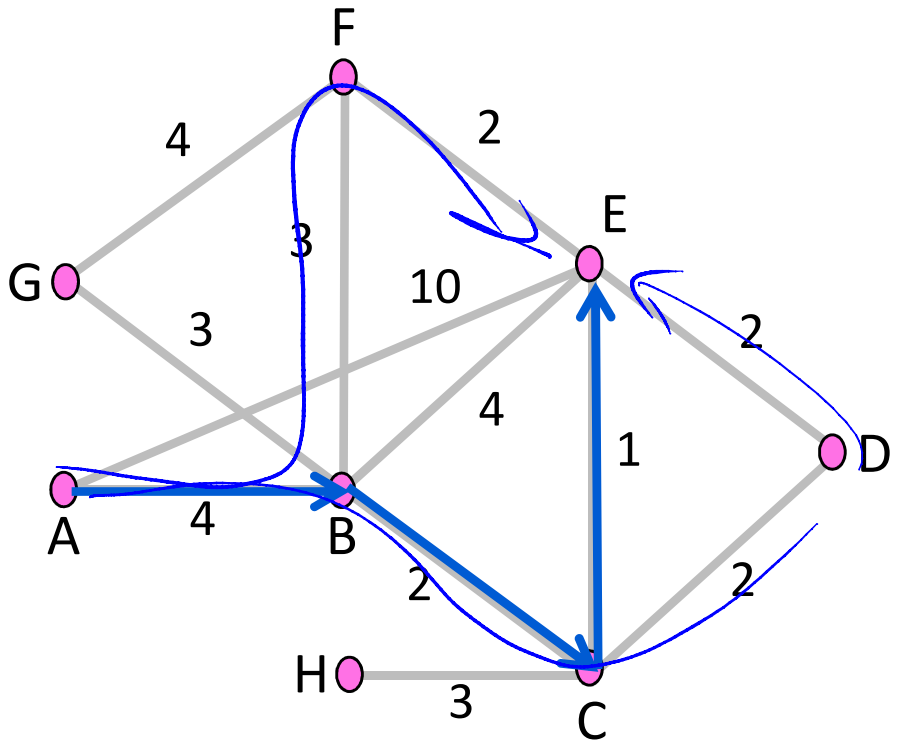
- Find the shortest path A → E
- All links are bidirectional, with equal costs in each direction
  - Can extend model to unequal costs if needed



Shortest Paths (3)

- ABCE is a shortest path
- dist(ABCE) = 4 + 2 + 1 = 7

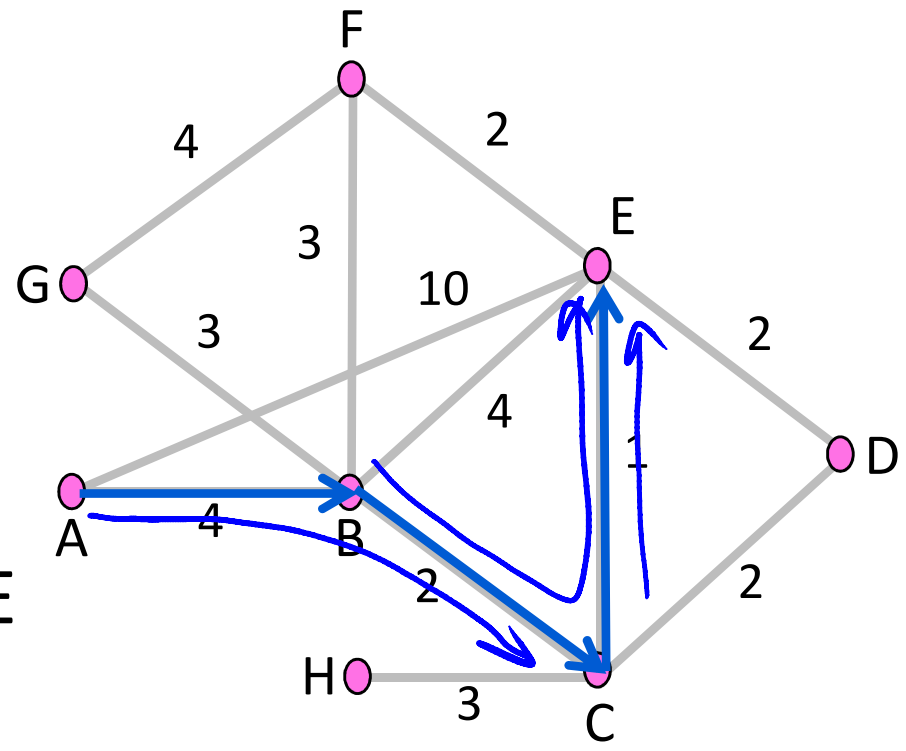
- This is less than:
  - dist(ABE) = 8
  - dist(ABFE) = 9
  - dist(AE) = 10
  - dist(ABCDE) = 10



Shortest Paths (4)

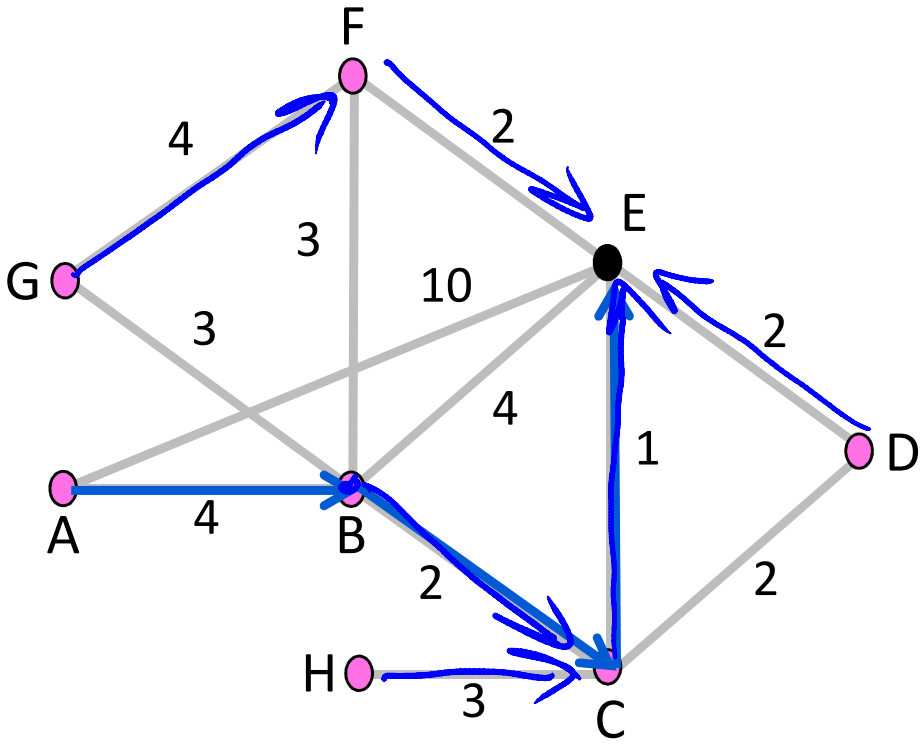
- Optimality property:
  - Subpaths of shortest paths are also shortest paths
- ABCE is a shortest path

→So are ABC, AB, BCE, BC, CE



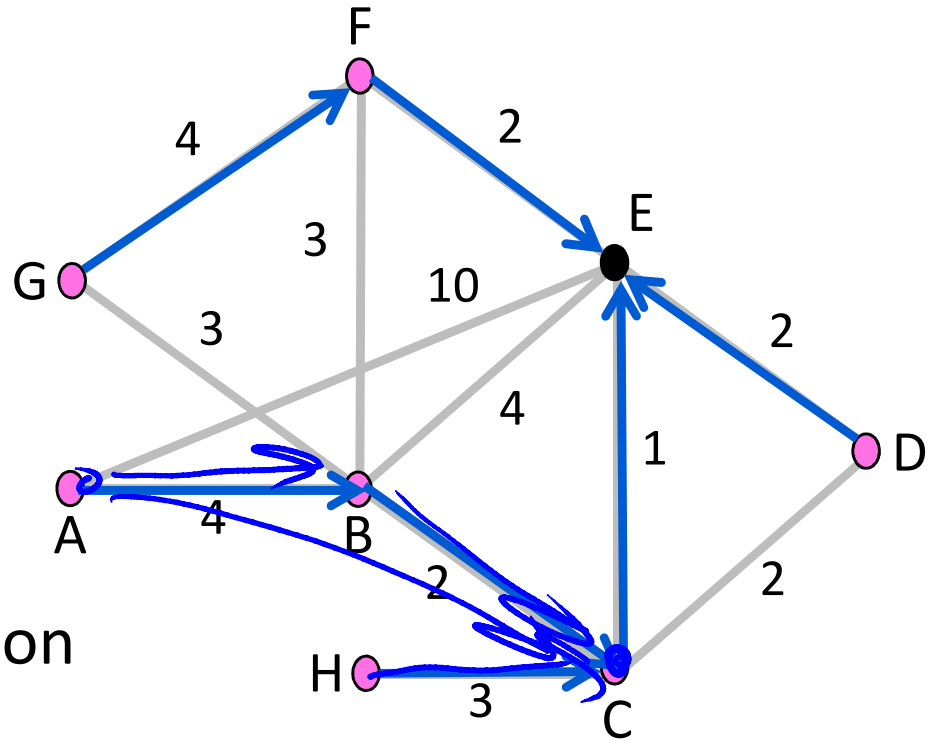
Sink Trees

- Sink tree for a destination is the union of all shortest paths towards the destination
  - Similarly source tree
- Find the sink tree for E



Sink Trees (2)

- Implications:
  - Only need to use destination to follow shortest paths
  - Each node only need to send to the next hop



- Forwarding table at a node
  - Lists next hop for each destination
  - Routing table may know more

END