SE331: Introduction to Computer Networks	**Recitation 13**
Semester 1 5785	**3 Feb 22025**
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Queuing Disciplines

1 Queuing Disciplines

Flow	Packet	Size
A	P1	200
A	P2	200
B	P3	160
B	P4	120
B	P5	160
C	P6	210
C	P7	150
C	P8	90

Suppose a router has three input flows and one output. It receives the packets below 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 each of the following queue management strategies.

(a) First In First Out queuing

(b) Priority Queuing with Flow A as HIGH, Flow B as MEDIUM, Flow C as LOW

(c) Round Robin Queuing

(d) Fair Queuing (No Skew)

2 Fair Queuing without Skew

Flow	Packet	Size
A	P1	200
A	P2	100
A	P3	150
A	P4	80
B	P5	100
B	P6	180
B	P7	80
C	P8	90
C	P9	350
C	P10	100

Suppose a router has three input flows and one output. It receives the packets listed in the table above 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 each of the following queue management strategies.

(a) Fair Queuing

(b) Weighted Fair Queuing, with flow A having weight 2.5, flow B having weight 1.75, and flow C having weight 1

Assume all ties are resolved in the order A, B, C.

3 Fair Queuing with Skew (Shorter)

Consider a router that is managing three flows, on which packets of constant size arrive at the following wall clock times:

Flow	Packet	Size	Arrival
A	A3	1	3
A	A4	1	4
A	A5	1	5
A	A7	1	7
B	B1	1	1
B	B4	1	4
B	B7	1	7
C	C1	1	1
C	C6	1	6
C	C9	1	9

All three flows share the same outbound link, on which the router can transmit one packet per time unit. Assume that there is an infinite amount of buffer space.

Suppose the router implements fair queuing. Arrival time ties are to be resolved in order A, B, C.

For each packet, give the wall clock time when it is transmitted by the router.

Note: Wall clock time $T = 2$ is Fair Queuing clock time $A_i = 1.5$.

4 Fair Queuing with Skew (Longer)

Consider a router that is managing three flows, on which packets of equal size (1) arrive at the following wall clock times:

Flow	Packet	Size	Arrival
A	A1	1	1
A	A3	1	3
A	A5	1	5
A	A6	1	6
A	A8	1	8
A	A9	1	9
A	A11	1	11
B	B1	1	1
B	B4	1	4
B	B7	1	7
B	B8	1	8
B	B9	1	9
B	B13	1	13
B	B15	1	15
C	C1	1	1
C	C2	1	2
C	C4	1	4
C	C6	1	6
C	C7	1	7
C	C12	1	12

All three flows share the same outbound link, on which the router can transmit one packet per time unit. Assume that there is an infinite amount of buffer space.

(a) Suppose the router implements fair queuing. For each packet, give the wall clock time when it is transmitted by the router. Arrival time ties are to be resolved in order A, B, C. Note that wall clock time T = 2 is FQ-clock time $A_i = 1.333$.

5 Fair Queuing with Skew (Longer)

Consider a router that is managing three flows, on which the following packets arrive at the following wall clock times. Packet size is given in terms of size units:

Packet	Arrival Time	Size
A1	1	5
A2	4	6
A3	9	3
A4	18	8
A5	22	4
A6	27	9
B1	1	8
B2	8	10
B3	13	4
B4	18	9
B5	25	5
B6	27	4
C1	2	8
C2	8	4
C3	9	10
C4	11	10
C5	13	12
C6	28	5

All three flows share the same outbound link, on which the router can transmit one size unit per time unit. Assume that there is an infinite amount of buffer space.

(a) Suppose the router implements fair queuing. For each packet, give the calculated F_i and the wall clock time when it is transmitted. Additionally, write the order in which the packets will be sent by the router. Resolve ties in transmission times in the order A, B, C.

(b) Suppose the router implements weighted fair queuing with flow A having weight 2, flow B having weight 1, and flow C having weight 1.5. For each packet, give the calculated F_i and the wall clock time when it is transmitted. Additionally, write the order in which the packets will be sent by the router. Resolve ties in transmission times in the order A, B, C.

