OS Lecture Slide 6: Example of Shortest-remaining-time-first
Example of **Shortest-remaining-time-first**
https://mycareerwise.com/content/srtf-process-and-examples/content/exam/gate/computer-science

Process No.	Arrival Time (AT)	Burst Time (BT)
P1	0	8
P2	1	4
P3	2	9
P4	3	5

Turn Around Time (TAT) and Waiting Time (WT)

Completion Time- CT

Process P1 is started at time 0, since it is the only process in the queue. Process P2 arrives at time 1. The remaining time for process P1 (7 milliseconds) is larger than the time required by process P2 (4 milliseconds), so process P1 is preempted, and process P2 is scheduled.

TAT = CT - AT, WT = TAT – BT
And
Response Time (RT) = FR (First Response) – AR (Arrival Time)

P_No.	AT	BT	CT	TAT	WT	First Response (FR)	RT
P1	0	8	17	(17 – 0) = 17	(17 – 8) = 9	0	(0 – 0) = 0
P2	1	4	5	(5 – 1) = 4	(4 – 4) = 0	1	(1 – 1) = 0
P3	2	9	26	(26 – 2) = 24	(24 – 9) = 15	17	(17 – 2) = 15
P4	3	5	10	(10 – 3) = 7	(7 – 5) = 2	5	(5 – 3) = 2

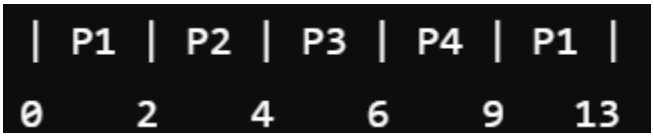
$$\textbf{AVG Turn Around Time (ATAT)} = \frac{17 + 4 + 24 + 7}{4} = 13$$

$$\textbf{AVG Waiting Time (AWT)} = \frac{9 + 0 + 15 + 2}{4} = 6.5$$

Example of SRTF

Consider the following set of processes with their arrival times and burst times:

Process	Arrival Time	Burst Time
P1	0	6
P2	2	2
P3	4	1
P4	6	3



Process	Arrival Time	Burst Time	Completion Time	Turnaround Time	Waiting Time
P1	0	6	13	13	7
P2	2	2	5	3	1
P3	4	1	6	2	1
P4	6	3	9	3	0

Average Times

- Average Turnaround Time:

$$\frac{13+3+2+3}{4} = \frac{21}{4} = 5.25$$

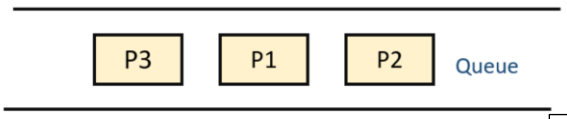
- Average Waiting Time:

$$\frac{7+1+1+0}{4} = \frac{9}{4} = 2.25$$

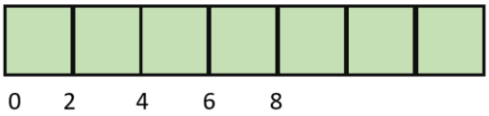
Example of Round-robin Scheduling

Consider this following three processes

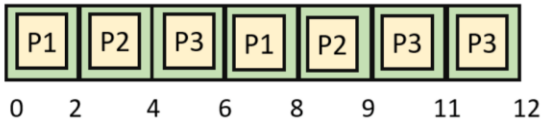
Process Queue	Burst time
P1	4
P2	3
P3	5



Time Slice = 2



Time Slice = 2



Turnaround Time = Completion Time/Finish Time - Arrival Time
Example:
Turnaround Time = Completion Time - Arrival Time = 4 - 0 = 4
if Arrival time is not given, then set it to 0

Waiting Time = Turnaround Time - Burst Time

Let's calculate the **average waiting time** for above example.
Wait time [**Waiting time (WT) = Finish Time - CPU burst time**]

1. **P1:**
   - P1 finishes at time 6 ms.
   - Waiting time = Finish time - Burst time = 6 - 4 = 2 ms.
2. **P2:**
   - P2 finishes at time 8 ms.
   - Waiting time = Finish time - Burst time = 8 - 3 = 5 ms.
3. **P3:**
   - P3 finishes at time 11 ms.
   - Waiting time = Finish time - Burst time = 11 - 5 = 6 ms.

Average Waiting Time

$$\text{Average Waiting Time} = \frac{\text{Waiting Time of P1} + \text{Waiting Time of P2} + \text{Waiting Time of P3}}{3}$$

$$= \frac{2+5+6}{3} = \frac{13}{3} = 4.33\,\text{ms}$$

Answer

The **average waiting time** is **4.33 ms**.

Examples RR

In the following example, there are six processes named as P1, P2, P3, P4, P5 and P6. Their arrival time and burst time are given below in the table. The time quantum of the system is 4 units.

Process ID	Arrival Time	Burst Time
1	0	5
2	1	6
3	2	3
4	3	1
5	4	5
6	6	4

1. Turn Around Time = Completion Time - Arrival Time
2. Waiting Time = Turn Around Time - Burst Time

Process ID	Arrival Time	Burst Time	Completion Time	Turn Around Time	Waiting Time
1	0	5	17	17	12
2	1	6	23	22	16
3	2	3	11	9	6
4	3	1	12	9	8
5	4	5	24	20	15
6	6	4	21	15	11

Avg Waiting Time = (12+16+6+8+15+11)/6 = 76/6 units

Slide 24 [Non-preemptive]

Example of Priority Scheduling

Process	Burst Time	Priority
P_1	10	3
P_2	1	1
P_3	2	4
P_4	1	5
P_5	5	2

- Priority scheduling Gantt Chart

- Average waiting time = 8.2 msec

Assume that all processes arrive at time 0.

1. **P2:**
   - Starts at time 0, finishes at time 1.
   - Waiting time = 0 ms (starts immediately).
2. **P5:**
   - Starts at time 1, finishes at time 6.
   - Waiting time = Start time - Arrival time = 1 - 0 = 1 ms.
3. **P1:**
   - Starts at time 6, finishes at time 16.
   - Waiting time = Start time - Arrival time = 6 - 0 = 6 ms.
4. **P3:**
   - Starts at time 16, finishes at time 18.
   - Waiting time = Start time - Arrival time = 16 - 0 = 16 ms.
5. **P4:**
   - Starts at time 18, finishes at time 19.
   - Waiting time = Start time - Arrival time = 18 - 0 = 18 ms.

Step 4: Calculate Average Waiting Time

$$\text{Average Waiting Time} = \frac{\text{Sum of all Waiting Times}}{\text{Number of Processes}}$$

$$\text{Average Waiting Time} = \frac{0+1+6+16+18}{5} = \frac{41}{5} = 8.2\,\text{ms}$$