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cs3544
Intro to CS: Java

Problem Set 5

5.)

1440 * 900 = 1296000 pixels

1296000 * 16 = 20736000 bits ≈ 20.7 Mb

20.7 Mb / 0.01 = 2073.6 ≈ 2074 Mbps

The minimal necessary line speed to transmit this information in less than 0.01 second, is 2074 Mbps, which would necessitate a line type that is at least as powerful as a 10-gigabit Ethernet line.

11.)

a.

Assuming there are N nodes in a wide area network, with N => 2, the smallest number of point-to-point communication links such that every node in the network is able to talk to every other node is N-1 communication links.

b.

If I am worried about having a disconnected network, I should use a completely connected store-and-forward network, where each node is actually literally connected to every other node.

16.)

a.

There are 7 simple paths from node A to G.

ADECG, ABECG, ADEBCG, ABEDCG, AFG, ADCG and ABCG

b.

The shortest path from node A to G is both ABECG and ADECG.

The overall delay is 10.

Work is attached on end of pdf.

c.

If node E fails, that does change the shortest path.

The shortest path becomes three options: AFG, ABCG, and ADCG.

All of these paths have an overall delay of 11.

Work is attached on end of pdf.

17.)

This heuristic will not always deliver the message from node A to node B. This is because solely choosing the shortest path, if not the second-shortest path without being able to send it back to the previous node and keep track which node the information has visited, means that the information could potentially get stuck in a loop and never reach the destination. The shortest path might lead to one node, and the shortest, or second-shortest path for that node could lead to a previously traveled node, and that node's shortest, or second-shortest path, could once again lead back to a node it has just left. In other words, this heuristic, without enabling the message to avoid nodes it has traveled previous to the one immediately before, and without enabling it to backtrack, causes the message to ultimately only have one pre-determined travel route.

20.)

Because the path that each individual packet follows is determined by the network every time, each individual path always adapts to that which is fastest. Furthermore, that also means the receiving node of the path is able to receive one portion of the data at a time and reduce the chances of a complete loss of information.

The advantages of breaking up a single logical message into a number of fixed-sized packets and sending each one of those packets independently through the network are therefore (1) an increased transmission rate as well as (2) a greater chance of retaining some data if the connection is broken.

21.)

Leonard Kleinrock, one of the designers of the original ARPANET, gave incredible contributions to the field of computer networking and ultimately, to the development of the Internet. He was the one who suggested using packets rather than circuits, and who was later proven right in the utility of packet switching following Roberts' experimentations in 1965. It was a result of this confirmation and all the work down by so many other scientists, that Larry Roberts was able to go to DARPA to begin drafting the idea of the computer network. Ultimately, this led to a plan for the world's very first computer network, called the ARPANET. Later, in 1968, he and his team at UCLA became responsible for the network measurement system, which was also then chosen to be the very first node, of the ARPANET. A sizable factor in this accomplishment was due to the packet-switching theory as mentioned earlier on. Furthermore, later, after connecting the Stanford Research Institute's second node to the ARPANET, Kleinrock and his team were able to send the first host-to-host message. From there, another two nodes were added to the ARPANET so that by the end of the year, the world had its infant-stage Internet successfully running. After 8 or so more years, Kleinrock then succeeded with writing and publishing the very first book on the ARPANET, discussing at length the intricate procedures and their corresponding fallbacks. As a result of this publication, Kleinrock's fascination with packet switching was distributed wide across the scientific internet community. Also, during the 1980s, Kleinrock chaired the National Research Council Committee, and ended up releasing a report that significantly impacted Senator Al Gore's policies. This, consequently, led to the rise of high speed networks that ultimately became the base for the modern version of the vast Internet computer network. In fact, they later released another report that would then even begin to address the controversy of ownership and rights in the Internet.

16 b

Current

A = 0 :

B : 5+0 = 5

F : 3+0 = 3 – Update prev node and values

D : 6+0 = 6

A is now visited.

Next node w/ shortest tentative distance

F = 3 :

G = 8+3 = 11 – Update prev node and value

A is already visited.

F is now visited.

B = 5 :

C : 4+5 = 9

E : 2+5 = 7 = Update prev node and values

A is already visited. B is now visited.

D = 6 :

C : 3+6 = 9 > no update w/ values.

E : 1+6 = 7 Update prev node because values for distance are equivalent!

A is already visited.

D is now visited.

E = 7 :

C : 1+7 = 8 – Update prev node and value

B, D, are already visited.

E is now visited.

C = 8 :

G : 2+8 = 10 – Update prev node and value

B, D, E already visited.

C is now visited.

G = 10 All other nodes are visited. Algorithm ends.

Unvisited	Prev Node	Visited
~~A~~ : 0	~~N~~/A	A
~~B~~ : ~~∞~~ 5	A	B
~~C~~ : ~~∞~~ ~~9~~ 8	~~B~~, ~~D~~, E	C
~~D~~ : ~~∞~~ 6	A	D
~~E~~ : ~~∞~~ 7	B, D	E
~~F~~ : ~~∞~~ 3	A	F
~~G~~ : ~~∞~~ ~~11~~ 10	~~F~~ C	G

Shortest Path :

$\boxed{\text{ABECG}}$

(formed by working backwards from G) ⇒ G, C, E (B, D), A

$\boxed{\text{ADECG}}$

Shortest Distance :

$\boxed{G = 10}$

$\boxed{16c}$ – E node fails

Current Node

A = 0 :

B : 5 + 0 = 5
F : 3 + 0 = 3 — Update
D : 6 + 0 = 6

F = 3 :

G : 8 + 3 = 11 - Update

B = 5 :

C : 4 + 5 = 9 - Update

E is not functional.

D = 6 :

C : 3 + 6 = 9 - Equivalent value, update prev node.
(add D to list)

C = 9 :

G : 2 + 9 = 11 - Equivalent value, update prev node (add C)

$\boxed{G = 11}$: Done

Unvisited	Prev Node	Visited
~~A~~ = 0	N/A	A
~~B~~ = ~~∞~~ 5	A	B
~~C~~ = ~~∞~~ 9	B, D	C
~~D~~ = ~~∞~~ 6	A	D
~~E~~ - Fails	/	/
~~F~~ = ~~∞~~ 3	A	F
~~G~~ = ~~∞~~ 11	F, C	G

Working Backwards : Shortest Path

G → F → A : $\boxed{AFG}$

G → C → B → A : $\boxed{ABCG}$

G → C → D → A : $\boxed{ADCG}$

Shortest Length :

$\boxed{G = 11}$

11