CPU Scheduling

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States of a Process

There are three states a process can be in:

- Waiting - When a process is waiting to be selected for the ready queue by the CPU scheduler.
- Ready - When a process will be ran on the CPU the next time a thread is available.
- Running - When a process is currently running on the CPU.

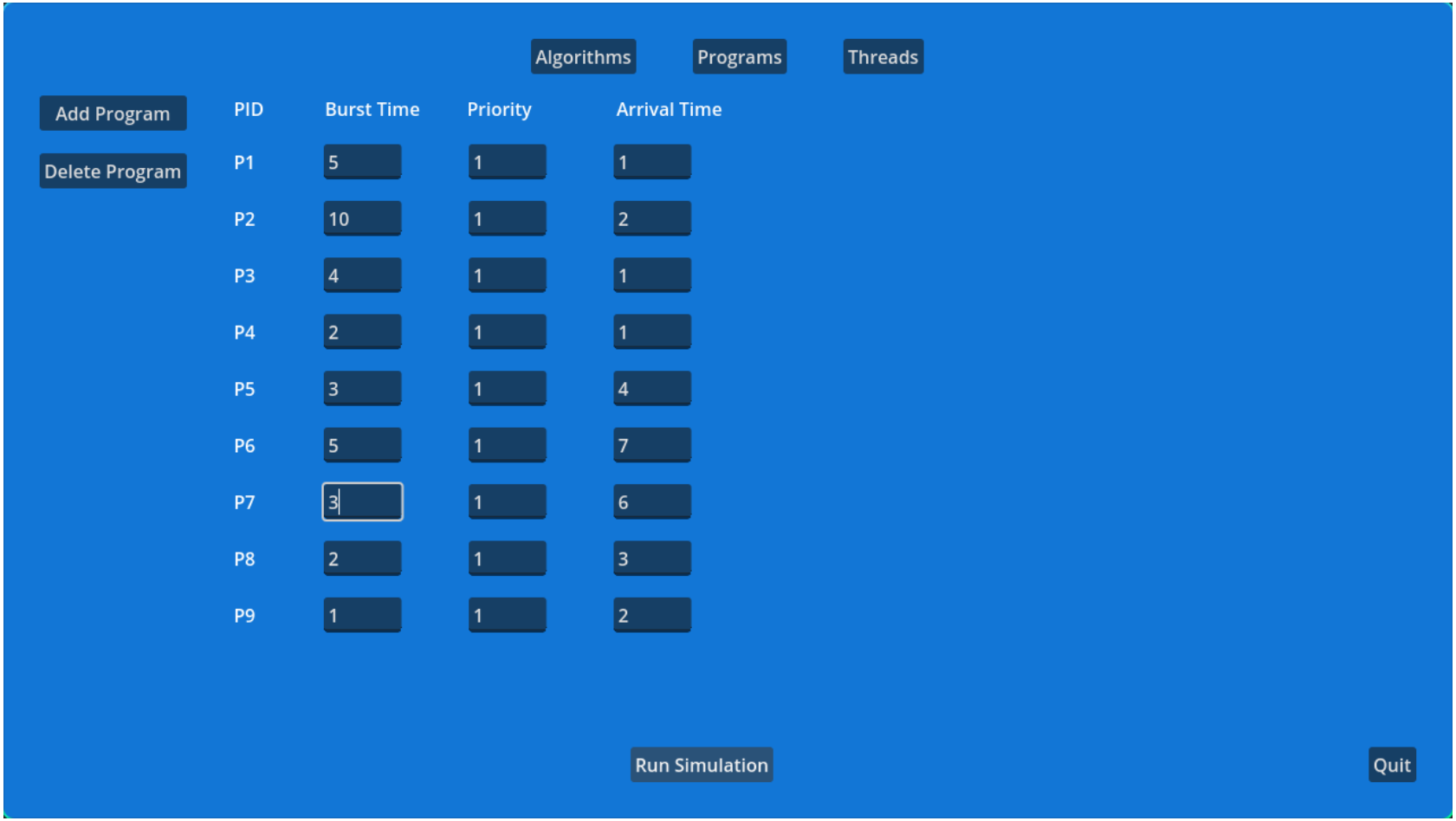
Algorithms Implemented

- First Come First Served (FCFS) - The processes will be scheduled in order of arrival time.
- Shortest Job First (SJF) - The processes will be scheduled in order of shortest burst time.
- Priority - Priority scheduling is when each process is given a priority level, which determines the order of processes to be executed in.

Grading Criteria

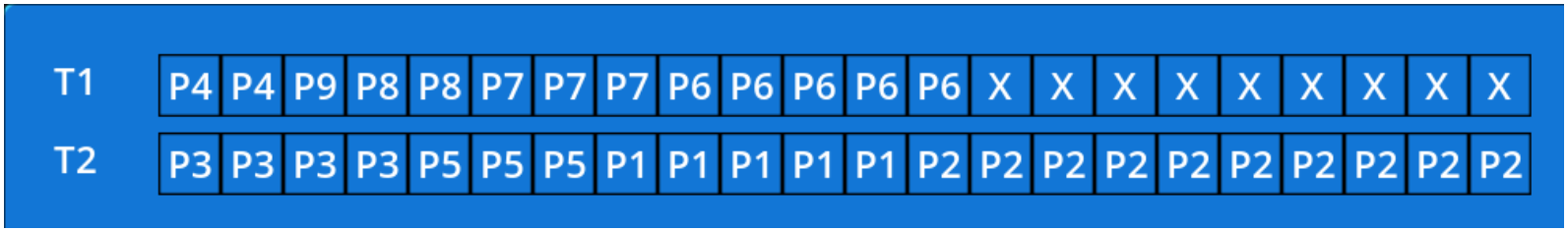
- CPU Utilization - Can range from 0 to 100 percent. Represents how busy the average thread of the CPU is.
- Throughput - Average number of processes that are completed per time unit.
- Turnaround Time - Interval of time from the submission of a process to the time of completion of a process. Sum of time spent in ready queue, execution time, and time doing I/O.
- Waiting Time - Sum of the periods spent in the ready queue.
- Response Time - The time it takes a process to start responding, rather than completing.

Our Example



The example we will use with the different algorithms

Shortest Job First



SJF's Schedule

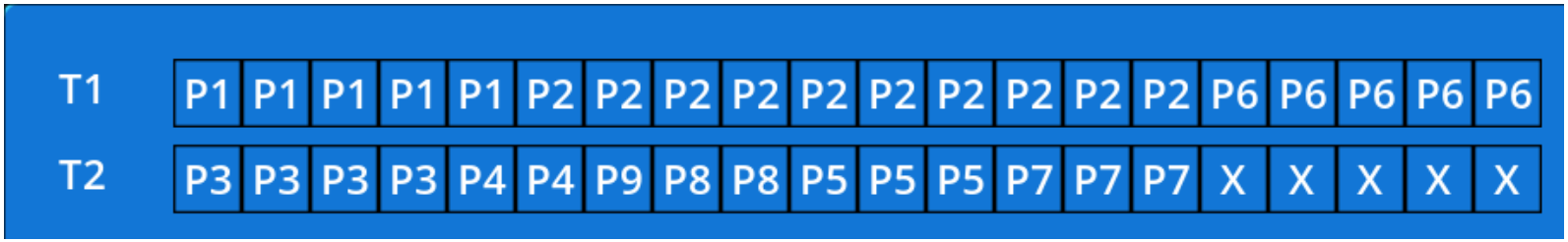
Utilization: 0.79545454545455

Throughput: 0.20454545454545

Waiting Time: 9.0

SJF's Grade

First Come First Serve



FCFS's Schedule

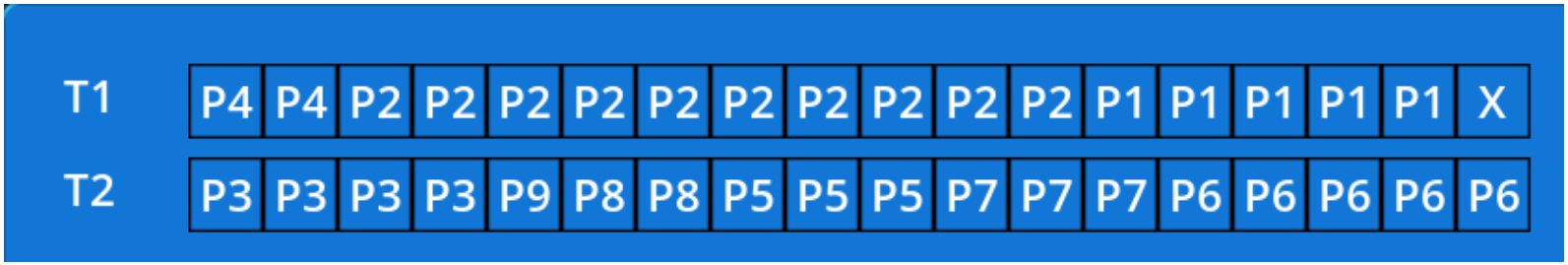
Utilization: 0.875

Throughput: 0.225

Waiting Time: 5.0

FCFS's Grade

SJF with Priority



Priority's Schedule

Utilization: 0.972222222222222

Throughput: 0.25

Waiting Time: 1.0

Priority's Grade

Future Considerations

- Multithreading
- More complex algorithms like Highest Response Ratio Next and Multilevel Queue.

Conclusions

- There is no "perfect" scheduling algorithm since it is dependent on a cpu's use case and prioritizing appropriately.
- Scheduling algorithms are often combinations of previous less complex algorithms.
- This program can be found at https://github.com/ColbysPrograms/cpuScheduling

References

[1] Peter Baer Galvin Abraham Silberschatz and Greg Gagne. "Operating System Concepts". In: Tenth. Wiley, 2018. Chap. 5, pp. 202–214.

[2] GeeksforGeeks. *Highest Response Ratio Next (HRRN) CPU Scheduling*. Jan. 2025.