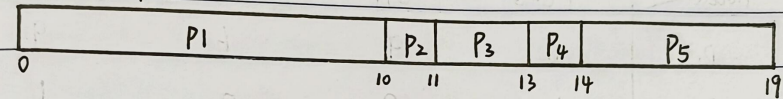


### 3<sup>rd</sup> CPU 调度

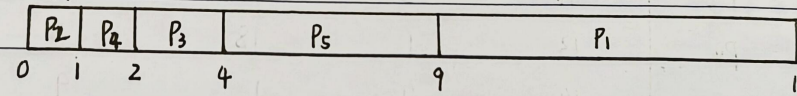
1. Importance of distinguishing I/O-bound programs <sup>from</sup> and CPU-bound programs?

A: I/O 密集型程序通常具有大量短 CPU 执行, CPU 密集型程序可能只有少量长 CPU 执行。区分两种类型的程序, 对于选择合适的 CPU 调度算法从而提高运行效率有重要作用。

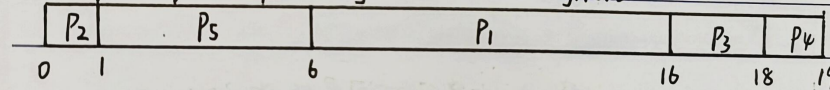
2. a. ① FCFS:



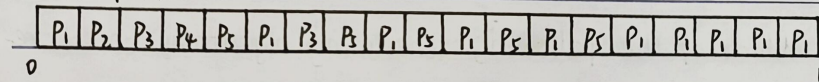
② STF:



③ nonpreemptive priority (smaller  $\rightarrow$  higher)



④ RR (quantum = 1)



b. 周转时间 (等待 + 执行)

| process \ algorithms | FCFS | STF | nonpreemptive priority | RR |
|----------------------|------|-----|------------------------|----|
| P <sub>1</sub>       | 10   | 19  | 16                     | 19 |
| P <sub>2</sub>       | 11   | 1   | 1                      | 2  |
| P <sub>3</sub>       | 13   | 4   | 18                     | 7  |

(接上页表)

| process \ algorithms | FCFS | SJF | nonpreemptive priority | RR  |
|----------------------|------|-----|------------------------|-----|
| P <sub>4</sub>       | 14   | 2   | 19                     | 4   |
| P <sub>5</sub>       | 19   | 9   | 6                      | 14  |
| AVG                  | 13.4 | 7   | 12                     | 9.2 |

c. 等待时间

| process \ algorithms | FCFS | SJF | nonpreemptive priority | RR  |
|----------------------|------|-----|------------------------|-----|
| P <sub>1</sub>       | 0    | 9   | 6                      | 9   |
| P <sub>2</sub>       | 10   | 0   | 0                      | 1   |
| P <sub>3</sub>       | 11   | 2   | 16                     | 5   |
| P <sub>4</sub>       | 13   | 1   | 18                     | 3   |
| P <sub>5</sub>       | 14   | 4   | 1                      | 9   |
| AVG                  | 9.6  | 3.2 | 8.2                    | 5.4 |

d. 短作业优先(SJF) 算法平均等待时间最短, 为 3.2 (ms)

3. Which of the following scheduling algorithms could result in starvation?

b. short job first (SJF) and d. Priority

4. A: (1) new priorities:

$$P_1 = 40/2 + 60 = 80, P_2 = 18/2 + 60 = 69, P_3 = 10/2 + 60 = 65$$

优先级从高到低为  $P_3, P_2, P_1$

(2) 传统的 unix 调度方法降低了 CPU 密集型进程的相对优先级。  
因为 CPU 密集型进程比 I/O 密集型进程占用更多 CPU 时间, 该计算方法以 Recent CPU usage / 2 为增量, CPU 密集型进程 Priority 值增长更快, 故优先级也降低得更快, 所以其相对优先级是降低的。