**CPU Scheduling Simulator**

**You are required to implement the following scheduling algorithms, description and examples are provided below:**

1. Highest response ration next (HRRN) [Non-preemptive].
2. Shortest remaining time first (SRTF) [Preemptive].

**For each Algorithm:**

1. **input will be:** 
   * Number of processes
   * ID of each process
   * Arrival time for each process
   * Burst time of each process
2. **Output will be:** 
   * The order of how the processes were scheduled to execute (Gantt Chart). Such as

(P1 => P2 => P1 => P3…)  Average waiting time.

* + Average turnaround time.
  + For HRRN (print the updated response time after each step).

**Grading Criteria:**

|  |  |  |
| --- | --- | --- |
|  | **HRRN** | **SRTF** |
| Implementation | 30 | 25 |
| **Run and Output** | |  |
| Valid process execution order | 10 | 10 |
| Valid average waiting time | 5 | 5 |
| Valid average turnaround time | 5 | 5 |
| Response Ratio updates | 5 | ــــ |

**Highest Response Ratio Next (HRRN)**

Highest Response Ratio Next (HRNN) is one of the most optimal scheduling algorithms. This is a non-preemptive algorithm in which, the scheduling is done on the basis of an extra parameter called Response Ratio. A Response Ratio is calculated for each of the available jobs and the Job with the highest response ratio is given priority over the others.

Response Ratio is calculated by the given formula.

**Response Ratio = (WT+BT) /BT**

**WT** → Waiting Time

**BT** → Service Time or Burst Time

If we look at the formula, we will notice that the job with the shorter burst time will be given priority but it is also including an extra factor called waiting time. Hence, this algorithm not only favors shorter job but it also concern the waiting time of the longer jobs.

**Example:**

**Process ID**

**Arrival Time**

**Burst Time**

0

**0**

**3**

1

**2**

**5**

2

**4**

**4**

3

**6**

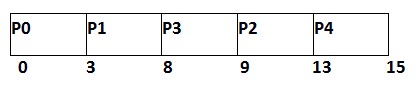
**1**

4

**8**

**2**

**Solution:**



At time 0, The Process P0 arrives with the CPU burst time of 3 units. Since it is the only process arrived till now, hence this will get scheduled immediately.

P0 is executed for 3 units, meanwhile, only one process P1 arrives at time 3. This will get scheduled immediately since the OS doesn't have a choice.

P1 is executed for 5 units. Meanwhile, all the processes get available. We have to calculate the Response Ratio for all the remaining jobs.

RR (P2) = ((8-4) +4)/4 = 2

RR (P3) = (2+1)/1 = 3

RR (P4) = (0+2)/2 = 1

Since, the Response ratio of P3 is higher hence P3 will be scheduled first.

P3 is scheduled for 1 unit. The next available processes are P2 and P4. Let's calculate their Response ratio.

RR (P2) = (5+4)/4 = 2.25

RR (P4) = (1+2)/2 = 1.5

The response ratio of P2 is higher hence P2 will be scheduled.

Now, the only available process is P4 with the burst time of 2 units, since there is no other process available hence this will be scheduled.

**Shortest Remaining Time First (SRTF)**

**Selection criteria:**

The process with the least remaining burst time among the list of available processes and the running process.

**Decision Mode:**

Preemptive, when a new process arrives, its priority is compared with current process priority. If the new job has highest priority than the current, the current process is suspended and new job is started.

**Example**:

