Chapter 3: Operating Systems

- 3.1 The History of Operating Systems
- 3.2 Operating System Architecture
- 3.3 Coordinating the Machine’s Activities
- 3.4 Handling Competition Among Processes
- 3.5 Security

Functions of Operating Systems

- Oversee operation of computer
- Store and retrieve files
- Schedule programs for execution
- Coordinate the execution of programs

Evolution of Shared Computing

- Batch processing
- Interactive processing
  - Requires real-time processing
- Time-sharing/Multitasking
- Multiprocessor machines
Types of Software

- Application software
  - Performs specific tasks for users
- System software
  - Provides infrastructure for application software
  - Consists of operating system and utility software

**Figure 3.1 Batch processing**

- User domain
- Machine domain
- Job queue
- Job execution
- Jobs: Program, data, and directions
- Results

**Figure 3.2 Interactive processing**

- User domain
- Machine domain
- Program execution
- Programs, data, directions, and results

**Figure 3.3 Software classification**

- Software
  - Application
  - System
    - Operating system
    - Shell
    - Kernel
  - Utility
Operating System Components

- **Shell**: Communicates with users
  - Text based
  - Graphical user interface (GUI)
    - Window manager
- **Kernel**: Performing basic required functions
  - File manager
  - Device drivers
  - Memory manager
  - Scheduler and dispatcher

**Figure 3.4** The shell as an interface between users and the operating system

File Manager

- **Directory (or Folder)**: A user-created bundle of files and other directories (subdirectories)
- **Directory Path**: A sequence of directories within directories

Memory Manager

- Allocates space in main memory
- May create the illusion that the machine has more memory than it actually does (virtual memory) by playing a “shell game” in which blocks of data (pages) are shifted back and forth between main memory and mass storage
Getting it Started (Bootstrapping)

- **Bootstrap (啟動):** Program in ROM (唯讀記憶體)
  - Run by the CPU when power is turned on
  - Transfers operating system from mass storage to main memory
  - Executes jump to operating system

**Figure 3.5 The booting process**

### Process Administration

- **Scheduler (排程):** Adds new processes to the process table and removes completed processes from the process table (工作單元表)
- **Dispatcher (時段分配):** Controls the allocation of time slices to the processes in the process table
  - The end of a time slice is signaled by an interrupt.
Figure 3.6  Time-sharing between process A and process B

Figure 3.7  A deadlock resulting from competition for nonshareable railroad intersections

Handling Competition for Resources

- **Semaphore**: A “control flag”
- **Critical Region**: A group of instructions that should be executed by only one process at a time
- **Mutual exclusion**: Requirement for proper implementation of a critical region

Deadlock

- Processes block each other from continuing
- Conditions required for deadlock
  1. Competition for non-sharable resources
  2. Resources requested on a partial basis
  3. An allocated resource cannot be forcibly retrieved
Security (安全性)

- Attacks from outside
  - Problems
    - Insecure passwords
    - Sniffing software (竊聽軟體)
  - Counter measures (反制措施)
    - Auditing software (監控軟體)

Security (continued)

- Attacks from within
  - Problem: Unruly processes
  - Counter measures: Control process activities via privileged modes and privileged instructions (特權指令)