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CS 3800  
Professor Korah  
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Assignment #4

1. . (Ch 5: P4) [6pts] Consider the network shown below. Using Dijkstra’s algorithm, and showing your work using a table (similar to the one in the lecture and textbook), do the following:  
   A picture containing sky, photo

   Description automatically generated
   1. Compute the shortest path from t to all network nodes.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Step | N’ | D(u), p(u) | D(v), p(v) | D(w), p(w) | D(x), p(x) | D(y), p(y) | D(z), p(z) |
| 0 | t | 2, t | 4, t | ∞ | ∞ | 7, t | ∞ |
| 1 | tu | 2, t | 4, t | 5, u | ∞ | 7, t | ∞ |
| 2 | tuv | 2, t | 4, t | 5, u | 7, v | 7, t | ∞ |
| 3 | tuvw | 2, t | 4, t | 5, u | 7, v | 7, t | ∞ |
| 4 | tuvwx | 2, t | 4, t | 5, u | 7, v | 7, t | 15, x |
| 5 | tuvwxy | 2, t | 4, t | 5, u | 7, v | 7, t | 15, x |
| 6 | tuvwxyz | 2, t | 4, t | 5, u | 7, v | 7, t | 15, x |

* 1. Compute the shortest path from u to all network nodes.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Step | N’ | D(t), p(t) | D(v), p(v) | D(w), p(w) | D(x), p(x) | D(y), p(y) | D(z), p(z) |
| 0 | u | 2, u | 3, u | 3, u | ∞ | ∞ | ∞ |
| 1 | ut | 2, u | 3, u | 3, u | ∞ | 9, t | ∞ |
| 2 | utv | 2, u | 3, u | 3, u | 6, v | 9, t | ∞ |
| 3 | utvw | 2, u | 3, u | 3, u | 6, v | 9, t | ∞ |
| 4 | utvwx | 2, u | 3, u | 3, u | 6, v | 9, t | 14, x |
| 5 | utvwxy | 2, u | 3, u | 3, u | 6, v | 9, t | 14, x |
| 6 | utvwxyz | 2, u | 3, u | 3, u | 6, v | 9, t | 14, x |

* 1. Compute the shortest path from v to all network nodes.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Step | N’ | D(t), p(t) | D(u), p(u) | D(w), p(w) | D(x), p(x) | D(y), p(y) | D(z), p(z) |
| 0 | v | 4, v | 3, v | 4, v | 3, v | 8, v | ∞ |
| 1 | vx | 4, v | 3, v | 4, v | 3, v | 8, v | 11, x |
| 2 | vxu | 4, v | 3, v | 4, v | 3, v | 8, v | 11, x |
| 3 | vxut | 4, v | 3, v | 4, v | 3, v | 8, v | 11, x |
| 4 | vxutw | 4, v | 3, v | 4, v | 3, v | 8, v | 11, x |
| 5 | vxutwy | 4, v | 3, v | 4, v | 3, v | 8, v | 11, x |
| 6 | vxutwyz | 4, v | 3, v | 4, v | 3, v | 8, v | 11, x |

* 1. Compute the shortest path from x to all network nodes.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Step | N’ | D(t), p(t) | D(u), p(u) | D(v), p(v) | D(w), p(w) | D(y), p(y) | D(z), p(z) |
| 0 | x | ∞ | ∞ | 3, x | 6, x | 6, x | 8, x |
| 1 | xy | 7, v | 6, v | 3, x | 6, x | 6, x | 8, x |
| 2 | xvu | 7, v | 6, v | 3, x | 6, x | 6, x | 8, x |
| 3 | xvuw | 7, v | 6, v | 3, x | 6, x | 6, x | 8, x |
| 4 | xvuwy | 7, v | 6, v | 3, x | 6, x | 6, x | 8, x |
| 5 | xvuwyt | 7, v | 6, v | 3, x | 6, x | 6, x | 8, x |
| 6 | xvuwytz | 7, v | 6, v | 3, x | 6, x | 6, x | 8, x |

* 1. Using the routes generated above, compute the forwarding table for t, u, v and x.

Forwarding table for t

|  |  |  |
| --- | --- | --- |
| Destination | Cost | Next Hop |
| t | 0 | - |
| u | 2 | u |
| v | 4 | x |
| w | 5 | w |
| x | 7 | z |
| y | 7 | y |
| z | 15 | z |

Forwarding table for u

|  |  |  |
| --- | --- | --- |
| Destination | Cost | Next Hop |
| t | 2 | t |
| u | 0 | - |
| v | 3 | x |
| w | 3 | w |
| x | 6 | z |
| y | 9 | y |
| z | 14 | z |

Forwarding table for v

|  |  |  |
| --- | --- | --- |
| Destination | Cost | Next Hop |
| t | 4 | t |
| u | 3 | u |
| v | 0 | - |
| w | 4 | w |
| x | 3 | z |
| y | 8 | y |
| z | 11 | z |

Forwarding table for x

|  |  |  |
| --- | --- | --- |
| Destination | Cost | Next Hop |
| t | 7 | t |
| u | 6 | u |
| v | 3 | v |
| w | 6 | w |
| x | 0 | - |
| y | 6 | y |
| z | 8 | z |

1. [5pts] Consider the network shown below. Compute the all pairs shortest paths between the nodes using the DVR algorithms. Provide calculations.

A close up of a clock

Description automatically generated

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | U | U | V | W | X | Y | | U | 0 | 2 | ∞ | ∞ | ∞ | | V | ∞ | ∞ | ∞ | ∞ | ∞ | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | V | U | V | W | X | Y | | U | ∞ | ∞ | ∞ | ∞ | ∞ | | V | 2 | 0 | 6 | 6 | ∞ | | W | ∞ | ∞ | ∞ | ∞ | ∞ | | X | ∞ | ∞ | ∞ | ∞ | ∞ | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | W | U | V | W | X | Y | | V | ∞ | ∞ | ∞ | ∞ | ∞ | | W | ∞ | 6 | 0 | 5 | ∞ | | X | ∞ | ∞ | ∞ | ∞ | ∞ | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | X | U | V | W | X | Y | | V | ∞ | ∞ | ∞ | ∞ | ∞ | | W | ∞ | ∞ | ∞ | ∞ | ∞ | | X | ∞ | 6 | 5 | 0 | 7 | | Y | ∞ | ∞ | ∞ | ∞ | ∞ | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Y | U | V | W | X | Y | | X | ∞ | ∞ | ∞ | ∞ | ∞ | | Y | ∞ | ∞ | ∞ | 7 | 0 | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | U | U | V | W | X | Y | | U | 0 | 2 | 8 | 8 | 15 | | V | 2 | 0 | 6 | 6 | ∞ | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | V | U | V | W | X | Y | | U | 0 | 2 | ∞ | ∞ | ∞ | | V | 2 | 0 | 6 | 6 | 13 | | W | ∞ | 6 | 0 | 5 | ∞ | | X | ∞ | 6 | 5 | 0 | 7 | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | W | U | V | W | X | Y | | V | 2 | 0 | 6 | 6 | ∞ | | W | 8 | 6 | 0 | 5 | 12 | | X | ∞ | 6 | 5 | 0 | 7 | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | X | U | V | W | X | Y | | V | 2 | 0 | 6 | 6 | ∞ | | W | ∞ | 6 | 0 | 5 | ∞ | | X | 8 | 6 | 5 | 0 | 7 | | Y | ∞ | ∞ | ∞ | 7 | 0 | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Y | U | V | W | X | Y | | X | ∞ | 6 | 5 | 0 | 7 | | Y | ∞ | 13 | 12 | 7 | 0 | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | U | U | V | W | X | Y | | U | 0 | 2 | 8 | 8 | 15 | | V | 2 | 0 | 6 | 6 | 13 | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | V | U | V | W | X | Y | | U | 0 | 2 | 8 | 8 | ∞ | | V | 2 | 0 | 6 | 6 | 13 | | W | 8 | 6 | 0 | 5 | 12 | | X | ∞ | 6 | 5 | 0 | 7 | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | W | U | V | W | X | Y | | V | 2 | 0 | 6 | 6 | 13 | | W | 8 | 6 | 0 | 5 | 12 | | X | 8 | 6 | 5 | 0 | 7 | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | X | U | V | W | X | Y | | V | 2 | 0 | 6 | 6 | 13 | | W | 8 | 6 | 0 | 5 | 12 | | X | 8 | 6 | 5 | 0 | 7 | | Y | 15 | 13 | 12 | 7 | 0 | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Y | U | V | W | X | Y | | X | 8 | 6 | 5 | 0 | 7 | | Y | 15 | 13 | 12 | 7 | 0 | |

1. (Ch 6: P18) [Extra credit 4pts] Suppose nodes A and B are on the same 10 Mbps broadcast channel, and the propagation delay between the two nodes is 325 bit times (A bit time is the time need to transmit a bit). Suppose CSMA/CD and Ethernet packets are used for this broadcast channel. Suppose node A begins transmitting a frame and, before it finishes, node B begins transmitting a frame. Can A finish transmitting before it detects that B has transmitted? Why or why not? If the answer is yes, then A incorrectly believes that its frame was successfully transmitted without a collision. Hint: Suppose at time t=0 bits, A begins transmitting a frame. In the worst case, A transmits a minimum-sized frame of 512 + 64 bit times. So A would finish transmitting the frame at t= 512 + 64 bit times. Thus, the answer is no, if B’s signal reaches A before bit time t=512+64 bits. In the worst case, when does B’s signal reach A?

Speed of the Ethernet bus = 10 Mbps

Propagation delay between node A and node B = 325 times

At t = 0 node A transmits the frame

At t = 576, node A completes transmitting the frame

Worst case: node B begins its transmission at time just before the first bit of node A arrives at node B (before time propagation delay). So, node B begins its transmission at time t = 324.

As propagation delay is 325 times, at time t 324 + 325 = 649, the first bit of node B arrives at node A.

Node A finishes its transmission before detecting that transmission by node B started. Node A believes incorrectly that the frame sent by node A is transmitted successfully without collision.