Lab #2 - CPU Scheduling

Karl-Johan Grinnemo
`karl-johan.grinnemo@kau.se`
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Preparations

Read Section 5.3, "Scheduling Algorithms", in the textbook (ninth and tenth edition).

Description

This lab aims at reinforcing the student's understanding of some common CPU scheduling algorithms: First-Come, First-Served (FCFS), Shortest-Job First (SJF), and Round Robin (RR). The students should implement a CPU-scheduling simulator, `sched`, that takes as input,

- a process information file, `<process information file>`, which contains information about *which* process arrives *when*, and *how much* CPU time it requests, i.e., *burst time*;
- the name of the employed scheduling algorithm: `FCFS`, `SJF`, or `RR`; and,
- if RR is employed, the time quantum, `<time quantum>`, in milliseconds.

The `sched` simulator computes:

- the *waiting time* and *turnaround time* for the respective process, and
- the *average waiting time* and *average turnaround time*.

The `sched` simulator should be implemented in C, C++, Java, or Python. Other programming languages might be possible to use, however, this needs to be discussed with the lab assistants.

A synopsis for the `sched` simulator is given below.

```
sched -f <process information file> -a [FCFS | SJF | RR] [-q <time quantum>]
```

The `-q` option is only applicable when the RR scheduling algorithm is selected.

The format of a process information file is as follows:

```
<PID>,<arrival time>,<burst time><newline character>
...
<PID>,<arrival time>,<burst time><newline character>
```

Both `<arrival time>` and `<burst time>` are given in milliseconds; `<PID>` denotes the process identification.

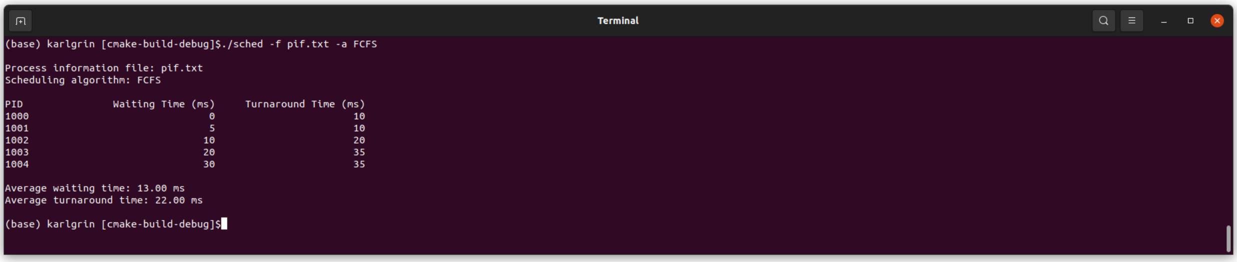
As an example, consider a process information file, `pif.txt`, with five processes with PIDs: 1000, 1001, 1002, 1003, and 1004, arrival times: 0 ms, 5 ms, 5 ms, 5 ms, and 10 ms, and with burst times: 10 ms, 5 ms, 10 ms, 15 ms, and 5 ms:

File

pif.txt

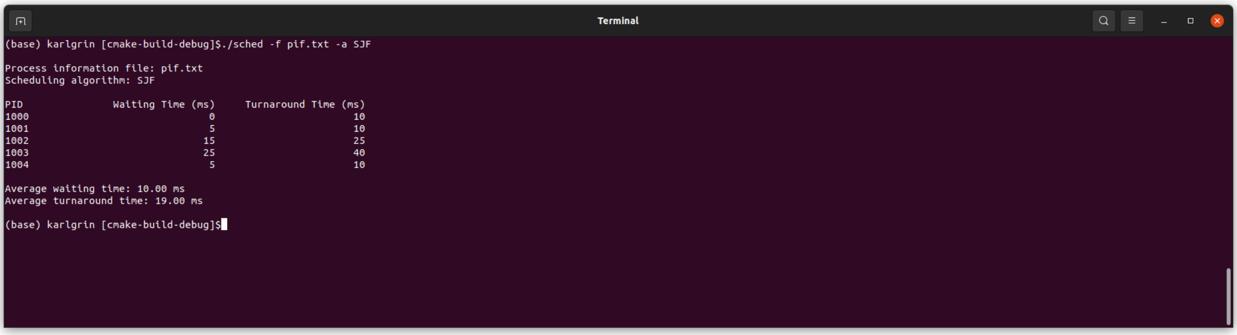
```
1000,0,10
1001,5,5
1002,5,10
1003,5,15
1004,10,5
```

The sample output for the three possible scheduling algorithms is shown in the figures below.



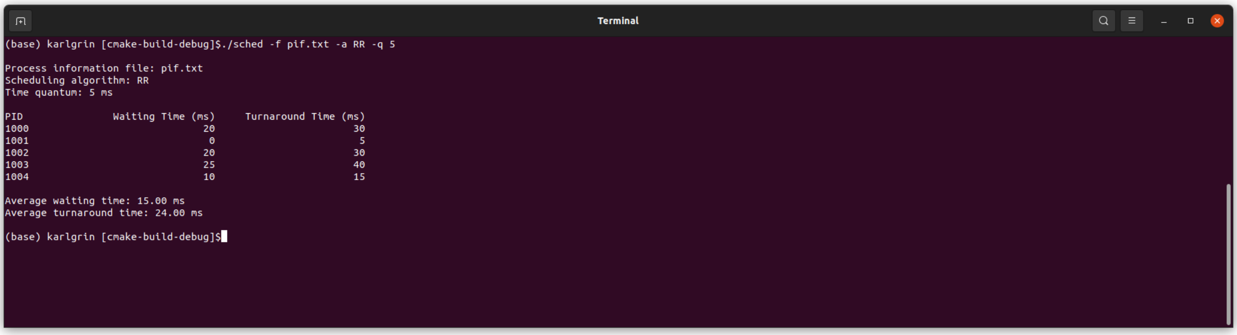
```
(base) karlgrin [cmake-build-debug]$./sched -f pif.txt -a FCFS

Process information file: pif.txt
Scheduling algorithm: FCFS

PID               Waiting Time (ms)     Turnaround Time (ms)
1000                              0                       10
1001                              5                       10
1002                             10                       20
1003                             20                       35
1004                             30                       35

Average waiting time: 13.00 ms
Average turnaround time: 22.00 ms

(base) karlgrin [cmake-build-debug]$
```

Figure 1: Screenshot from a simulation of FCFS.



```
(base) karlgrin [cmake-build-debug]$./sched -f pif.txt -a SJF

Process information file: pif.txt
Scheduling algorithm: SJF

PID               Waiting Time (ms)     Turnaround Time (ms)
1000                              0                       10
1001                              5                       10
1002                             15                       25
1003                             25                       40
1004                              5                       10

Average waiting time: 10.00 ms
Average turnaround time: 19.00 ms

(base) karlgrin [cmake-build-debug]$
```

Figure 2: Screenshot from a simulation of SJF.



```
(base) karlgrin [cmake-build-debug]$./sched -f pif.txt -a RR -q 5

Process information file: pif.txt
Scheduling algorithm: RR
Time quantum: 5 ms

PID               Waiting Time (ms)     Turnaround Time (ms)
1000                             20                       30
1001                              0                        5
1002                             20                       30
1003                             25                       40
1004                             10                       15

Average waiting time: 15.00 ms
Average turnaround time: 24.00 ms

(base) karlgrin [cmake-build-debug]$
```

Figure 3: Screenshot from a RR simulation with a time quantum of 5 ms.

Examination

The lab is graded as *pass* or *failed*. To pass, the students should demonstrate their CPU-scheduling simulator to a lab assistant.

End of Lab