Homework #11

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Points: 20

For due date, please see Canvas. You must show your work in order to receive any credit.

1. Suppose a congestion-control scheme results in a collection of competing flows that achieve the following throughput rates: 300 KBps, 150 KBPS, and 90 KBps. Calculate the fairness index for this scheme.

   Round your answer to three decimal places.

   Fairness index = (Σ xi)^2 / (n * Σ (xi^2))

   where xi is the throughput rate of the ith flow and n is the total number of flows.

   In this case, we have the following throughput rates: x1 = 300 KBps, x2 = 150 KBps, and x3 = 90 KBps.

   Fairness index = ((300 + 150 + 90)^2) / (3 * (300^2 + 150^2 + 90^2))
   Fairness index = (540^2) / (3 * (90000 + 22500 + 8100))
   Fairness index = 291600 / (3 * 120600)
   Fairness index = 291600 / 361800
   Fairness index ≈ 0.806

   The fairness index for this scheme is approximately 0.806.

2. Suppose a router has three input flows and one output. It receives the packets listed in the below table all at about the same time, in the order listed, during a period in which the output port is busy but all queues are otherwise empty. Give the order in which the packets are transmitted using the different types of approaches listed below. If there is a tie, go with the lower packet number (first column of the table).
   (a) Fair queuing.

   In fair queuing, each flow is served equally, regardless of the packet size. In this case, we process one packet from each flow in a round-robin fashion. The order of packets transmitted is:

   F1.1 = max(0, 0) + 100 = 100

   F1.2 = max(100, 0) + 100 = 200

   F1.3 = (= max(200, 0) + 210 = 410

   F1.4 = max(410, 0) + 100 = 510

$F1.5$ = max(510, 0) + 40 = 550

$F2.6$ = max(0, 0) + 190 = 190

$F2.7$ = max(190, 0) + 200 = 390

$F2.8$ = max(390, 0) + 120 = 510

$F3.9$= max(0, 0) + 310 = 310

$F3.10$= max(310, 0) + 20 = 330

Packet 1, Packet 6, Packet 2, Packet 9, Packet 10, Packet 7, Packet 3, Packet 4, Packet 8, Packet 5

(b) Weighted fair queuing, with Flow 1 having weight 4, Flow 2 having weight 3, and Flow 3 having weight 5.

Packet	Size	Flow
1	100	1
2	100	1
3	210	1
4	100	1
5	40	1
6	190	2
7	200	2
8	120	2
9	310	3
10	20	3

In weighted fair queuing, each flow is served based on its assigned weight. The order of packets transmitted is determined by dividing the packet size by the flow's weight, and the packets with the lowest resulting value are transmitted first. The weights are as follows: Flow 1 has weight 4, Flow 2 has weight 3, and Flow 3 has weight 5. Calculate the transmission order:

1: max(0,0) + 100 / 4 = 25

2: max(25,0) + 100 / 4 = 50

3: max(50,0) + 210 / 4 = 102.5

4: max(102.5,0) + 100 / 4 = 127.5

5: max(127.5,0) + 40/ 4 = 137.5

6: max(0,0) + 190 / 3 ≈ 63.33

7: max(63.33,0) + 200 / 3 ≈ 130

8: max(130,0) + 120 / 3 = 170

9: max(0,0) + 310 / 5 = 62

10: max(62,0) + 20 / 5 = 66

The order of packets transmitted is:

Packet 1, Packet 2, Packet 9, Packet 6, Packet 10, Packet 3, Packet 4, Packet 7, Packet 5, Packet 8