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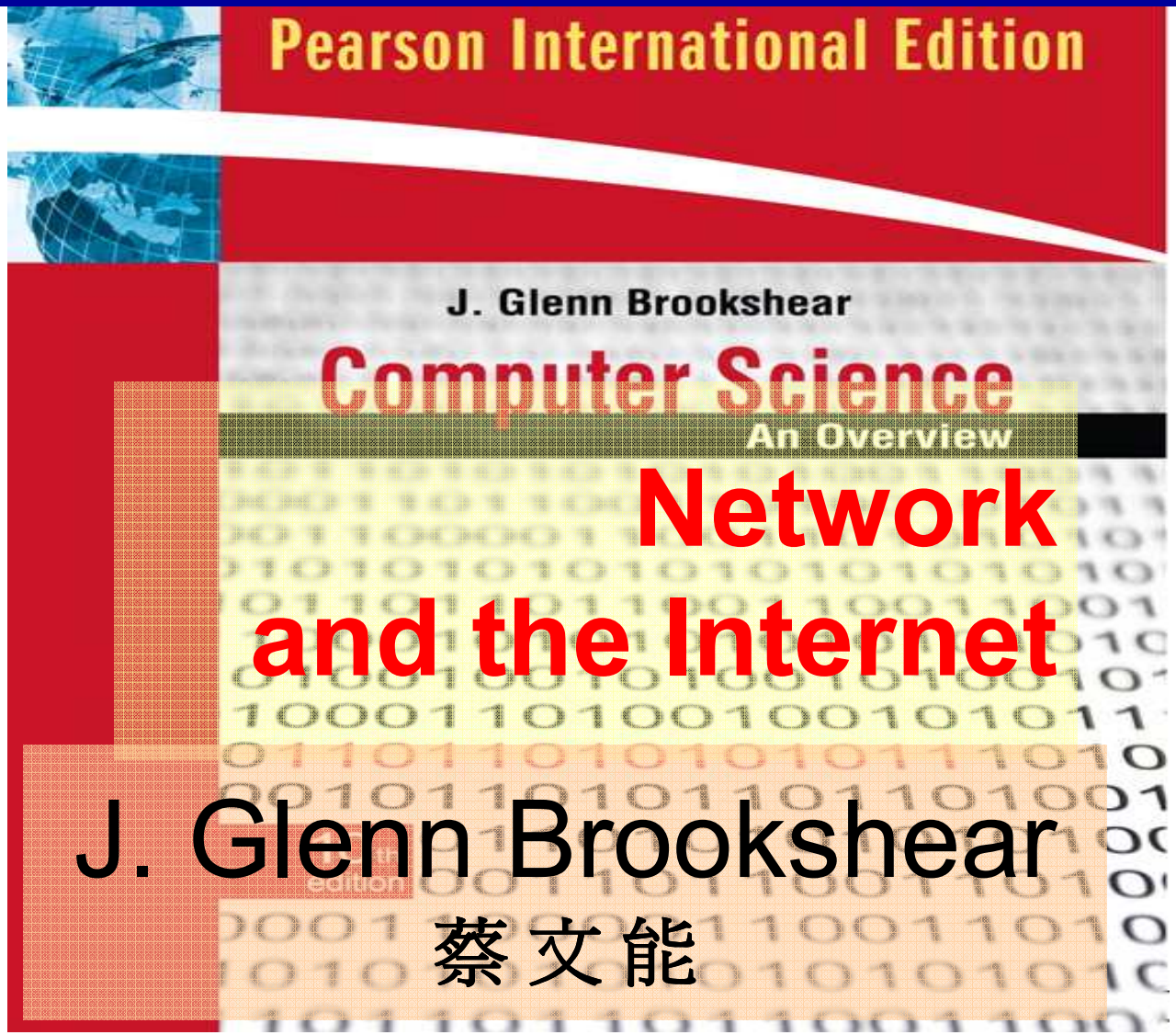
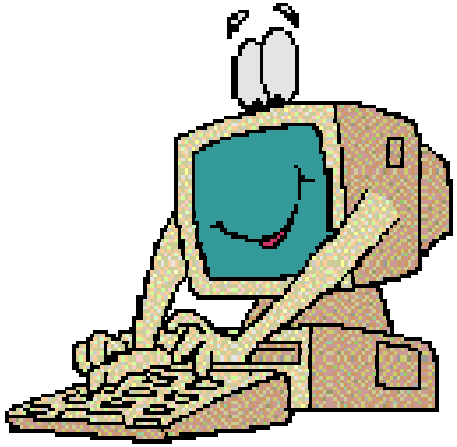
Chapter 4

Part A



Network and the Internet

J. Glenn Brookshear
蔡文能



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Agenda

4.1 Network Fundamentals
4.2 The Internet (p.23)
4.3 The World Wide Web (p.52)

Part A

4.4 Network Protocols
4.5 Security

Part B

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常見名詞術語

- MAC Address 00-D0-B7-25-3F-A8
- IP Address 140.113.2.138
- Prot # TCP 21 (for FTP)
- FQDN ftp.csie.nctu.edu.tw
- DNS Server Domain Name Service
- Router, Switch, Hub
  - Layer 3 Switch ==~~ Router

http://en.wikipedia.org/wiki/MAC_address

tsaiwn@csie.nctu.edu.tw

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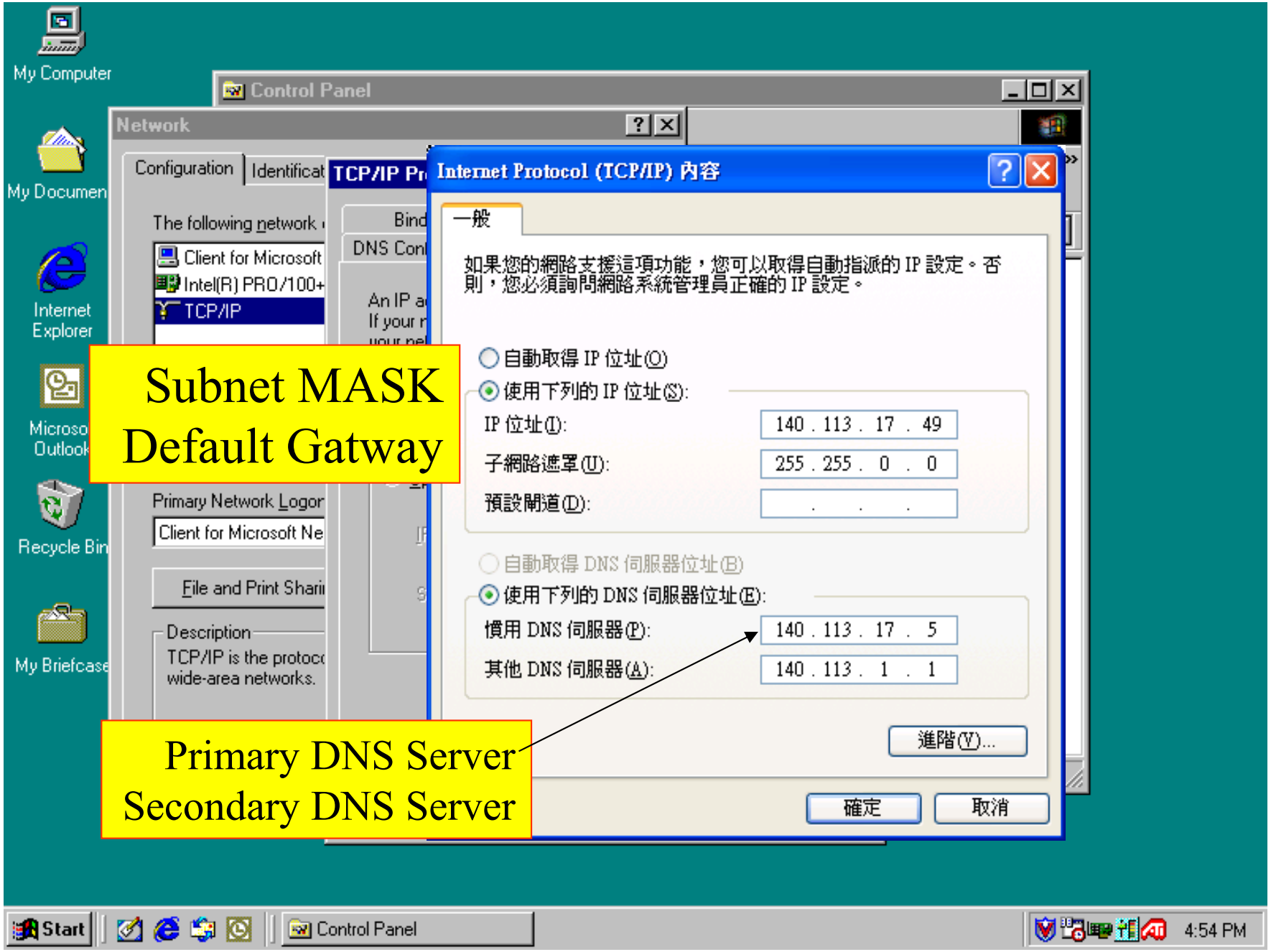

ping www.mit.edu 這樣到底做了哪些事? 用到啥?

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Networks and Distributed Systems

- Interaction of computers via networking has become common
- Distributed systems
  - Examples: global information retrieval system, company-wide accounting and inventory systems, some computer games
  - Consists of units executing on different computers in a network
- Network software is evolving into a network-wide operating system

Mail/FTP/BBS/News/WWW/**ICQ**/MSN…

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Network Classifications (1/2)

- By the geographical area
  - **Local** area network (LAN) 區域網路
    - In a building or building complex
  - **Wide** area network (WAN) 廣域網路
    - In neighboring cities or opposite sides of the world
- By the ownership
  - **Intranet**: Closed, or proprietary (private) 私有
  - **Internet**: Open Network (public) 公眾網路

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Network Classifications (2/2)

LAN vs. WAN

Wired vs. Wireless

Classification based on diameter:

1 m	System	Multi-processor
10 m	Room	**PAN** (Personal Area Networks)
100 m	Building	**LAN** (Local Area Networks)
1 km	**Campus**	
10 km	City	**MAN** (Metropolitan Area Networks)
100 km	Country	**WAN** (Wide Area Networks)
1,000 km	Continent	
10,000 km	Planet	The Internet

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Network Logical Topology(1/2) (Network Configurations)

Objective : to provide maximum possible reliability of data or information and give the end user the best possible response time and throughput

- **Bus Topology 匯流排拓樸架構**
- Ring Topology 環狀拓樸架構
- Star Topology 星狀拓樸架構

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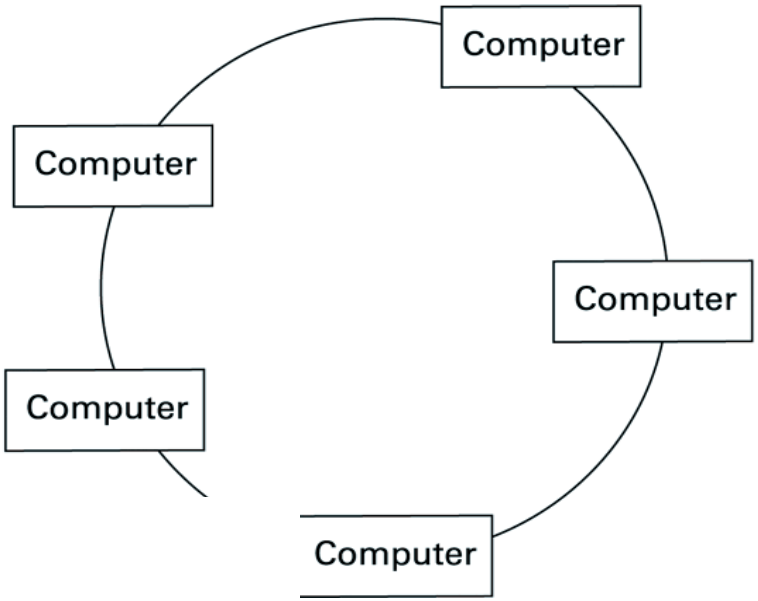
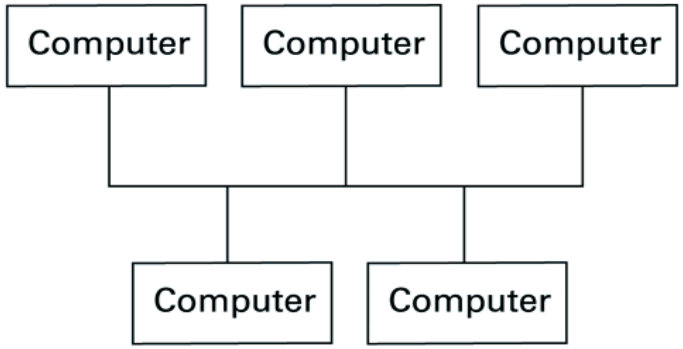
Network Topologies (2/2)

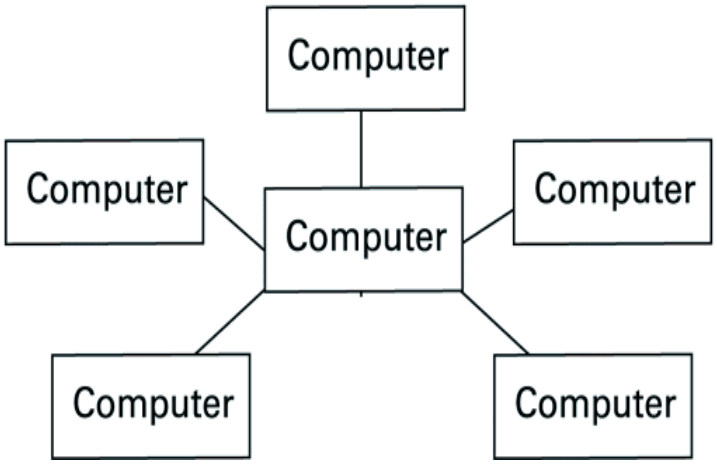
a. Ring



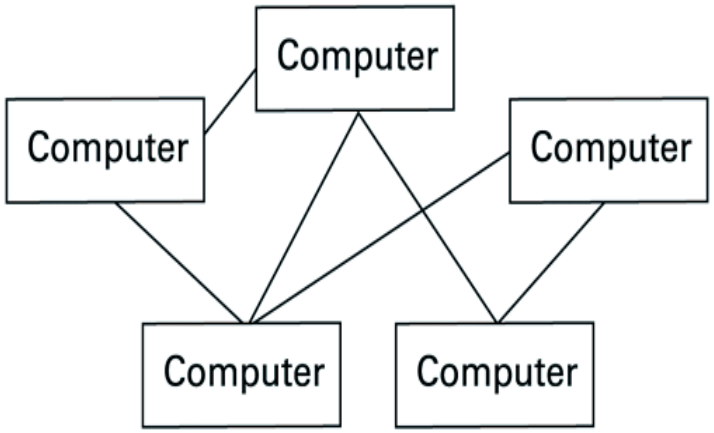
b. Bus



c. Star



d. Irregular



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Connecting Networks

- Bridge 橋接器
  - Connects two compatible networks
  - Connecting **homogeneous** domains
- Router 路由器
  - Connects two incompatible networks
  - Connecting **heterogeneous** domains
  - Resulting "network" is called an internet

Internet vs. internet

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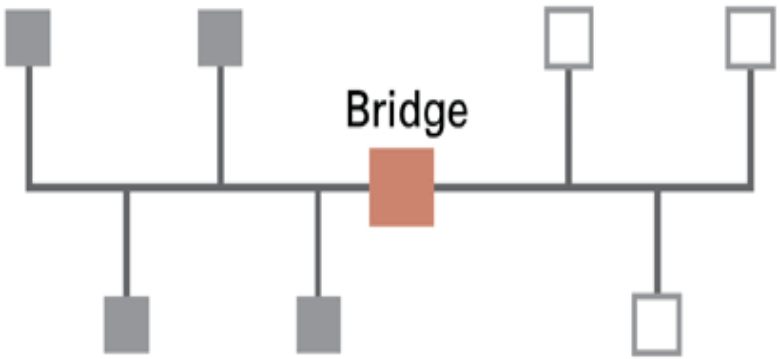
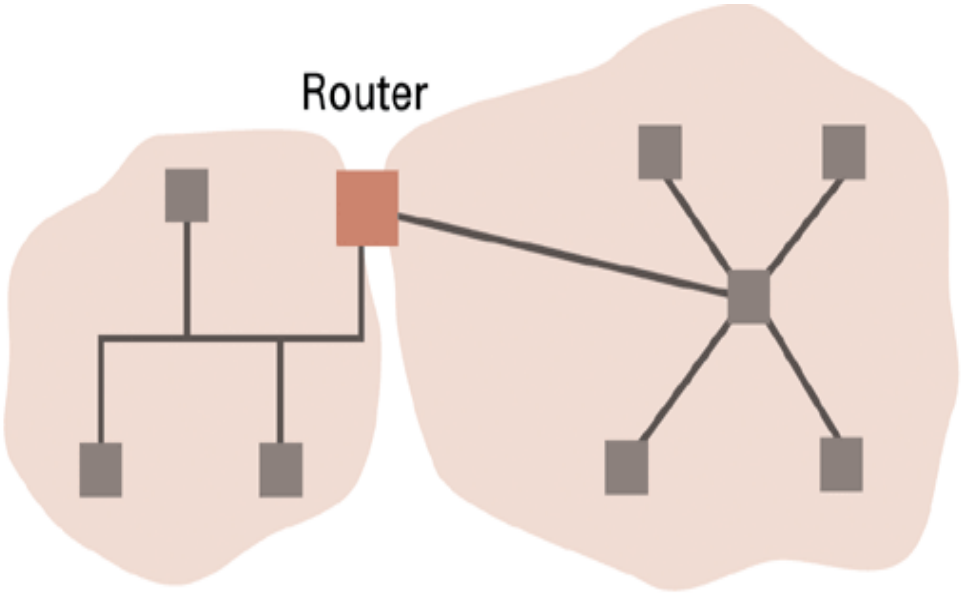
Bridge vs. Router



a. A bridge connecting two bus networks to form one large network



b. A router connecting a bus network to a star network to form an Internet consisting of two networks

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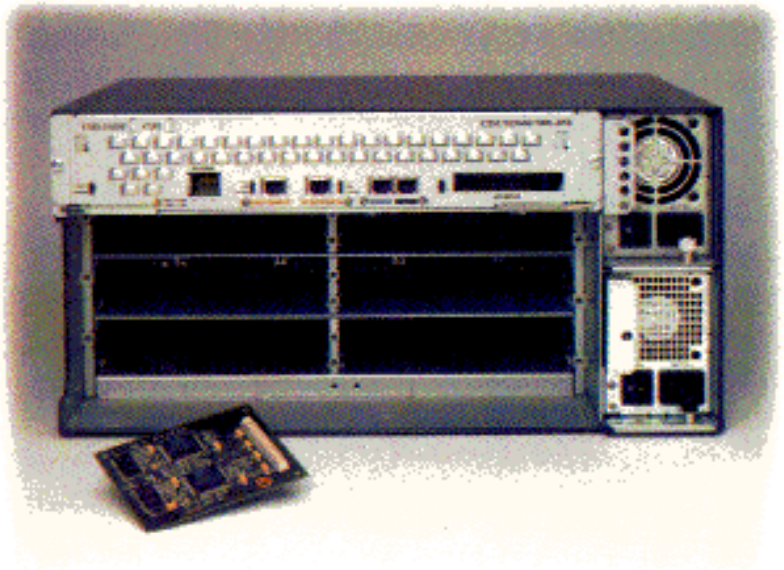
網路中繼設備 (Repeater)

- 路由器(Router)



Router vs. Bridge ?

- 交換器(Switch) 與 集線器(Hub)

tsaiwn@csie.nctu.edu.tw

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Bridges (橋接器)

- Link layer device (不認識 IP address)
  - stores and forwards Ethernet frames
  - examines frame header and selectively forwards frame based on **MAC** dest address
  - when frame is to be forwarded on segment, uses CSMA/CD to access segment
- transparent
  - hosts are unaware of presence of bridges
- plug-and-play, self-learning
  - bridges do not need to be configured

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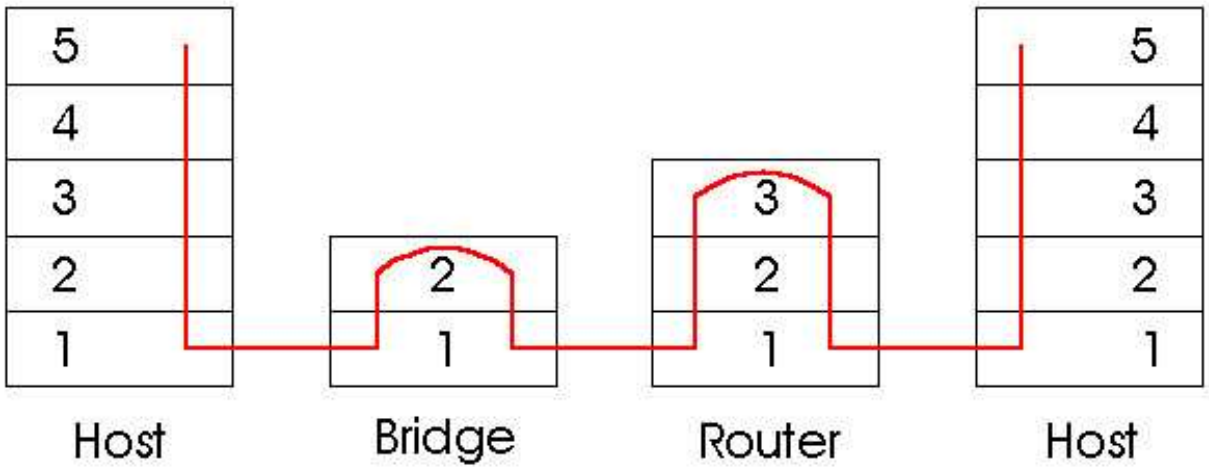
Bridges vs. Routers (1/3)

Router (路由器)

- both store-and-forward devices
  - routers: **network layer** devices (examine network layer headers)
  - bridges are **link layer** devices (認識MAC但不認識IP)
- routers maintain routing tables, implement routing algorithms
- bridges maintain bridge tables, implement filtering, learning and spanning tree algorithms



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Routers vs. Bridges (2/3)

Router (路由器)

Bridges + and -

+ Bridge operation is simpler requiring less packet processing

+ Bridge tables are self learning

- All traffic confined to spanning tree, even when alternative bandwidth is available

- Bridges do not offer protection from broadcast storms

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Routers vs. Bridges (3/3)

Router (路由器)

Routers + and -

+ arbitrary topologies can be supported, cycling is limited by TTL counters (and good routing protocols)
+ provide protection against broadcast storms
- require IP address configuration (not plug and play)
- require higher packet processing

- bridges do well in small (few hundred hosts) while routers used in large networks (thousands of hosts)

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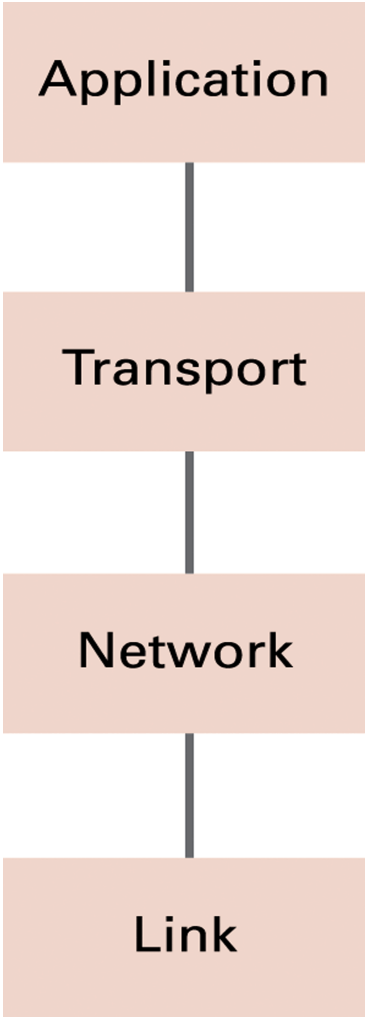
TCP/IP 4 Layers

- Application layer (Layer 4)
  - HTTP, FTP, Telnet
- Transport layer (Layer 3)
  - TCP, UDP
- **Network** layer (Layer 2) (**IP** layer)
  - Routing
- **Link** layer (Layer 1) (**MAC** layer)
  - Token ring or Ethernet



MAC: Media Access Control

TCP/IP 不定義實體層

The 7 Layers of the OSI Model

ISO (國際標準組織)

OSI : Open System Interconnection

7	Application	Network Processes to Applications
6	Presentation	Data Representation
5	Session	Interhost Communication
4	Transport	End-to-end Connections
3	Network	Address and Best Path
2	Data Link	Access to Media
1	Physical	Binary Transmission • Wires, connectors, voltages, data rates

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Inter-Process Communication

- Client-server
  - One server, many clients
  - Server must run continuously
  - Client initiates communication
- Peer-to-peer
  - Two processes communicating as equals
  - Both as the client and server

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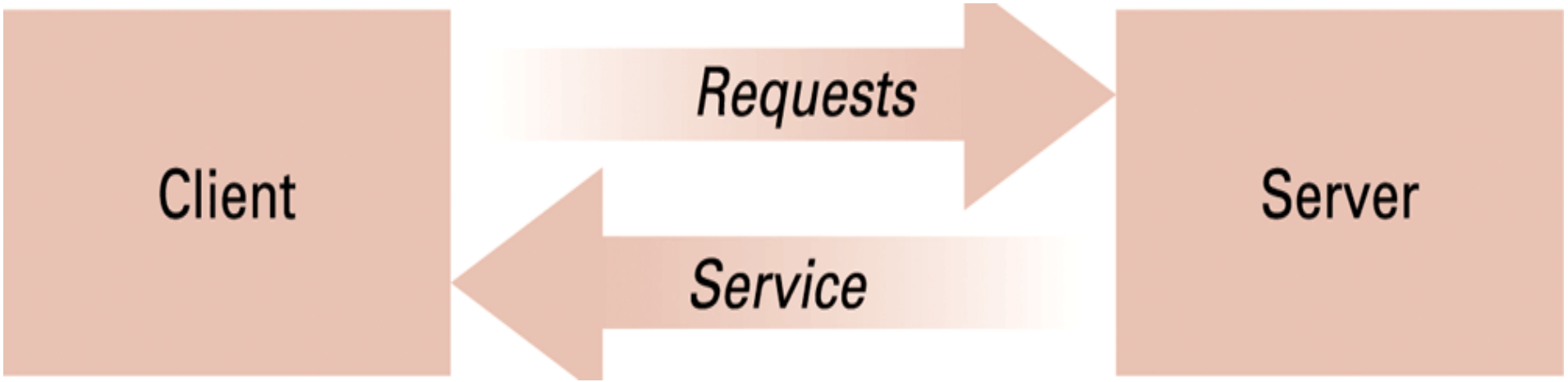
Client/Server model



Example: BBS, News, DNS, …

吃麵的: Client; 賣麵的: Server

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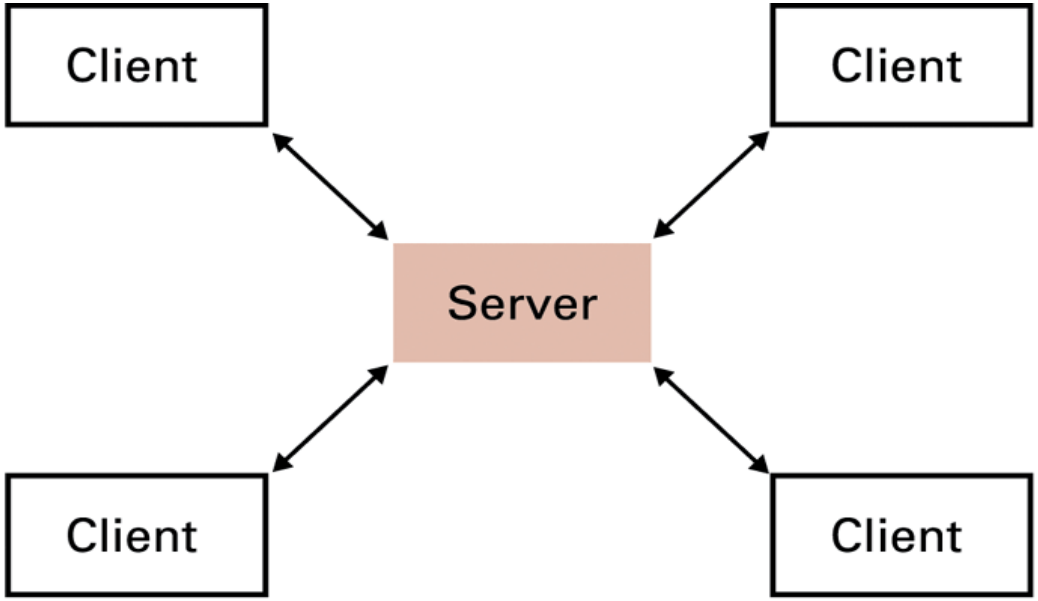
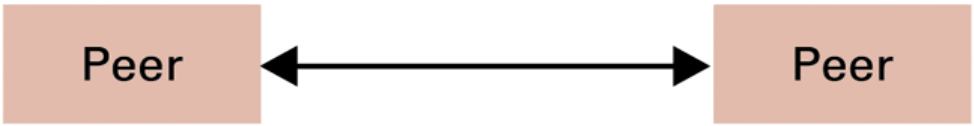
Client-Server vs. P2P



a. Server must be prepared to serve multiple clients at any time.



b. Peers communicate as equals on a one-to-one basis.

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Distributed Systems 分散式系統

- Software consists of parts running on different computers in a network
- Also known as network applications
- Infrastructure usually provided by standardized toolkits
  - Example: Enterprise Java Beans from Sun Microsystems
  - Example: .NET framework from Microsoft
- Example
  - Global information retrieval system such as WWW
  - World-wide entertainment systems such as the **online games** (**線上遊戲**)
  - Company-wide accounting and inventory systems such as **online banks** (**網路銀行**)

Cloud computing 雲端運算?

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Agenda

- 4.1 Network Fundamentals
- 4.2 The Internet
- 4.3 The World Wide Web
- 4.4 Network Protocols
- 4.5 Security

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Internet Architecture

- The **Internet**: one internet spanning the world
  - Started by **DARPA** in 1973
  - Today involves thousand millions of machines
- Domain = network or internet controlled by one organization
- Gateway = router connecting a domain to the cloud
  - **cloud** = **the rest of the Internet**
- Domains must be registered by their owners
  - Internet Corporation for Assigned Names & Numbers (**ICANN**) serves as registrar

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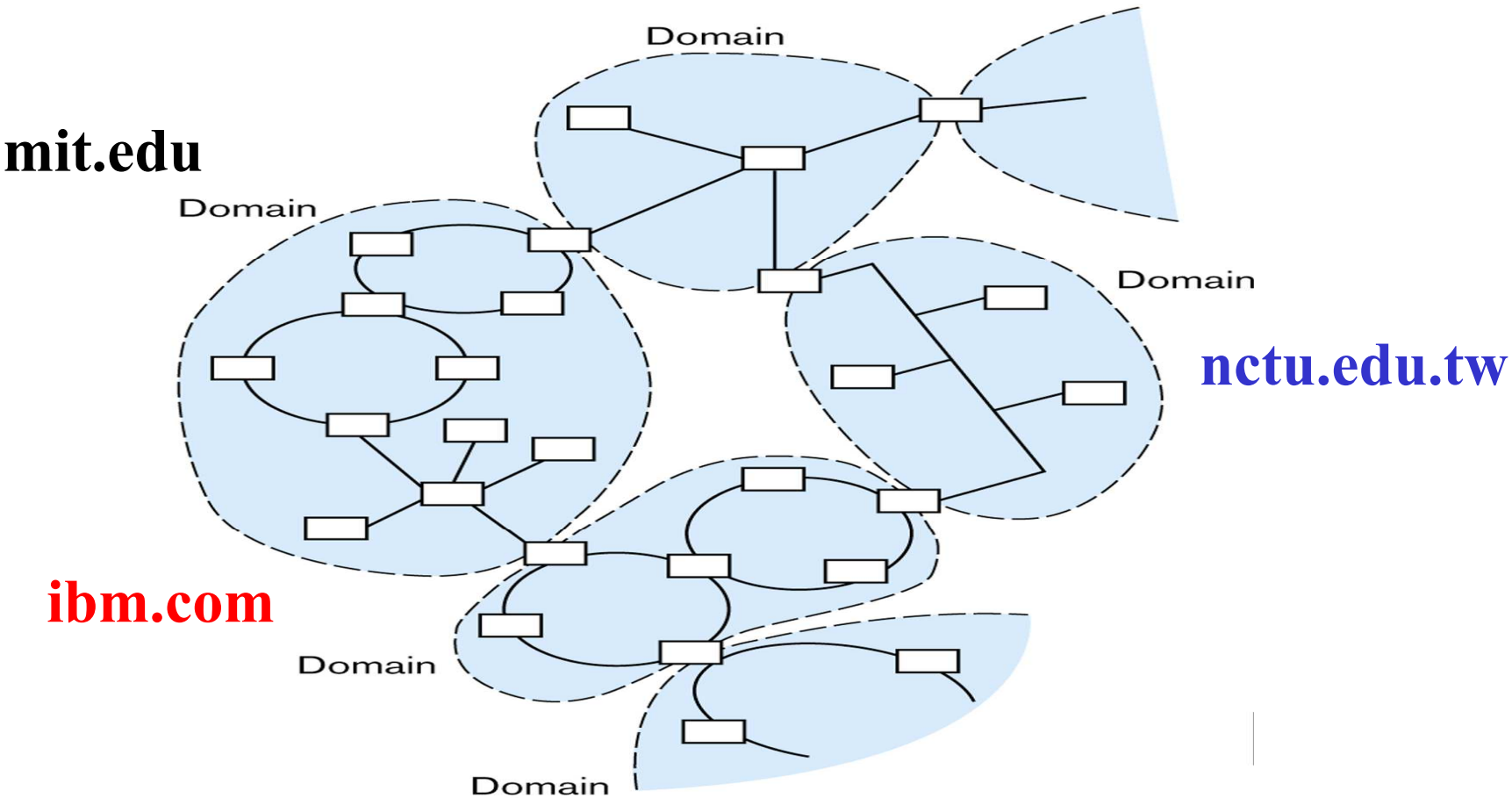
Internet as a Collection of Domains

The Internet Cloud



Gateway (閘道; 閘門) ?

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Establishment and Operation of Domains

- Register with **ICANN** (Internet Corporation for Assigned Names and Numbers)
- Attached to a network already in the Internet by a router (**gateway**, as the domain's gate to the outside world, or cloud)
- Any message being transmitted to a destination within the domain is handled within the domain
- Any message being transmitted to a destination outside the domain is directed toward the **gateway**, where it is sent out to the cloud

ICANN : Internet Corporation for Assigned Names and Numbers
TWNIC 台灣網路資訊中心

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Strategies for connecting to the Internet

- Large organization: buy a direct connection
- Small organization or individual: link domain to the domain of an ISP
- Individual: temporarily link computer into ISP's domain

ISP : Internet Service Provider

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Individuals Seeking Internet Access

- Can register, implement, and maintain their domains
- More common via a domain established by an organization or an Internet Service Provider (ISP)
- Most cases takes the form of a temporary telephone connection (Dial-up MODEM, ADSL, **xDSL**)

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Internet Addressing : IP address

- IP address, **32 bits** (IPV4) (IPV6 : 128 bits)
- encodes a network identifier (**network prefix**) and a **host number**
  - **Network** identifier (identifying the domain)
    - Assigned under the authority of ICANN
    - e.g. 140.113 for Nation Chiao-Tung University
  - **Host** address
    - Assigned by local authority
    - e.g. 140.113.**17.5**
- Domain Naming System (DNS)
  - e.g. www.amazon.com
  - Top-Level Domain (TLD):
    - e.g. com.tw, edu.tw, gov.ca, org, net

網址可切爲左右兩邊: 左邊 網路號碼, 右邊爲電腦主機號碼

ICANN : Internet Corporation for Assigned Names and Numbers
TWNIC 台灣網路資訊中心 (早期在交大資科系辦公室)

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Internet Addressing: host names

- Host name = **mnemonic** name (FQDN)
  (注意 mn的 m 不發音)
  - Example: mymachine.ibm.com
  - **Domain name** = part assigned by a registrar
    - Example: aw.com
    - Top level domain = classification of domain owner
      - By usage – Example: .com = commercial
      - By country – Example: .tw = Taiwan
  - **Subdomains** and individual machine names
    - Assigned by domain owner
    - Domain owner must run a name server.

FQDN : Full Qualified Domain Name

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Domain Name Service Server (DNS Server; Name server)

- Maintains a directory containing the **mnemonic address** and the corresponding **numeric IP address** within the **domain.** (Because that IP addresses are hard to remember!)
- Responds to requests regarding address information
- **All of the name servers throughout the Internet constitute an Internet-wide directory system**
- When a human requests that a message be sent to a destination given in mnemonic form, this system of name servers converts that mnemonic address into equivalent bit-pattern form.
- Such a task is normally completed in a fraction of a second .

Try this: nslookup FAHRVERGNUGEN.MIT.EDU

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IP address in Dotted Decimal Notation

- IP addresses are written in a so-called ***dotted decimal notation***
- Each byte is identified by a decimal number in the range [0..255]:
- **Example:**

10001100	01110001	00010001	00000101
1st Byte	2nd Byte	3rd Byte	4th Byte
= 140	= 113	= 17	= 5

140.113.17.5

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Network prefix and host number

- The network prefix identifies a network and the host number identifies a specific host (actually, interface on the network). (因其實一部電腦可有多張網路卡)

network prefix	host number

- **How do we know how long the network prefix is?**
  - **Before 1993:** The network prefix is implicitly defined (see **class-based addressing**) (for eg., 255.255.0.0 for class B)

  or

  - **After 1993:** The network prefix is indicated by a **netmask.**

網址可切爲左右兩邊: 左邊 網路號碼, 右邊爲電腦主機號碼

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Classful IP Adresses (Until 1993)

- When Internet addresses were standardized (early 1980s), the Internet address space was divided up into classes:
  - **Class A:** Network prefix is 8 bits long
  - **Class B:** Network prefix is 16 bits long
  - **Class C:** Network prefix is 24 bits long
- Each IP address contained a key which identifies the class:
  - **Class A:** IP address starts with “0”
  - **Class B:** IP address starts with “10”
  - **Class C:** IP address starts with “110”

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Internet Address (IPv4 Addresses)

The old way : Classful IP addresses

- **Five Classes**

bit #

	0	1	2	3	4		8		16		24		31
Class A	0	**netid**					**hostid**						
Class B	1	0	**netid**						**hostid**				
Class C	1	1	0	**netid**							**hostid**		
Class D	1	1	1	0	Multicast Address								
Class E	1	1	1	1	0	**Reserved** for Future Use							

- **IP Address Format**

(netid, hostid)

Identifies a network — Identifies a host on that network

10001100 01110001 00010001 00000101

- **Dotted Decimal Notation** **140.113.17.5**

127.0.0.1 代表任何一台 IP 主機自己

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Classes of IP Addresses (till 1993) According to the **First Byte**

- Class A: 1– 126 (16M hosts each)
  - 18 mit.edu; 試試 **ping fahrvergnugen.mit.edu**
- Class B: 128 – 191 (65,536 hosts each)
  - **140.113 交大**; 140.114 清大; 140.112 台大; 140.115 中央; 140.116 成大
- Class C: 192 – 223 (256 hosts each)
- Class D: 224 – 239 (multicast mode)
- Class E: 240 – 255 (for future use)
- **Loopback address: 127.0.0.1 (localhost)**

Try : **ping 18.18.18.18**

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Problems with Classful IP Addresses

By the early 1990s, the original classful address scheme had a number of problems

- **Flat address space.** Routing tables on the backbone Internet need to have an entry for each network address. When Class C networks were widely used, this created a problem. **By the 1993, the size of the routing tables started to outgrow the capacity of routers**.

Other problems:

- **Too few network addresses for large networks**
  - Class A and Class B addresses were gone
- **Limited flexibility for network addresses:**
  - **Class A and B addresses are overkill (>64,000 addresses)**
  - **Class C address is insufficient (e.g., requires 40 Class C addresses)**

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CIDR resolves Problems with Classful IP

- IP backbone routers have one routing table entry for each network address:
  - With subnetting, a backbone router only needs to know one entry for each Class A, B, or C networks
  - This is acceptable for Class A and Class B networks
    - $2^7 = 128$ Class A networks
    - $2^{14} = 16{,}384$ Class B networks
  - **But this is not acceptable for Class C networks**
    - **$2^{21} = 2{,}097{,}152$ Class C networks**
- **In 1993, the size of the routing tables started to outgrow the capacity of routers**
- **Consequence: The Class-based assignment of IP addresses had to be abandoned**

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CIDR -- Classless Inter Domain Routing

- **在 1993 年 IEEE Network 的提案增加了 CIDR 的擴充，而打破了 Class 分級的局限。**如果您的系統支持 CIDR 協定，就可以拋開等級的界限，使用**可變長度的 netmask** (VLSM) 靈活的的設計 IP 網路的範圍與路由。當然，如果要和其它網路溝通，您使用的 Router 也必須支援 CIDR 才行，不過，**現在的 Router 幾乎都使用 CIDR 的了**。

- 引入 CIDR之後，如果您覺得 169.158.88.254/255.255.0.0 和 140.113.1.1/255.255.255.0 這樣的 IP 表現方法實在太麻煩了，則可用一個更簡便的表示法：使用 mask 的 bit 數目長度表示 Net Mask。這樣，我們就可以將前面兩個 IP 寫成這樣：169.158.88.254/**16** 和 140.113.1.1/**24** 。

VLSM : Variable Length Subnet Mask

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CIDR and Routing

- **Aggregation** of routing table entries:
  - 128.143.0.0/16 and 128.144.0.0/16 are represented as 128.142.0.0/15
- **Longest prefix match**: Routing table lookup finds the routing entry that matches the longest prefix

What is the outgoing interface for 128.143.137.0/24 ?

Prefix	Interface
128.0.0.0/4	interface #5
128.128.0.0/9	interface #2
128.143.128.0/17	interface #1

Routing table

Route aggregation can be exploited when IP address blocks are assigned in an hierarchical fashion

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Why do people still talk about class ABC..

- CIDR eliminates the concept of class A, B, and C networks and replaces it with a network prefix
- Existing classful network addresses are converted to CIDR addresses:

  140.113.0.0 → 140.113.0.0/16
- The change has not affected many (previously existing) enterprise networks
  - Many network administrators (especially on university campuses) have not noticed the change (and still talk about classfull Ip address)

(Note: CIDR was introduced with the role-out of BGPv4 as inter-domain routing protocol.

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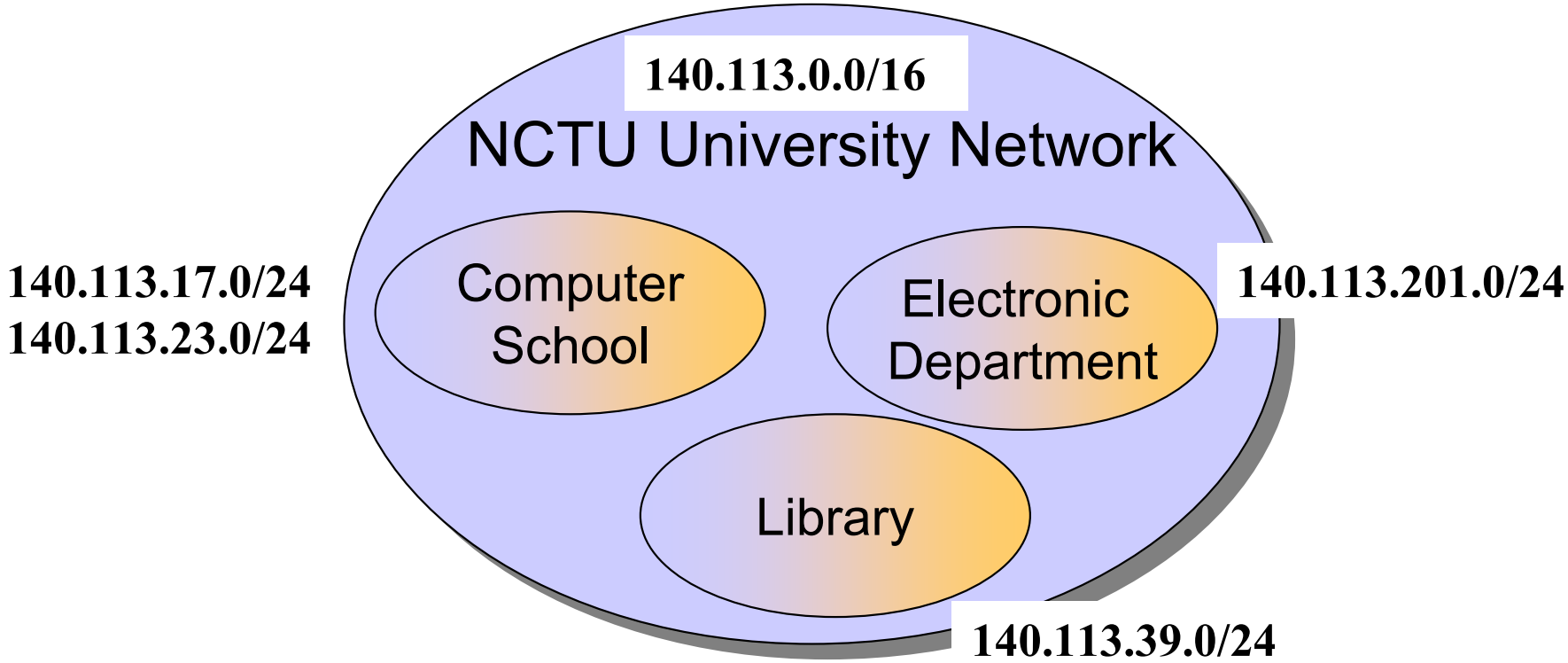
Address assignment with **subnetting**

Each part of the organization is allocated a range of IP addresses (**subnets** or **subnetworks**)

Addresses in each subnet can be administered locally



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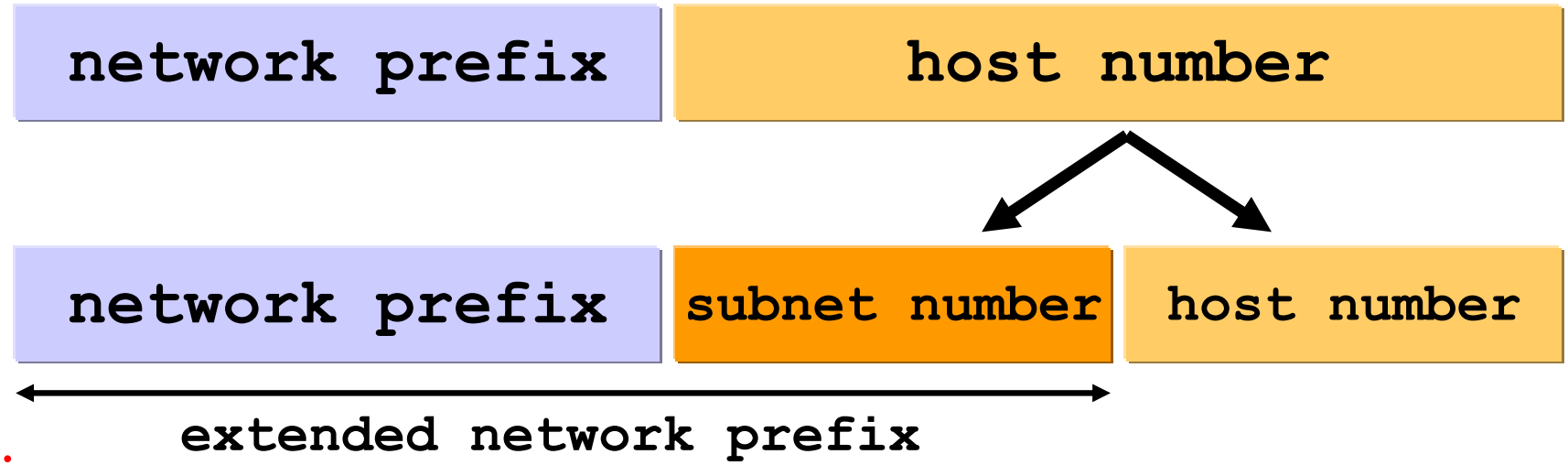
Basic Idea of Subnetting

Split the host number portion of an IP address into a **subnet number** and a (smaller) **host number**.

Result is a **3-layer** hierarchy



- Then:
  - Subnets can be freely assigned within the organization
  - Internally, subnets are treated as separate networks
  - Subnet structure is not visible outside the organization

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Example: Subnetmask

- **140.113.0.0/16 is the IP address of the network**
- **140.113.17.0/24 is the IP address of the subnet**
- **140.113.17.5 is the IP address of the host**
- **255.255.255.0 (or ffffff00) is the subnetmask of the host**

Prefix or CIDR notation: **140.113.17.5/24**

- **When subnetting is used, one generally speaks of a "subnetmask(子網路遮罩)" (instead of a netmask) and a "subnet(子網路)" (instead of a network)**
- Use of subnetting or length of the subnetmask if decided by the network administrator
- **Consistency of subnetmasks is responsibility of administrator**

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Advantages of **Subnetting**

- With subnetting, IP addresses use a 3-layer hierarchy:
  - » Network
  - » **Subnet**
  - » Host
- **Reduces router complexity**. Since external routers do not know about subnetting, the complexity of routing tables at external routers is reduced.
- Note: **Length** of the **subnet mask** need not be identical at all subnetworks.

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Special IP Addresses (1/2)

- **Reserved or (by convention) special addresses:**
  - **Loopback interfaces**
    - **all addresses 127.0.0.1-127.255.255.255 are reserved for loopback interfaces**
    - **Most systems use 127.0.0.1 as loopback address**
    - loopback interface is associated with name "**localhost**"
  - **IP address of a network (host part all zero) (network address)**
    - Host number is set to all zeros, e.g., 140.113.209.**0**
  - **Broadcast address (host part all ones)**
    - Host number is all ones, e.g., 140.113.209.**255**
    - **Broadcast goes to all hosts on the network**
    - **Routers typically do not forward these datagrams**
    - Often ignored due to security concerns
  - **Network part all zeros** : Means the **host** on this network
  - **255.255.255.255** : Means limited broadcast. Used as a destination address to send packets to all hosts on the **local network** where the source is.
  - **0.0.0.0** : Means **this host**, used by machines as **source address** when they boot up (if they don't know their IP address, and need to get it from a boot server, e.g., in RARP, DHCP)

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Special IP Addresses (2/2)

- **Reserved for Test / Experimental addresses**
  - Certain address ranges are **reserved** for "experimental use".
  - Packets **should get dropped** if they contain this destination address (see RFC 1918):

    class A: 10.0.0.0 - 10.255.255.255
    class B: 172.16.0.0 - 172.31.255.255
    class C: 192.168.0.0 - 192.168.255.255

Private IP address

- **Convention 慣例 (but not a reserved address)**

  Default **gateway** has host number set to '1', e.g., e.g., 192.0.1.**1**

中央大學用此慣例
(Host 是 1 當作 Gateway)

交大選 254

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Public vs. Private IP (公共 IP與私有 IP) 1/2

- ✓ 公共 IP(Public IP)
  - 當我們要將網路連上 Intetnet 的時候，我們必須先註冊好 Net ID，如果該 ID 已經被使用了，您就必須選用另外的 ID 了。負責 Internet IP 註冊的機構叫做 InterNIC (Network Information Center)，他們的網路位址是 **http://www.internic.net**。不過，實際上的運作，一般機構或個人是不太可能直接從 InterNIC 上註冊 IP 的，而是經您的 ISP 分配下來。這些經過合法授權使用的 IP ，我們稱之爲 **公共 IP (Public IP)** 。
- ✓ 私有IP位址 (Private IP address)
  - ➢ 由於 Internet 的爆炸性成長，IP 的位址越來越少，而且在很多機構裡，也不是所有機器都有必要使用註冊的 IP 位址。於是，我們就在 A、B、C 這三個class裡面，各劃出一些位址範圍保留給私有位址所用，它們分別是：
    - **10.0.0.0 - 10.255.255.255 (Class A)**
    - **172.16.0.0 - 172.31.255.255 (Class B)**
    - **192.168.0.0 - 192.168.255.255 (Class C)**
  - ➢ 這些無需註冊就能自由使用的 IP ，我們稱之爲 **私有 IP (Private IP)**。

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Public vs. Private IP (公共 IP與私有 IP) 2/2

- ✓ Private IP 之封包在網路上的限制
  - 10.0.0.0 - 10.255.255.255 (Class A)
  - 172.16.0.0 - 172.31.255.255 (Class B)
  - 192.168.0.0 - 192.168.255.255 (Class C)
  - 當您使用這些private位址的時候，當然是有所限制的：
    - ➢ 私有位址的路由資訊不能對外散播
    - ➢ 使用私有位址作爲來源或目的位址的封包，不能透過 Internet 來轉送
    - ➢ 關於私有位址的參考紀錄，只能限於內部網路使用
- ✓ 正是由於這些限制，當我們使用這些私有位址來設定網路的時候，就無需擔心會和其它也使用相同位址的網路衝突。
- ✓ 那這些使用 private IP 的電腦如何與外界機器溝通?
  - ➢ **NAT --- Network Address Translation**

NAT？ 寬頻分享器?

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Internet Applications

- Electronic mail (e-mail) (SMTP) : 25
- File Transfer Protocol (FTP) : 21
- Remote login: telnet, etc. : 23
- World Wide Web (HTTP) : 80

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Electronic mail

- Mail server: set up by domain owner
  - Mail sent from domain members goes through mail server
  - Mail sent to domain members is collected by mail server
  - **SMTP** protocol (Simple Mail Transfer Protocol)
  - Mail delivered to clients on demand
    - **POP3**
    - **IMAP**

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Agenda

- 4.1 Network Fundamentals
- 4.2 The Internet
- 4.3 The World Wide Web
- 4.4 Network Protocols
- 4.5 Network Security

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The World Wide Web (WWW) (1/2)

- **Originated at the Conseil Européen pourla Recherche Nucléaire (CERN).**
- **Uses a browser (例如 IE或Netscape) program** to access Web documents called Web pages **and to display the hypertext (including text, pictures, etc.) in the Web pages.**
- **Uses HyperText Mark-up Language (HTML) to write Web pages.**

CERN 歐洲核子研究組織

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The World Wide Web (2/2)

- Intertwined web of related information implemented on the Internet
- **Hypertext**
  - Documents contain text, images, sound, and video, and may be linked to other documents (Hyperlinks)
- **Web pages 網頁**
  - Hypertext document on the World Wide Web
- **Web site 網站**
  - Collection of closely related Web pages

http://w3c.org

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WWW-related Events

Date	Event
03/1989	WWW project was originated by **Timothy Berners-Lee**
11/1990	A revised version of project by NeXT computer
03/1991	**Release of WWW for testing**
08/1993	Release of 1st version of Marc Andreessen's **Mosaic** by NCSA in University of Illinois at Urbana-Champaign
10/1993	> 500 known HTTP servers in operation
10/1994	> 10,000 know HTTP servers in operation

August 1995 **Microsoft** announced its first Browser : MSIE

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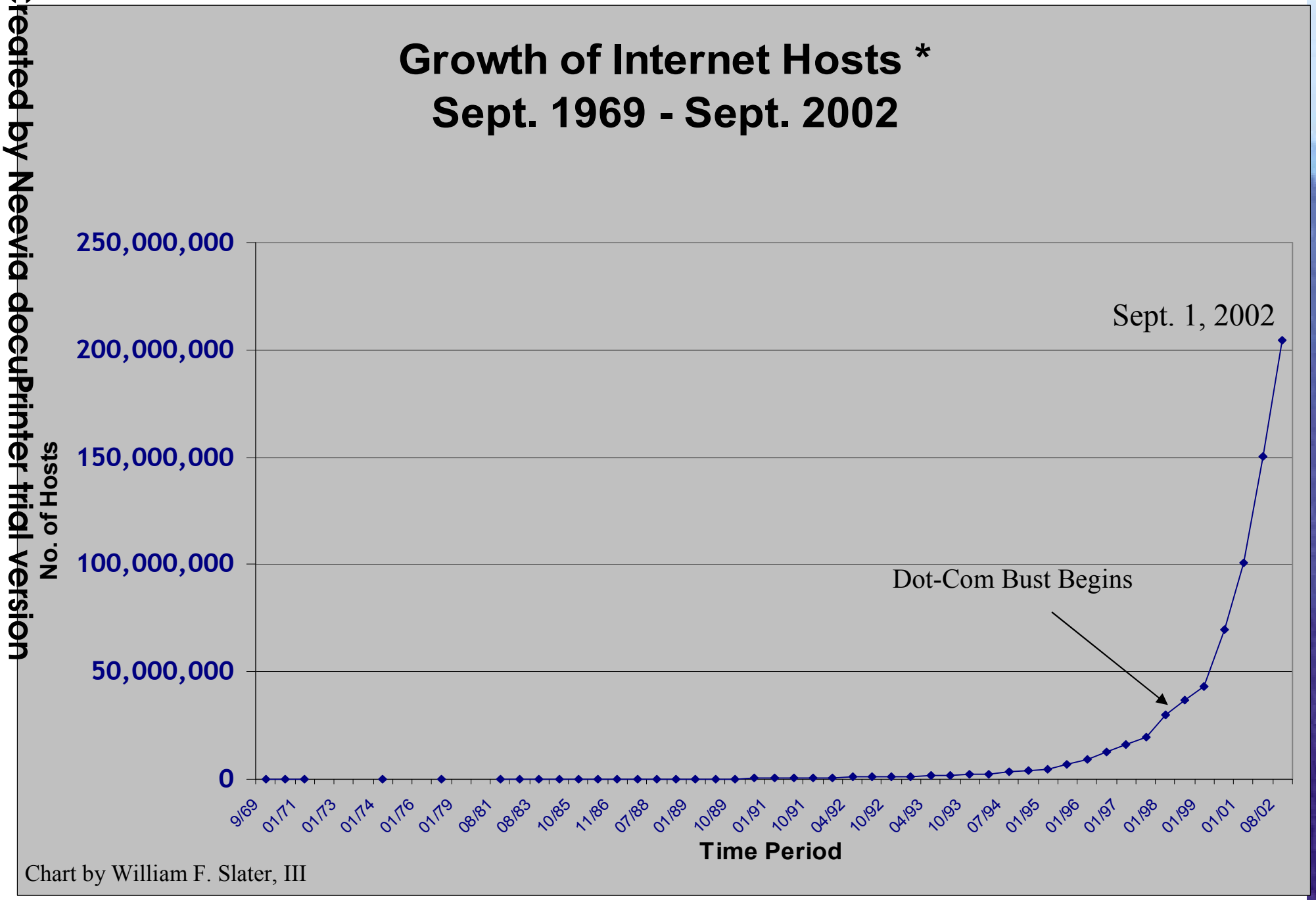

The Internet was not known as "The Internet" until January 1984, at which time there were 1000 hosts that were all converted over to using TCP/IP.

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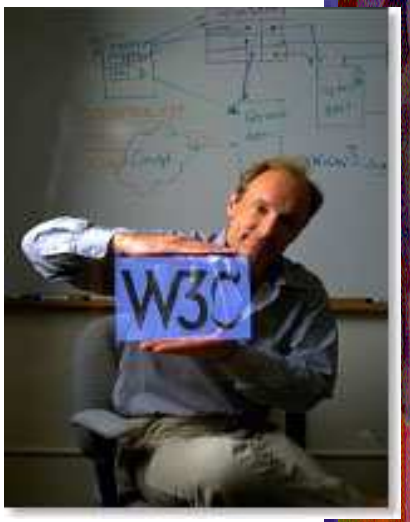
WWW 發明人 Tim Berners-Lee

- Berners-Lee,the inventer of HTML, has software in his blood. Both his parents were programmers who worked for the British company Ferranti on one of the first commercial computers.
  He read physics at Queen's College, **Oxford**, where he built his first computer with a soldering iron, a microprocessor chip and an old television set.
- Graduating in 1976, he worked first for Plessey and later for a firm writing typesetting software.



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Browser and Web Page Server

- Web **Browser**
  - As a client
  - Obtains materials requested by the user and presents these materials to the user in an organized manner
- Web page Server (Web server)
  - Provides access to the documents on the machine as requested by clients

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1993: Mosaic was born

- One of these programmers was **Marc Andreessen**, who was working for the *NCSA* in Urbana-Champaign, Illinois. (NCSA @ 伊利諾大學香濱校區)
- In January **1993**, Andreessen released a version of his new, handsome, point-and-click **graphical browser** for the Web, designed to run on **Unix** machines.
- In **August 1993**, Andreessen and his co-workers at the center released free versions for **Macintosh** and **Windows**.

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Mosiac Communications (Netscape)

- December 1993 Andreersson left NCSA and founded **Mosiac** Communications, now called **Netscape**.
- Many of the key developers from NCSA went with him to work on a new browser.

- **August 1995 Microsoft** announced its first Browser Windows Internet Explorer, abbreviated to **MSIE 1.0** or IE 1.0. (Run on Windows95)
- **2009/03/19 : Internet Explorer 8.0 was released.**
- **MSIE 9.0** will be released in year **2011**.

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如何在WWW下建立雙向溝通之應用環境 - Microsoft Internet Explorer

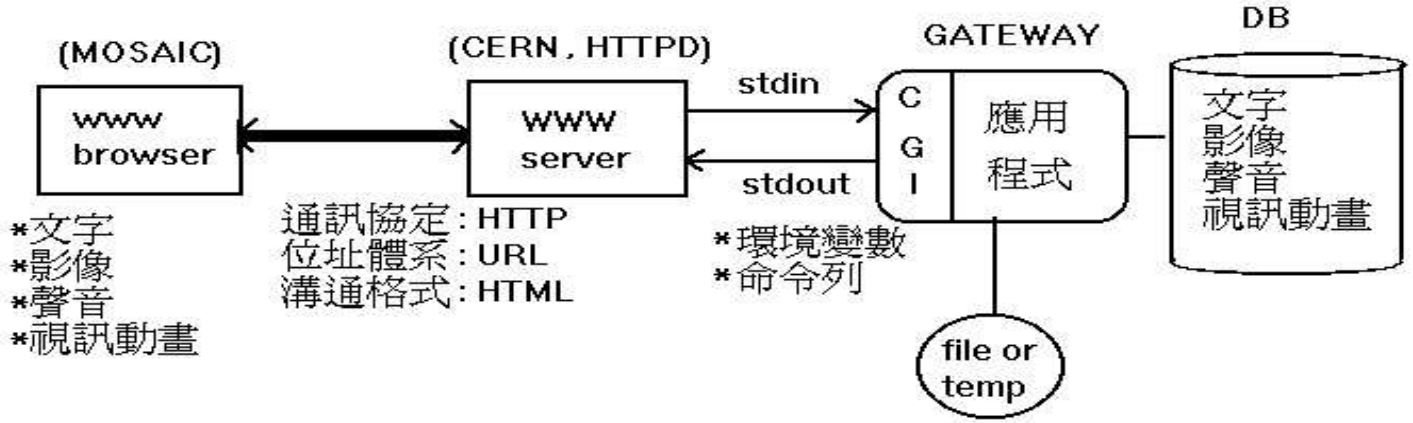
檔案(F) 編輯(E) 檢視(V) 我的最愛(A) 工具(T) 說明(H)

上一頁 搜尋 我的最愛 媒體

網址(D) http://thccx11.cc.nthu.edu.tw/wjchou/docs/www-cgi.html#form-cgi 移至 連結 Norton AntiVirus

WWW之應用架構

WWW 主從（ Client and server ）架構應用示意圖如圖（ 1 ）所示。一般用戶以瀏覽器對伺服主機要求服務，主機依據客機要求抓取資料以作回應，瀏覽器再依回應資料屬性與本身之驅動環境配合，才能展現媒體應有的效果（ 如聲音、影像、圖形等)[3]。主從間是以屬於自己的 HTTP （ HyperText Transmission Protocal ）爲通訊協定。以「一致性資源定位器」（Uniform Resource Locator，URL ）[4]爲位址體系（ Addressing scheme ），以便在 INTERNET 要取得資料時能快速確定資料之位置與取得方式。在 WWW 中最常被共同存取的資源，是由富有邏輯階層形式的超文件建構語言（ Hypertext Ma rkup Language，HTML ）[5]所建構的超文件。可藉此 HTML 文件內之所謂「超鏈結」（ Hyper link ）連接到其它不同型態的文件（如聲音，影像，圖形，視訊等超媒體）與服務（如 FTP，GOPHER，NEWS，WAIS， TELNET 等），以參用 INTERNET 網路上之現有可用的資源。至於要在瀏覽器輸入資料並執行類似交易行爲與遠端主機交換資訊，則務必透過表格 (FORM) [6]與共通閘道介面（ Commom Gateway Interface，CGI ）[7]，以解決傳統應用程式與伺服主機間介面上的問題。



(圖 1)WWW主從架構應用示意圖

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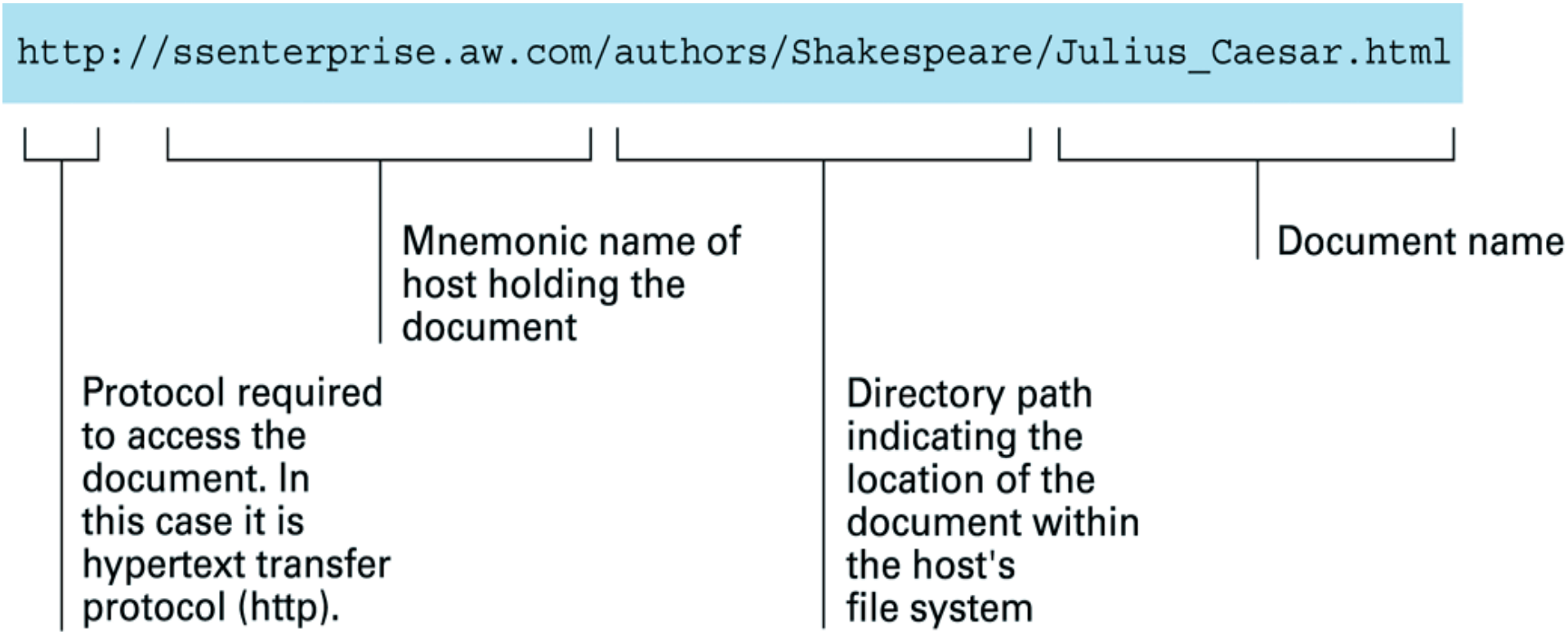
Uniform Resource Locator (URL)

- To locate and retrieve documents on WWW



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What is HTML？網頁標示語言

- HTML – HyperText **Markup** Language
  - HTML are the instructions that tell a browser how to lay out the information (text, images, etc) in the browser window (排版語言)
- It is made up of **tags**
  - an opening tag **<html>** and a closing tag **</html>** with the content that the tag is applied to, in between them.
  - Some tags have no closing tag: **
** **<hr>**

    and thus usually written as **
** **<hr/>**

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Hypertext document format

- Entire document is a **text** file contains printable characters
- Contains **tags** to control display
  - Display appearance
  - **Links to other documents and content**
  - Dynamic functions (JavaScript, …)

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A simple Web page

a. The page encoded using HTML.

Tag indicating beginning of document

Preliminaries

Part of the page that will be displayed by browser

Tag indicating end of document

```
<html>
<head>
<title>demonstration page</title>
</head>
<body>
<h1>My Web Page</h1>
<p>Click here for another page.</p>
</body>
</html>
```

My Web Page

Click here for another page.

其實點了沒有用!

Why ?

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An enhanced simple Web page

a. The page encoded using HTML.

```
<html>
<head>
<title>demonstration page</title>
</head>
<body>
<h1>My Web Page</h1>
<p>Click
    <a href="http://crafty.com/demo.html">
    here
    </a>
    for another page.</p>
</body>
</html>
```

Anchor tag containing parameter

Closing anchor tag

My Web Page

Click here for another page.

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HTML basic Elements

- Headings, Font Sizes, Color
- Comments <!-- .. .. -->
- Backgrounds
- Links and hyperlinks
- E-mail
- Pictures
- Lists
- Tables, Frames, FORM and CGI, …

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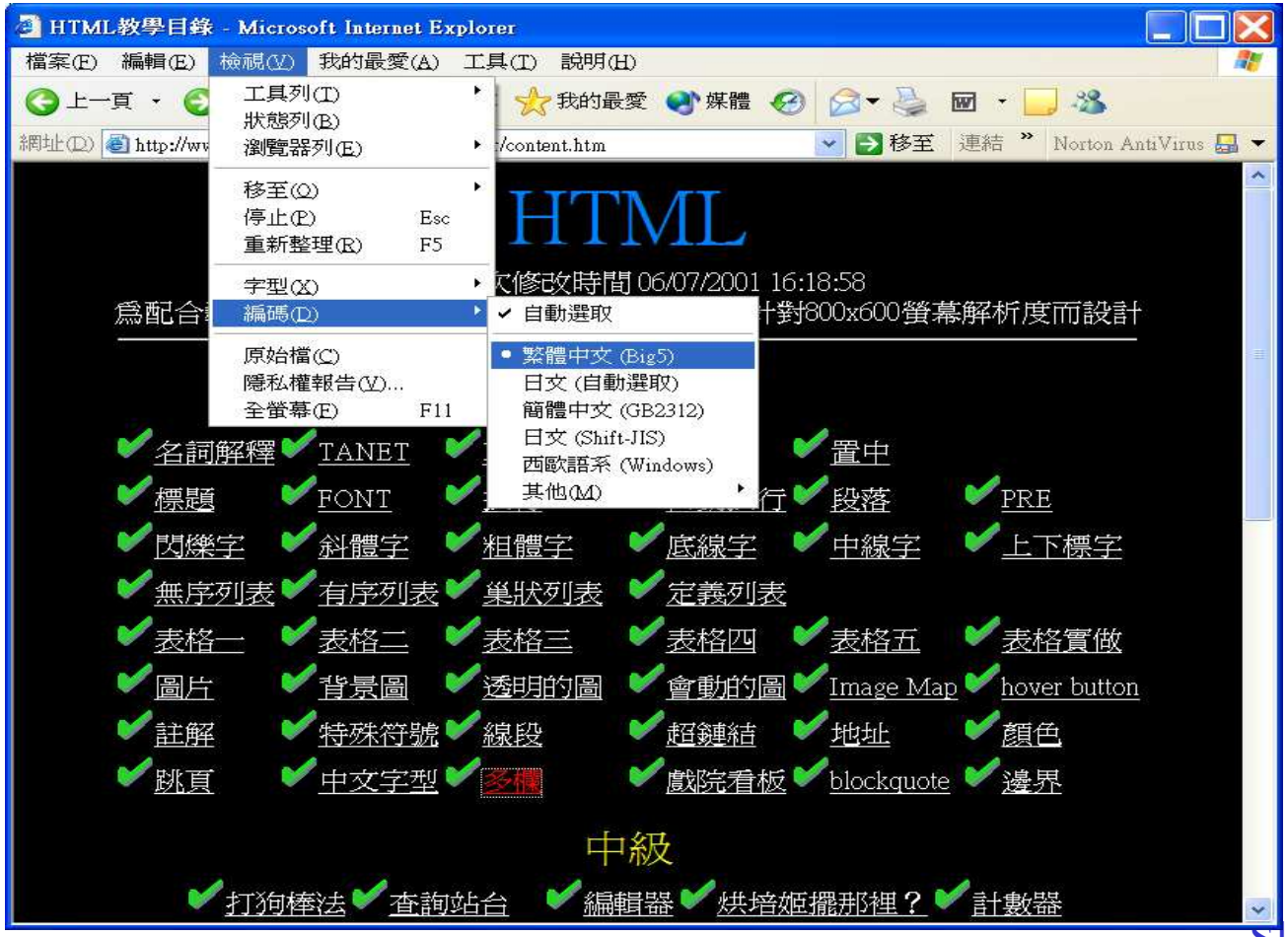
Head裡可強制用中文 big5 編碼

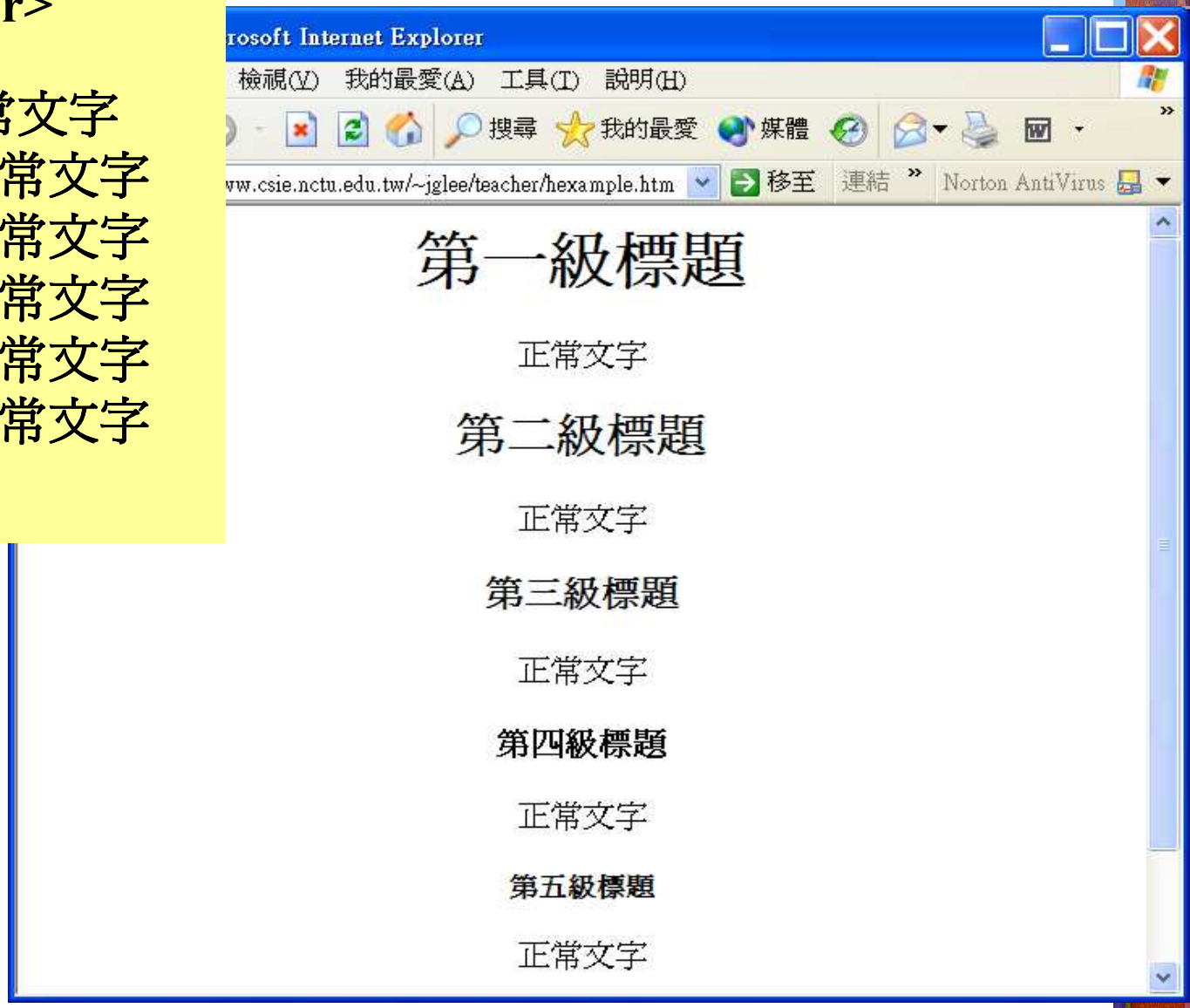
- <meta http-equiv="Content-Type"
  content="text/html; charset=big5">



Center 置中與標題 heading

```
<center>內容會置中</center>

<h1>第一級標題</h1>正常文字
  <h2>第二級標題</h2>正常文字
  <h3>第三級標題</h3>正常文字
  <h4>第四級標題</h4>正常文字
  <h5>第五級標題</h5>正常文字
  <h6>第六級標題</h6>正常文字
```



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常用控制用的 tag

- 字串
-
換列 new Line
- <p>段落開始
- **<pre>** 文件照所寫樣子顯示,
  包括換列, what you see what you get …
  </pre>
- **< b>粗體字** ***斜體字***
- 標準^{上標}標準_{下標}標準

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常用語法介紹－段落, 畫水平線

- <P ALIGN = LEFT>該段內文靠左對齊...該段內文靠左對齊.. 該段內文靠左對齊:該段內文靠左對齊: (預設值) </P>
- <P ALIGN = CENTER>該段內文置中對齊...該段內文置中對齊.. 該段內文置中對齊: </P>
- <P ALIGN = RIGHT>該段內文靠右對齊 ...該段內文靠右對齊:.. 該段內文靠右對齊: </P>
- <HR ALIGN="left" WIDTH=60% SIZE=3>
- <hr width=500 size=5 color=blue align="right">
- <hr width=680 size=2 color= “99bb88" align="center">

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Comments (註解)

- 註解的意識是說：這段文字是給人看的，所以電腦不會去理會該段文字。

- 在C語言裡面：　/*…註解…*/
- 在C++語言裡面：// …註解…
- ＨＴＭＬ語言：　<!--　…註解…　-->
  - 舊式註解　<!　註解 comment one line　>

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Special symbol 特殊符號 < & > "

< **(less then)** **來顯示小於符號** <

> **(greater then)** 來顯示大於符號 >

& **(ampersand)** **來顯示 & 符號**

" (quotes)來顯示雙引號 "

** ** (non-breaking space) **是一個空白**

在 **<pre>** … **</pre>** 中的文字 **<** 和 **&**
一定要用上述寫法, 否則會被 Browser 吃掉

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A Sample HTML page

```
<HTML>
<HEAD>
  <TITLE>歸去來辭 </TITLE>
 </HEAD>
<BODY>
<H1 ALIGN = CENTER><FONT COLOR = RED>
歸去來辭          ——陶淵明</FONT></H1>
余家貧，耕植不足以自給。幼稚盈室，缾無儲粟。生生所資，未見其術。親故多
余爲長吏，脫然有懷，求之靡途。...  <HR> <BR>
<P ALIGN = CENTER><FONT COLOR=BLUE> 歸去來兮！田園將蕪胡不歸？
<BR>
既自以心爲形役，奚惆悵而獨悲？<BR>悟已往之不諫，知來者之可追；<BR> 實
迷途其未遠，覺今是而昨非。<BR>舟遙遙以輕颺，風飄飄而吹衣。<BR>
問征夫以前路，恨晨光之熹微。<BR><BR>
乃瞻衡宇，載欣載奔，僮僕歡迎，稚子候門。<BR>三徑就荒，松菊猶存。
<BR>...</FONT></P>
<!-- 出自陶淵明 . 歸去來辭  -------->
</BODY>
</HTML>
```

排版結果在下頁

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歸去來辭　　——陶淵明

余家貧，耕植不足以自給。幼稚盈室，缾無儲粟。生生所資，未見其術。親故多余爲長吏，脫然有懷，求之靡途。...

歸去來兮！田園將蕪胡不歸？
既自以心為形役，奚惆悵而獨悲？
悟已往之不諫，知來者之可追；
實迷途其未遠，覺今是而昨非。
舟遙遙以輕颺，風飄飄而吹衣。
問征夫以前路，恨晨光之熹微。

乃瞻衡宇，載欣載奔，僮僕歡迎，稚子候門。
三徑就荒，松菊猶存。
...

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unordered list： UL , LH , LI

無序列表 - Microsoft Internet Explorer

http://www.csie.nctu.edu.tw/~jglee/teacher/ul.htm

無序列表

基本格式	範例	執行結果
<UL> <LH>標題 <LI>第一項 <LI>第二項 <LI>第三項 </UL>	<UL> <LH>資工營營規 <LI>上課不睡覺 <LI>睡覺不打呼 <LI>打呼不流口水 </UL>	資工營營規 • 上課不睡覺 • 睡覺不打呼 • 打呼不流口水

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Ordered List : OL , LH , LI

有序列表 - Microsoft Internet Explorer

檔案(F) 編輯(E) 檢視(V) 我的最愛(A) 工具(T) 說明(H)

上一頁 搜尋 我的最愛 媒體

網址(D) http://www.csie.nctu.edu.tw/~jglee/teacher/ol.htm 移至 連結 Norton AntiVirus

有序列表

基本格式	範例	執行結果
<OL> <LH>標題 <LI>第一項 <LI>第二項 <LI>第三項 </OL>	<OL> <LH>資工營營規 <LI>上課不睡覺 <LI>睡覺不打呼 <LI>打呼不流口水 </OL>	資工營營規 1. 上課不睡覺 2. 睡覺不打呼 3. 打呼不流口水

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Nested List

巢狀列表 - Microsoft Internet Explorer

http://www.csie.nctu.edu.tw/~jglee/teacher/ulol.htm

巢狀列表

格式	執行結果
<OL> <LI>第一項 <UL> <LI>第一點 <LI>第二點 </UL> <LI>第二項 <LI>第三項 </OL>	1. 第一項 ∘ 第一點 ∘ 第二點 2. 第二項 3. 第三項

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DL , LH , DT , DD

定義列表 - Microsoft Internet Explorer

檔案(F) 編輯(E) 檢視(V) 我的最愛(A) 工具(T) 說明(H)

上一頁 搜尋 我的最愛 媒體

網址(D) http://www.csie.nctu.edu.tw/~jglee/teacher/dldtdd.htm 移至 連結 Norton AntiVirus

定義列表

格式	範例	結果

<DL>
<LH>標題
<DT>第一個專有名詞
  <DD>定義內容
<DT>第二個專有名詞
  <DD>定義內容
...
</DL>
	<DL>
	<LH>交通大學
	<DT>工學院
	  <DD>資工系
	  <DD>電工系
	  <DD>電信系
	<DT>理學院
	  <DD>物理系
	  <DD>化學系
	  <DD>數學系
	</DL>
		交通大學
		工學院
		  資工系
		  電子系
		  電物系
		  電信系
		理學院
		  物理系
		  化學系
		  數學系

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Links (參照)

- 超鏈結文字
- <a **href=http://www.nctu.edu.tw**
  target=_blank
  align=bottom >學校網頁
- <A href= "mailto:tsaiwn@csie.nctu.edu.tw">
- <img src= "路徑/圖檔檔名"
  alt= "找不到圖檔時出現的 文字"
  width=寬度 height=高度 border="邊框大小">
- <a name=Anchors> : Links within a page

 goto Anchors

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Music and Sound

- <bgsound src="together.mid" LOOP=INFINITE >
- <embed src="together.mid" LOOP=true>.

此語法用以**設定背景音樂**，此語法可放在BODY中任何位置，在放置的地方會出現一個播放音樂的小視窗。WIDTH用以設定小視窗之寬度，HEIGHT設定小視窗之高度，如果不要顯示小視窗，可設WIDTH=2 HEIGHT=0（最好不要設成WIDTH=0 HEIGHT=0），或設HIDDEN=TRUE。
AUTOSTART=TRUE表示首頁一讀進來就播放背景音樂（相對值是FALSE，待使用者按下PLAY之後才會播放音樂）。 **LOOP=TRUE表示循環播放不停止，LOOP=2表示播放二次，其餘類推。**

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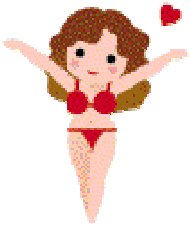
Background (背景圖) 與Table (表格)



- <body background="路徑/圖檔檔名">

- <table border=n bgcolor=pink>
  <caption>表格標題</caption>
  <TR><**TH>標題一</TH><TH>標題二</TH>**</TR>
- <tr><td>列一行一</td><td>列一行二
  </td></tr>
  <tr><td>列二行一</td><td>列二行二
  </td></tr>
  </table>

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Tables again

- <table> </table> defines a table
  - <tr> </tr> - Table row
  - <td> </td> - Table column

```
<table border=2>
 <tr>      <!--  start a table row  -->
    <td colspan=3> If you have two &lt;TR&gt; tags
     in your table, you will have two rows in your table. </td>
 </tr>
 <tr>
    <td>If you have three &lt;td&gt; tags</td>
    <td>in a row, you will have</td>
    <td>three cells in the row.</td>
 </tr>
</table>
```

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Hover Button

DOM : Document Object Model

```
<a href="content.htm"
   onMouseOver='document.haha.src="http://www.csie.nctu.edu.tw/~tsaiwn/course/FLCS/images/button2.gif" '
onMouseOut=document.haha.src="http://www.csie.nctu.edu.tw/~tsaiwn/course/FLCS/images/button1.gif">

  <img name=haha src=
   "http://www.csie.nctu.edu.tw/~tsaiwn/course/FLCS/images/button1.gif"
   border=0>
</a>
```

http://en.wikipedia.org/wiki/Document_Object_Model

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Meta refresh －自動換頁

```
<HTML>
<HEAD>
<TITLE>自動換頁</TITLE>
<meta http-equiv="refresh" content="5;url=http://www.cwb.gov.tw/">
</HEAD>
<BODY>
五秒鐘後將自動連向中央氣象局全球資訊網；若五秒鐘後無法連結。
請按下列連結，謝謝！
<a href="http://www.cwb.gov.tw/">http://www.cwb.gov.tw/</a>
</BODY>
</HTML>
```

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Meta http-equiv= "Content-Type" 指定文字的編碼

```
<head>
  <meta http-equiv="Content-Type"
  content="text/html; charset=big5" />

</head>
<body>
<font color=blue size=4><b><pre>
   What you see What you Get
    …
```

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MARQUEE －跑馬燈

```
<html>
<head>
<title>跑馬燈練習</title>
</head>
<body>
<MARQUEE BEHAVIOR=ALTERNATE width=50%>
<IMG SRC="http://www.sinica.edu.tw/~nick/images/005.gif" border=0>
<FONT color=#0bcdef>圖片和文字都可以喔！</FONT></MARQUEE>
<MARQUEE DIRECTION=LEFT>我往左跑</MARQUEE><P>
<MARQUEE DIRECTION=RIGHT>我往右跑</MARQUEE><P>
</body>
</html>
```

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HTML with JavaScript

```
<html>
<head>
<title>最後更新日</title>
</head>
<body>
<b>Hello there <hr color=red width=33% align=Left>
<script language="JavaScript">

<!--  courier new font
document.write("<font color=blue size=6>");
document.write("最後更新日期: " +
    document.lastModified);
//  左邊的 // 要留著  -->
</script>
</body>
</html>
```

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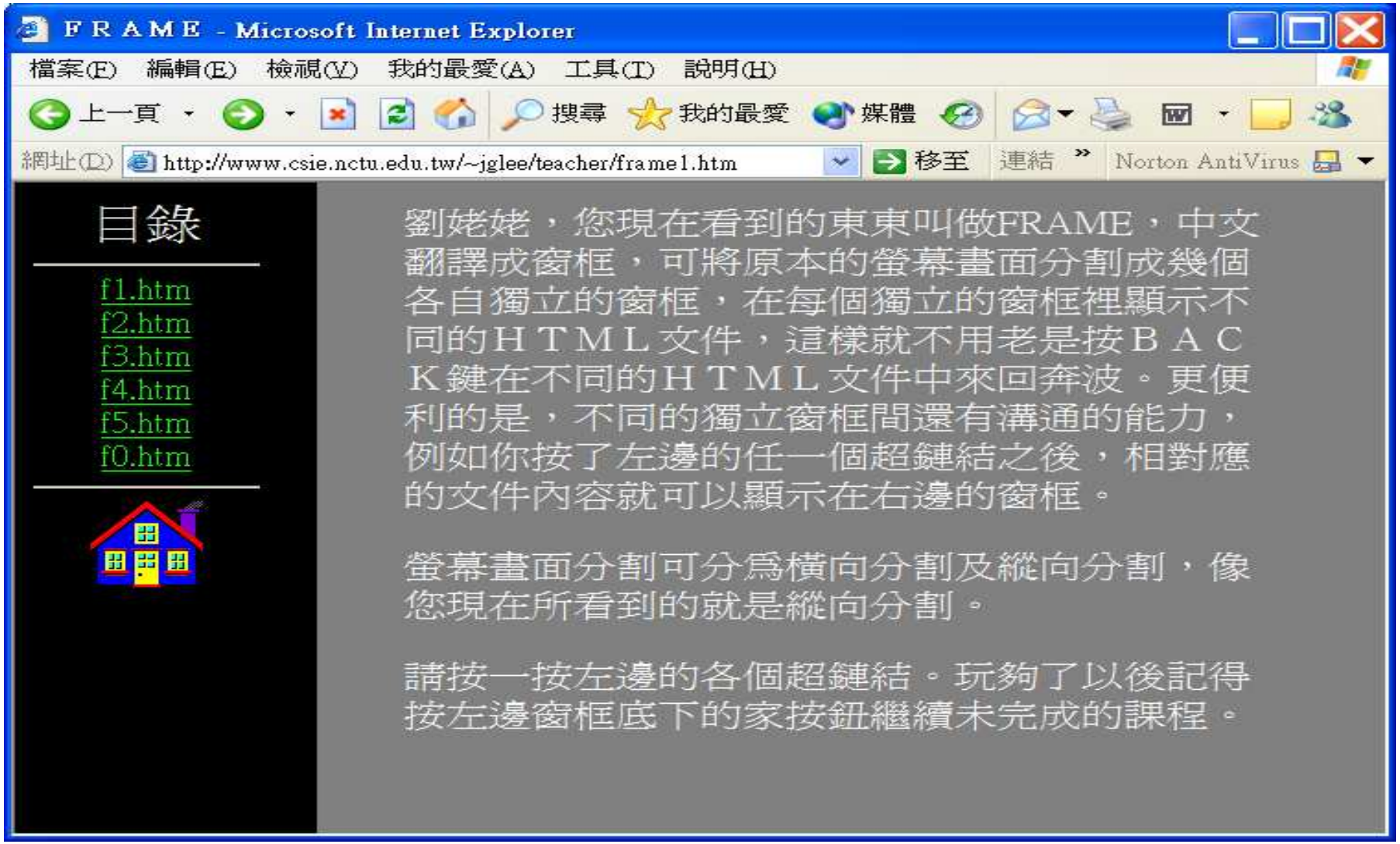
Using Frame



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Frame test 1 --先左右分多重頁框

```
<HTML><HEAD>
    <TITLE>Frame框架實作 test 1</TITLE>  </HEAD>
<FRAMESET COLS="120,*"> <!--先左右分割 -->
  <FRAME SRC="http://www.sinica.edu.tw/" >
  <FRAMESET ROWS="100,*">
      <FRAME SRC="http://www.pchome.com.tw">
      <FRAME SRC="http://www.google.com">
  </FRAMESET>
</FRAMESET>
<BODY>
</BODY>
</HTML>
```

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Frame test 2 --先上下分多重頁框

```
<html>
<head> <TITLE>Frame框架實作 test 2</TITLE>
  </head>
<frameset rows="30%,*"> <!--分割上下頁框-->
<frame src="top.htm"  name=ggyy><!--指定上頁框的檔案-->
<frameset cols="30%,*">
   <!--再將下頁框分割成左右-->
<frame src="left.htm" name=index><!--指定左頁框的檔案-->
<frame src="right.htm" name=right><!--指定右頁框的檔案-->
</frameset>
</frameset>
</html>
```

必要時要指定 target=_blank 或是 target=right

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left.htm for previous frame

```
<html><head>   <title>Frame Index</title>
 <META HTTP-EQUIV="Content-Type"
   CONTENT="text/html; charset=big5">
</head>
<body bgcolor="#000000"
  text="Blue" LINK="#0099aa" VLINK="#00FF00"
     ALINK="#FF0000">
<center><Font Size=5> Index haha </Font>
<hr width=88%><!-- ============ -->
<a href=f1.htm target=right>f1.htm</a><br>
<a href=f2.htm target=right>f2.htm</a><br>
<a href=f3.htm target=right>f3.htm</a><br>
<a href=f4.htm target=right>f4.htm</a><br>
<a href=f5.htm target=right>f5.htm</a><br>
<a href=f0.htm target=right>f0.htm</a><br>
<!=============================>
<hr width=100%><img src=
"http://www.csie.nctu.edu.tw/~tsaiwn/gifdir/fire1.gif">
</center></body></html>
```

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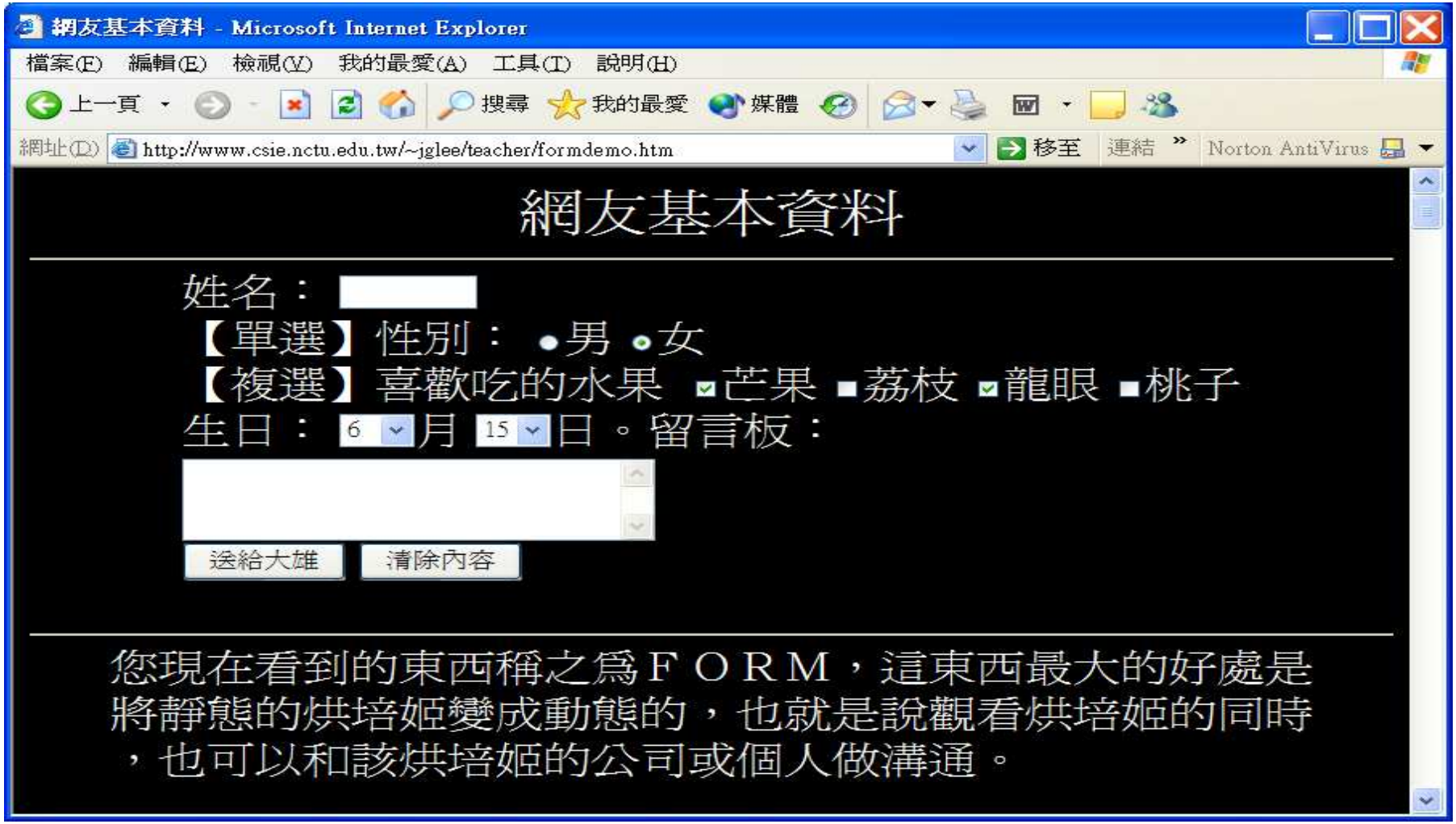
FORM and CGI (1/2)



http://www.csie.nctu.edu.tw/~tsaiwn/sample/

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FORM and CGI (2/2)

```
<form method=post
  action="http://www.csie.nctu.edu.tw/~tsaiwn/cgi-bin/haha.cgi">
   姓名：<input type=text name=NAME value="" size=8 maxlength=8>
   密碼：<input type=password name=passwd value="" size=8 maxlength=8>
   <input type=radio name=SEX value=男>男
   <input type=radio name=SEX value=女 checked>女
   <br> <input type=submit value="送出去">
   <input type=reset value="清除內容">
</form>
```

method=post vs. method=GET

The CGI should receive the FORM data through the standard input stream (stdin) when METHOD="POST" is used.

GET/PUT: **The form data is encoded (by browser) into the URL.**
CGI program in C: `char * p = getenv("QUERY_STRING");`

http://www.csie.nctu.edu.tw/~tsaiwn/sample/

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View Source
善用 Browsers 的 “檢視原始檔”能力

- One of the most important thing is to look at the source of a file.
- Internet Explorer – **View – Source**
- Netscape – View – Page Source
- Firefox – ? Finger out by yourself ☺
- Helps to learn HTML
- Get new ideas from other guys’ Web pages..☺

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Techniques for Dynamic web pages

- Client-side
  - Examples: Java Applets, Javascript/VBScript, Macromedia (Adobe) **Flash**
- Server-side
  - Common Gateway Interface (CGI)
    - A runnable program on server in any language
  - DBMS + SQL
  - Servlets
  - ASP, PHP, JSP
  - Server Side Javascript, SSI, …

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What is DHTML? (1/2)

- DHTML is the combination of several built-in browser features in fourth generation browsers that enable a web page to be more dynamic.
- DHTML is NOT a scripting language (like JavaScript), but a browser feature- or enhancement- that makes the browser dynamic
- It uses a host of different technologies - JavaScript, VBScript, the Document Object Model (DOM), layers, cascading stylesheets - to create HTML that can change even after a page has been loaded into a browser

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What is DHTML? (2/2)

- It is considered to be made up of
  - **HTML**
  - **Cascading Style Sheets (CSS)**
  - **Scripting Language**
- All three of these components are linked via **Document Object Model** (DOM)
- DOM is the **interface** that allows scripting languages to access the content, style, and structure of the web documents and change them dynamically

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Tools of DHTML

- **HTML** and **XML**
  - Partitions and Organizes the content
- **CSS**, XSL - CSS1, CSSP, CSS2
  - Defines the Presentation of the content
- **Scripting** - JavaScript, JScript, VBScript
  - Adds interactivity to the page
- **DOM**- Document Object Model
  - Defines **what** and **how** elements are exposed for script access

http://en.wikipedia.org/wiki/Java_API_for_XML_Processing

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eXtensible Markup Language (XML)

- **XML**: a language for constructing markup languages, similar to HTML
  - A descendant of **SGML**
- Allows the development of new markup languages in that they emphasize semantics rather than appearance (with DTD)
- http://www.xml.org/ **http://www.xml.org/**

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http://W3.org

World Wide Web Consortium - Microsoft Internet Explorer

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Mobile Web Initiative

W3C has launched the Mobile Web Initiative (MWI) to make Web access from a mobile device as simple, easy, and convenient as Web access from a desktop device. Read about

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▸ W3C Launches Indian Office

2005-10-27: W3C is pleased to announce the opening of the W3C Indian Office in Noida, India. The Office is hosted by the Centre for Development of Advanced Computing (C-DAC

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What is CSS? (1/2)

- CSS is an acronym of **C**ascading **S**tyle **S**heets
- It is a **specification** controlled by the World Wide Web Consortium (W3C).
- Home Page
  - ✓ HTML controls the organization of a Web page document (structure)
  - ✓ CSS controls the **presentation and layout** of the Web page document elements
  - ✓ Client side Script (e.g., Javascript) controls the behavior

http://en.wikipedia.org/wiki/CSS

http://w3c.org http://w3c.org

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What is CSS? (2/2)

- CSS1- **visual presentation** of elements
- CSSP - **positioning** of elements
- CSS2 -**visual and audio** presentation of elements. It includes attributes from CSS1 and CSS-P
- What **CSS is to HTML**, **XSL is to XML**

http://en.wikipedia.org/wiki/CSS

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What CSS can do?

- Control **presentation and layout** (alignment, spacing, margins, colors, font-size, floating elements, etc.)
- **Maintain and update many pages** faster and easier
- With CSS you can **separate form from structure**
  - ✓ HTML controls the **structure** of a Web page
  - ✓ CSS controls the **form** (**presentation and layout**) of the Web page

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CSS example (1/2)

- 超連結去底線 (沒底線, 但仍可以點按)

【語法】

1.在<head>…</head> 之中加入下列語法

```
<style>
  a{text-decoration:none}
 </style>
```

2.或是在<body>…</body>加入下列語法

```
<a style="text-decoration: none" href="網址">連結名稱</a>
```

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CSS example (2/2)

```
<html>  <head>  <title>CSS應用</title>
<style>
   a{text-decoration:none; color:red}
   H2 {color : green ; Font-size:18pt}
</style>  </head>
<body><font size=3>  <h2> Ha haha </h2> <h3>He <font color=red
     size=5>heehee</font> La!
</h3>
<a style="color:Blue"     href="http://www.nctu.edu.tw"
  target=_blank>    交通大學</a>    <br><font size=2>
<a  href="http://www.sinica.edu.tw">
中央研究院</a> </font> <br/>
 <a  style="background-color:yellow;font-size:28px;
   text-decoration:underline;"
  href="http://www.nthu.edu.tw">清華大學</a>
<b><font coolor=blue styyle="color:red" color=Yellow>
 La La La </font>ha ha
</body>
</html>
```

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CSS-Terminology (1/2)

- CSS is declared as **rules**:
  - Eg: **H1 {color: green}**
  - Means that all text surrounded by the **<H1></H1>** tags should be displayed in **green** color
- A rule has two parts
  - **H1 {color:green}**

SELECTOR { DECLARATION }

http://en.wikipedia.org/wiki/CSS

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CSS – Terminology (2/2)

- **Declaration** has two parts:

H1 **{color : green }**

property : Value

- In general:

Element(s) { **Property1**:**Value1**; **Property2** : **Value2a** , **Value2b** }

Eg.: H1, B {**color:olive**; **background:yellow**; **fontfamily**: **arial**, **courier** }

http://en.wikipedia.org/wiki/CSS

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CSS - How to use CSS to add styles to web pages

- **Four** ways
  1) **Embed** a style sheet within HTML document
  2) **Add** styles **inline** in the HTML document
  3) **Link** to an **external stylesheet** from the HTML document
  4) **Importing** style sheets

http://en.wikipedia.org/wiki/CSS

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1) CSS -Embed a style sheet

- All stylesheet information lies at the top of the HTML code (in the **head** portion)

Eg:

```
<HTML> <Head>
<STYLE TYPE="text/css">
<!--
H1 {color: green; font-family: impact}
-->
</STYLE>
</Head>
<BODY> . . .
  < H1>   green green green  … </ H1>
```

- Style **applies to the whole document**

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2) CSS-Add styles **inline**

- Applying stylesheets rules to **particular HTML tags**

Eg:

<B STYLE="color: purple; background: yellow">Adding Inline styles</B>

- The style **applies to only that particular** <B> **tag**

inline CSS (就是直接寫在 tag 宣告內)

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3) CSS - Link to an external stylesheet

- **An externally defined stylesheet** is used as a style template that can be applied to a number of pages
- A **text file** (with ext .css) contains the stylesheet rules to be applied to a page (or set of pages)

Eg. A file named **'mystyles.css'**

```
H1 {color: green; font-family: impact}
B {color: red; font-family: courier}
```

- This **file is linked** to the HTML document (<LINK>)

In the web Page:

```
<HTML>
<LINK REL=stylesheet HREF="mystyles.css" TYPE="text/css">
<HEAD>
<BODY>
 . . .
```

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4) CSS – Importing Stylesheets

- Style Sheets which are **external** to the HTML document are imported (included) into the <style> element within the <head> element of the current document.
- **Similar to linking**, but useful when you want to **override some style rules** when you include it in your own stylesheet.

```
<style type="text/css">
<!-- @import url(http://www.cen.com/houseBasic.css);
ul { list-style-type: circle; } -->    </style>
```

- The imported sheets must appear before any document-specific styles

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Tools to build a Web Page

- You can just use **NOTEPAD / Notepad+**
  - Write some **bunch of code** in a HTML file
- Or you can use **WYSIWYG** (pronounced "wiz-ee-wig", means “What You See Is What You Get) editors.
  - Netscape Composer
  - Microsoft Front Page
  - **Dreamweaver MX**
  - HTML ABC, HotDog, …
  - Hundreds of other Editors available on the Internet – the Cyber spaces ☺

http://en.wikipedia.org/wiki/Web_development

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HTML editor? DreamWeaver? Microsoft FrontPage? …

- Why do I need to know HTML when I have an html editor?
  - **An HTML editor will work fine for what you want to do 99% of time**, but there are little 'quirks' to the GUI interface that will cause your webpage to look slightly different than what you intended. But if you know some html you can look at the 'code' of the html document and make simple adjustments.
- So, why don't you just write in HTML all the time?
  - **Why don't you walk to Taipei from Hsinchu instead of drive**? Because it takes too long!
    - Except for the occasional code tweak, you will design a website infinity faster in an HTML editor and with less errors.
      - I can't type more than a line or two before I will mistype or misspell something. If you do this in your 'code', the webpage will not work and/or will not look the way you intended.
      - Trouble shooting a large page of code is tedious and difficult.

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Web Applications (*1/2*)

- Web application or webapp is an application that is accessed with a Web browser over a network such as the Internet or an intranet. (from *Wikipedia*)
- Web applications are usually smaller than regular desktop applications, and can have rich graphical interactive interfaces (GUI programs).
- Web applications are used to implement WebMail, Discussion boards, Blogs, Online Retail sales, Online Auctions, Online Games, Wikis, and many other functions.

WWW 被稱爲影響力最大的軟體發明

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Web Applications (2/2)

- A Web application is typically downloaded on demand each time it is "executed", allowing a developer to update the application for all users when needed.
- Web applications typically have some form of programmatic control, either on the client, on the server or a combination of both.
  - technologies used on server side: DBMS + SQL, CGI/ASP/JSP/PHP, …
  - technologies used on client side: CSS, Java Applets, Javascript/VBScript, Macromedia (Adobe) **Flash**

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Apache Struts – a Framework for Webapp

- Apache Struts is a free open-source framework for creating Java web applications.
- The Struts framework is designed to help developers create web applications that utilize a Model-View-Controller (MVC) architecture. Struts works well with conventional REST (REpresentational State Transfer) applications and with new technologies like SOAP and AJAX.
- The framework provides three key components:
  - A "request" handler provided by the application developer that is mapped to a standard URI.
  - A "response" handler that transfers control to another resource which completes the response.
  - A tag library that helps developers create interactive form-based applications with server pages.

HTTP Request Messages

- GET – retrieve document specified by URL
- PUT – store specified document under given URL
- HEAD – retrieve info. about document specified by URL
- OPTIONS – retrieve information about available options
- POST – give information (eg. annotation) to the server
- DELETE – remove document specified by URL
- TRACE – loopback request message
- CONNECT – for use by caches

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HTTP Request Format

request-line (request request-URI HTTP-version)
headers (0 or more)
<blank line>
body (only for POST request)

- First type of HTTP message: *requests*
  - Client browsers construct and send message
- Typical HTTP request:
  - GET http://www.cs.wisc.edu/index.html HTTP/1.0

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HTTP Response Format

status-line (HTTP-version response-code response-phrase)
headers (0 or more)
<blank line>
body

- Second type of HTTP message: *response*
  - Web servers construct and send response messages
- Typical HTTP response:
  - HTTP/1.0 301 Moved Permanently

    Location: http://www.wisc.edu/cs/index.html

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HTTP Response Codes

- 1xx – Informational – request received, processing
- 2xx – Success – action received, understood, accepted
- 3xx – Redirection – further action necessary
- 4xx – Client Error – bad syntax or cannot be fulfilled
- 5xx – Server Error – server failed

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Thank You!

CHAPTER 4

Networking and the Internet

Part A

To be continued

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