

# 第10讲 进程描述与结构



# Process Description

**? 问题:**

**OS 如何感知进程、控制进程及其所用的系统资源?**



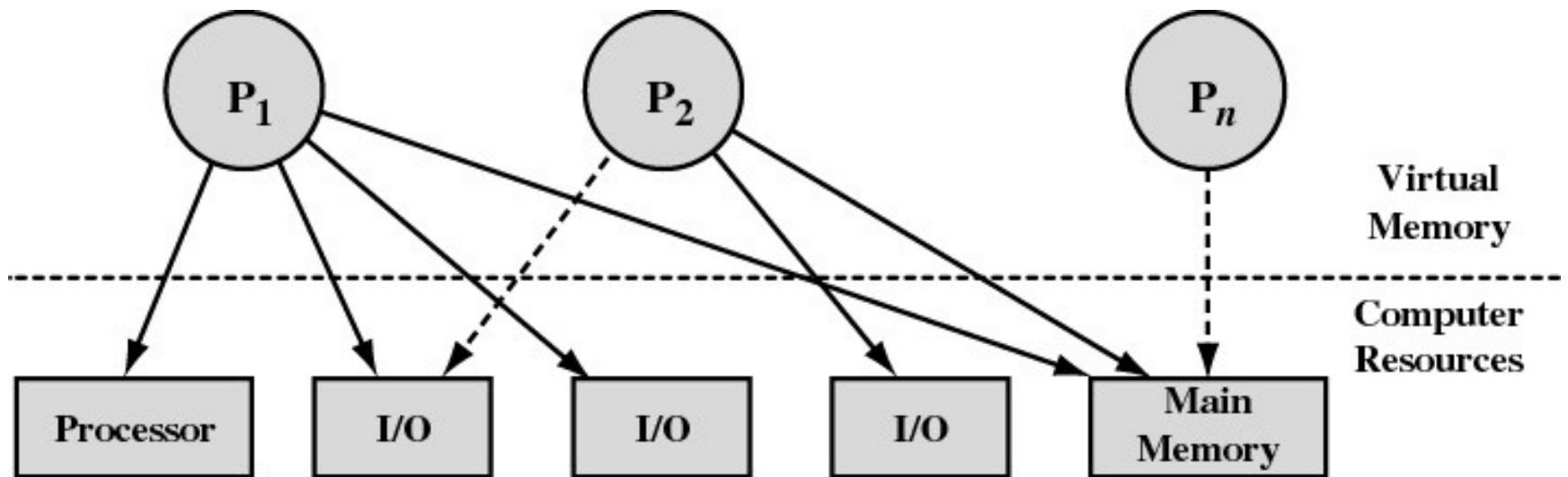


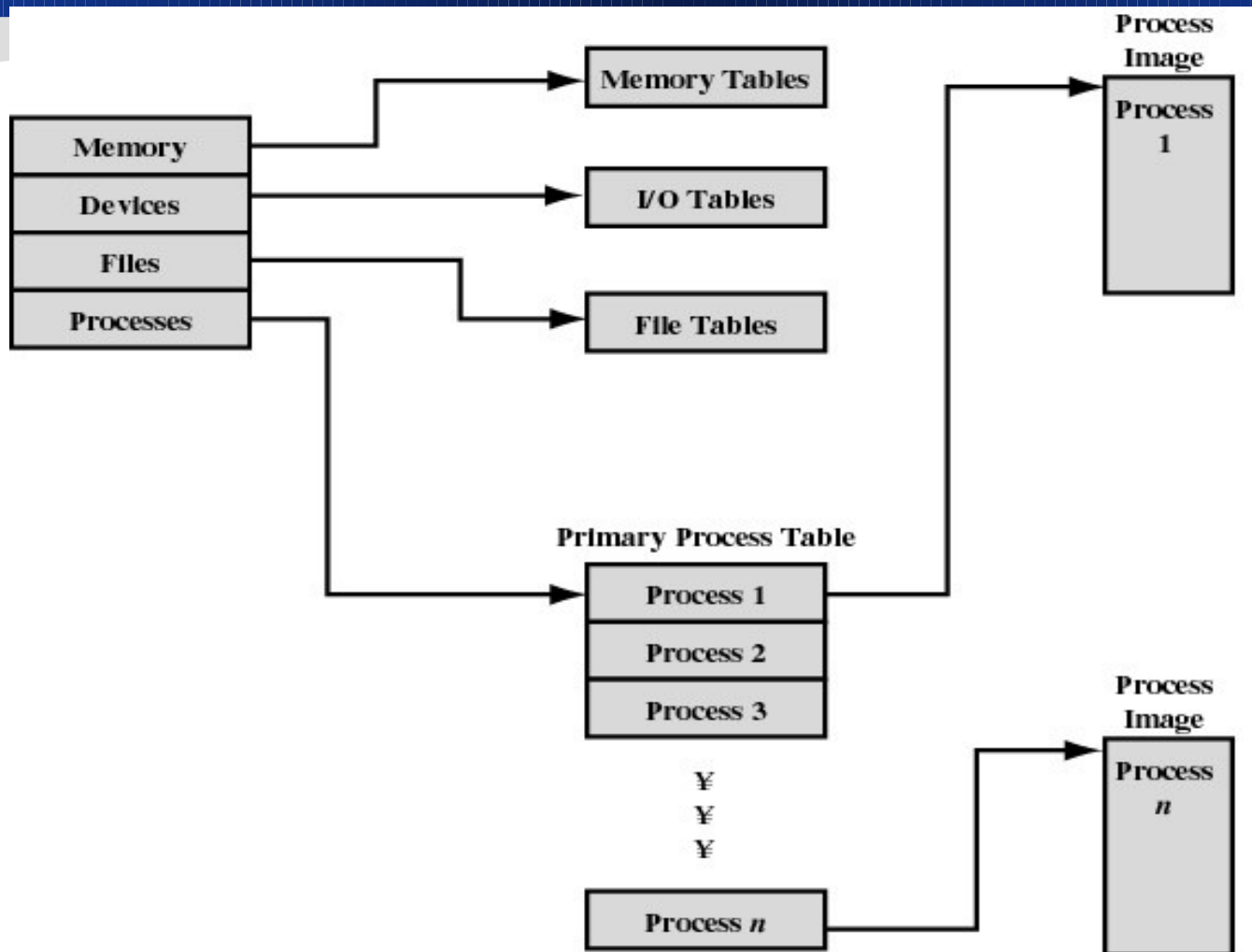
Figure 3.9 Processes and Resources (resource allocation at one snapshot in time)



# Operating System Control Structures

- Information about the current status of each process and resource
- Tables are constructed for each entity the operating system manages
  - *Memory Tables*
  - *I/O Tables*
  - *File Tables*
  - *Process Table*





**Figure 3.10 General Structure of Operating System Control Tables**



# Memory Tables

- Allocation of main memory to processes.
- Allocation of secondary memory to processes.
- Protection attributes for access to shared memory regions.
- Information needed to manage virtual memory（虚拟存储）.



# I/O Tables

- I/O device is available or assigned.
- Status of I/O operation.
- Location in main memory being used as the source or destination of the I/O transfer.



# File Tables

- **Existence of files.**
- **Location on secondary memory.**
- **Current Status.**
- **Attributes.**
- **Sometimes this information is maintained by a file-management system.**





# Process Table

- **Where process is located.**
- **Attributes necessary for its management.**
  - **Process ID**
  - **Process state**
  - **Location in memory**

# Process Location

- **Process includes set of programs to be executed.**
  - Data locations for local and global variables.
  - Any defined constants.
  - Stack.
- **Process control block ( PCB ) .**
  - Collection of attributes.
- **Process image (进程映像)**
  - Collection of program, data, stack, and attributes.



# Process image

- User Data
- User Program
- System Stack : 存放系统及过程调用地址、参数
- Process Control Block ( PCB ) : OS 感知进程、控制进程的数据结构



# Process Control Block

- 简称 PCB：是 OS 控制和管理进程时所用的基本数据结构
- 作用：PCB 是相关进程存在于系统中的唯一标志；系统根据 PCB 而感知相关进程的存在。
- 内容：通常情况下，PCB 包含 Identifiers（标识）、状态、控制、指针等多种信息。



# Process Control Block ( PCB )

## ● Process identification

### ■ Identifiers

- Identifier of this process ( 进程 ID )
- Identifier of the process that created this process (parent process) ( 父进程 ID )
- User identifier ( 用户 ID )



# Process Control Block

## ● Processor State Information

### ■ User-Visible Registers （用户可见寄存器）

- A user-visible register is one that may be referenced by means of the machine language that the processor executes.
- Typically, there are from 8 to 32 of these registers, although some RISC implementations have over 100.



# Process Control Block

## ● Processor State Information

### ■ Control and Status Registers

There are a variety of processor registers that are employed to control the operation of the processor.

These include

- **Program counter**: Contains the address of the next instruction to be fetched.
- **Condition codes**: Result of the most recent arithmetic or logical operation (e.g., sign, zero, carry, equal, overflow).
- **Status information**: Includes interrupt enabled/disabled flags, execution mode .



# Process Control Block

## ● Processor State Information

### ■ Stack Pointers

- Each process has one or more last-in-first-out (LIFO) system stacks associated with it.
- A stack is used to store parameters and calling addresses for procedure and system calls.
- The stack pointer points to the top of the stack.





# Process Control Block

## ● Process Control Information

### ■ Scheduling and State 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.
- **Scheduling-related information**: This will depend on the scheduling algorithm used.
- **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.
- 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.



# Process Control Block

## ● Process Control Information

### ■ Interprocess Communication

- Various flags, signals, and messages may be associated with communication between two independent processes.

### ■ Process Privileges

- Processes are granted privileges in terms of the memory that may be accessed and the types of instructions that may be executed.



# Process Control Block

## ● Process Control Information

### ■ Memory Management

- This section may include pointers to segment and/or page tables that describe the virtual memory assigned to this process.

### ■ Resource Ownership and Utilization

- Resources controlled by the process may be indicated, such as opened files. A history of utilization of the processor or other resources may also be included; this information may be needed by the scheduler.



# Process Control Block

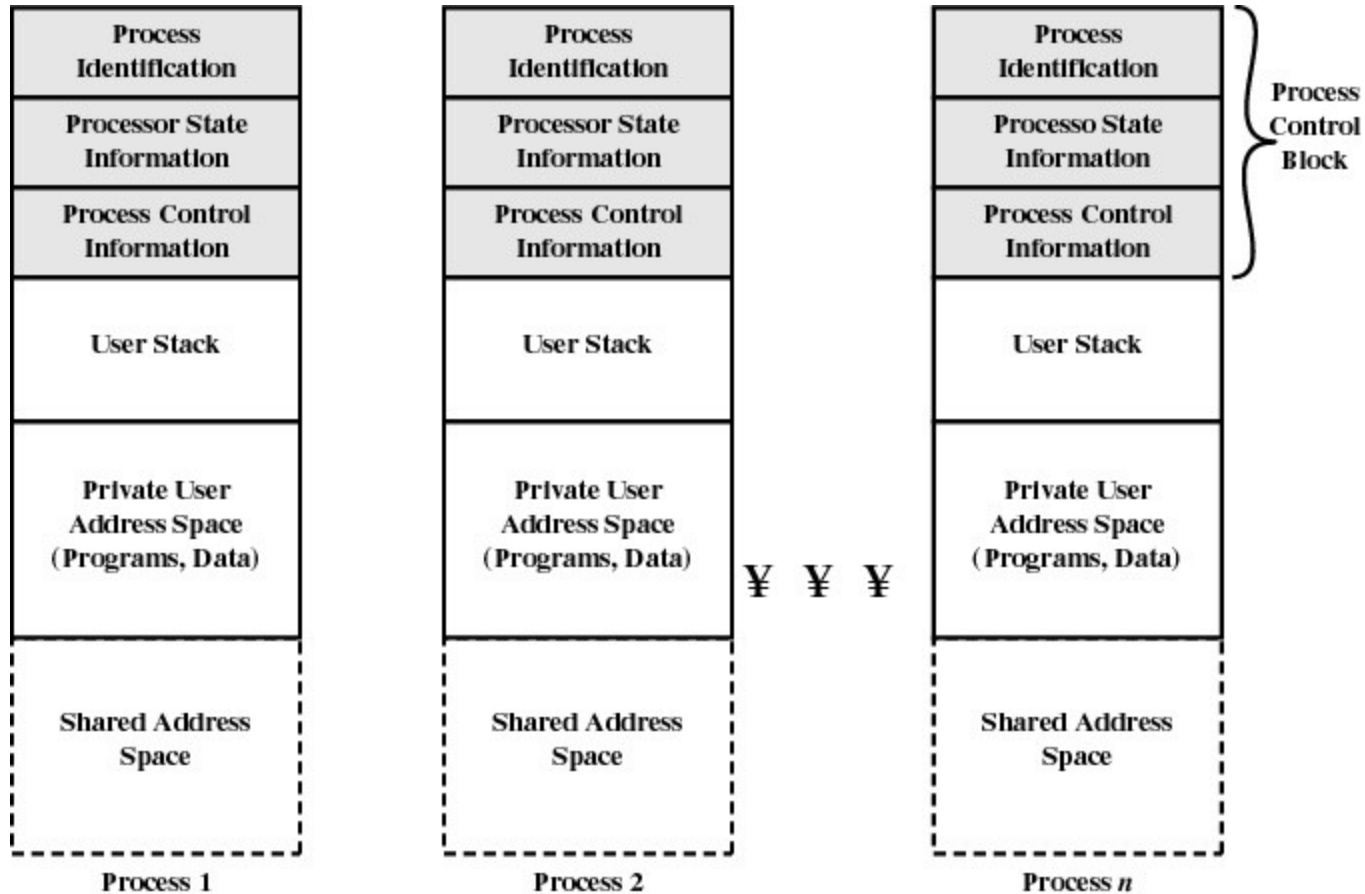


Figure 3.12 User Processes in Virtual Memory

