

Process Control Block

- Process Control Information

- Scheduling and State Information

This is information that is needed by the operating system to perform its scheduling function. Typical items of information:

- *Process state*: defines the readiness of the process to be scheduled for execution (e.g., running, ready, waiting, halted).

- *Priority*: One or more fields may be used to describe the scheduling priority of the process. In some systems, several values are required (e.g., default, current, highest-allowable).

- *Scheduling-related information*: This will depend on the scheduling algorithm used. Examples are the amount of time that the process has been waiting and the amount of time that the process executed the last time it was running.

- *Event*: Identity of event the process is awaiting before it can be resumed

Process Control Block

- Process Control Information
 - Data Structuring
 - A process may be linked to other process in a queue, ring, or some other structure. For example, all processes in a waiting state for a particular priority level may be linked in a queue. A process may exhibit a parent-child (creator-created) relationship with another process. The process control block may contain pointers to other processes to support these structures.

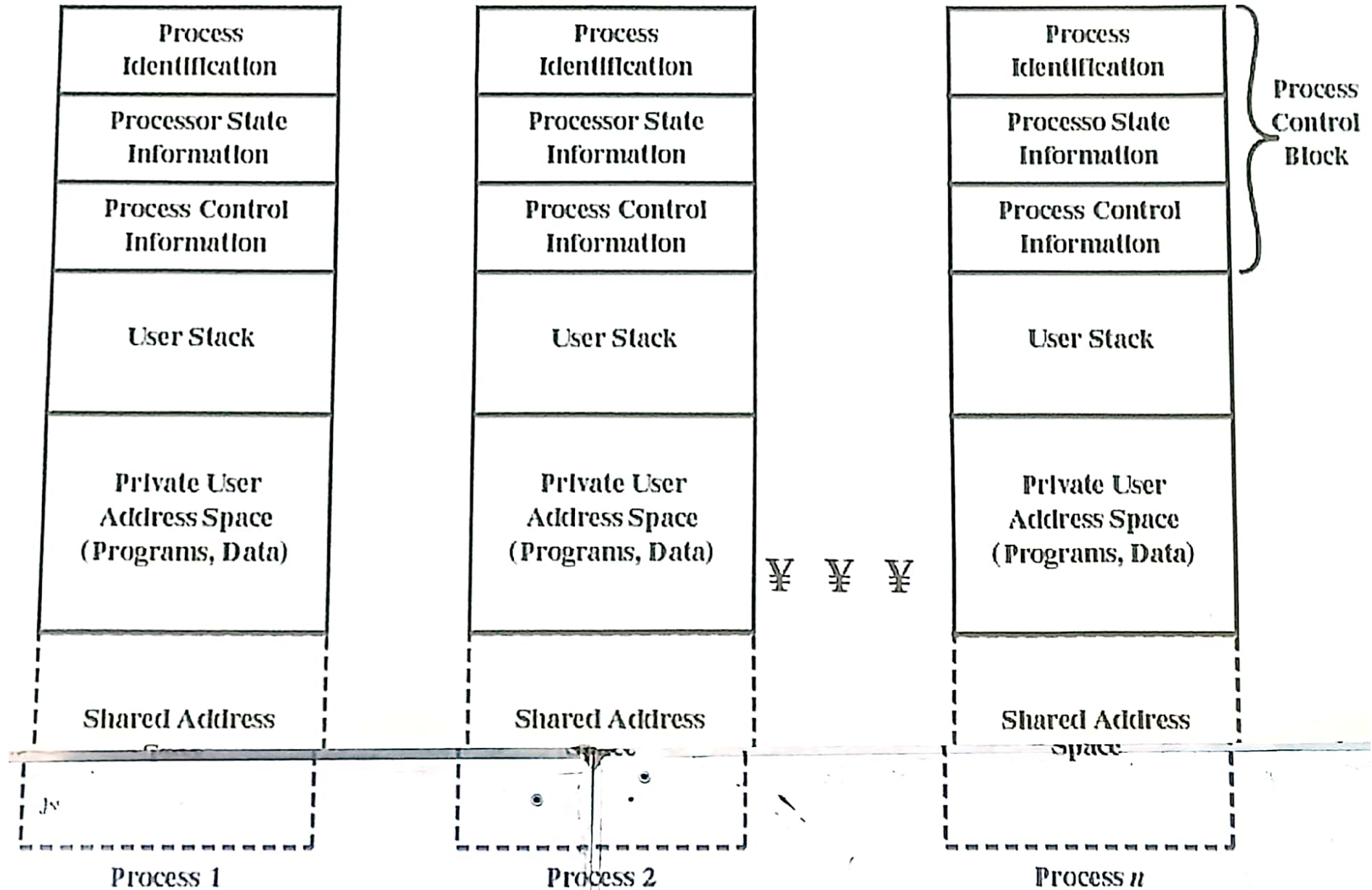
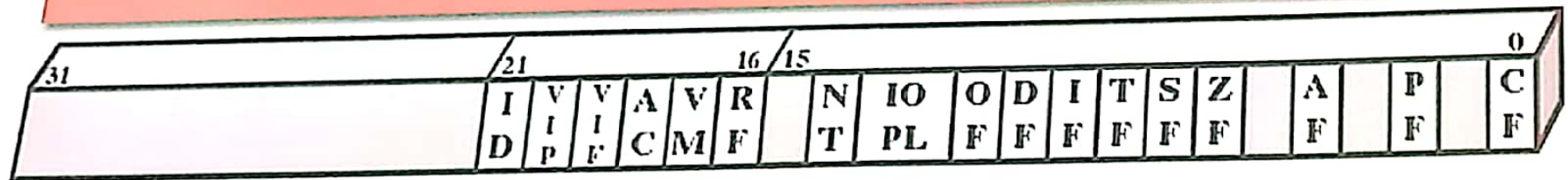


Figure 3.12 User Processes in Virtual Memory

Processor State Information

- Contents of processor registers
 - User-visible registers
 - Control and status registers
 - Stack pointers
- Program status word (PSW)
 - contains status information
- Example: the EFLAGS register on Pentium machines

Pentium II EFLAGS Register



ID = Identification flag
VIP = Virtual interrupt pending
VIF = Virtual interrupt flag
AC = Alignment check
VM = Virtual 8086 mode
RF = Resume flag
NT = Nested task flag
IOPL = I/O privilege level
OF = Overflow flag

DF = Direction flag
IF = Interrupt enable flag
TF = Trap flag
SF = Sign flag
ZF = Zero flag
AF = Auxiliary carry flag
PF = Parity flag
CF = Carry flag

Figure 3.11 Pentium II EFLAGS Register

Modes of Execution

- User mode
 - Less-privileged mode
 - User programs typically execute in this mode
- System mode, control mode, or kernel mode
 - More privileged mode
 - Kernel of the operating system

Process Creation

- Assign a unique process identifier
- Allocate space for the process
- Initialize process control block
- Set up appropriate linkages
 - Ex: add new process to linked list used for scheduling queue
- Create or expand other data structures
 - Ex: maintain an accounting file

When to Switch a Process

- Clock interrupt
 - process has executed for the maximum allowable time slice
- I/O interrupt
- Memory fault
 - memory address is in virtual memory so it must be brought into main memory

When to Switch a Process

- Trap
 - error occurred
 - may cause process to be moved to Exit state
- Supervisor call
 - such as file open

When to Switch a Process

- Clock interrupt
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- I/O interrupt
- Memory fault
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Change of Process State

- Save context of processor including program counter and other registers
- Update the process control block of the process that is currently running
- Move process control block to appropriate queue - ready, blocked
- Select another process for execution

Change of Process State

- Update the process control block of the process selected
- Update memory-management data structures
- Restore context of the selected process

Execution of the Operating System

- Non-process Kernel
 - execute kernel outside of any process
 - operating system code is executed as a separate entity that operates in privileged mode
- Execution Within User Processes
 - operating system software within context of a user process.
 - process executes in privileged mode when executing operating system code

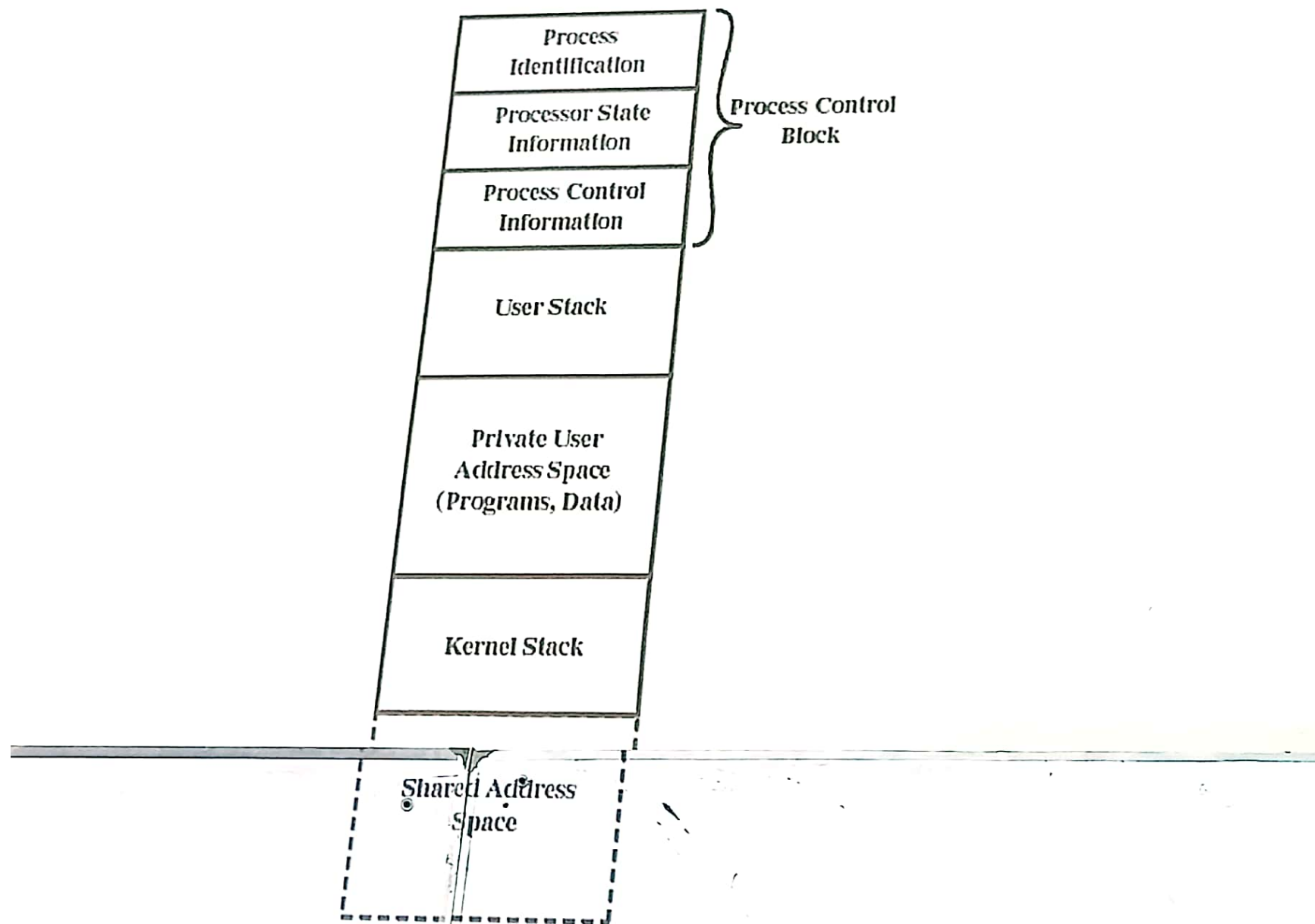


Figure 3.15 Process Image: Operating System
Executes Within User Space

Execution of the Operating System

- Process-Based Operating System
 - major kernel functions are separate processes
 - Useful in multi-processor or multi-computer environment

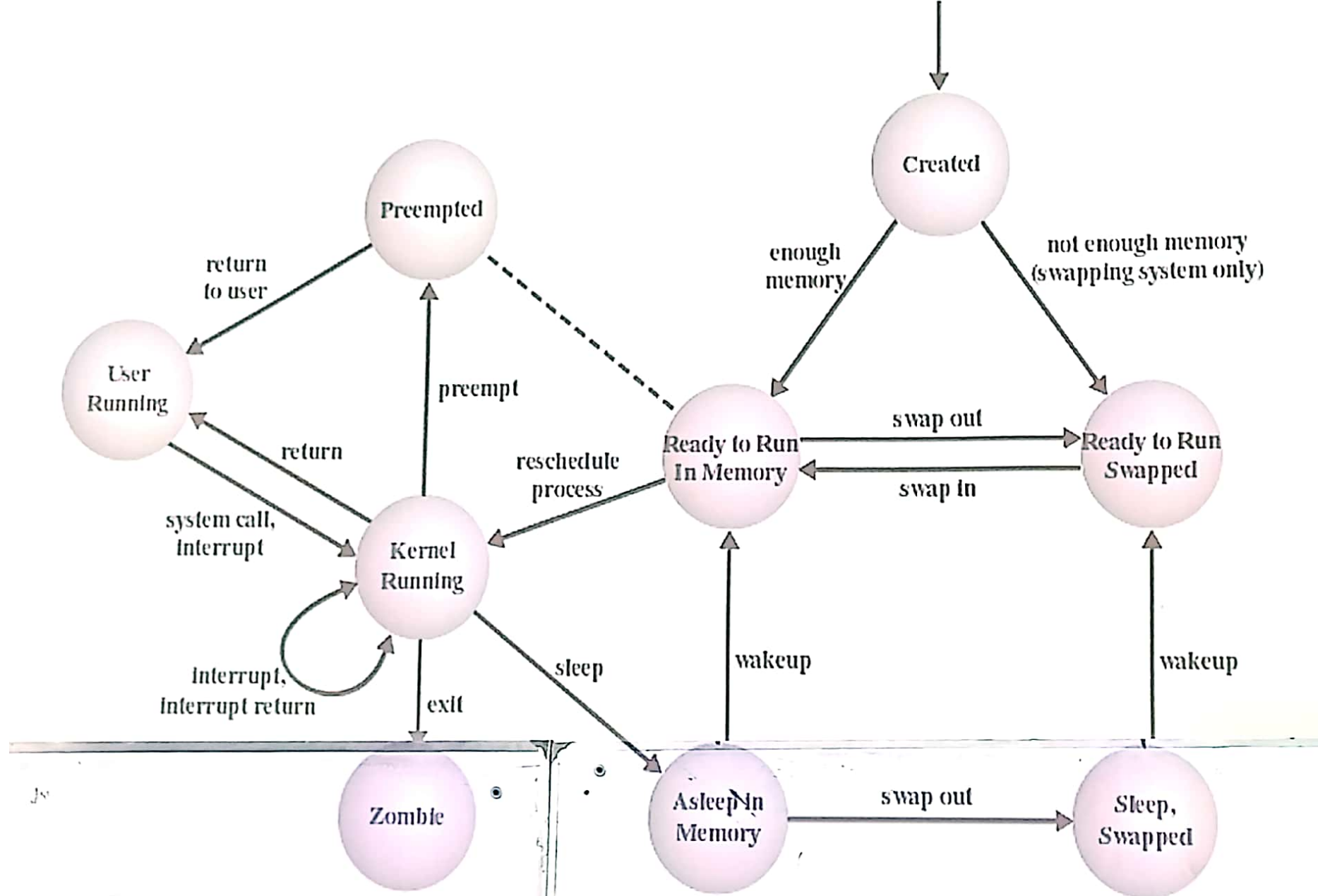


Figure 3.16 UNIX Process State Transition Diagram