

CSC 121

Computers and Scientific Thinking

Fall 2005

Computer Basics

1

What is a Computer?



a *computer* is a device that receives, stores, and processes information

different types of computers have different characteristics

- *supercomputers*: powerful but expensive; used for complex computations (e.g., weather forecasting, engineering design and modeling)
- *desktop computers*: less powerful but affordable; used for a variety of user applications (e.g., email, Web browsing, document processing)
- *laptop computers*: similar functionality to desktops, but mobile
- *palmtop computers*: portable, but limited applications and screen size



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Desktop Specifications

purchasing a computer can be confusing

- sales materials contain highly technical information and computer jargon

the following specs describe two computer systems for sale in June, 2003

- Desktop 1 is a low-end system, inexpensive but with limited features
- Desktop 2 is a high-end system, uses the latest technology so expensive

| | Desktop System 1 | Desktop System 2 |
|---------------------|--------------------------------------|--|
| CPU | 2.2 GHz Intel® Celeron® Processor | 3.2 GHz Intel® Pentium® 4 Processor |
| Memory | | |
| Cache | 256 K Cache | 512 K Cache |
| RAM | 256 MB RAM | 1 GB RAM |
| Hard Drive | 40 GB hard drive | 500 GB hard drive |
| Floppy Drive | 3.5" 1.44 MB diskette drive | 3.5" 1.44 MB diskette drive |
| CD-ROM/DVD | 48x/24x/48x CD-RW/DVD Drive | 48x/24x/48x CD-RW/DVD-RW Drive |
| Input/Output | | |
| Keyboard | Multi-function Keyboard | Multi-function Keyboard |
| Pointing Device | Optical Wheel Mouse | Optical Wheel Mouse |
| Screen | 17" Color Monitor (15.9" viewable) | 18" LCD Flat Panel Display |
| Speakers | Speakers | 5-piece sound system |
| Modem | 56 K Modem | 56 K Modem |
| Network Adapter | 10/100 Ethernet Adapter | 10/100/1000 Ethernet Adapter |
| Software | | |
| Operating System | Microsoft Windows XP Home Edition | Microsoft Windows XP Home Edition |
| Applications | Internet Explorer Microsoft Works | Internet Explorer Microsoft Office XP Small Business Quicken® New User Edition Norton Anti-Virus™ |

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Hardware vs. Software

the term *hardware* refers to the physical components of a computer system

- e.g., monitor, keyboard, mouse, hard drive

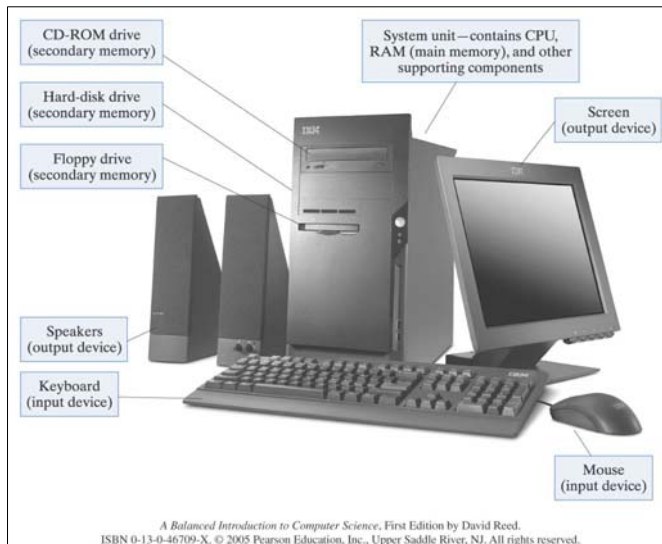
the term *software* refers to the programs that execute on the computer

- e.g., word processing program, Web browser

| | Desktop System 1 | Desktop System 2 | |
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Common Desktop Hardware



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von Neumann Architecture

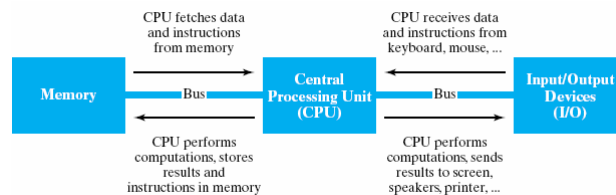


although specific components may vary, virtually all modern computers have the same underlying structure

- known as the *von Neumann architecture*
- named after computer pioneer, John von Neumann, who popularized the design in the early 1950's

the von Neumann architecture identifies 3 essential components

1. *Input/Output Devices (I/O)* allow the user to interact with the computer
2. *Memory* stores information to be processed as well as programs (instructions specifying the steps necessary to complete specific tasks)
3. *Central Processing Unit (CPU)* carries out the instructions to process information



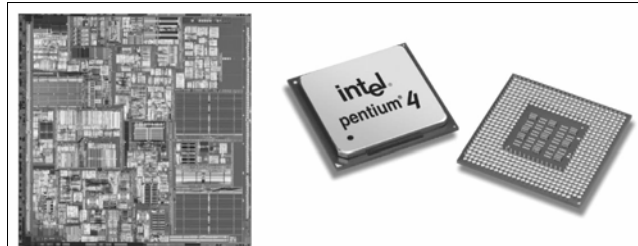
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Central Processing Unit (CPU)



the CPU is the "brains" of the computer, responsible for controlling its inner workings

- made of *circuitry* – electronic components wired together to control the flow of electrical signals
- the circuitry is embedded in a small silicon chip, 1-2 inches square
- despite its small size, the CPU is the most complex part of a computer (CPU circuitry can have 10's of millions of individual components)
- commercial examples: Intel Pentium 4, AMD Athlon, Motorola PowerPC G4



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CPU (cont.)



the CPU works by repeatedly fetching a program instruction from memory and executing that instruction

- individual instructions are very simple (e.g., add two numbers, or copy this data)
- complex behavior results from incredible speed
 - a 2.2 GHz Celeron processor can execute 2.2 billion instructions per second
 - a 3.2 GHz Pentium 4 processor can execute 3.2 billion instructions per second

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Memory

memory is the part of the computer that stores data and programs

modern computers are *digital* devices, meaning they store and process information as *binary digits (bits)*

- bits are commonly represented as either 0 or 1
- bits are the building block of digital memory
 - by grouping bits together, large ranges of values can be represented

| | | |
|---------|-------------------------|--|
| 1 bit | → 2 values | 0 1 |
| 2 bits | → 4 values | 00 01 10 11 |
| 3 bits | → 8 values | 000 001 010 011 100 101 110 111 |
| 4 bits | → 16 values | 0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1111 |
| 5 bits | → 32 values | 00000 00001 00010 00011 00100 00101 00110 00111 01000 01001 01010 ... |
| 6 bits | → 64 values | 000000 000001 000010 000011 000100 000101 000110 000111 001000 ... |
| 7 bits | → 128 values | 0000000 0000001 0000010 0000011 0000100 0000101 0000110 0000111 ... |
| 8 bits | → 256 values | 00000000 00000001 00000010 00000011 00000100 00000101 00000110 ... |
| 9 bits | → 512 values | 000000000 000000001 000000010 000000011 000000100 000000101 ... |
| 10 bits | → 1,024 values | 0000000000 0000000001 0000000010 0000000011 0000000100 0000000101 ... |
| . | | . |
| . | | . |
| N bits | → 2 ^N values | |

Memory (cont.)

memory capacity is usually specified in bytes

- a *byte* is a collection of 8 bits – so can represent a range of $2^8 = 256$ values
- large collections of bytes can be specified using prefixes

| | |
|---------------|--|
| byte | → 8 bits |
| kilobyte (KB) | → 2 ¹⁰ bytes = 1,024 bytes (= 8,192 bits) |
| megabyte (MB) | → 2 ²⁰ bytes = 1,048,576 bytes (= 8,388,608 bits) |
| gigabyte (GB) | → 2 ³⁰ bytes = 1,073,741,824 bytes (= 8,589,934,592 bits) |
| terabyte (TB) | → 2 ⁴⁰ bytes = 1,099,511,627,776 bytes (= 8,796,093,022,208 bits) |

since a byte is sufficient to represent a single character, can think of memory in terms of text

- a kilobyte can store a few paragraphs (roughly 1 thousand characters)
- a megabyte can store a book (roughly 1 million characters)
- a gigabyte can store a small library (roughly 1 billion characters)
- a terabyte can store a book repository (roughly 1 trillion characters)

Memory (cont.)

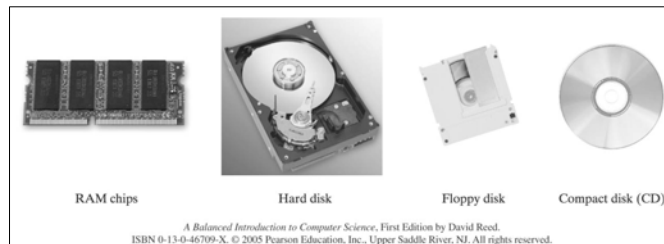
modern computers use a combination of memory types, each with its own performance and cost characteristics

main memory (or primary memory) is fast and expensive

- data is stored as electric signals in circuitry, used to store active data
- memory is volatile – data is lost when the computer is turned off
- examples: Random Access Memory (RAM), cache

secondary memory is slower but cheaper

- use different technologies (magnetic signals on hard disk, reflective spots on CD)
- memory is permanent – useful for storing long-term data
- examples: hard disk, floppy disk, compact disk (CD), flash drive



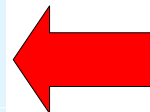
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Memory (cont.)

higher-end computers tend to have

- more main memory to allow for quick access to more data and programs
- more secondary memory to allow for storing more long-term data

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Input/Output (I/O)

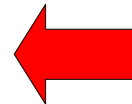
input devices allow the computer to receive data and instructions from external sources

- examples: keyboard, mouse, track pad, microphone, scanner

output devices allow the computer to display or broadcast its results

- examples: monitor, speaker, printer

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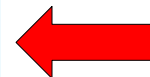
Software

recall: *hardware* refers to the physical components of computers
software refers to the programs that execute on the hardware

a software program is a sequence of instructions for the computer (more specifically, for the CPU) to carry out in order to complete some task

- e.g., word processing (Microsoft Word, Corel WordPerfect)
- e.g., image processing (Adobe Photoshop, Macromedia Flash)
- e.g., Web browsing (Internet Explorer, Netscape Navigator)

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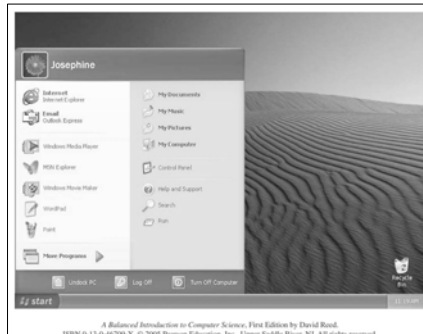
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Operating Systems



the *Operating System (OS)* is a collection of programs that controls how the CPU, memory, and I/O devices work together

- it controls how data and instructions are loaded and executed by the CPU
- it organizes and manages files and directories
- it coordinates the CPU, memory, and I/O devices
 - most modern OS's utilize a Graphical User Interface (GUI) to make interacting with the computer easy
 - GUI's utilize windows, icons, menus, and pointers



Quick Net & Web Overview



the Internet is a vast, international network of computers

- the physical connections between computers vary, but the overall effect is that computers around the world can communicate and share resources
- the Internet traces its roots back to 1969, when the U.S. government sponsored the first long-distance computer network
- starting with only 4 computers, the network would eventually evolve into today's Internet

the World Wide Web is a collection of software that spans the Internet and enables the interlinking of documents and resources

- the basic idea for the Web was proposed by Tim Berners-Lee in 1989
- his system interlinked documents (including multimedia elements such as images and sound clips) over the Internet
- through the use of well-defined rules, or *protocols*, that define how they are formatted, documents could be shared across networks on various types of computers

Internet \neq World wide Web



THINK:

Internet is *hardware*

- consists of computers around the world and the communications links that connect them

World Wide Web is *software*

- consists of Web pages, images, sound files, etc., and the software that stores and retrieves these files

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the Internet could exist without the Web

- and did, in fact, for many years (applications included email and news groups)

the Web couldn't exist without the Internet

- the Internet is the hardware that stores and executes the Web software

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Viewing a Web Page

a *Web page* is a text document that contains additional formatting information in a language called HTML (HyperText Markup Language)

a *Web browser* is a program that accesses a Web page, interprets its content, and displays the page



```

<HTML>
<!-- sample.html          Dave Reed -->
<!-- Sample Web page. -->
<!--
<title> Sample Web Page </title>
</head>
<body>
<div style="text-align:center">

</div>
<p>Hello, and welcome to my page! If you
would like, you can find out more about me
<a href="personal.html">here</a>.</p>
</body>
</HTML>

```

A Web page is a text document that contains HTML formatting.



Sample Web Page - Microsoft Internet Explorer


Address: A:\sample.html

Dave's Page



Hello, and welcome to my page! If you would like, you can find out more about me [here](#).

Dave



A Web browser is a program that interprets the HTML and displays the page.

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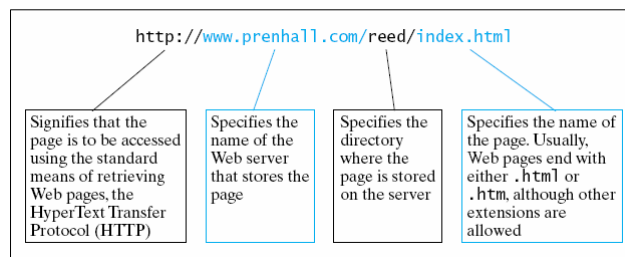
Web Addresses

a *Web server* is an Internet-enabled computer that stores Web pages and executes software for providing access to the pages

- when you request a Web page, the browser sends a request over the Internet to the appropriate server
- the server locates the specified page and sends it back to your computer

Web pages require uniform names to locate and identify them uniquely

- each page is assigned a *Uniform Resource Locator (URL)*
- URL's are commonly referred to as *Web addresses*
- the different parts of the Web address provide information for locating the page



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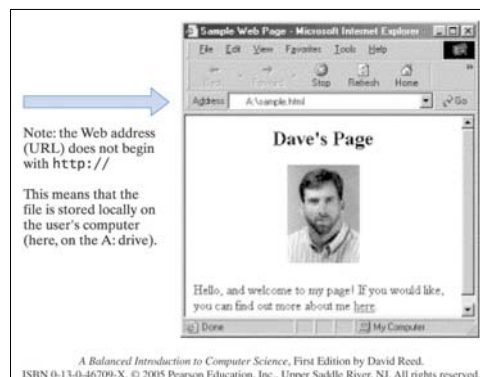
Viewing Local Web Pages

a Web browser can be used to view pages stored on the same computer

- can go through the File menu to select the local page, or
- can enter the File location in the address box (without the http prefix)

this feature is handy when developing Web pages

- can create a Web page and view it in the browser before uploading to a server



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