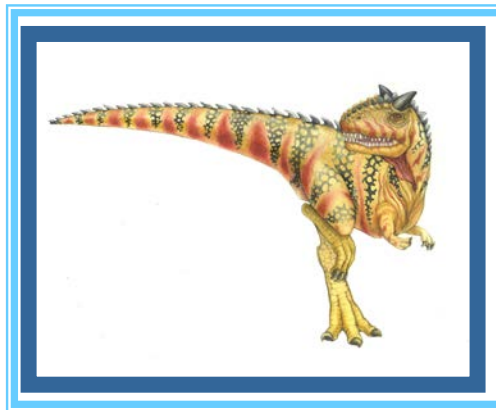


Chapter 3: Process-Concept





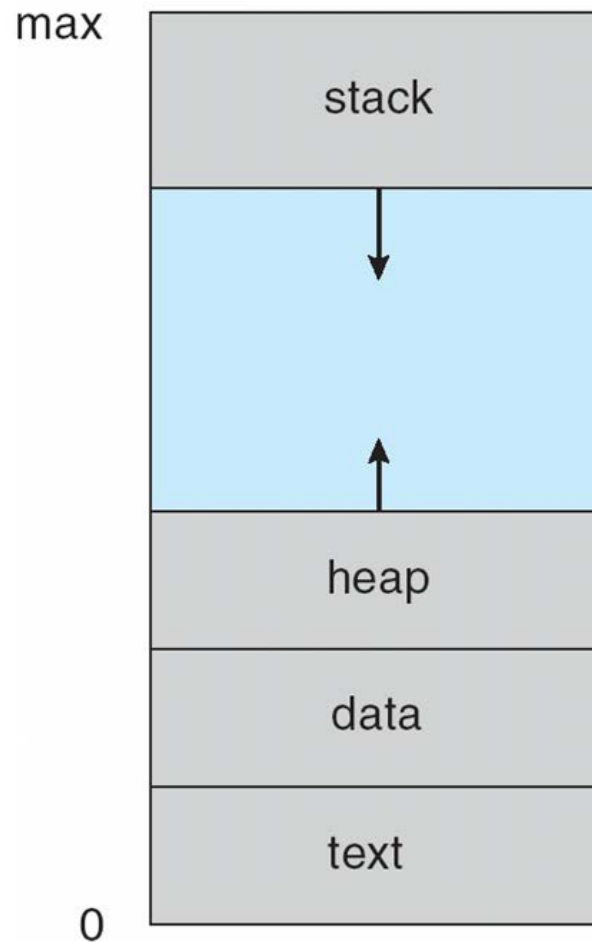
Process Concept

- An operating system executes a variety of programs:
 - Batch system – jobs
 - Time-shared systems – user programs or tasks
- Textbook uses the terms *job* and *process* almost interchangeably
- Process – a program in execution; process execution must progress in sequential fashion
- A process includes:
 - program counter
 - stack
 - data section





Process in Memory





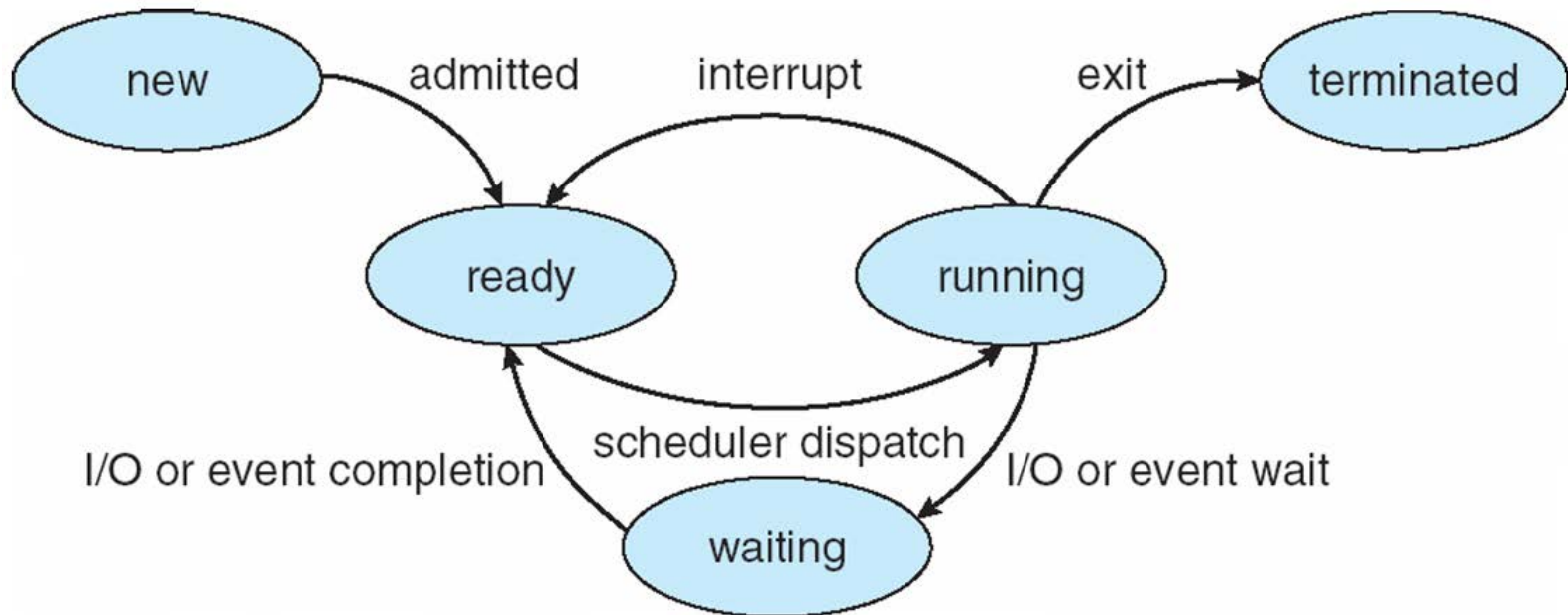
Process State

- As a process executes, it changes *state*
 - **new**: The process is being created
 - **running**: Instructions are being executed
 - **waiting**: The process is waiting for some event to occur
 - **ready**: The process is waiting to be assigned to a processor
 - **terminated**: The process has finished execution





Diagram of Process State





Process Control Block (PCB)

Information associated with each process

- ❑ Process state
- ❑ Program counter
- ❑ CPU registers
- ❑ CPU scheduling information
- ❑ Memory-management information
- ❑ Accounting information
- ❑ I/O status information



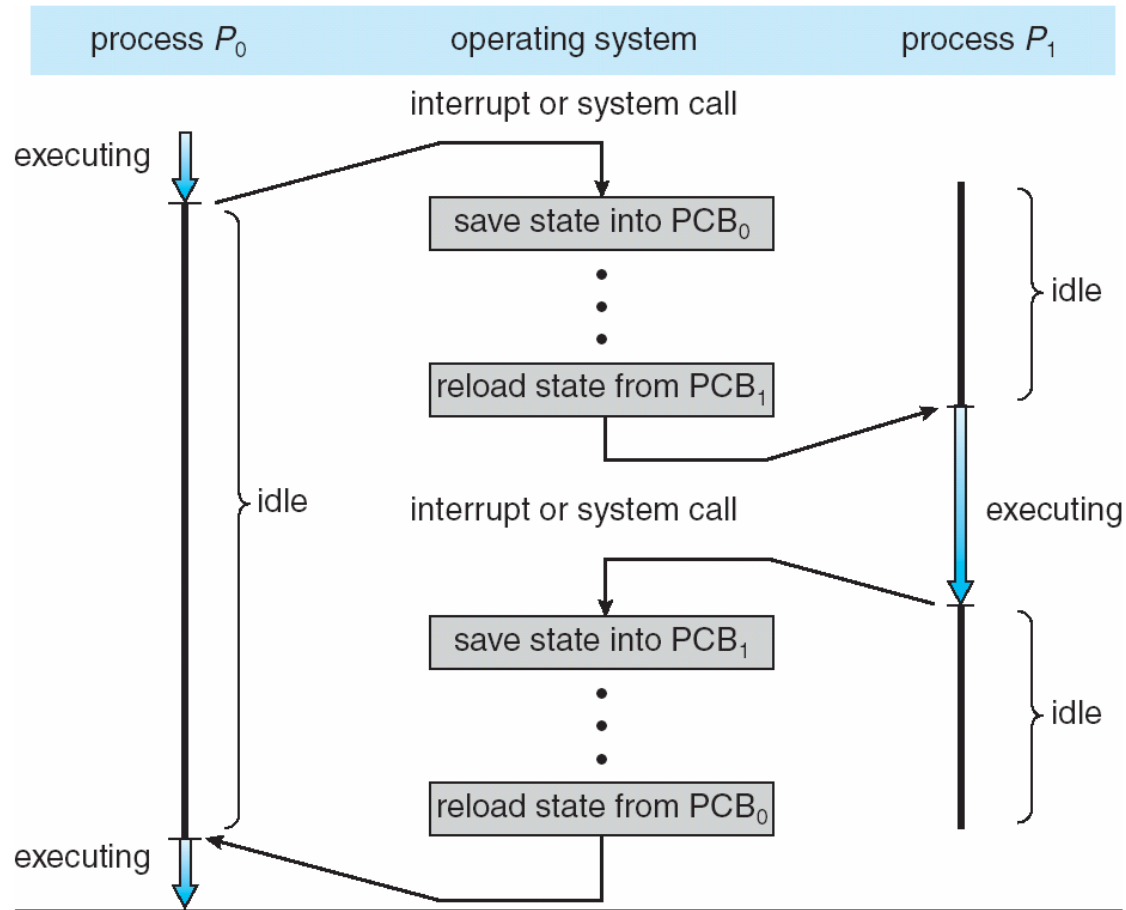


Process Control Block (PCB)





CPU Switch From Process to Process





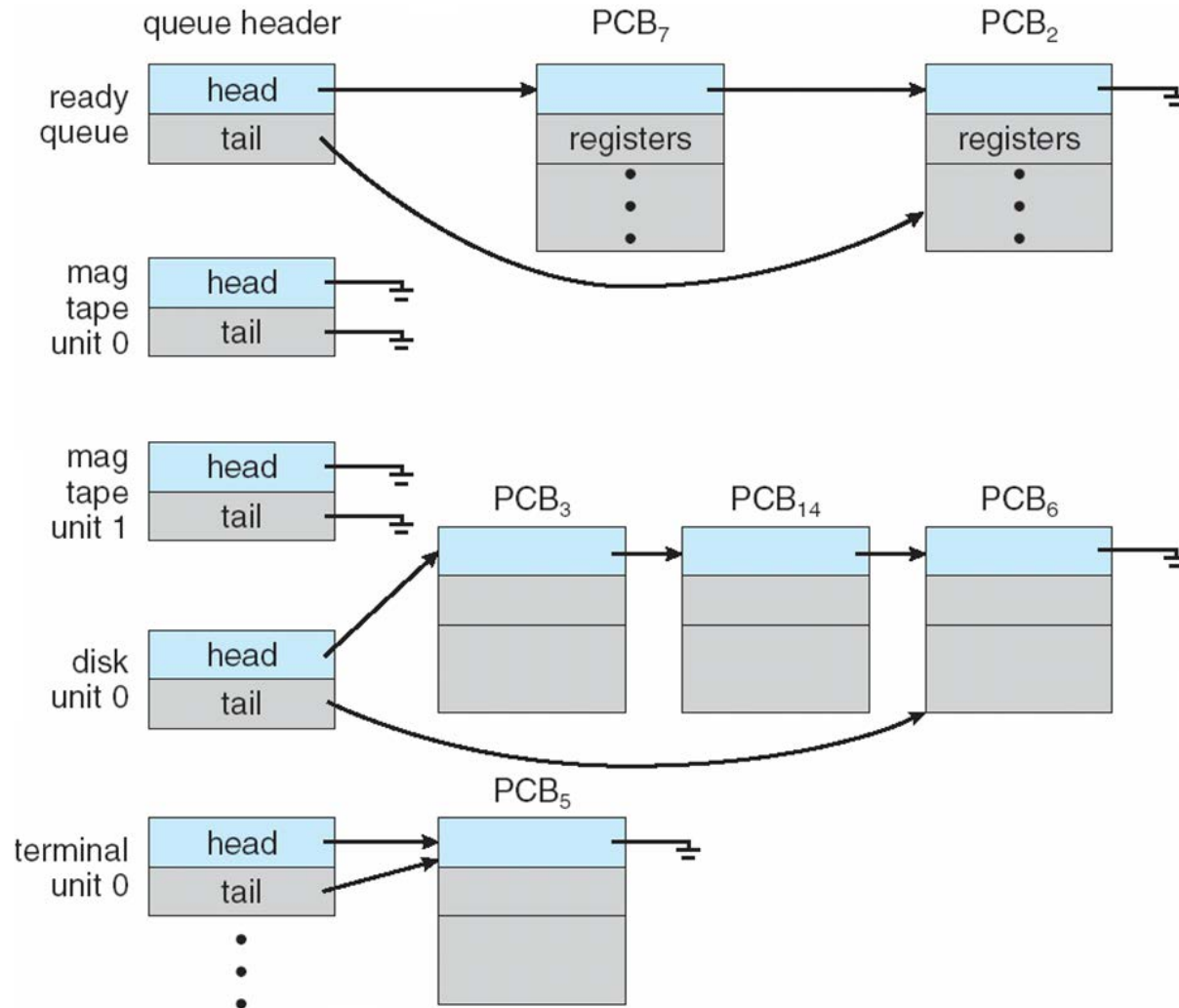
Process Scheduling Queues

- **Job queue** – set of all processes in the system
- **Ready queue** – set of all processes residing in main memory, ready and waiting to execute
- **Device queues** – set of processes waiting for an I/O device
- Processes migrate among the various queues



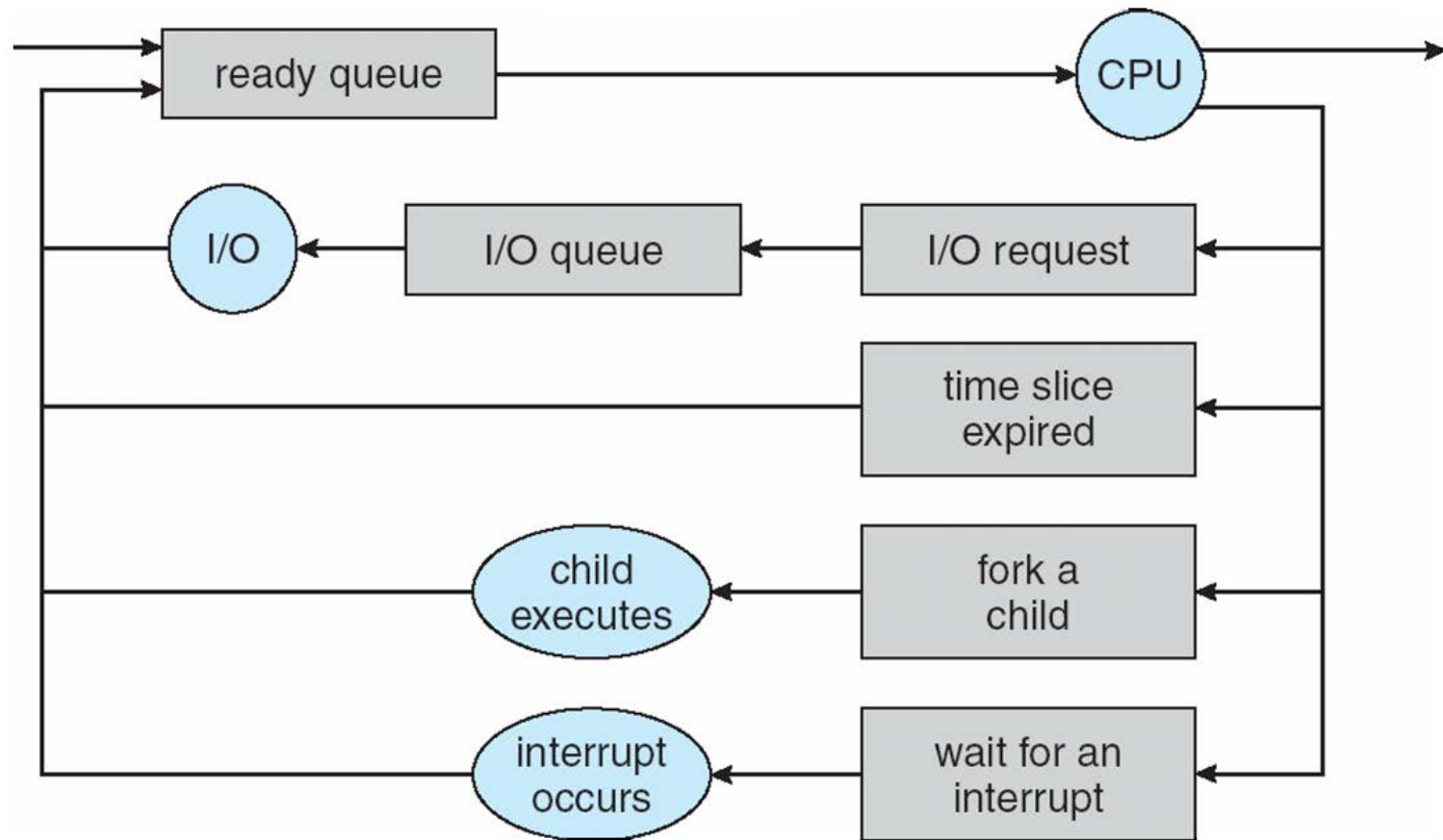


Ready Queue And Various I/O Device Queues





Representation of Process Scheduling





Schedulers

- **Long-term scheduler** (or job scheduler) – selects which processes should be brought into the ready queue
- **Short-term scheduler** (or CPU scheduler) – selects which process should be executed next and allocates CPU





Schedulers (Cont)

- Short-term scheduler is invoked very frequently (milliseconds) \Rightarrow (must be fast)
- Long-term scheduler is invoked very infrequently (seconds, minutes) \Rightarrow (may be slow)
- The long-term scheduler controls the *degree of multiprogramming*
- Processes can be described as either:
 - **I/O-bound process** – spends more time doing I/O than computations, many short CPU bursts
 - **CPU-bound process** – spends more time doing computations; few very long CPU bursts





Context Switch

- When CPU switches to another process, the system must save the state of the old process and load the saved state for the new process via a **context switch**
- **Context** of a process represented in the PCB
- Context-switch time is overhead; the system does no useful work while switching
- Time dependent on hardware support

