CSE 3

- Comics
- Updates
- Shortcut(s) of the day
- Relevant Units of Measure
- How Computers Work
  - Pages 304-311; Ch 24-28

Relevant Units of Measure – Time

<table>
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<th>Symbol</th>
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<th>Prefix</th>
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<td>1 sec</td>
<td></td>
<td>1000 ms</td>
<td></td>
</tr>
<tr>
<td>1 ms</td>
<td></td>
<td>1/1000 sec</td>
<td>10^-3</td>
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<tr>
<td>1 μs</td>
<td></td>
<td>1/1,000,000 sec</td>
<td>10^-6</td>
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<tr>
<td>1 ns</td>
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<td>1/1,000,000,000 sec</td>
<td>10^-9</td>
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<td>1/1,000,000,000,000 sec</td>
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<td>1 fs</td>
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<td>1/1,000,000,000,000,000 sec</td>
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1 GHz processor = 1 ns cycle time

Relevant Units of Measure – Space

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<td>G</td>
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<td>T</td>
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<td>Exa</td>
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<td>yotta</td>
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Chapter 3:
Making the Connection: The Basics of Networking

Fluency with Information Technology
Third Edition
by Lawrence Snyder

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Third Edition
by Lawrence Snyder

Networked Computers Change Our Lives

- The Information Age has brought profound changes
  - Nowhere is remote
  - People are interconnected
  - Social relationships are changing
  - English is becoming a universal language
  - Freedom of speech and assembly have expanded

Nowhere Is Remote

- Internet is a complete information resource no matter where you are
  - Some differences remain because older sources are not yet all online
- Homes are not remote from work
  - Information workers can telecommute and live long distances from their offices
People Are More Interconnected

- Family and friends stay in closer, more frequent contact via Internet than via telephone or "snail mail"
- WWW lets us meet people passively
  - People with similar interests find each other through search engines
  - Associations can form rapidly

Social Interactions Are Changing

- Time spent online displaces other in-person social activities (displacement effect)
- The effects are complicated (pros/cons)
- The Internet is changing social interactions, but we don't fully understand how

English Is Becoming a Universal Language

- Influence of American pop culture since World War II
- Dominance of science and technology in English-speaking countries
- Much software is available only in English
- Most web pages are in English

Freedom of Speech and of Assembly Have Expanded

- Internet use is unmediated
  - No editorial oversight or significant restrictions
  - Wikis
- Allows for political and artistic expression
- Blogs record personal thoughts for public viewing
- Like-minded people can communicate, even on private topics

Communication Types

- General Communication
  - Synchronous: sender and receiver are active at the same time
    - e.g., telephone call, instant messaging (IM)
  - Asynchronous: sending and receiving occur at different times
    - e.g., e-mail
  - Broadcast communication (or multicast): single sender and many receivers
  - Point-to-point communication: single sender and single receiver

Figure 3.1: A diagram of the Internet.
The Internet's Communication Properties

- Internet provides a general communication “fabric” linking all computers connected to it
  - Can be applied in many ways:
    - Point-to-point asynchronous
      - E-mail is alternative to standard mail
    - Point-to-point synchronous
      - IM is alternative to telephone
    - Multicasting
      - Chat rooms are alternatives to magazines
    - Broadcasting
      - Web pages are alternatives to radio and television

The Client/Server Structure

- Server is the computer that stores the web page
  - Web server, file server, mail server
- Client is the computer that accesses the web page
- When you click link, your computer enters client/server relationship with web server
- Once the page is sent to you, the client/server relationship ends
- Server can form many brief relationships so it can serve many clients at the same time

The Medium of the Message

- The Name Game of Computer Addresses
  - IP addresses: Each computer connected to the Internet is given a unique numerical address
    - For example: 128.95.1.207
  - Hostnames: Human-readable symbolic names, based on domain hierarchy
    - Easier to read and remember
    - For example: spiff.cs.washington.edu
DNS Servers

- The Domain Name System (DNS) translates the human-readable hostnames into IP addresses
- Internet host knows the IP address of its nearest DNS server, a computer that keeps a list of host/domain names and corresponding IP addresses
- When you use a hostname to send information, your computer asks the DNS server to look up the IP address
- If the DNS server doesn’t know the IP address, it asks a Root name server, which keeps the master list of name-to-address relationships

Top-level Domains

- Domain is a related group of networked computers
- Top-level domains appear in the last part of domain name:
  - .edu educational institutions
  - .org organizations
  - .net networks
  - .mil military
  - .gov government agencies
  - Mnemonic two-letter country designators such as .ca (Canada)

Following Protocol

- A protocol describes how the information is actually sent
- TCP/IP (Transmission Control Protocol/Internet Protocol)
  - Information is broken into a sequence of small fixed-size units called IP packets
  - Each packet has space for the unit of data, the source and destination IP addresses, and a sequence number
  - The packets are sent over the Internet one at a time using whatever route is available
  - Because each packet can take a different route, congestion and service interruptions do not delay transmissions

Figure 3.3: The seven-layer model of the Internet reference model (continued)

Figure 3.5: DNS hierarchy (continued)

Figure 3.6: DNS lookup with local DNS server

Figure 3.7: The TCP/IP protocol analogy
Moving Packets: Wires and More

- Internet uses electrical, electronic, and optical communication means
- Telephone lines, dedicated fiber optic lines, etc.
- The technology used to move the packet is independent from the protocol; transmission of a single file may use multiple technologies

Far and Near: WAN and LAN

- Internet is a collection of Wide Area Networks (WAN), designed to send information between widely separated locations
  - Multiple hops
    - ping, traceroute
- Local Area Networks (LAN) connect computers close enough to be linked by a single cable or wire pair
  - Ethernet is the main technology for LAN

Ethernet

- Channel (wire, wire pair, or optical fiber) that winds past a set of computers
- Each computer is connected to the channel, allowing it to send a signal that can be detected by all computers connected to the channel
- Decentralized scheme: Each computer listens to the channel, and if it's quiet, it's free. The computer transmits unless another starts at the same time. In that case, both stop for a random time and then try again.

Connecting a Computer to the Internet

- By ISP:
  - Internet Service Providers sell connections to Internet (like AOL and Earthlink)
  - User plugs into telephone system or dedicated connection to ISP (DSL, cable)
  - Home computer talks to ISP's computer
  - ISP's computer is connected to Internet, and relays information for its customers
Connecting a Computer to the Internet (cont’d)

• By Enterprise Network Connections (LAN):
  – Large networked organizations such as schools, businesses, or governmental units
  – The organization creates a LAN or intranet
  – The intranet connects to the Internet by a gateway
  – Information from a Web computer is sent across Internet, through gateway, across LAN to user’s computer

Wireless Networks

• A variation on the LAN connection
• A computer (called the access point or hub) is physically connected to the Internet (wired)
  – The hub broadcasts and receives radio frequency (rf) signals (wireless)
  – Mobile computers also send and receive signals (wireless)
  – Access point hands out temporary IP addresses via DHCP (Dynamic Host Configuration Protocol)
• The hub relays Internet requests for the connected wireless computers

The World Wide Web

• Web servers: Computers programmed to send files to browsers running on other computers connected to the Internet
• Web servers and their files make up the World Wide Web
• The World Wide Web is a subset of the Internet

Requesting a Web Page

• Web request creates a client/server interaction
• Uniform Resource Locator (URL) has three main parts
  1. Protocol:
    • http:// ftp://
    • Hypertext Transfer Protocol File Transfer Protocol
    • Tells the computer how to handle the file
  2. Server computer’s name:
    • Server’s IP address given by the domain hierarchy
  3. Page’s pathname:
    • Tells the server which file (page) is requested and where to find it.

Describing a Web Page

• Pages are stored as a description of how they should appear on the screen
• Web browser created the image from the description file
  – Browser can adapt the source image more easily

Hypertext

• Hypertext Markup Language (HTML)
• Markup languages describe the layout of a document
  – Margin width
  – Font
  – Text style
  – Image placement
  – Etc.
• Hypertext provides a way to jump from point to point in documents (non-linear)
• Combination of hypertext and markup languages lets us build non-linear documents for the dynamic and interconnected Net and Web
  – Much more on HTML in Chapter 4
The Internet and the Web

- When is the "www" required and when is it optional?
- WWW is just a name; web servers do not have to use it
- In order for DNS to work, user must give the exact hostname
- To help users reach them, organizations do two things:
  1. Redirection: server inserts the "www" or redirects to a different server
  2. Registering multiple domain names
     - Museum of Modern Art has registered both "moma.org" and "www.moma.org" to the same IP address

File Structure

- Directory, or folder, is a named collection of files, other directories, or both
- Directory Hierarchy: Directories can contain other directories, which can contain other directories, etc.
  - Down, or lower in the hierarchy, means moving into subdirectories
  - Up, or higher in the hierarchy, means into enclosing (parent) directories

File Structure (cont’d)

- Part of the directory hierarchy is shown in the pathnames of URL’s.
  - http://www.nasm.si.edu/galleries/ga1100/pioneer.html
- Page is given by pathname:
  - /galleries/ga1100/pioneer.html
- Each time we pass a slash (/), we move into a subdirectory or into the file (lower in the hierarchy)

Organizing the Directory

- When a URL ends in a slash, the browser looks for a file called index.html in that directory
  - http://www.widget.com/ and http://www.widget.com/index.html are the same
- If the browser does not find an index.html file, the browser automatically tries to display a directory listing (index) of the files there
- Why are hierarchies important?
  - People use them to organize their thinking and work
  - Directories are free; there is no reason not to use them