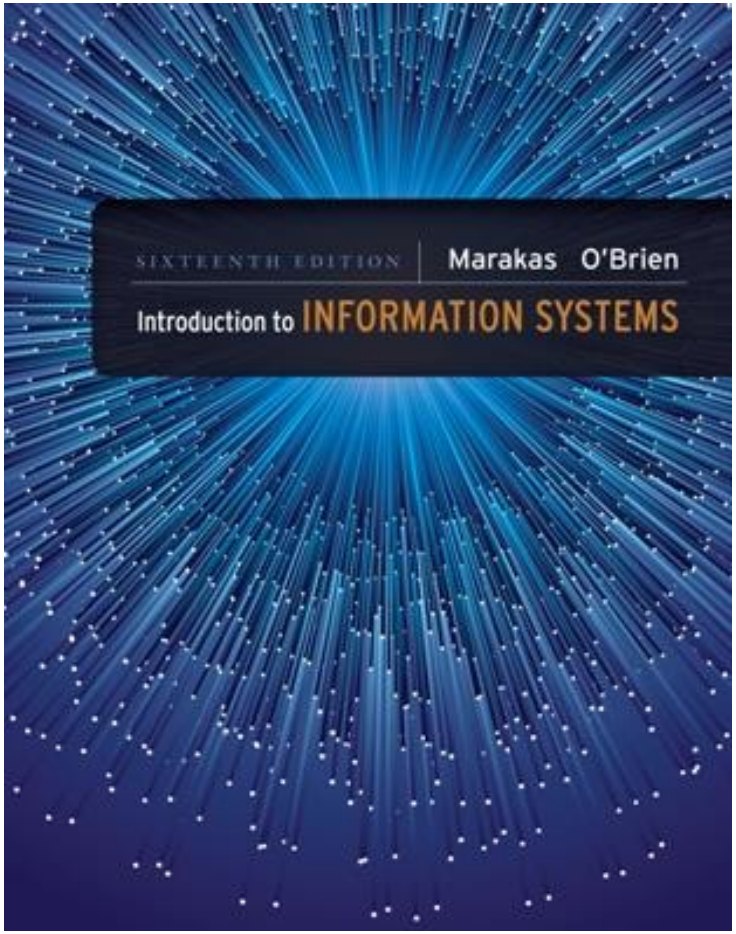
Chapter 3

Computer Hardware



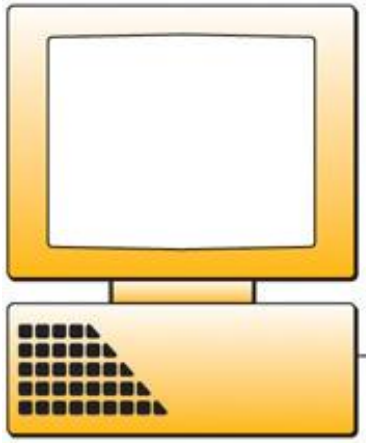
授課老師：台大工管系 楊立偉

Section 1

Computer Systems: End User and Enterprise Computing

Types of Computer Systems

- **Computers come in a variety of sizes, shapes, and computing capabilities**

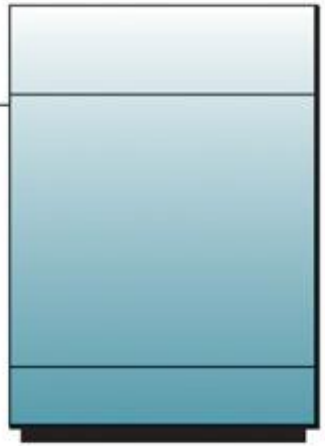


■ **Microcomputer Systems**
Personal computers, network computers, technical workstations, personal digital assistants, information appliances, etc.

微電腦

■ **Midrange Systems**
Network servers, minicomputers, Web servers, multiuser systems, etc.

中型電腦



■ **Mainframe Systems**
Enterprise systems, superservers, transaction processors, supercomputers, etc.

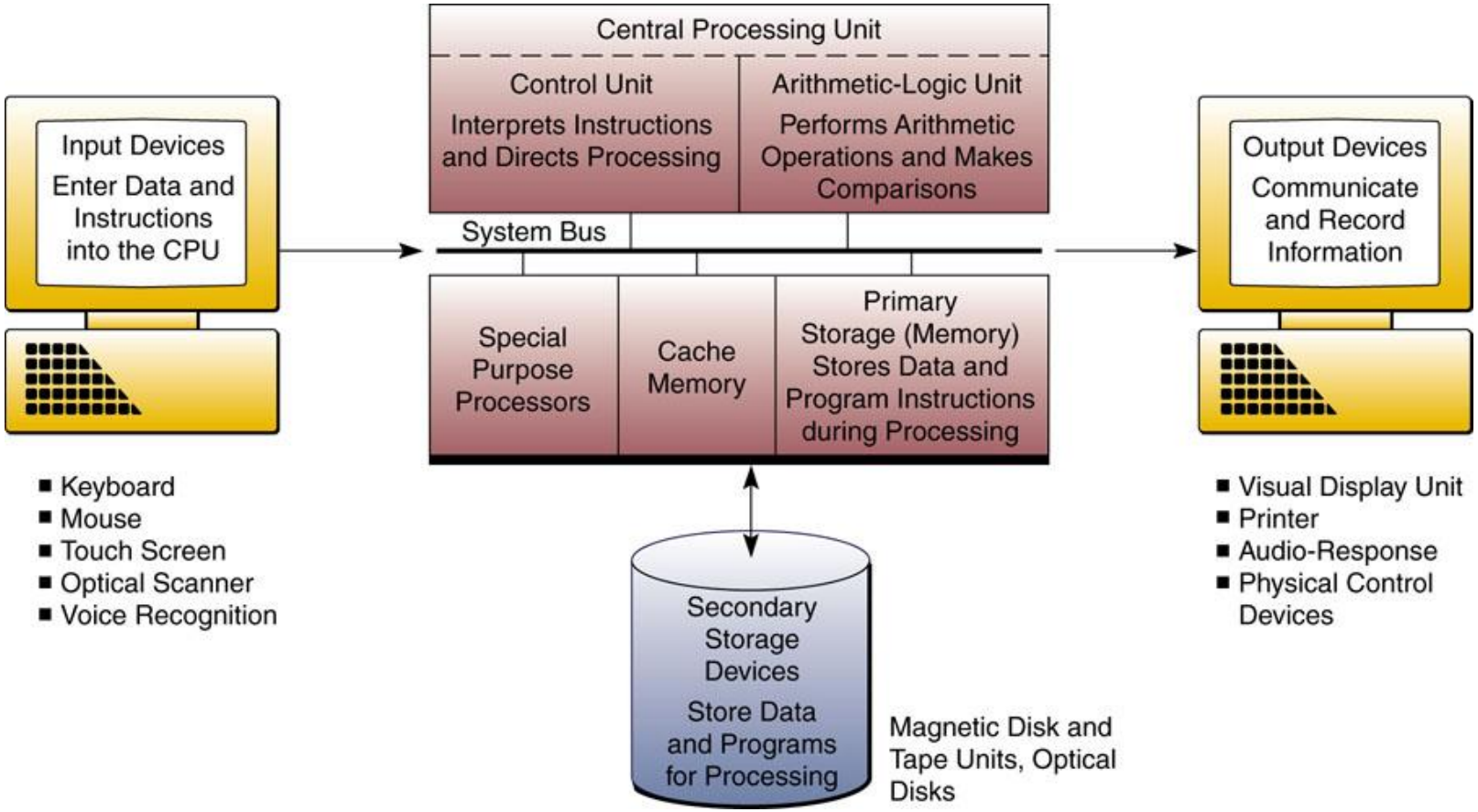
大型主機

Corporate PC Criteria

- Why laptops instead of desktops?
  - Why tablet instead of laptops?
- Why would a change in OS be disruptive?
- What are the strengths vs. risks of cabled vs. wireless PCs?

FIGURE 3.7
Midrange computer systems can handle large-scale processing without the high cost or space considerations of a large-scale mainframe.

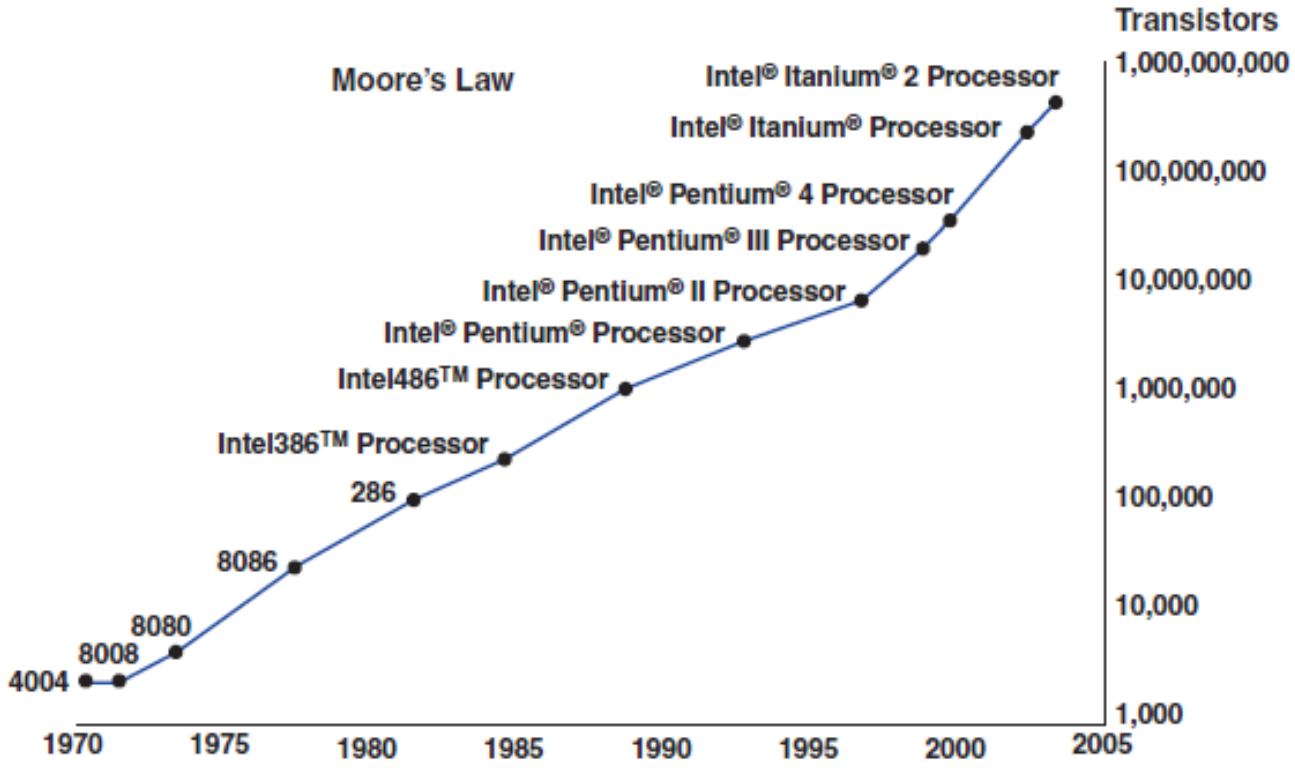
VI. Technical Note: The Computer System Concept



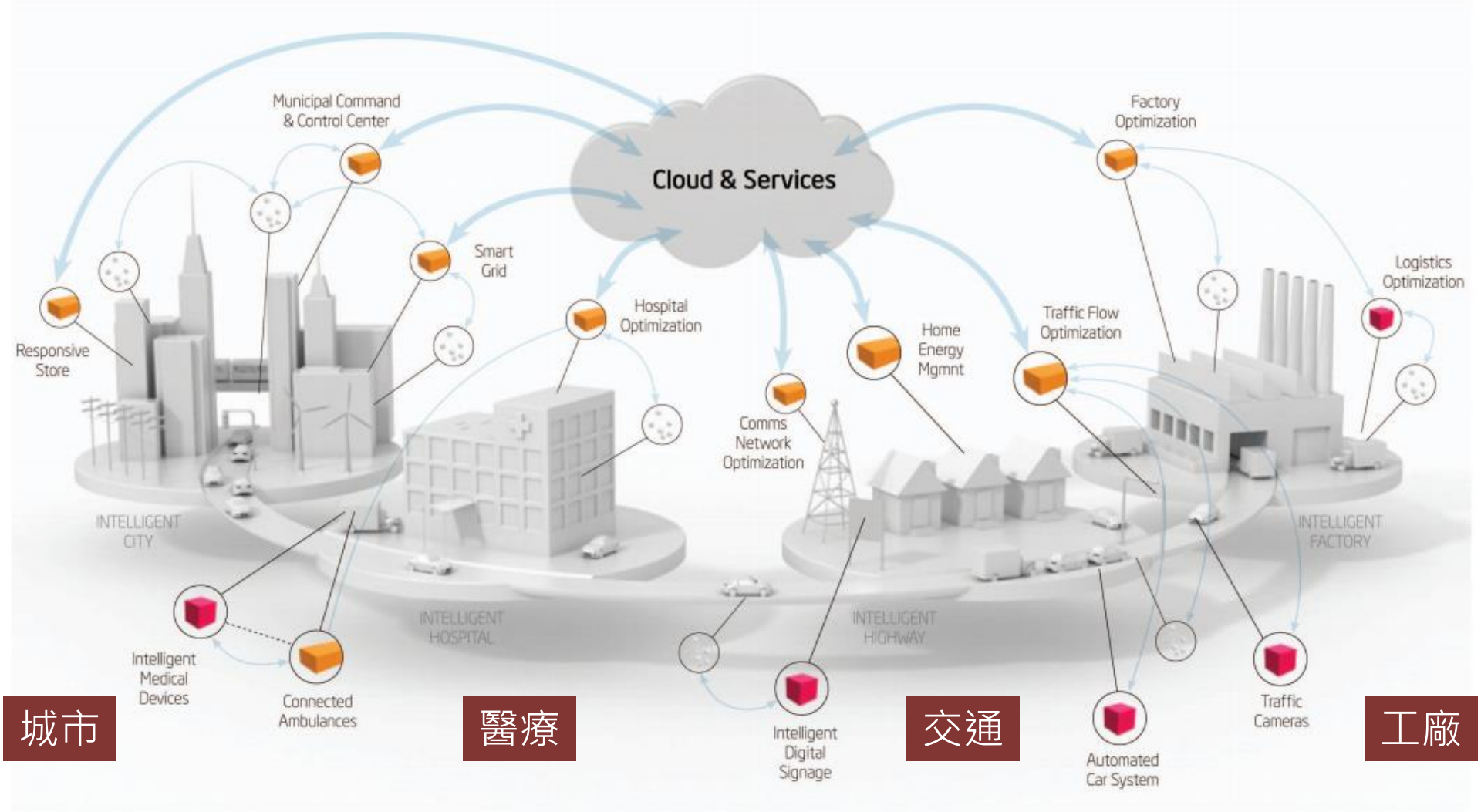
- **The Next Wave of Computing – minisupercomputers; connecting all the power of unused desktops in an organization**
  - **Distributed (Grid) Computing – parallel computing over a network**
    - **Advantages – purchase nodes as a commodity, economies of scale**
    - **Disadvantages – untrustworthy calculations, lack of centralized control**
  - **Internet of Things (IoT)**

- **Moore's Law 1965 – the number of transistors on a chip will double every 18-24 months; more broadly interpreted – the power or speed of a computer will double every 18-24 months**
  - **The Price would halve in that same time, which has also proven to be true**
  - **Recent statistics indicate this time has decreased to 12 months**

FIGURE 3.12
Moore's law suggests that computer power will double every 18 to 24 months. So far, it has.



雲端運算 與 物聯網 應用情境



Source : Internet of Things Also a Security Threat by Anthony Myers

Section 2

Computer Peripherals: Input, Output, and Storage Technologies

I. Peripherals

Peripheral - a generic name for all input, output, and secondary storage devices not part of the CPU but part of the system

- **Online – electronically connected to and controlled by the CPU**
- **Offline – separate from and not controlled by the CPU**

II. Input technologies

- Source Document – the original record of the data, very important for auditing purposes; now accepted in both electronic or physical form
- Graphical User Interface (GUI) – presents icons, buttons, windows, etc. for use with Pointing Devices (as opposed to a text-based interface)

II. Input technologies

- Input Devices – keyboards, mice, light pens, trackballs, touch screens
- Speech Recognition Systems – understands spoken commands/words
  - Discrete Speech Recognition – speak each word separately
  - Continuous Speech Recognition – recognizes conversationally-paced speech
  - Speaker-Independent Voice Recognition – understands speech from a voice it has never heard before

II. Input technologies

- Optical Scanning – converts text or graphics to digital input for direct entry of source documents
  - Bar code, QR code, to 3D Scan
- Other Input Technologies
  - Magnetic Stripe – on credit cards
  - Smart Cards – contain an embedded chip
  - Digital Cameras
  - Magnetic Ink Character Recognition (MICR) – used in banking industry (i.e. Machine-readable)
  - Radio-frequency Identification (RFID)

Gati Limited: Real-Time Delivery with Handheld Technology

- **What is a POD? Why is it important?**
  - **proof-of-delivery (POD) documents are in essence the only binding evidence that products were delivered safe, sound, and on time**
- **How long did it take to return a POD?**
- **Why and How does this help online tracking?**
- **How long did ROI take?**
  - **"Whether return on investment (ROI) drives more technology decisions than total cost of ownership(TCO) shows how your company views IT."**

Forget the ATM: Deposit Checks Without Leaving Home

- **What does federal Check 21 Act allow?**
  - **The Check Clearing for the 21st Century Act (or Check 21 Act) in 2003 allows the recipient of the original paper check to create a digital version of the original check, thereby eliminating the need for further handling of the physical document**
- **What is the concern of consumers remotely depositing checks?**
- **What basic security is provided?**
- **What limits/restrictions are placed on the consumers?**

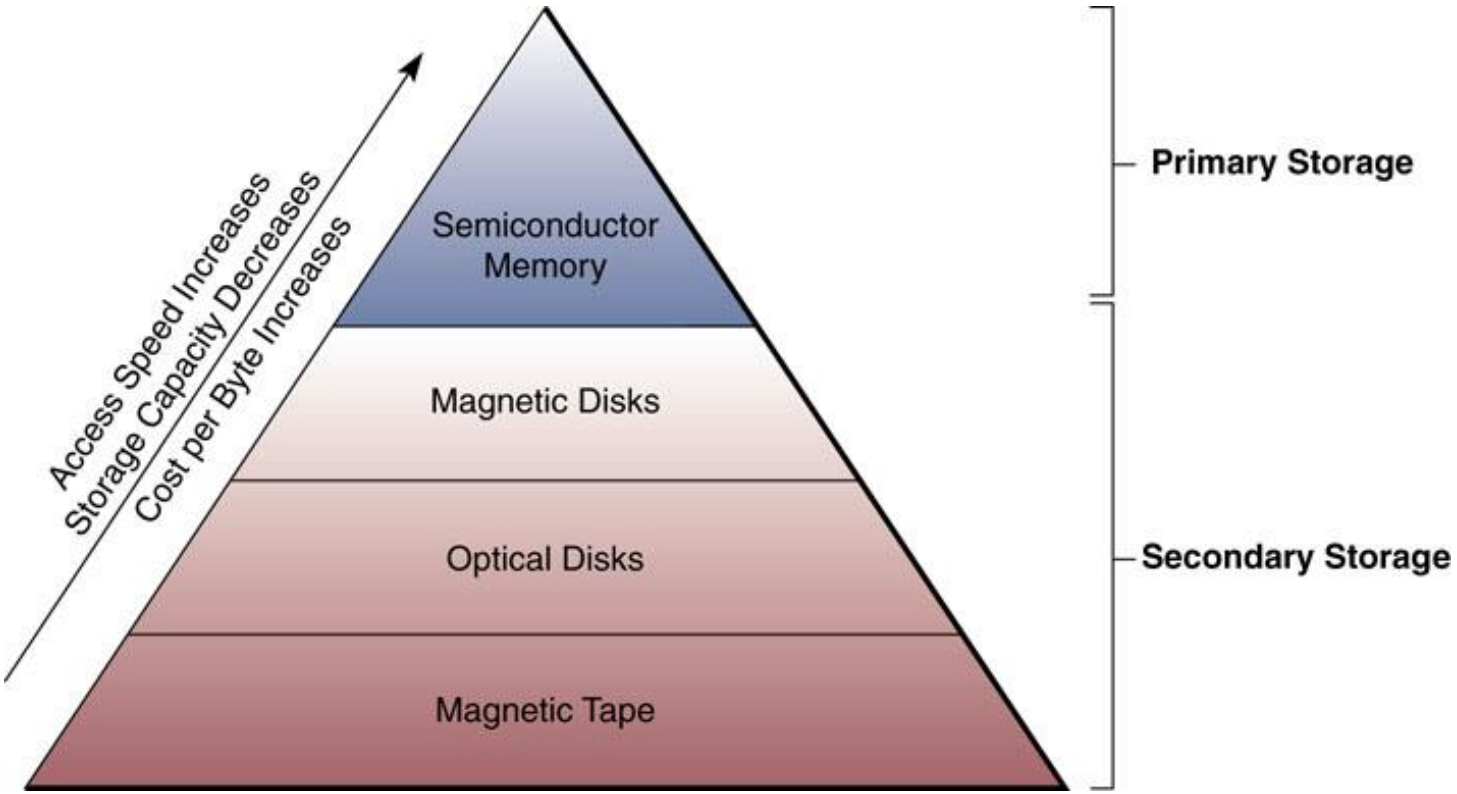
III. Output Technologies

- Most popular are video and printed output
  - Video Output – most popular form of output
  - Printed Output (Hardcopy) – most popular after video; still required for some legal purposes

IV. Storage Tradeoffs

- Tradeoffs are Cost vs. speed vs. capacity, but all regularly increase in speed, cost and capacity
  - Primary Storage (Random Access Memory or RAM) – Semiconductor memory, Volatile; faster but more expensive
  - Secondary Storage – Magnetic Disks, Optical Disks, Magnetic Tape; Non-Volatile; slower but cheaper

IV. Storage Tradeoffs



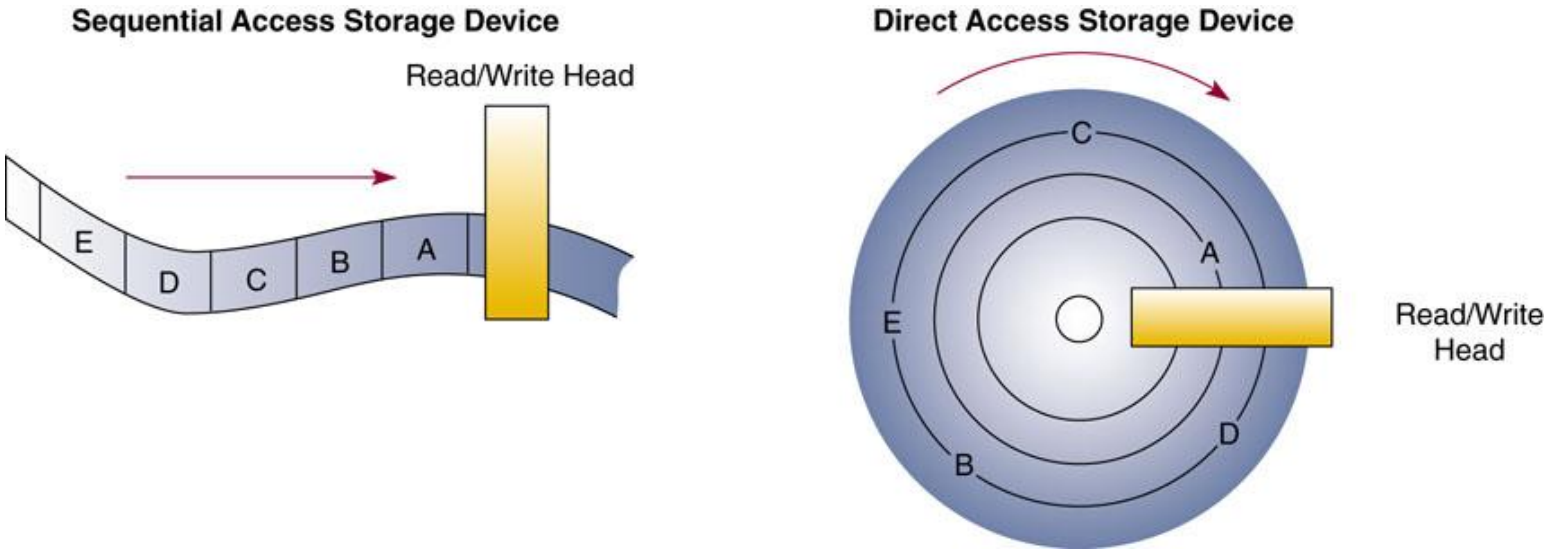
IV. Storage Tradeoffs

- **Computer Storage Fundamentals**
  - **Binary Representation – Two-state, on/off, +/-, 0/1**
  - **Bit – Binary digit, 0/1**
  - **Byte – Grouping of bits (typically 8 bits/byte), represents a single character**
  - **ASCII – formalized code determining what byte values represent which character**
  - **Storage capacities – kilobytes (KB), megabytes (MB), gigabytes (GB), terabytes (TB), petabytes (PB), Exabytes (EB), zettabytes (ZB), yottabytes (YB)**

IV. Storage Tradeoffs

- **Direct and Sequential Access**
  - **Direct Access – Random Access Memory (RAM) and Direct Access Storage Devices (DASD) – Direct Access and Random Access are the same concept; locate an address on the storage device and go directly to that location for access to the datum**
  - **Sequential Access – All tape devices are accessed serially – device must be read one record at a time from the first stored datum until the desired datum is located**

IV. Storage Tradeoffs



V. Semiconductor Memory

- ROM (Read Only Memory) – non-volatile, may be read but not over-written or erased; PROM and EPROM may be reprogrammed
- RAM (Random Access Memory) – volatile, may be read and over-written
- Flash (Jump) Drives – solid-state memory
- Solid-State Drive (SSD) – transistor device created to be accessed like a hard drive; no moving parts, non-volatile, much faster access speed

VI. Magnetic Disks – the most common form of secondary storage

- **RAID Storage (Redundant Arrays of Independent Disks) – interconnected groups of hard drives, fast speeds, fault tolerant (redundant backups) through networks**
- **Network attached storage (NAS)** 網路儲存設備，有企業及家用，價格已普及
- **Storage area network (SAN)** 企業用的儲存網路，由多個儲存設備所組成的儲存網路，擴展性及容量更大，價格較高

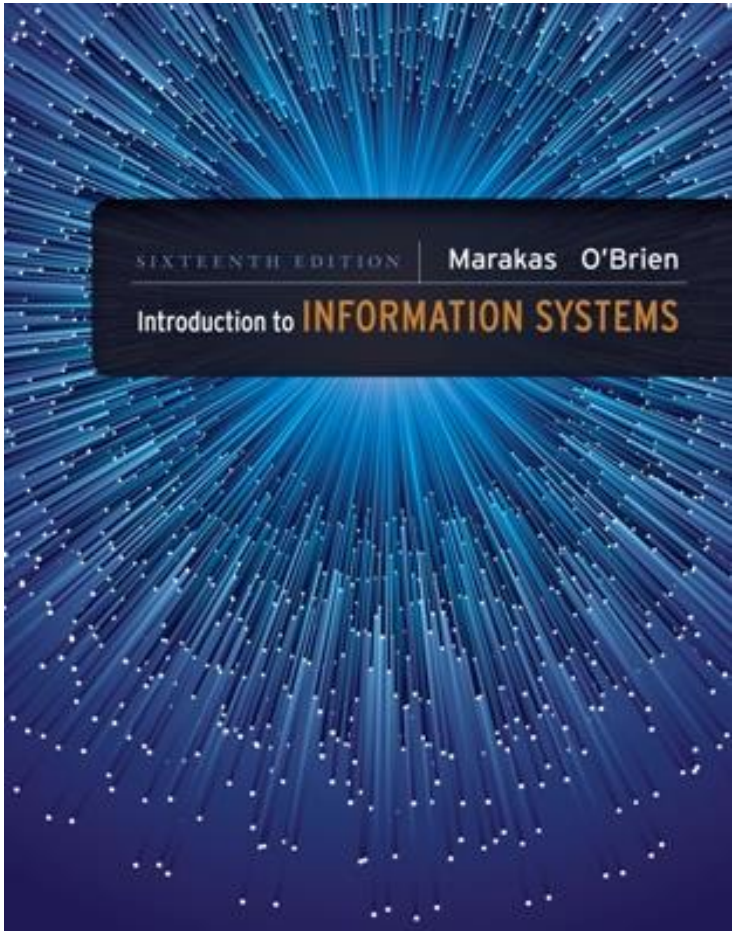
VII. Radio Frequency Identification (RFID)

RFID – for tagging and identifying mobile objects (store merchandise, postal objects, sometimes living organisms); provides information to a reader when requested

- **Passive – no power source, derives power from the reader signal**
- **Active – self-powered, do not need to be close to the reader**
- **RFID Privacy Issues – may be used as spychips; gathers sensitive information about an individual without consent**

Chapter 4

Computer Software



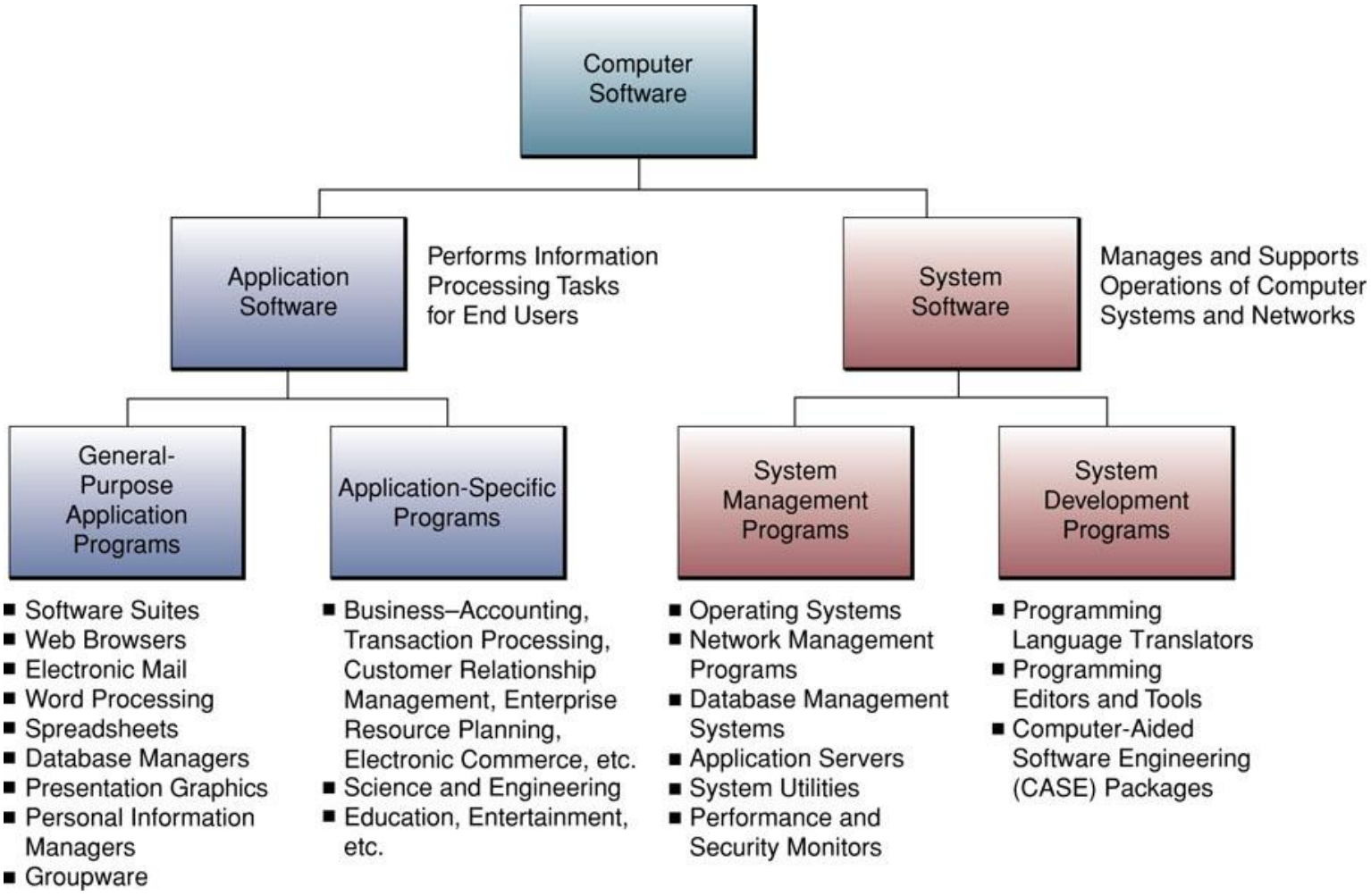
授課老師：台大工管系 楊立偉

Section 1
Application Software: End-user Applications

I. Introduction to Software

- What is Software? – software is programs – instructions that tell the computer and associated peripherals what to do
- Types of Software
  - System Software – programs that run the computer
  - Application Software – programs perform a function/job for you

I. Introduction to Software



II. Business Application Software

- Available to support any part of business
- Reengineer/Automate Business Processes
  - Customer Relationship management (CRM)
  - Enterprise Resource Planning (ERP)
  - Supply Chain Management (SCM)
- Internal Organizational Activities
  - Human Resource management (HRM)
  - Accounting
  - Finance
- Decision Support tools
  - Data Mining
  - Enterprise Information Portals
  - Knowledge Management Systems

FIGURE 4.3

The business applications in Oracle's E-Business Suite software illustrate some of the many types of business application software being used today.

III. Software Suites and Integrated Packages

- **Software Suites – bundle together a variety of general-purpose software applications (i.g. MS Office)**
  - **Advantages:**
    - **Lower cost than buying each package individually**
    - **All the programs use a common graphical user interface (GUI)**
    - **The programs are designed to work together**
  - **Disadvantages:**
    - **Many features are never used ; Suites take up a lot of disk space**
- **Integrated Packages – combine some but not all of the functions of several programs; offer advantages in a smaller package**
  - **Less powerful than software suites – leave out some functions**
  - **Take up less disk space and cost than software suites**

XI. Software Alternatives

- Custom Software – designed and created specifically to do a particular job for one company
- Commercial Off-the-Shelf Software – developed to sell many copies (usually for profit); source code may not be modified by user
- Open Source Software – anyone may modify the software, the documentation and source code are available to anyone
- Application Service Providers – provide necessary applications for a fee (rather than a firm developing or purchasing the software)
- Cloud Computing – a recent advance in computing and software delivery; software and virtualized hardware are provided as a service over the Internet (a.k.a Software as a Service, SaaS)

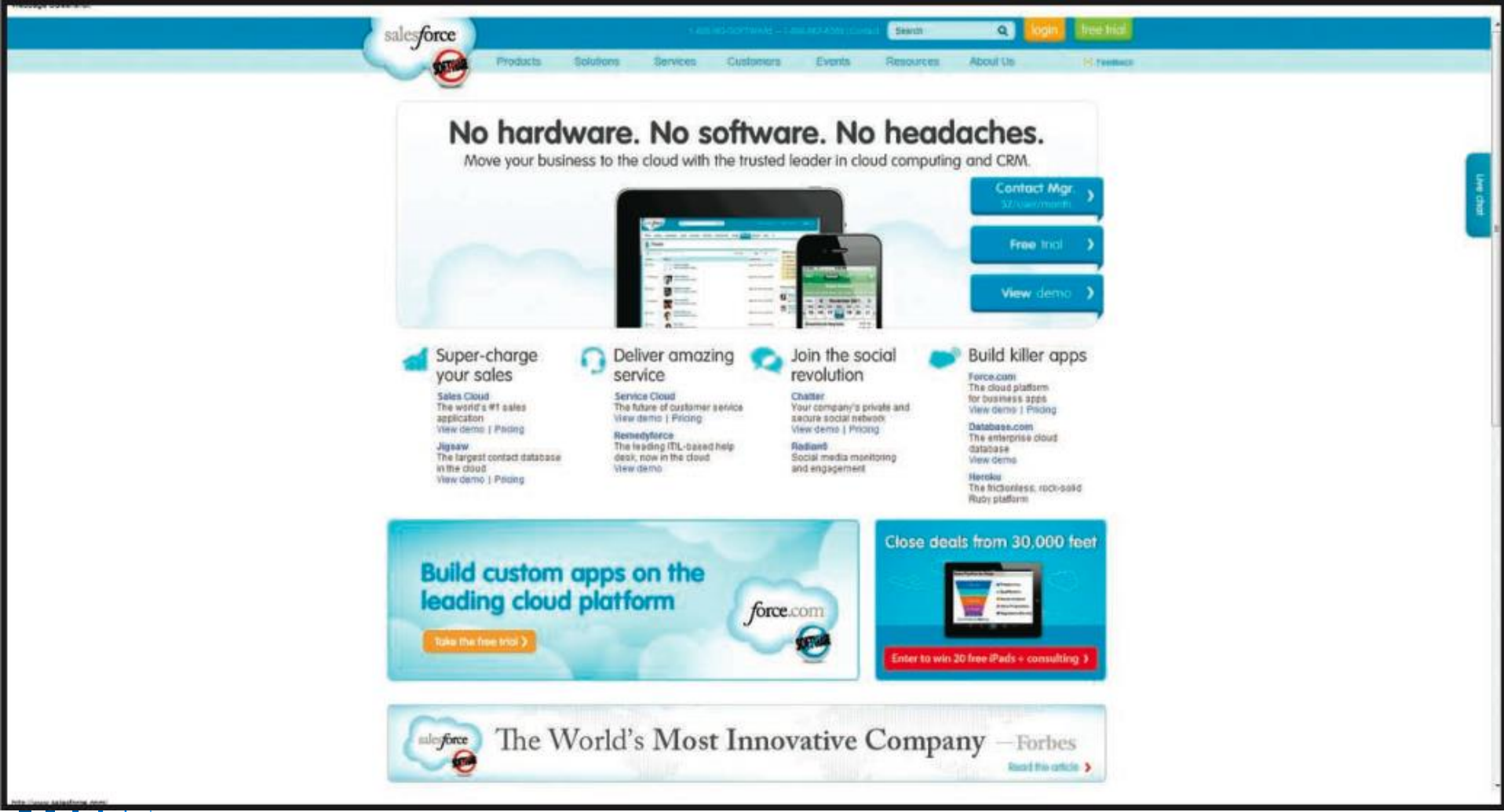
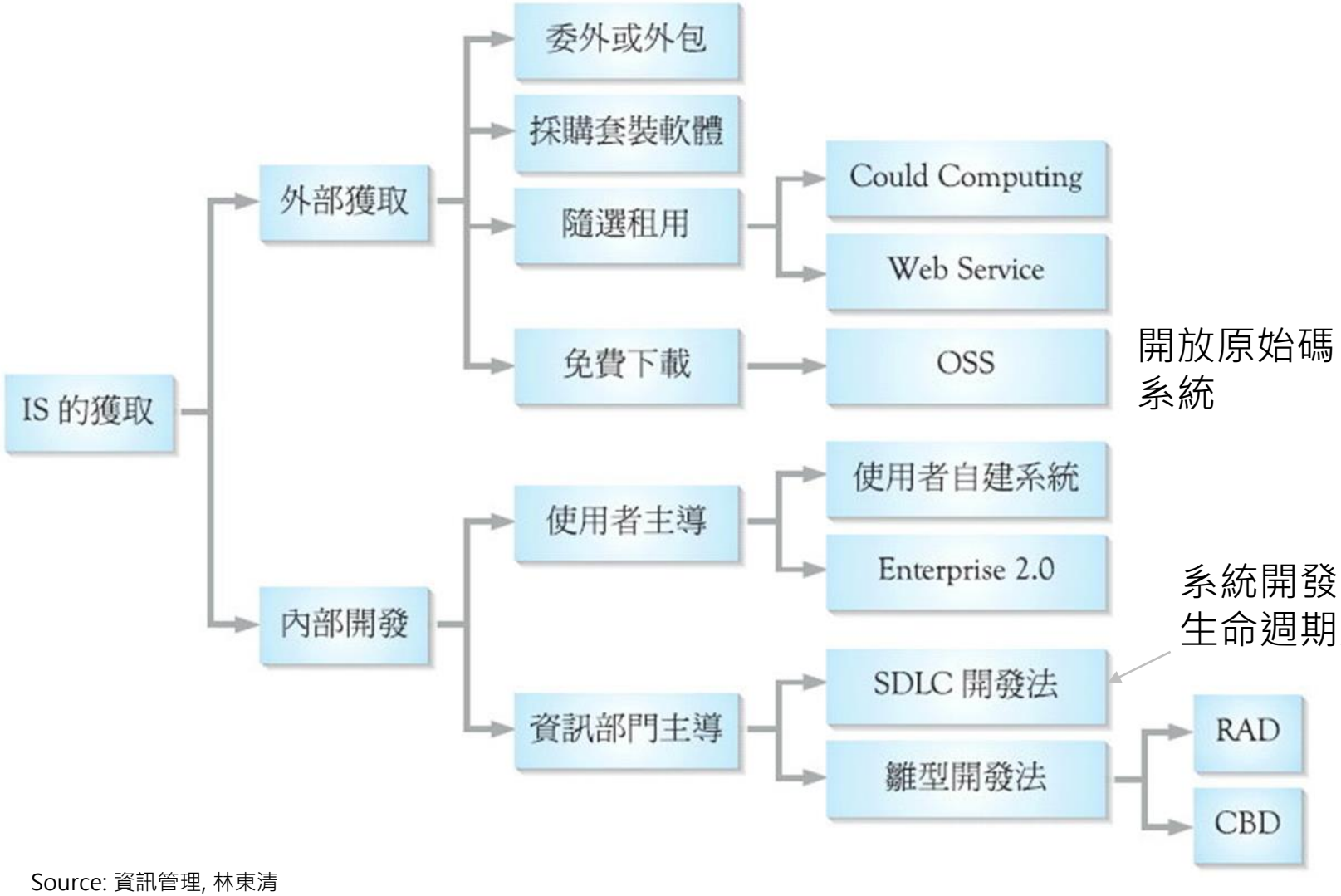


FIGURE 4.12
Salesforce.com is a leading application service provider of Web-based sales management and customer relationship management services to both large and small businesses.

McAfee Inc.: Security under a Software-as-a-Service Model

- **What SaaS does McAfee offer?**
- **What are the advantages of this service?**
- **How is different from other products on the market?**

主要獲取資訊系統的方法



Source: 資訊管理, 林東清

資訊系統委外 Outsourcing

- 部分或全部的資訊系統功能，以契約的方式委託外部的資訊系統供應商來發展、管理或提供
- 委外的優點

資源與能力	成本與風險方面
• 核心能力的專注 • 提升IS的品質 • 解決資源不足的問題	• 形成經濟規模 • 減低投資風險 • 產生節約意識 • 減少長期資本投資

Source: 資訊管理, 林東清

委外的關鍵成功因素

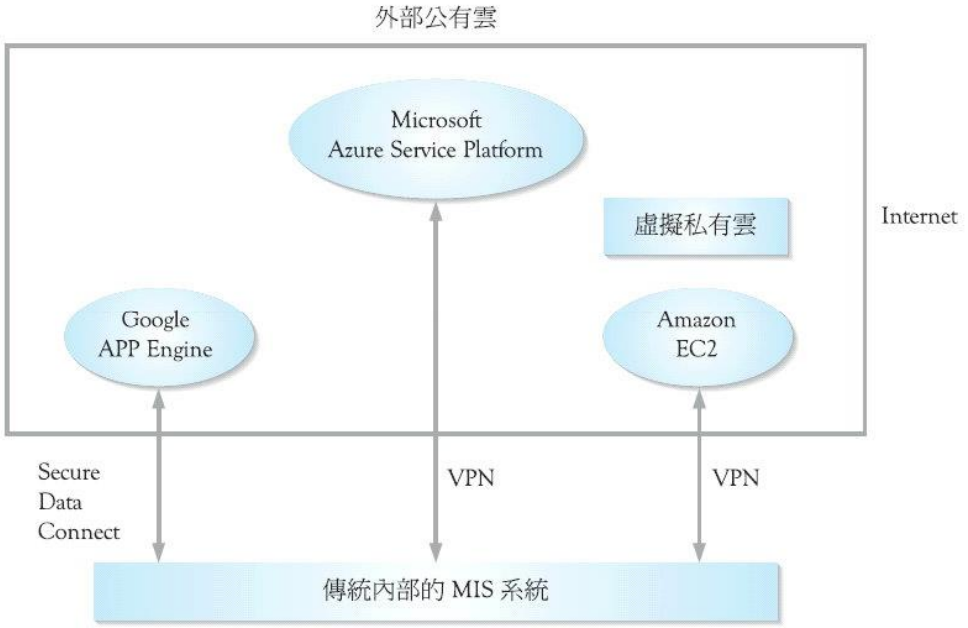
企業本身方面	• 企業內部相關人員的配合度與抗拒程度 • 委外專案管理的規劃與執行品質 • 企業對專案團隊的授權程度
供應商方面	• 供應商的支援能力及服務品質 • 供應商對委外承包商的瞭解程度
雙方合作方面	• 雙方的合作態度與溝通程度 • 合約的合理規範與執行 • 雙方合作的合夥關係與互信程度

委外承包商的選擇因素

口碑經驗方面	• 公司名譽與成功案例 • 現在與過去顧客的關係與口碑 • 保密、分擔風險的承諾
專業能力方面	• 具有產業專業知識的程度 • 產品技術具有彈性 • 具多種資訊科技架構處理的經驗 • 具有全球化支援的能力程度
經營體質方面	• 健全的財務、穩健經營 • 研發經費預算的高低
支援與服務方面	• 服務品質及對顧客意見的接受度 • 協商期間的彈性程度 • 協力廠商的陣容 • 與公司理念、文化、策略的相容程度

傳統的委外與雲端運算的比較

比較項目	傳統資訊委外服務	雲端運算
系統擁有與管理	自行擁有與管理	雲端供應商擁有與管理
軟體採購模式	一次買斷	租賃／隨選，彈性收費
服務配送方式	到府服務	線上服務
軟體應用模式	客製化	標準化、模組化
委外經營模式	一對一	一對多
價位	昂貴	大幅下降



亦可採用軟體及
雲端運算混合方案

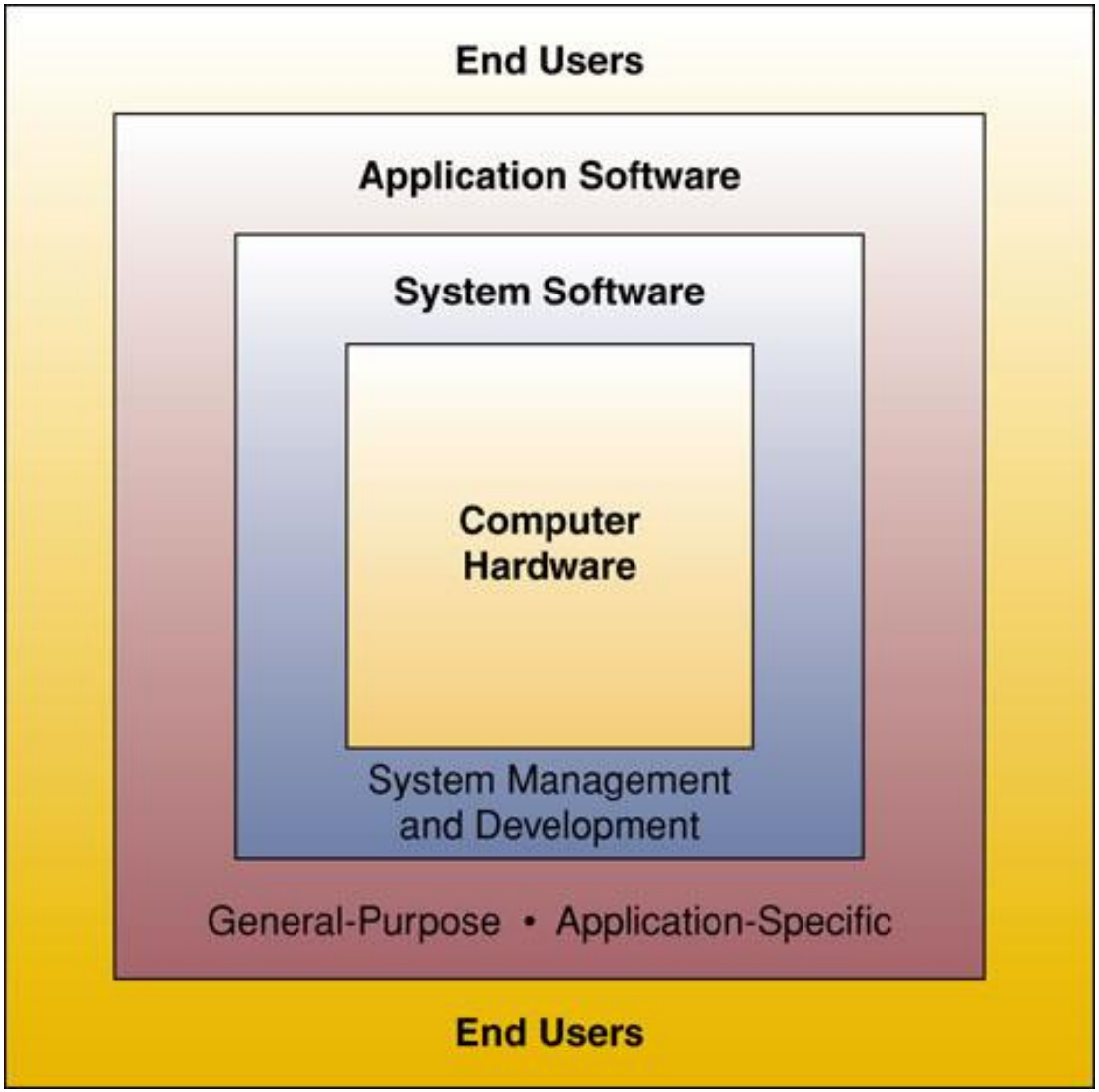
Section 2

System Software: Computer System Management

I. System Software Overview

- System Management Programs – programs that manage the hardware, software, network, and data resources
- System Development Programs – programs that help users develop IS programs and procedures; CASE tools

I. System Software Overview



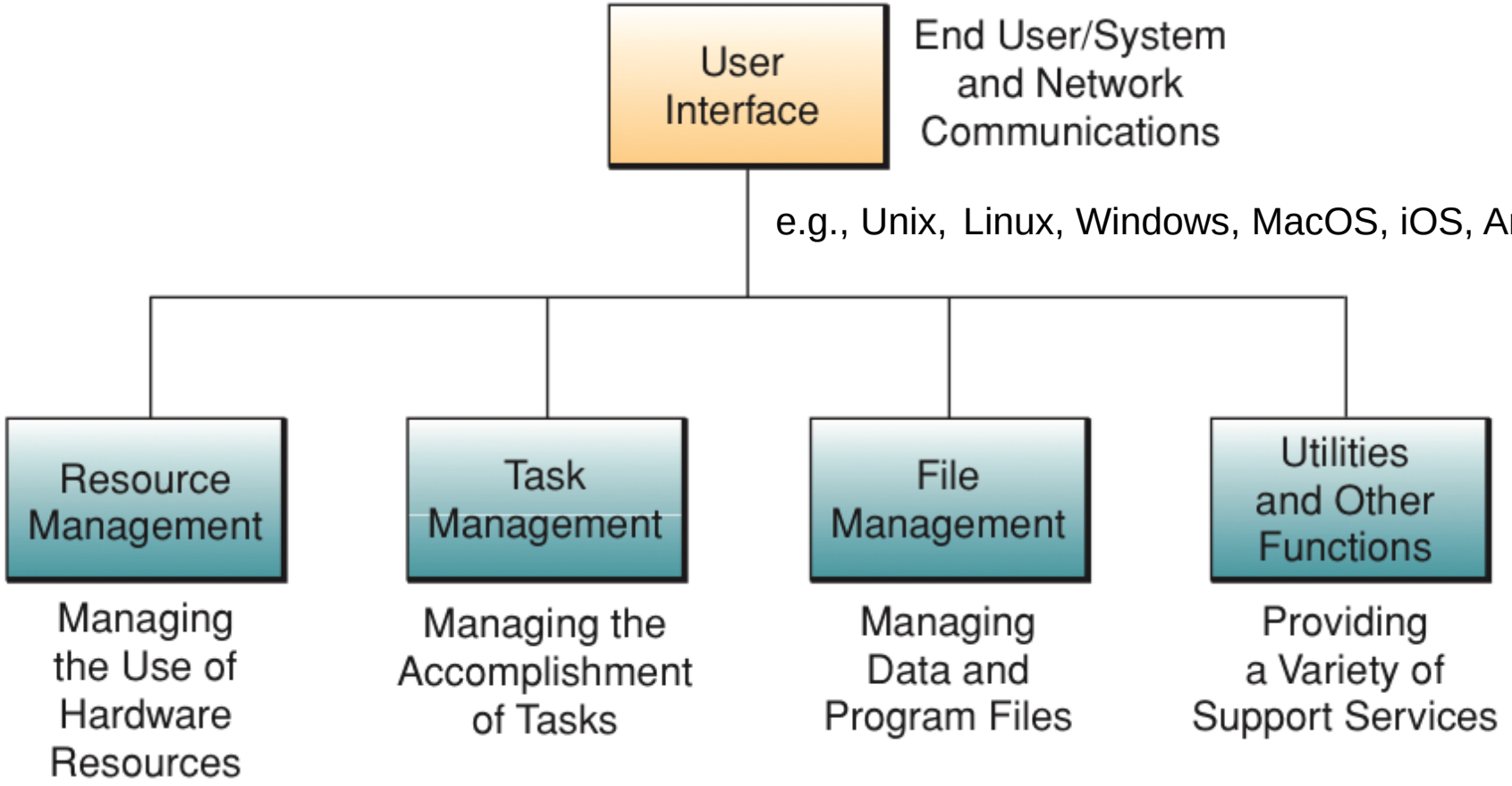


FIGURE 4.15
The basic functions of an operating system include a user interface, resource management, task management, file management, and utilities and other functions.

Software Category	What It Does	IBM Product	Customers	Main Competitor	Customers
Network management	Monitors networks to keep them up and running.	**Tivoli**	T. Rowe Price uses it to safeguard customer records.	**HP OpenView**	Amazon.com uses it to monitor its servers.
Application server	Shuttles data between business apps and the Web.	**WebSphere**	REI uses it to serve up its Web site and distribute data.	**BEA WebLogic**	Washingtonpost.com builds news pages with it.
Database manager	Provides digital storehouses for business data.	**DB2**	Mikasa uses it to help customers find its products online.	**Oracle 11g**	It runs Southwest Airlines' frequent-flyer program.
Collaboration tools	Powers everything from e-mail to electronic calendars.	**Lotus**	Retailer Sephora uses it to coordinate store maintenance.	**Microsoft Exchange**	Time Inc. uses it to provide e-mail to its employees.
Development tools	Allows programmers to craft software code quickly.	**Rational**	Merrill Lynch used it to build code for online trading.	**Microsoft Visual Studio .NET**	Used to develop management system.

FIGURE 4.17
Comparing system software offered by IBM and its main competitors.

Four Levels of Programming Languages

- **Machine Languages:**
  Use binary coded instructions
  1010 11001
  1011 11010
  1100 11011
- **High-Level Languages:**
  Use brief statements or arithmetic notations
  BASIC: X = Y + Z
  COBOL: COMPUTE X = Y + Z
- **Assembler Languages:**
  Use symbolic coded instructions
  LOD Y
  ADD Z
  STR X
- **Fourth-Generation Languages:**
  Use natural and nonprocedural statements
  SUM THE FOLLOWING NUMBERS

FIGURE 4.18
Examples of four levels of programming languages. These programming language instructions might be used to compute the sum of two numbers as expressed by the formula X 5 Y 1 Z.

IV. Programming Languages

- Fourth-Generation Languages (4GL) – non-procedural languages; users tell the computer What results they want, but the computer decides How to get there (Generator)
- Fifth Generation Languages (5GL) – natural languages, very close to English, conversational
- Object-Oriented Languages – combine the data elements and the programs that act on them into Objects; Reusability

Modern (and Automatic?) Code Generation

- **Why is automatic code generation important?**
- **Why would this be important for non-programmers?**

人人都該學程式設計
但不是人人未來都當程式設計師 (未來應該會減少)

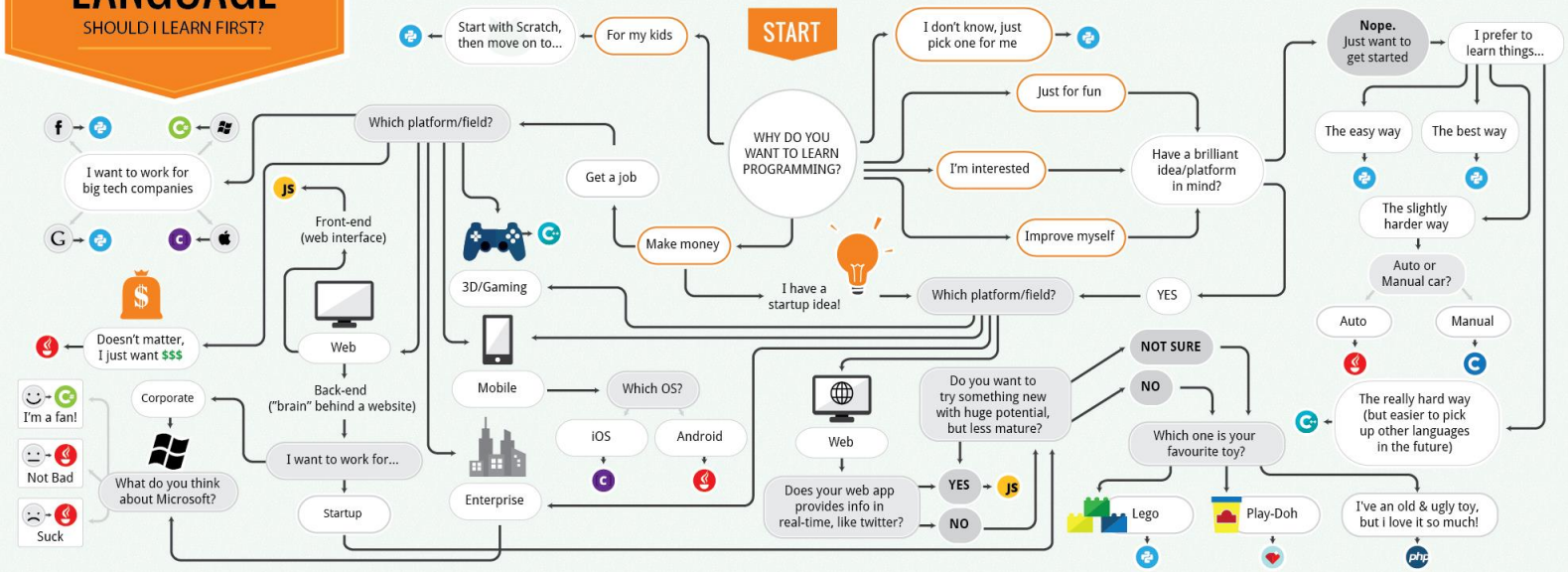
WHICH PROGRAMMING LANGUAGE SHOULD I LEARN FIRST?

WHAT IS PROGRAMMING?

Writing very specific instructions to a very dumb, yet obedient machine.

LANGUAGES

PYTHON · JAVA · C · PHP · C++ · JAVASCRIPT · C# · RUBY · OBJECTIVE-C



THE LORD OF THE RINGS ANALOGY TO PROGRAMMING LANGUAGES

Python
The Ent

DIFFICULTY

Help little Hobbits (beginners) to understand programming concepts

Help Wizards (computer scientists) to conduct researches

Widely regarded as the best programming language for beginners

Easiest to learn

Widely used in scientific, technical & academic field, i.e. Artificial Intelligence

You can build website using Django, a popular Python web framework

POPULARITY

USED TO BUILD
YouTube, Instagram, Spotify

AVG. SALARY
$107,000

Java
Gandalf

DIFFICULTY

Wants peace & works with everyone (portable)

Very popular on all platforms, OS, and devices due to its portability

One of the most in demand & highest paying programming languages

Slogan: write once, work everywhere

POPULARITY

USED TO BUILD
Gmail, Minecraft, Most Android Apps, Enterprise applications

AVG. SALARY
$102,000

C
One Ring

DIFFICULTY

The power of C is known to them all

Everyone wants to get its Power

Lingua franca of programming language

One of the oldest and most widely used language in the world

Popular language for system and hardware programming

A subset of C++ except the little details

POPULARITY

USED TO BUILD
Operating systems and hardware

AVG. SALARY
$102,000

C++
Saruman

DIFFICULTY

Everyone thinks that he is the good guy

But once you get to know him, you will realize he wants the power, not good deeds

Complex version of C with a lot more features

Widely used for developing games, industrial and performance-critical applications

Learning C++ is like learning how to manufacture, assemble, and drive a car

Recommended only if you have a mentor to guide you

POPULARITY

USED TO BUILD
Operating systems, hardware, and browsers

AVG. SALARY
$104,000

JavaScript
Hobbit

DIFFICULTY

Frequently underestimated (powerful)

Well-known for the slow, gentle life of the Shire (web browsers)

"Java and Javascript are similar like Car and Carpet are similar" - Greg Hewgill

Most popular clients-side web scripting language

A must learn for front-end web developer (HTML and CSS as well)

One of the hottest programming language now, due to its increasing popularity as server-side language (node.js)

POPULARITY

USED TO BUILD
Paypal, front-end of majority websites

AVG. SALARY
$99,000

C#
Elf

DIFFICULTY

Beautiful creature (language), but stays in their land, Rivendell (Microsoft Platform)

A popular choice for enterprise to create websites and Windows application using .NET framework

Can be used to build website with ASP.NET, a web framework from Microsoft

Similar to Java in basic syntax and some features

Learn C# instead of Java if you are targeting to work on Windows platform only

POPULARITY

USED TO BUILD
Enterprise and Windows applications

AVG. SALARY
$94,000

Ruby
Man (Middle Earth)

DIFFICULTY

Very emotional creature

They (some Ruby developers) feel they are superior & need to rule the Middle Earth

Mostly known for its popular web framework, Ruby on Rails

Focuses on getting things done

Designed for fun and productive coding

Best for fun and personal projects, startups, and rapid development

POPULARITY

USED TO BUILD
Hulu, Groupon, Slideshare

AVG. SALARY
$107,000

PHP
Orc

DIFFICULTY

Ugly guy (language) and doesn't respect the rules (inconsistent and unpredictable)

Big headache to those (developers) to manage them (codes)

Yet still dominates the Middle-earth (most popular web scripting language)

Suitable for building small and simple sites within a short time frame

Supported by almost every web hosting services with lower price

POPULARITY

USED TO BUILD
Wordpress, Wikipedia, Flickr

AVG. SALARY
$89,000

Objective-C
Smaug

DIFFICULTY

Lonely and loves gold

Primary language used by Apple for Mac OS X & iOS

Choose this if you want to focus on developing iOS or OS X apps only

Consider to learn Swift (newly introduced by Apple in 2014) as your next language

POPULARITY

USED TO BUILD
Most iOS Apps and part of Mac OS X

AVG. SALARY
$107,000

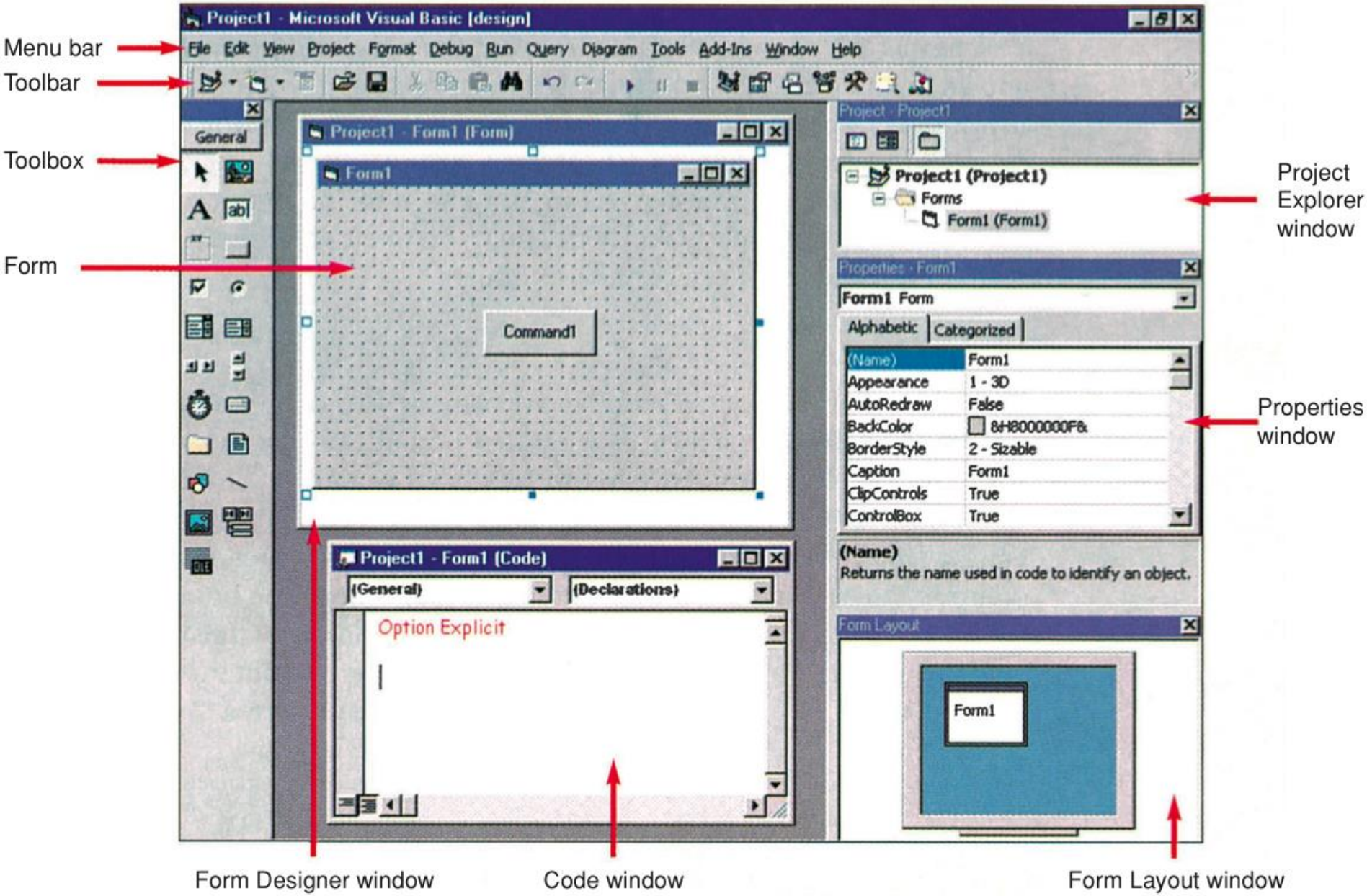


FIGURE 4.20

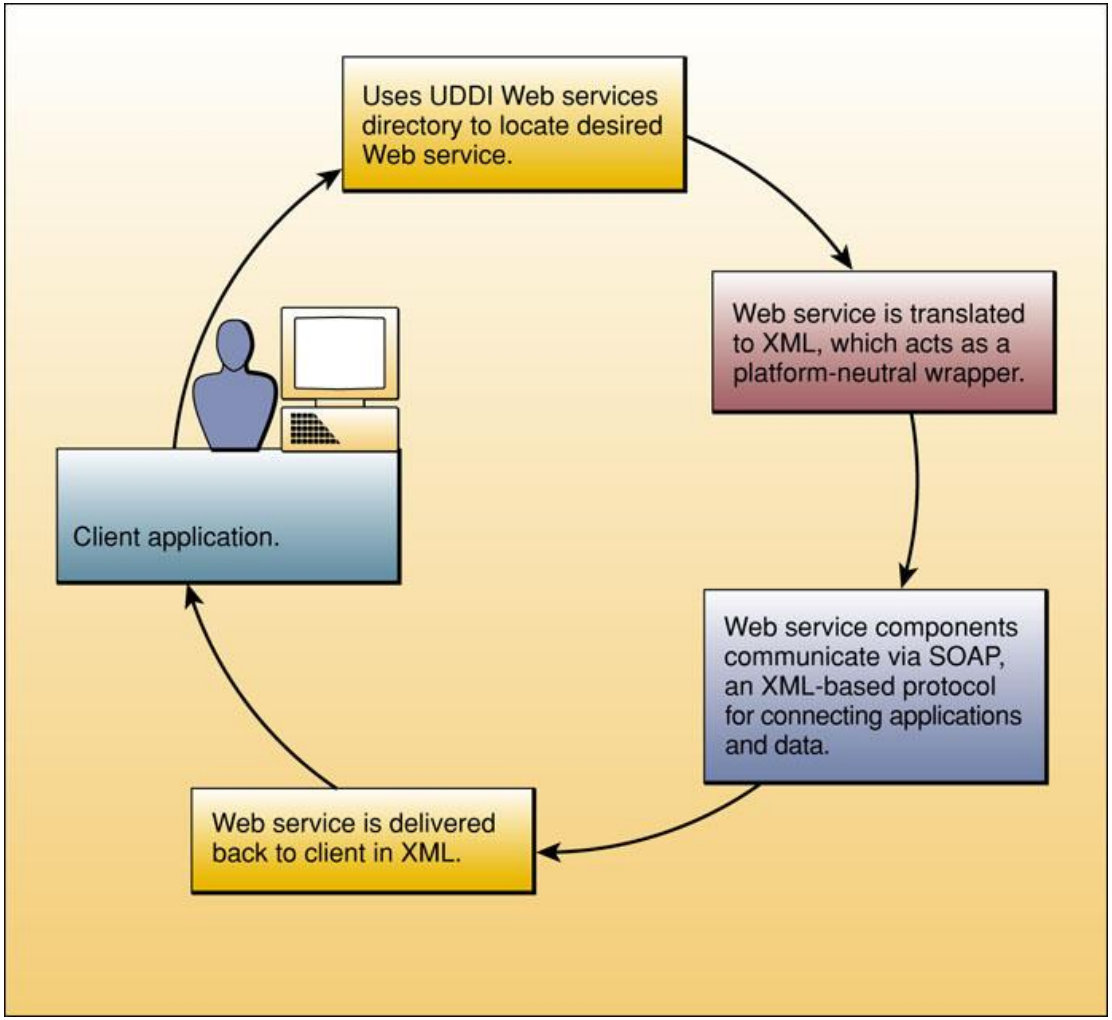
The Visual Basic object-oriented programming environment.

MIT Scratch project : Programming for Junior

V. Web and Internet Languages and Services

- Java and .NET
  - Java – a platform independent, object-oriented programming language; very powerful
  - Applets – small Java programs that can be executed by any computer running any OS anywhere on the network
  - .NET – Microsoft's collection of programming support for Web services
- Web Services – software that electronically links applications of different users and different platforms

V. Web and Internet Languages and Services



Airbus: Flying on SAP and Web Services

- Why does Airbus like an open architecture?
- Why did Airbus want a Web-services based travel management system?
- What benefits does this system provide?
  - see also : 全球機票訂位系統
    - Abacus, Amadeus, Galileo, etc.

VI. Programming Software

- Language Translator Programs – instructions must be translated into binary to be executed by the computer
  - Assembler – translates symbolic instructions written in assembly language
  - Compiler – translates high level language statements; translates the entire program (Source code) into binary (Object code) then executes the entire binary program
  - Interpreter – translates and executes one line of the program at a time
- Programming Tools – help programmers identify and minimize errors as they write the code
  - CASE Tools (Computer-Aided Software Engineering) – automated software support tools for developing systems
  - IDE (Integrated Development Environment)