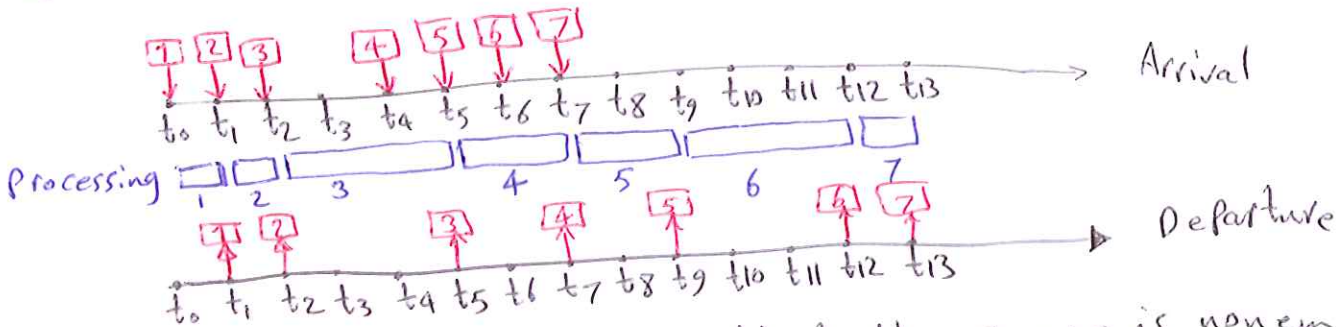
Solutions to Selected Problems in chapter 30.

P. 30.2

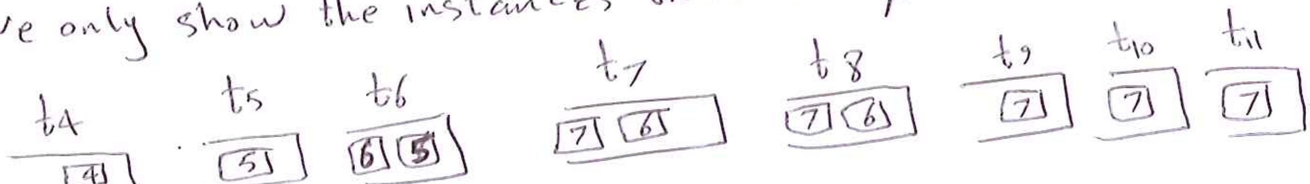
it can be implemented with n=1 packet in each clock tick which is $\frac{1}{2}$ second. we will have a FIFO queue that stores the packets and sends out one each half second. the problem is that this is an unstable system. after some time the queue becomes full and we will drop new packets.

P. 30.3

a)



we only show the instances that the queue is nonempty.



b)

Packet	1	2	3	4	5	6	7
Arrival	t_0	t_1	t_2	t_4	t_5	t_6	t_7
Departure	t_1	t_2	t_5	t_7	t_9	t_{12}	t_{13}
time spent in router	1	1	3	3	4	6	6
Relative departure delay	-	1	3	2	2	3	1

c) there is jitter as the relative departure delay between each packet is not the same.

P. 30.4

a)

AAAA BBC AAAABBC ......

b) AAAA BB AAAABB AA

C) BBCBBCBCCCCCCCC

P. 30.6

- First tick $n=8000$

after sending frame 1: $n=8000-4000=4000$

after " " 2: $n=4000-4000=0$

$n<$ size of next frame

Second tick $n=8000$

after sending frame 3: $n=8000-4000=4000$

" " " 4: $n=4000-4000=0$

$n<$ size of next frame

third tick $n=8000$

after sending frame 5: $n=8000-3200=4800$

" " " 6 $n=4800-3200=1600$

$n<$ size of next frame.

Fourth tick $n=8000$

after sending frame 7: $n=8000-3200=4800$

" 8: $n=4800-400=4400$

" " " 9: $n=4400-400=4000$

" " " 10: $n=4000-2000=2000$

" " " 11: $n=2000-2000=0$

" "

fifth tick $n=8000$ no more frames to send.

After sending frame 12: $n=8000-2000=6000$

P. 30.7.

We assume we just have input for the first 12 seconds and nothing after.

input = $100 \times \frac{12}{60} = 20$ gallons

after first minute we will have 15 gallons and the bucket will be empty after 4 minutes.

P 30.9.

n=1000 bits time tick to one second. in each second only two packets (800 bits) will be transmitted.

n=1000, first tick

after sending packet 1 : n = 1000 − 400 = 600

" " " 2 : n = 600 − 400 = 200

n < size of next packet

second tick, n=1000

after sending packet 3: n = 1000 − 400 = 600

" " " 4 : n = 600 − 400 = 200

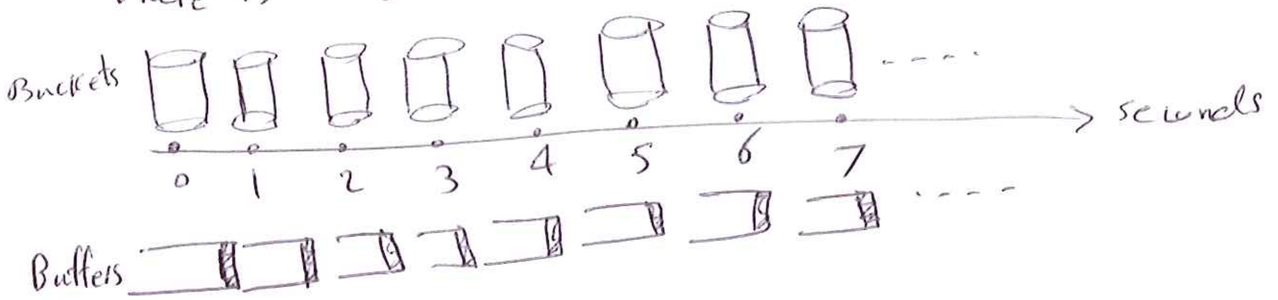
n < size of next packet

⋮

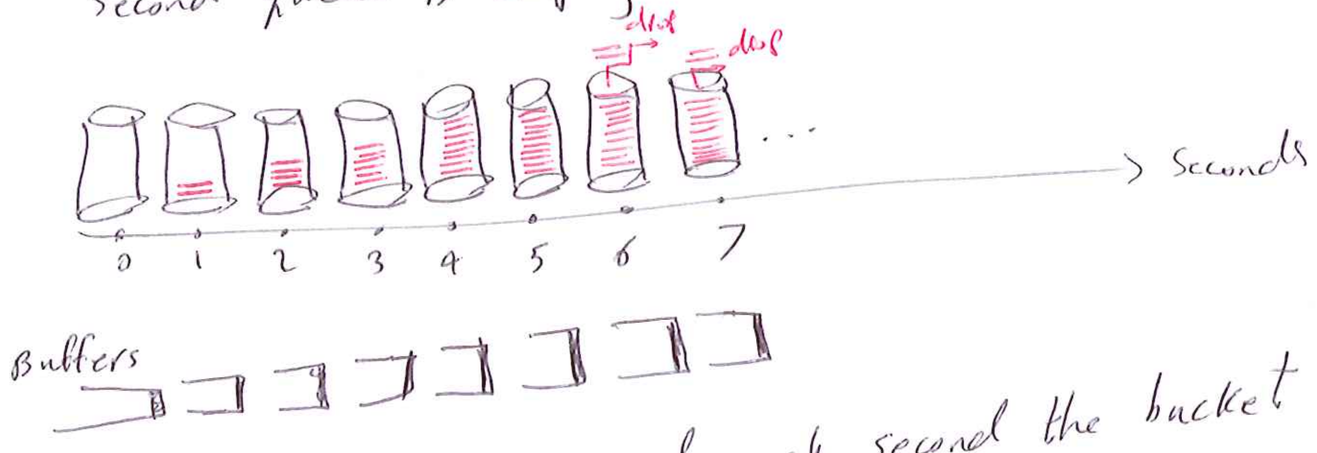
the process repeats every second. the output data rate is 0.8 Kbpsec which is less than 1 Kbps.

P. 30.10.

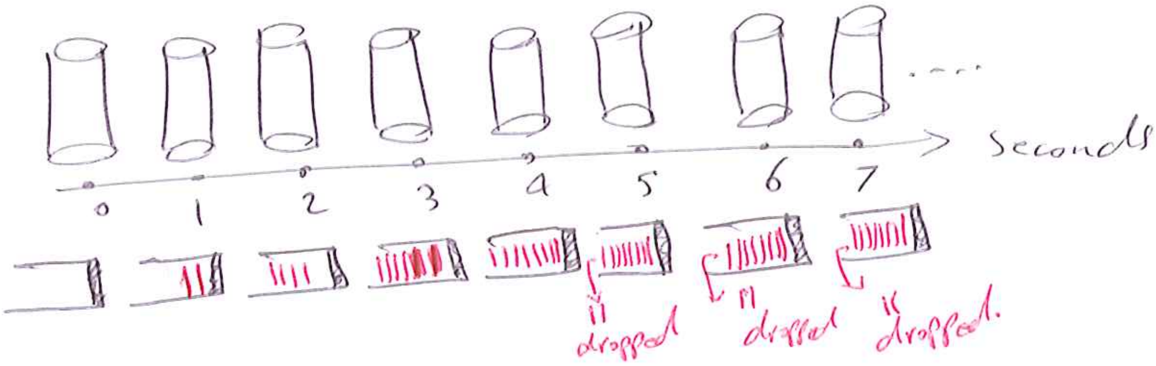
a) perfect situation. five packets arrive and depart every second. 5 tockens added and used per second. there is no jitter.



b) the sender does not use full capacity of the switch. at end of each second there will be some unused tokens. after 5 seconds bucket becomes full and has to drop tokens. at end of each second queue is empty. there is no jitter.



c) unstable system. at end of each second the bucket uses all its tokens. some packets need to wait in queue untill new tokens are added to the bucket. after 4 seconds queue becomes full. some packets are lost. the rest face jitter.



P. 38.11 Solve with r = 5