Basics of Routing and Link-State Routing

Antonio Carzaniga

Faculty of Informatics
University of Lugano

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Outline

- Routing problem
- Graph model
- Classes of routing algorithms
- Broadcast routing
- Link-state routing
- Dijkstra's algorithm

Routing Problem

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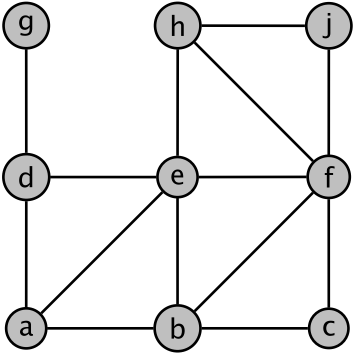

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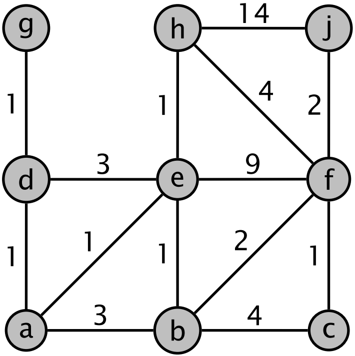

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  - A *cost* function $c : E \to \mathbb{R}$
    - costs are always positive: $c(e) > 0$ for all $e \in E$
    - links are symmetric: $c(u, v) = c(v, u)$ for all $u, v \in N$

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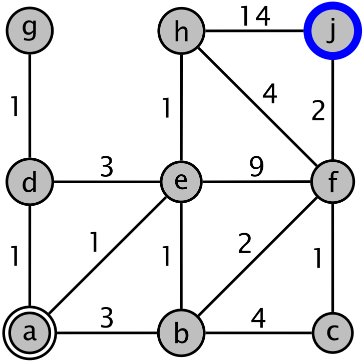
- Compile u's forwarding table by adding the following entry:

$$A(v) \to I_u(x_1)$$

  - $A(v)$ is the address (or set of addresses) of router v
  - $I_u(x_1)$ is the interface that connects u to the first next-hop router x_1 in $P_{u \to v} = u, x_1, x_2, \ldots, x_n, v$

Back To The Example



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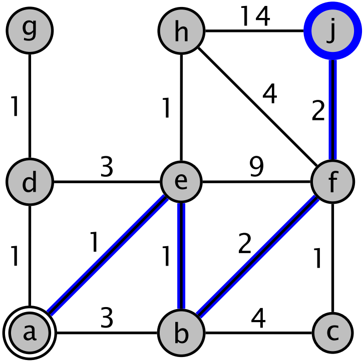

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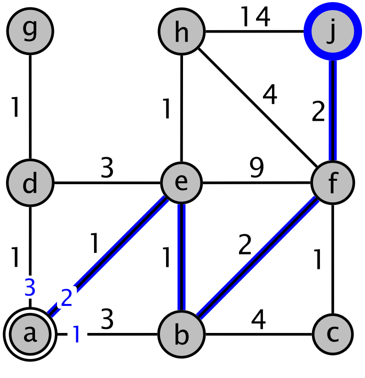

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  - least-cost path is $P_{a \to j} = a, e, b, f, j$
  - a's forwarding table will contain an entry $\boxed{j \to 2}$ since $I_a(e) = 2$

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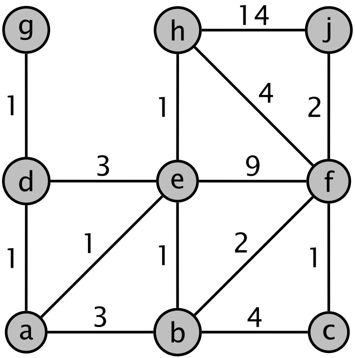
Link-State Advertisements



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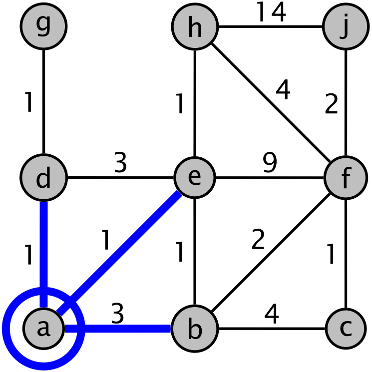

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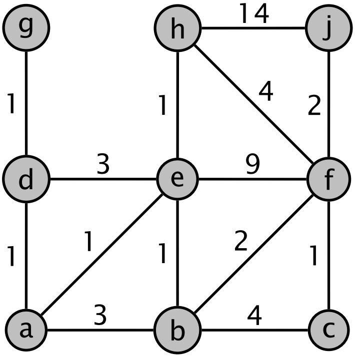

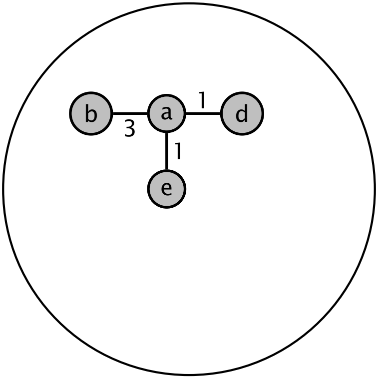

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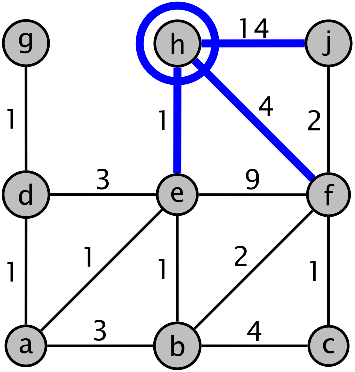

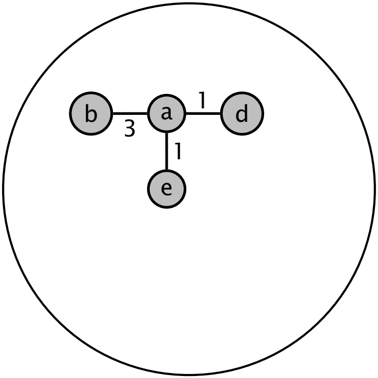

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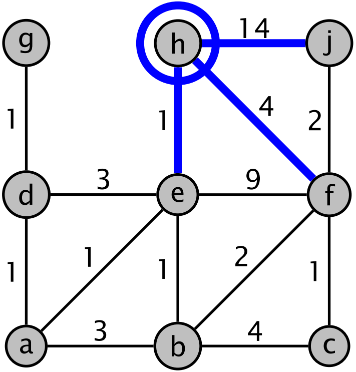

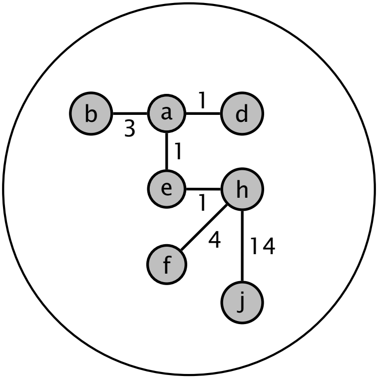

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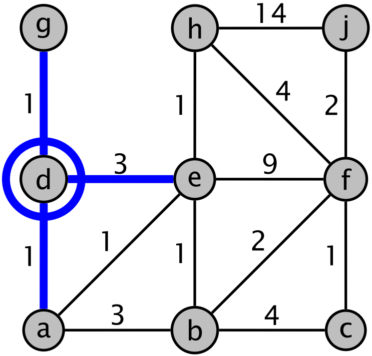

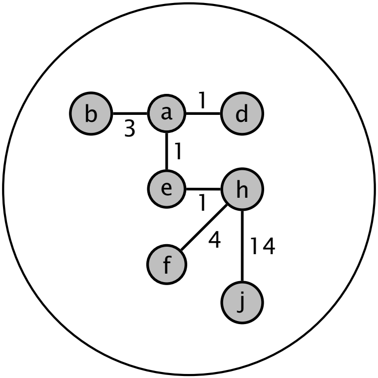

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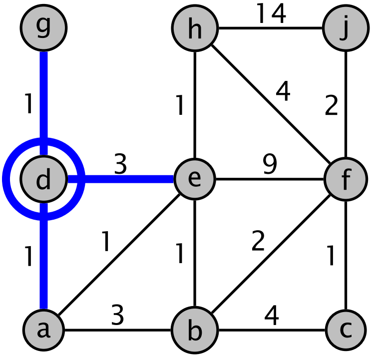

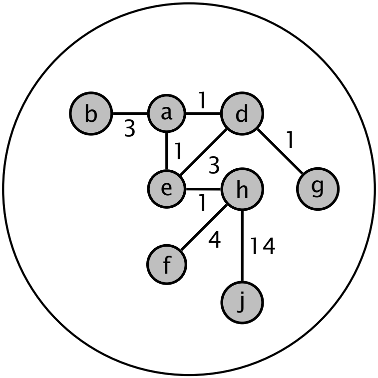

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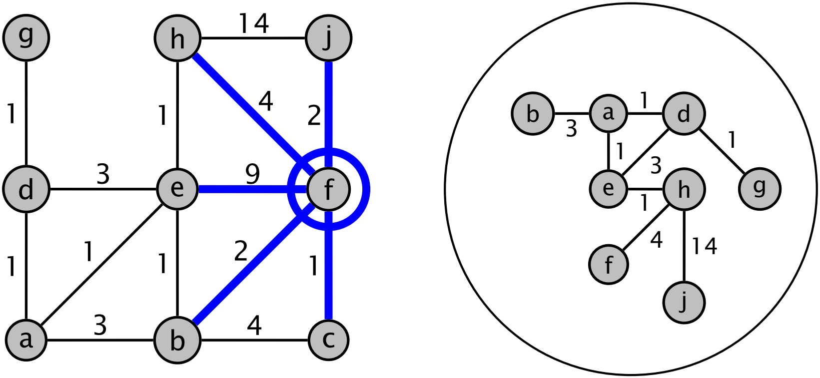

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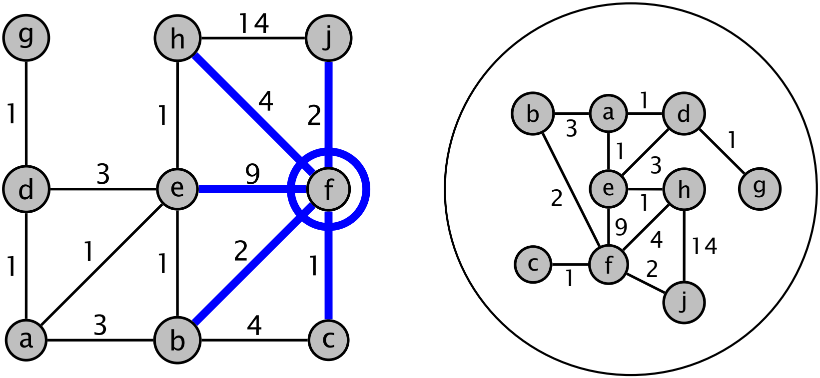

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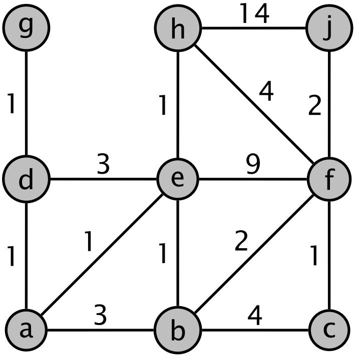

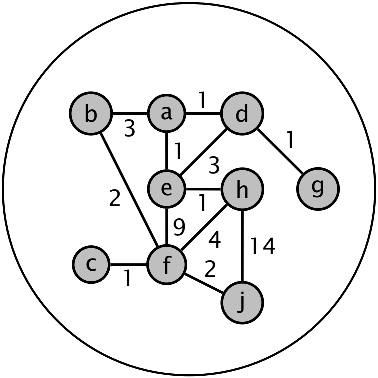

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- Once we have all the LSAs from every router, and therefore we complete knowledge of G, we need an *algorithm to compute least-cost paths in a graph*

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  - it requires (unicast) routing information
  - so it is obviously useless to implement a routing algorithm

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  - u updates its table of sequence numbers $n_s \leftarrow seq(p)$

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  - N, nodes of G whose least-cost path from u is definitely known

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N ← {u}
for all v ∈ V
        do if v ∈ neighbors(u)
                then D[v] ← c(u, v)
                     p[v] ← u
                else D[v] ← ∞
while N ≠ V
        do find w ∉ N such that D[w] is minimum
           N ← N ∪ {w}
           for all v ∈ neighbors(w) \ N
                do if D[w] + c(w, v) < D[v]
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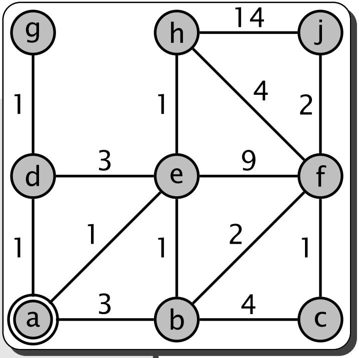
Example

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