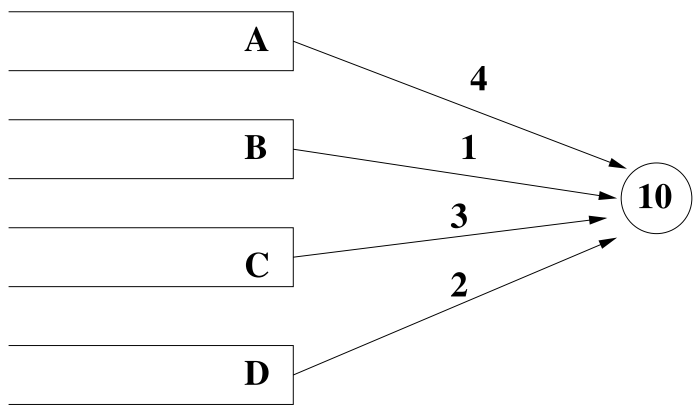
Review problem 1

[4 pts] (1) Explain why weighted fair queuing is not adopted in today's Internet. What is the most prevalent queuing discipline today and what disadvantage does it have?

It requires keeping per flow state and therefore is too expensive in core Internet routers. Drop-tail, there is no fairness.

[10 pts] (2) Consider a system of four queues being serviced according to a WFQ (Weighted Fair Queuing) scheduling policy. The weights given to the four queues (A, B, C, D) are 4, 1, 3, and 2 respectively. They are being serviced by a processor at the rate of 10 Mbps.



The table below gives a list of different input traffic rates (in Mbps) at the four input queues. Fill in the resultant output rates for each of the four queues. [Each row 2 points]

INPUT RATES				OUTPUT RATES			
A	B	C	D	A	B	C	D
1	1	1	1				
10	10	10	10				
6	6	2	2				
8	0	0	8				
1	5	3	5				

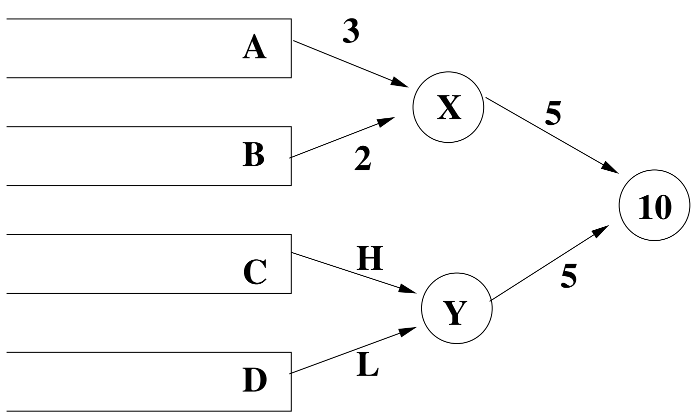
INPUT RATES				OUTPUT RATES			
A	B	C	D	A	B	C	D
1	1	1	1	1	1	1	1
10	10	10	10	4	1	3	2
6	6	2	2	4.8	1.2	2	2
8	0	0	8	6.67	0	0	3.33
1	5	3	5	1	2	3	4

[6 pts] (3) This time we still have the same four queues, but the processors are split in two levels and are based on priority queuing, WFQ, or Time Division Multiplexing (TDM).

Each of the two second level processors X and Y have a weight of 5. The policy implemented between these two processors is that of TDM, i.e., each of the processors gets a fixed share of the bandwidth.

Processor X implements a WFQ scheduling between its two queues A and B. A has a weight of 3 and B has a weight of 2.

Processor Y implements a strict priority between its two queues C and D. Queue C has strictly higher priority than queue D.



The table below gives a list of different input traffic rates (in Mbps) at the four input queues. Fill in the resultant output rates for each of the four queues. [Each row 2 points]

INPUT RATES				OUTPUT RATES			
A	B	C	D	A	B	C	D
6	6	2	2				
2	6	2	6				
6	2	6	2				

INPUT RATES				OUTPUT RATES			
A	B	C	D	A	B	C	D
6	6	2	2	3	2	2	2
2	6	2	6	2	3	2	3
6	2	6	2	3	2	5	0

Review problem 2

[10 pts] (a) We would like to transfer 20KB file across a network from node A to node F. Packets have a length of 1 KB (neglecting header). The path from node A to node F passes through 5 links, and 4 intermediate nodes. Each of the links is a 10km optical fiber with a rate of 10 Mbps. The 4 intermediate nodes are store-and-forward devices and each intermediate node must perform a 50 μsec routing table look up after receiving a packet before it can begin sending it on the outgoing link. How long does it take to send the entire file across the network? (Describe individual delay components.) (Assume the propagation speed through optical fiber is $2 \times 10^8 m/sec$).
Answer:
Number of packets to transfer is $20KB/1KB = 20$ packets.

The per packet transmission time is: $TRANS = \frac{8\times 2^{10} bits/packet}{1\times 10^7 bits/sec} = 819.2\mu$sec per packet.

The per link propagation delay is $PROP = \frac{10^4 m}{2\times 10^8 m/sec} = 50\mu$ sec
The total transfer time is $20TRANS + 4TRANS + 4PROC + 5PROP = 20.11ms.$

[10pts] (b) [Please ignore all the assumptions in part (a)] Suppose we would like to transfer a file of K bits from node A to node C. The path from node A to node C passes through two links and one intermediate node, B, which is a store-and-forward device. The two links are of rate R bps. The packets contain P bits of data and a 6 byte header. What value of P minimizes the time it takes to transfer the file from A to C?

Answer:
Number of packets to transmit the file: $\frac{Kbits/file}{Pbits/packet} = \frac{K}{P}$ packets.

(You can ignore the header size)

The transmission time of a packet on each link accounting for the 48 bit header is:
$TRANSP = \frac{(P+48)bits/packet}{Rbits/sec} = \frac{P+48}{R}$sec per packet.

The overall expression for Transfer Time is $TT = (\#packets{+}1store\&forward)TRANSP + 2PROP = (\frac{K}{P}+1)\frac{P+48}{R} + 2PROP$.

Taking the first derivative with respect to the packet size P:
$\frac{d}{dP}TT = \frac{1}{R} - \frac{48K}{R}P^{-2}$.

Setting it to zero and solve: $P = 4\sqrt{3K}$.

Review problem 3

Consider a datagram network using 8-bit host addresses. Suppose a router uses longest prefix matching with the following forwarding table:

Prefix_match interface
10000000 0
11000000 1
11100000 2
otherwise 3

-10000000 through 1011111 $64 = 2^6$
-11000000 through 1101111 $32 = 2^5$
-11100000 through 1111111 $32 = 2^5$
-00000000 through 0111111 $128 = 2^7$

Review problem 4

Click on a link using web browser to get a web page. IP address for the URL not cached on local host, so a dns lookup is necessary. n DNS servers visited before you get the IP, successive visits incur an RTT of RTT1 ,... RTTn.

Web page associated with the link containing exactly one object. small html text.

RTT0 is the RTT btweeen local host and the server. zero transmission time, how long does it take when user clicks until the client receive the object?

DNSRTT = sum of RTT[1...n]

2RTT0: one TCP handshake, one get the object.

HTML references 3 small objects on same server:

1. nonpersistent HTTP with no parallel TCP connections

2RTT0+2RTT0*3 + DNSRTT

2. nonpersistent HTTP w/ parallel connections:

2RTT0 + 2RTT0 + DNSRTT

3. persistent HTTP w/ pipelining:

2RTT0 + RTT0 + DNSRTT