EECS 122: Introduction to Communication Networks

Homework 4 Solutions

Solution 1. For the given network there are many ways to use just two rows in each table and correctly forward packets. One possibility is shown in figure 1.

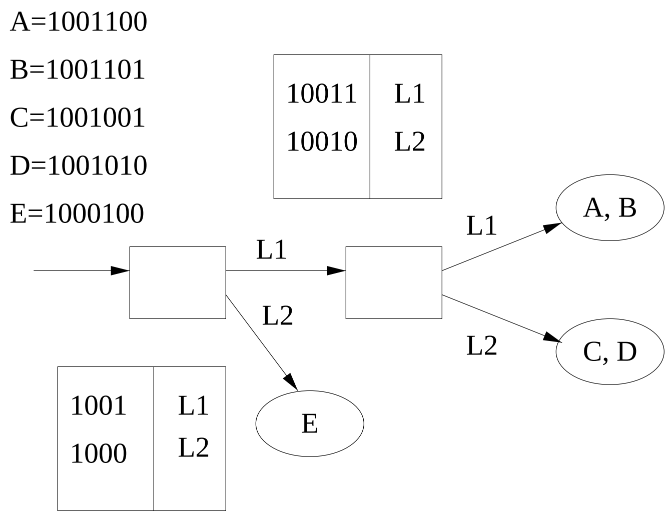

Figure 1: Solution 1

Solution 2. In every step of the Dijkstra algorithm we look at the set of unshaded nodes, choose the one with the smallest estimate, shade it, and finally update the estimates of the neighboring nodes. The successive steps of the algorithm for the given graph are shown in figure 2.

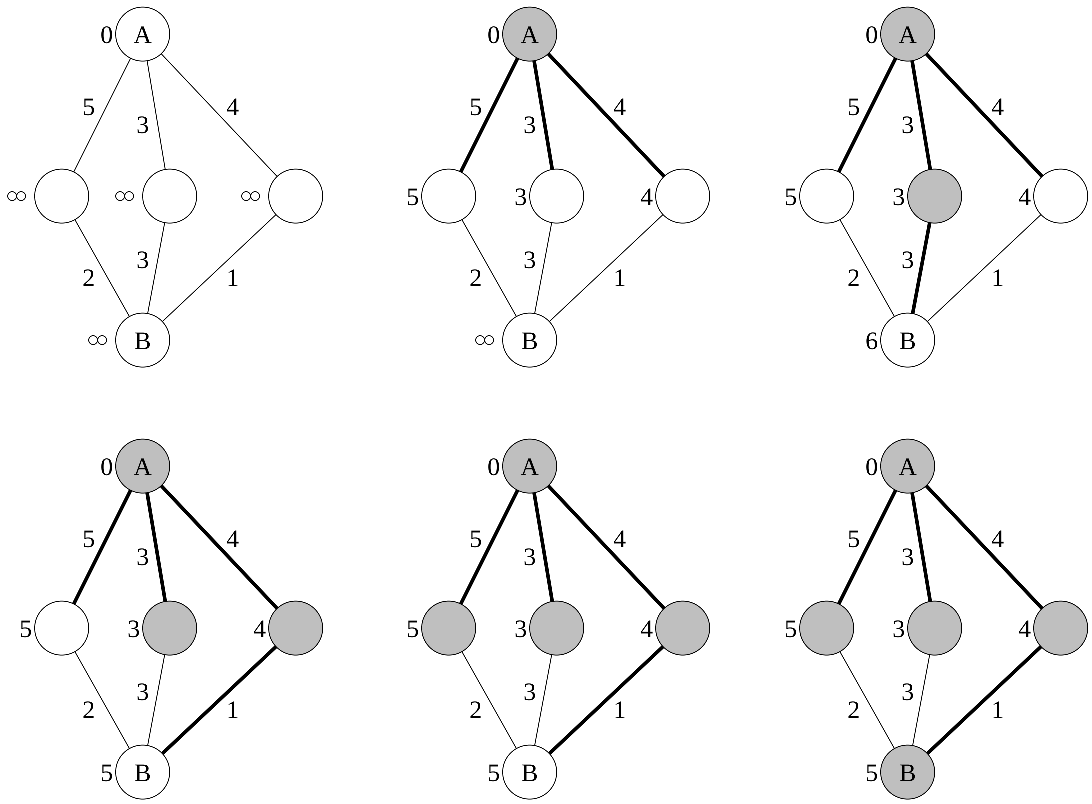

Figure 2: Solution 2

Solution 3. According to the flooding algorithm defined on pages 65 & 66 of the textbook, the first time a node receives a message, it sends the message on all its interfaces except one. If it ever receives the same message again, it ignores it. The node who creates the message in the first place is an exception—it sends the message on *all* its interfaces. Since there are N nodes with an average of d interfaces each, there are a total of Nd interfaces in the network. (Notice that individual nodes can have different numbers of interfaces, and d need not be an integer. The only thing d really tells us is the total number of interfaces in the network.) If every node sent one message on all its interfaces, the total number of packets sent would be Nd. However, each of the nodes except one omits one of its interfaces, so the total number of packets sent is $Nd-(N-1)=Nd-N+1$.

A real life flooding algorithm might differ slightly from the one defined in the textbook. For example, nodes might not forward a message immediately after they receive it, and in the meantime, they might receive additional copies from other interfaces. In that case, it would be sensible to refrain from forwarding the message on all the interfaces it came from, in which case fewer than $Nd-N+1$ packets might be sent.

Solution 4.

a) The probability of receiving the datagram correctly is the probability of receiving all fragments correctly. The probability of receiving one fragment correctly is 0.99. The probability of receiving all fragments correctly is the product of the probabilities of receiving the individual fragments correctly. Thus:

$$P(\text{correct datagram}) = \prod_{n=1}^{10} P(\text{correct } n^{\text{th}} \text{ fragment}) = 0.99^{10} \doteq 0.9044$$

b) If we send each fragment twice, then the probability of receiving a fragment correctly is the probability that at least one of the two copies is received correctly. This probability is equal to one minus the probability that both copies are received *in*correctly. Therefore, the probability of a fragment being received correctly is $1 - 0.01^2 = 0.9999$. Thus, the probability of receiving the datagram correctly is:

$$P(\text{correct datagram}) = \prod_{n=1}^{10} P(\text{correct } n^{\text{th}} \text{ fragment}) = 0.9999^{10} \doteq 0.9990$$

We see that transmitting each fragment twice significantly increases the probability of correct transmission for the datagram, as expected.