INTRODUCTION TO OS

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Shortest Job First(SJF) Scheduling

Shortest Job First scheduling works on the process with the shortest **burst time** or **duration** first.

- This is the best approach to minimize waiting time.
- This is used in Batch Systems.
- It is of two types:
  1. Non Pre-emptive
  2. Pre-emptive
- To successfully implement it, the burst time/duration time of the processes should be known to the processor in advance, which is practically not feasible all the time.
- This scheduling algorithm is optimal if all the jobs/processes are available at the same time. (either Arrival time is `0` for all, or Arrival time is same for all)

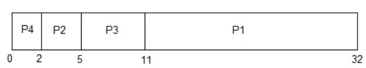
Non Pre-emptive Shortest Job First

Consider the below processes available in the ready queue for execution, with **arrival time** as `0` for all and given **burst times**.

PROCESS	BURST TIME
P1	21
P2	3
P3	6
P4	2

In Shortest Job First Scheduling, the shortest Process is executed first.

Hence the GANTT chart will be following :



Now, the average waiting time will be = (0 + 2 + 5 + 11)/4 = 4.5 ms

As you can see in the **GANTT chart** above, the process **P4** will be picked up first as it has the shortest burst time, then **P2**, followed by **P3** and at last **P1**.

We scheduled the same set of processes using the First come first serve algorithm in the previous tutorial, and got average waiting time to be `18.75 ms`, whereas with SJF, the average waiting time comes out `4.5 ms`.

Problem with Non Pre-emptive SJF

If the **arrival time** for processes are different, which means all the processes are not available in the ready queue at time `0`, and some jobs arrive after some time, in such situation, sometimes process with short burst time have to wait for the current process's execution to finish, because in Non Pre-emptive SJF, on arrival of a process with short duration, the existing job/process's execution is not halted/stopped to execute the short job first.

This leads to the problem of **Starvation**, where a shorter process has to wait for a long time until the current longer process gets executed. This happens if shorter jobs keep coming, but this can be solved using the concept of **aging**.

Pre-emptive Shortest Job First

In Preemptive Shortest Job First Scheduling, jobs are put into ready queue as they arrive, but as a process with **short burst time** arrives, the existing process is preempted or removed from execution, and the shorter job is executed first.

Pre-emptive Shortest Job First Scheduling

The average waiting time will be,((5-3)+(6-2)+(12-1))/4=8.75

The average waiting time for preemptive shortest job first scheduling is less than both,non preemptive SJF scheduling and FCFS scheduling

As you can see in the **GANTT chart** above, as **P1** arrives first, hence it's execution starts immediately, but just after `1 ms`, process **P2** arrives with a **burst time** of `3 ms` which is less than the burst time of **P1**, hence the process **P1**(1 ms done, 20 ms left) is preemptied and process **P2** is executed.

As **P2** is getting executed, after `1 ms`, **P3** arrives, but it has a burst time greater than that of **P2**, hence execution of **P2** continues. But after another millisecond, **P4** arrives with a burst time of `2 ms`, as a result **P2**(2 ms done, 1 ms left) is preemptied and **P4** is executed.

After the completion of **P4**, process **P2** is picked up and finishes, then **P2** will get executed and at last **P1**.

The Pre-emptive SJF is also known as **Shortest Remaining Time First**, because at any given point of time, the job with the shortest remaining time is executed first.

Program for SJF Scheduling

In the below program, we consider the **arrival time** of all the jobs to be `0`.

Also, in the program, we will **sort** all the jobs based on their **burst time** and then execute them one by one, just like we did in FCFS scheduling program.

```
        total_tat = total_tat + tat[i];
        cout << " " << proc[i].pid << "\t\t"
             << proc[i].bt << "\t " << wt[i]
             << "\t\t " << tat[i] <<endl;
    }

    cout << "Average waiting time = "
         << (float)total_wt / (float)n;
    cout << "\nAverage turn around time = "
         << (float)total_tat / (float)n;
}

// main function
int main()
{
    Process proc[] = {{1, 21}, {2, 3}, {3, 6}, {4, 2}};
    int n = sizeof proc / sizeof proc[0];

    // sorting processes by burst time.
    sort(proc, proc + n, comparison);
```

OUTPUT:

```
Order in which process gets executed
4 2 3 1
Processes  Burst time  Waiting time  Turn around time
 4            2       0             2
 2            3       2             5
 3            6       5             11
 1            21      11            32
Average waiting time = 4.5
Average turn around time = 12.5
```

Try implementing the program for SJF with variable **arrival time** for different jobs, yourself.

More...