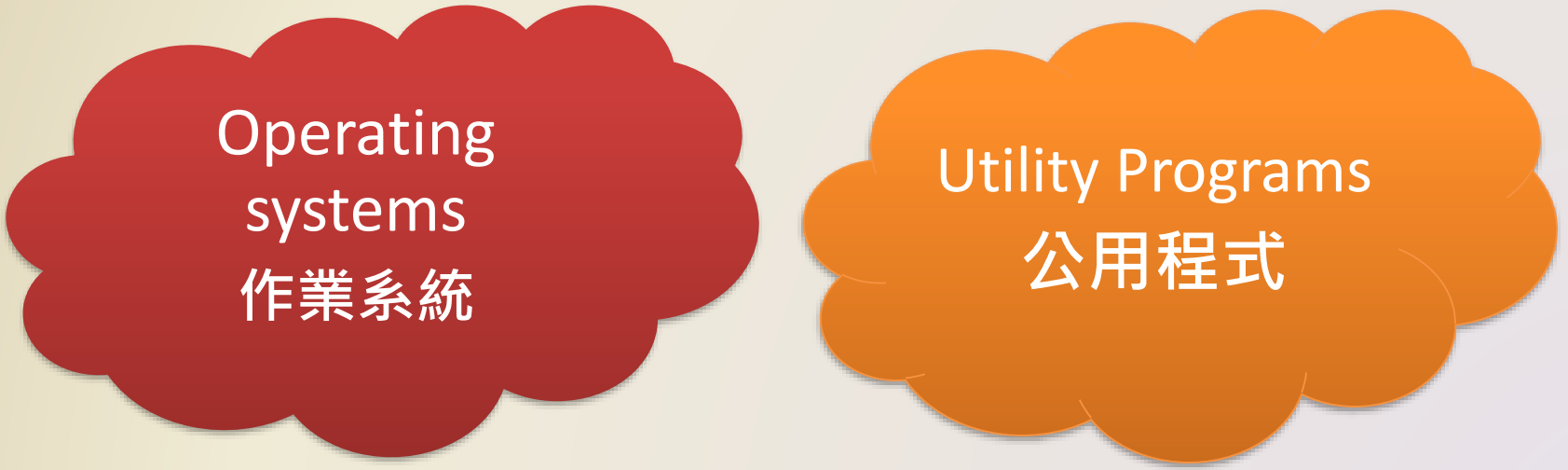
Chapter 9
Operating Systems

System Software系統軟體

- System software
  - consists of the programs that control or maintain the operations of the computer and its devices
    系統軟體 是指控制或維護電腦與其裝置運作的一組程式



Operating Systems 作業系統

- An **operating system** (**OS**) is a set of programs containing instructions that work together to **coordinate all the activities among computer and mobile device hardware**

Start and shut down a computer or mobile device	Provide a user interface	Manage programs	Manage memory
Coordinate tasks	Configure devices	Establish an Internet connection	Monitor performance
Provide file management and other device or media-related tasks	Updating operating system software	Control a network	Administer security

Operating Systems

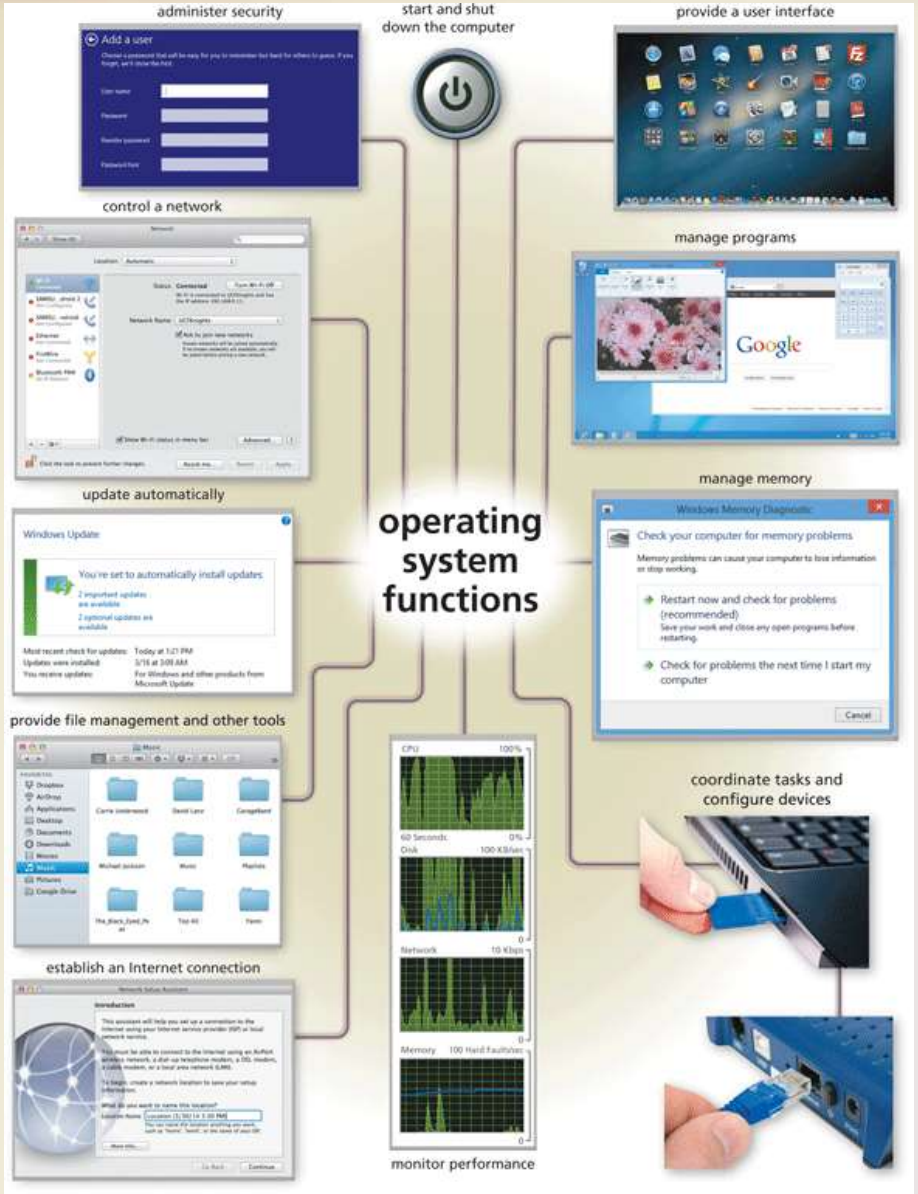


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Figure 9-1

Operating Systems

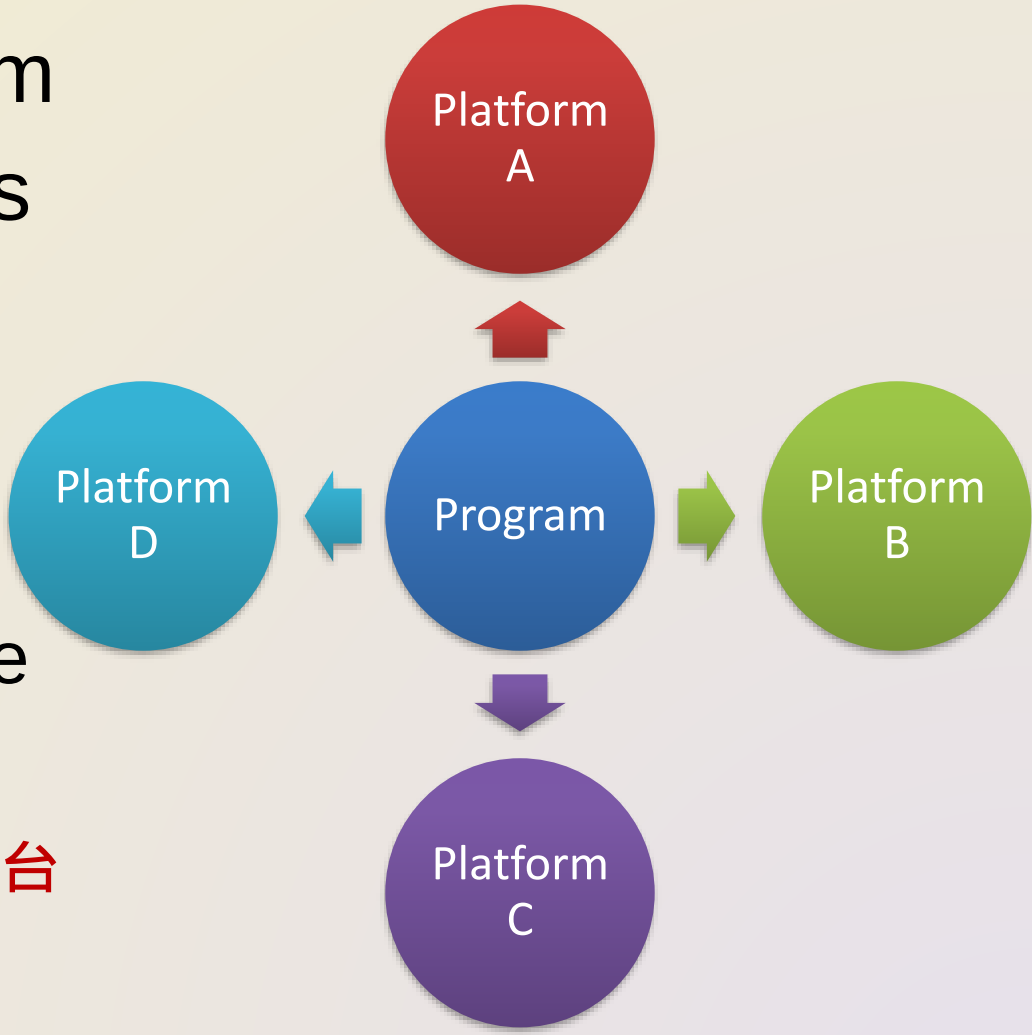
- An operating system can run USB flash drive, media in an optical drive, or an from an external drive, in most cases, an operating system resides inside a computer or mobile device.
  - it is installed on a **hard disk or SSD** in a laptop or desktop.
  - On mobile devices, the operating system may reside on **firmware** in the device.
  - Firmware
    - ROM chips or flash memory chips that store permanent instructions, such as a computer or mobile device's start-up instructions

Operating Systems

- **Operating System generally are written to run on a specific type of computer.**
  - A server does not use the same operating system as a personal computer.
  - When purchasing application software, you must ensure that it works with the operating system installed on your computer or mobile device.
  - Some, however, can run multiple operating systems.

Operating Systems

- The operating system that a computer uses sometimes is called the **platform**.平台
- A **cross-platform** application that runs the same way on multiple operating systems. 跨平台



Operating System Functions

Starting Computers and Mobile Devices

- If a computer or mobile device is off, you press a power button to turn it on
- The method you use to restart a computer or device differs, depending on the **situation and also the hardware.**

Examples of power buttons on computers and mobile devices

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Figure 9-2

Operating System Functions

Page 401
Figure 8-3

The start-up process

Step 1:

When you turn on the computer or mobile device, the power supply or battery sends an electrical current to circuitry in the computer or mobile device.

Step 2:

The charge of electricity causes the processor chip to reset itself and finds the firmware that contains start-up instructions.

Step 3:

The start-up process executes a series of tests to check the various components. These tests vary depending on the type of computer or devices and can include checking the buses, system clock, adapter cards, RAM chips, mouse, keyboard, and drives. It also includes making sure that any peripheral devices are connected properly and operating correctly. If any problems are identified, the computer or device may beep, display error messages, or cease operating — depending on the severity of the problem.

Step 4:

If the tests are successful, the kernel of the operating system and other frequently used instructions load from the computer or mobile device's internal storage media to its memory (RAM). The ***kernel*** is the core of an operating system that manages memory and devices, maintains the internal clock, runs programs, and assigns the resources, such as devices, programs, apps, data, and information. The kernel is ***memory resident*** , which means it remains in memory while the computer or mobile device is running. Other parts of the operating system are ***nonresident*** ; that is, nonresident instructions remain on a storage medium until they are needed, at which time they transfer into memory (RAM).

Step 5:

The operating system in memory takes control of the computer or mobile device and loads system configuration information. The operating system may verify that the person attempting to use the computer or mobile device is a legitimate user. Finally, the user interface appears on the screen, and any start-up applications, such as antivirus software, run.

start-up process

- Setp3
  - The start-up process executes a series of tests to check the various components.
  - These tests vary depending on the type of computer or devices and can include checking the **buses, system clock, adapter cards, RAM chips, mouse, keyboard, and drives.**
  - It also includes making sure that **any peripheral devices are connected properly and operating correctly.**

Operating System Functions

- Setp3
  - The **kernel** is the **core of an operating system** that manages memory and devices , maintains the computer's clock, starts programs and assigns the computer's resources.
  - The kernel is memory resident which means **it remains in memory while the computer is running**.
  - Other parts of the operating system are nonresident; that is, **nonresident instructions remain on a storage medium until they are needed**, at which time they transfer into memory (RAM).

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Operating System Functions

- The **BIOS**, which stands for **basic input/output** , is **firmware** that contains the computer's startup instructions.
- **POST** (power-on self test)
  - Check the various system components including the buses, system clock , adapter cards, RAM chips, mouse, keyboard, and drives.

Consider This

What is Meant by the phase, Booting a Computer?

What is Meant by the phase, Booting a Computer?

- The process of **starting** or **restarting** a computer is called **booting**
  啟動或重新啟動電腦的過程稱為開機

Cold boot

- 啟動一台電源被完全關閉的電腦

Warm boot

- 使用作業系統來重新啟動電腦

What is Meant by the phase, Booting a Computer?

冷開機與暖開機何者開機較快?

A **warm boot** generally is faster than a cold boot because it skips some of the operating system start-up instructions that are included as part of a cold boot.

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What is Meant by the phase, Booting a Computer?

在何情況下使用冷開機?

- If you suspect a **hardware problem**, it is recommended that you use a cold boot to start a computer or device because this process detects and checks connected hardware devices.

在何情況下使用暖開機?

- If **a program or app stops working**, a warm boot often is sufficient to restart the device because this process clears memory.

What is Meant by the phase, Booting a Computer?

A **boot drive** is the drive from which your computer starts

開機磁碟機 指的是個人電腦是從該磁碟機開始開機 (啟動) 程序的

- You can boot from a **boot disk also called recovery disk**
  可使用**開機磁碟**來開機
- A **recovery disk** contains a few system files that will start the computer
  復原磁碟內含能啟動電腦的系統檔案
- In situations when a boot disk is required to restart a computer or device that will not start from its boot drive, the boot disk often is referred to as *recovery media* .

What is Meant by the Term, Booting a Computer?

- **Boot disk**, which is removable media, such as a CD or USB flash drive, that contains only the necessary operating system files required to start the computer.
- The media can be used to start the computer.
  - Live USB
  - Live CD

Shutting Down Computers and Mobile Devices

- An operating system includes various power options
  作業系統內含各種不同的關機選項

Sleep mode saves any open documents and programs to **RAM**, turns off all unneeded functions, and then places the computer in a low-power state

睡眠模式是把開啟中文件和程式儲存在RAM之中，關閉所有不需要的功能，並將電腦切換至低功率狀態

Hibernate saves any open documents and programs to a **hard disk** before removing power from the computer

休眠是先把開啟中文件和程式儲存在**硬碟**，然後再關閉電源

Providing a User Interface

- A **user interface** (**UI**)使用者介面
  - controls how you enter data and instructions and how information is displayed on the screen
    是控制你如何輸入資料和指令，以及資訊會如何呈現在螢幕上
- Two type of user interfaces
  - Graphical User Interface 圖形使用者介面
  - Command-line interface 文字介面

Pages 414
Figure 9-3

Providing a User Interface

- **Graphical User Interface**
  - With a **graphical user interface** (GUI), with menus and visual images you interact

  圖形化使用者介面 (GUI) 讓使用者能透過功能表或視覺圖形來下達命令

- A graphical user interface designed for touch input sometimes is called a ***touch user interface*** .

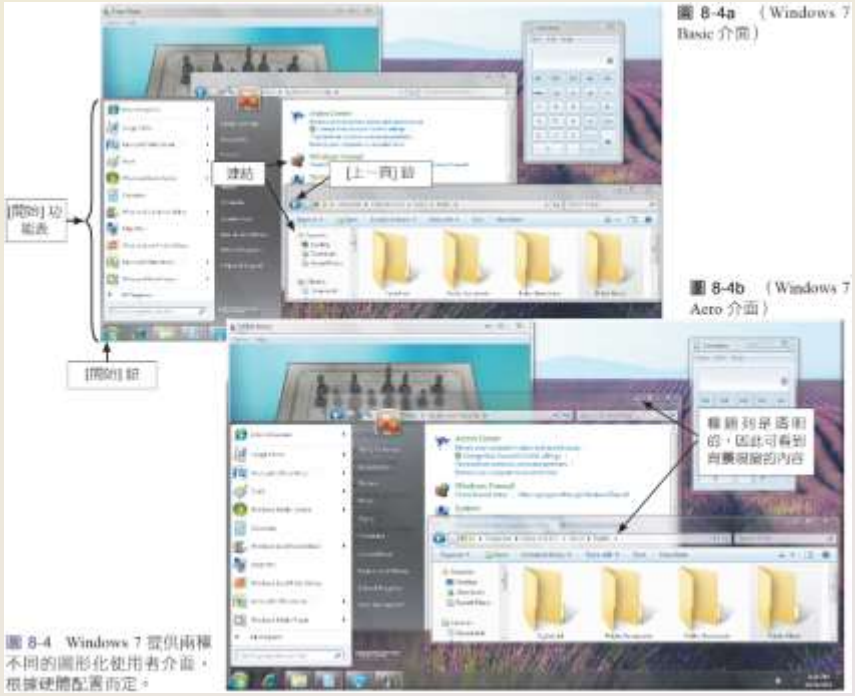

圖 8-4 Windows 7 提供兩種不同的圖形化使用者介面，根據硬體配置而定。

What is a Natural user Interface?

With a **natural user interface (NUI)**, users interact with the software through **ordinary, intuitive behavior.** 自然使用者介面

NUIs are implemented in a variety of ways:

- touch screens (touch input),
- gesture recognition (motion input),手勢辨識
- speech recognition (voice input),
- and virtual reality (simulations).

自然介面(Natural UI) 將主導未來科技

自然使用者介面

- 並非使用於鍵盤或滑鼠，而是憑著動感、手勢、說話、甚至繪畫來操控
- 自然使用者介面(Natural User Interface；NUI)是透過自然的語言、手勢、動作等方式與電子產品互動的方式，目的在於去除操作電子產品時必須學習操作介面或輸入裝置，如滑鼠、鍵盤、辨別功能鍵意義等障礙，讓操作電子產品成為一件不必涉入太多學習過程的事。
- 目前市場上最常見的自然使用者介面為觸控式輸入法、語音辨識以及體感操作等。

自然使用者介面 - DigiTimes電子時報

自然使用者介面

- 微軟的「Project Natal」
  一個最初設計在Xbox 360遊戲機上的附加裝置，通過3D感應器和相機，將玩家的身體變成控制器。無論是賽車、網球或射擊遊戲，玩家都再不需要遙按器，而是以手勢和動作操控遊戲。

XBOX 360 Project Natal

- 微軟一直投放大量資源在研發 NUI，在2010年08年5月微軟主席 Bill Gates展示了一款名為「TouchWall」的技術，可以將一個簡易觸按的介面投射至類似白板的屏幕上。

TouchWall

自然介面(Natural UI) 將主導未來科技

自然使用者介面

- 「Mobile Surface」計劃
  該技術利用了一個裝有內置鏡頭投射系統的移動裝置，將任何平面，如桌面或手掌等，都變成一個多點觸控的顯示屏。
- NUI的發展
  試想想當辦公室或客廳都變為電腦，當牆壁和其他垂直的表面都變得可以多點觸控，就如「Microsoft Surface」電腦一樣，未來的科技發展將能夠影響到公司企業，甚至社會大眾。

Mobile Surface

Microsoft Surface

自然介面(Natural UI) 將主導未來科技

Providing a User Interface

- **Command-Line Interface**
  - In a **command-line interface**, a user types commands represented by short keywords or abbreviations or presses special keys on the keyboard to enter data and instructions
  - When working with a command-line interface, the set of commands used to control actions is called the ***command language*** .

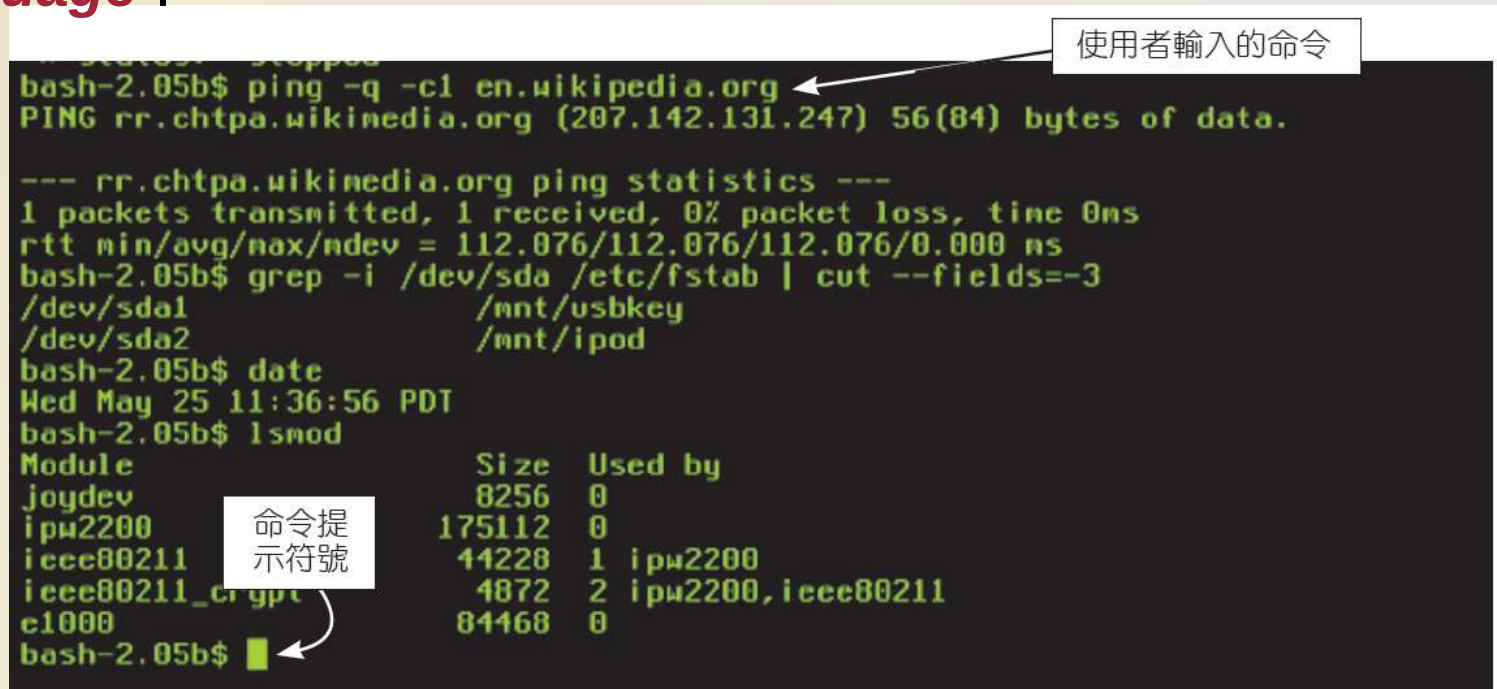

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Figure 9-4

Managing Programs

- How an operating system handles programs directly affects your productivity
  作業系統如何處理程式將直接影響工作效率

Single tasking and multitasking
單工或多工

Single user and multiuser
單人或多人

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Managing Programs

A single tasking operating system

- allows only one program or app to run at a time.

A multitasking operating system

- allows two or more programs or apps to reside in memory at the same time.
- **Foreground** contains program you are using前景模式
- **Background** contains programs that are running but are not in use背景模式

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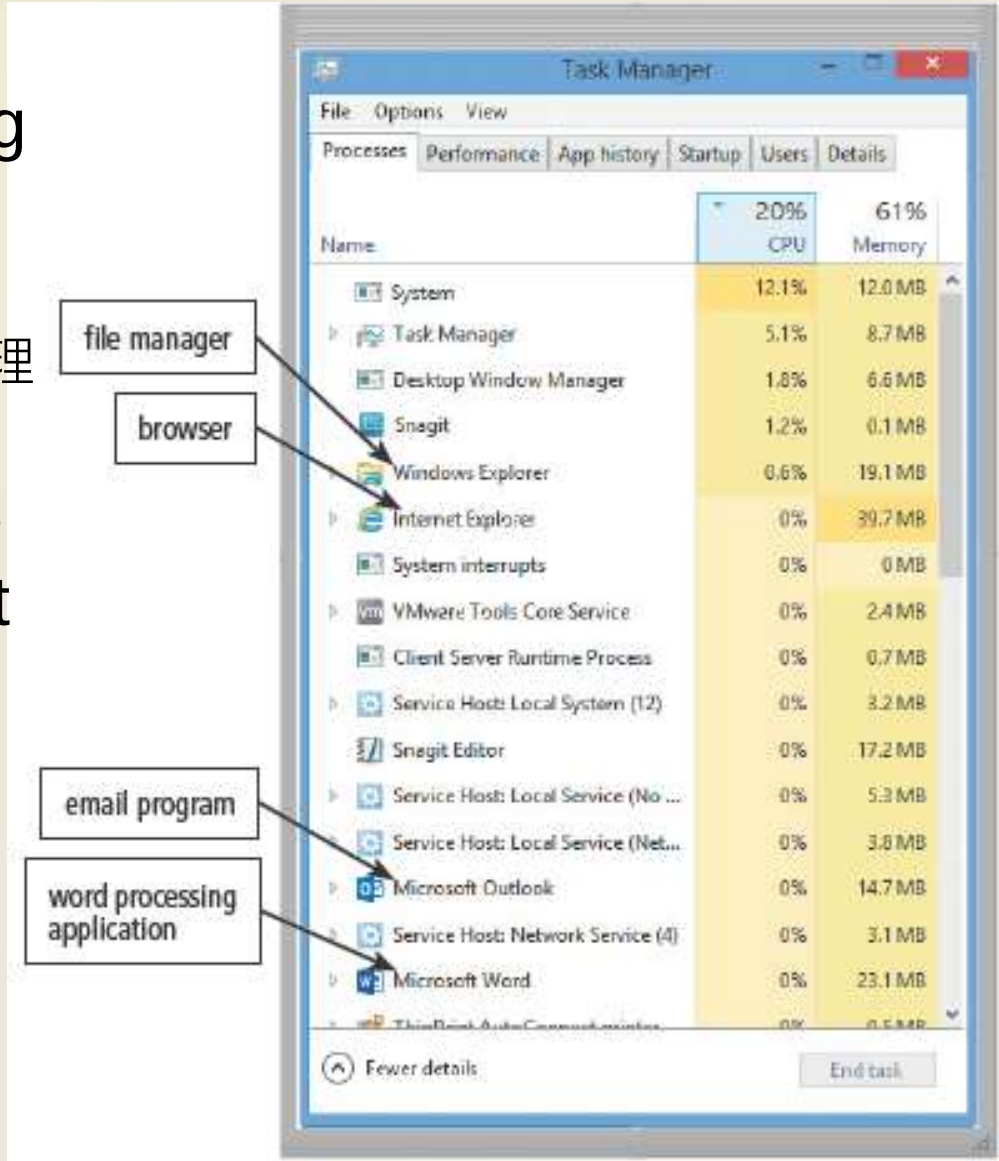
Managing Programs

- In addition to managing applications, an operating system manages other processes.
  作業系統不僅管理應用程式還管理處理程序
- These processes include programs or routines that provide support to other programs or hardware.
- Some are memory resident. Others run as they are required.



Source: Microsoft

Managing Memory

- **The purpose of memory management** is to optimizes the use of RAM
  - 記憶體管理的目的是讓RAM的使用最佳化 (optimize)

1. The operating system **allocates, or assigns**, data and instructions to an area of memory while they are being processed.
2. Then, it carefully **monitors** the contents of memory.
3. Finally, the operating system releases these items from being monitored in memory when the processor no longer requires them.

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Figure 9-8

Managing Memory

- **Virtual memory** 虛擬記憶體
  - the operating system allocates a portion of a storage medium, such as the hard disk or a USB flash drive, to function as additional RAM
    是指被當作額外的RAM來使用的一部分的儲存媒體
- Because virtual memory is slower than RAM, users may notice the computer slowing down while it uses virtual memory.

Managing Memory

- The **area of the hard disk** used for virtual memory is called a **swap file**. **置換檔**
- A **page** **is amount of data and program instructions** that can **swap** at a given time.**分頁**
  置換的資料和程式指令數量以分頁為單位
- The technique of swapping items between memory and storage, called **paging** .**分頁處理**
  在記憶體與儲存體之間置換項目的技術則稱為**分頁處理**
- When an operating system **spends much of its time paging**, instead of executing application software, it is said to be **thrashing**.**輾轉現象**

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How a Computer Might Use Virtual Memory

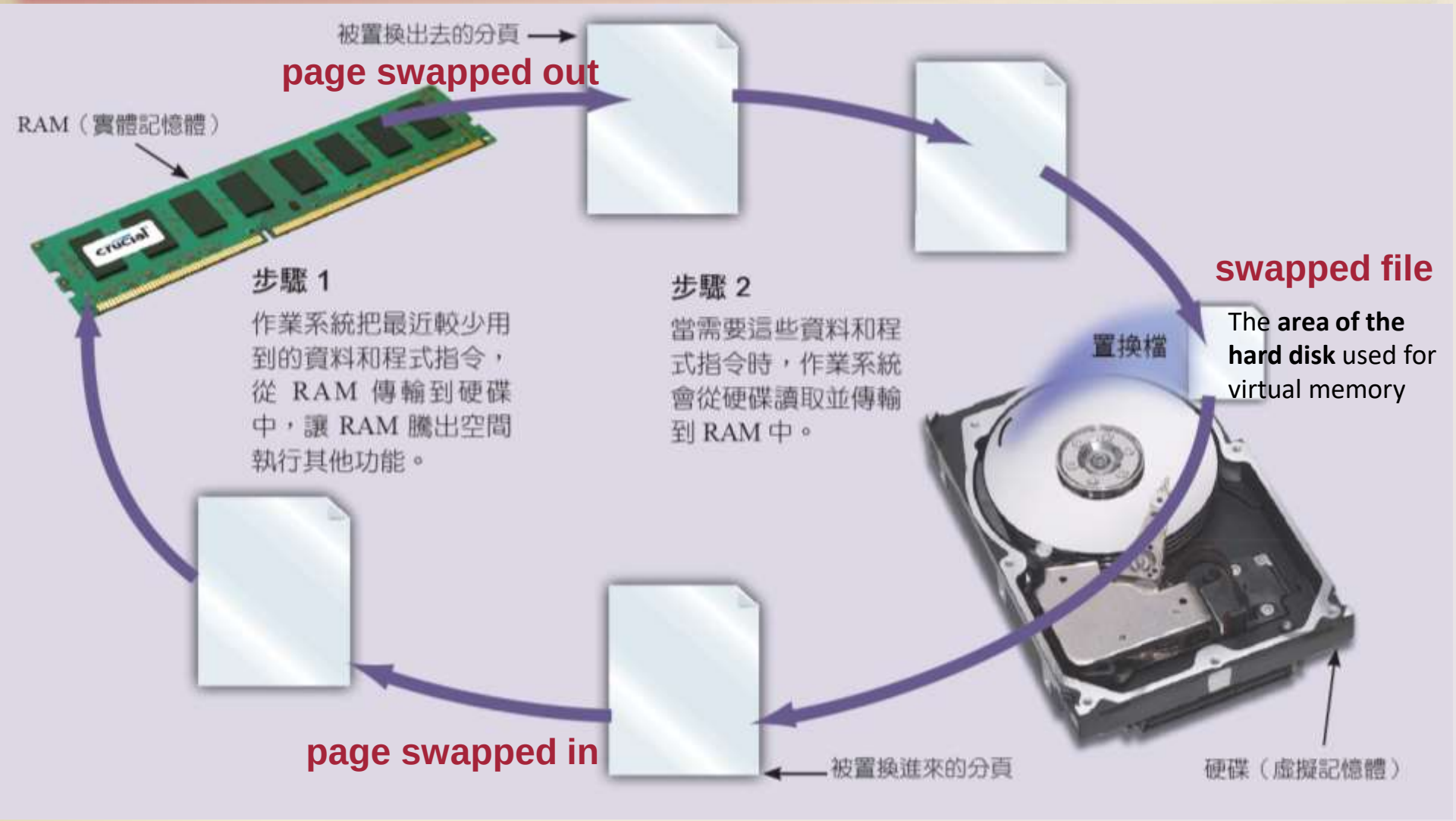

Figure 9-8

What Happens if an Application Stops Responding or the Computer Appears to Run Sluggishly?

When this occurs, try to **exit the program**. If that does not work, try a **warm boot** and then a **cold boot**.

To help prevent future occurrences of thrashing, you might consider the following:

1. Remove unnecessary files and uninstall seldom used programs and apps.
2. Defragment the hard disk.
   (Read How To 8-1 for instructions about defragmenting a hard disk.)
3. Purchase and install additional RAM.
   (Read How To 6-1 for instructions about installing memory modules.)

Coordinating Tasks

The operating system determines the order in which tasks are processed

作業系統負責決定任務的處理順序

- Operating system schedule jobs based on **job's priority**

A **job** is operation the processor manages

工作指處理器所管理的運作

- Receiving data from input device
- Processing instructions
- Transferring items between storage and memory
- Sending information to output device

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Coordinating Tasks

- The processor operates at a much faster rate of speed than peripheral devices.
- 當等待周邊設備空閒時，作業系統將資訊放到緩衝區
- Buffer緩衝區
  - is a **segment of memory or storage** in which items are placed while waiting to be transferred from an input device or to an output device.
    一個區段的記憶體或儲存體 ，暫時存放由**輸入設備**傳送來或要傳送到**輸出設備**的資訊

Coordinating Tasks

- The operating system commonly uses **buffers** with printed documents.
- **Spooling** 多工緩衝處理
  - **Sending print jobs to buffer instead of directly to printer**
  - Print jobs line up in **queue**
- **Printer spooler** 列印多工緩衝處理程式
  - Intercepts documents to be printed from the operating system and places them in the queue.
    請求列印的文件統一放在佇列中，待印表機空閒後，再將資料送往印表機處理.

Spooling increases both processor and printer efficiency by placing documents to be printed **in a buffer on disk** before they are printed.

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Figure 9-9

Configuring Devices

A **driver** is a small program that tells the operating system how to communicate with a specific device

驅動程式 是一種讓作業系統知道如何與某特定裝置溝通的小型程式

Plug and Play automatically configures new devices as you install them

隨插即用 功能是指作業系統在你安裝新裝置時會自動設定

Configuring Devices

- When you attach a Plug and Play device to a computer, the operating system determines and appropriate IRQ to use.
  - An **IRQ (Interrupt request line)** is a communications line between a device and the processor.

補充

BCC-16 (in Chinese) 計算機概論十六講

IRQ設定與簡單說明

Monitoring Performance

- A **performance monitor** is a program that assesses and reports information about various computer resources and devices
  效能監視器是指負責評估並回報電腦中各資源與裝置相關資訊的程式

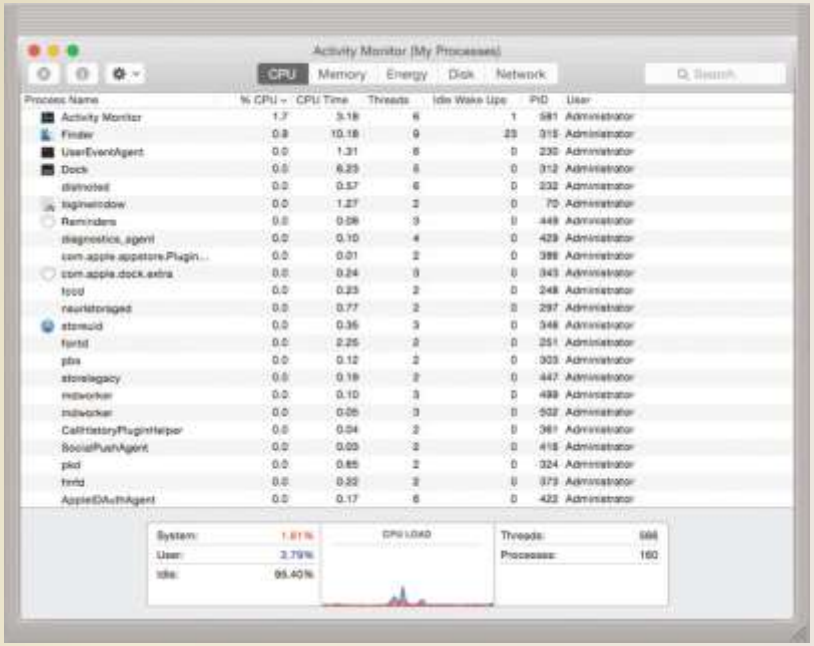

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Figure 9-10

Establishing an internet Connection

Operating systems typically provide a means to establish Internet connections

作業系統通常會提供建立網際網路連線的工具

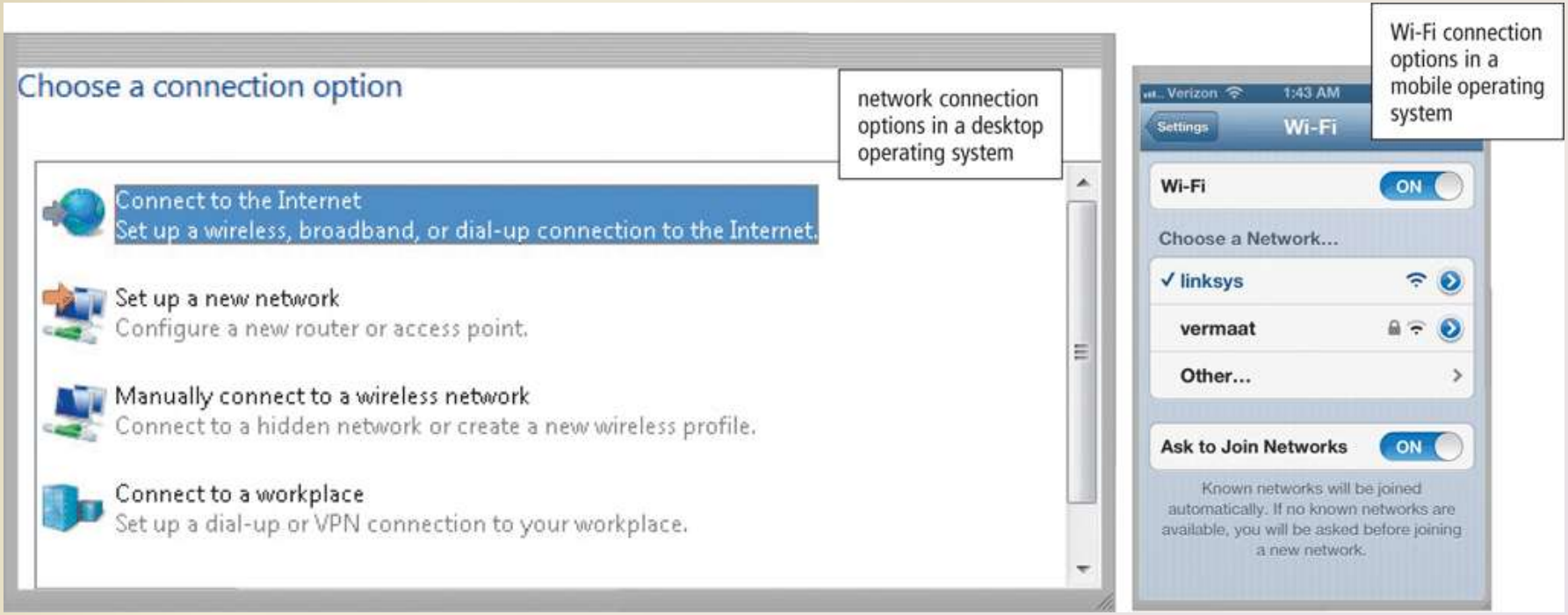

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Figure 9-11

Establishing an internet Connection

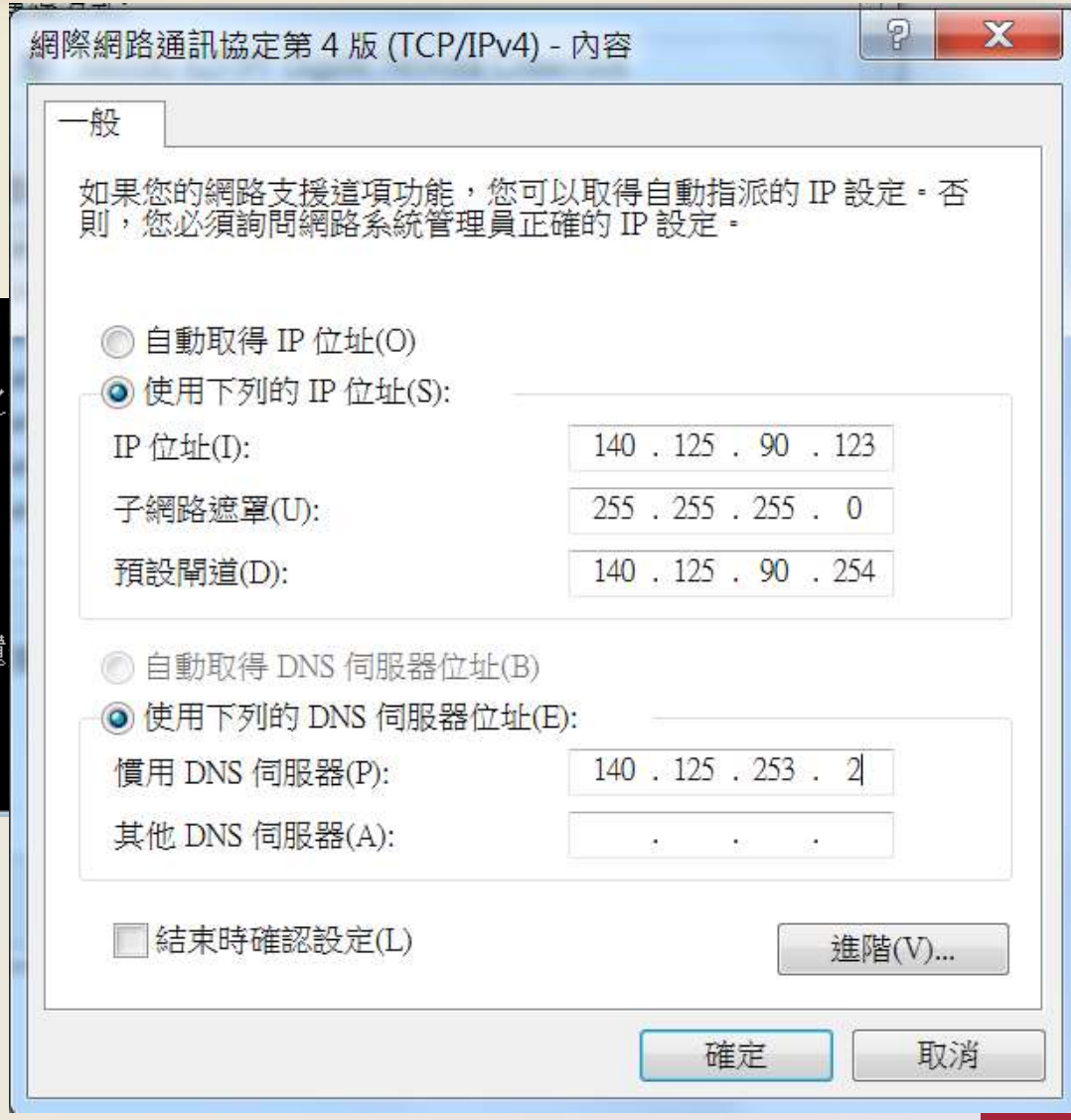
Establishing an internet Connection

```
C:\Users\Melanie>ping dns.yuntech.edu.tw

Ping dns.yuntech.edu.tw [140.125.253.2] (使用 32 位
回覆自 140.125.253.2: 位元組=32 時間=10ms TTL=57
回覆自 140.125.253.2: 位元組=32 時間=9ms TTL=57
回覆自 140.125.253.2: 位元組=32 時間=10ms TTL=57
回覆自 140.125.253.2: 位元組=32 時間=9ms TTL=57

140.125.253.2 的 Ping 統計資料:
    封包: 已傳送 = 4，已收到 = 4，已遺失 = 0 (0% 遺
大約的來回時間 (毫秒):
    最小值 = 9ms，最大值 = 10ms，平均 = 9ms

C:\Users\Melanie>
```



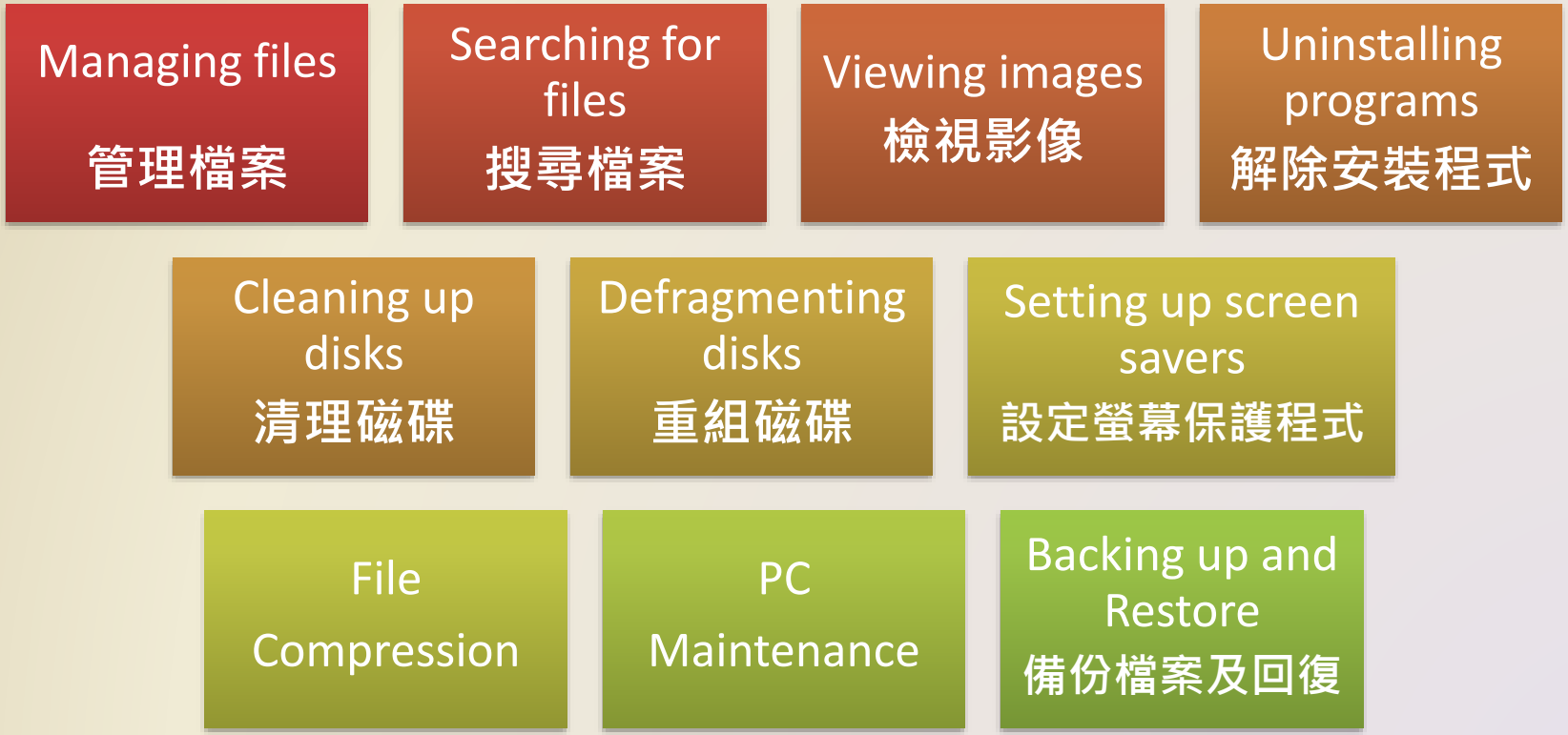
Updating Operating System Software

- Many programs, including operating systems, include an **automatic update** automatically provides new features or corrections to the program
  自動更新功能，自動替該程式提供更新程式
  - **service pack**
    software makers provide free down loadable updates

Page 421-422
Figure 9-12

Providing File and Disk Management

- Operating systems often provide users with a variety of **tools** related to managing a computer, its devices, or its programs (又稱Utility Programs)



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File and Disk Management Tools

Tool	Function
File Manager	Performs functions related to displaying files; organizing files in folders; and copying, renaming, deleting, moving, and sorting files
Search	Attempts to locate a file on your computer or mobile device based on specified criteria
Image Viewer	Displays, copies, and prints the contents of a graphics file
Uninstaller	Removes a program or app, as well as any associated entries in the system files
Disk Cleanup	Searches for and removes unnecessary files
Disk Defragmenter	Reorganizes the files and unused space on a computer's hard disk so that the operating system accesses data more quickly and programs and apps run faster

Page 422 Table9-1

File and Disk Management Tools

Tool	Function
Screen Saver	Causes a display's screen to show a moving image or blank screen if no keyboard or mouse activity occurs for a specified time
File Compression	Shrinks the size of a file(s)
PC Maintenance	Identifies and fixes operating system problems, detects and repairs disk problems, and includes the capability of improving a computer's performance
Backup and Restore	Copies selected files or the contents of an entire storage medium to another storage location

Page 422 Table9-1

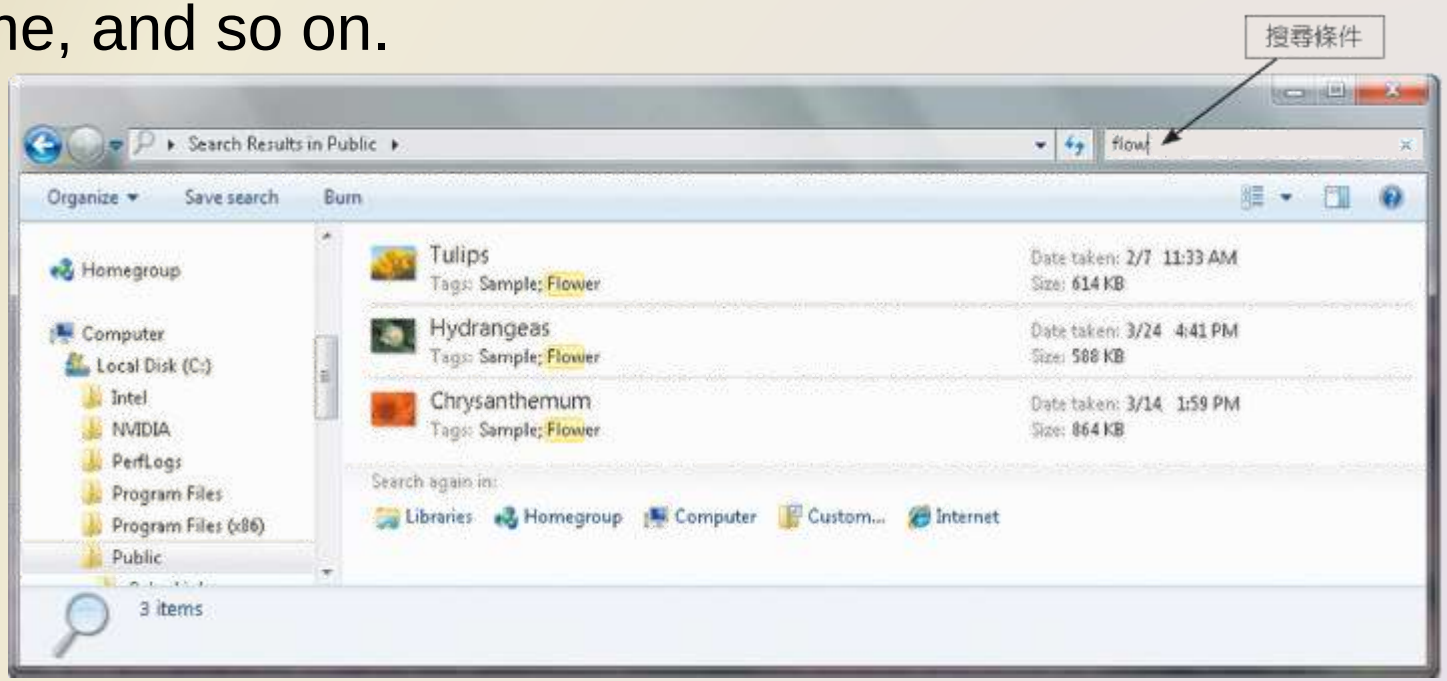
Utility Programs

- A **file manager** 檔案管理員
  - is a utility that performs functions related to file management
    是一種執行檔案管理相關功能的公用程式
  - Displaying a list of files
    顯示檔案清單
  - Organizing files in folders
    將檔案組成資料夾
  - Copying, renaming, deleting, moving, and sorting files and **folders**
    複製、重新命名、刪除、搬移和排序檔案和**資料夾**
  - Creating **shortcuts**　建立**捷徑**

Windows Explorer

Utility Programs

- A search utility搜尋公用程式
  - is a program that attempts to locate a file on your computer based on criteria you specify
    是根據輸入的條件，嘗試找出電腦上某個檔案的位置
  - A index stores a variety of information about a file including its name, date created, date modified, author name, and so on.



Utility Programs

- An image viewer allows users to display, copy, and print the contents of a graphics file

看圖軟體是一種能顯示、複製和列印照片等圖像檔案內容的公用程式

Utility Programs

- An **uninstaller** removes a program, as well as any associated entries in the system files

  解除安裝程式 是一種可移除程式檔案，同時移除該程式在系統檔案中相關項目的公用程式

  – In Windows , uninstaller is available through the Uninstall a program command in the Control Panel

Utility Programs

- A **disk cleanup** utility searches for and removes unnecessary files

  磁碟清理公用程式是負責搜尋並移除不必要的檔案

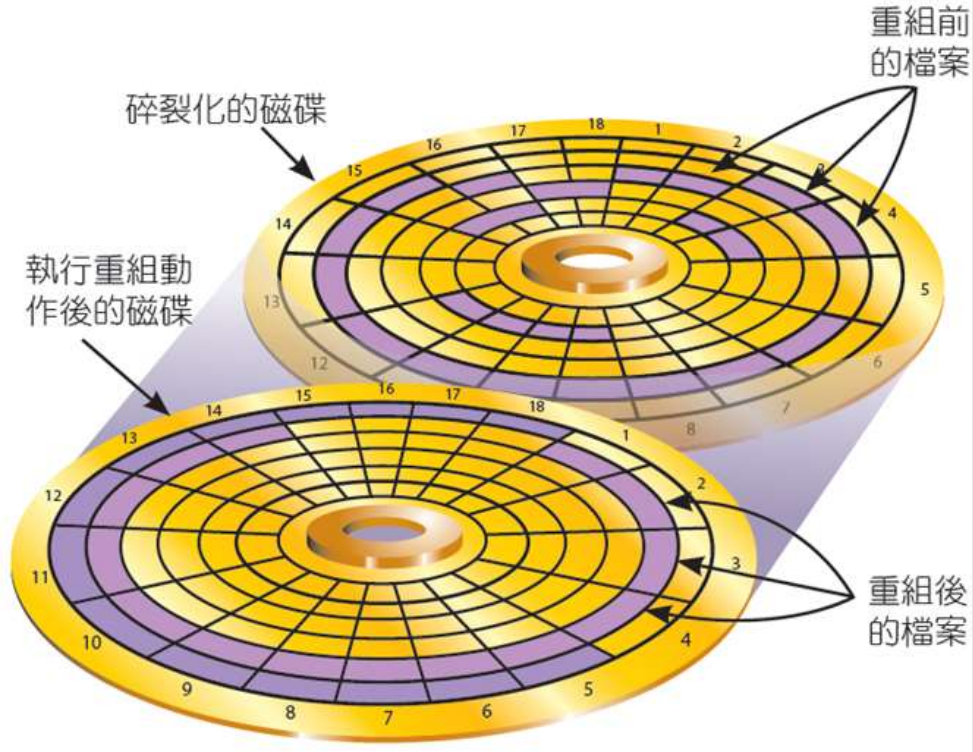
- 不必要的檔案:
  - Downloaded program files
    已下載的程式檔案
  - Temporary Internet files
    暫存的Internet檔案
  - Deleted files 已刪除檔案
  - Unused program files
    很少用的程式檔案

Utility Programs

- A **disk defragmenter**磁碟重組程式
  - reorganizes the files and unused space on a computer's hard disk so that the operating system accesses data more quickly and programs run faster
    是一種會重新組織硬碟上的檔案和未使用空間，讓作業系統能更快速存取資料、程式執行速度更快的公用程式
  - **Defragmenting** 重組動作

Utility Programs

- A fragmented disk has many files stored in noncontiguous sectors.
- Defragmenting reorganizers the files so that they are located in **contiguous sectors**, which speeds access time.



Utility Programs

- A **backup utility** allows users to copy files to another storage medium
  備份公用程式能讓使用者複製檔案到其他儲存媒體中
- 許多備份程式於備份過程中會壓縮檔案
- A **restore utility** reverses the process and returns backed up files to their original form
  還原公用程式可還原整個過程，並

將備份的檔案回復為原本的格式

Utility Programs

- A **screen saver** causes a display device's screen to show a moving image or blank screen if no activity occurs for a specified time

螢幕保護程式能在滑鼠或鍵盤停止活動一段預定時間後，在裝置的螢幕上自動顯示動態或空白畫面

- A **personal firewall** detects and protects a personal computer from unauthorized intrusions

個人防火牆可偵測並保護個人電腦避免被非法入侵

Utility Programs

- A **file compression utility** shrinks the size of a file(s)

  檔案壓縮公用程式能縮小檔案大小

  – Compressing files frees up room on the storage media

    將檔案壓縮能讓儲存媒體釋出更多空間

  – Two types of compression

    壓縮技術分成兩種

    - Lossy　　有失真壓縮
    - Lossless　非失真壓縮

- Compressed files sometimes are called **zipped files**

  壓縮檔有時又稱為zipped檔，
  已壓縮檔案通常它的副檔名為 **.zip**

  – Can be **uncompressed**

    必須**解壓縮**才能使用

  – Two popular utilities

    - PKZIP
    - WinZip

Controlling a Network

- Some operating systems are designed to work with a server on a network
  有些作業系統是專門為擔任網路上的伺服器而設計的
- These multiuser operating systems allow multiple users to share a printer, Internet access, files, and programs
  多使用者伺服器作業系統使多位使用者分享印表機，網路存取和程式
- A network administrator uses the server operating system to:
  網路管理人員可使用伺服器作業系統：
  - Add and remove users, computers, and other devices
  - Configure the network, install software and administer network security

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Administering Security

- A user account enables a use to **sign in** to, or access resources on, a network or computer
  - A **user name**, or **user ID**, identifies a specific user
    使用者名稱或稱**使用者ID**在同一系統是唯一的，用來辨識每位使用者
  - A **password** is a private combination of characters associated with the user name
    密碼是一組由字元組成的保密字串，與使用者名稱搭配在一起輸入

- These ***permissions*** define who can access certain resources and when they can access those resources.

Pages 423 - 424
Figure 9-13

Types of Operating Systems
Characteristics of operating systems

- 早期作業系統
  - **Device-dependent**
    - Runs only on specific type of computer or mobile device
  - **Proprietary software** 非自由軟體
    - Privately owned and limited to specific vendor or computer or device model
- 目前趨勢
  - **Device-independent**
    - Runs on many manufacturers' computers

Types of Operating Systems
Characteristics of operating systems

Downward compatible 向下相容

- New versions of an **operating system** usually works with application software written for earlier version of operating system

Upward compatible 向上相容

- **Application** may or may not runs on new versions of operating system
  應用程式不一定可以在新版的作業系統中執行

Types of Operating Systems

Table 9-2 Examples of Operating Systems by Category	
Category	**Name**
Desktop	Windows
	OS X
	UNIX
	Linux
	Chrome OS
Server	Windows Server
	Mac OS X Server
	UNIX
	Linux
Mobile	Google Android
	Apple iOS
	Windows Phone

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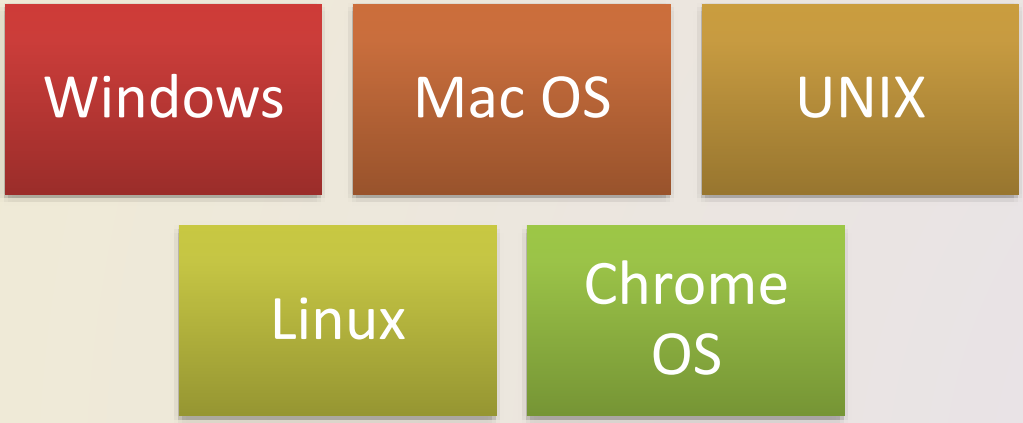
Table 9-2

Desktop Operating Systems

- A **desktop operating system**, sometimes called a ***stand-alone operating system*** , is a complete operating system that works on desktops, laptops, and some tablets.
- Desktop operating systems sometimes are called ***client operating systems*** because they also work in conjunction with a server operating system. Client operating systems can operate with or without a network.



Desktop Operating Systems

- The latest versions of Windows offer these features
  - Uses **tiles** to access apps
  - Includes the desktop interface
  - Support for input via touch, mouse, and keyboard
  - Email app, calendar app, and browser included
  - Photos, files, and settings you can **sync with OneDrive (Microsoft's cloud server)**
  - Enhanced security through an antivirus program, firewall, and automatic updates
  - **Windows Store** offers additional applications for purchase

Desktop Operating Systems

- **Mac OS**
  - Since it was released in 1984 with Macintosh computers, Apple's ***Macintosh operating system (Mac OS)*** has earned a reputation for its ease of use and has been the model for most of the new GUIs developed for non-Macintosh systems.
  - The latest version, **OS X** , is a multitasking operating system available for computers manufactured by Apple.
  - **http://www.apple.com/tw/osx/**
  - 現在版本macOS Sierra 10.12 " sierra "

Pages 427 - 428

http://www.apple.com/tw/macos/sierra/

Sierra七個主要的功能

- Sierra 在 Siri 之外，還有七個主要的功能
  - **Auto Unlock（自動解鎖）**- 如果你戴著 Apple Watch 的話，電腦可以自動解鎖，不用再輸入密碼
  - **Universal Clipboard（通用剪貼簿）**- 跨裝置的剪貼簿
  - **iCloud Drive** - 現在允許多台 macOS 裝置共用桌面（也就是把桌面變成共用資料夾）、同時　iOS 也可以看桌面檔案。
  - **Optimized Storage（最佳化存儲）**- 這個功能一閃而過，但聽起來是把電腦上一部份不常用到的檔案自動放到 iCloud 上，讓電腦本機端的空間可以釋放出來。
  - **Apple Pay on the Web（網頁版 Apple Pay）**- 支援的網站會有 Apple pay 按鈕，按下後會透過 Continuity 要你在 iPhone 上使用 Touch ID 認證，然後就可以完成付款了。
  - **Tabs everywhere** - 讓任何第三方 App 都可以啟動多個副本，每個副本都可以分配到一個 tab。
  - **Picture in Picture** - 讓影片在最上層播放，像 iOS 現在可以做的那樣

Desktop Operating Systems

UNIX is a **multitasking operating** system developed in the early 1970s

UNIX是在1970年代早期開發的一種多工作業系統

Linux is a popular, multitasking **UNIX-based operating system**

Linux是一種開放原始碼、受歡迎的UNIX類型多工作業系統

Pages 429
Figures 9-14 – 9-15

UNIX

- is a multitasking operating system developed in the early 1970s by scientists at Bell Laboratories.
- Bell Labs (a subsidiary of AT&T) was prohibited from actively promoting UNIX in the commercial marketplace because of federal regulations.
- Bell Labs instead licensed UNIX for a low fee to numerous colleges and universities, where UNIX obtained a wide following.
- UNIX was implemented on many different types of computers.
- In the 1980s, the source code for UNIX was licensed to many hardware and software companies to customize for their devices and applications.
- As a result, several versions of this operating system exist, each with slightly different features or capabilities.
- An industry standards organization, The Open Group, now owns UNIX as a trademark.

Pages 429

LInux

- Linux is open source software, which means its code is provided for use, modification, and redistribution.
- **Linux is available in a variety of forms, known as distributions**.
- Users obtain versions of Linux in a variety of ways. Some download it free from a
- provider's website and create media to install it on a computer, or they create a Live CD or Live USB from which to preview it.

Desktop Operating Systems

- **Chrome** [krom] **OS** is a **Linux-based operating system** designed to work primarily with **web apps**

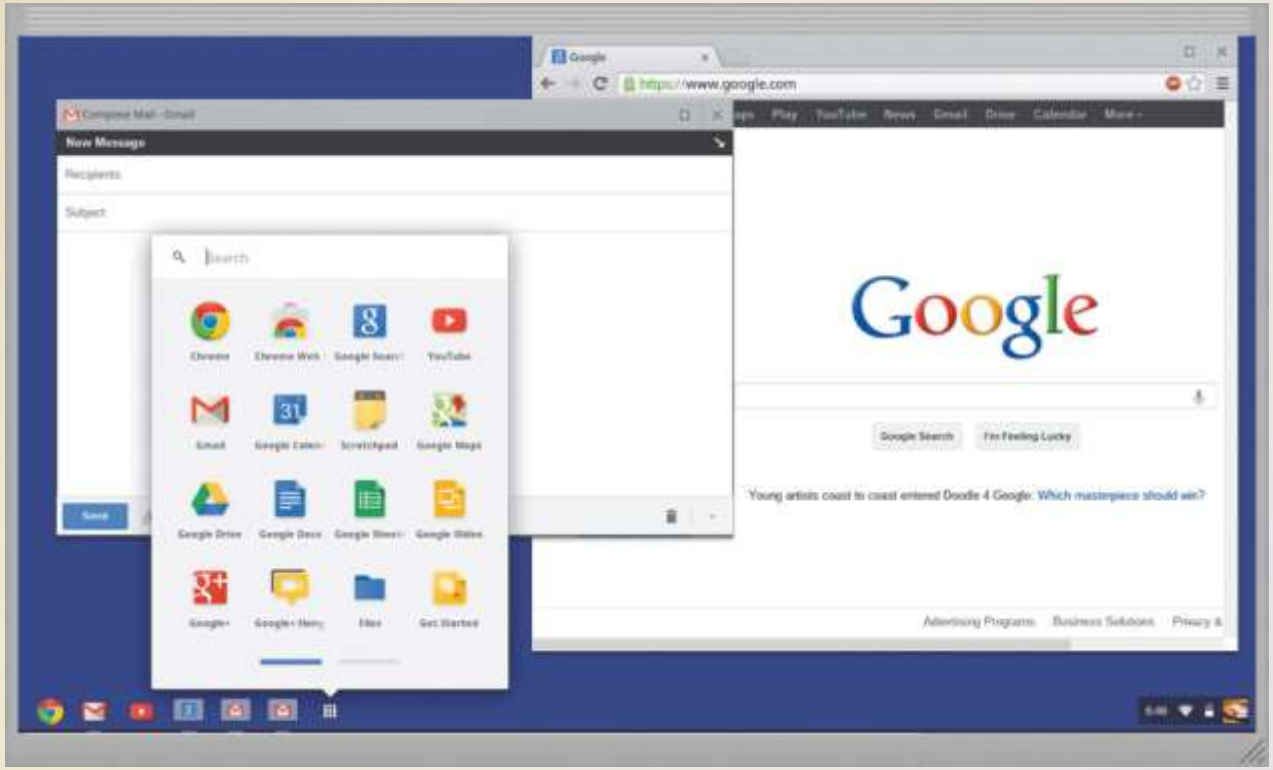


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Figure 9-16

Desktop Operating Systems

Chrome OS

- A specialized **laptop** that runs Chrome OS is called a ***Chromebook.***
- A specialized **desktop** that runs Chrome OS is called a ***Chromebox*** .
- Chromebooks and Chromeboxes typically use **SSDs for internal storage**.
- Users also can run Chrome OS as a virtual machine.

Running Multiple Desktop Operating Systems

- If you want to run **multiple operating systems on the same computer**,
  - you could **partition**分割 the hard drive
  - or you could create a **virtual machine.** 虛擬機器
- **Partitioning** divides a hard drive is separate logical storage areas that appear as distinct drives.磁碟分割
  - Partitions enable a single drive to be treated as multiple drives.

Running Multiple Desktop Operating Systems

- **A virtual machine (VM) is an environment on a computer in which you can install and run an operating system and programs.** 虛擬機器
  - VMs enable you to install a second operating system on a computer.
- Another option for Mac users who want to run Windows programs is a program called Boot Camp.
  - Newer versions of Mac OS enable you to install Windows on a computer using a program called Boot Camp .
    - Apple program that **enables you to install Windows on an Apple computer.**

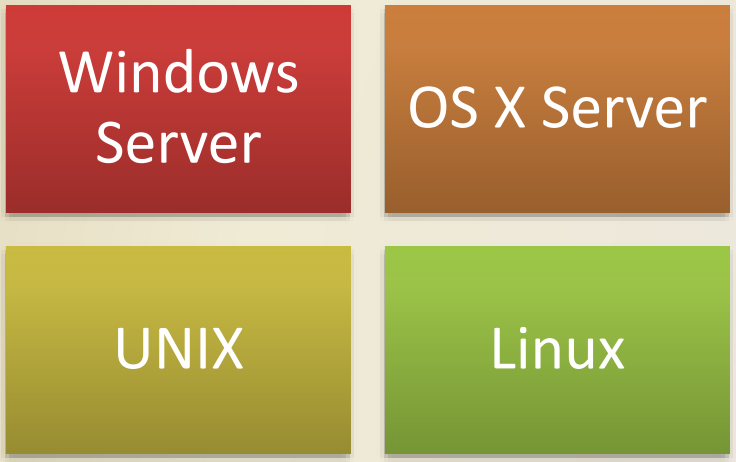
Set Up and Use a Virtual Machine

A ***virtual machine*** enables a computer to run another operating system in addition to the one installed.

- To set up a virtual machine, you will need **software** that can set up a virtual machine, as well as **installation media for the operating system** you want to install in the virtual machine.

Server Operating Systems

- A **server operating system** is a **multiuser operating system** that organizes and coordinates how multiple users access and share resources on a network.
- Client computers on a network rely on server(s) for access to resources.



Operating systems, such as UNIX and Linux, that function as both desktop and server operating systems sometimes are called ***multipurpose operating systems*** .

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Server Operating Systems

- Many also support virtualization.
- **Virtualization is the practice of sharing or pooling computing resources, such as servers or storage devices**.
- Through **virtualization**, for example, **server operating systems can separate a physical server into several virtual servers.**
- **Each virtual server then can perform independent, separate functions.**

Mobile Operating Systems

- The operating system on mobile devices and many consumer electronics is called a **mobile operating system** and resides on firmware

Windows Phone

Android

iOS

Pages 433 - 434

Mobile Operating Systems

- **Android** is an **open source**, **Linux-based** mobile operating system designed by Google for smartphones and tablets
- Features unique to recent versions of the Android operating system include the following:
  - ***Google Play*** app store provides access to apps, songs, books, and movies.
  - ***Google Drive*** provides access to email, contacts, calendar, photos, files, and more.
  - Face recognition can unlock the device.
  - Share contacts and other information by touching two devices together (using NFC technology).
  - Speech output assists users with vision impairments.

Mobile Operating Systems

- **iOS**, developed by Apple, is a proprietary mobile operating system specifically made for Apple's mobile devices
- Supported devices include the iPhone, iPod Touch, and iPad.

iPhone 上的 iOS 10

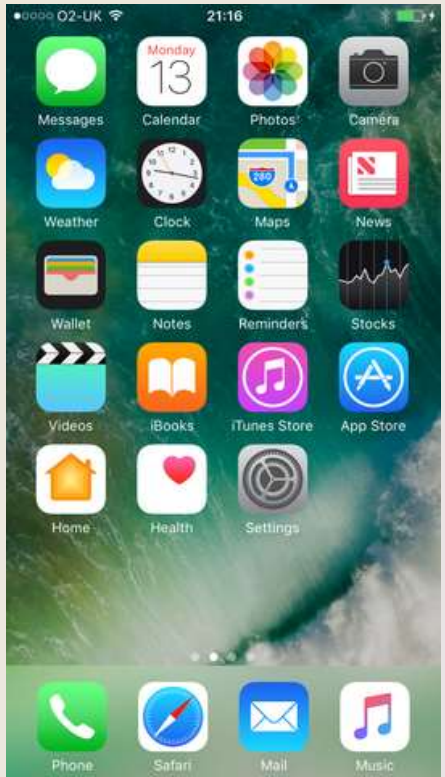

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Figure 9-18

Mobile Operating Systems

- Features unique to recent versions of the iOS operating system include the following:
  - ***Siri*** , a **voice recognition app**, enables you to speak instructions or questions to which it takes actions or responds with speech output.
  - ***Passbook*** app provides a centralized location for coupons, boarding passes, loyalty cards, and mobile payment accounts in a single, easily accessible location.
  - ***iCloud*** enables you to sync mail, calendars, contacts, and other items.
  - ***iTunes Store*** provides access to music, books, podcasts, ringtones, and movies.
  - Integrates with iPod to play music, video, and other media.
  - Mac App Store provides access to additional apps and software updates.

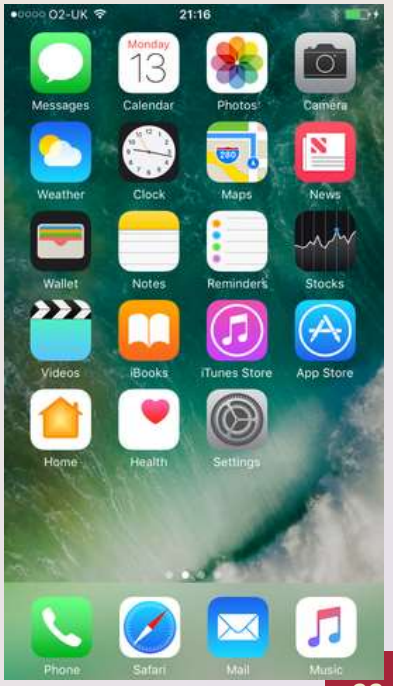

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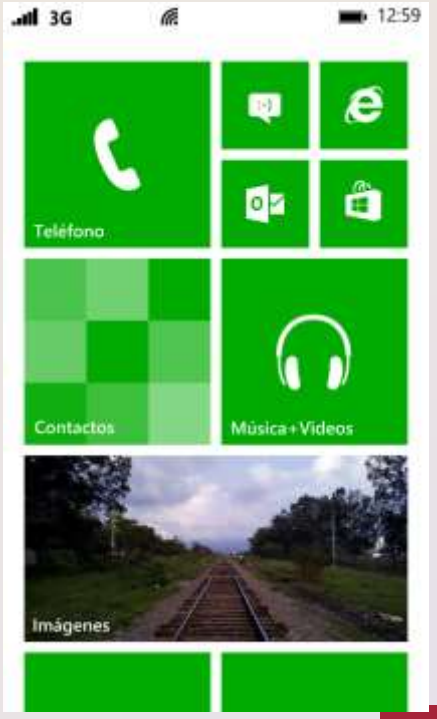
Figure 9-18

Mobile Operating Systems

- Windows Phone, developed by Microsoft, is a proprietary mobile operating system that runs on some smartphones
- Features unique to recent versions of the Windows Phone operating system include the following
  - Sync photos, files, and settings with **OneDrive**.
  - Use your **phone as a remote control** for your TV
  - Access a global catalog of music, videos, or podcasts, or listen to iTunes music.
  - ***Windows Phone Store*** provides access to additional apps and software updates.
  - ***Wallet*** app provides a centralized location for coupons, credit cards, loyalty cards, and memberships in a single, easily accessible location.



Windows Phone 8的螢幕截圖

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Figure 9-19

Do Other Mobile Operating Systems Exist?

- **Blackberry operating system** is **a proprietary** mobile operating system that runs on Blackberry smartphones and Blackberry tablets.
- **Firefox OS** is a Linux-based open source operating system that runs on smartphones and tablets developed by Mozilla.
- Several phones also run a version of Linux.

Do Embedded Computers use Mobile Operating Systems?

- Typically, an embedded computer uses an embedded operating system , sometimes called a **real-time operating system (RTOS)**.
- Examples of products that use embedded operating systems include digital cameras, ATMs, digital photo frames, HDTV receivers, fuel pumps, ticket machines, process controllers, robotics, and automobile components.
- Embedded operating systems often **perform a single task**, **usually without requiring input from a user**.

Steven Anthony Ballmer

蒂芬·安東尼·巴爾默

1956年3月24日

- 微軟公司前任執行長
- 哈佛大學數學和經濟學學士
- 斯坦福商學院工商行政管理碩士

- 2016年其資產**$28.5 Billion**在Forbes富豪榜中排名第15位
- 2000/1至2014/2擔任微軟公司執行長
- 大學與比爾·蓋茨建立了深厚友誼

Virtual Memory

- 虛擬記憶體, 一種作業系統管理記憶體的方法
- One common technique for dealing with memory shortages is to set aside part of a hard disk as virtual memory. Thanks to the OS, this chunk of disk space looks just like internal memory to the CPU, even though access time is slower.
- 作業系統使用一種查表的方式將應用程式使用的記憶體位址轉換為真實的記憶體位址, 並可暫時將某些現在不用的記憶體區搬到硬碟上暫存, 使可用記憶體數量比實際記憶體數量來得多.
- 移動記憶體的動作是以**頁 (PAGE)** 為數量來完成, 所以被稱為 **PAGING**, 有些作業系統稱為 **SWAPPING**

Disk thrashing(1/2)

- In systems that use virtual memory, the resulting condition of a hard drive being used excessively for virtual memory because the physical memory (i.e., RAM) is full.
- The process of moving data into and out of virtual memory also is called swapping pages.
- **Disk thrashing** considerably **slows down the performance** of a system because data has to be transferred back and forth from the hard drive to the physical memory.
- A sure sign that your computer is thrashing is when an application stops responding but the disk drive light keeps blinking on and off.

Disk thrashing(2/2)

- **Thrashing** is generally caused by too many processes competing for scarce memory resources.
- To temporarily stop thrashing, you need to terminate one or more applications.
- To stop it permanently, you need to install more main memory.
- Disk thrashing can result in permanent failure of the hard drive; as the data is transferred back and forth, the hard drive's read/write heads are subjected to considerable wear and tear.

High-Tech Talk

Virtual Machines

http://dscov.com/16/09h3a

- The five best programs that create and run virtual machines
  - **VirtualBox (Free)** WINDOWS MAC OS X LINUX

    VirtualBox is powerful, brimming with terrific features and, best of all — free.
  - **VMware (Free — $250)** WINDOWS MAC OS X LINUX

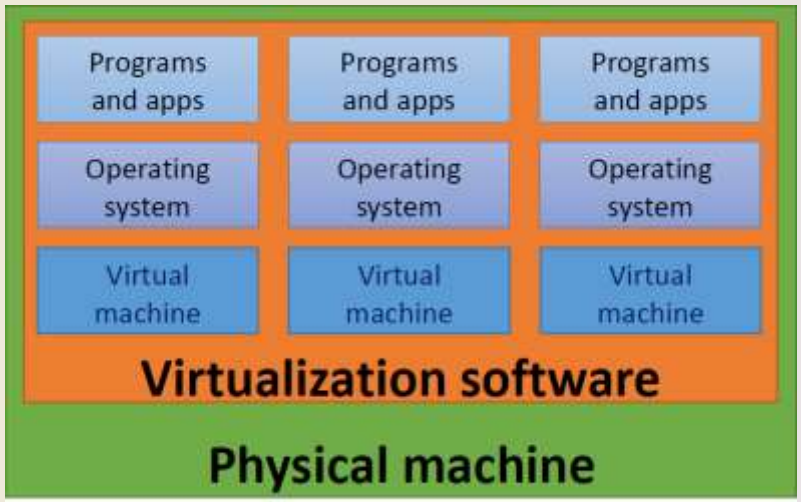
    has been in the virtual machine game since ’98, and offers three differing pieces of virtualization software: VMware Workstation ($250), VMware Fusion ($80), and VMware Workstation Player (Free).
  - **Parallels Desktop 11 ($80)** MAC OS X
  - **QEMU (Free)** LINUX

    The open-source QEMU, short for “Quick EMUlator,” is ideal for Linux power users who want a customizable virtual machine.
  - **Boot Camp (Free)** MAC OS X

    isn’t a virtual machine in any sense of the word, but it’s worth a mention given users researching virtual machines are often curious about it.

virtualization

- Virtualization is the practice of sharing or pooling computing resources, such as servers or storage devices.
- Server virtualization is a type of virtualization that divides one physical server into several virtual servers, where each virtual server can run its own server operating system and perform its own function.



virtualization

- The ability to run multiple virtual servers on a single physical server can provide significant cost savings for IT departments because it is no longer necessary to purchase a separate physical server each time you require additional functions and capabilities.
  - For instance, if a company requires a web server and a server to store and share files, two physical servers used to be required, and each of the two servers might not have even been used near or at its full capacity.

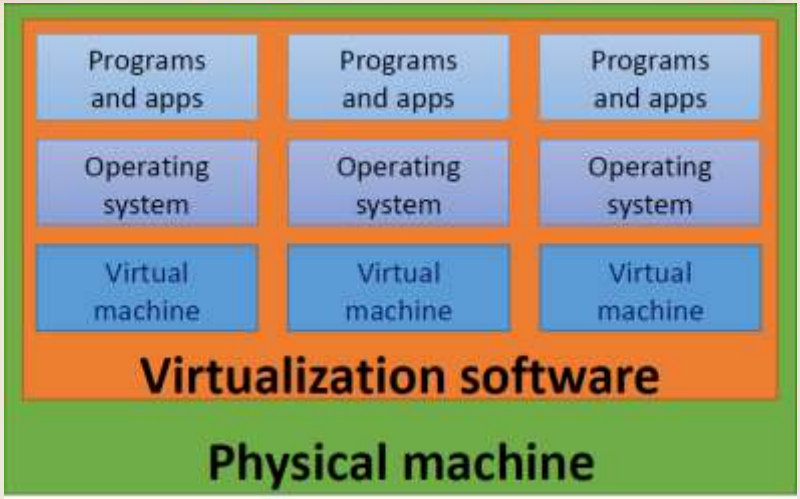


Figure 3: An example of virtualization.

- In addition, one physical server running multiple virtual servers may consume less power and require less cooling than multiple physical servers.

virtualization

- Today, one physical server using virtualization can **host multiple virtual servers where each one performs a unique function**, such as hosting websites.
- Virtualization also results in a higher utilization of each physical server. Most new servers today are very powerful and can be configured to run multiple virtual servers simultaneously.

- In addition to having the proper hardware to support virtualization, you also must have the proper virtualization software running on the physical server to support the virtual servers.
  - Virtualization software, such as VMware Server, VMware ESXi, and Microsoft Hyper-V, allows you to create one or more virtual servers.
- Virtualization software manages the resources on the physical server (also called the **host server**) by controlling the processing power, storage, and memory each virtual server can use.

Types of Virtualization

Type of Virtualization	Description
Application virtualization	Runs applications independently from the computer accessing it, and does not require installation of the application on the client computer.
Network virtualization	Combines various resources, including hardware and software, to appear as if they are one, connected unit.
Operating system virtualization	Allows you to run multiple operating systems on one physical computer. Many people use operating system virtualization to install multiple operating systems on their computer (such as installing Windows on a Mac).
Server virtualization	Divides one physical server into multiple virtual servers, each performing a different function.
Storage virtualization	Multiple storage devices that are connected to a network, appearing as a single storage device.