Contents:

Introduction to Scheduling

Scheduling is a way in which the CPU solves the problem of deciding which of the awaiting requests is to be allocated first. Scheduling algorithms are the mechanisms used to find a solution to this problem.

There are two types of CPU scheduling: preemptive and non-preemptive.

Preemptive:

When running tasks are interrupted in order to run a more important one.

Non-Preemptive:

When tasks are only released after execution or by termination, regardless of the present of an awaiting higher priority task.

The Simple Scheduler

The Simple Scheduler is a straightforward console-based program that uses four out of many other scheduling algorithms; First-Come-First-Served (FCFS), Shortest-Job-First (SJF), Priority Scheduling and Round Robin (RR), with the option of using some them in their preemptive or non-preemptive form. It also provides the Gantt Chart of the FCFS algorithm in addition to brief information about a few of the algorithms.

The user has the option of writing process details then picking which algorithm to use to calculate the waiting time, turn-around time, response time and context switching. Or they can load processes details from a text file. The application then stores the results in a text file.

Manual

How to use this application:

1. User should choose whether they would like to manually enter process details or load them from an existing file by entering 1 for the former, and 2 for the latter.

2. User should choose which algorithm they would like to use. (1 for FCFS, 2 for SJF, 3 for Priority, 4 for RR)

3. User should pick a scheme for their algorithm. i.e.: preemptive or non-preemptive. (1 for preemptive, 2 for non-preemptive)

4. The results of the chosen algorithm be displayed; the waiting time, turnaround time, response time and the average of each of them are calculated as well as the context switching and the Gantt chart.

5. User will be asked whether they would like to continue using the program or not. (for yes press Y, for no press N)

6. Results can be found in a text file called *results.txt* in the project's folder.

Running Example

Start of The Program

```
**********************************************
* Welcome to the Simple Scheduler Program *
**********************************************

What would you like to do?
    1. Enter Process Details
    2. Load Process Details From Text File
```

1. FCFS

User input

```
Number of processes: 5
Arrival Time: 0 1 2 3 4
Burst Time: 2 6 4 9 12

Pick An Algorithm to Implement:
    1. First-Come-First-Served (FCFS)
    2. Shortest-Job-First (SJF)
    3. Priority Scheduling
    4. Round Robin (RR)
1

Note: FCFS is Only a Non-Preemptive Algorithm.
```

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion time
P1	0	2	0	2	0
P2	1	6	1	7	8
P3	2	4	6	10	12
P4	3	9	9	18	21
P5	4	12	17	29	33

```
Average waiting time: 6.6
Average turn around time: 13.2
Average response time: 14.8
Context switching: 4


                GANTT CHART

        | P[1]  | P[2]  | P[3]  | P[4]  | P[5] |
        0       0       8       12      21      33
```

Read from File

```
Would You Like To Try Another Algorithm? (Y/N)
Y
What would you like to do?
    1. Enter Process Details
    2. Load Process Details From Text File
2

Do You Want To Load a File:
     1.With Arrival Time
     2.Wtithout Arrival Time
1
Pick An Algorithm to Implement:
    1. First-Come-First-Served (FCFS)
    2. Shortest-Job-First (SJF)
    3. Priority Scheduling
    4. Round Robin (RR)
1

Note: FCFS is Only a Non-Preemptive Algorithm.
```

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion time
P1	0	2	0	2	0
P2	0	3	2	5	5
P3	0	6	5	11	11
P4	0	2	11	13	13

```
Average waiting time: 4.5
Average turn around time: 7.75
Average response time: 7.25
Context switching: 3


                GANTT CHART

        | P[1]  | P[2]  | P[3]  | P[4] |
        0       0       5       11      13
```

2. SJF

- Preemptive (SRTF)

User Input

```
Please Enter Process Details...

Number of processes: 6
Arrival Time: 0 1 2 3 4 5
Burst Time: 8 4 2 1 3 2

Pick An Algorithm to Implement:
    1. First-Come-First-Served (FCFS)
    2. Shortest-Job-First (SJF)
    3. Priority Scheduling
    4. Round Robin (RR)
2
For Preemptive Enter 1, For Non-Preemptive Enter 2
1

Note: The Preemptive Version of the SJF Algorithm is Called Shortest-Remaining-Time-First(SRTF)

Process      Arrival Time       Burst Time      Waiting Time       Turn Around Time      Completion t:
P1                 0                 8              12                 20                   20
P2                 1                 4              5                  9                    10
P3                 2                 2              0                  2                    4
P4                 3                 1              1                  2                    5
P5                 4                 3              6                  9                    13
P6                 5                 2              0                  2                    7

Average waiting time: 4.0
Average turn around time: 7.3333335
Average response time: 9.833333
Context switching: 6
```

Read from File

Note: The Preemptive Version of the SJF Algorithm is Called Shortest-Remaining-Time-First (SRTF)

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion time
P1	0	2	0	2	2
P2	0	3	4	7	7
P3	0	6	7	13	13
P4	0	2	2	4	4

Average waiting time: 3.25

Average turn around time: 6.5

Average response time: 6.5

Context switching: 4

- Non-Preemptive SJF

User Input

```
Please Enter Process Details...

Number of processes: 5
Arrival Time: 1 3 6 7 9
Burst Time: 7 3 2 10 8

Pick An Algorithm to Implement:
    1. First-Come-First-Served (FCFS)
    2. Shortest-Job-First (SJF)
    3. Priority Scheduling
    4. Round Robin (RR)
2
For Preemptive Enter 1, For Non-Preemptive Enter 2
2
Process      Arrival Time       Burst Time      Waiting Time       Turn Around Time      Completion time
P1                1                  7              0                  7                    8
P2                3                  3              7                  10                   13
P3                6                  2              2                  4                    10
P4                7                  10              14                24                   31
P5                9                  8              4                  12                   21

Average waiting time: 5.4
Average turn around time: 11.4
Average response time: 16.6
Context switching: 4
```

Read from File

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion time
P1	0	2	0	2	2
P2	0	2	2	4	4
P3	0	3	4	7	7
P4	0	6	7	13	13

Average waiting time: 3.25
Average turn around time: 6.5
Average completion/response time: 6.5
Context switching: 3

3. Non-Preemptive Priority Scheduling

User Input

```
Number of processes: 5
Arrival Time: 1 2 3 4 5
Burst Time: 3 5 1 7 4

Pick An Algorithm to Implement:
    1. First-Come-First-Served (FCFS)
    2. Shortest-Job-First (SJF)
    3. Priority Scheduling
    4. Round Robin (RR)
3
Please enter the priority for each process in order. (highest priority: 1) 3 4 1 7 8

Note: Priority Scheduling can be both preemptive and non-preemptive. This application only calculates non-preemptive.

Process      Arrival Time       Burst Time      Waiting Time       Turn Around Time      Completion time
P1                1                  3               0                  3                    4
P2                2                  5               2                  7                    9
P3                3                  1               6                  7                    10
P4                4                  7               6                  13                   17
P5                5                  4               12                 16                   21

Average waiting time: 5.2
Average turn around time: 9.2
Average response time: 12.2
Context switching: 4
```

Read from File

```
Please enter the priority for each process in order. (highest priority: 1)  1 2 3 4
Note: Priority Scheduling can be both preemptive and non-preemptive. This program only calculates non-preemptive.

Process      Arrival Time      Burst Time      Waiting Time      Turn Around Time      Completion time
P1                0                 2                0                 2                    2
P2                0                 3                2                 5                    5
P3                0                 6                5                 11                   11
P4                0                 2                11                13                   13

Average waiting time: 4.5
Average turn around time: 7.75
Average response time: 7.75
Context switching: 3
```

4. Round Robin

User input:

```
Please Enter Process Details...

Number of processes: 4
Arrival Time: 0 1 2 3
Burst Time: 10 4 5 3

Pick An Algorithm to Implement:
    1. First-Come-First-Served (FCFS)
    2. Shortest-Job-First (SJF)
    3. Priority Scheduling
    4. Round Robin (RR)
4
Please enter the time quantum:
3

Note: Round Robin is only a preemptive algorithm.

Process      Arrival Time       Burst Time      Waiting Time       Turn Around Time      Completion time
P1                 0                 10              12                 22                    22
P2                 1                 4               11                 15                    15
P3                 2                 5               11                 16                    16
P4                 3                 3               6                  9                     9

Average waiting time: 10.0
Average turn around time: 15.5
Average response time: 15.5
Context switching: 31
```

Read from File

```
Please enter the time quantum:
2

Note: Round Robin is only a preemptive algorithm.

Process      Arrival Time       Burst Time      Waiting Time       Turn Around Time      Completion time
P1                 0                 2              0                  2                    2
P2                 0                 3              6                  9                    9
P3                 0                 6              7                  13                   13
P4                 0                 2              6                  8                    8

Average waiting time: 4.75
Average turn around time: 8.0
Average response time: 8.0
Context switching: 18
```

End of the Program

```
Would You Like To Try Another Algorithm? (Y/N)
N
BUILD SUCCESSFUL (total time: 13 minutes 20 seconds)
```

Results in File *results.txt*

FCFS RESULTS

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	0	2	0	2	0
P2	1	6	1	7	8
P3	2	4	6	10	12
P4	3	9	9	18	21
P5	4	12	17	29	33

Average Waiting Time: 6.6
Average Turn Around Time: 13.2
Average Response Time: 14.8
Context Switching: 4

FCFS RESULTS

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	0	2	0	2	0
P2	0	3	2	5	5
P3	0	6	5	11	11
P4	0	2	11	13	13

Average Waiting Time: 4.5
Average Turn Around Time: 7.75
Average Response Time: 7.25
Context Switching: 3

PREEMPTIVE SJF RESULTS (SRTF)

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	0	8	12	20	20
P2	1	4	5	9	10
P3	2	2	0	2	4
P4	3	1	1	2	5
P5	4	3	6	9	13
P6	5	2	0	2	7

Average Waiting Time: 4.0
Average Turn Around Time: 7.3333335
Average Response Time: 9.833333
Context Switching: 6

PREEMPTIVE SJF RESULTS (SRTF)

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	0	2	0	2	2
P2	0	3	4	7	7
P3	0	6	7	13	13
P4	0	2	2	4	4

Average Waiting Time: 3.25
Average Turn Around Time: 6.5
Average Response Time: 6.5
Context Switching: 4

NON-PREEMPTIVE SJF RESULTS

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	1	7	0	7	8
P2	3	3	5	8	11
P3	6	2	5	7	13
P4	7	10	6	16	23
P5	9	8	14	22	31

Average Waiting Time: 6.0
Average Turn Around Time: 12.0
Average Response Time: 17.2
Context Switching: 4

NON-PREEMPTIVE SJF RESULTS

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	0	2	0	2	2
P2	0	2	2	4	4
P3	0	3	4	7	7
P4	0	6	7	13	13

Average Waiting Time: 3.25
Average Turn Around Time: 6.5
Average Response Time: 6.5
Context Switching: 3

NON-PREEMPTIVE PRIORITY RESULTS

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	0	3	0	3	3
P2	2	5	1	6	8
P3	1	4	7	11	12
P4	4	2	8	10	14
P5	6	9	8	17	23
P6	5	4	18	22	27
P7	7	10	20	30	37

Average Waiting Time: 8.857142
Average Turn Around Time: 14.142858
Average Response Time: 17.714285
Context Switching: 6

NON-PREEMPTIVE PRIORITY RESULTS

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	0	2	0	2	2
P2	0	3	2	5	5
P3	0	6	5	11	11
P4	0	2	11	13	13

Average Waiting Time: 4.5
Average Turn Around Time: 7.75
Average Response Time: 7.75
Context Switching: 3

ROUND ROBIN RESULTS

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	0	10	12	22	22
P2	1	4	11	15	15
P3	2	5	11	16	16
P4	3	3	6	9	9

Average Waiting Time: 10.0
Average Turn Around Time: 15.5
Average Response Time: 15.5
Context Switching: 31

ROUND ROBIN RESULTS

Process	Arrival Time	Burst Time	Waiting Time	Turn Around Time	Completion Time
P1	0	2	0	2	2
P2	0	3	6	9	9
P3	0	6	7	13	13
P4	0	2	6	8	8

Average Waiting Time: 4.75
Average Turn Around Time: 8.0
Average Response Time: 8.0
Context Switching: 18

The Simple Scheduler's Pros and Cons

Pros:

- It is a very simple program that anyone can use
- It can be helpful for beginners who are still learning about CPU scheduling algorithms
- It is a fast program

Cons:

- It only includes the Gantt chart of the FCFS algorithm.
- It does not include the preemptive priority algorithm.
- Some calculations may be inaccurate for some algorithms