Exercise 4: OSPF and CIDR

S-38.121 Routing in Communications Networks

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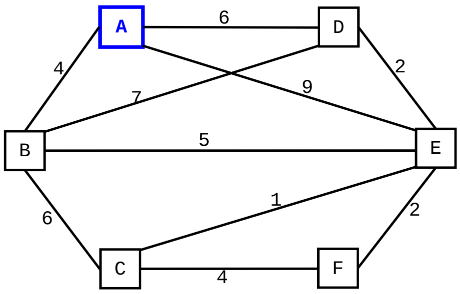
Contents

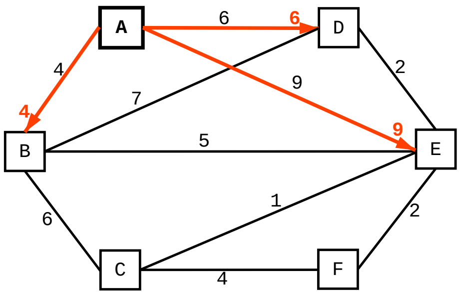
1 Exercise

1.1 Use the Dijkstra's algorithm to find the routes in Network 1 from A to all the other nodes.

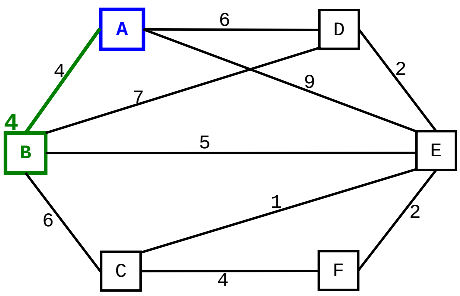
- Initialization setp: We have the original Network, node A is the source.



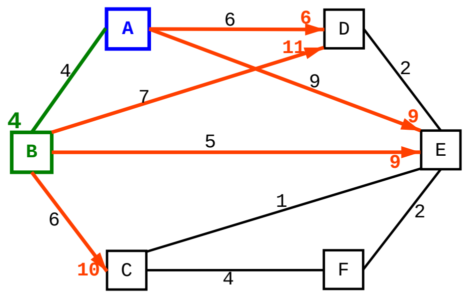
- Step 1: Orange arrows point to nodes reachable from the startnode.



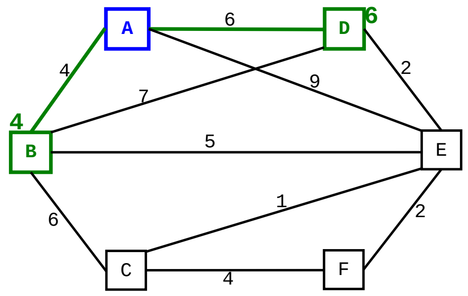
- Step 2: Node B has the minimum distance. Node B will be colored green to indicate 4 is the length of the shortest path to B.



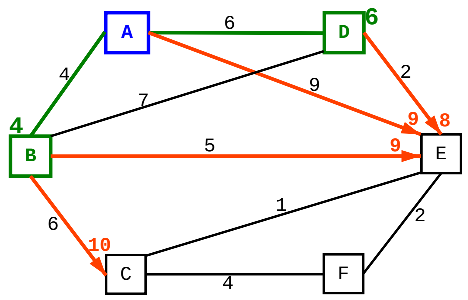
- Step 3: Orange arrows point to nodes reachable from nodes that already have a final distance.



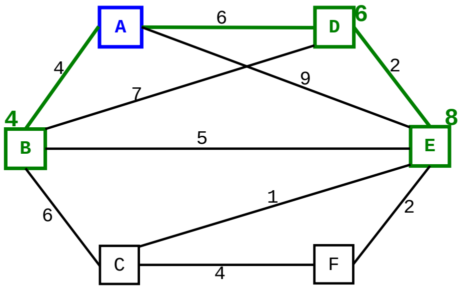
- Step 4: Node D has the minimum distance. Node D will be colored green to indicate 6 is the length of the shortest path to D.



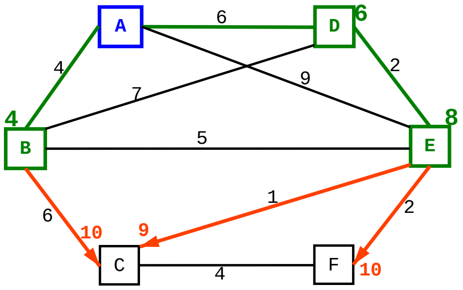
- Step 5: Orange arrows point to nodes reachable from nodes that already have a final distance.



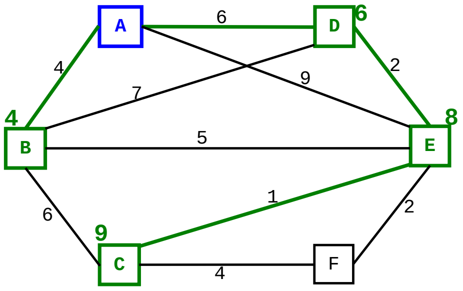
- Step 6: Node E has the minimum distance. Node E will be colored orange to indicate 8 is the length of the shortest path to E.



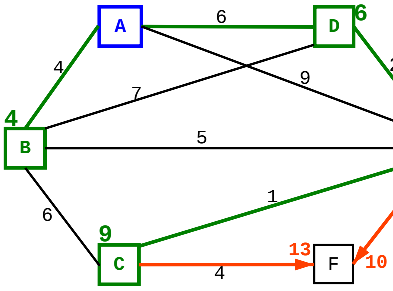
- Step 7: Orange arrows point to nodes reachable from nodes that already have a final distance.



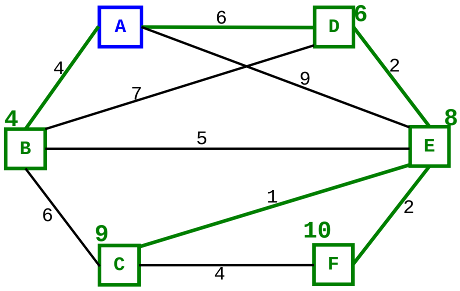
- Step 8: Node C has the minimum distance. Node C will be colored orange to indicate 9 is the length of the shortest path to C.



- Step 9: Orange arrows point to nodes reachable from nodes that already have a final distance.



- Step 10: Node F will be colored orange to indicate 10 is the length of the shortest path to F. This is the final step, we have the shortest distances from A to all other nodes.



1.2 Analyse the main differences between this algorithm and Bellman-Ford one.

The Bellman-Ford algorithm is slower, it converges in O(N.M) and Dijkstra algorithm in O(M.logM). Dijkstra algorithm supports precise metrics, and even multiple metrics to know the network topology. With a little modification on the Dijkstra algorithm it can support multiple paths to a destination.

2 Compare RIP and OSPF in the aspects of their implementation and other performance

Implementation

- OSPF belongs to the link state family and RIP belongs to the distance vector family. (*family*)
- OSPF uses Dijkstra algorithm to calculate routes, based on topology information, while RIP uses Bellman-Ford algorithm, based on the routing table information.(*algorithm*)
- OSPF is built over IP and RIP is built over UDP.(*protocol*).
- OSPF supports multiple metrics, multiple areas, external routes, ... And RIP supports authentication, multicasting, ...

Performance

- OSPF is more scalable than RIP relatively large networks, while RIP is suitable for small networks, it has a limit of 15 hops.(*scalability*)
- OSPF can keep stable in relatively complex networks, while RIP is suitable if the network topology is simple and it doesn't have much link failures. With RIP there are time while the network is unstable and loops may happen.(*stability*)
- OSPF is more complex than RIP. OSPF has five messages and three procedures while RIP has only two messages. (*complexity*)
- OSPF can find and remove the loops when all link state databases are consistent. RIP can detect a loop with counting the distance to infinity. (*loop avoidance*)

3 CIDR

Assume two ISP A and B. ISP A connects 3 clients. One of its basic services is to assign IP addresses for them. The following table lists three organizations' requirements.

Clients	Requirements
Organization X	Few than 1024 addresses
Company Y	Few than 4096 addresses
Company Z	Few than 512 addresses

ISP A was authorized by RIPE NCC to begin its network addresses with 195.133.10.0 and end with 195.136.255.255.

ISP B is allocated a block of 1024 class C networks starting from 191.51.0.0. Both A and B connect to a regional network.

3.1 a) Represent the two ISPs' blocks of network addresses in the form of IP Prefix[network mask].

ISP A network addresses:

- 195.133.10.0 / 255.255.0.0
- 195.134.0.0 / 255.255.0.0
- 195.135.0.0 / 255.255.0.0
- 195.136.0.0 / 255.255.0.0

ISP B network addresses:

- 191.51.0.0 / 255.255.0.0
- 191.52.0.0 / 255.255.0.0
- 191.53.0.0 / 255.255.0.0
- 191.54.0.0 / 255.255.0.0

3.2 b) How many class C network addresses does the ISP A offer? Is its address space enough big to fulfil all requirements of 3 clients? Use the exact numbers to draw you conclusion.

The ISP A offer 1014 class C network addresses.

Yes, it's enough to fulfil the requirements of the 3 clients. The number of addresses that the ISP A can allocate is: $1014 * 256 = 259586$, and the clients only need 5632 addresses.

3.3 c) Help the ISP A to allocate the address spaces for 3 clients. Indicate the thresholds of these address spaces and describe the corresponding routes by IP prefixes

- Organization X: Few than 1024 addresses

  195.134.0.0 - 195.134.3.255

  195.134.0.0 / 255.255.252.0

- Company Y: Few than 4096 addresses

  195.134.16.0 - 195.134.32.255

  195.134.16.0 / 255.255.240.0

- Company Z: Few than 512 addresses

  195.134.4.0 - 195.134.5.255

  195.134.4.0 / 255.255.254.0

3.4 d) Assume that organization X will change the service provider from ISP A to new one ISP B.

Follow the rules for route advertisement and features of multi-homed routing domain. List the advertisements in IP prefix with comment

- from ISP A to the regional network

  A: 195.133.10.0 / 255.255.0.0

  A: 195.134.0.0 / 255.255.0.0

  A: 195.135.0.0 / 255.255.0.0

  A: 195.136.0.0 / 255.255.0.0

  Y: 195.134.16.0 / 255.255.240.0

  Z: 195.134.4.0 / 255.255.254.0

  X: 195.134.0.0 / 255.255.252.0

- from ISP B to the regional network

  B: 191.51.0.0 / 255.255.0.0

  B: 191.52.0.0 / 255.255.0.0

  B: 191.53.0.0 / 255.255.0.0

  B: 191.54.0.0 / 255.255.0.0

  X: 195.134.0.0 / 255.255.252.0