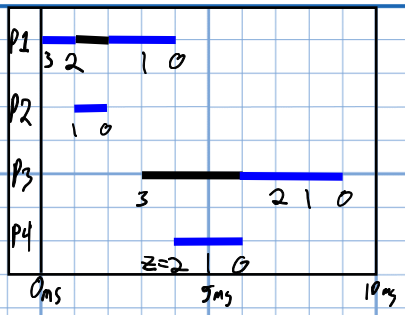
Time chart legend
= waiting
= running
= I/O req

TITLE: OS Homework
NAME: Wayne Stegner
DATE: 2020-02-16

Q1

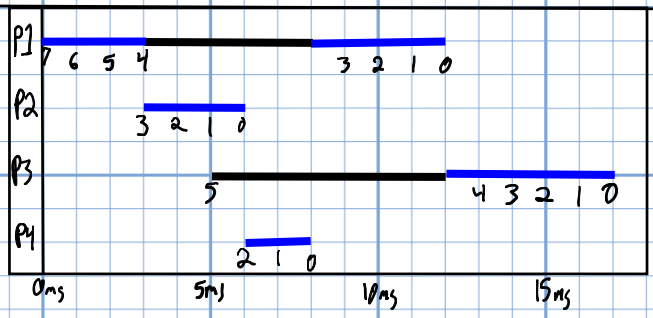
Process	Arrival	T_{cpu}
P1	0	3
P2	1	1
P3	3	3
P4	4	2



@t=4: Avg. wait time is $\frac{2}{4}=0.5$ ms
Target avg. wait time is 1 ms
To achieve this wait time, we need to add 2ms total wait time.
This occurs when $z=2$ ms

Q2.

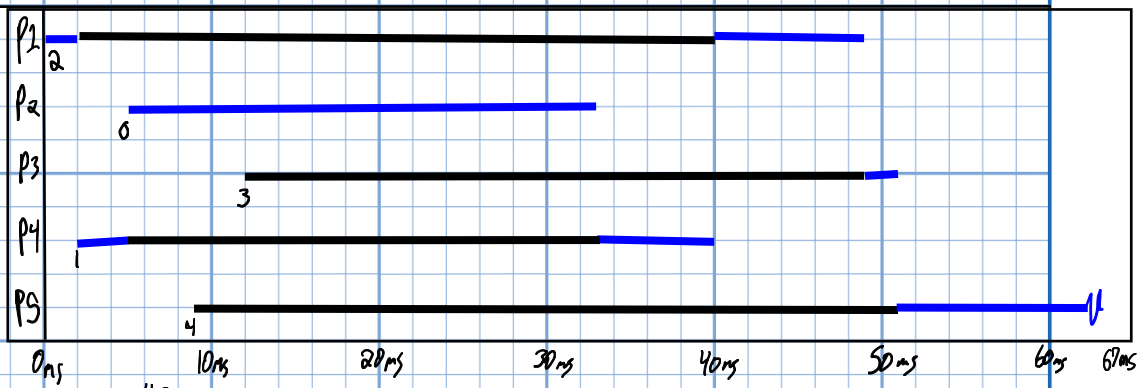
Process	Arrival	T_{cpu}
P1	0	7
P2	3	3
P3	5	5
P4	6	2



Avg. wait time: $\frac{5+7\text{ ms}}{4}=3$ ms

Q3.

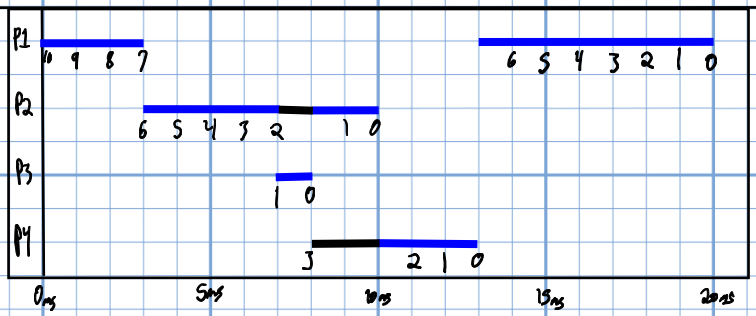
Process	Arrival	T_{cpu}	Priority
P1	0	11	2
P2	5	28	0
P3	12	2	3
P4	2	10	1
P5	9	16	4



Avg. wait time: $\frac{38+37+28+42\text{ ms}}{5}=29$ ms

Q4

Process	Arrival	T_{cpu}
P1	0	10
P2	3	6
P3	7	1
P4	8	3



Avg. turnaround time: $\frac{(20-0)+(10-3)+(8-7)+(13-8)\text{ ms}}{4}=8.25$ ms

Time chart legend
- = waiting
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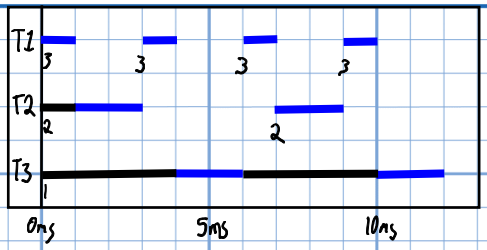
Q5.

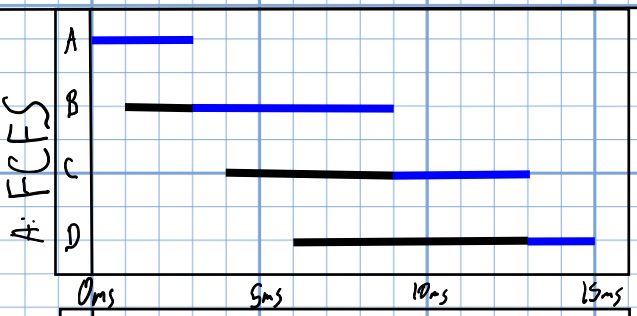
Task	Period	T_{cpu}	Priority
T1	3	1	0.33→3
T2	7	2	0.14→2
T3	20	4	0.05→1



T3 finishes its first instance after 12ms.

Q6.

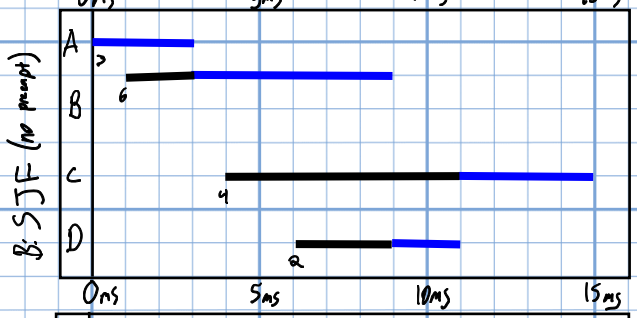
Process	Arrival	T_{cpu}
A	0	3
B	1	6
C	4	4
D	6	2



Avg. turnaround time:

$$\frac{(3-0)+(9-1)+(13-4)+(15-6)\text{ ms}}{4}$$

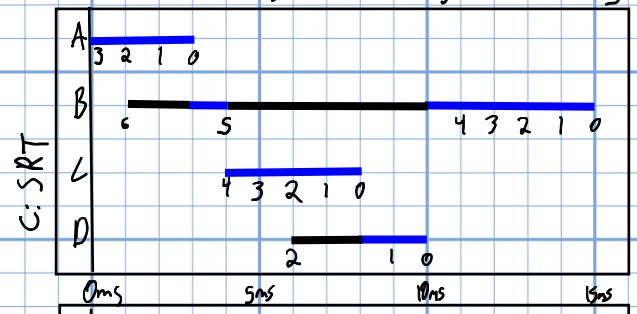
$$= 7.25\text{ ms}$$



Avg. turnaround time:

$$\frac{(3-0)+(9-1)+(15-4)+(11-6)\text{ ms}}{4}$$

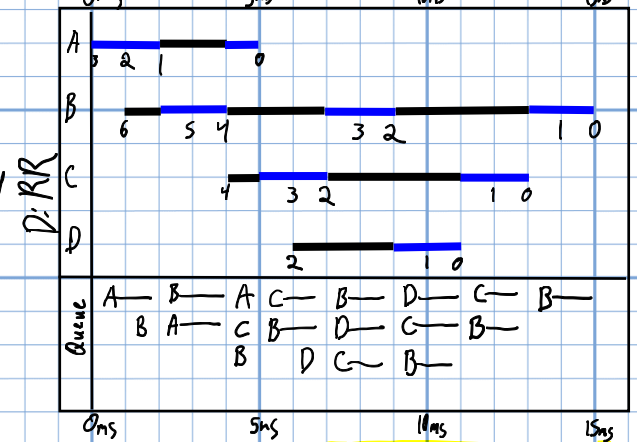
$$= 6.75\text{ ms}$$



Avg. turnaround time:

$$\frac{(3-0)+(15-1)+(8-4)+(10-6)\text{ ms}}{4}$$

$$= 6.25\text{ ms}$$



Note:
For RR, I enqueue the new process before the pre-empted process.

Avg. turnaround time:

$$\frac{(5-0)+(15-1)+(13-4)+(11-6)\text{ ms}}{4}$$

$$= 8.25\text{ ms}$$

Shortest turnaround time: C: Shortest time remaining

Time chart legend
- = waiting
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TITLE: OS Homework
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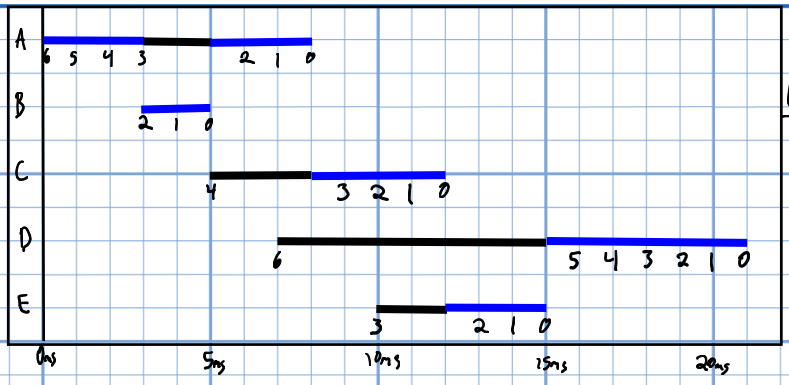
Q7.

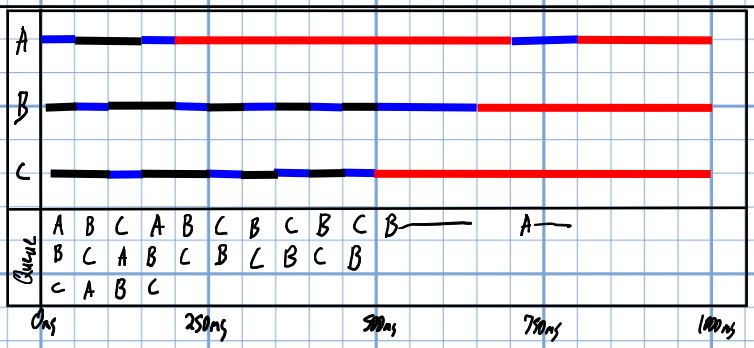
Process	Arrival	T_{cpu}
A	0	6
B	3	2
C	5	4
D	7	6
E	10	3



Avg. turnaround time:
$\frac{(8-0)+(5-3)+(12-5)+(21-7)+(15-10)\,ms}{5} = 7.2\,ms$

Q8.

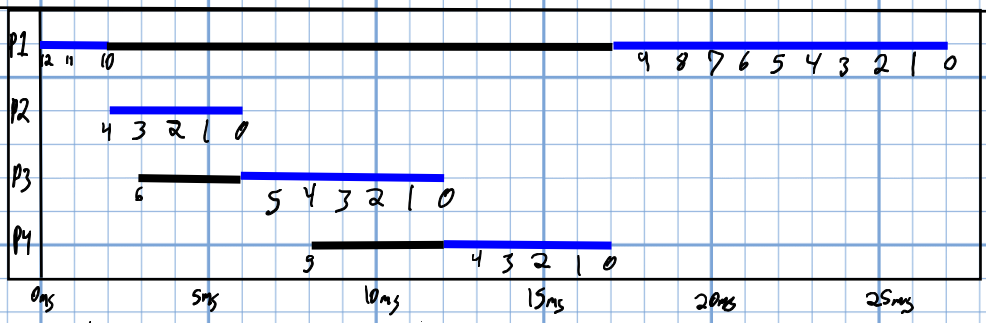
Process	Arrival	T_{cpu}	$T_{I/O}$
A	0	100	500
B	5	350	500
C	10	200	500



Process C completes first I/O @ 1000ms

Q9.

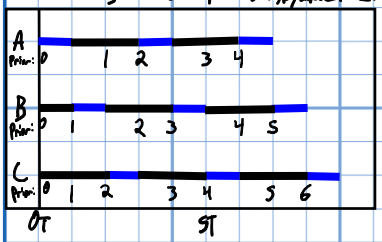
Process	Arrival	T_{cpu}
P1	0	12
P2	2	4
P3	3	6
P4	8	5



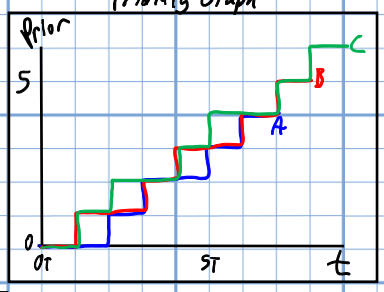
Avg. wait time: $\frac{(17-2)+(6-3)+(12-8)\,ms}{4} = 5.5\,ms$

Q10.

Say we have 3 processes: A, B, and C. If they all run for 3T time units:



Priority Graph



This result is the same as a Round Robin scheduler with a quantum of T units.
First, A, B, and C are all equal priority, so we choose A.
Next, A is 1 priority level lower than B and C, which are equal. We choose B.
Finally, A and B are equal priority, which is 1 level lower than C. We choose C.
This cycle repeats until processes finish.

The answer is B

Time chart legend
= waiting
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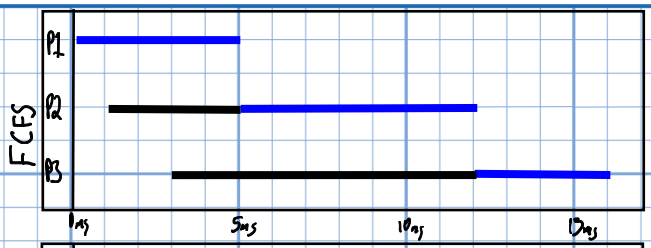
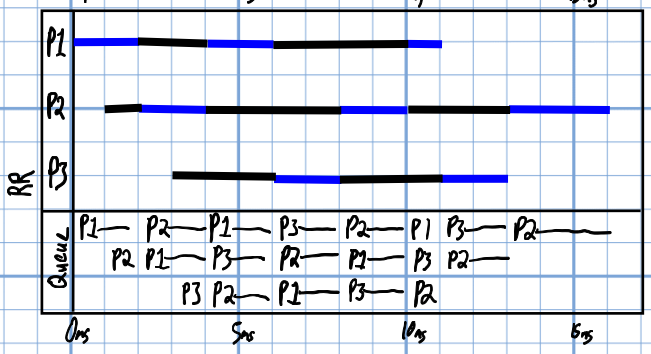
TITLE	OS Homework	
NAME	Wayne Stegner	DATE 2020-02-16

Q11.

Process	Arrival	T_{cpu}
P1	0	5
P2	1	7
P3	3	4



Completion Order: P1, P2, P3

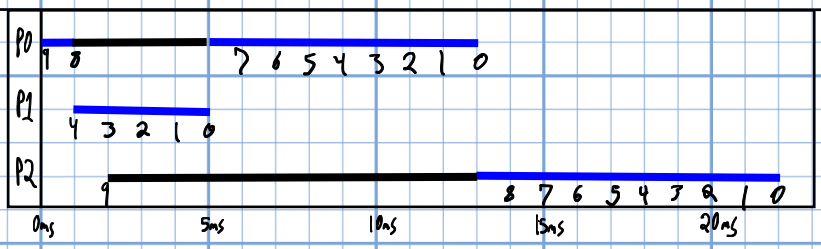


Completion order: P1, P3, P2

Answer: C

Q12.

Process	Arrival	T_{cpu}
P0	0	9
P1	1	4
P2	2	9

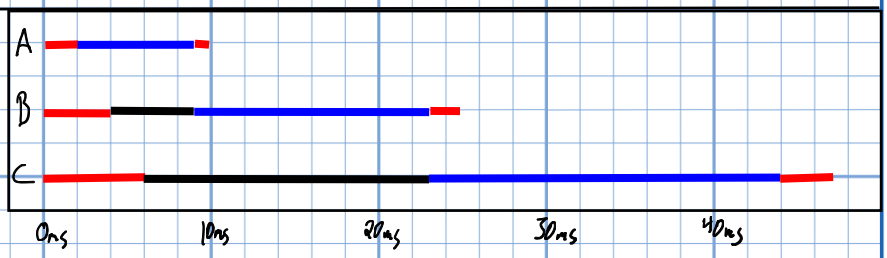


Avg wait time $= \frac{(5-1)+(15-2)}{3}\text{ms} = 5\text{ms}$

Answer: A

Q13.

Process	$T_{I/O}$	T_{cpu}	$T_{I/O}$
A	2	7	1
B	4	14	2
C	6	21	3



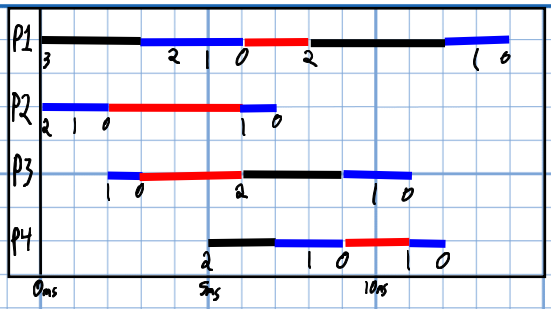
Total cycles: 47 Idle cycles: 5 (2 beginning, 3 end) Idle time: $\frac{5}{47} \approx 10.64\%$

Time chart legend
= waiting
= running
= I/O proc

TITLE OS Homework
NAME Wayne Steyner DATE 2020-02-16

Q14.

Process	Arrival	T_{cpu}	$T_{I/O}$	T_{cpu}
P1	0	3	2	2
P2	0	2	4	1
P3	2	1	3	2
P4	5	2	2	1



Note: Priority ties are broken by FCFS.

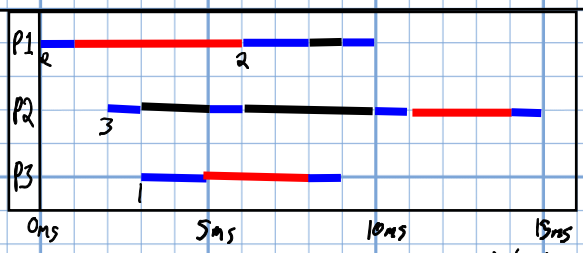
Avg. Wait time: $\frac{1+4+6+4\text{ ms}}{4} = 5.75\text{ ms}$

Avg. turnaround time: $\frac{(14-0)+(7-0)+(11-2)+(12-5)\text{ ms}}{4} = 9.25\text{ ms}$

Note: Depending on how priority ties are broken, the answer may be slightly different.

Q15

Process	Arrival	Priority	T_{cpu}	$T_{I/O}$	T_{cpu}
P1	0	2	1	5	3
P2	2	3	3	3	1
P3	3	1	2	3	1



Avg. wait time: $\frac{6+9+3}{3} = 6\text{ ms}$

Avg turnaround time: $\frac{(10-0)+(15-2)+(9-3)}{3} = 9.67\text{ ms}$