

# Project 01

## Project Description

Please write a program to perform process scheduling according to the following requirements:

- The programming language is of your choice.
- It can be run on the Windows operating system.
- It can be executed via the command line using the following syntax:

**MSSV1\_MSSV2.exe** <INPUT\_FILE> <OUTPUT\_FILE>

For example:

*MSSV1\_MSSV2.exe input.txt output.txt*

- The input and output files are both saved in text format (\*.txt).
- Syntax of the <INPUT\_FILE>:

- The first line: an integer from 1 to 4 representing the scheduling algorithm

| # | Scheduling algorithm                |
|---|-------------------------------------|
| 1 | FCFS (First Come First Serve)       |
| 2 | RR (Round Robin)                    |
| 3 | SJF (Shortest Job First)            |
| 4 | SRTN (Shortest Remaining Time Next) |

- In case of the Round Robin scheduling algorithm, the second line is a positive integer representing the time quantum.
- The next line: a positive integer N representing the number of processes to be scheduled, up to maximum of 4 processes.
- The following N lines: each line describes the scheduling information of a process with the syntax:  
 <Arrival time in Ready Queue> [<CPU Burst Time> <Resource Usage Time>]
- It is known that:
  - In the scheduling table, each process can use CPU and R multiple times, but up to a maximum of 3 times for each (CPU/R)

- In the scheduling table, a process may complete earlier than other processes. This means that the number of CPU and R usages for each process is different.
- The system only has one resource R. The scheduling algorithm on resource R is always FCFS.
- Give priority to new processes in case of conflict in the entrance of Ready Queue.

For example:

| FCFS/SJF/SRTN  | Round Robin   |              |     |     |     |     |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
|--|---|--------------|-----|-----|-----|-----|---|---|---|---|----|---|---|--|--|----|---|---|---|--|--|---|----|-----|---|-----|---|-----|----|---|---|---|---|--|--|----|---|---|--|--|--|--|----|---|---|---|--|--|--|----|---|---|---|---|---|---|
| 1<br>3<br>0 5 3 4<br>1 4<br>2 3 3  | 2<br>3<br>4<br>0 5 3 4<br>2 4<br>5 3 3<br>3 6 2 3 8 1 |              |     |     |     |     |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
| <table><tr><th>#</th><th>Arrival Time</th><th>CPU</th><th>R</th><th>CPU</th></tr><tr><td>P1</td><td>0</td><td>5</td><td>3</td><td>4</td></tr><tr><td>P2</td><td>1</td><td>4</td><td></td><td></td></tr><tr><td>P3</td><td>2</td><td>3</td><td>3</td><td></td></tr></table> | #   | Arrival Time | CPU | R   | CPU | P1  | 0 | 5 | 3 | 4 | P2 | 1 | 4 |  |  | P3 | 2 | 3 | 3 |  | <table><tr><th>#</th><th>AT</th><th>CPU</th><th>R</th><th>CPU</th><th>R</th><th>CPU</th></tr><tr><td>P1</td><td>0</td><td>5</td><td>3</td><td>4</td><td></td><td></td></tr><tr><td>P2</td><td>2</td><td>4</td><td></td><td></td><td></td><td></td></tr><tr><td>P3</td><td>5</td><td>3</td><td>3</td><td></td><td></td><td></td></tr><tr><td>P4</td><td>3</td><td>6</td><td>2</td><td>3</td><td>8</td><td>1</td></tr></table> | # | AT | CPU | R | CPU | R | CPU | P1 | 0 | 5 | 3 | 4 |  |  | P2 | 2 | 4 |  |  |  |  | P3 | 5 | 3 | 3 |  |  |  | P4 | 3 | 6 | 2 | 3 | 8 | 1 |
| #  | Arrival Time  | CPU          | R   | CPU |     |     |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
| P1   | 0   | 5            | 3   | 4   |     |     |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
| P2   | 1   | 4            |     |     |     |     |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
| P3   | 2   | 3            | 3   |     |     |     |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
| #  | AT  | CPU          | R   | CPU | R   | CPU |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
| P1   | 0   | 5            | 3   | 4   |     |     |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
| P2   | 2   | 4            |     |     |     |     |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
| P3   | 5   | 3            | 3   |     |     |     |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |
| P4   | 3   | 6            | 2   | 3   | 8   | 1   |   |   |   |   |    |   |   |  |  |    |   |   |   |  |  |   |    |     |   |     |   |     |    |   |   |   |   |  |  |    |   |   |  |  |  |  |    |   |   |   |  |  |  |    |   |   |   |   |   |   |

- Syntax of the **<OUTPUT\_FILE>**:

- The first line: an integer sequence separated by a single whitespace, represents the Gantt chart of the process scheduling on the CPU. Note that the numbers 1, 2, 3, 4 represent processes P1, P2, P3, P4; and a hyphen ( \_ ) denotes the time slot during which no process is using the CPU.

- The second line: has a similar structure to the first line, but it represents the scheduling on the resource R.
- The third line: an integer sequence separated by a single whitespace, represents the turn-around time of all processes.
- The fourth line: an integer sequence separated by a single whitespace, represents the waiting time of all processes.

For example:

| Input                             | Output   |    |              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |   |  |  |  |  |  |    |    |    |  |  |  |  |    |    |    |  |  |  |                  |  |              |  |    |    |  |   |  |    |   |  |   |  |    |    |  |   |  |
|-----------------------------------|--|----|--------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|---|--|--|--|--|--|----|----|----|--|--|--|--|----|----|----|--|--|--|------------------|--|--------------|--|----|----|--|---|--|----|---|--|---|--|----|----|--|---|--|
| 1<br>3<br>0 5 3 4<br>1 4<br>2 3 3 | 1 1 1 1 1 2 2 2 2 3 3 3 1 1 1 1<br>______ 1 1 1 _____ 3 3 3<br>16 8 13<br>4 4 7  |    |              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |   |  |  |  |  |  |    |    |    |  |  |  |  |    |    |    |  |  |  |                  |  |              |  |    |    |  |   |  |    |   |  |   |  |    |    |  |   |  |
|                                   | <table><tr><td></td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td></tr><tr><td>CPU</td><td>P1</td><td>P1</td><td>P1</td><td>P1</td><td>P1</td><td>P2</td><td>P2</td><td>P2</td><td>P2</td><td>P3</td><td>P3</td><td>P3</td><td>P1</td><td>P1</td><td>P1</td><td>P1</td><td></td></tr><tr><td>R</td><td></td><td></td><td></td><td></td><td></td><td>P1</td><td>P1</td><td>P1</td><td></td><td></td><td></td><td></td><td>P3</td><td>P3</td><td>P3</td><td></td><td></td></tr></table> <table><tr><td></td><td colspan="2">Turn-around Time</td><td colspan="2">Waiting Time</td></tr><tr><td>P1</td><td colspan="2">16</td><td colspan="2">4</td></tr><tr><td>P2</td><td colspan="2">8</td><td colspan="2">4</td></tr><tr><td>P3</td><td colspan="2">13</td><td colspan="2">7</td></tr></table> |    | 0            | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | CPU | P1 | P1 | P1 | P1 | P1 | P2 | P2 | P2 | P2 | P3 | P3 | P3 | P1 | P1 | P1 | P1 |  | R |  |  |  |  |  | P1 | P1 | P1 |  |  |  |  | P3 | P3 | P3 |  |  |  | Turn-around Time |  | Waiting Time |  | P1 | 16 |  | 4 |  | P2 | 8 |  | 4 |  | P3 | 13 |  | 7 |  |
|                                   | 0  | 1  | 2            | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |   |  |  |  |  |  |    |    |    |  |  |  |  |    |    |    |  |  |  |                  |  |              |  |    |    |  |   |  |    |   |  |   |  |    |    |  |   |  |
| CPU                               | P1   | P1 | P1           | P1 | P1 | P2 | P2 | P2 | P2 | P3 | P3 | P3 | P1 | P1 | P1 | P1 |    |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |   |  |  |  |  |  |    |    |    |  |  |  |  |    |    |    |  |  |  |                  |  |              |  |    |    |  |   |  |    |   |  |   |  |    |    |  |   |  |
| R                                 |  |    |              |    |    | P1 | P1 | P1 |    |    |    |    | P3 | P3 | P3 |    |    |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |   |  |  |  |  |  |    |    |    |  |  |  |  |    |    |    |  |  |  |                  |  |              |  |    |    |  |   |  |    |   |  |   |  |    |    |  |   |  |
|                                   | Turn-around Time   |    | Waiting Time |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |   |  |  |  |  |  |    |    |    |  |  |  |  |    |    |    |  |  |  |                  |  |              |  |    |    |  |   |  |    |   |  |   |  |    |    |  |   |  |
| P1                                | 16   |    | 4            |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |   |  |  |  |  |  |    |    |    |  |  |  |  |    |    |    |  |  |  |                  |  |              |  |    |    |  |   |  |    |   |  |   |  |    |    |  |   |  |
| P2                                | 8  |    | 4            |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |   |  |  |  |  |  |    |    |    |  |  |  |  |    |    |    |  |  |  |                  |  |              |  |    |    |  |   |  |    |   |  |   |  |    |    |  |   |  |
| P3                                | 13   |    | 7            |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |   |  |  |  |  |  |    |    |    |  |  |  |  |    |    |    |  |  |  |                  |  |              |  |    |    |  |   |  |    |   |  |   |  |    |    |  |   |  |

## Submission

- Deadline: **23h59 February 3rd, 2024.**
- Team size: 1-2 students/team.
- The project must be submitted by the deadline and formatted according to the requirements.
  - **MSSV1\_MSSV2** folder contains:
    - **MSSV1\_MSSV2-Code** folder: the entire source code of the program, remove all irrelevant subfolders to reduce the size.

- **MSSV1\_MSSV2.EXE** file: a executive program that can be run via the command line on Windows.
- **Input.txt** file: a sample input file that your program can be executed.
- **Output.txt** file: a sample output file that your program writes out corresponding to the input file above.
- **Compress** the entire MSSV folder above and name it **MSSV1\_MSSV2.zip** (accept .zip format only)

## Important Notes

- **Each student must understand clearly the code for a minimum 2 of 4 scheduling algorithms**, as determined by the teacher through questioning.
- Do not accept any late submissions for any reason.
- Submitting in the wrong format as required will result in a point deduction.
- Do not accept any copying of work from other students for any reason. Any violation of this policy will result in failure of the assignment/course.

**-- THE END --**