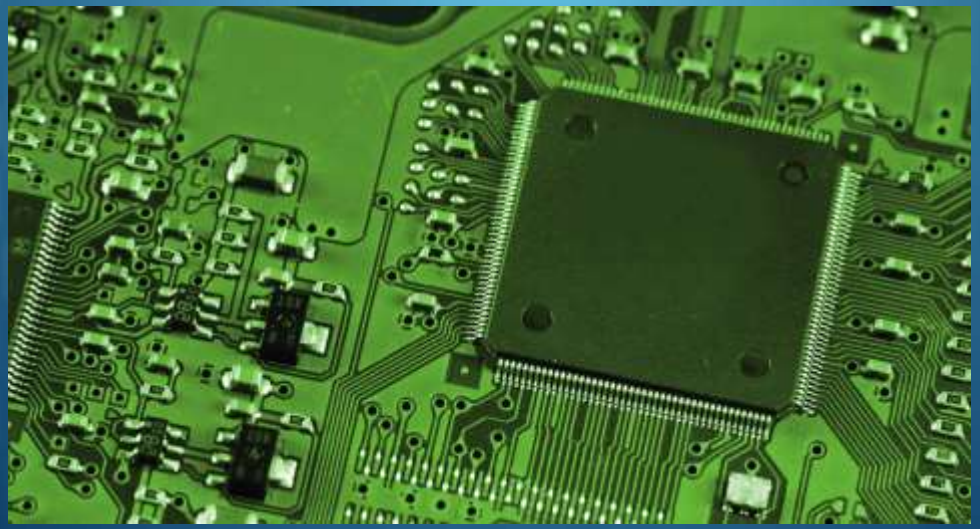
Discovering Computers 2016

Tools, Apps, Devices, and the Impact of Technology

Chapter 6

Computing Components



Objectives Overview

- 分辨在桌上型電腦、筆記型電腦和行動裝置上不同類型的系統單元
- 學會辨識主機板中的晶片、介面卡和其他元件
- 說明處理器內的控制單元和算術邏輯單元，並解釋機器週期中的4個步驟
- 辨別目前市場上各種個人電腦處理器的特色，並說明處理器的散熱方式
- 定義何謂位元並描述如何以一串位元來表達資料

See Page 209
for Detailed Objectives

Objectives Overview

- 區分不同種類的記憶體
- 描述擴充槽和介面卡的目的和種類，並能區分各種不同的卸除式快閃記憶體裝置的插槽
- 說明電腦中各種類型的匯流排
- 解釋電源供應器的目的並說明它如何散熱

See Page 209
for Detailed Objectives

The System Unit

- The **system unit** or chassis is a case that contains and protects the motherboard, hard disk drive, memory, and other electronic components of the computer from damage.

  系統單元 (system unit)是一個外殼裡面裝有及保護主機版，硬碟，記憶體和其它的電子元件不被破壞。

Cases for computers and mobile devices are available in a variety of shapes and sizes.

Inside the Case

- The inside of the system unit on a desktop personal computer includes:

Drive bay(s) 磁碟機隔間

Power supply 電源供應器

Sound card 音效卡

Video card 顯示卡

Processor 處理器

Memory 記憶體

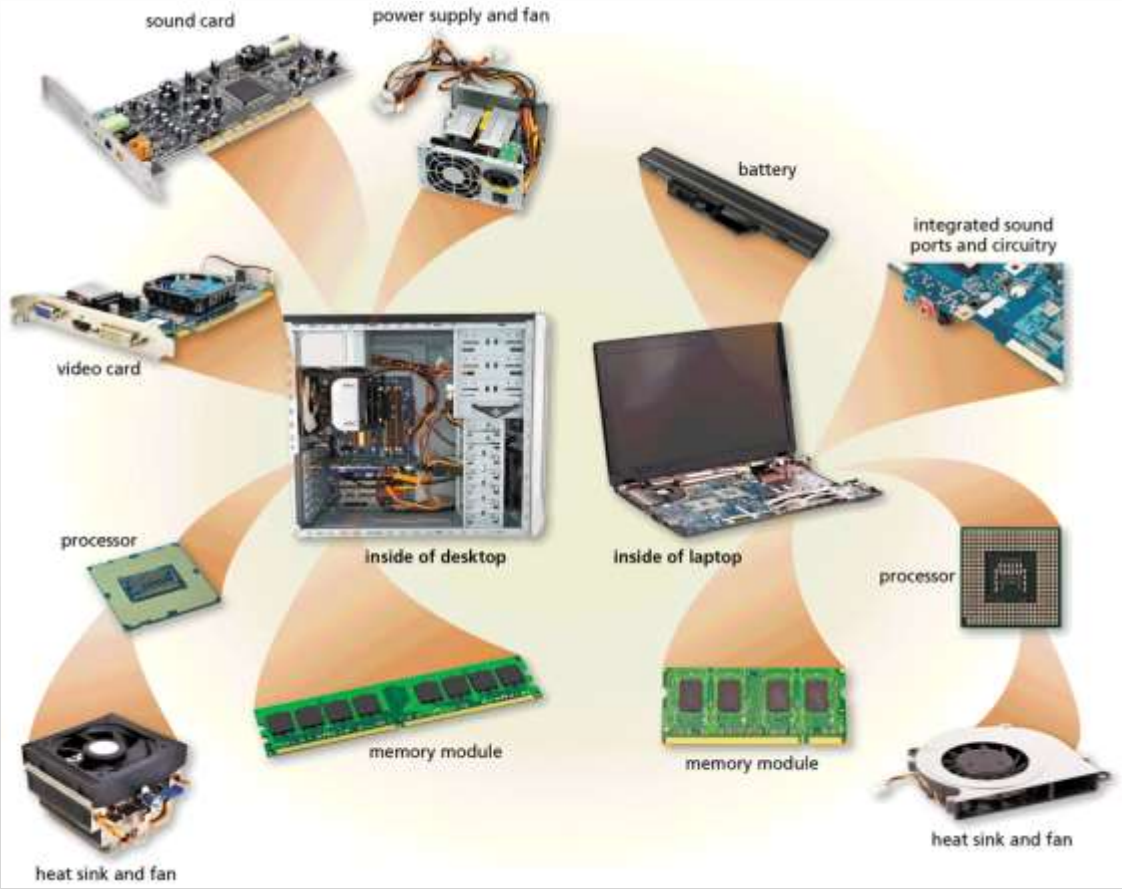


Figure 6-2

Inside the Case

- The **motherboard** is the main circuit board of the system unit**主機板** 是系統單元中主要的電路板
  - Many electronic components, such as the processor and memory, attach to the motherboard; others are built into it.
  - A computer **chip** contains integrated circuits
    電腦**晶片**中包含積體電路

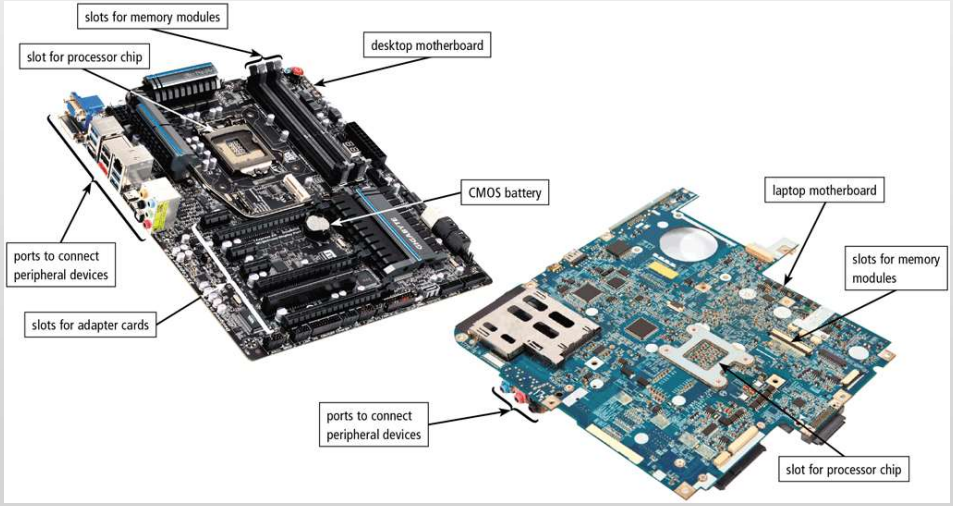


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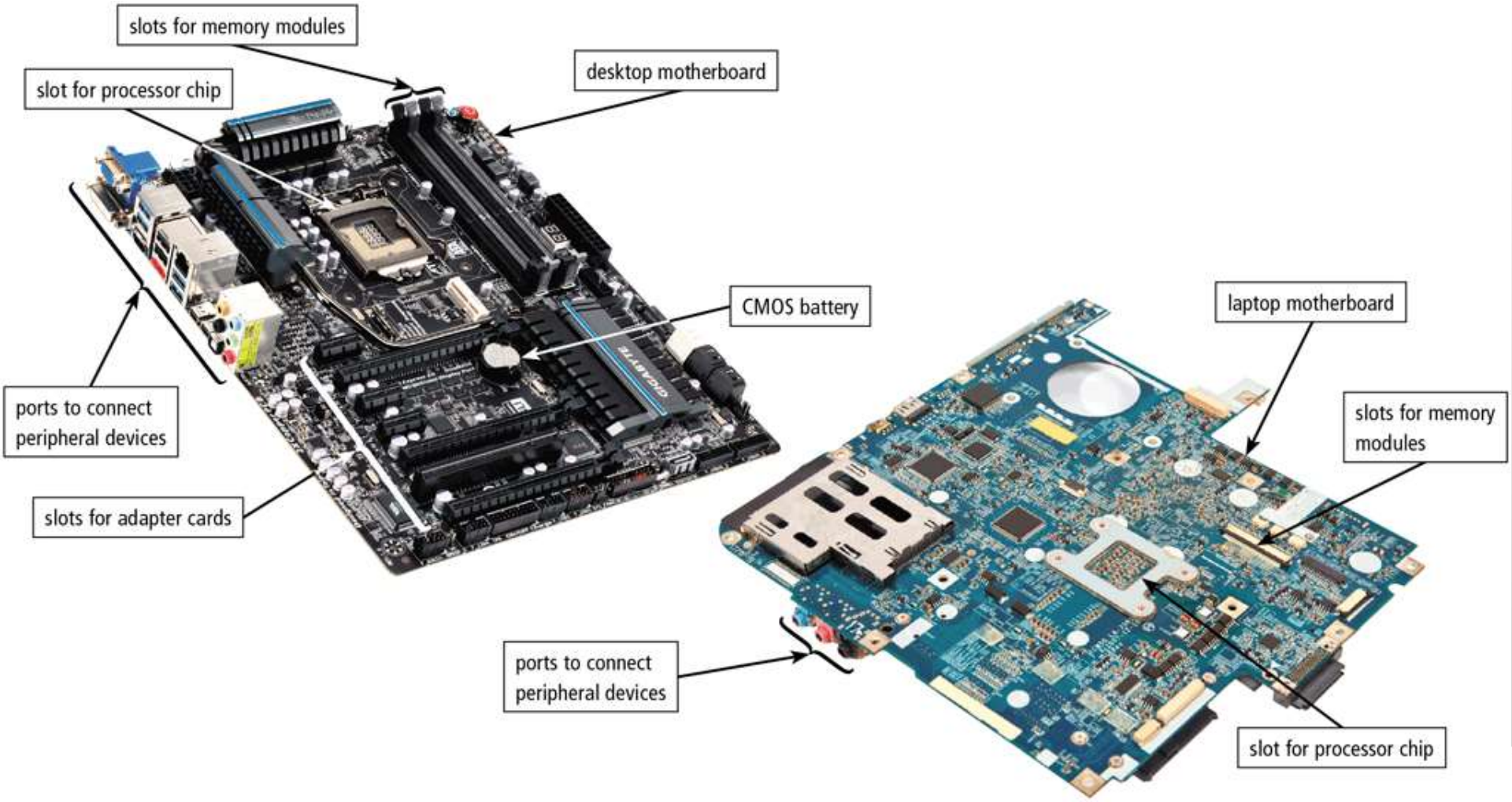
Figure 6-3

The motherboard



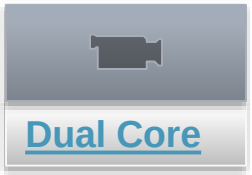
The motherboard

- A computer **chip** contains many microscopic pathways capable of carrying electrical current.
- Each **integrated circuit** can contain millions of elements such as resistors, capacitors, and transistors. 積體電路
- A **transistor** can act as an electronic switch that opens or closes the circuit for electrical charges. Today's computer chips contain millions or billions of transistors.電晶體

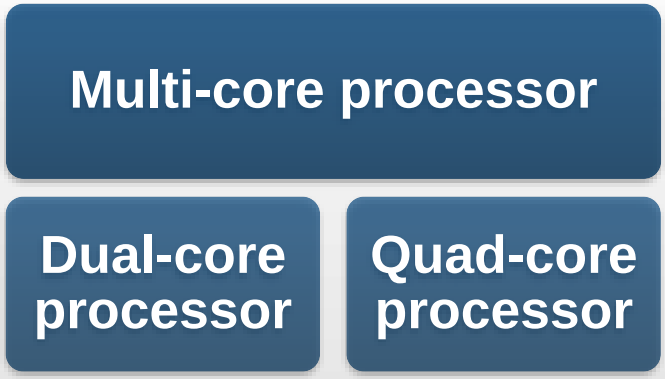
Processor

- The processor, also called the central processing unit (CPU), interprets and carries out the basic instructions that operate a computer
  處理器又稱作中央處理器負責解讀和執行電腦運作的基本指令
  - Contain a control unit and an arithmetic logic unit (ALU)
    包含控制單元與算數邏輯運算單元
  - Some computer and chip manufacturers use the term microprocessor to refer to a personal computer processor chip.

Processor



- A **multi-core processor** is a single chip with two or more separate processor cores
- A dual-core processor
  - is a single chip that contains two separate processors
- A multi-core processor
  - is a chip with two or more separate processors



Are Multi-Core Processors Better Than Single-Core Processors?

Are Multi-Core Processors Better Than Single-Core Processors?

- Each processor on a dual-core/multi-core chip generally runs at a slower speed, but increase overall performance
- The performance increase is especially noticeable when users are running multiple programs simultaneously such as antivirus software, spyware remover, email program, instant messaging, media player, and photo editing software.
  當同時執行多個程式時執行效益的提升特別顯著
- Multi-core processors also are more energy efficient than separate multiple processors, requiring lower levels of power consumption and emitting less heat inside the case.
  多核心CPU效能比較高且需要較少的電力產生較少的熱

Processors

Q 請說明右圖

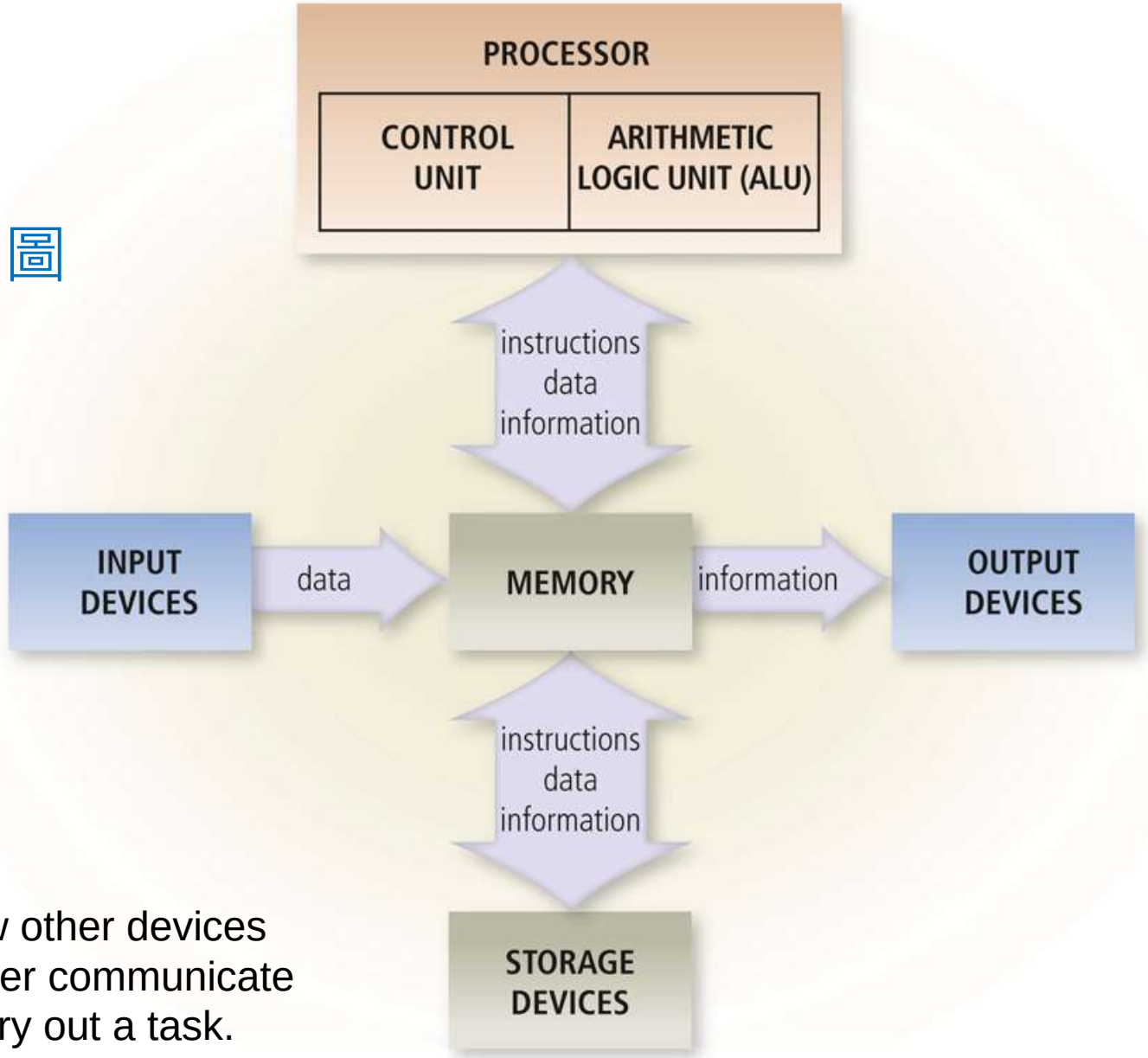
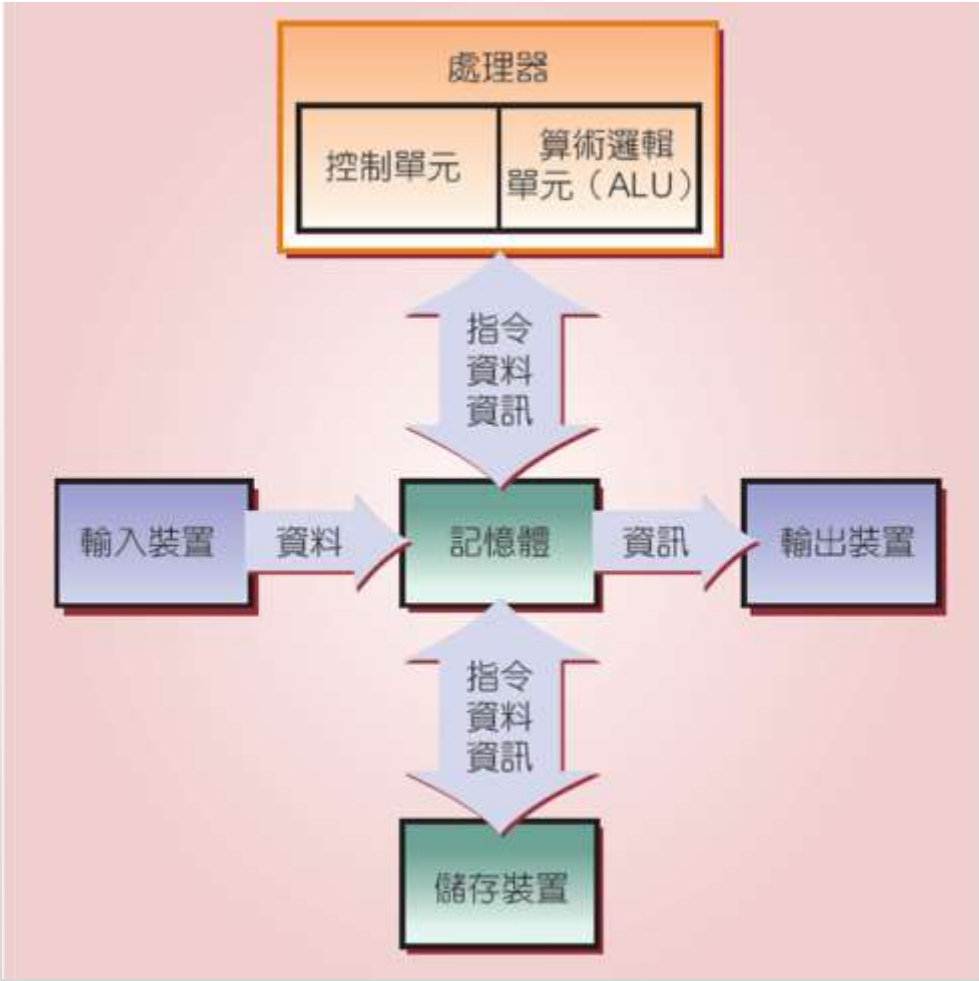


Figure 6-4 illustrates how other devices connected to the computer communicate with the processor to carry out a task.

Processor

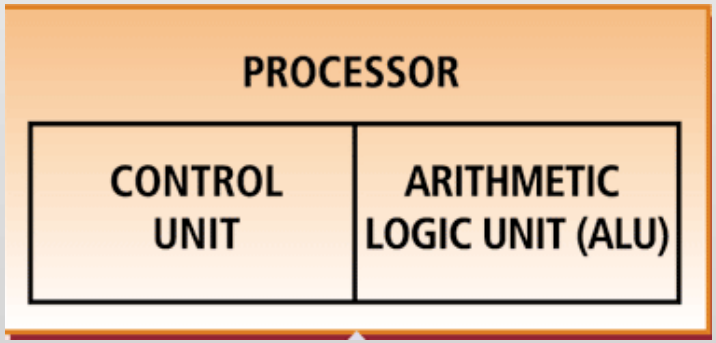
How CPU works

- When a user start a program,
  1. its instructions transfer from a storage device to memory
  2. Data needed by programs enters memory from either an input device or a storage device.
  3. The control unit interprets and executes instructions in memory
  4. And the ALU performs calculations on the data in memory
  5. Resulting information is stored in memory from which it can be sent to an output device or a storage device for future access as ,needed.



The control unit and The arithmetic logic unit

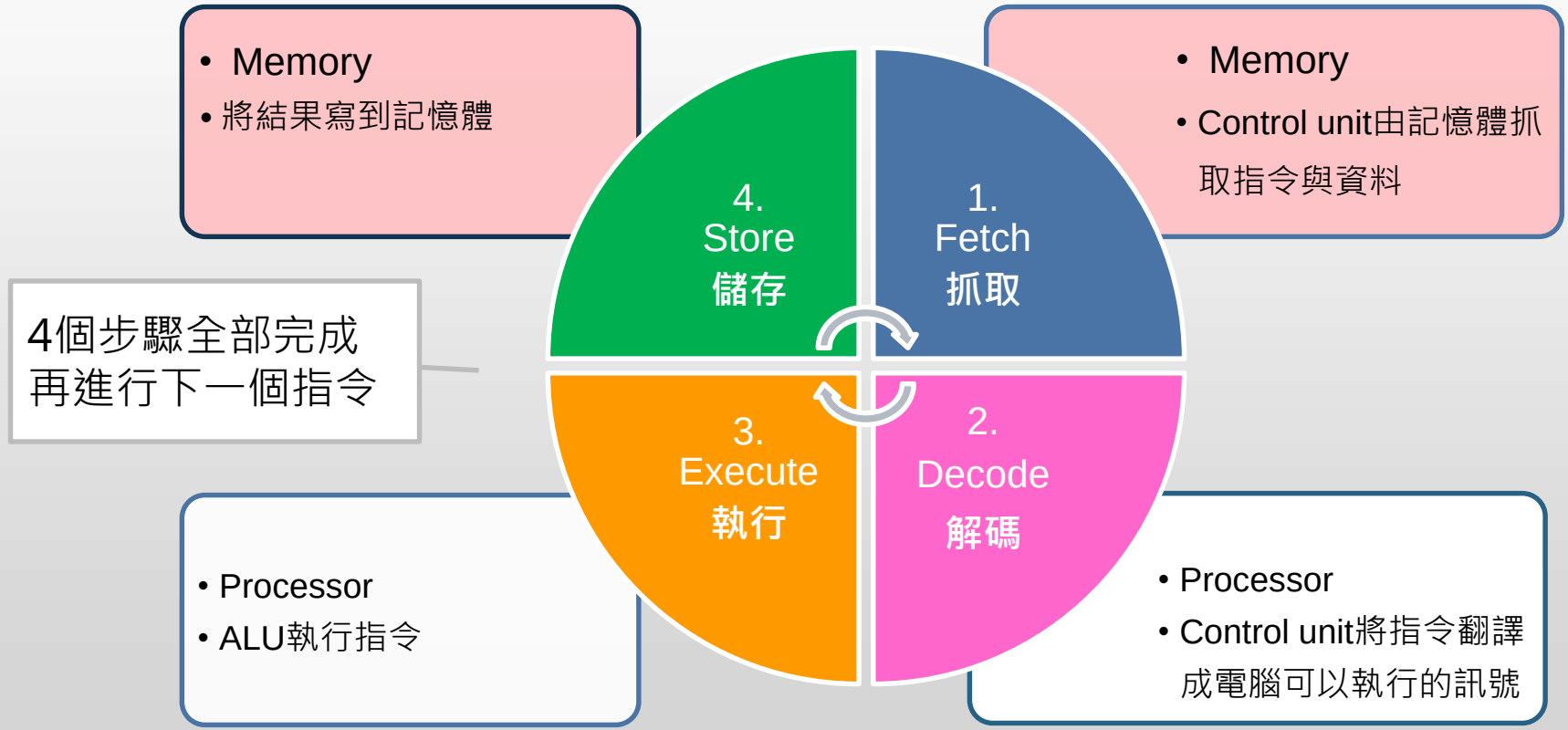
- Processor contain a **control** and an **arithmetic logic unit (ALU).**
- The **control unit** is the component of the processor that directs and coordinates most of the operations in the computer
  控制單元負責指揮和協調電腦的大多數動作
  - 就像交通警察
  - 控制的元件有 **arithmetic logic unit、register and buses**
- The **arithmetic logic unit** (ALU) performs arithmetic, comparison, and other operations
  算術邏輯單元
  - 負責執行算術(加減乘除)
  - 比較(大於小於等於)
  - 和其他運算動作



Machine cycle

- For every instruction, a processor repeats a set of , which comprise a **machine cycle**

  針對每個指令，處理器會重複一組4個基本動作，這4個動作組成一個**機器週期**



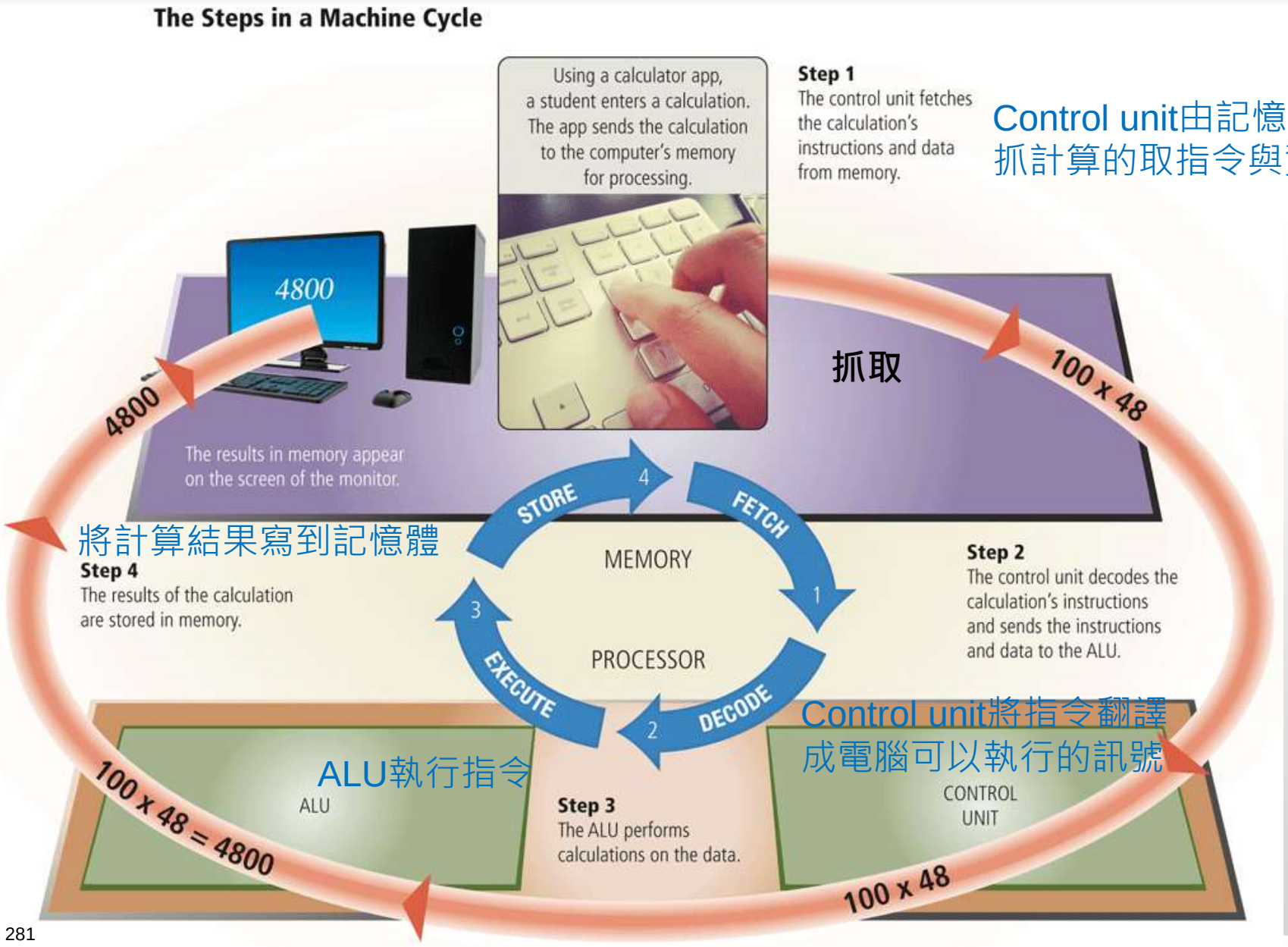


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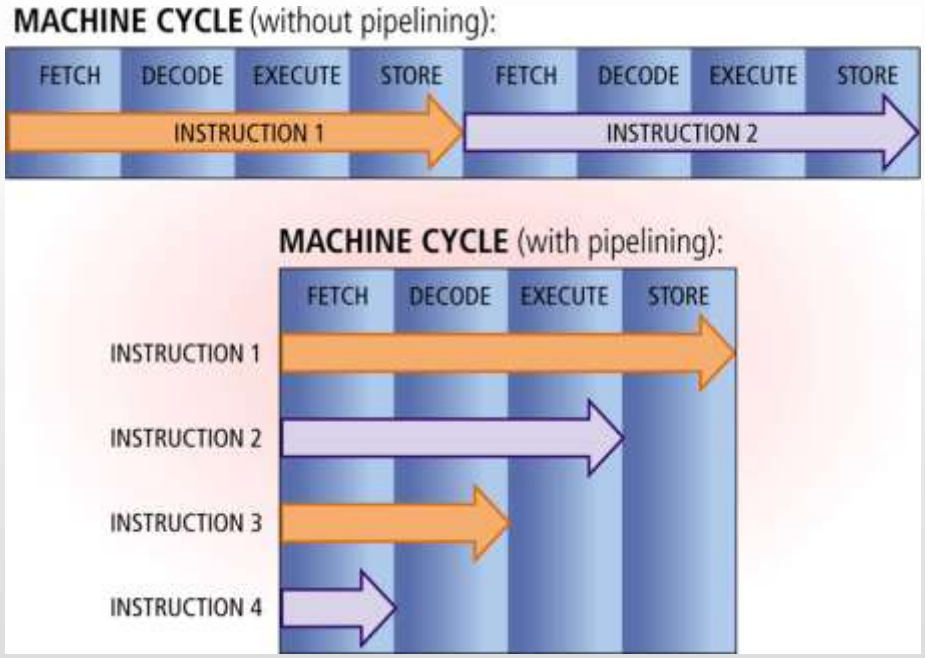
Figure 6-5

Processor

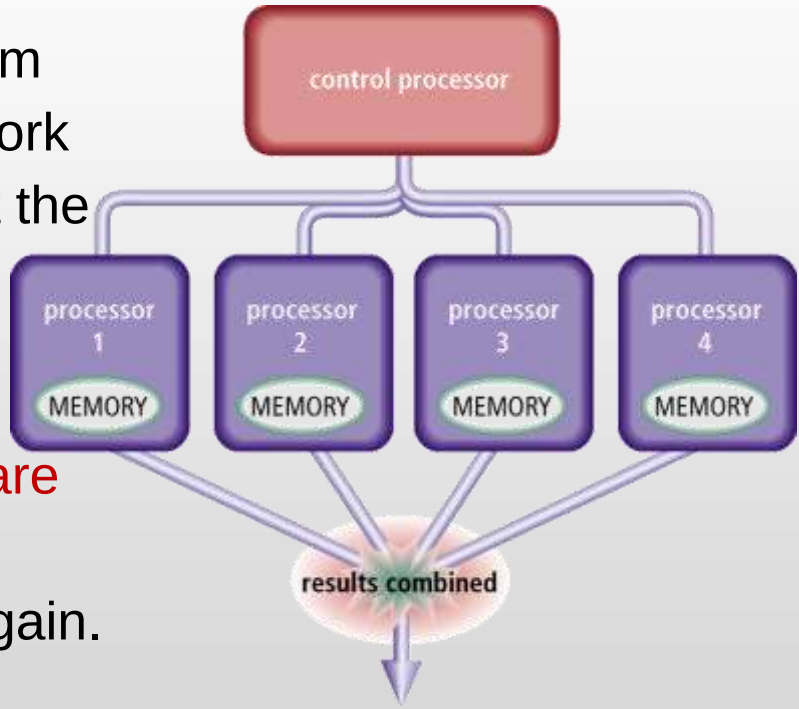
- Most current personal computers support pipelining管線技術
  - Processor begins fetching a second instruction before it completes the machine cycle for the first instruction

    在完成第一個指令週期前，CPU開始擷取第二個指令



Processor

- Parallel processing uses multiple processors simultaneously to execute a single program or task
  平行處理是同時使用多個處理器執行單一程式或工作的技術
- Parallel processing divides a single problem into portions so that multiple processors work on their assigned portion of the problem at the same time.
- Parallel processing requires special software that recognizes how to divide the problem and then bring the results back together again.



Processor

- Some personal computers implement parallel processing with multi-core processors. Others, called multiprocessor computers, have two or more separate processor chips.
- Massively parallel processing involves hundreds or thousands of processors
  大規模平行處理架構包含數百數千個處理器
- Supercomputers use massively parallel processing for applications such as artificial intelligence and weather forecasting.

Pipelining divides a single problem into portions so that multiple processors work on their assigned portion of the problem at the same time.

True False

Free Source P8~P9

Registers

- The processor contains registers
  - that temporarily hold data and instructions
  - part of the processor
    處理器內建暫存器，用來暫時存放資料和指令

- Processors have many different types of registers

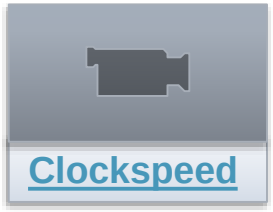
1. Stores **location** from where instruction was fetched

2. Stores **instruction** while it is being decoded

3. Stores **data** while ALU computes it

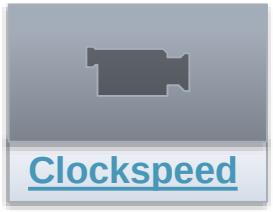
4.Stores **results** of calculation

Processor



- The **system clock**
  - Each tick is a clock cycle
  - **Superscalar** which means they can execute more than one instruction per clock cycle.超純量
  - The system clock controls the timing of all computer operations
    系統時鐘控制電腦所有運作的時間
  - Generates regular electronic pulses, or ticks, that set operating pace of components of system unit
    產生規律的電子脈衝(或跳動)，電子脈衝可以設定系統組件裡所有元件的執行速度

Processor



- The **system clock**
  - The pace of the system clock is called the clock speed, and is measured in gigahertz (GHz)
    系統時鐘的速度稱作時脈速度，以GHz (gigahertz) 為測量單位
  - hertz is one cycle per second 赫茲每秒鐘一個時脈週期
  - 1 GHz = one billion ticks of system clock per second 每秒十億次
  - 3 GHz = 每秒有30億個時脈週期
  - Processor speed can also be measured in millions of instructions per second (MIPS)每秒百萬指令

The system clock

Q The speed of the **system clock** is just one factor that **influences a computer's performance**. Other factors, such as

- the **type of processor chip**,
- **amount of cache** ,
- **memory access time**,
- **bus width**,
- and **bus clock speed**

BTW
System Clock and Peripheral Device
The speed of the system clock has no effect on peripheral devices such as a printer or disk drive.

Personal Computer and Mobile Device Processors

- The leading manufacturers of personal computer processor chips are Intel and AMD
  - 高效率 Intel Core family
  - 便宜基本Pentium or Celeron family

- AMD是Intel相容電腦的領導商
  - have an internal design similar to Intel processors perform the same functions, and can be as powerful, but often are less expensive.
- These manufacturers often identify their processor chips by a model name or model number.

Internet Research

Sear for : fastest processor

What are the fastest processor clock speed?

Processor

- Best Processors October - 2016 - Futuremark

- What is the fastest computer processor?
  - As of 2015, the world's fastest computer processor is from Intel, and it's the Core i7-5960X Extreme Edition

Comparison of Currently Available Personal Computer Processors

	Name	Multi-Core Availability	Manufacturer
SERVER PROCESSORS	Xeon	8 Core, 6 Core, Quad Core, Dual Core	Intel
	Itanium	Quad Core, Dual Core	Intel
	Opteron	6 Core, Quad Core	AMD
DESKTOP PERSONAL COMPUTER PROCESSORS	Core i7 Extreme	6 Core, Quad Core	Intel
	Core i7	6 Core, Quad Core	Intel
	Core i5	Quad Core, Dual Core	Intel
	Core i3	Dual Core	Intel
	Celeron	Dual Core	Intel
	Phenom	6 Core, Quad Core, Triple Core	AMD
	Athlon	Quad Core, Triple Core, Dual Core	AMD
	Sempron		AMD
NOTEBOOK COMPUTER PROCESSORS	Core i7 Extreme	Quad Core	Intel
	Core i7	Quad Core, Dual Core	Intel
	Core i5 and i3	Dual Core	Intel
	Atom		Intel
	Phenom	Quad Core, Triple Core, Dual Core	AMD
	Turion	Dual Core	AMD
	Athlon	Dual Core	AMD
	Sempron		AMD

Processor

- Processor chips include technologies
  - to improve processing performance
    - for example, to improve performance of media and 3-D graphics
  - to track computer hardware and software, diagnose and resolve computer problems, and secure computers from outside threats.
    - Intel® vPro™
- Processors for mobile computers also include technology to
  - optimize and extend battery life and integrate wireless capabilities.

Processor

- Intel® vPro™ (博銳™) 技術
  - 是為盡量縮短停機時間而設計，可從遠端監控、診斷及修復電腦，即使電腦關機或作業系統沒有反應也不成問題，因而減少到場維護的次數。

http://www.intel.com/cd/products/services/apac/zht/vpro/378994.htm

Processor

- 買新電腦時應該根據這台電腦的使用規劃來選擇處理器

選擇個人電腦處理器的準則

使用

- 使用工作站的高階使用者
- 網路上的低階伺服器

Itanium 

Xeon 

Opteron 

- 用於專業製圖、製作影片、錄製或編輯音樂、參與視訊會議、建立專業網站、參與多人網路遊戲的專業或一般使用者
- 用於設計專業文件（如內含圖片的新聞稿或大量數字的試算表）、製作多媒體簡報、將網站視為主要研究工具、透過網站傳送文件和圖片、觀賞影片、圖案複雜的光碟遊戲，以及製作個人網站的使用者
- 用於管理個人財務、使用文書處理和試算表軟體製作基本文件、編輯相片、經由電子郵件、聊天室和討論區與他人在網路上交流、網路購物、製作基本網頁，以及把電腦當作數位娛樂中心的家庭使用者

Core i7 

Core i7 Extreme 

Phenom II 

Athlon X2 

Athlon II 

- 用於管理個人財務、使用文書處理和試算表軟體製作基本文件、編輯相片、製作賀卡和日曆、使用教育或娛樂光碟，以及經由電子郵件、聊天室和討論區與他人在網路上交流的家庭使用者

Core i7 

Core i5 

Sempron 

- 傳統筆記型電腦或平板電腦的使用者

Core i7 

Core i5 

Turion II 

- netbook 的使用者

Atom 

Celeron 

Athlon X2 

Processor

桌上型電腦主流		
	Intel	AMD
高階	Core i7	FX 系列
主流	Core i5	A10 / A8
入門	Core i3	X4 系列

Mid-Range
AMD FX-8300
4 Modules
$120on Amazon

Extreme
Intel Core i7-5960X
Eight Cores
$1000 on Amazon

CPU 型號識別				
陣營	CPU家族	世代	型號識別	下一代
Intel	Core i7/i5/i3	第六代	6xxx	7xxx
AMD	A10 / A8 /A6 /A4	第四代	7xxx	8xxx

Intel 迎來首款 10 核心 Core 處理器

- Intel 最新在 Computex 上發佈了 Core i7-6950X Extreme Edition 10 核心處理器，時脈為 3GHz（可超頻至 3.5GHz），有著 25MB cache 緩存和支援自家的 Turbo Boost 3.0 功能
- Intel 開發代號 Kaby Lake，
  第七代 Core 桌上型處理器與
  200 系列晶片組，
  將於 2017 年 1 月正式發表推出。

http://chinese.engadget.com/2016/05/31/intel-debuts-its-first-10-core-cpu-the-core-i7-extreme-edition/

Intel 迎來首款 10 核心 Core 處理器

UNLOCKED INTEL® CORE™ i7-69XX/68XX PROCESSOR FAMILY

Brand Name & Processor Number[1]	Base Clock Speed (GHz)	Intel® Turbo Boost Max Techology 3.0	Intel® Turbo Boost Technology 2.0 Frequency[2] (GHz)	Cores/ Threads	Cache	PCI Express* 3.0 Lanes	Memory Support	TDP	Socket (LGA)	Pricing (1K USD)
NEW Intel® Core™ i7 6950X	3.0	Enabled	Up to 3.5	10/20	25MB	40	4 channels DDR4-2400	140W	2011-v3	$1723
NEW Intel® Core™ i7 6900K	3.2	Enabled	Up to 3.7	8/16	20MB	40	4 channels DDR4-2400	140W	2011-v3	$1089
NEW Intel® Core™ i7 6850K	3.6	Enabled	Up to 3.8	6/12	15MB	40	4 channels DDR4-2400	140W	2011-v3	$617
NEW Intel® Core™ i7 6800K	3.4	Enabled	Up to 3.6	6/12	15MB	28	4 channels DDR4-2400	140W	2011-v3	$434

http://chinese.engadget.com/2016/05/31/intel-debuts-its-first-10-core-cpu-the-core-i7-extreme-edition/

CPU規格

速度
system clock

核心
Core

超執行緒
Thread

快取記憶體
Cache

CPU規格

- 核心
  - 以前一顆CPU只有1個運算核心(Core)，如今已全面走向雙核或多核，表示在同一時間內可同步運算的能力愈強。
  - 若欲充分發揮多核心CPU效能，必須搭配上作業系統以及應用程式的支援

CPU規格

- 超執行緒
  - 除了增加實體的核心來提升CPU效能外，另一種方式則是讓每個CPU核心可用時處理2個指令行程(即所謂『執行緒』,Thread)
  - 對電腦而言雖然只有1個真實的CPU，但執行上卻好比有2個或多個邏輯處理器一樣，這就是由Intel所提出的超執行緒(Hyper-Threading, HT)技術
  - 以xCxT稱呼具有HT技術的CPU 1C2T表示1個core2個Thread

CPU規格

- 快取記憶體(Cache)
  - L1,L2,L3
  - L1,L2整合於CPU核心內
  - 所以指的cache是指L3

Technology Innovators

NVIDIA

Maker of high-performance graphics processors

Nvidia

- Maker of high-performance graphics processors,
- NVIDIA為全球視覺運算技術領導廠商與繪圖處理器(GPU)之發明者，為各種個人電腦、工作站、遊樂器和更多其他裝置帶來突破性的互動式繪圖技術與效能。
- Nvidia's Tegra processors are examples of SoC (system-on-a-chip) technology.
- They consume little power and enable high-performance audio and video.
- In the film and entertainment worlds, Sony Pictures, Sportvision, and Weather Central rely on Nvidia's processor chips to produce imagery and animation.
- In medicine, the company's processors helped researchers to design a device that stabilizes the heart during bypass surgery and also to develop virtual reality simulations that help burn victims undergoing therapy.
- Nvidia's CUDA (Compute Unified Device Architecture) technology was used to enhance the historic Apollo 11 video of Neil Armstrong walking on the moon.

Nvidia

- Which statement regarding Nvidia's GPU processors is correct?

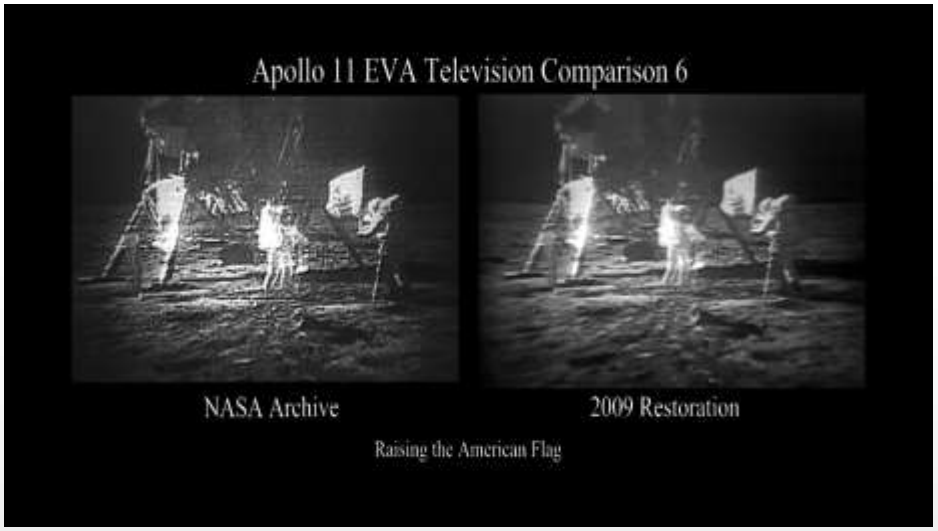
A. They require high power to produce high-performance graphics.

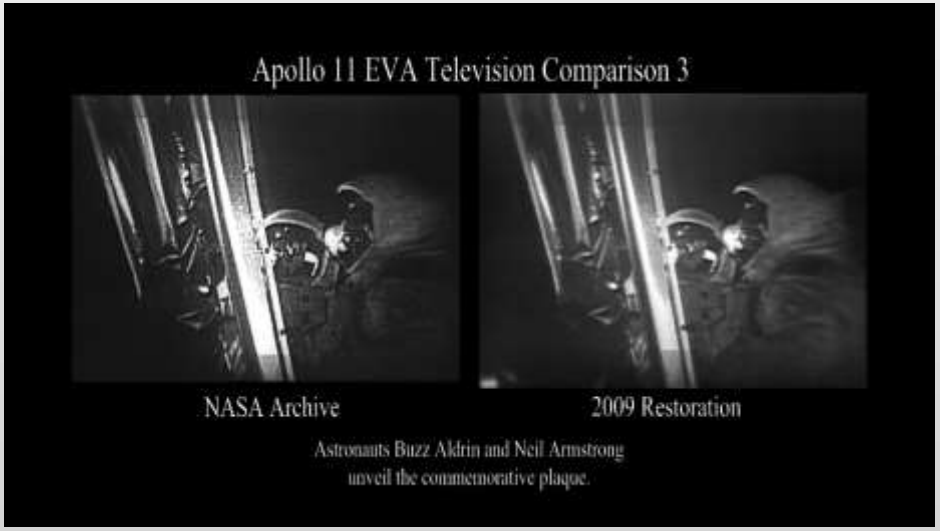
B. They are examples of system-on-a-chip technology.

C. They are not practical for mobile devices with small screens.

D. Their first use in aerospace was to track the International Space Station.

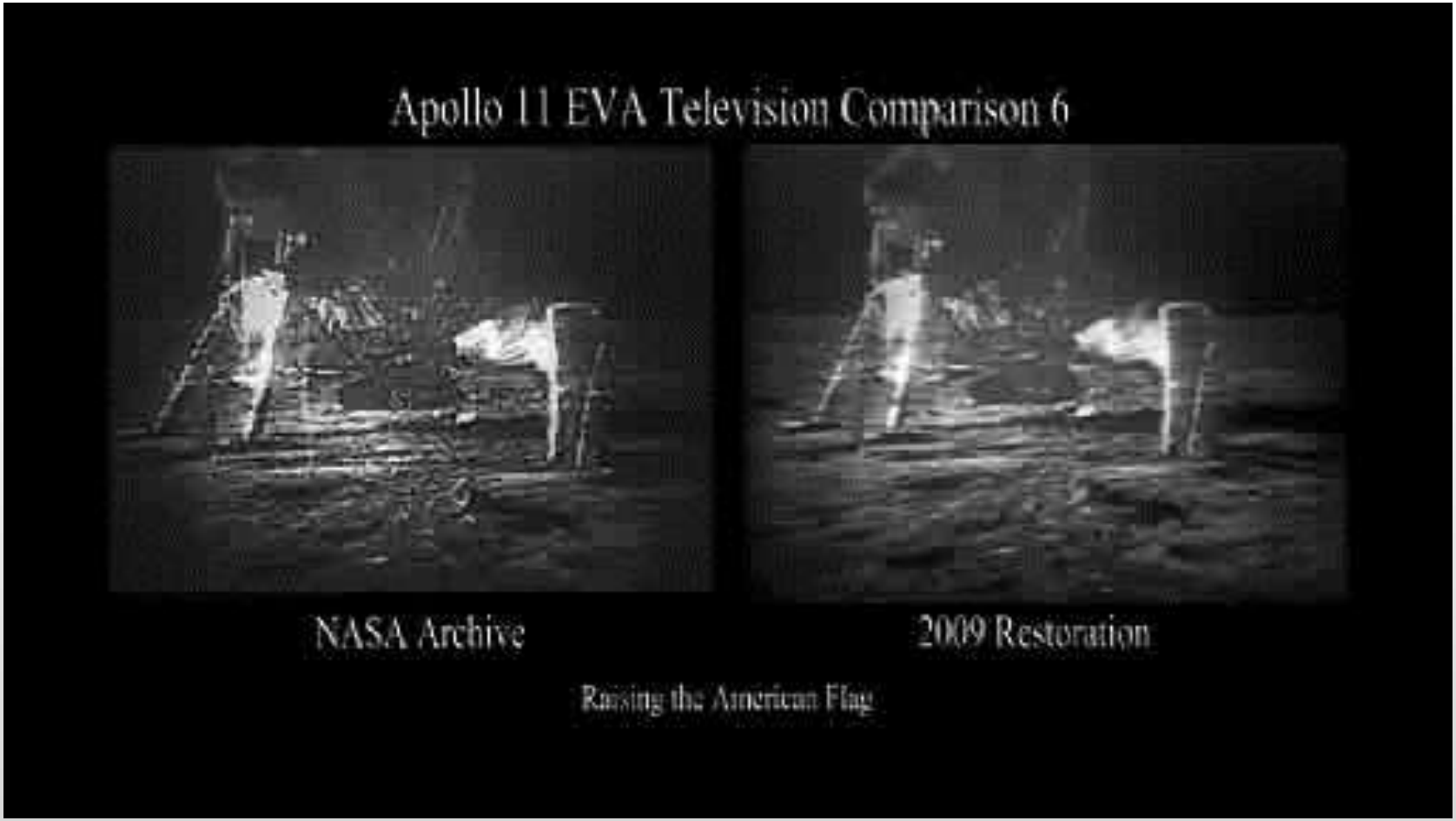
Nvidia





[NVIDIA CUDA Technology Used To Recover Historic APOLLO 11 Man On The Moon Video]

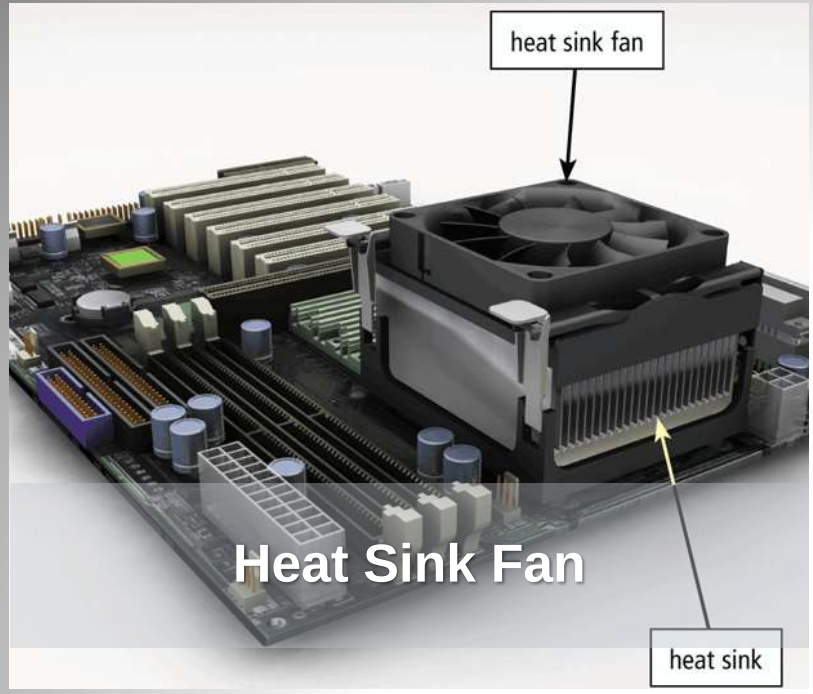
Nvidia



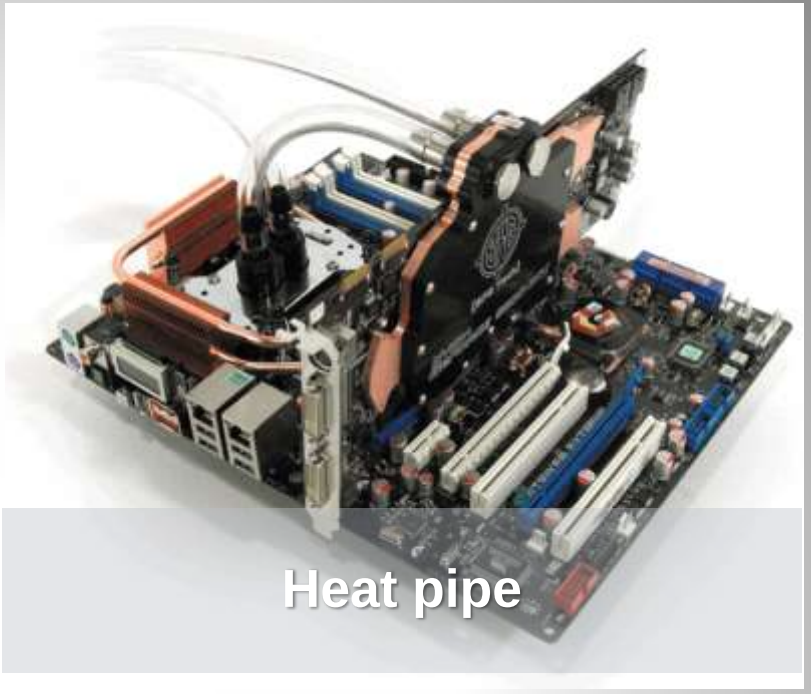
Raising the American Flag

Processor Cooling

- A processor chip generates heat that could cause the chip to malfunction or fail. Require additional cooling
  - Heat sinks散熱器
    is a small ceramic or metal component with fins on its surface that absorbs and disperses heat produced by electrical components, such as a processor.
  - Heat pipe
    smaller device for notebook computers
  - Liquid cooling technology 水冷技術
    uses a continuous flow of fluids to transfer heat away
  - Cooling mats (pads)
    - Pad that rests below a laptop and protects the computer from overheating and also the user's lap from excessive heat.



Heat Sink Fan



Heat pipe

Heat Sink Fan

Cooling pad

IOT

Cloud Computing

- Home and business users choose cloud computing for a variety of reasons

Accessibility 容易取得	• Data and/or applications are available worldwide from any computer or device with an Internet connection.
Cost savings 省錢	• The expense of software and high-end hardware, such as fast processors and high-capacity memory and storage devices, shifts away from the user.
Space savings 省空間	• Floor space required for servers, storages devices, and other hardware shifts away from the user.
Scalability 擴充性	• Provides the **flexibility** to increase or decrease computing requirements as needed.

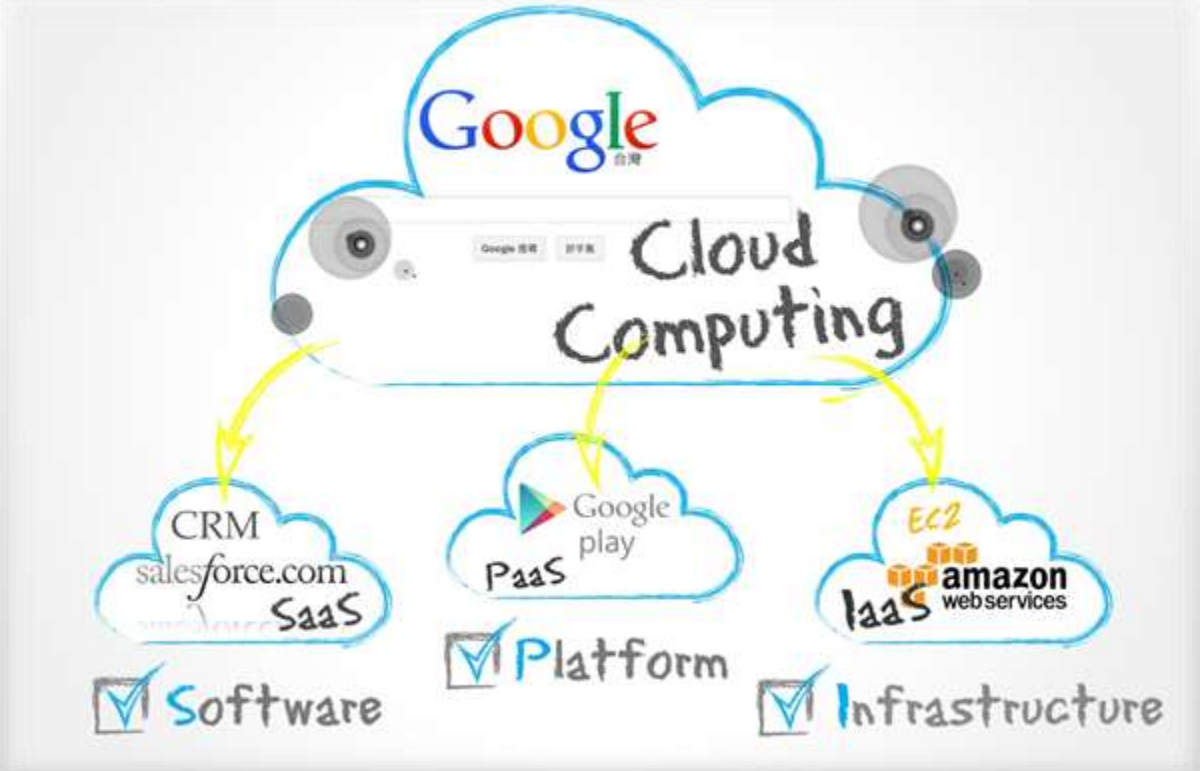
Cloud Computing

- Cloud computing consists of a front end and a back end, connected to each other through a network.
- **The front end** includes the hardware and software with which a user interacts to access the cloud.
  - For example, a user might access a resource on the cloud through a browser on a laptop.
- **The back end** consists of the servers and storage devices that manage and store the resources accessed by users.

Cloud Computing Services

雲端運算徹底了解：基礎篇

你，雲端了嗎？



Cloud Computing

- Cloud computing allows companies to outsource, or contract to third-party providers, elements of their information technology infrastructure.
- They **pay only for** the computing power, storage, bandwidth, and access to applications that they actually use.
- As a result, companies need not make large investments in equipment, or the staff to support it.
- Consumers and organizations rely on cloud computing services to
  - manage IT infrastructure (Infrastructure as a Service),
  - provide applications (Software as a Service),
  - access online data (Data as a Service),
  - and create applications using web based development platforms (Platform as a Service).

Cloud Computing

- Infrastructure as a Service (IaaS)
  - uses software to emulate hardware capabilities, enabling companies to scale, or adjust up or down, storage, processing power, or bandwidth as needed.

Infrastructure as a Service (IaaS)

- Two special cases of IaaS
  - **Storage as a Service:** Cloud storage providers offer **file management services** such as storing files online, system backup, and archiving earlier versions of files.
  - **Desktop as a Service**: Some companies specify the applications, security settings, and computing resources available to employees on their desktop computers.
    - These images, or configurations, provide a common desktop work environment available to employees across an entire organization. Because the desktop and its applications appear to be installed on the user's own computer.
    - Desktop as a Service also is known as **a virtual desktop**.

Software as a Service (SaaS)

- Software as a Service (SaaS)
  - describes a computing environment where an Internet server hosts and deploys applications.
    - Editing documents or photos, sending email messages, and managing finances are common consumer tasks of SaaS applications.
  - A pioneering provider of SaaS applications for companies is Salesforce, which offers customer relationship management (CRM) software.
    - Salesforce users subscribe to modules to handle tasks such as sales and marketing campaigns and customer services.

Data as a Service (DaaS)

- **Data as a Service (DaaS)** allows users and applications to access a company‘s data.
  資料即服務可使使用者與應用程式存取一個公司的資料
- **Mashups** are applications that incorporate data from multiple providers into a new application.
  - Displaying homes or crime statistics on a map are examples of mashups that require data from real estate, police records, and mapping providers.

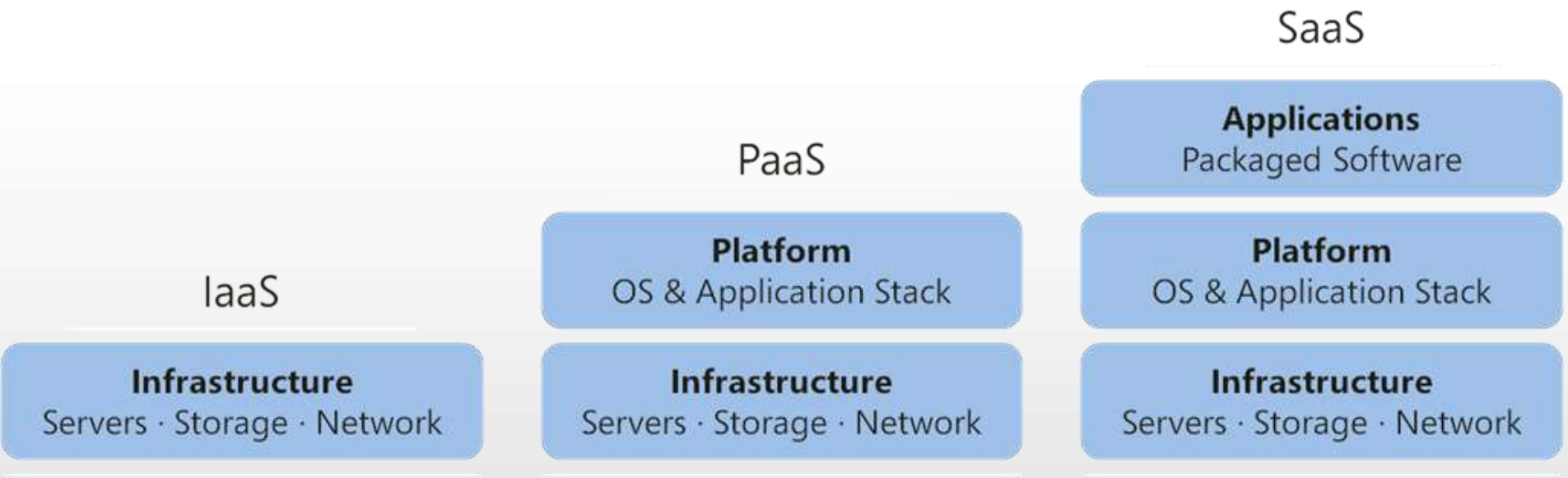
Platform as a Service (PaaS)

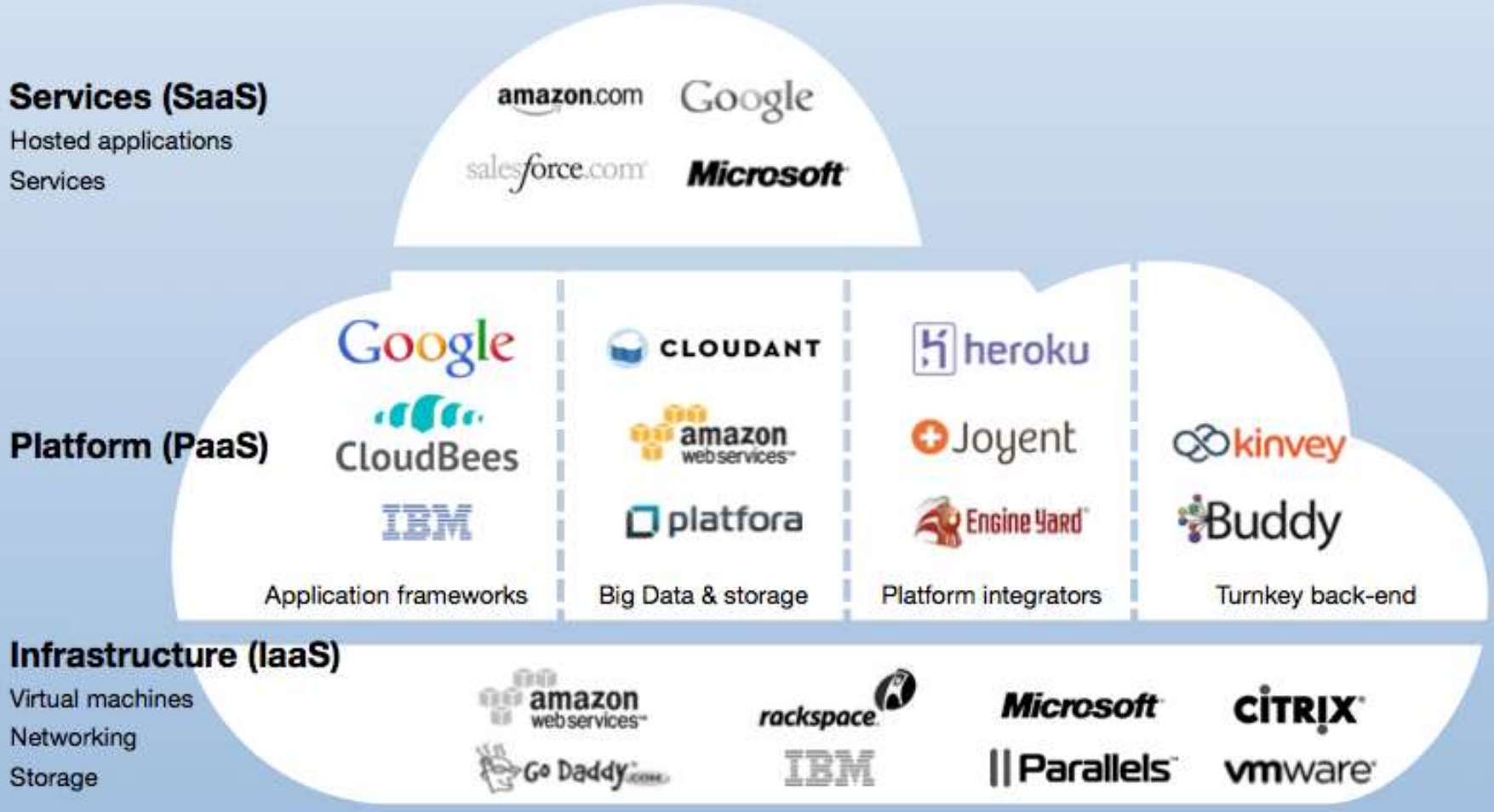
- **Platform as a Service (PaaS)** allows **developers to create, test, and run their solutions** on a cloud platform without having to purchase or configure the underlying hardware and software.

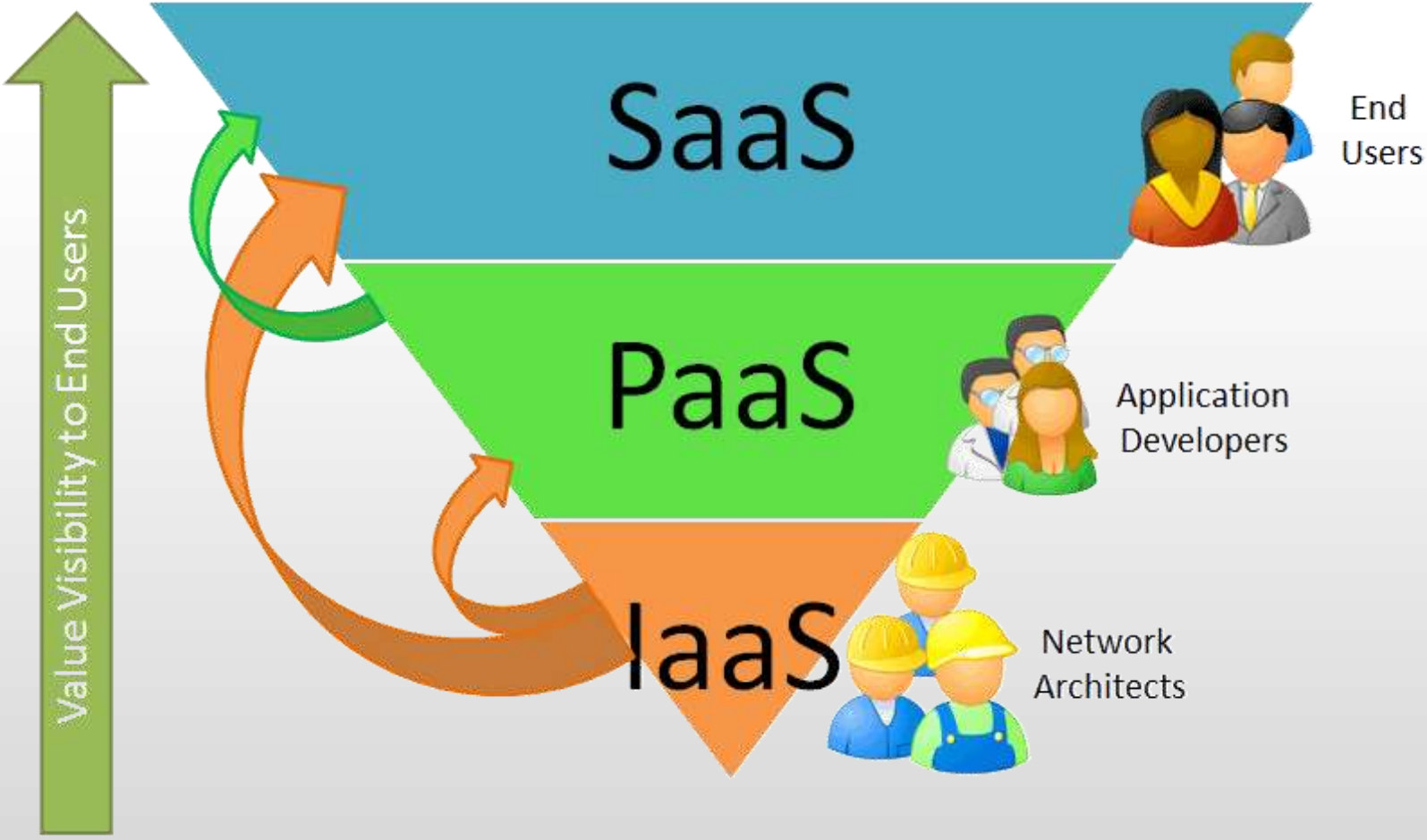
  平台即服務是使開發者可以在雲端平台上建立，測試，執行解決方案，而無需購買或設定所需的硬體與軟體

Cloud Computing

- Cloud computing services are based on a "**pay as you go**" model.

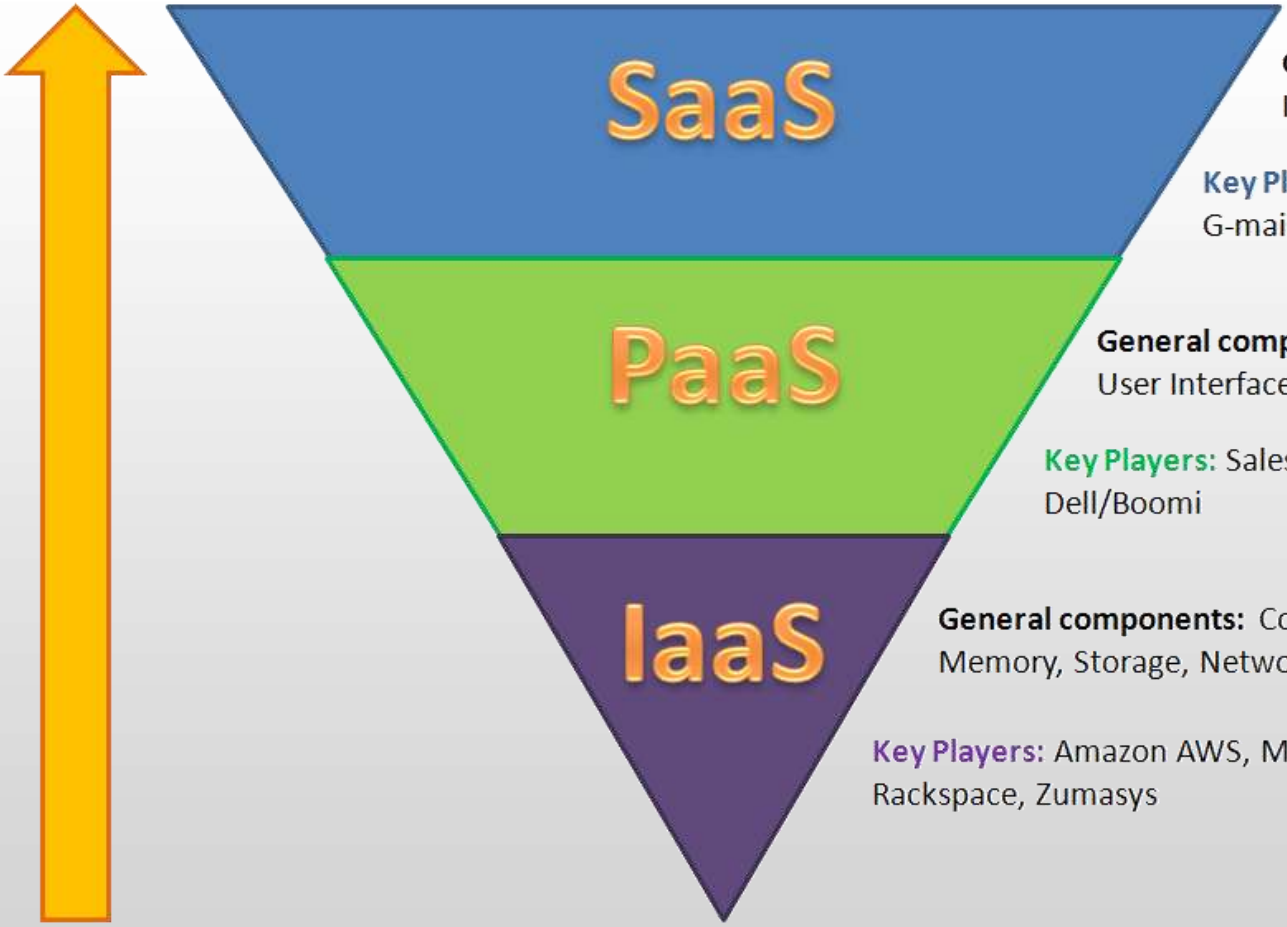

IaaS
Infrastructure
Servers · Storage · Network
PaaS
Platform
OS & Application Stack
Infrastructure
Servers · Storage · Network
SaaS
Applications
Packaged Software
Platform
OS & Application Stack
Infrastructure
Servers · Storage · Network


Services (SaaS)
Hosted applications
Services
amazon.com
Google
salesforce.com
Microsoft
Platform (PaaS)
Google
CloudBees
IBM
CLOUDANT
amazon web services
platfora
heroku
Joyent
Engine Yard
kinvey
Buddy
Application frameworks
Big Data & storage
Platform integrators
Turnkey back-end
Infrastructure (IaaS)
Virtual machines
Networking
Storage
amazon web services
Go Daddy
rackspace
IBM
Microsoft
Parallels
CITRIX
vmware


Value Visibility to End Users
SaaS
PaaS
IaaS
End Users
Application Developers
Network Architects

End-Users

Awareness of technology to end-users



General components: End-user Interface, User customization

Key Players: Facebook, LinkedIn, G-mail, Office365, Pinterest

General components: Point-and-click User Interface design, self-provisioning, etc.

Key Players: Salesforce, NetSuite, MuleSoft, Dell/Boomi

General components: Compute, Redundancy, Memory, Storage, Network, etc.

Key Players: Amazon AWS, Microsoft, Google, Fujitsu, Rackspace, Zumasys

Cloud Data Privacy

- The security of this data and the reliability of cloud companies trigger concerns.
  雲端上資料的安全性與雲端公司的可靠性引發關注
  - Foremost is the worry about data security.資料安全性
  - Another concern arises when transferring data between a network and the cloud.
    - Interception資料傳送時被攔截
- To minimize risk, security experts emphasize that a browser's web address must begin with **https**, and the data should be **encrypted** and **authenticated**.

Data Representation

To understand how a computer processes data, you should know how a computer represents data.

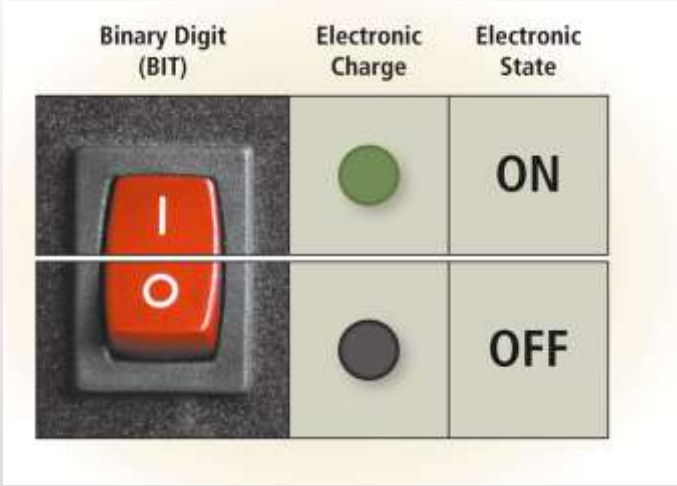
Human	Computer
類比訊號 (analog signal)	數位訊號 (digital signal)

- **Analog** signals are continuous and vary in strength and quality
  類比訊號是連續的，其強度和品質一直在不斷變化

- **Digital** signals are in one of two states: on or off
  數位訊號只有開 (on) 和關 (off) 兩種狀態
- 是以預先定義的符號表示不連續的訊號 ，沒有大小之分

Bits and bytes

- The **binary system** is a number system that has just two unique digits, 0 and 1, called bits.
- A bit is the smallest unit of data the computer can process.
- 數字0表示關閉的電子狀態
  (電荷不存在)
  數字1代表開啟的電子狀態
  (電荷存在)



The circuitry in a computer or mobile device represents the on or the off states electronically by the presence or absence of an electronic charge

Bits and bytes

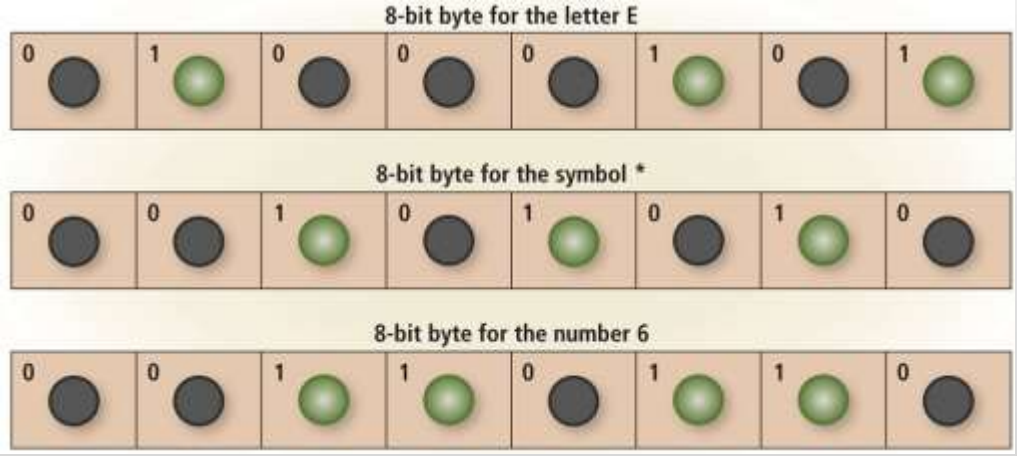
- When 8 bits are grouped together as a unit, they form a byte.
- A byte provides enough different combinations of 0s and 1s to represent 256 different characters.
  - These characters include numbers, uppercase and lowercase letters of the alphabet, punctuation marks, and other keyboard symbols, such as an asterisk (*), ampersand (&), and dollar sign ($).

Coding Schemes

- The combinations of 0s and 1s that represent uppercase and lowercase letters, numbers, and special symbols are defined by patterns called a coding scheme.
- Coding schemes map a set of alphanumeric characters (letters and numbers) and special symbols to a sequence of numeric values that a computer can process.

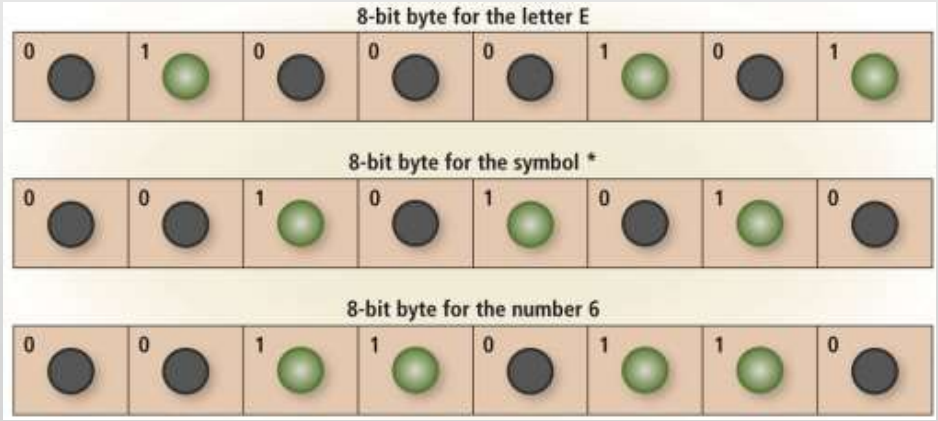
Coding Schemes

- ASCII (American Standard Code for Information Interchange, which stands for American Standard Code for Information Interchange, is the most widely used coding scheme to represent a set of characters.
- In the ASCII coding scheme
  - E is represented as 01000101
  - * is represented as 00101010
  - 6 is represented as 00110110



Coding Schemes

- Eight bits grouped together as a unit are called a byte.
  將8個位元集合成一個單位叫做位元組
- A byte represents a single character in the computer or mobile device
  每個位元組可代表在電腦上的1個字元
  - 可以用來表示一個英語系或歐語系的字母、數字、符號。
  - 稱為字元 character
- 中文字用兩個元位組來表示
  - 稱為字組word



Pages 289
Figures 6-9

How a Letter is Converted to Binary Form and Back

Why are Coding Schemes Necessary

- Computers rely on logic circuits, which are controlled by electronic switches whose state can be either on or off.
- Each switch's on/off state is represented by one bit, whose value is either 0 or 1.
- **Coding schemes translate real-world data into a form that computers can process easily.**

Coding Schemes

- Three popular coding systems to represent data
  表示資料最常用的三個編碼系統
  - **ASCII** (American Standard Code for Information Interchange)
    - is the most widely used coding scheme to represent data
  - **EBCDIC** (Extended Binary Coded Decimal Interchange Code)
    - High-end servers sometimes use
    - The EBCDIC first was used on the IBM System/360 mainframe computer in the 1960's and still is in use with some IBM servers.

Coding Schemes

ASCII	Symbol	EBCDIC
00110000	0	11110000
00110001	1	11110001
00110010	2	11110010
00110011	3	11110011

ASCII	SYMBOL
00110000	0
00110001	1
00110010	2
00110011	3
00110100	4
00110101	5
00110110	6
00110111	7
00111000	8
00111001	9
01000001	A
01000010	B
01000011	C
01000100	D
01000101	E
01000110	F
01000111	G
01001000	H
01001001	I
01001010	J
01001011	K
01001100	L
01001101	M

ASCII	SYMBOL
01001110	N
01001111	O
01010000	P
01010001	Q
01010010	R
01010011	S
01010100	T
01010101	U
01010110	V
01010111	W
01011000	X
01011001	Y
01011010	Z
00100001	!
00100010	
00100011	#
00100100	$
00100101	%
00100110	&
00101000	(
00101001	)
00101010	*
00101011	+

Coding Schemes

- Three popular coding systems to represent data
  表示資料最常用的三個編碼系統
  - **Unicode**
    - capable of representing all world's languages
    - is a 16-bit coding scheme that uses more than 65,000 characters and symbols.
    - Unicode依照通用字符集（Universal Character Set）的標準來發展
    - 每個新版本都加入更多新的字元，目前最新的版本為2016年6月21日公布的9.0.0
    - To obtain the Unicode code for a symbol, add the symbol's corresponding digit in the left-most column to the end of the symbol's corresponding three-digit code in the right-most column heading. For example, the Unicode for the capital letter C is 0043.

文字表示法

ASCII	• 2^7，存放在一個位元組
ASCII-8	• 2^8 ，前128個字元與ASCII相同，剩下的128字元用來表示控制字元或非字元的圖像
EBCDIC	• IBM , 2^8
中文編碼系統	• 繁體：BIG5(16位元) 、王安碼、 CCCII • 簡體：國標碼GB或漢字碼HZ為主。
Unicode	• 16位元表示 • 使用2^{16} (65563)個字元，前128個字元與ASCII相同

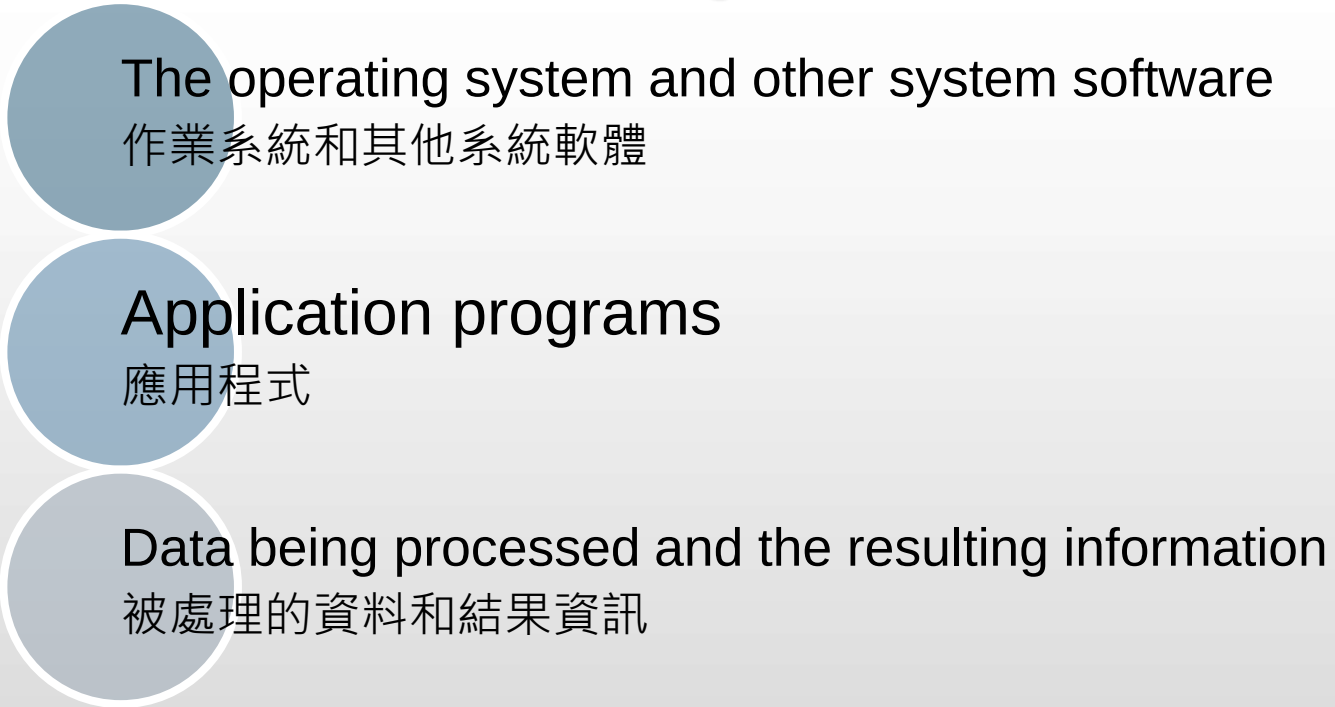
Memory

- **Memory** consists of electronic components that store
  - instructions waiting to be executed by the processor,
  - data needed by those instructions,
  - and the results of processing the data

  記憶體由電子元件組成，負責儲存準備讓處理器執行的指令、指令所需的資料，以及資料處理後的結果

Memory

- Memory stores **three basic categories of items**



- This role of memory to store both data and program is known as the **stored program concept**

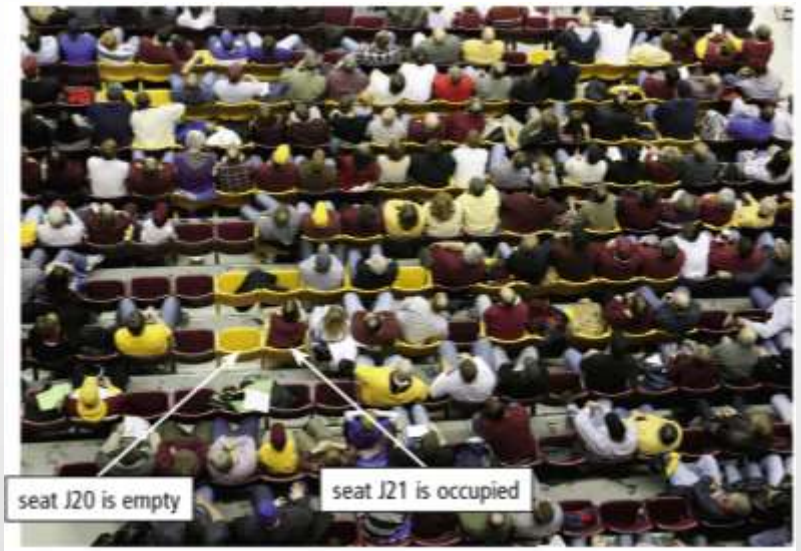
Bytes and Addressable memory

- A byte (character) is the basic storage unit in memory
  位元組又稱字元(character)是記憶體基本儲存單位
- 當應用程式的指令和資料從儲存設備傳送到記憶體，指令和資料以**位元組**的方式存在
- Each byte resides temporarily in a location in memory that has an address.
  每個位元組暫存在記憶體中有位址的地方
  - address
    - Unique number that identifies the location of a byte in memory.
- To access data or instructions in memory, the computer references the addresses that contain bytes of data.
- **Each location in memory has an address**
  記憶體中的每個位置都有位址

Bytes and Addressable memory

- seats in a stadium are similar to addresses in memory

Stadium	memory
• a seat is identified by a unique seat number, • holds one person at a time	• a location in memory, which is identified by a unique address, • holds a single byte;
• a seat is identified by a seat number • A seat can be empty	• a byte is identified by an address • can be empty.



每一個位元組都存在一個獨特的位置，叫做位址，就像體育場的每一個座位；也可能是空的

Memory

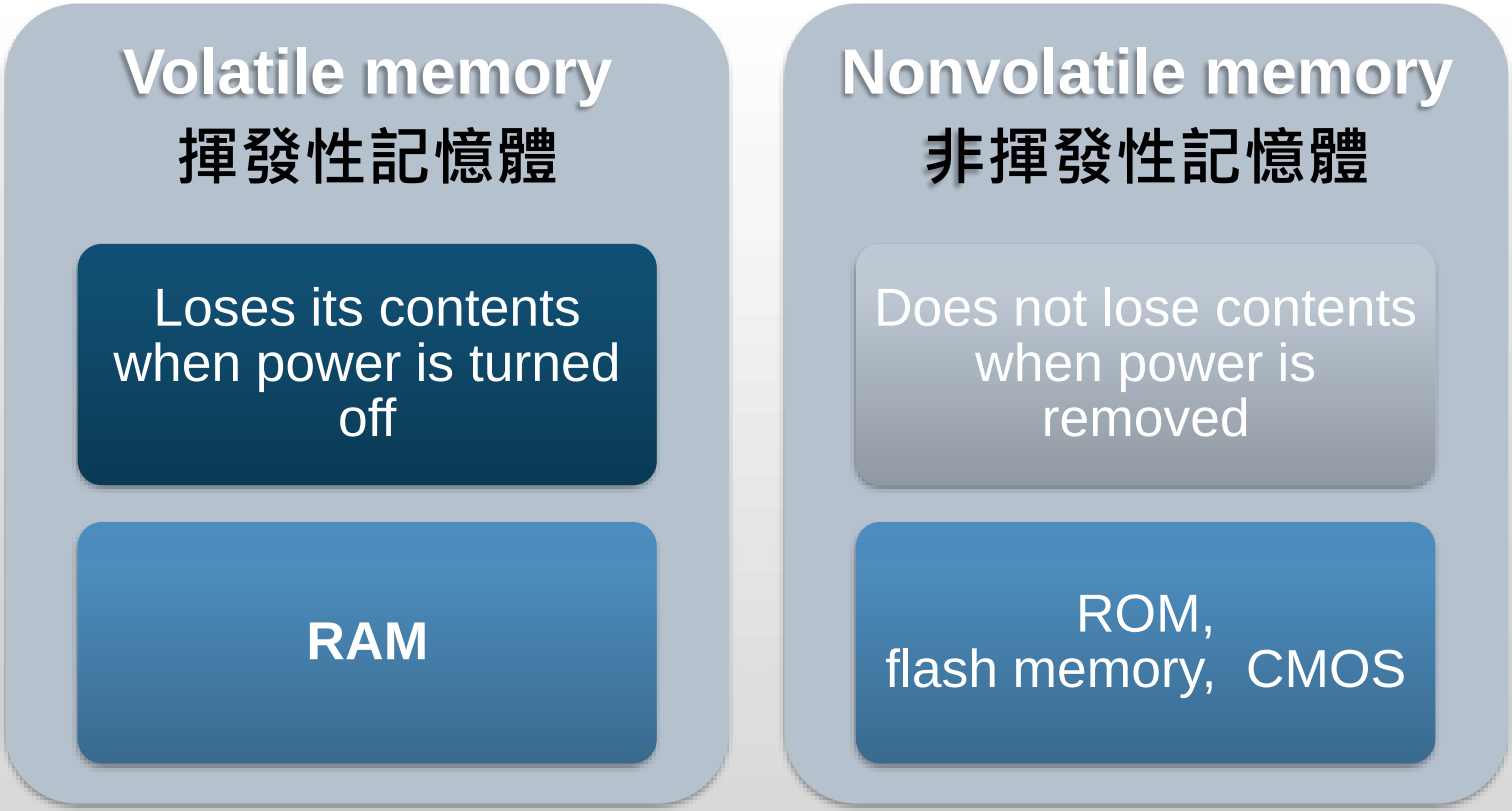
- Manufacturers state the size of memory in terms of the number of bytes it has available for storage.
- Memory size is measured in
  - **kilobytes** (**KB** or **K**),**千位元組**
  - **megabytes** (**MB**),百萬位元組
  - **gigabytes** (**GB**),十億位元組
  - **terabytes** (**TB**)兆位元組

Memory Sizes

Term	Abbreviation	Approximate Number of Bytes	Exact Number of Bytes	Approximate Number of Pages of Text
Kilobyte	KB or K	1 thousand	1,024	1/2
Megabyte	MB	1 million	1,048,576	500
Gigabyte	GB	1 billion	1,073,741,824	500,000
Terabyte	TB	1 trillion	1,099,511,627,776	500,000,000

Types of memory

- The system unit contains **two types of memory**:



RAM

- Random Access Memory (RAM) 隨機存取記憶體
  - Memory chips that can be read from and written to by processor
  - Also called **main memory** or **primary storage**
  - Most RAM is volatile, it is lost when computer's power is turned off
  - The more RAM a computer has, the faster it responds

RAM

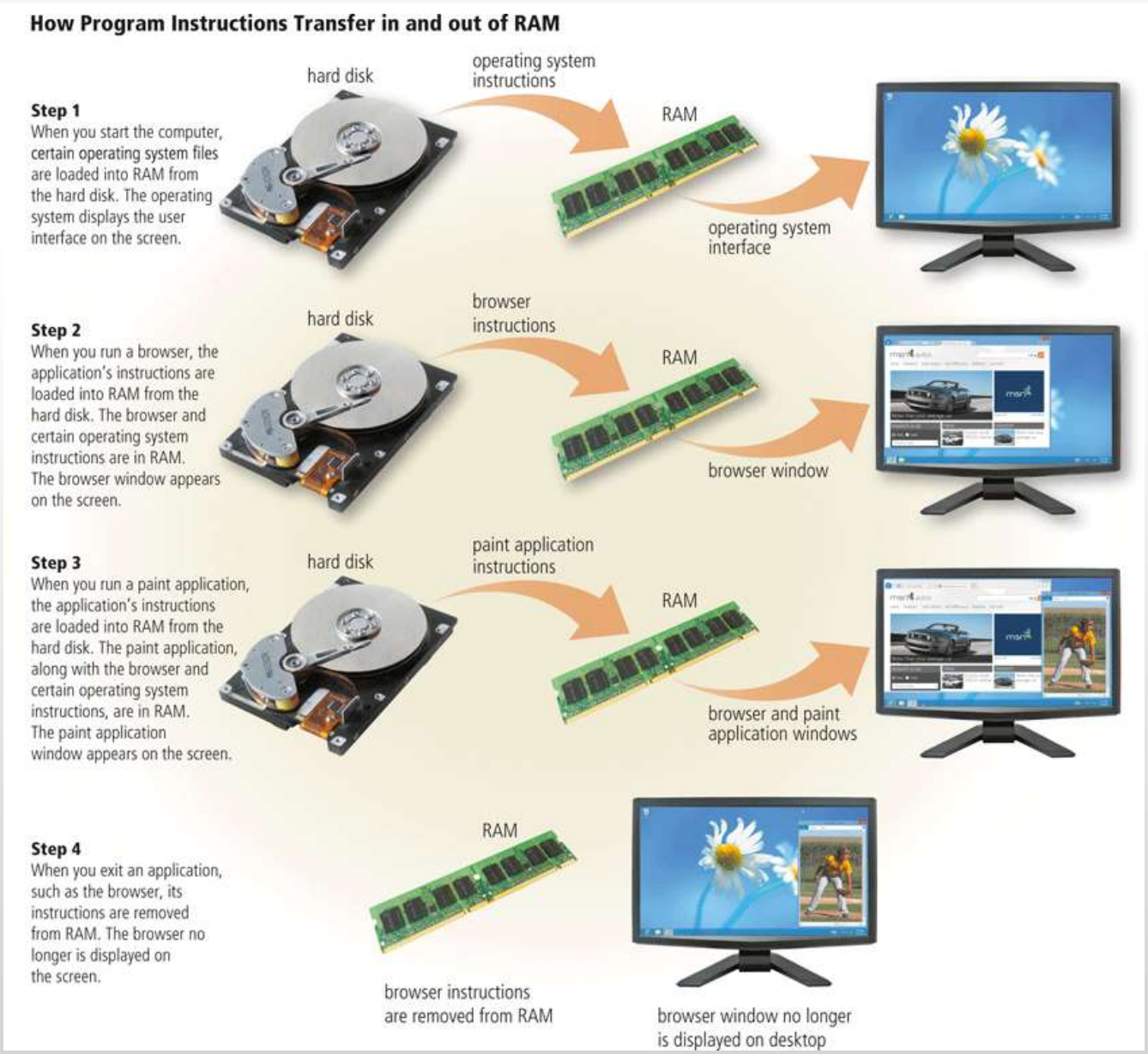


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Figure 6-12

程式指令如何進出 RAM

步驟 1

當你啟動電腦時，會從硬碟載入特定作業系統檔案到 RAM 中。作業系統在螢幕上顯示使用者介面。

步驟 2

開啟網頁瀏覽器時，會從硬碟載入此程式的指令到 RAM 中，此時網頁瀏覽器和特定作業系統指令都在 RAM 中，網頁瀏覽器視窗顯示在螢幕上。

步驟 3

接下來開啟小畫家程式，會從硬碟載入此程式的指令到 RAM 中，此時小畫家程式以及網頁瀏覽器和特定作業系統指令都在 RAM 中，小畫家程式視窗顯示在螢幕上。

步驟 4

假如關閉網頁瀏覽器程式，它的程式指令會從 RAM 中被移除。此時網頁瀏覽器不再顯示於螢幕上。

Type of RAM

- RAM主記憶體的製造目前是以模組的形式而成的
- Two common types of RAM chips exist:

Dynamic RAM (DRAM)

- Dynamic RAM chips must be reenergized需週期性充電 constantly or they lose their contents.
- Many variations of DRAM chips exist, most of which are faster than the basic DRAM.

Static RAM (SRAM)

- Static RAM chips are faster and more reliable than any variation of DRAM chips.
- do not have to be reenergized as often as DRAM chips
- SRAM chips are much more expensive than DRAM chips.
- Special applications such as cache use SRAM chips.

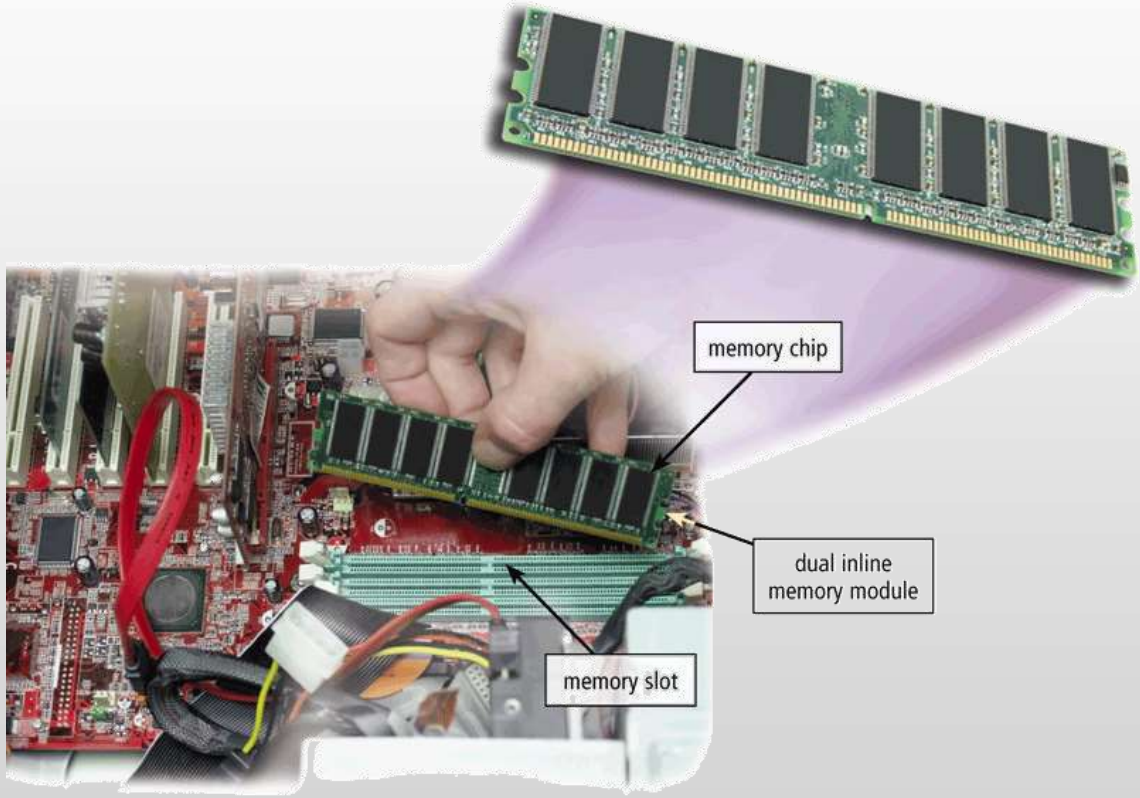
Table 6-1 Common DRAM Variations

Name	Comments
SDRAM (Synchronous DRAM) 同步隨機存取記憶體	• Synchronized to the system clock • Much faster than DRAM
DDR SDRAM (Double Data Rate SDRAM) 雙倍同步隨機存取記憶體	• Transfers data twice, instead of once, for each clock cycle • Faster than SDRAM 它的存取速度為SDRAM的二倍。
DDR2	• Second generation of DDR • Faster than DDR
DDR3	• Third generation of DDR • Designed for computers with multi-core processors • Faster than DDR2
DDR4	• Fourth generation of DDR • Faster than DDR3
RDRAM (Rambus DRAM) 記憶體匯流排動態隨機存取記憶體	• Much faster than SDRAM

https://shop.transcend-info.com/center.asp?indexnum=1

Memory Modules

- RAM chips usually reside on a **memory module** and are inserted into **memory slots**

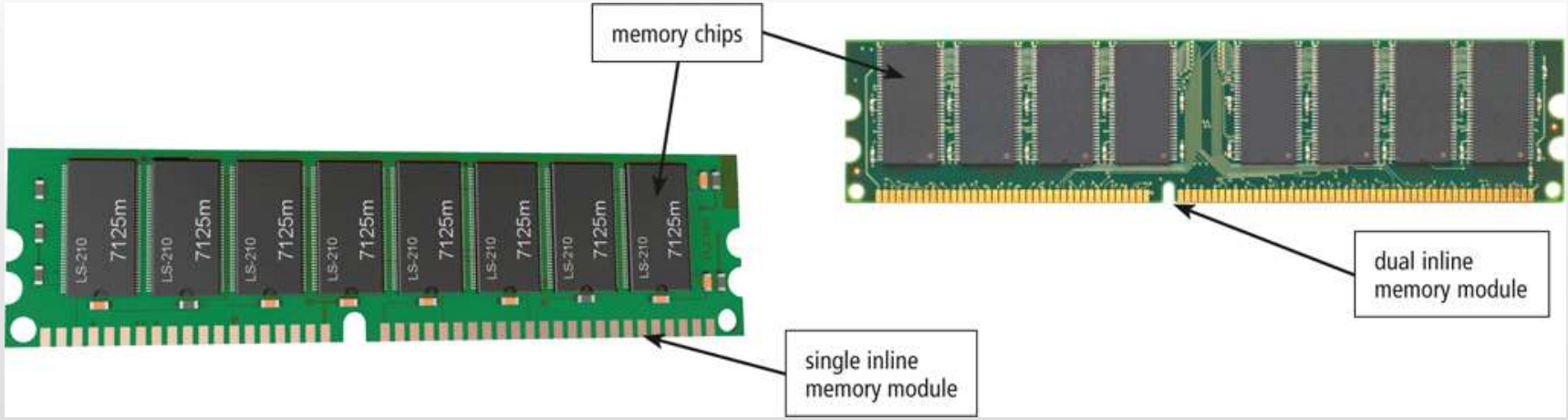


Memory Modules

- Two types of memory modules are SIMMs and DIMMs

單線記憶模組

雙線記憶模組



Memory modules contain memory chips.

RAM

Two types of memory modules are SIMMs and DIMMs

SIMM

- has pins on opposite sides of the circuit board that connect together to form a single set of contacts.

電路板正反兩面針腳相連在一起

DIMM

- has pins on opposite sides of the circuit board that do not connect, thereby forming two sets of contacts

電路板正反兩面針腳則各有其獨立電路

RAM

Two types of memory modules are SIMMs and DIMMs

SIMM

- Single In-Line Memory Module
- 一種將記憶體晶片(RAM)銲在表面的電路板模組, 使記憶體的安裝與拆除較直接安裝晶片為容易
- used in computers from the early 1980s to the late 1990s
- 電路板正反兩面針腳相連在一起
- SIMM 的資料通道寬度為 32 位元

DIMM

- Dual In-Line Memory Module
- 將數個記憶體晶片(DRAM)裝於一塊電路板上的記憶體模組
- 電路板正反兩面針腳則各有其獨立電路
- DIMM 的資料通道寬度(data path)是 SIMM 的兩倍, 為 64 位元

補充

Difference Between SIMM and DIMM

DRAM - What is the difference between a SIMM and a DIMM

What is the difference between SIMM, DIMM, and SODIMM?

RAM

- 主記憶體的包裝方式
  - SIMM (Single Inline Memory Module，單線記憶模組)
  - DIMM (Double Inline Memory Module，雙線記憶模組)
  - RIMM (Rambus Inline Memory Module)

30- (top) and 72-pin (bottom) SIMMs.
Early 30-pin modules commonly had either 256 KB or 1 MB of memory.

a 168-pin SDRAM module (top) and a 184-pin DDR SDRAM module (bottom).

RAM

- **RIMM**模組它不僅提供更高速的資料存取速度，也提供更低的消耗功率。
- 是英特爾(Intel)公司於1999年推出晶片組(Chipset)所支援的記憶體模組。
- developed by Kingston Technology Corp
- RIMM是Direct Rambus memory module的註冊專有名稱。
- A RIMM module consists of RDRAM chips

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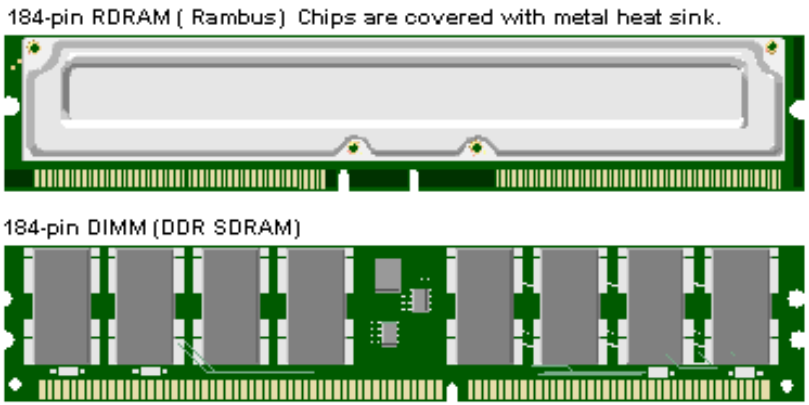


RIMMs and DIMMs
RDRAM memory for computers was easily identifiable by its metal cover that served as a heat sink.

RAM

- 由於RIMM模組有較快的存取與傳輸速率，故需要較好的散熱功能以預防系統當機，因此模組外包裹了一層稱為散熱片(Heat Spreader)的鋁製外殼，以確保晶片不會過熱。
- **RIMM必須成對使用於電腦系統上**，如果只有一支RIMM，則必須安裝一支CRIMM (Continuation Rambus Inline Memory Module)於另一插槽中，以維持電腦系統正常運作。

Cache

- Most of today's computers improve their processing times with **cache**, which is a **temporary storage area**.
- Two common types of cache are **memory cache** and **disk cache**.
- Most **personal computers** today have two types of memory cache: **Level 1 (L1) cache and Level 2 (L2) cache**. Some also have **Level 3 (L3) cache**.

Cache

L1 cache

- is built directly on the **processor** chip.
- L1 cache usually has a very small capacity.

L2 cache

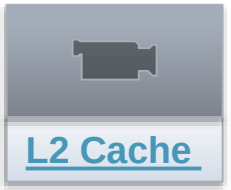
- is slightly slower than L1 cache but has a much larger capacity.
- Current processors include **advanced transfer cache (ATC)**, a type of L2 cache built directly on the processor chip.
- Processors that use ATC perform at much faster rates than those that do not use it.
- When discussing cache, most users are referring to L2 cache.

L3 cache

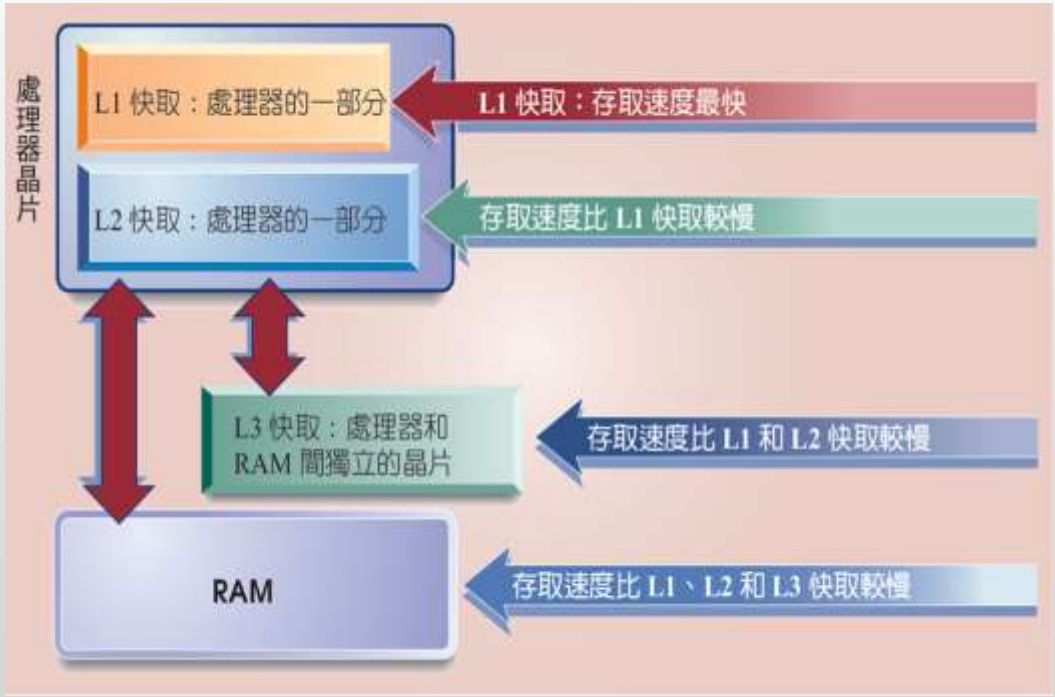
- is a cache on the **motherboard** that is separate from the processor chip. (通常)
- L3 cache exists only on computers that use L2 advanced transfer cache.

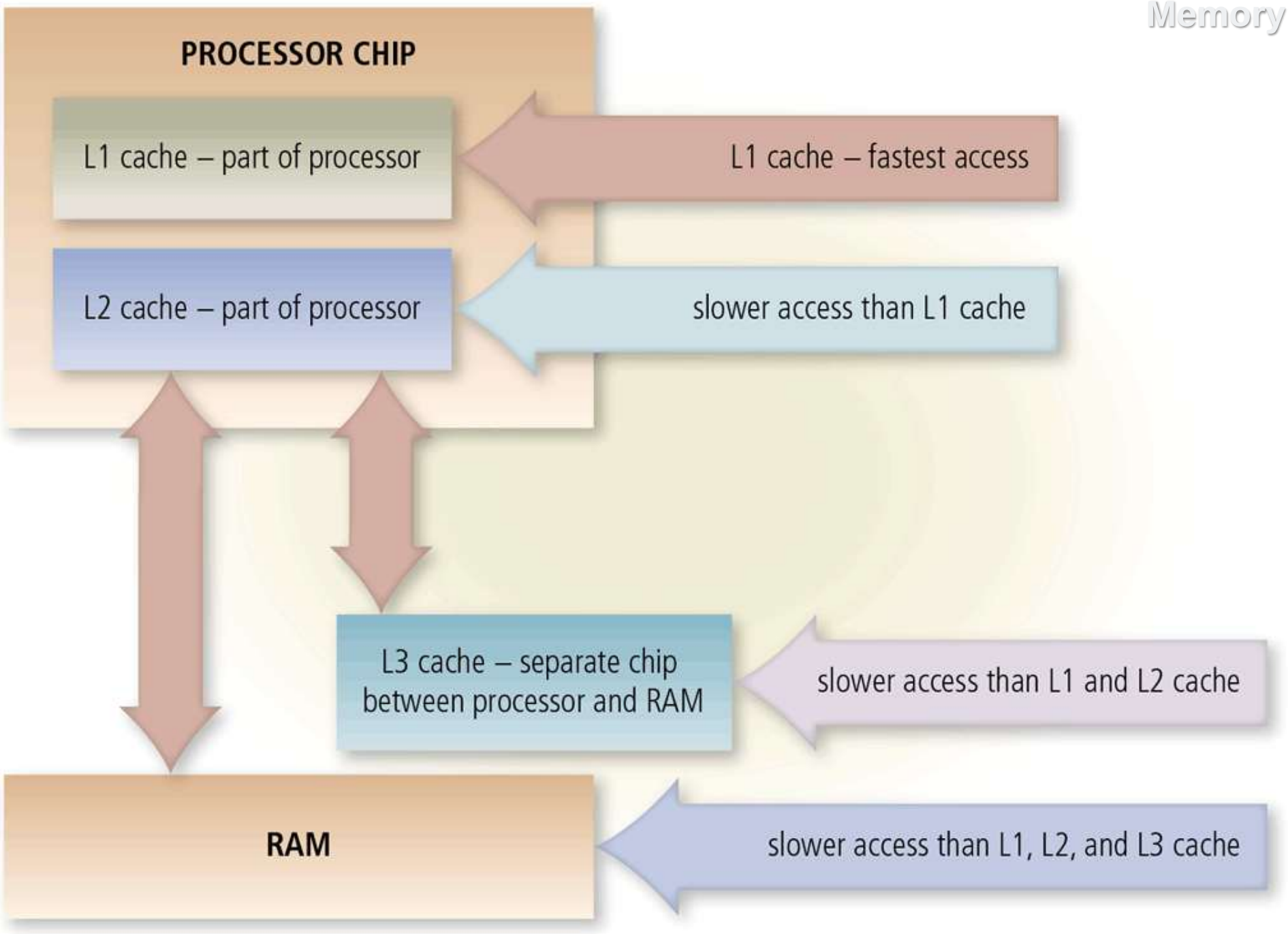
Cache

- **Memory cache**快取記憶體
  speeds the processes of the computer because it stores frequently used instructions and data
  儲存常用的指令和資料，來加速電腦處理進度



- **L1** cache built into processor
- **L2** cache slower but has larger capacity
- **L2** advanced transfer cache is faster, built directly on processor chip
- **L3** cache is separate from processor chip on motherboard (L3 is only on computers that use L2 advanced transfer cache)




PROCESSOR CHIP
L1 cache – part of processor
L1 cache – fastest access
L2 cache – part of processor
slower access than L1 cache
L3 cache – separate chip between processor and RAM
slower access than L1 and L2 cache
RAM
slower access than L1, L2, and L3 cache

Cache

- 當處理器需要指令或資料時，它的搜尋記憶體的順序

  - 若記憶體中找不到，則到速度較慢的儲存設備如硬碟、光碟中搜尋

- **Windows Ready Boost** 補充
  - which can allocate available storage space on removable flash memory devices as addition cache.

Windows Ready Boost

2012-04-05

- **Win7 ReadyBoost** 就是利用隨身碟中的快取記憶體空間來增加硬碟的快取記憶體容量，這樣就能有效的提升硬碟的存取速度，提升或加速系統的整體效能。這個功能對於記憶體與硬碟等級較低的電腦確實有用。反之如果電腦記憶體已達 2GB 且已配備 SATA 硬碟，那麼這個功能就可說是：「英雄無用武之地。」用了反而會拖慢速度。
- ReadyBoost 這個功能在 Vista 時就已存在，而 Win7 仍然保留這項功能，而這項功能對於低記憶體容量、低轉速與低緩衝記憶體硬碟的使用者就顯得比較實用。尤其是機齡四年左右的筆記型電腦，原因是當時的主流筆記型電腦一般都是搭配 IDE 介面 5400 轉與 1MB、2MB 緩衝記憶體的硬碟一起販售。
- 結論：如果你的電腦記憶體容量低於 1GB 且硬碟為 IDE 介面 5400 轉與 1MB、2MB 緩衝記憶體的情況下，您可以嘗試利用 Windows ReadyBoost 這個功能來提升系統效率。

http://ramupdate.myweb.hinet.net/Win7-35.htm

ROM

- Read-only memory (ROM) refers to memory chips storing permanent data and instructions
- Nonvolatile memory, it is not lost when computer's power is turned off
- **Firmware 韌體**
  - Manufactured with permanently written data, instructions, or information.
  - contain permanently written data, instructions, or information such as a computer or mobile device's start-up instructions.

Flash memory

- can be erased electronically and rewritten
  快閃記憶體可以進行電子式清除和覆寫
- Most computers use flash memory to hold their start-up instructions because it allows the computer to update its contents easily.
- **Flash memory chips also store data and programs on many mobile devices and peripheral devices,** such as smartphones, portable media players, printers, digital cameras, automotive devices, and digital voice recorders

Flash memory

- Wiping Mobile Phone Memory
  - A thief can plug a small device, called a **Cellular Seizure Investigation (CSI) stick** into the phone and then download sensitive data in seconds.

CMOS互補金氧半導體

- Complementary metal-oxide semiconductor memory
- CMOS technology provides high speeds and consumes little power 速度快且低耗能
- Stores **date, time, and computer's startup information**
- Uses battery power to retain information when other power is turned off
- Used in some RAM chips, flash memory chips, and other types of memory chips

電腦內以電池驅動的晶片
儲存系統參數的晶片
硬碟的類型
軟碟的規格
系統日期

Memory Access Times

- **Access time** is the amount of time it takes the processor to read from memory
  存取時間是處理器從記憶體中讀取資料、指令和資訊所需的時間量
  - Measured in **nanoseconds** 以**奈秒**為測量單位
  - **one billionth of a second**

Table 6-2 Access Time Terminology

Term	Abbreviation	Speed
Millisecond	ms	One-thousandth of a second
Microsecond	µs	One-millionth of a second
Nanosecond	ns	One-billionth of a second
Picosecond	ps	One-trillionth of a second

存取時間術語

專有名詞	縮寫	速度
毫秒（Millisecond）	ms	千分之一秒
微秒（Microsecond）	µs	百萬分之一秒
奈秒（Nanosecond）	ns	十億分之一秒
微微秒（Picosecond）	ps	兆分之一秒

Memory Access Times

- Other manufactures state access times in **MHz**
  - For example : 800MHz DDR2 SDRAM
- 將MHz轉為ns

1000,000,000/800,000,000

=1.25ns

It takes 1/10 of a second to blink your eye
a computer can perform
up to 10 million operations in same amount of time

Adapter Cards

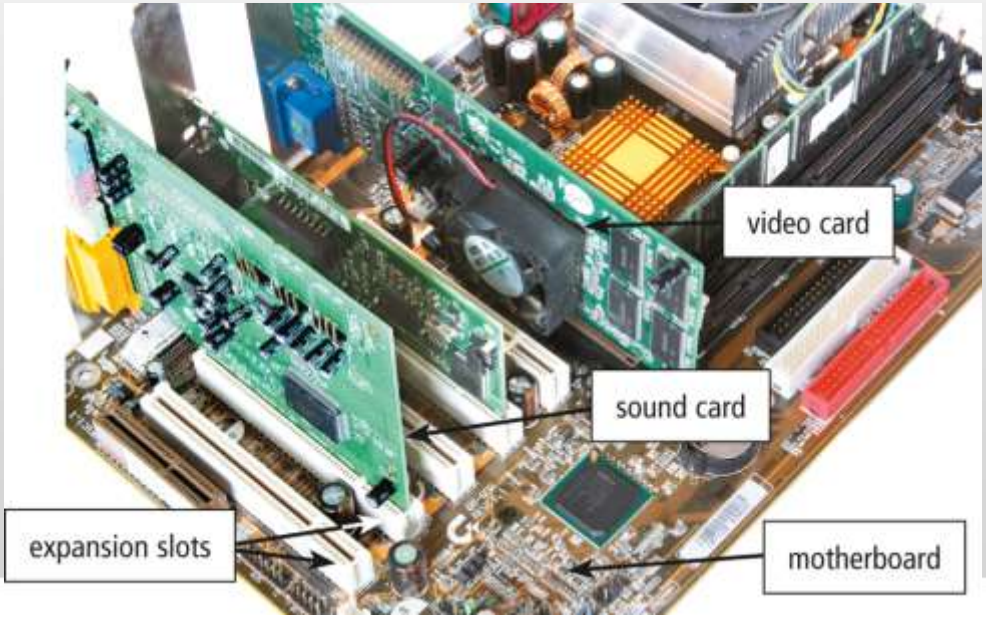
- Although the circuitry in many of today's computers integrates all the necessary functionality, some require additional capabilities in the form of adapters
- Desktops and servers use adapter cards; mobile computers use USB adapters.

Adapter Cards

- An **adapter card** enhances functions of a component of the system unit and/or provides connections to **peripherals**
  介面卡是加強主機元件功能或提供周邊裝置連結的電路板
- Sometimes called an **expansion card or adapter board**

Adapter Cards

- An **expansion slot** is a socket on a desktop or server motherboard that can hold an adapter card.
  擴充槽是主機板上可以容納介面卡的插槽
- With **Plug and Play**, the computer automatically can recognize peripheral devices as you install them



Pages 297 - 298
Figure 6-16

Adapter Cards

- Two popular adapter cards are sound cards and video cards.
- A **sound card** enhances the sound-generating capabilities of a personal computer by allowing sound to be input through a microphone and output through external speakers or headphones. 音效卡
- A **video card**, also called a **graphics card**, converts computer output into a video signal that travels through a cable to the monitor, which displays an image on the screen. 顯示卡

Adapter Cards

- Table 6-3 identifies the purpose of some adapter cards. Sometimes, all functionality is **built in the adapter card**. With others, **a cable connects the adapter card to a device**, such as a digital video camera, outside the computer.

Table 6-3 Adapter Cards

Type	Purpose
Bluetooth	Enables Bluetooth connectivity
MIDI	Connects to musical instruments
Modem	Connects to transmission media, such as cable television lines or phone lines
Network	Provides network connections, such as to an Ethernet port
Sound	Connects to speakers or a microphone
TV tuner	Allows viewing of digital television broadcasts on a monitor
USB	Connects to high-speed USB ports
Video	Provides enhanced graphics capabilities, such as accelerated processing or the ability to connect a second monitor
Video capture	Connects to a video camera

介面卡類型

介面卡	用途
CableCARD	觀看數位有線電視頻道
磁碟控制器	連接磁碟機
FireWire	連接到 FireWire 裝置
HDTV 轉台器	在顯示器上觀看 HDTV 節目
MIDI	連接樂器
數據機	透過電話線、有線電視纜線或其他傳輸媒體連線到其他電腦
網路	連線到其他電腦和周邊裝置
PC 到電視轉換器	連接電視
音效	連接喇叭或麥克風
TV 轉台器	在顯示器上觀賞電視頻道
USB	連接到 USB 裝置
視訊	連接顯示器
影片擷取	連接類比攝影機或 VCR

Types of Adapter Cards

Adapter Card	Purpose
CableCARD	Allows viewing of digital cable television channels
Disk controller	Connects disk drives
FireWire	Connects to FireWire devices
HDTV tuner	Allows viewing of HDTV broadcasts on the monitor
MIDI	Connects musical instruments
Modem	Connects other computers through telephone lines, cable television lines, or other transmission media
Network	Connects other computers and peripherals
PC-to-TV converter	Connects a television
Sound	Connects speakers or a microphone
TV tuner	Allows viewing of television channels on the monitor
USB	Connects to USB devices
Video	Connects a monitor
Video capture	Connects an analog video camera or VCR

Display Devices
Networking
Audio
Input, output, and storage Devices

USB Adapters

- Adapters for mobile computers are in the form of a removable flash memory device.
- A **USB adapter** which is a dongle that **plugs into a USB port**, enhances functions of a mobile computer and/or provides connections to peripheral
- **USB adapters** can be used to add memory, communications, multimedia, security, and storage capabilities to mobile computers.

USB Adapters

- With **Plug and Play**, the computer automatically can configure adapter cards and other peripherals as you install them

  隨插即用

  功能是電腦可自動設定介面卡和其他你安裝的週邊裝置

- **Hot plugging熱插拔**
  - Allows your to insert and remove the removable flash memory and other devices while the computer is running.

Buses

- Electrical channel that transfers electronic bits internally within the circuitry of a computer, allowing the devices both inside and attached to the system unit to communicate with each other.

  匯流排 能讓主機內外各式各樣的裝置彼此通訊

- Just as vehicles travel on a highway, bits travel on a bus. Buses are used to
  - transfer bits from input devices to memory,
  - from memory to the processor,
  - from the processor to memory,
  - and from memory to output or storage devices.

Buses

- The **data bus** is used to transfer actual data資料匯流排
- The **address bus** is used to transfer information about where the data should reside in memory.位址匯流排

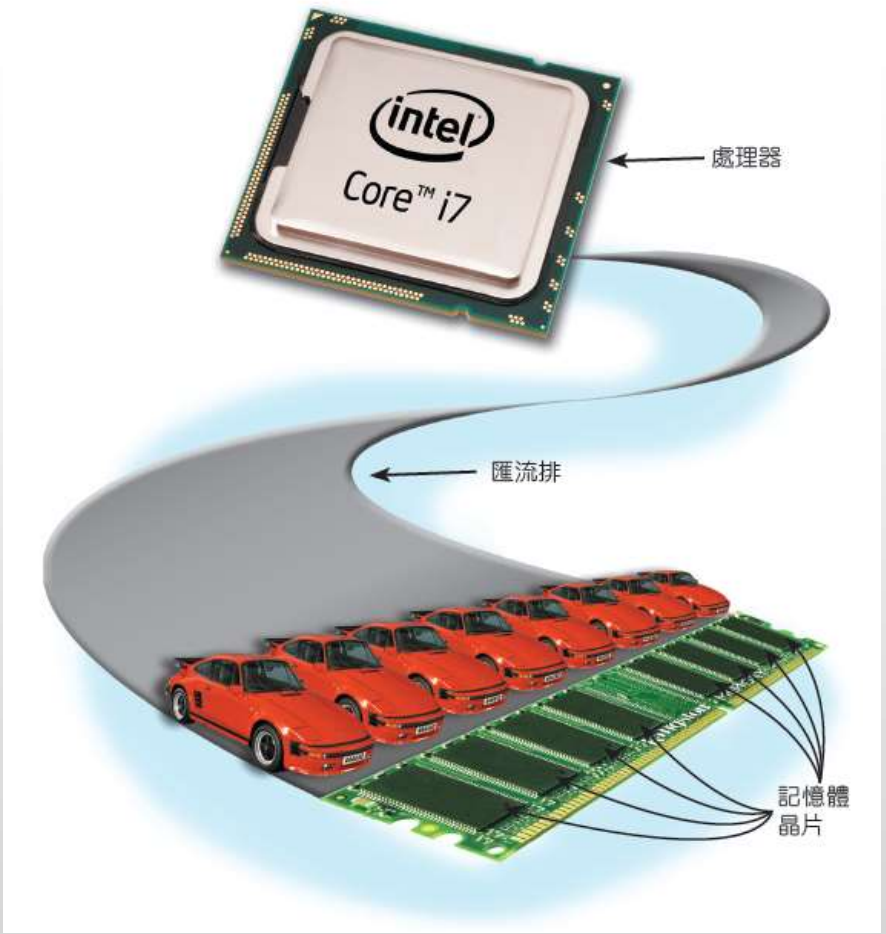
Bus Width匯流排寬度

- The size of a bus, called the **bus width**, determines the number of bits that the computer can transmit at one time.
  匯流排寬度是指匯流排可一次同時傳輸的資料數，以位元為單位，如32位元或64位元
  - On a 32-bit bus can transmit 32 bits (4 bytes) at a time.
  - on a 64-bit bus, bits transmit from one location to another 64 bits (8 bytes) at a time.
  - The larger the number of bits handled by the bus, the faster the computer transfers data.
  - Using the highway analogy again, assume that one lane on a highway can carry one bit. A 32-bit bus is like a 32-lane highway. A 64-bit bus is like a 64-lane highway.

Buses

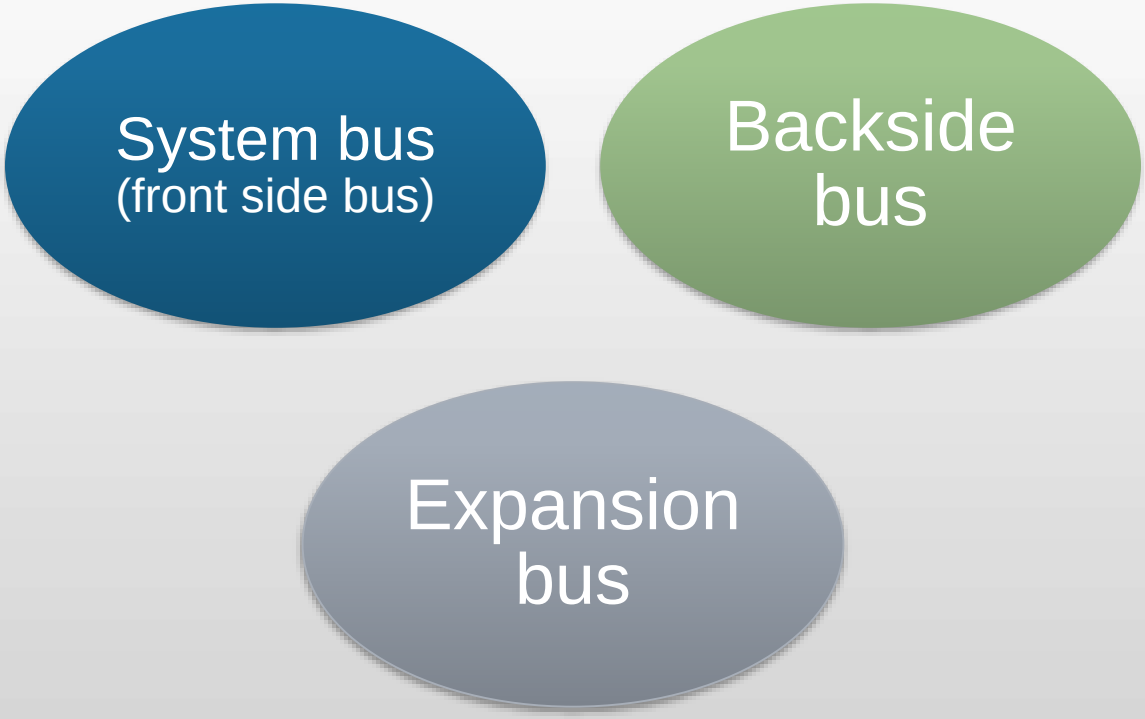
- **Word size** is the number of bits the processor can interpret and execute at a given time

  字組大小 是指處理器一次同時能解譯和執行的位元數目



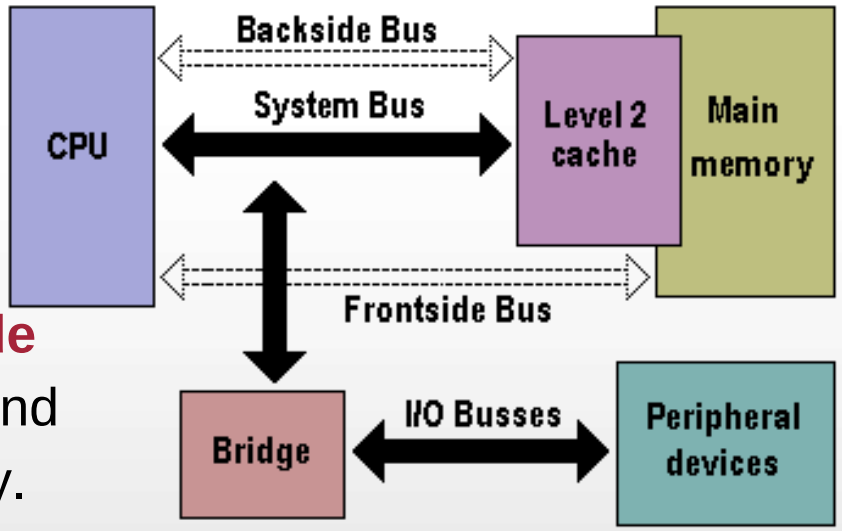
Types of Buses

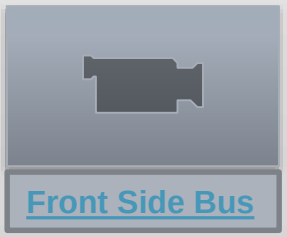
- A computer might have these three types of buses
  - a system bus, possibly a backside bus, and an expansion bus.



Buses

- Every bus also has a clock speed.
- A computer has these basic types of buses
  - A **system bus**, also called the **front side bus(FBS),** is part of the motherboard and connects the processor to main memory.
  - A **backside bus(BSB)** connects the processor to cache.
  - An **expansion bus** allows the processor to communicate with peripherals.





How is Bus Speed Measured?

- Every bus also has a clock speed. Just like the processor, manufacturers state the clock speed for a bus in **hertz**.
- The higher the bus clock speed, the faster the transmission of data, which results in programs running faster.

Power Supply and Battery

The power supply or laptop AC adapter converts the wall outlet AC power into DC power
電源供應器負責把牆上插座的交流電轉換成直流電

Mobile computers and devices can run using either a power supply or batteries

Batteries typically are rechargeable lithium-ion batteries

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Figure 6-19 6-20

電腦的基本單位

- 電腦的儲存容量

表 2.1 電腦的儲存容量

單位	簡寫	準確值	近似值
千位元組 (kilobyte)	KB	2^{10}Bytes = 1,024Bytes	10^{3}Bytes
百萬位元組 (megabyte)	MB	2^{20}Bytes = 1,048,576Bytes	10^{6}Bytes
十億位元組 (gigabyte)	GB	2^{30}Bytes = 1,024MB = 1,073,741,824Bytes	10^{9}Bytes
兆位元組 (terabyte)	TB	2^{40}Bytes = 1,024GB = 1,099,511,627,776Bytes	10^{12}Bytes
千兆位元組 (petabyte)	PB	2^{50}Bytes = 1,024TB = 1,125,899,906,842,624Bytes	10^{15}Bytes
百京位元組 (exabyte)	EB	2^{60}Bytes = 1,024PB = 1,152,921,504,606,846,976Bytes	10^{18}Bytes

- 資料的傳輸速率
  - bps (bits per second) 每秒傳輸多少位元
  - Kbps (kilobits per second) 2^{10}
  - Mbps (Megabits per second) 2^{20}
  - Gbps (gigabits per second) 2^{30}

數字系統

- 電腦使用 0 與 1 組成的二進位系統 (binary system)
- 八進位系統 (octal system)
- 十六進位系統 (hexadecimal system)

表 2.2 二、八、十、十六進位對照表

十進位	二進位	八進位	十六進位	十進位	二進位	八進位	十六進位
0	0000	0	0	16	10000	20	10
1	0001	1	1	17	10001	21	11
2	0010	2	2	18	10010	22	12
3	0011	3	3	19	10011	23	13
4	0100	4	4	20	10100	24	14
5	0101	5	5	21	10101	25	15
6	0110	6	6	22	10110	26	16
7	0111	7	7	23	10111	27	17
8	1000	10	8	24	11000	30	18
9	1001	11	9	25	11001	31	19
10	1010	12	A	26	11010	32	1A
11	1011	13	B	27	11011	33	1B
12	1100	14	C	28	11100	34	1C
13	1101	15	D	29	11101	35	1D
14	1110	16	E	30	11110	36	1E
15	1111	17	F	31	11111	37	1F

Video

- How the Intel Processor is Made
- From sand to chip - How a CPU is made (AMD)
- Clockspeed
- Front Side Bus
- L2 Cache
- Dual Core