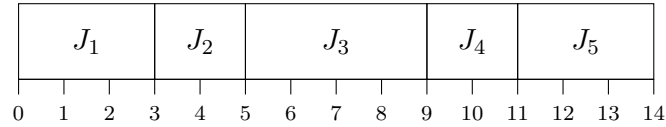


Lecture 4

Single-machine Scheduling

It is the simplest type of machine scheduling. In this type, n jobs will be processed on a single machine with processing time p_i , $i = 1, \dots, n$.

Suppose we have 5 jobs with processing times $p_1 = 3, p_2 = 2, p_3 = 4, p_4 = 2, p_5 = 3$, and release dates $r_1 = 0, r_2 = 2, r_3 = 0, r_4 = 5, r_5 = 7$. These jobs will be processed on a single machine with the order $1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5$, then the scheduling will be as below:

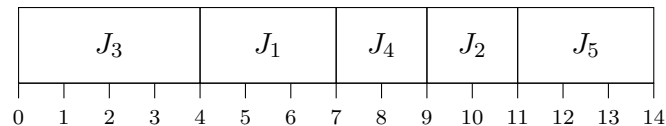


The dynamic data for this scheduling will be as below:

J_i	S_i	C_i	F_i	W_i
J_1	0	3	3	0
J_2	3	5	3	1
J_3	5	9	9	5
J_4	9	11	6	4
J_5	11	14	7	4

$$C_{max} = \max\{C_1, \dots, C_5\} = \max\{3, 5, 9, 11, 14\} = 14$$

Note: if the same jobs are processed in another order, like $3 \rightarrow 1 \rightarrow 4 \rightarrow 2 \rightarrow 5$, then the scheduling will be as follows:



J_i	S_i	C_i	F_i	W_i
J_1	4	7	7	4
J_2	9	11	9	7
J_3	0	4	4	0
J_4	7	9	4	2
J_5	11	14	7	4

In both orders of Jobs, $C_{\max} = 14$. This shows that in a single machine scheduling, the makespan depends on total processing time, not on job order, while the dynamic data will depend on it.

Single-machine Scheduling Algorithms

– First Come First Serve Scheduling Algorithm (FCFS)

It is one of the simplest types of single-machine scheduling algorithms. It is exactly what it sounds like: jobs(tasks) are attended to in the order in which they arrive in the ready queue.

FCFS Scheduling is a [non-preemptive algorithm](#), meaning once a process starts execution, it cannot be stopped until it is completed. This method schedules processes in the order they arrive, without considering priority or other factors.

How Does FCFS Work?

1. Arrival: jobs(tasks) enter the system and are placed in a queue in the order they arrive.
2. Execution: The machine(processor) takes the first job from the front of the queue, executes it until it is complete, and then removes it from the queue.
3. Repeat: The machine(processor) takes the next jobs(tasks) in the queue and repeats the execution process.

This continues until there are no more jobs(tasks) left in the queue.

Example of FCFS CPU Scheduling:

To understand the First Come, First Serve(FCFS) scheduling algorithm effectively, we'll use two examples

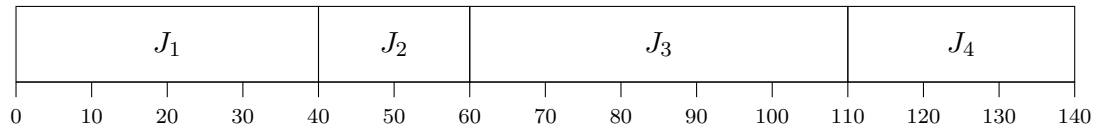
- one where all jobs arrive at the same time,
- another where jobs arrive at different times.

Scenario 1: jobs with Same Arrival Time

Consider the following table of arrival time and processing time for four jobs J_1 , J_2 , J_3 and J_4

J_i	r_i	p_i
J_1	0	40
J_2	0	20
J_3	0	50
J_4	0	30

Let us plot the Gantt Chart for using the FCFS scheduling algorithm and then calculate the average of the waiting time, completion time and Flowtime.



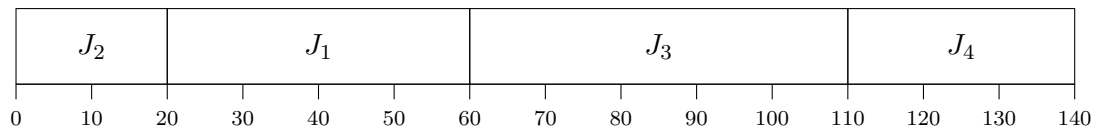
J_i	C_i	W_i	F_i
J_1	40	0	40
J_2	60	40	60
J_3	110	60	110
J_4	140	110	140
Average	87.5	52.5	87.5

Scenario 2: jobs with Different Arrival Times

Consider the following table of arrival time and processing time for four jobs J_1 , J_2 , J_3 and J_4

J_i	r_i	p_i
J_1	10	40
J_2	0	20
J_3	40	50
J_4	60	30

Let us plot the Gantt Chart for using the FCFS scheduling algorithm and then calculate the average of the waiting time, completion time and Flowtime.



J_i	C_i	W_i	F_i
J_1	60	10	50
J_2	20	0	20
J_3	110	20	70
J_4	140	50	80
Average	82.5	20	55