# Lab Five

Eric Stenton

Eric.Stenton1@Marist.edu

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## 1 Problem One

Consider the following set of processes, with the length of the CPU burst given in milliseconds:

| Process | Burst Time | Priority |
|---|---|---|
| $P_1$ | 10 | 3 |
| $P_2$ | 1 | 1 |
| $P_3$ | 2 | 3 |
| $P_4$ | 1 | 4 |
| $P_5$ | 5 | 2 |

The processes are assumed to have arrived in the order P1, P2, P3, P4, P5 all at time 0.

a. Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, nonpreemptive priority (a smaller priority number implies a higher priority), and RR (quantum = 1).

FFCS

| P1 | P1 | P1 | P1 | P1 | P1 | P1 | P1 | P1 | P1 | P2 | P3 | P3 | P4 | P5 | P5 | P5 | P5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

SJF

| P2 | P4 | P3 | P3 | P5 | P5 | P5 | P5 | P5 | P1 | P1 | P1 | P1 | P1 | P1 | P1 | P1 | P1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

Nonpreemptive Priority

| P2 | P5 | P5 | P5 | P5 | P5 | P1 | P1 | P1 | P1 | P1 | P1 | P1 | P1 | P1 | P1 | P3 | P3 | P4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

RR (Quantum = 1)

| P1 | P2 | P3 | P4 | P5 | P1 | P3 | P5 | P1 | P5 | P1 | P5 | P1 | P5 | P1 | P1 | P1 | P1 | P1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

b. What is the turnaround time of each process for each of the scheduling algorithms in part a?

FFCS: $(10 + 11 + 13 + 14 + 19)/5 = 67/5 = 13.4$

SJF: $(19 + 1 + 4 + 2 + 9)/5 = 35/5 = 7$

Non-preepmtive Priority: $(16 + 1 + 18 + 19 + 6)/5 = 60/5 = 12$

RR (Quantum = 1): $(19 + 2 + 7 + 4 + 14)/5 = 46/5 = 9.2$

c. What is the waiting time of each process for each of these scheduling algorithms?

FFCS: $(0 + 10 + 11 + 13 + 14)/5 = 48/5 = 9.6$

SJF: $(9 + 0 + 2 + 1 + 4)/5 = 16/5 = 3.2$

Non-preepmtive Priority: $(6 + 0 + 16 + 18 + 1)/5 = 41/5 = 8.2$

RR (Quantum = 1): $(9 + 1 + 5 + 3 + 9)/5 = 27/5 = 5.4$

d. Which of the algorithms results in the minimum average waiting time (over all processes)?

The shortest job first (SJF) algorithm results in the minimum average waiting time over all processes which makes sense because it is the optimal, albeit impossible to realistically implement, scheduling algorithm.