2.993: Principles of Internet Computing
Homework #5 Solutions

1. Peterson & Davie, Prob. 9.15
   On the average, 1.5 MB are transmitted every 3 sec. Thus, the rate is 1.5MB/s. Savings made during the 1.5 sec. interval are 0.75 MB (1.5×0.5 MB). We need to spend 1MB during the last half second, and we can send $0.5 \times 0.5 = 0.25$ MB. Hence, the bucket depth needs to be 0.75 MB.

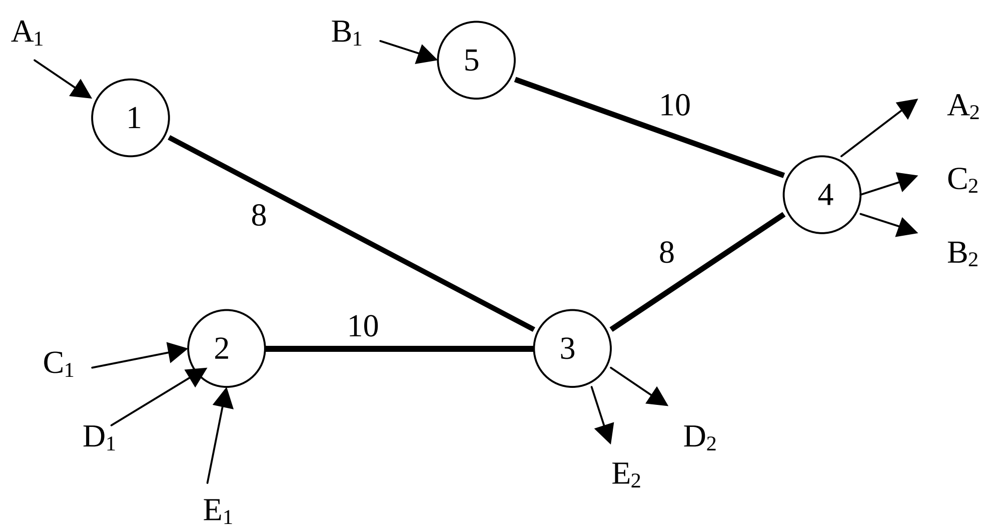
2. Peterson & Davie, Prob. 9.16
   For a bucket depth of 1 byte, the lowest rate is 2MB/s.

3. Peterson & Davie, Prob. 8.3
   Modify the bit-by-bit round robin as follows:
   P_i denotes the length of packet i. We use the lowest time-stamp to transmit.
   Consider two flows with weights 1 and 2. If the packet size of the packet in the queue of flow 2 is twice that of the packet in flow 1, then both packets should look equally attractive to transmit.
   Hence, the effective packet size is P_i/w, where w is the weight.
   The final time-stamps can be calculated as:

   $$F_i = max(F_{i-1}, A_i) + P_i/w$$

4.

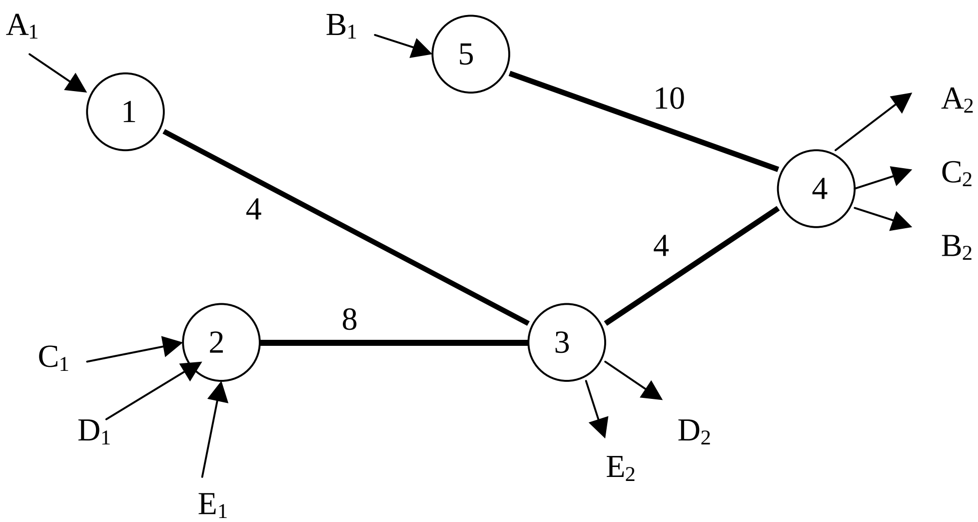
Max-Min Fairness Rate Allocation



(a)

rate	bottleneck link(s)
A = 8 - (10/3)	3 - 4
B = 10	4 - 5
C = 10/3	2 - 3
D = 10/3	2 - 3
E = 10/3	2 - 3

(b) After allocating 4 and 2 units to A and E, respectively, the shared rates are:



rate	bottleneck link(s)
A = 4 + 2 = 6	3 - 4
B = 10	4 - 5
C = 2	3 - 4
D = 3	2 - 3
E = 2 + 3 = 5	2 - 3

Note: C, D and E are not allocated 8/3 each. If that's the case, then flow A (sharing link 3-4 with C) only gets 4/3. The rate in link 1-3 for A is already smaller than the rate in link 2-3 for C, D and E. Thus, this is not fair allocation.