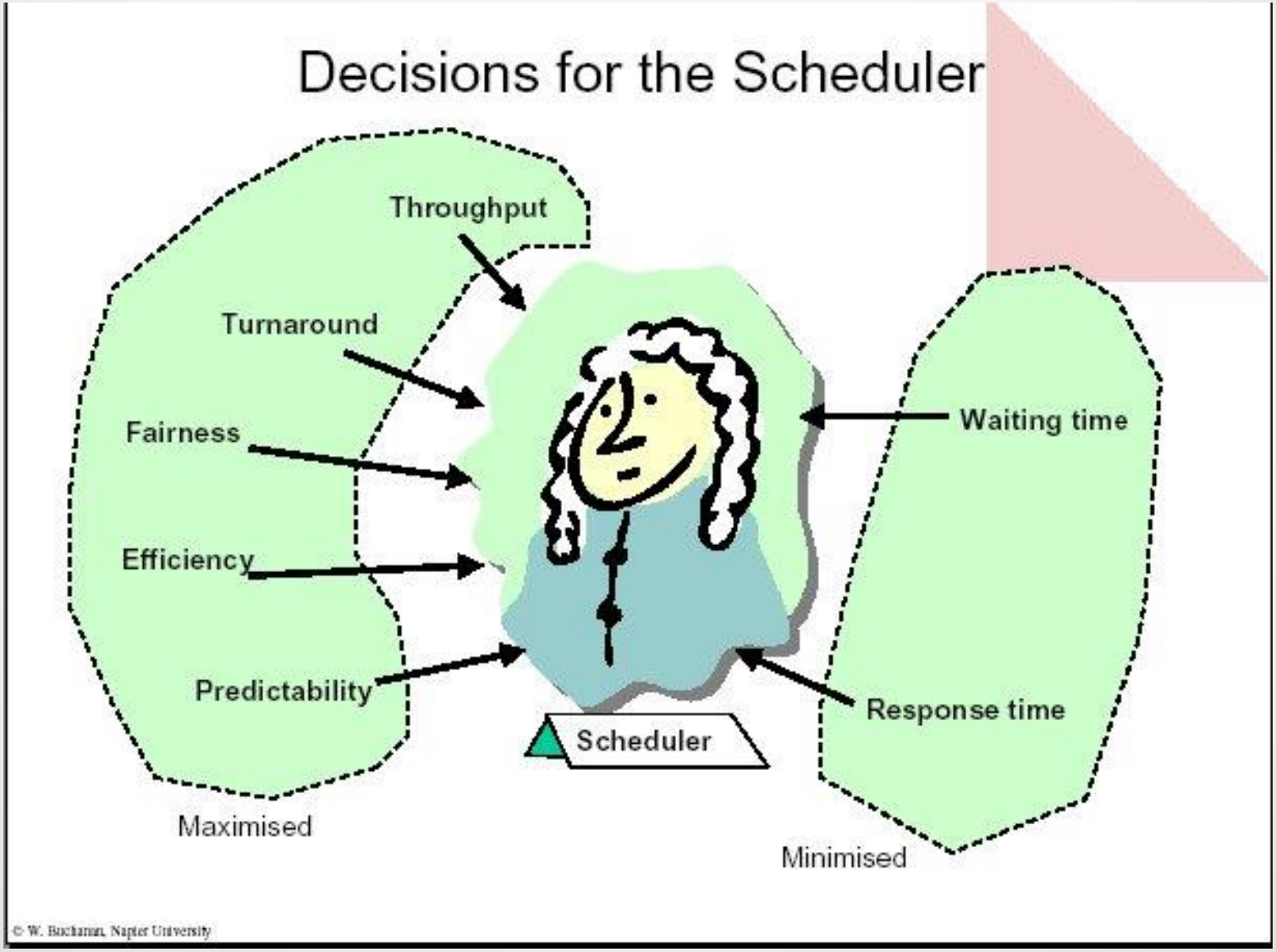
CST 347 – Real Time OS

Oregon TECH

Lecture 07 – CPU Scheduling I

Troy Scevers

CST 240 – Real Time OS



Topics

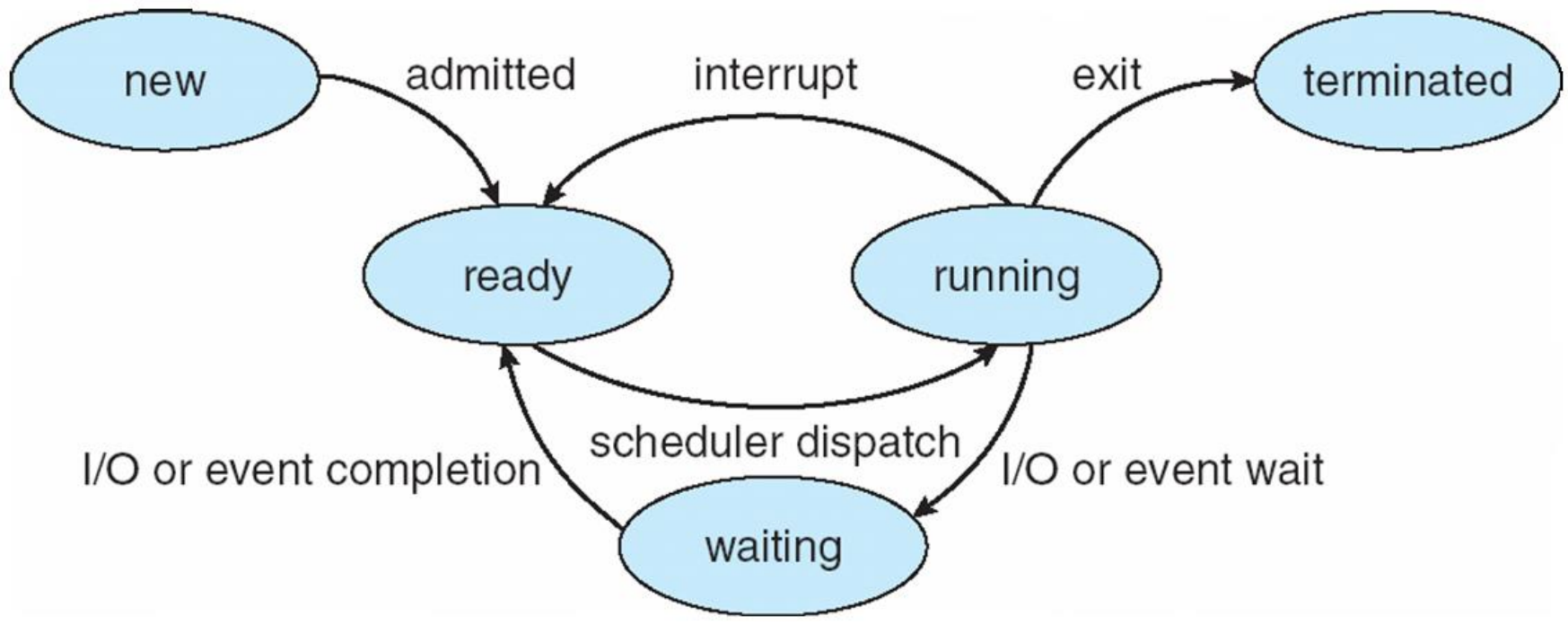
- Introduction
- Basic Concepts
- Scheduling Criteria
- Scheduling Algorithms
- Thread Scheduling
- Multiple-Processor Scheduling
- Real-Time CPU Scheduling
- Operating Systems Examples
- Algorithm Evaluation

Introduction

- Objectives
  - To introduce CPU scheduling, which is the basis for multiprogrammed operating systems
  - To describe various CPU-scheduling algorithms
  - To discuss evaluation criteria for selecting a CPU-scheduling algorithm for a particular system
  - To examine the scheduling algorithms of several operating systems

Introduction

Recall the state of a Process



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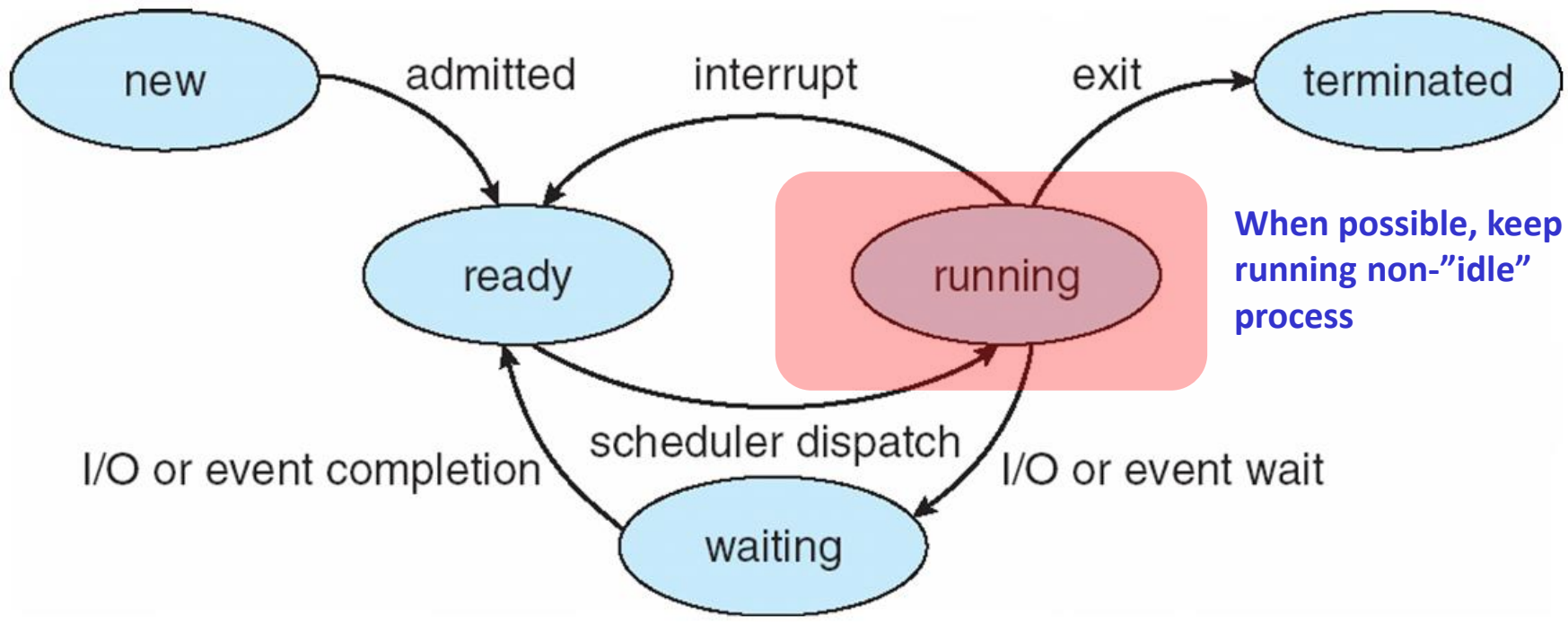

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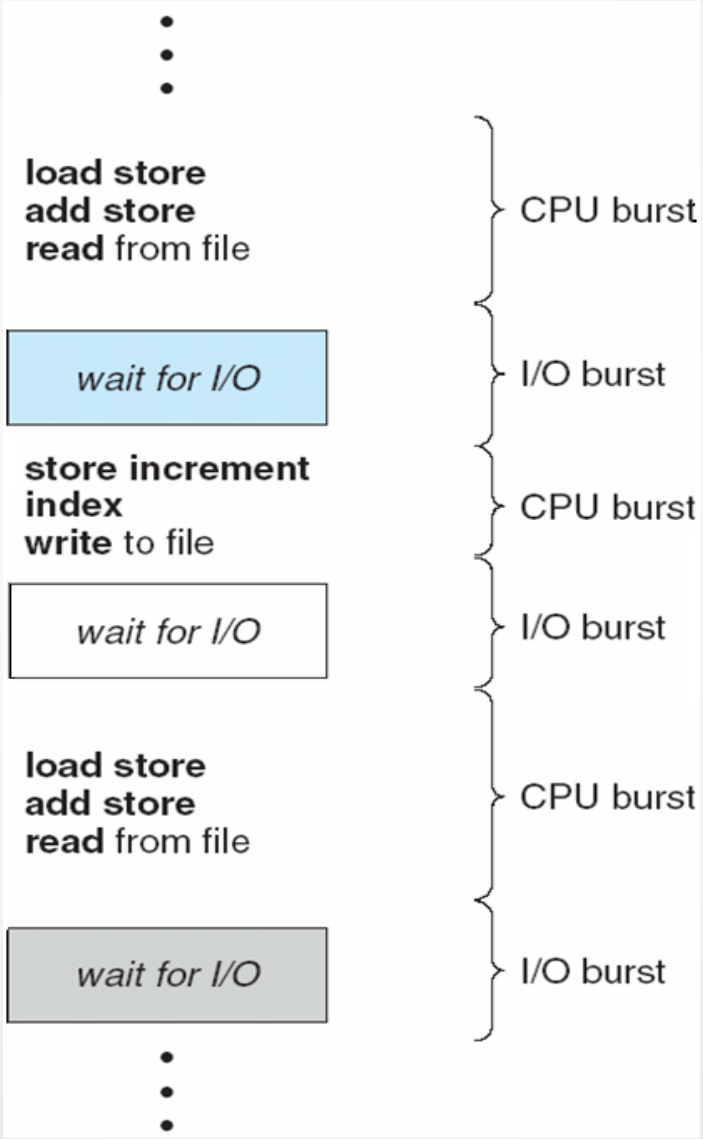

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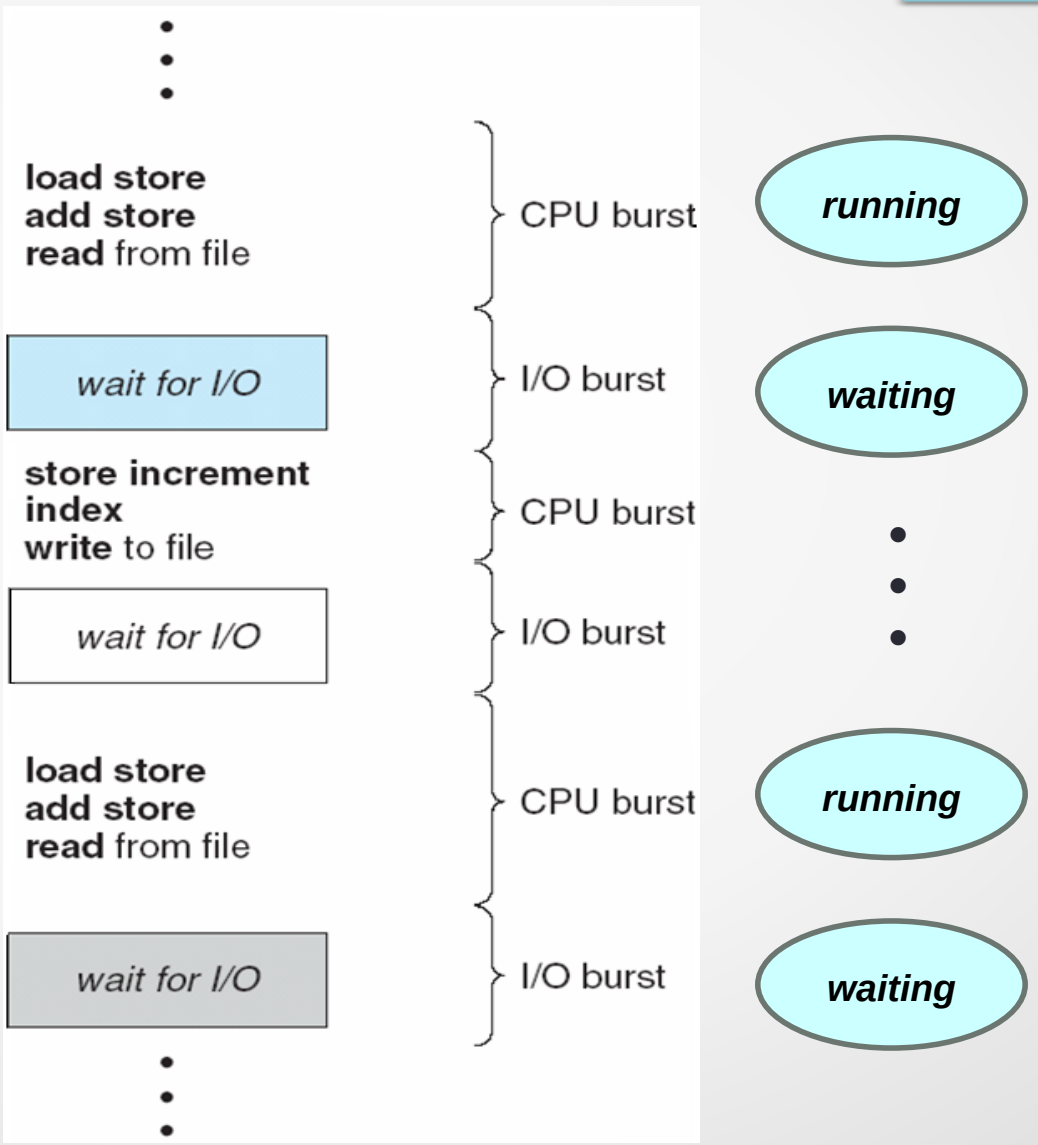

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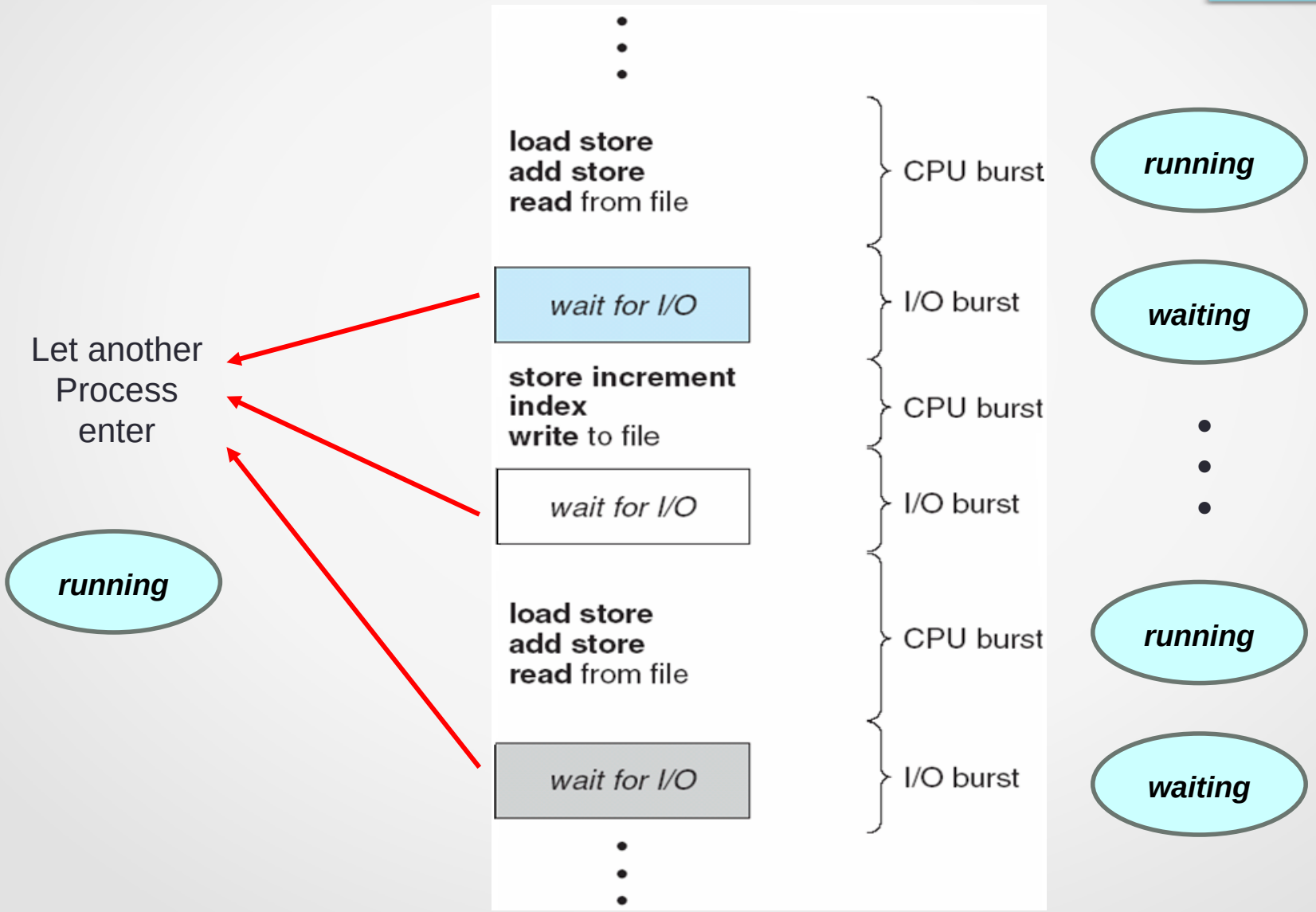
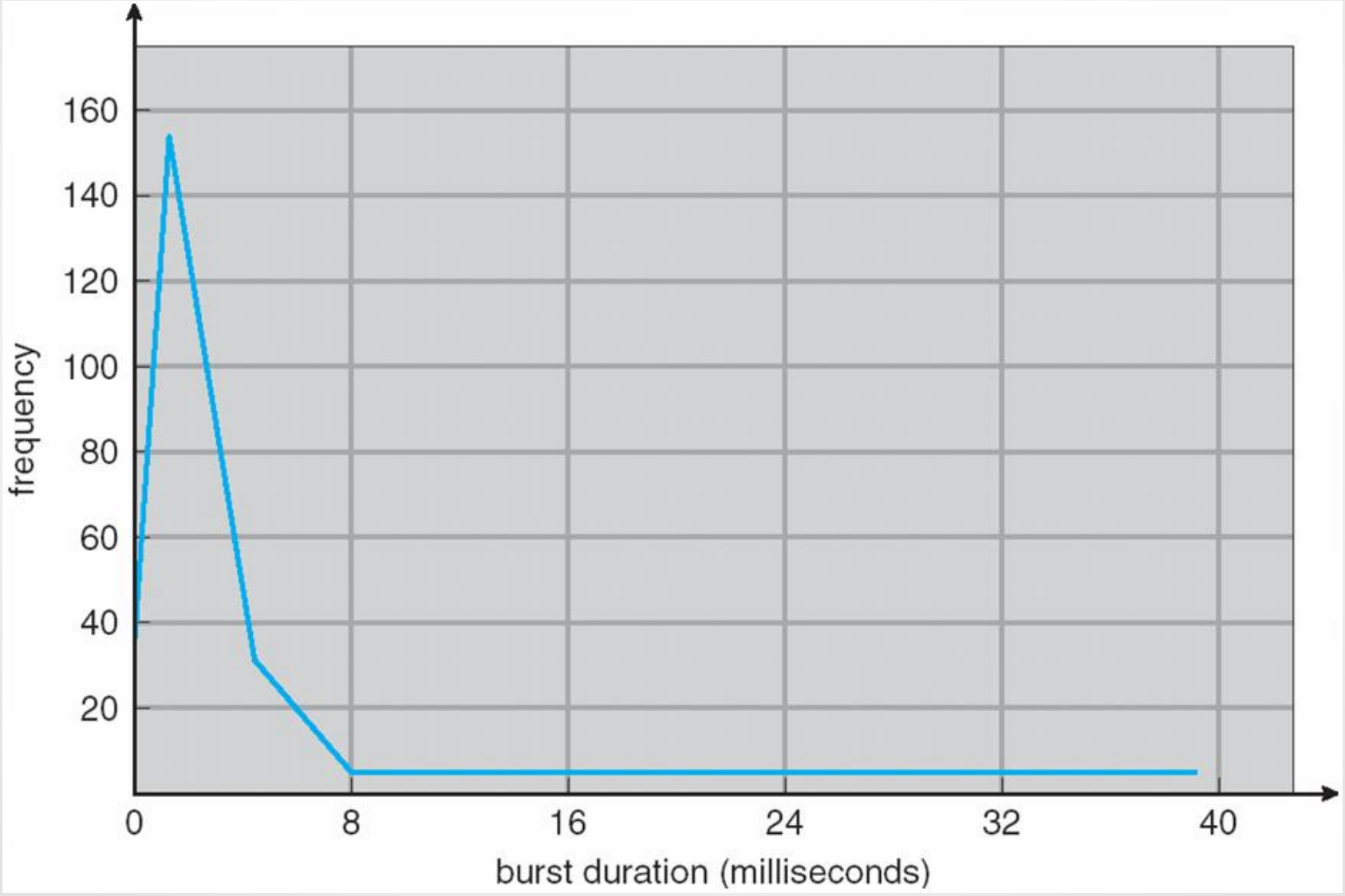


Histogram of CPU-burst Times



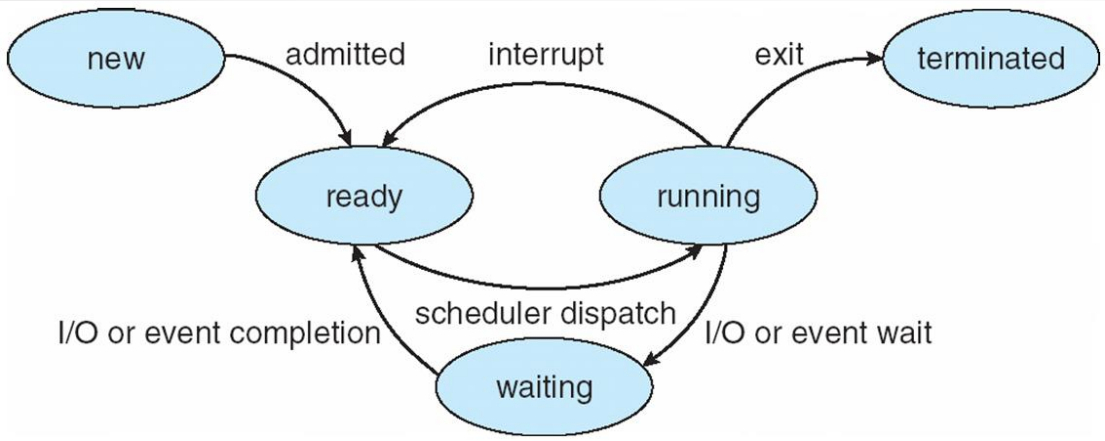
CPU Scheduler

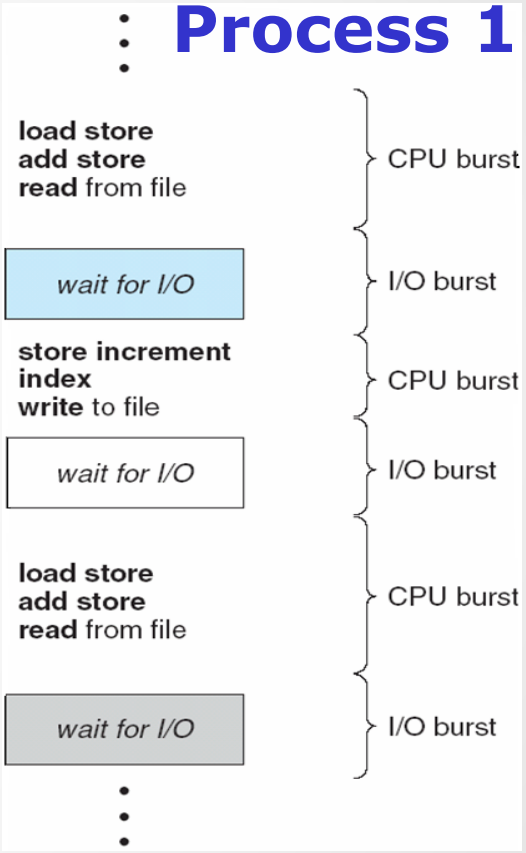
- Short-term scheduler selects from among the processes in ready queue, and allocates the CPU to one of them
  - Queue may be ordered in various ways
- CPU scheduling decisions may take place when a process:
  1. Switches from running to waiting state
  2. Switches from running to ready state
  3. Switches from waiting to ready
  4. Terminates
- Scheduling under 1 and 4 is non-preemptive
- All other scheduling is preemptive
  - Consider access to shared data
  - Consider preemption while in kernel mode
  - Consider interrupts occurring during crucial OS activities

Dispatcher

- Dispatcher module gives control of the CPU to the process selected by the short-term scheduler; this involves:
  - switching context
  - switching to user mode
  - jumping to the proper location in the user program to restart that program
- Dispatch latency – time it takes for the dispatcher to stop one process and start another running

Introduction





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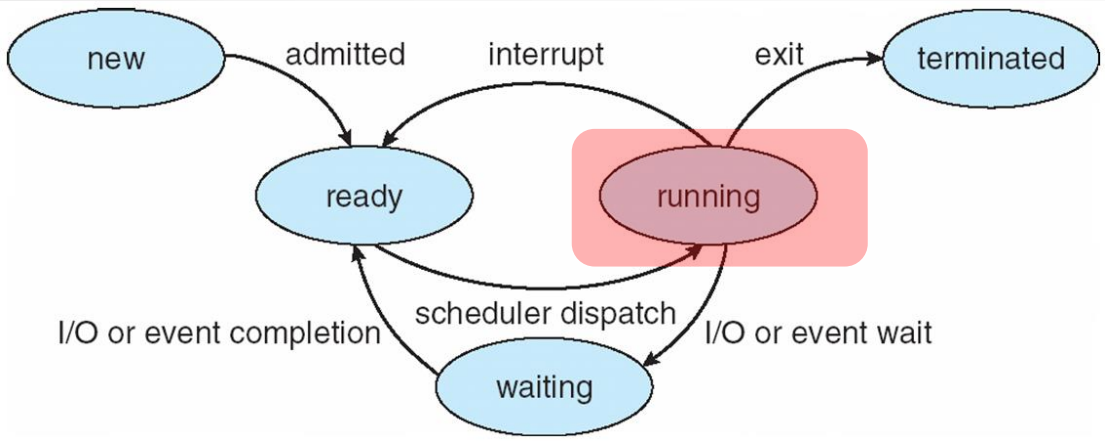

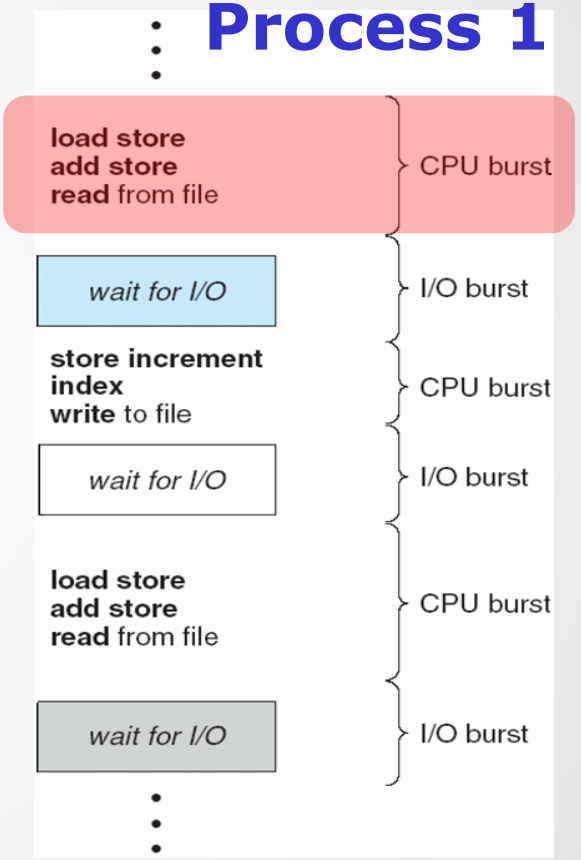

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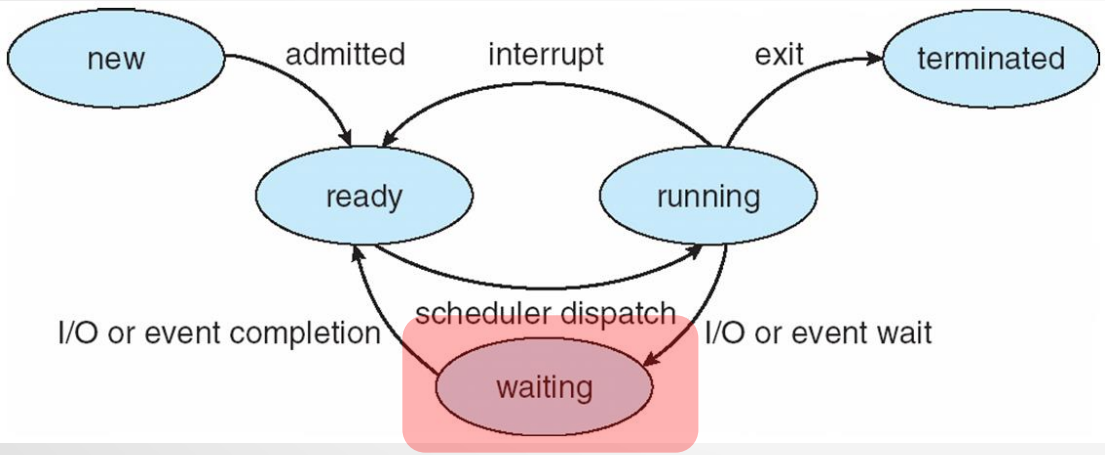

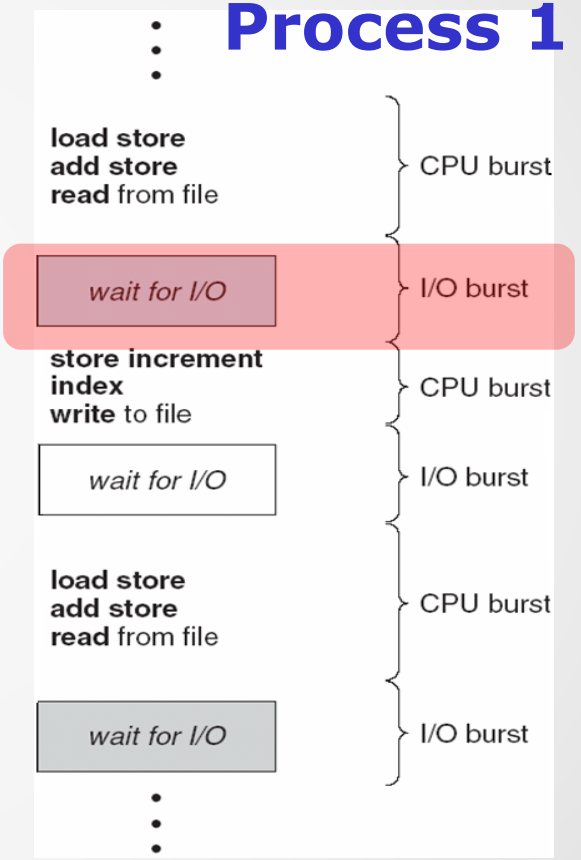

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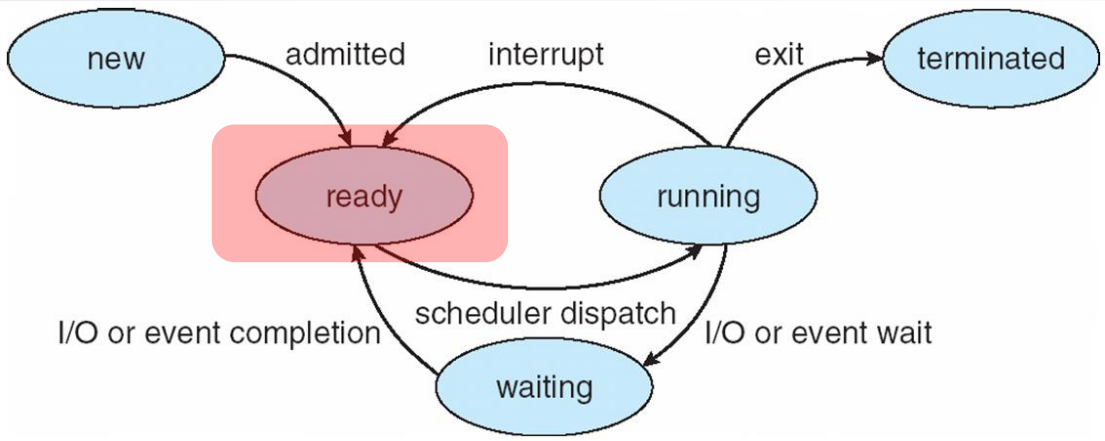

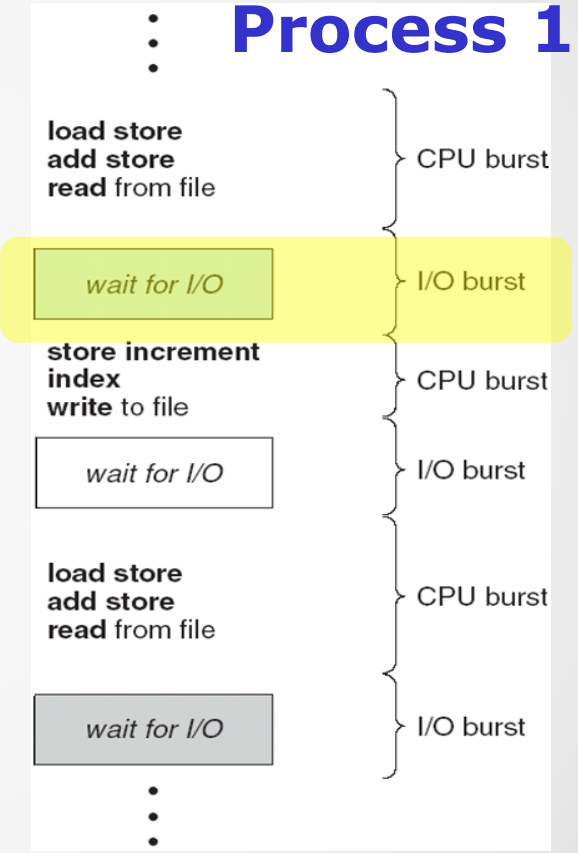

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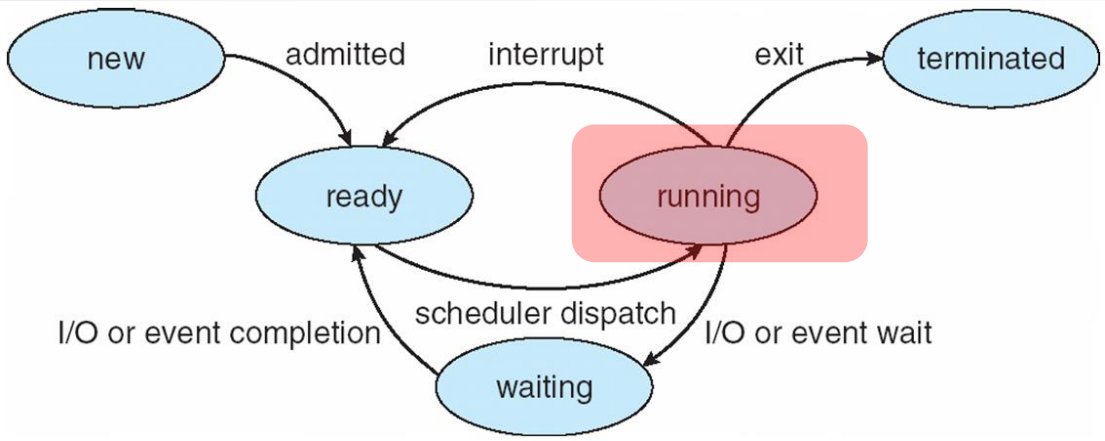

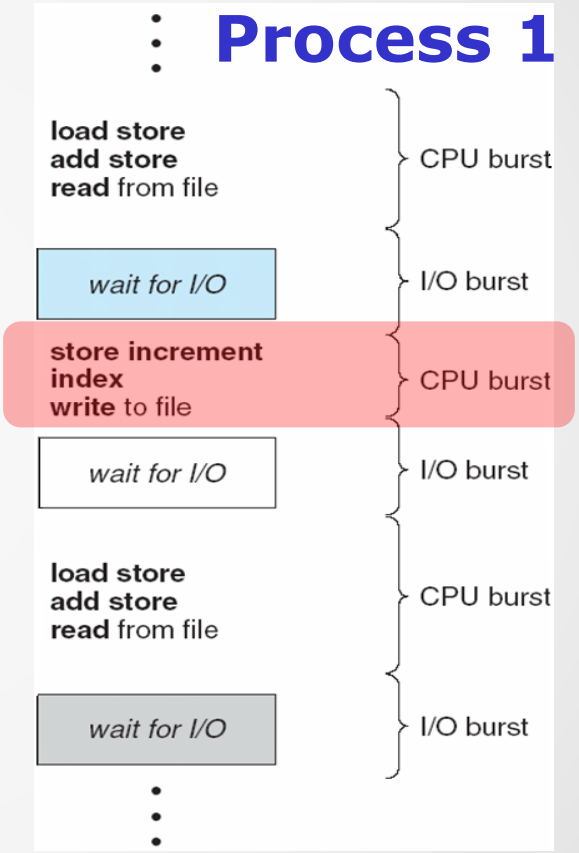

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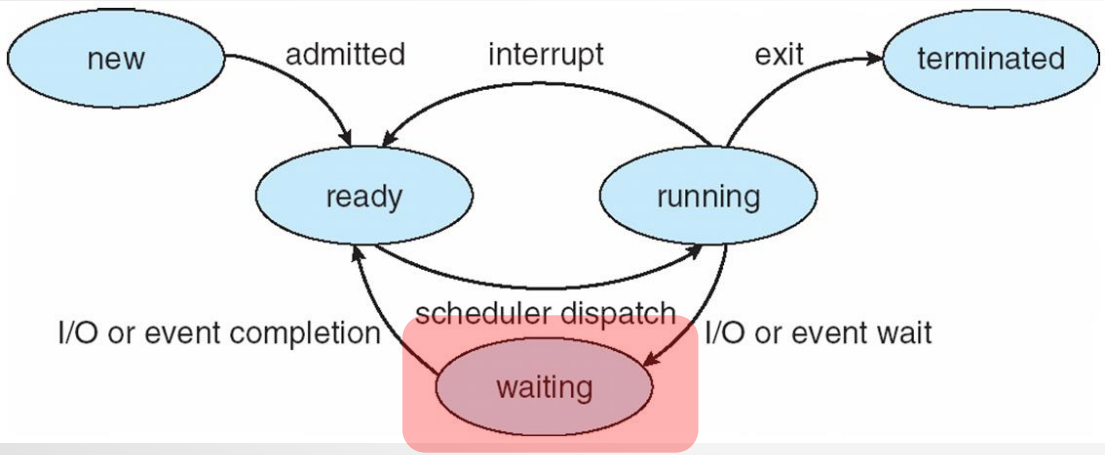

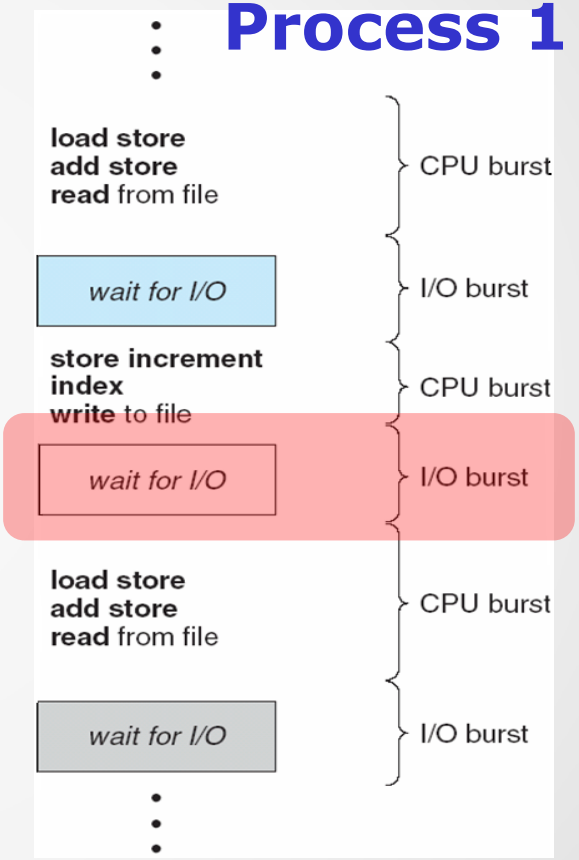

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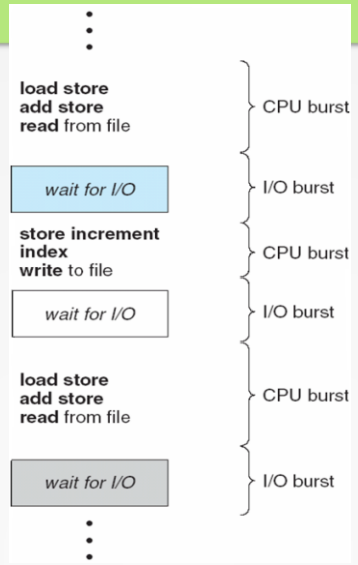
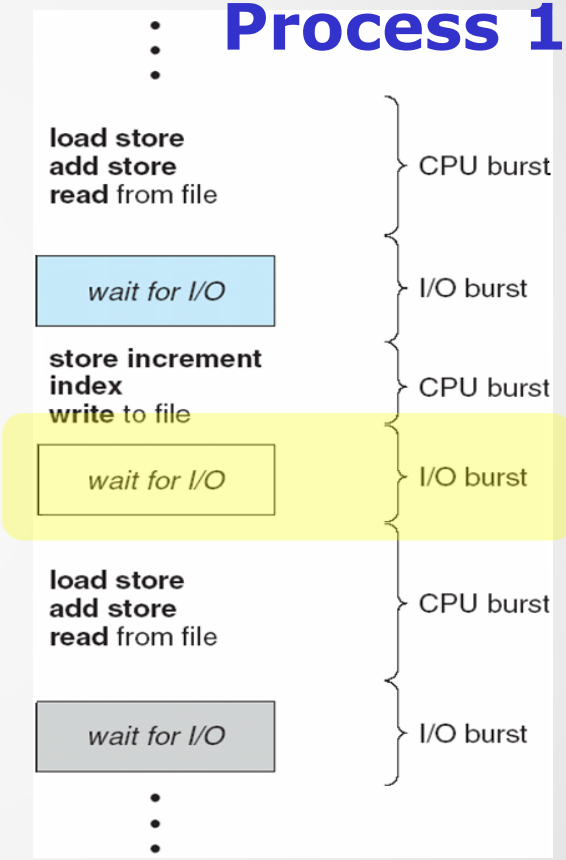
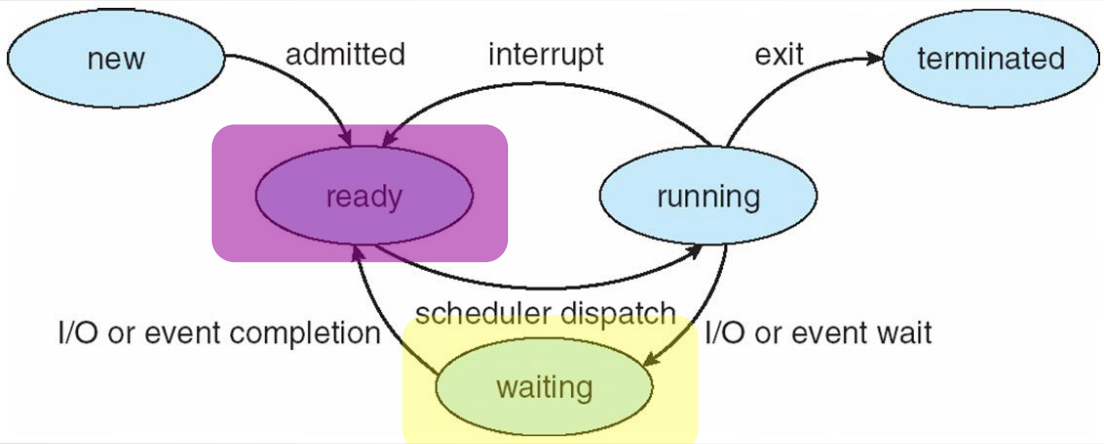


Process 2

Process 1





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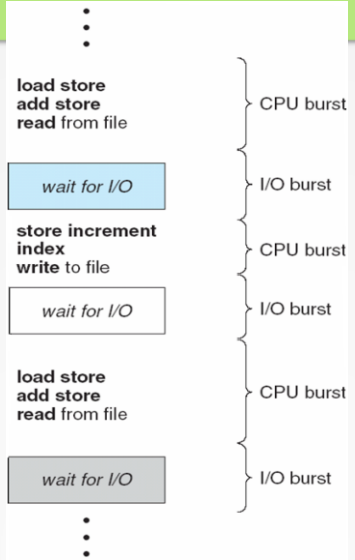
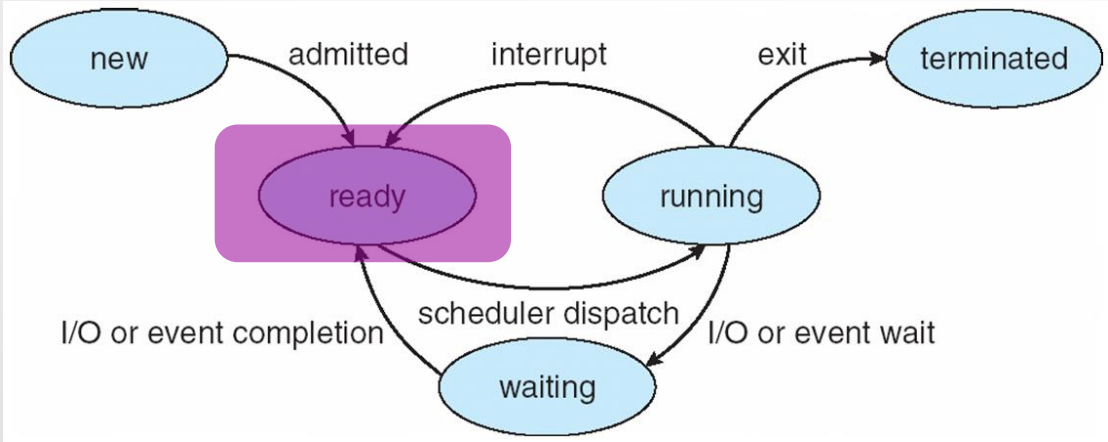
Process 2





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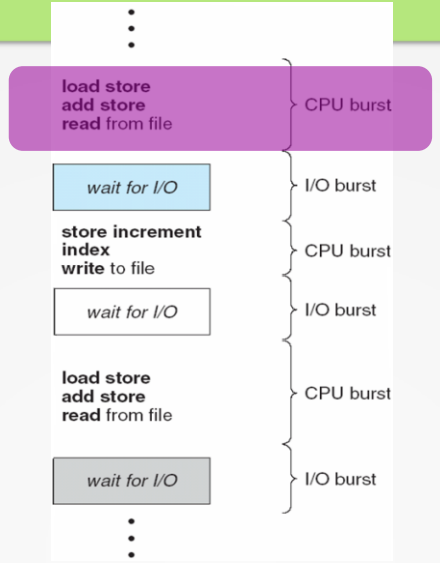

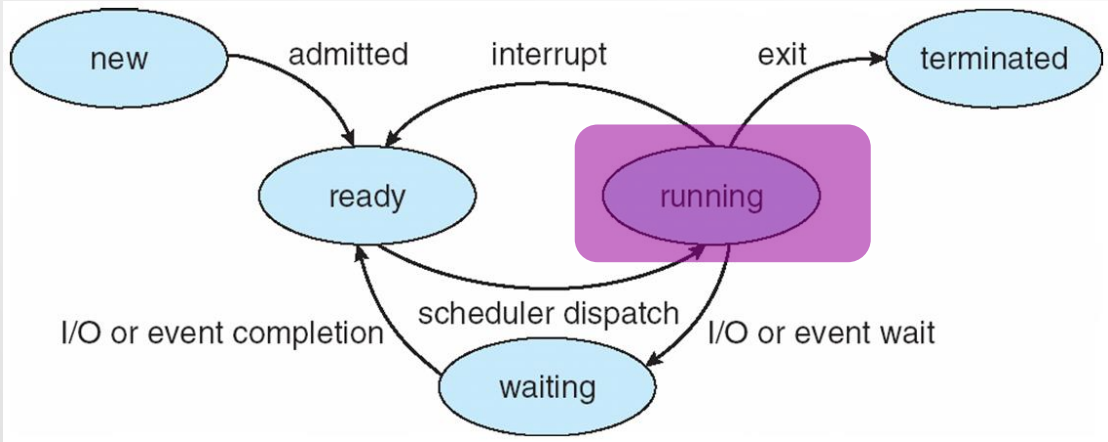

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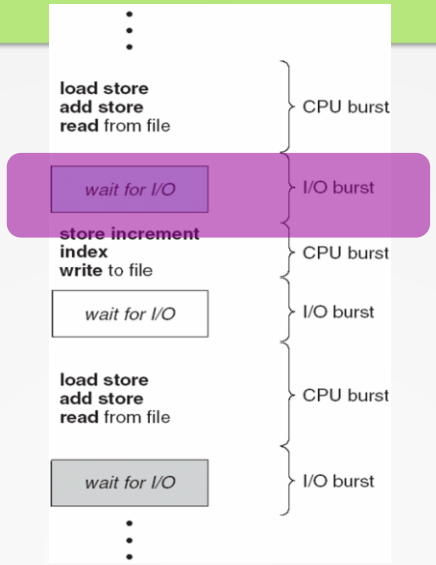

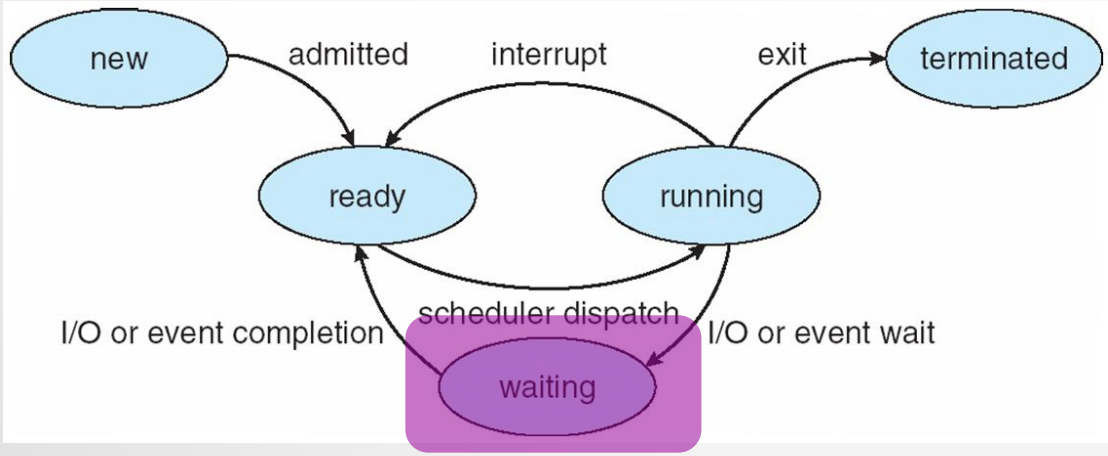

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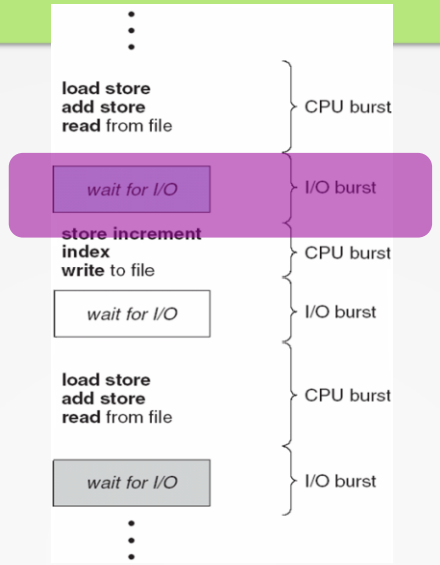

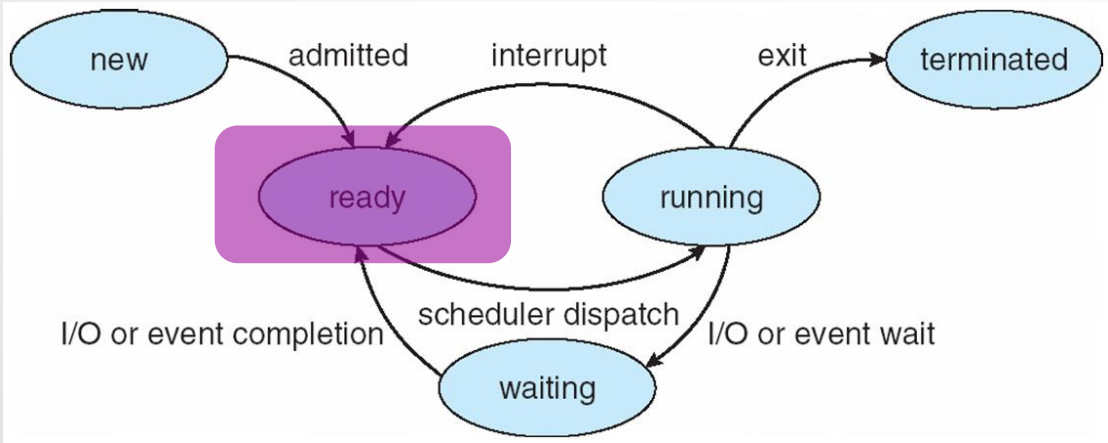

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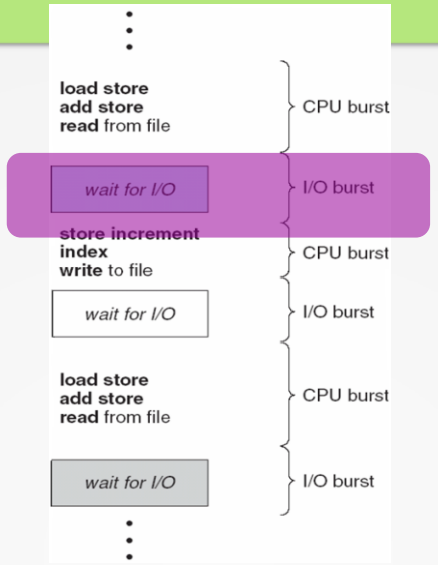
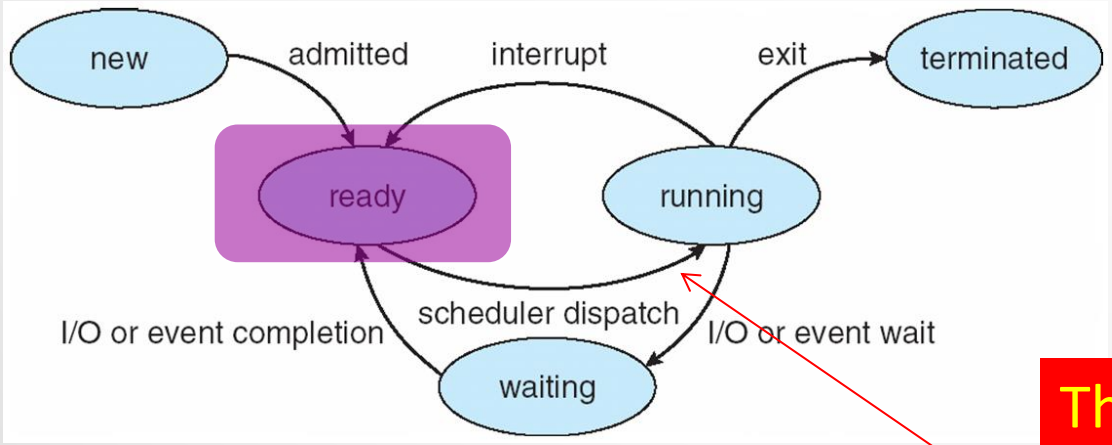
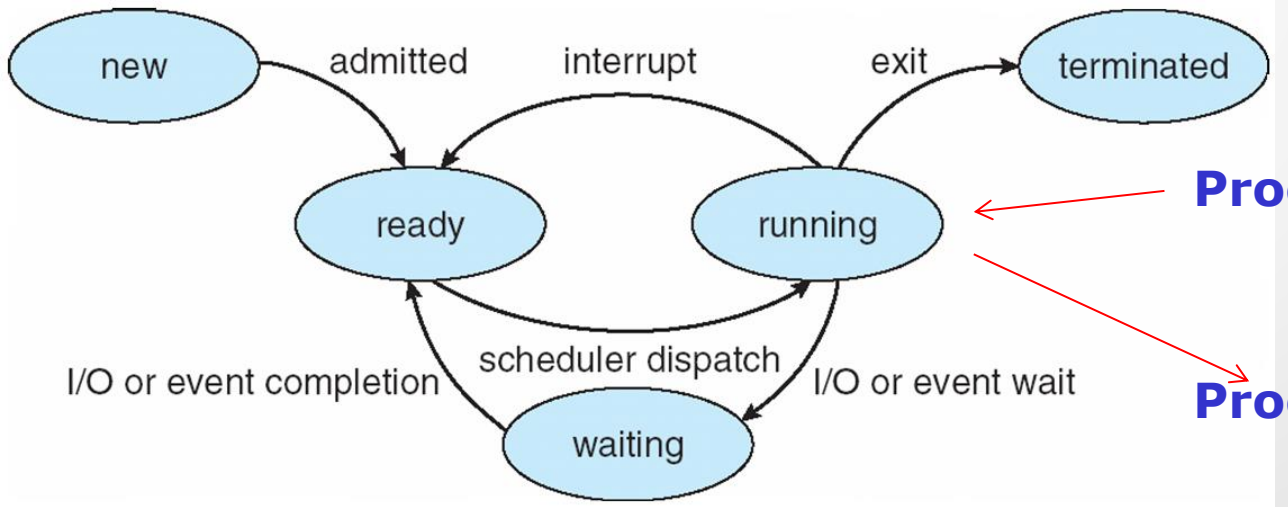




The *dispatcher* gives control of the CPU to the next Process to run

Scheduler Dispatcher

Switching context
Switching to user mode
Reentering the user program at proper location (PC modification - jump)



Scheduling Criteria

- **CPU utilization** – keep the CPU as busy as possible
- **Throughput** – # of processes that complete their execution per time unit
- **Turnaround time** – amount of time to execute a particular process
- **Waiting time** – amount of time a process has been waiting in the ready queue
- **Response time** – amount of time it takes from when a request was submitted until the first response is produced, not output (for time-sharing environment)

Scheduling Algorithm Optimization Criteria

- Max CPU utilization
- Max throughput
- Min turnaround time
- Min waiting time
- Min response time

Scheduling Algorithms

- First-Come, First-Served (FCFS)
- Shortest-Job-First (SJF) Scheduling
- Priority Scheduling
- Round-Robin Scheduling
- Multilevel Queue Scheduling