

Prerequisites for successful scheduling:

1.) CPU-I/O-Burst Cycle

Experience shows: I/O occurs after fixed amount of time in $\geq 90\%$
 \Rightarrow appropriate time for re-scheduling

2.) Preemptive Scheduling: Processes can be forced to relinquish processor

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Have various, often conflicting criteria to measure success of scheduling:

- CPU utilisation
- Throughput: Number of processes completed within a given time
- Turnaround time: Time it takes for each process to be executed
- Waiting time: Amount of time spent in the ready-queue
- Response time: time between submission of request and production of first response

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Scheduling Algorithms

1.) First-Come, First-Served (FCFS)

Jobs are put in a queue, and served according to arrival time

Easy to implement but CPU-intensive processes can cause long waiting time.

FCFS with preemption is called Round-Robin standard method in time sharing systems

Problem: get the time quantum (time before preemption) right.

- too short: too many context switches
- too long: Process can monopolise CPU

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Shortest Job First

Next job is one with shortest CPU-burst time (shortest CPU-time before next I/O-operation)

Not implementable, but this is algorithm with the smallest average waiting time
 \Rightarrow Strategy against which to measure other ones

Approximation: Can we predict the burst-time?

Only hope is extrapolation from previous behaviour
done by weighting recent times more than older ones.

$$\tau_{n+1} = \alpha t_n + (1 - \alpha)\tau_n$$

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Assumption: A priority is associated with each process

CPU is allocated to **process with highest priority**

Equal-priority processes scheduled according to FCFS

Two variations:

- **With preemption**: newly-arrived process with higher priority may gain processor immediately if process with lower priority is running
- **Without preemption**: newly arrived process always waits

Preemption good for ensuring quick response time for high-priority processes

Disadvantage: **Starvation** of low-priority processes **possible**

Solution: Increase priority of processes after a while (**Aging**)

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Applicable when processes can be **partitioned into groups** (e.g., interactive and batch processes):

Split ready-queue into several separate queues, with separate scheduling algorithm

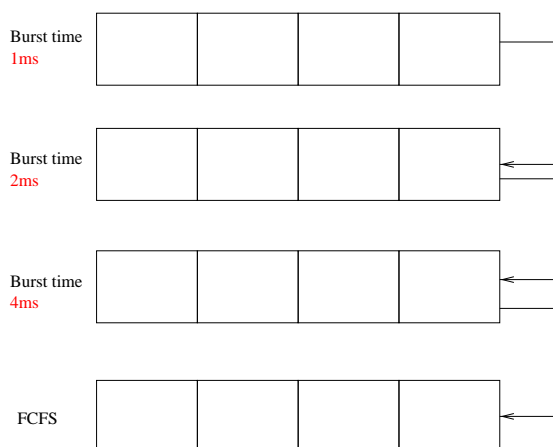
Scheduling between queues usually implemented as pre-emptive priority scheduling

Possible setup of queues:

- System processes
- Interactive processes
- Interactive editing processes
- Batch processes

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Other way of organising queues: **according to length of CPU-burst**



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