process	arrival time	Burst Time
P_0	2	3
P_1	0	7
P_2	2	4
P_3	4	1
P_4	5	4

FCFS

time

@ t=0 | P_1 | schedules P_1 to run

@ t=2 | P_2 | P_0 | $P_1(5)$

@ t=4 | P_3 | P_2 | P_0 | $P_1(3)$

@ t=5 | P_4 | P_3 | P_2 | P_0 | $P_1(2)$

@ t=7 P_1 terminates.

P_1 P_0 P_2 P_3 P_4

| P_1 | P_0 | P_2 | P_3 | P_4 |

0 7 10 14 15 19

waiting time = completion time − cpu burst − arrival time

P_0: 10 − 3 − 2 = 5

P_1: 7 − 7 − 0 = 0

P_2: 14 − 4 − 2 = ~~6~~ 8

P_3: 15 − 1 − 4 = 10

P_4: 19 − 4 − 5 = 10

/ 33

R.R. q = 3

@ t=0 | P_1 | P_1 → runs

@ t=2 | P_2 | P_0 | $P_1(5)$

@ t=3 P_1 is preempted, $P_1(4)$

| $P_1(4)$ | $P_2(4)$ | $P_0(3)$ | P_0 → runs

@ t=4 | $P_3(1)$ | $P_1(4)$ | $P_2(4)$ | $P_0(2)$

@ t=5 | $P_4(4)$ | $P_3(1)$ | $P_1(4)$ | $P_2(4)$ | $P_0(1)$

@ t=6 P_0 terminates, P_2 runs

| $P_4(4)$ | $P_3(1)$ | $P_1(4)$ |

@ t=9 P_2 is preempted, P_1 runs

| $P_2(1)$ | $P_4(4)$ | $P_3(1)$ | $P_1(4)$ |

@ t=12 P_1 is preempted, P_3 runs

| $P_1(1)$ | $P_2(1)$ | $P_4(4)$ | $P_3(1)$ |

@ t=13 P_3 terminates, P_4 runs

| $P_1(1)$ | $P_2(1)$ | $P_4(4)$ |

@ t=16 P_4 is preempted, P_2 runs

| $P_4(1)$ | $P_1(1)$ | $P_2(1)$ |

@ t=17 P_2 terminates

18 P_1 ✓

19 P_4 ✓

RR q = 3

P_0: 6 − 3 − 2 = 1

P_1: 18 − 7 − 0 = 11

P_2: 17 − 4 − 2 = 11

P_3: 13 − 1 − 4 = 8

P_4: 19 − 4 − 5 = 10

$$\frac{dn}{dt} = \lambda$$

arrival rate

$$\frac{\sum_i C_i}{\sum_i C_i + \sum_j I_j}$$

cpu	I/o	
80%	20%	L
70%	30%	
50%	50%	
30%	70%	$\theta \uparrow$ M
20%	80%	$\theta \downarrow$ H

FCFS

- reduces # of context switch
- maintains good

arrival rate $\sum_i C_i + \sum_j I_j$

$f(\lambda)$

20%

80%

8K — H

• maintains good locality

RR • good response

Q_0: if there is n_0 processes in Q_0

$(n_0-1)\cdot 8 / q_0$

n_1 . . . . , Q_1

$(n_1-1)\cdot q_1$

	arrival time	cpu burst
P_0	0	25
P_1	10	16
P_2	12	24
P_3	20	10

	Q_0 $q=8$	Q_1 $q=\cancel{16}$ 12	Q_2 FCFS
t=0	$P_0(25)$, run P_0	—	—
t=8	P_0 preempted —	$P_0(17)$, run P_0	
t=10	$P_1(16)$, run P_1	$P_0(15)$	
t=12	$P_2(24)$ $P_1(14)$		
t=18	$P_2(24)$	$P_1(8)$ $P_0(15)$	
t=20	$P_3(10)$ $P_2(22)$		
t=28	$P_3(10)$	$P_2(16)$ $P_1(8)$ $P_0(15)$	
t=34		$P_3(2)$ $P_2(16)$ $P_1(8)$ $P_0(15)$	
t=44		$P_3(2)$ $P_2(16)$ $P_1(8)$	$P_0(5)$
t=52		$P_3(2)$ $P_2(16)$	$P_0(5)$
t=64		$P_3(2)$	$P_2(4)$ $P_0(5)$
t=66	—	—	$P_2(4)$ $P_0(5)$

2ms

schedule P_2 to run

since we have run P_0 for 2ms, this round run P_0 for 10ms

P_1 terminates

P_3 terminates t = 66

P_0 terminates t = 71

P_2 terminates t = 75