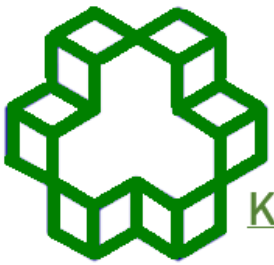


K. N. Toosi University of Technology

Solution 3

Optical Networks

Question 1)

a. One-step RWA is typically more complicated as it solve the problems of routing and wavelength assignment together. Due to this joint solution, one-step RWA gives a better result. In a lightly-loaded network, the multi-step scheme is more prescribed due to its simplicity and good optimality as you need not be worry about the occupied spectrum.
b. Every time a choice of wavelength is needed, all the available wavelengths are sorted as their current usage in network. The intuition is that a wavelength, mostly used in network, would be harder to be allocated later. So, it is better to take advantage of a wavelength in network as much as we can.

Question 2)

a. False, Dijkstra's Algorithm is used for solving single source shortest path problems. In this algorithm, a single node is fixed as a source node and shortest paths from this node to all other nodes in graph is found.
b. False, the shortest path between B-f would be 8.

B-F	B-G-A-F	8
B-F	B-C-G-A-F	12

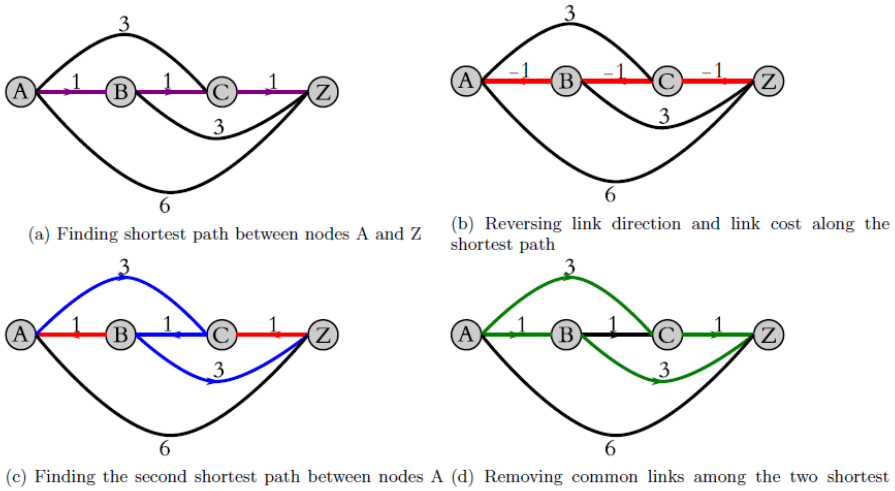
Question 3)

From	To	Shortest path	Distance
A	G	A-C-E-G	2

Computed path to G by applying Dijkstra is A-B-D-F,G but shortest path is A-C-E-G.

Question 4)

a. The steps of the Bhandari's algorithm are as indicated in figure 1.



(a) Finding shortest path between nodes A and Z

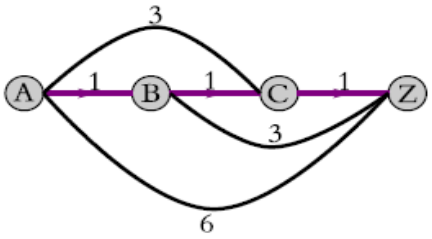
(b) Reversing link direction and link cost along the shortest path

(c) Finding the second shortest path between nodes A and Z

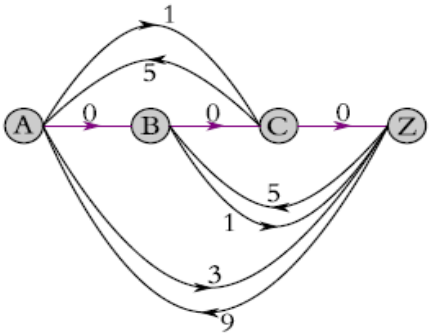
(d) Removing common links among the two shortest paths found

Figure 1: The steps of Bhandari algorithm

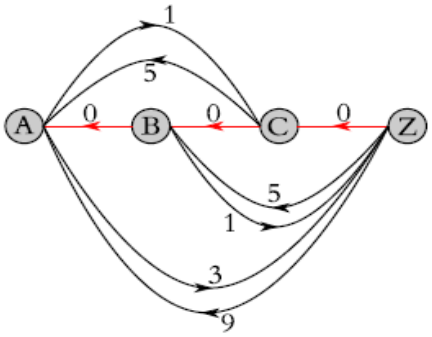
b. The steps of the Suurballe's algorithm are as indicated in figure 2.



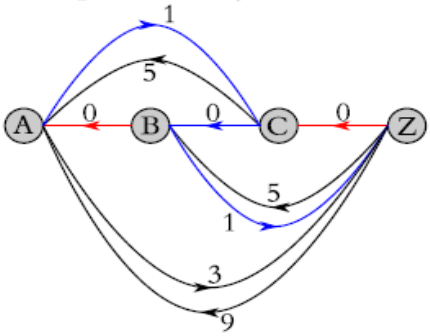
(a) Finding shortest paths from source node to all other nodes



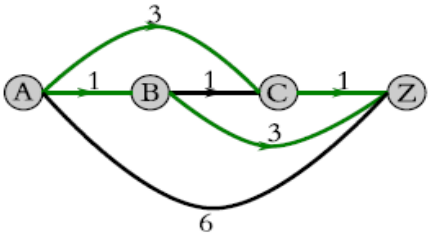
(b) Updating costs of all links according to $w_{\text{new}}(u,v) = w_{\text{old}}(u,v) + d(s,u) - d(s,v)$ and reversing link direction along the shortest path ($d(s,u)$ is the minimum cost of reaching node u from s)



(c) Reversing link direction along the shortest path tree



(d) Calculating a new shortest path between nodes A and Z

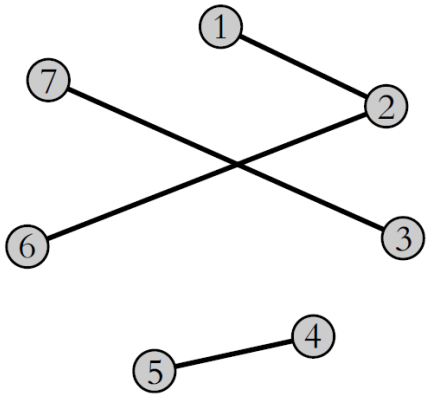


(e) Removing common links among the two shortest paths found

Figure 2: The steps of Suurballe's algorithm

Question 5)

The conflict graph is as follows:

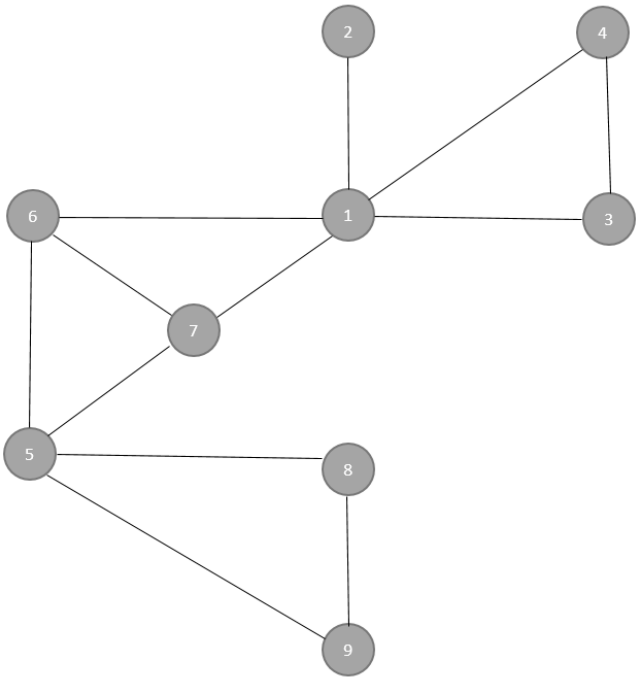


For first fit, we start from the first lightpath, assign the first free wavelength enumerating from λ_1 and move on the next lightpath. In most-used heuristics, the wavelength ordering is determined by the current usage of wavelengths in physical topology. The result of both algorithms is :

Lightpath ID	Nodelist	First-fit	Most-used
1	E-A-C	λ_1	λ_1
2	A-C-G-F	λ_2	λ_2
3	F-E-C-D	λ_1	λ_2
4	B-D-C	λ_1	λ_2
5	A-B-D	λ_2	λ_1
6	C-G	λ_1	λ_1
7	C-D-B	λ_2	λ_1

Question 6)

The conflict graph is as follows:



For first fit, we start from the first lightpath, assign the first free wavelength enumerating from λ_1 and move on the next lightpath. In most-used heuristics, the wavelength ordering is determined by the current usage of wavelengths in physical topology. The result of both algorithms is :

Lightpath	First-Fit	Most-Used
1	λ_1	λ_1
2	λ_2	λ_2
3	λ_2	λ_2
4	λ_3	λ_3
5	λ_1	λ_2
6	λ_2	λ_3
7	λ_3	Blocked
8	λ_2	λ_3
9	λ_3	λ_1