Problem Solving and Programming

CSE1001

Purpose

Course Objectives :

- **Develop** essential skills for a logical thinking to solve problems
- **Develop** essential skills in programming for solving problems using computers

Course Outcomes

On completion of the course, students will have the

- Ability to identify an appropriate approach to solve a problem
- Ability to write a pseudo code for the identified strategy
- Ability to translate the pseudocode into an executable program
- Ability to validate the program for all the possible inputs

Faculty Introduction

- ***Prof. Tulasi Prasad Sariki***
- tulasiprasad.sariki@vit.ac.in
- www.learnersdesk.weebly.com
- www.facebook.com/tulasi.prasad.127
- www.linkedin.com/in/tulasi-prasad
- Academic Block-1, 6th Floor Main, Cabin No – 3
- Open Hours – Friday (9:30 AM to 11:30 AM)

What-do-top-coders-recommend-to-newbies-before-learning-coding

- **Read enough code,** especially if written by authentic sources.
  - **Reading someone else's code** is not bad - if you failed even after your best try. It will give you **new ideas.**
- **Plan before coding; but planning too much** before coding is **also bad.**
- **Write code as much as you can.** (but don't copy and paste, try to make concept clear).
- **Patience is important.**
  - It is the thing you need every time you write a correct code **(according to you)**, but it still gives error (bug !!).
- **Set practical specific goals and deadlines** for learning coding or to make a project.
- **Do work at Data-Structures the most.**

What-do-top-coders-recommend-to-newbies-before-learning-coding

- **Do not just jump over several languages at same time** *(especially in beginning)*
- **Join online communities** *(like geeksforgeeks, hackerrank, codechef, etc.)*
- **Once clear with concept**, try to **find the pre-defined functions and classes** (if any) present in the language.
- **Endlessly research without** spending time actually writing **code is worthless.**
- **Learn how to use Google**
- **Help others :**
  - While explaining code, the concepts will be more clearer

Session Plan

- Core Python features required for problem solving - 30 Sessions that includes
  - 4 Assessments
  - 1 FAT
- Basics of 'C' language – 10 sessions that includes
  - 2 Assessment
  - 1 FAT

Category of Lab Sessions	No.
Practice Sessions	36
Consolidated Assessment Test (CAT)	02
Final Assessment Test(FAT)	02
Total sessions	40

CONTINUOUS ASSESSMENT PROCESS(CAP)

Component	Number Per Item	Max Marks Per Item	Weight per Item	Total Weight in the CAP
Periodic Assessment Test (PAT)	04	10	10 %	40 %
Consolidated Assessment Test (CAT)	02	50	10 %	20 %
Final Assessment Test (FAT)	02	50	20 %	40 %
Bonus Assessment Test (BAT)	01	100	10%	10%

Pointer to Ponder

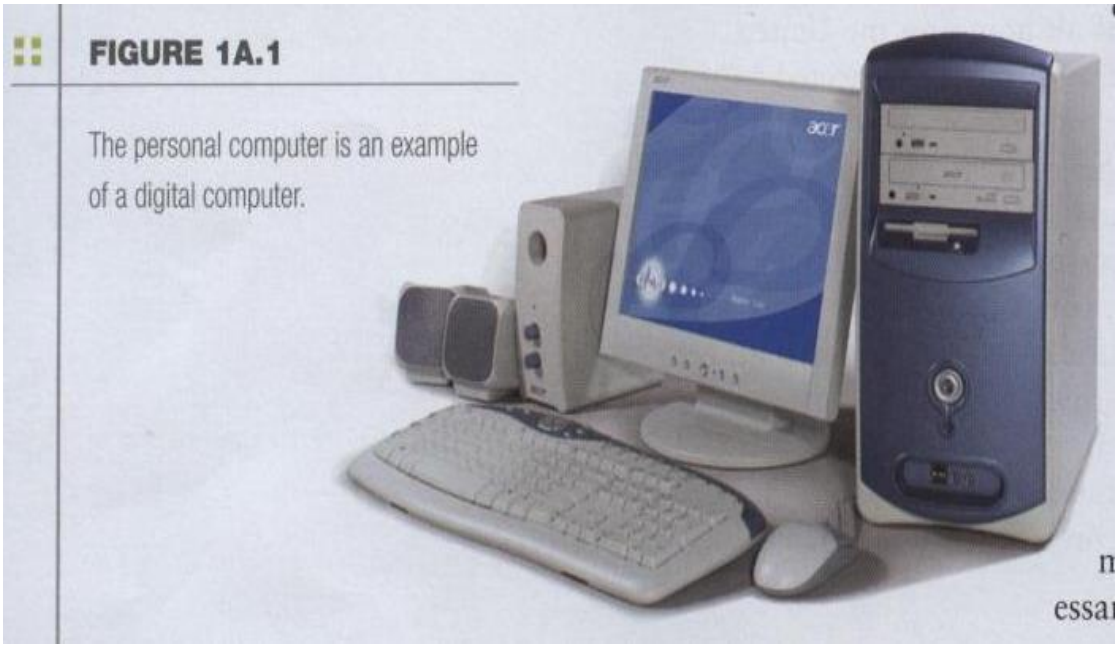
- Do not miss any class, practice problem, assessments and challenging tasks
- Be ethical and professional throughout the course
- Unethical practices are punishable
- PAT/CAT/FAT/BAT will not be conducted again for the students who have missed it(for valid or invalid reasons).
- Those missed-out students can make use of the Bonus Assessment Test in which one can top-up the score to a maximum of 10%

SCHEDULE OF IPS/PAT/CAT/BAT

Week	Name of the component
Aug 5-9	IPS I
Aug 12 - 16	IPS II , PAT I
Aug 26- 30	IPS III
Sep 2-6	IPS IV, PAT II
Sep 9 - 13	IPS V
Sep 16 - 20	IPS VI, PAT III
Sep 23-27	IPS VII
Oct 7 - 11	PAT IV, CAT I
Oct 14 - 18	IPS VIII. Upload of BAT
Oct 21- 25	IPS IX
Oct 28- Nov 1	IPS X, CAT II
Nov 8 11.59 PM	Last date for BAT Submission

Definition of Computer

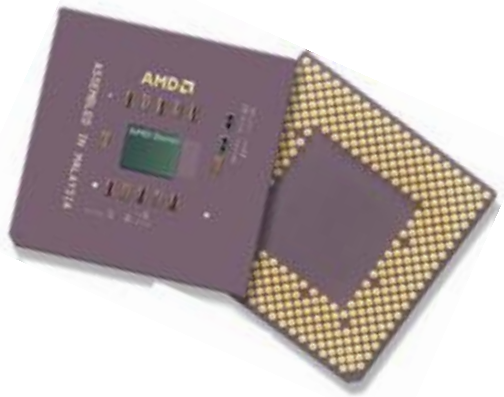
- Electronic device
- Converts data into information
- Modern computers are digital
  - Two digits combine to make data (0, 1)



Definition of Computer

A computer is:

- An electronic machine that can be programmed to accept data (*input*), and process it into useful information (*output*). Data is put in secondary storage (*storage*) for safekeeping or later use.
- The *processing* of input into output is directed by the software, but performed by the hardware.



Definition of Computer

- Older computers were analog
  - A range of values made data

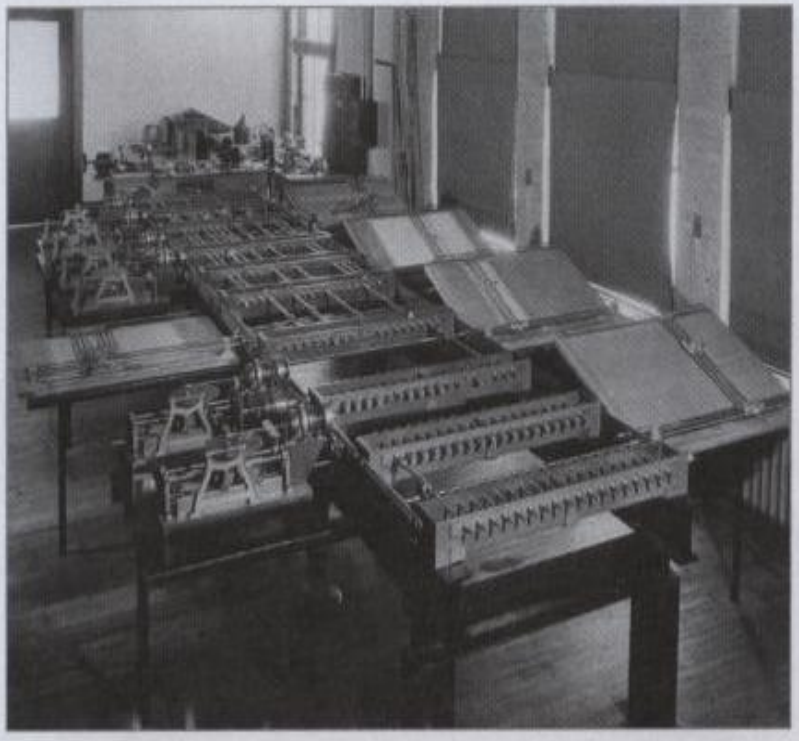


FIGURE 1A.2

This early analog computer, created by Vannevar Bush in the late 1920s, was called a "differential analyzer." It used electric motors, gears, and other moving parts to solve equations.

Definition of Computer

- Older computers were analog
  - A more manageable type -- the old-fashioned slide rule

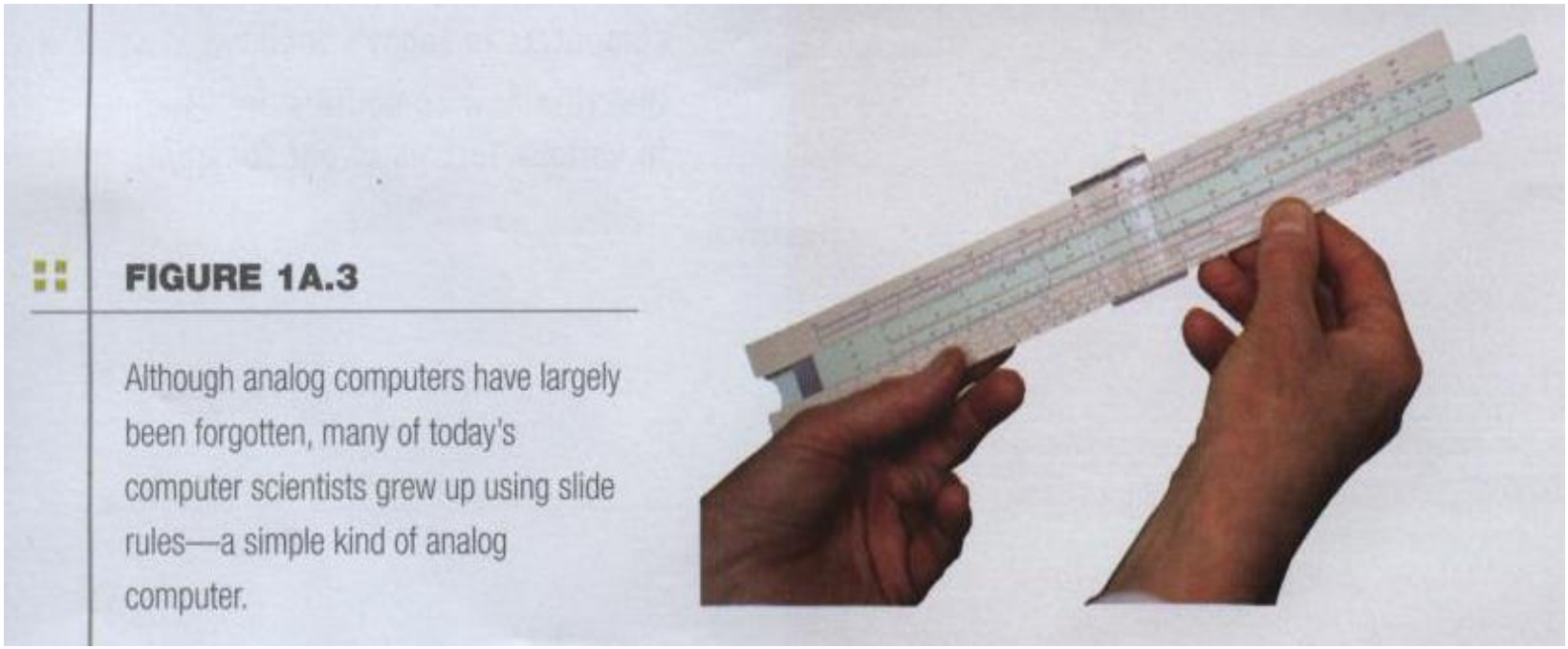


FIGURE 1A.3

Although analog computers have largely been forgotten, many of today's computer scientists grew up using slide rules—a simple kind of analog computer.

Types of Computer

- Desktop computers
  - Different design types

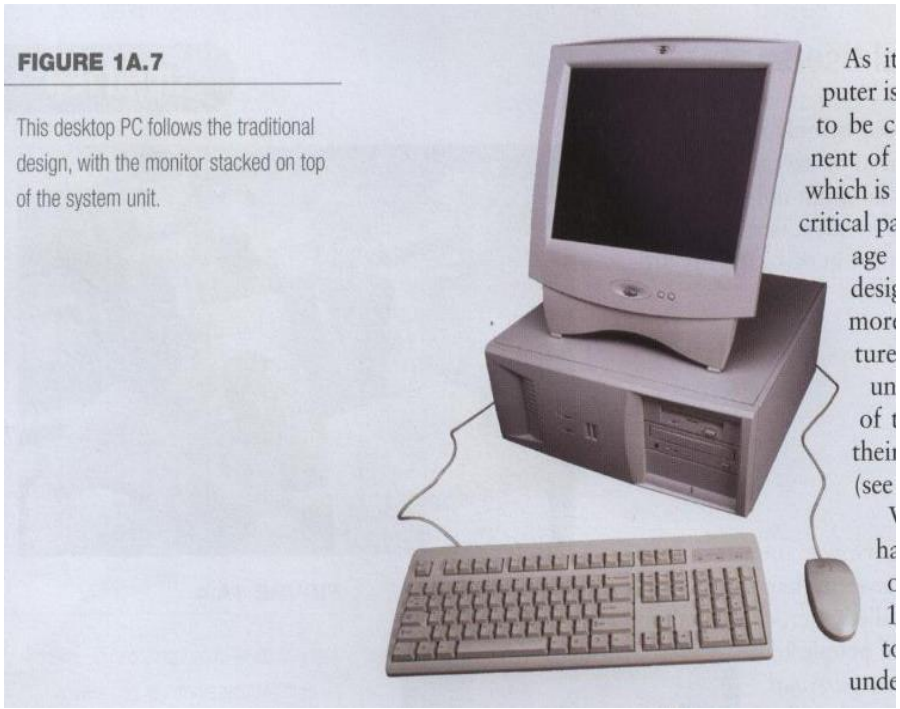


FIGURE 1A.7

This desktop PC follows the traditional design, with the monitor stacked on top of the system unit.

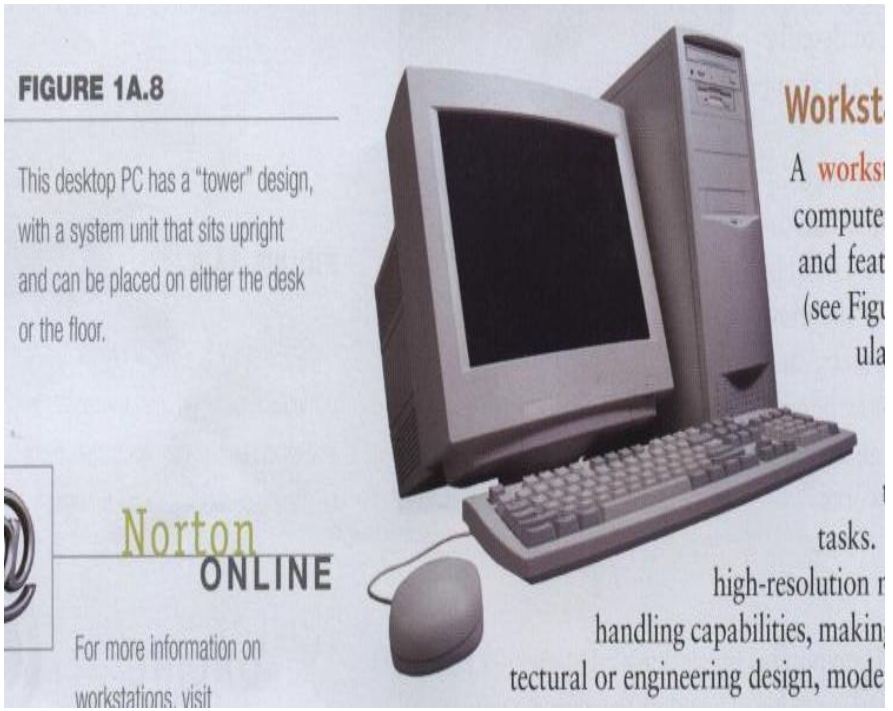


FIGURE 1A.8

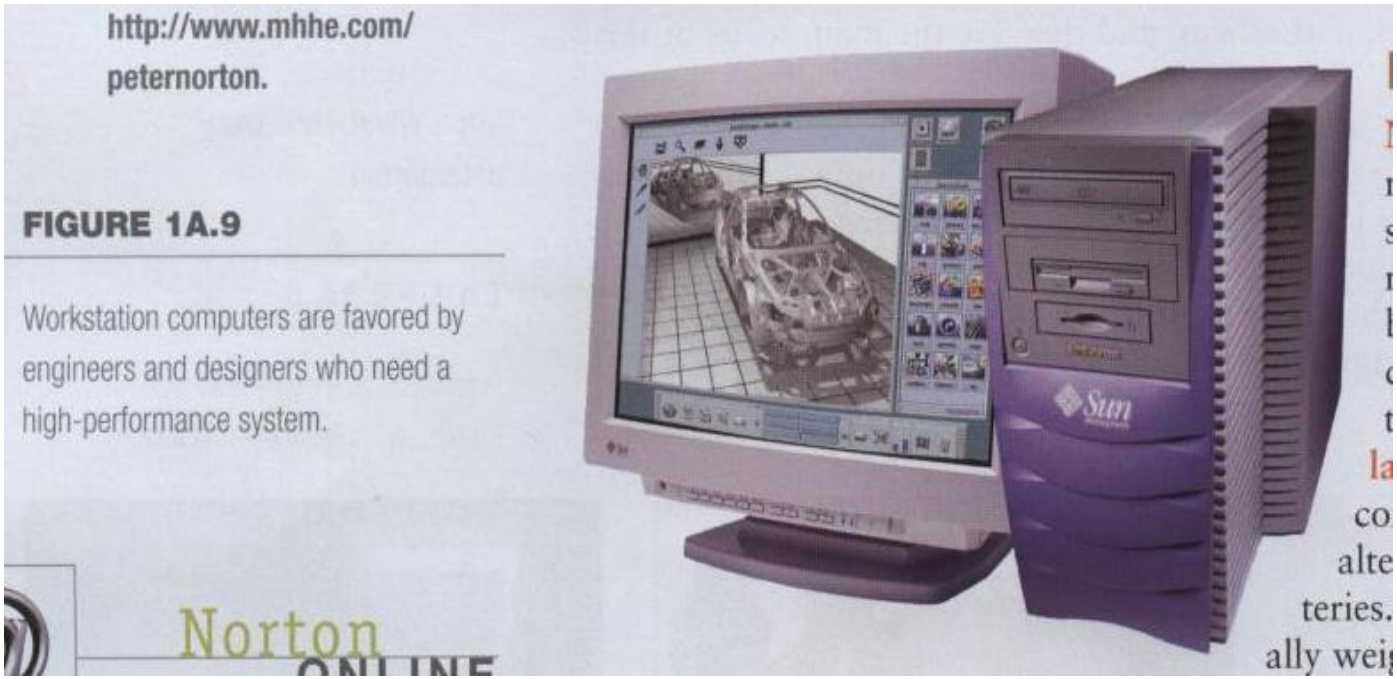
This desktop PC has a "tower" design, with a system unit that sits upright and can be placed on either the desk or the floor.

Norton ONLINE

For more information on workstations, visit

Types of Computer

- **Workstations**
  - Specialized computers
  - Optimized for science or graphics
  - More powerful than a desktop



Types of Computer

- **Notebook computers**
  - Small portable computers
  - Weighs between 3 and 8 pounds
  - About 8 ½ by 11 inches
  - Typically as powerful as a desktop
  - Can include a docking station

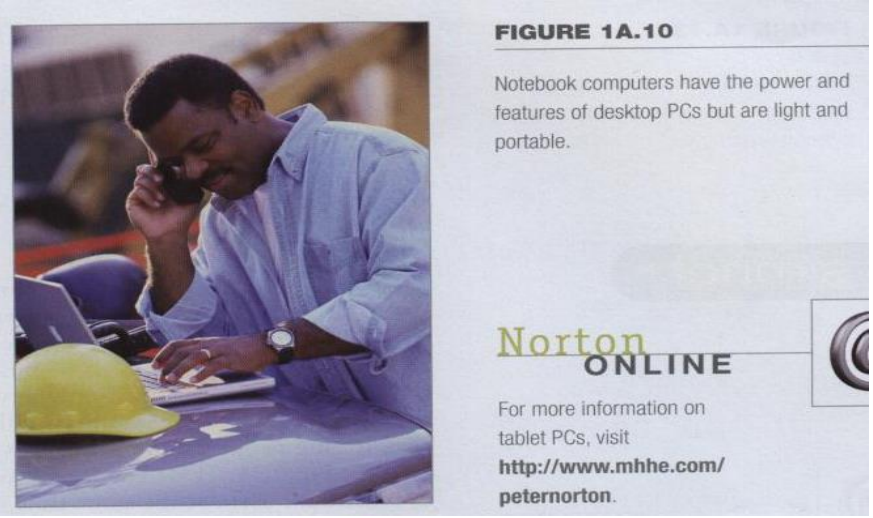


FIGURE 1A.10

Notebook computers have the power and features of desktop PCs but are light and portable.

Norton ONLINE

For more information on tablet PCs, visit **http://www.mhhe.com/peternorton**.

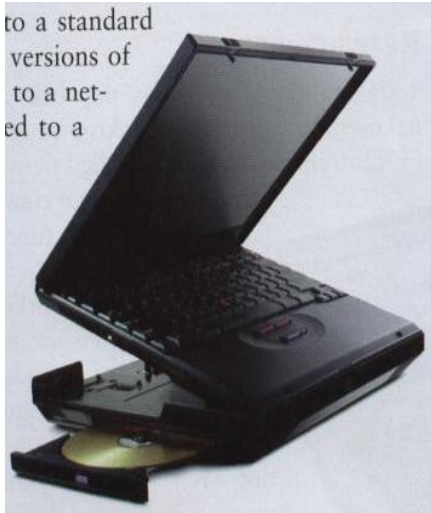


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FIGURE 1A.11

A docking station can make a notebook computer feel like a desktop system, by adding a full-size monitor, keyboard, and other features.

Norton ONLINE

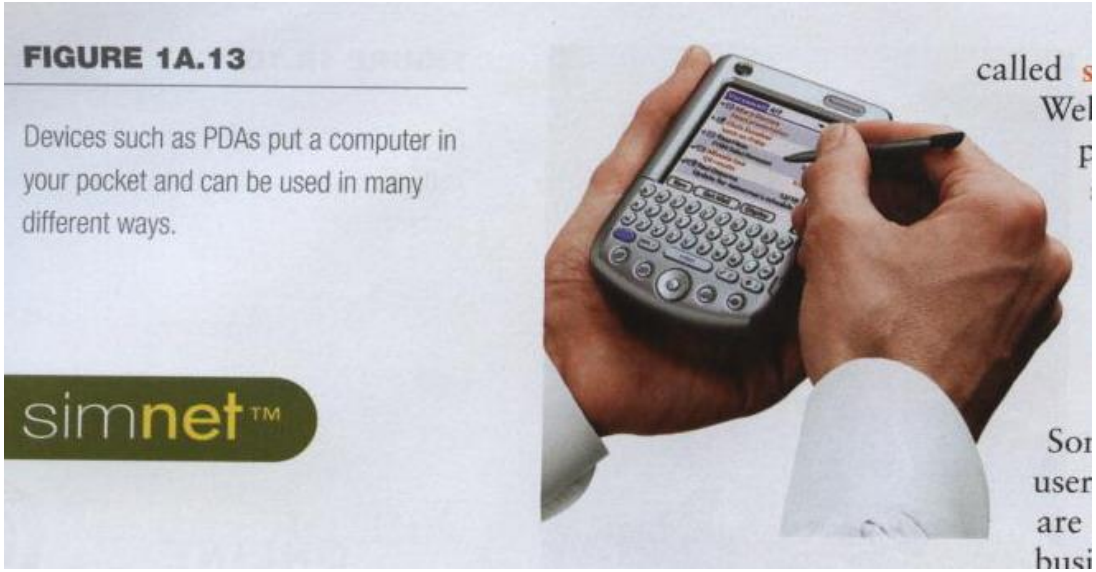
For more information on handheld PCs, visit

Types of Computer

- **Tablet computers**
  - Newest development in portable computers
  - Input is through a pen
  - Run specialized versions of office products

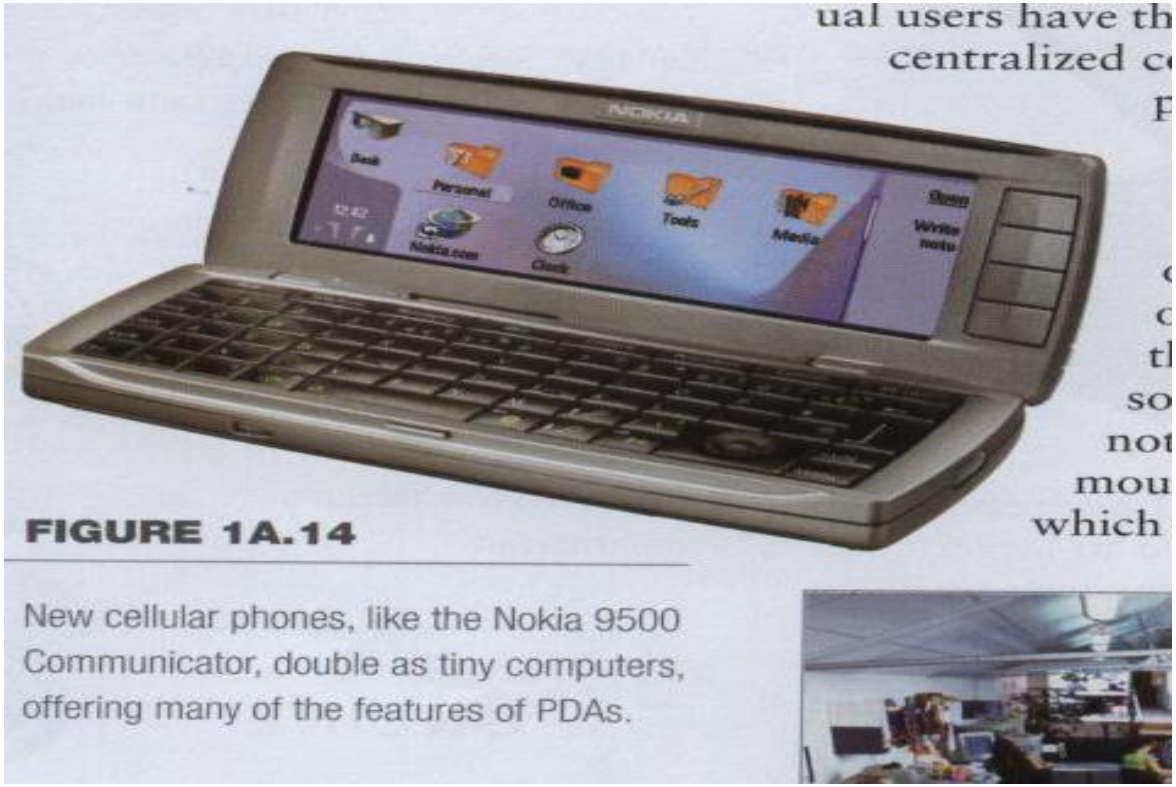
Types of Computer

- Handheld / Palm computer
  - Very small computers
  - Personal Digital Assistants (PDA)
  - Note taking or contact management
  - Data can synchronize with a desktop



Types of Computer

- Smart phones
  - Hybrid of cell phone and PDA
  - Web surfing, e-mail access



Computers for Organization

- Network servers
  - Centralized computer and All other computers connect
  - Provides access to network resources
  - Multiple servers are called server farms
  - Often simply a powerful desktop: Google
  - Flexibility to different kinds of tasks
  - Users use the Internet as a means of connecting even if away from the offices.

Computers for Organization

Mainframes

- Used in large organizations
- Handle thousands of users
- Users access through a terminal
- Large and powerful systems

Computers for Organization

- Mini-Computers
  - Called midrange computers
  - Power between mainframe and desktop
  - Handle hundreds of users
  - Used in smaller organizations
  - Users access through a terminal

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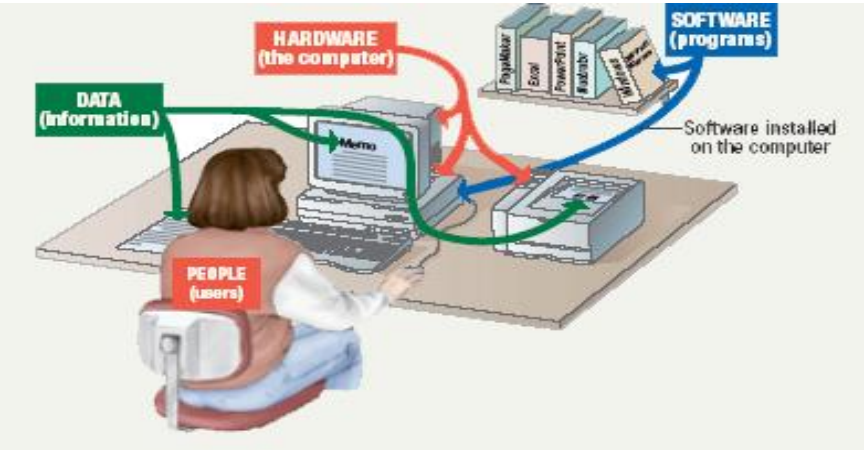
Computers for Organization

- Supercomputers
  - The most powerful computers made
  - Handle large and complex calculations
  - Process trillions of operations per second
  - Found in research organizations

Parts of Computer

- Computer systems have four parts
  - Hardware
  - Software
  - Data
  - User

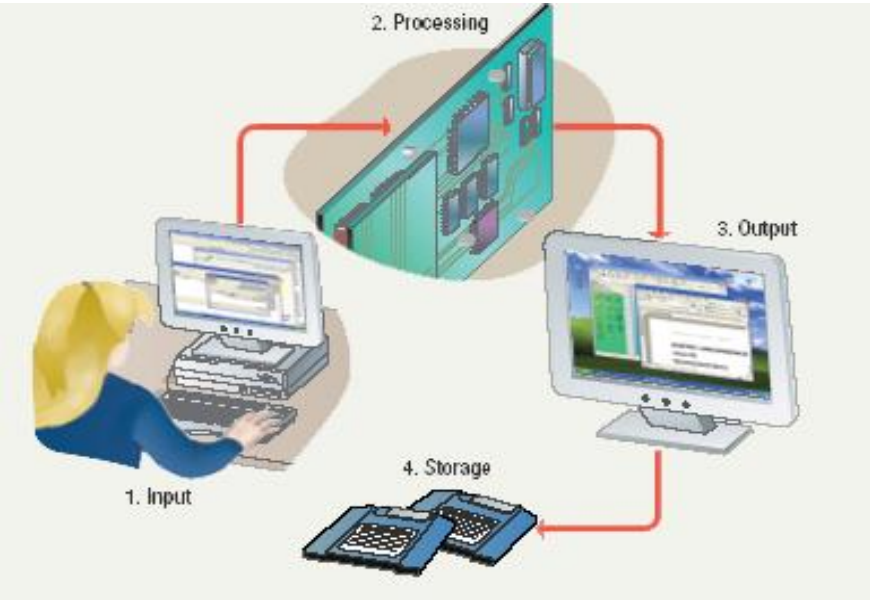


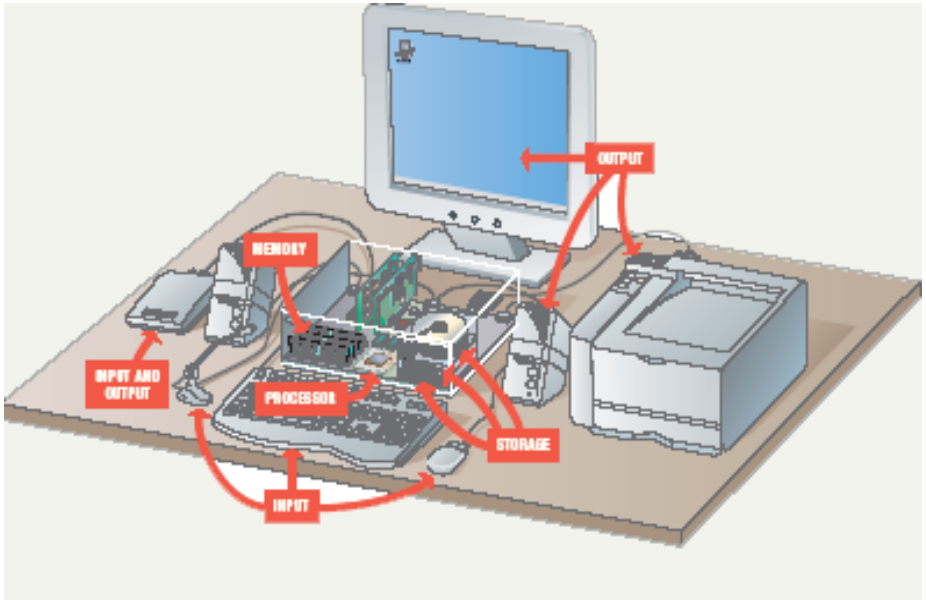
- Hardware
  - Mechanical devices in the computer
  - Anything that can be touched
- Software
  - Tell the computer what to do
  - Also called a program
  - Thousands of programs exist
- Data
  - Pieces of information
  - Computers organize and present data
- Users
  - People operating the computer
  - Most important part
  - Tell the computer what to do

Information Processing Cycle

Steps followed to process data

- Input
- Processing
- Output
- Storage



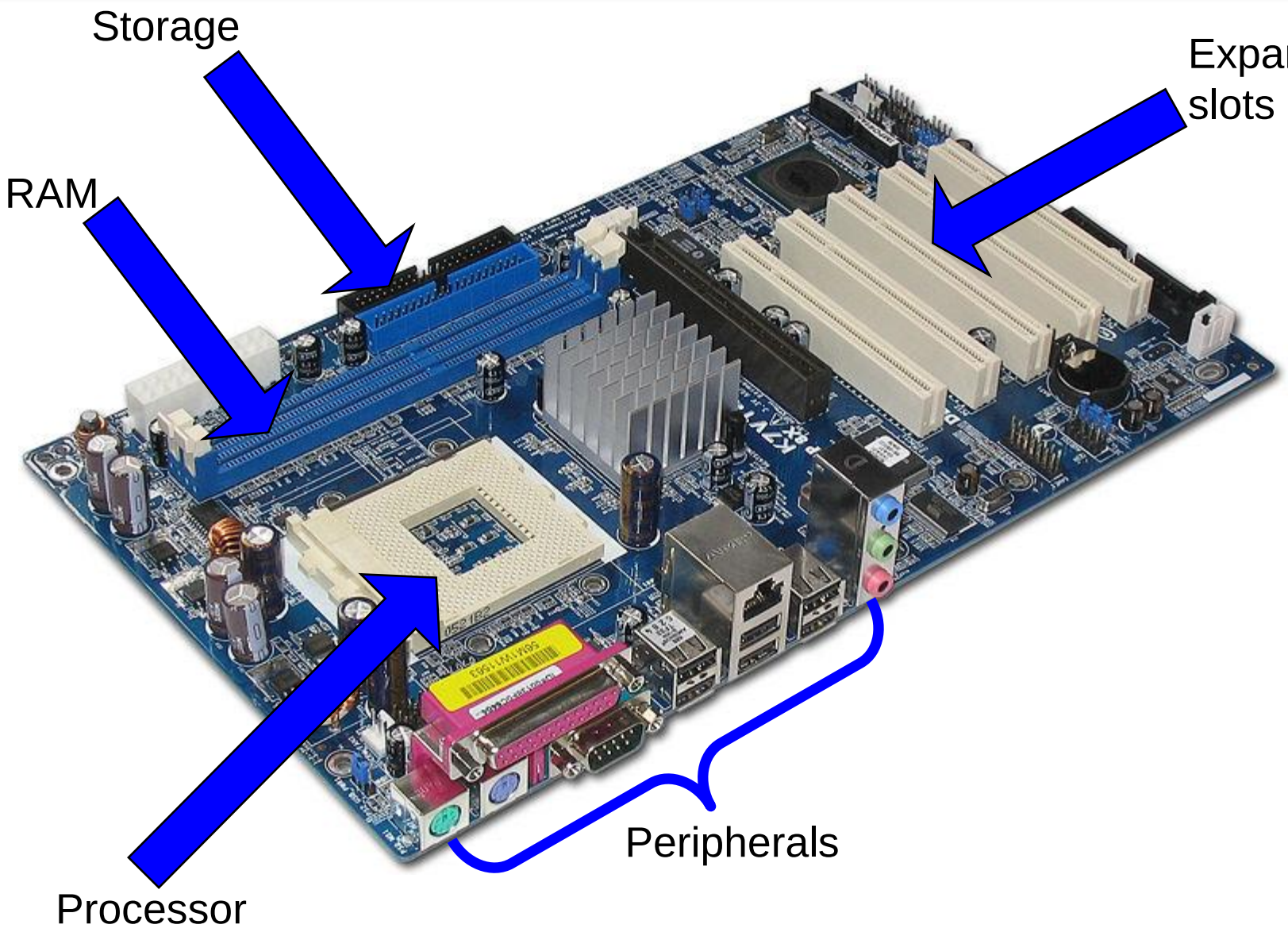


The System Unit

The System Unit houses the *central processing unit*, *memory modules*, *expansion slots*, and *electronic circuitry* as well as expansion cards that are all attached to the *motherboard*; along with *disk drives*, a fan or fans to keep it cool, and the *power supply*.

All other devices (*monitor, keyboard, mouse,* etc.), are linked either directly or indirectly into the system unit.

MotherBoard



Essential Computer Hardware

- **Processing devices**
  - Brains of the computer
  - Carries out instructions from the program
  - Manipulate the data
  - Most computers have several processors
  - Central Processing Unit (CPU)
  - Secondary processors
  - Processors made of silicon and copper
- **Memory devices**
  - Stores data or programs
  - Random Access Memory (RAM)
    - Volatile
    - Stores current data and programs
    - More RAM results in a faster system
  - Read Only Memory (ROM)
    - Permanent storage of programs
    - Holds the computer boot directions

Input and Output Devices

- Input and Output devices
  - Allows the user to interact
  - Input devices accept data
    - *Keyboard, mouse*
  - Output devices deliver data
    - Monitor, printer, speaker
  - Some devices are input and output
    - Touch screens

Keyboard

Mouse

Digtal tablet

Mic. & Earphone

Joystick

WebCamera

Input and Output Devices

Monitor

Projector

Speakers

Plotter

Laser Printer

Memory and Storage

Memory (e.g., RAM)

- The information stored is needed now
- Keep the information for a shorter period of time (usually volatile)
- Faster
- More expensive
- Low storage capacity (~1/4 of a DVD for 1 GB)

Storage (e.g., Hard disk)

- The information stored is not needed immediately
- The information is retained longer (non-volatile)
- Slower
- Cheaper
- Higher storage capacity (~50 DVD's for 200 GB)

Memory and Storage

- Storage devices
  - Hold data and programs permanently
  - Different from RAM
  - Magnetic storage
    - Floppy and hard drive
    - Uses a magnet to access data
  - Optical storage
    - CD and DVD drives
    - Uses a laser to access data

Software

- Tells the computer what to do
- Reason people purchase computers
- Two types
  - System software
  - Application software

- System software
  - Most important software
  - Operating system
    - Windows XP
  - Network operating system (OS)
    - Windows Server 2003
  - Utility
    - Symantec AntiVirus, K7…

- Application software
  - Accomplishes a specific task
  - Most common type of software
    - MS Word
  - Covers most common uses of computers

Computer Terms

Data

- Fact with no meaning on its own
- Stored using the binary number system
- Data can be organized into files

Users

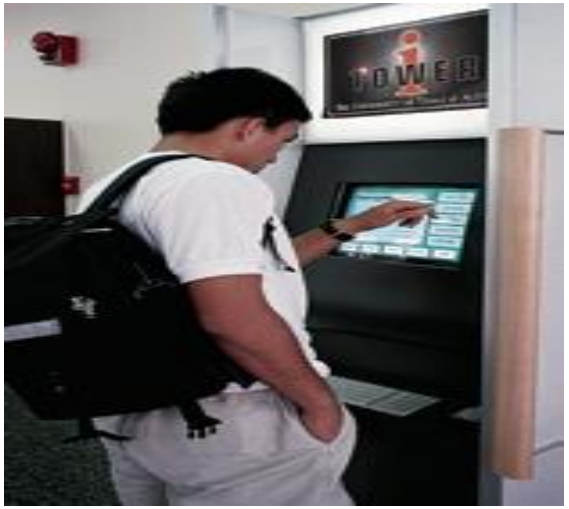
- Role depends on ability
  - Setup the system
  - Install software
  - Manage files
  - Maintain the system
- “Userless” computers
  - Run with no user input
  - Automated systems

Inputting Data In Other Ways

Devices for hand

- Pen based input
  - Tablet PCs, PDA
  - Pen used to write data
  - Pen used as a pointer
  - Handwriting recognition
  - On screen keyboard

- Touch screens
  - Sensors determine where finger points
  - Sensors create an X,Y coordinate
  - Usually presents a menu to users
  - Found in cramped or dirty environments



Devices for hand

- Game controllers
  - Enhances gaming experience
  - Provide custom input to the game
  - Modern controllers offer feedback
  - Joystick
  - Game pad

Optical I/P Devices

- Allows the computer to see input
- Bar code readers
  - Converts bar codes to numbers
    - UPC code
  - Computer find number in a database
  - Works by reflecting light
    - Amount of reflected light indicates number
- Image scanners
  - Converts printed media into electronic
  - Reflects light off of the image
  - Sensors read the intensity
  - Filters determine color depths

Optical I/P Devices

- Optical character recognition (OCR)
  - Converts scanned text into editable text
  - Each letter is scanned
  - Letters are compared to known letters
  - Best match is entered into document
  - Rarely 100% accurate

Audio visual I/p Devices

- Microphones
  - Used to record speech
  - Speech recognition
    - “Understands” human speech
    - Allows dictation or control of computer
    - Matches spoken sound to known phonemes
    - Enters best match into document
- Musical Instrument Digital Interface (MIDI)
  - Connects musical instruments to computer
  - Digital recording or playback of music
  - Musicians can produce professional results

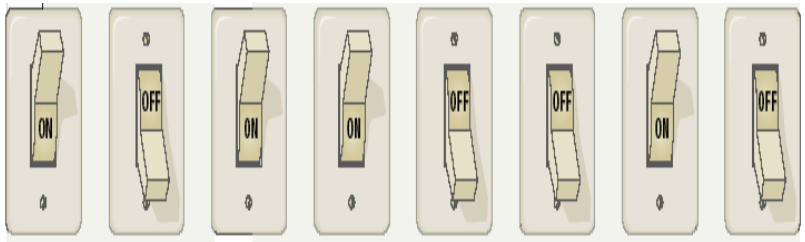
Audio visual I/p Devices

- Digital cameras
  - Captures images electronically
  - No film is needed
  - Image is stored as a JPG file
  - Memory cards store the images
  - Used in a variety of professions

Transforming Data Into Information

How Computer's Represent Data

- Number systems
  - A manner of counting
  - Several different number systems exist
- Decimal number system
  - Used by humans to count (0 – 9)
  - Contains ten distinct digits
  - Digits combine to make larger numbers
- Binary number system
  - Used by computers to count
  - Two distinct digits, 0 and 1
  - 0 and 1 combine to make numbers
- Bits and bytes
  - Binary numbers are made of bits
  - Bit represents a switch
  - A byte is 8 bits
  - Byte represents one character



How Computer's Represent Data

- Text codes
  - Converts letters into binary
  - Standard codes necessary for data transfer
  - ASCII (American English symbols)
  - Extended ASCII (Graphics and other symbols)
  - Unicode (All languages on the planet)

How Computer's Process Data

- The CPU
  - Central Processing Unit
  - Brain of the computer
  - Control unit
    - Controls resources in computer
    - Instruction set
  - Arithmetic logic unit
    - Simple math operations
    - Registers

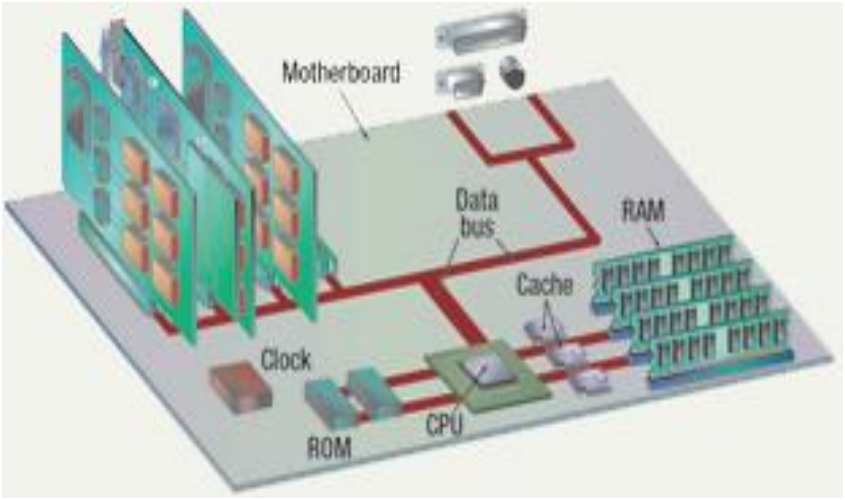
- Machine cycles
  - Steps by CPU to process data
  - Instruction cycle
    - CPU gets the instruction
  - Execution cycle
    - CPU performs the instruction
  - Billions of cycles per second
  - Pipelining processes more data
  - Multitasking allows multiple instructions

How Computer's Process Data

- Memory
  - Stores open programs and data
  - Small chips on the motherboard
  - More memory makes a computer faster
- Nonvolatile memory
  - Holds data when power is off
  - Read Only Memory (ROM)
  - Basic Input Output System (BIOS)
  - Power On Self Test (POST)
- Volatile memory
  - Requires power to hold data
  - Random Access Memory (RAM)
  - Data in RAM has an address
  - CPU reads data using the address
  - CPU can read any address
- Flash memory
  - Data is stored using physical switches
  - Special form of nonvolatile memory
  - Camera cards, USB key chains

Components Affecting Speed

- Registers
  - Number of bits processor can handle
  - Word size
  - Larger indicates more powerful computer
  - Increase by purchasing new CPU
- Virtual RAM
  - Computer is out of actual RAM
  - File that emulates RAM
  - Computer swaps data to virtual RAM
    - Least recently used data is moved
- The computer's internal clock
  - Quartz crystal
  - Every tick causes a cycle
  - Speeds measured in Hertz (Hz)
    - Modern machines use Giga Hertz (GHz)



- The bus
  - Electronic pathway between components
  - Expansion bus connects to peripherals
  - System bus connects CPU and RAM
  - Bus width is measured in bits
  - Speed is tied to the clock

Components Affecting Speed

- External bus standards
  - Industry Standard Architecture (ISA)
  - Local bus
  - Peripheral control interface
  - Accelerated graphics port
  - Universal serial bus
  - IEEE 1394 (FireWire)
  - PC Card
- Peripheral control interface (PCI)
  - Connects modems and sound cards
  - Found in most modern computers
- PC Card
  - Used on laptops
  - Hot swappable
  - Devices are the size of a credit card
- Accelerated Graphics Port (AGP)
  - Connects video card to motherboard
  - Extremely fast bus
  - Found in all modern computers
- Universal Serial Bus (USB)
  - Connects external devices
  - Hot swappable
  - Allows up to 127 devices
  - Cameras, printers, and scanners

Components Affecting Speed

- Cache memory
  - Very fast memory
  - Holds common or recently used data
  - Speeds up computer processing
  - Most computers have several caches
  - L_1 holds recently used data
  - L_2 holds upcoming data
  - L_3 holds possible upcoming data

Modern CPUs

Look Inside the Processor

- Architecture
  - Determines
    - Location of CPU parts
    - Bit size
    - Number of registers
    - Pipelines
  - Main difference between CPUs

Micro-Computer Processors

- Intel
  - Leading manufacturer of processors
  - Intel 4004 was worlds first microprocessor
  - IBM PC powered by Intel 8086
  - Current processors
    - Centrino
    - Itanium
    - Pentium IV
    - Xeon

Micro-Computer Processors

- Advanced Micro Devices (AMD)
  - Main competitor to Intel
  - Originally produced budget products
  - Current products outperform Intel
  - Current processors
    - Sempron
    - Athlon FX 64
    - Athlon XP

Micro-Computer Processors

- Freescale
  - A subsidiary of Motorola
  - Co-developed the Apple G4 PowerPC
  - Currently focuses on the Linux market
- IBM
  - Historically manufactured mainframes
  - Partnered with Apple to develop G5
    - First consumer 64 bit chip

Processor Comparison

- Speed of processor
- Size of cache
- Number of registers
- Bit size
- Speed of Front side bus

Advanced Processor Topics

- RISC processors
  - Reduced Instruction Set Computing
  - Smaller instruction sets
  - May process data faster
  - PowerPC and G5
- Parallel Processing
  - Multiple processors in a system
  - Symmetric Multiple Processing
    - Number of processors is a power of 2
  - Massively Parallel Processing
    - Thousands of processors
    - Mainframes and super computers

Extending The Processors Power

- Standard computer ports
  - Keyboard and mouse ports
  - USB ports
  - Parallel
  - Network
  - Modem
  - Audio
  - Serial
  - Video

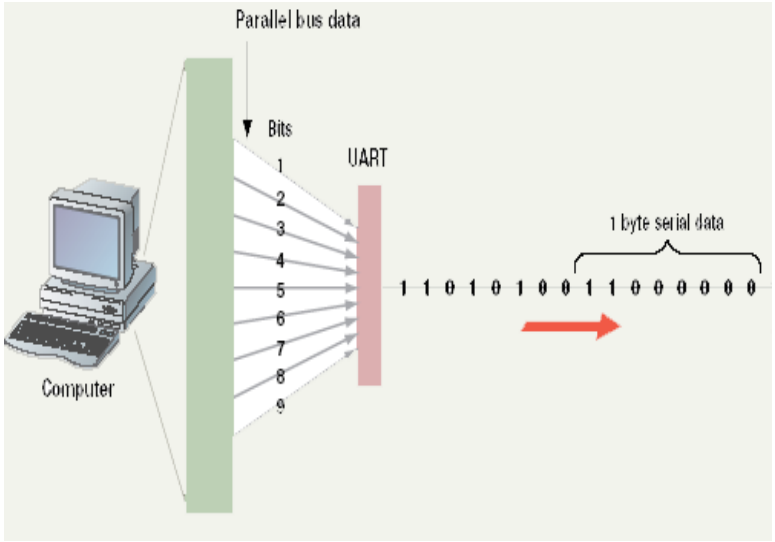
Extending The Processors Power

- Serial and parallel ports
  - Connect to printers or modems
  - Parallel ports move bits simultaneously
    - Made of 8 – 32 wires
    - Internal busses are parallel
  - Serial ports move one bit
    - Lower data flow than parallel
    - Requires control wires
    - UART converts from serial to parallel

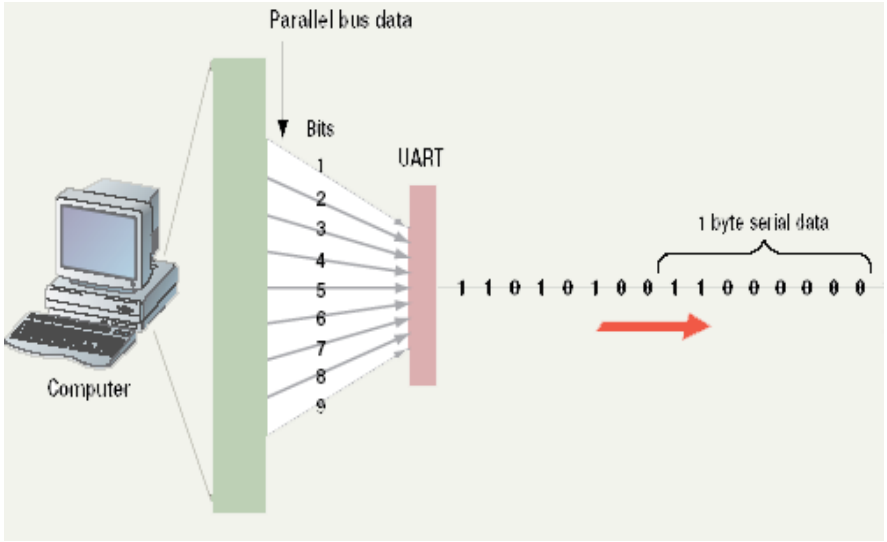
Communication Means…

- Exchanging of Data (Serial or Parallel)

Serial



Parallel



Extending The Processors Power

- SCSI
  - Small Computer System Interface
  - Supports dozens of devices
  - External devices daisy chain
  - Fast hard drives and CD-ROMs
- USB
  - Universal Serial Bus
  - Most popular external bus
  - Supports up to 127 devices
  - Hot swappable
- FireWire
  - IEEE 1384
  - Cameras and video equipment
  - Hot swappable
  - Port is very expensive
- PC Cards
  - Expansion bus for laptops
  - PCMCIA
  - Hot swappable
  - Small card size
  - Three types, I, II and III
  - Type II is most common

Extending The Processors Power

- Expansion slots and boards
  - Allows users to configure the machine
  - Slots allow the addition of new devices
  - Devices are stored on cards
  - Computer must be off before inserting

- Plug and play
  - New hardware detected automatically
  - Prompts to install drivers
  - Non-technical users can install devices

Operating System Basics

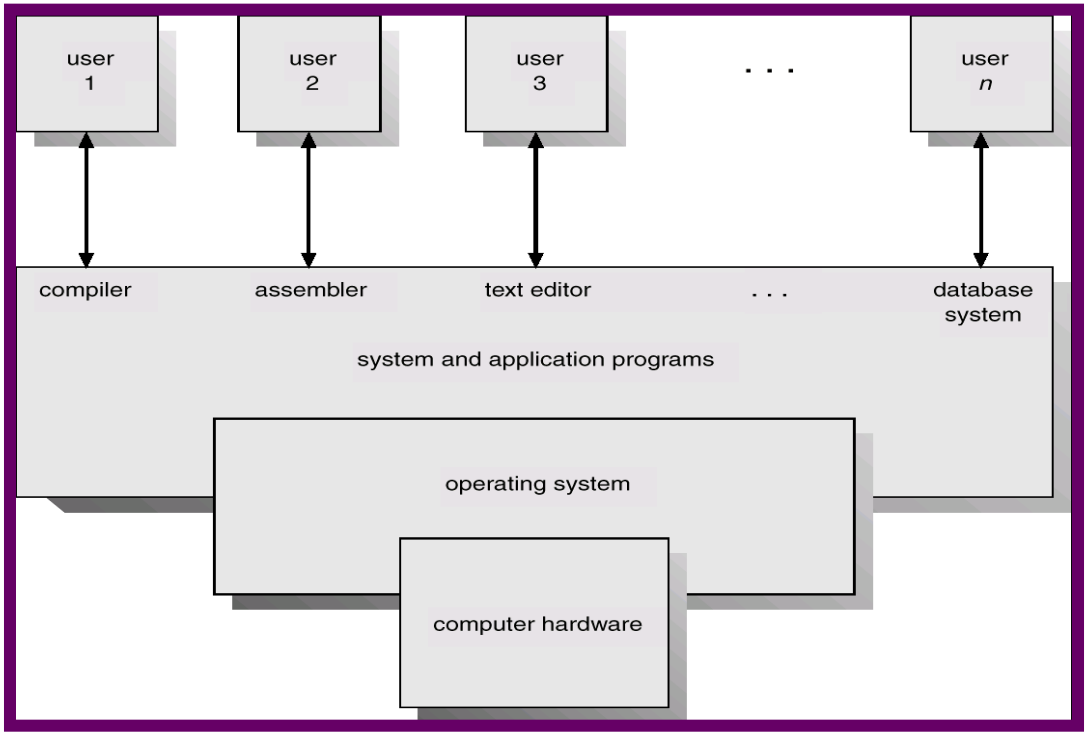
Operating Systems

- Like the brain the OS manages the computer
- A program that manages the computer hardware
- Provides services for application software
- Acts as an intermediary between a user and the computer hardware
- Without OS, no application program will run

- Resource allocator – manages and allocates resources.
- Control program – controls the execution of user programs and operations of I/O devices .
- Kernel – the one program running at all times (all else being application programs).

- Provides the means for proper use of the resources available
- Like a government, it performs no useful function by itself. It provides an environment within which other programs can do useful work

Abstract View of a Comp. System

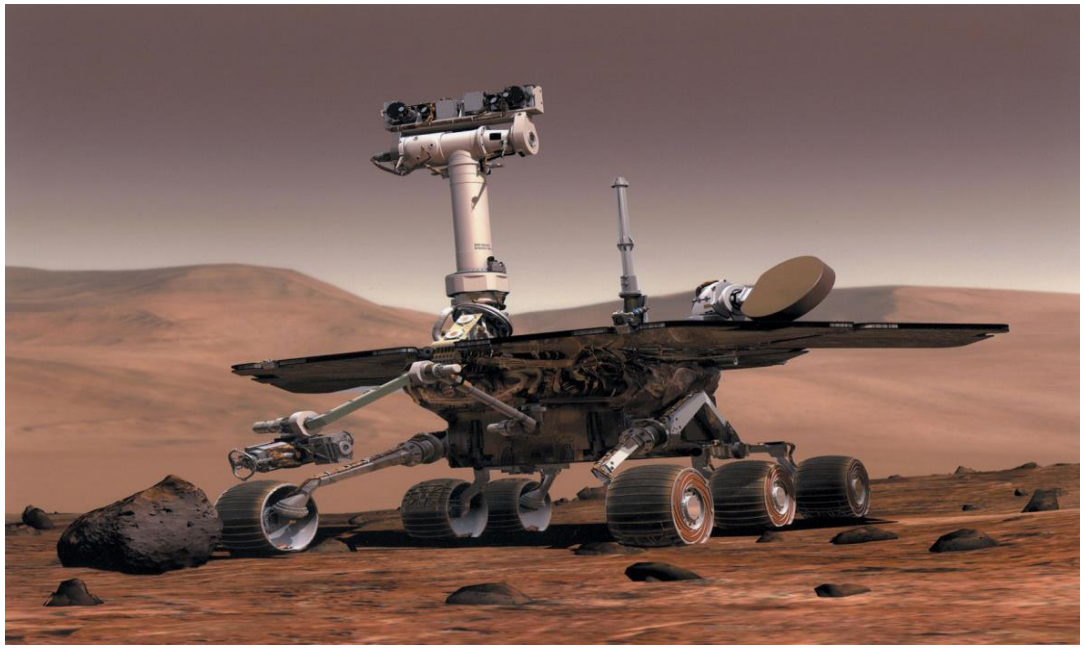


OS Functions

- Provide a user interface
- Run programs
- Manage hardware devices
- Organized file storage

Operating Systems Types

- Real-time operating system
  - Very fast small OS
  - Built into a device
  - Respond quickly to user input
  - MP3 players, Medical devices



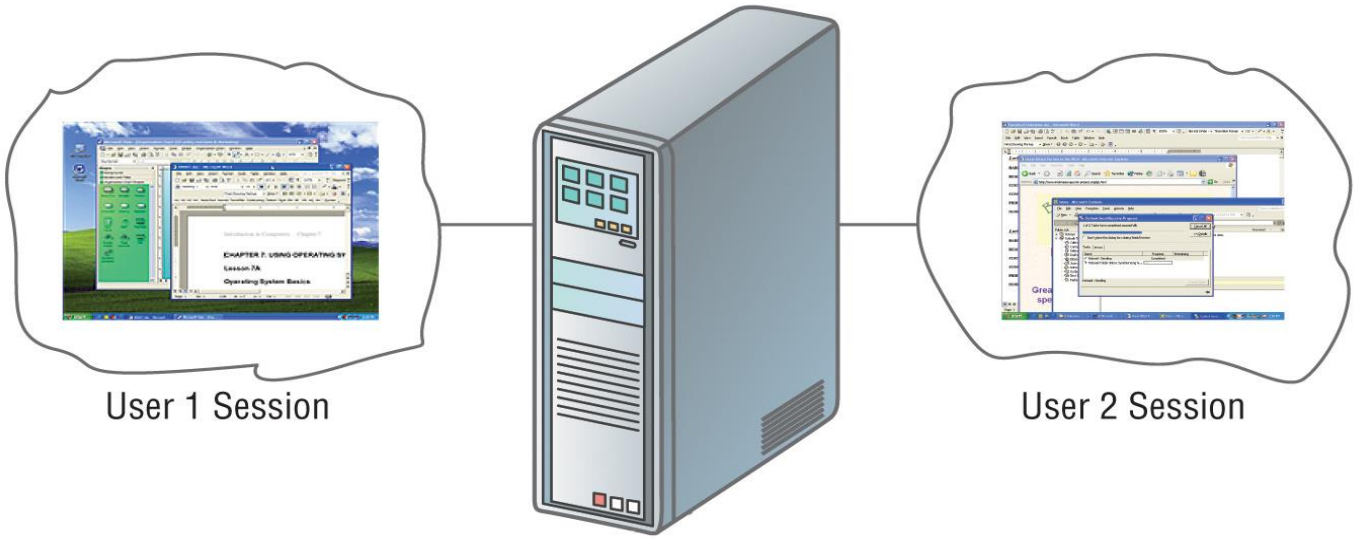
Operating Systems Types

- Single user/Single tasking OS
  - One user works on the system
  - Performs one task at a time
  - MS-DOS and Palm OS
  - Take up little space on disk
  - Run on inexpensive computers

- Single user/Multitasking OS
  - User performs many tasks at once
  - Most common form of OS
  - Windows XP and OS X
  - Require expensive computers
  - Tend to be complex

Operating Systems Types

- Multi user/Multitasking OS
  - Many users connect to one computer
  - Each user has a unique session
  - UNIX, Linux, and VMS
  - Maintenance can be easy
  - Requires a powerful computer



Provide Interface

- User interface
  - How a user interacts with a computer
  - Require different skill sets
- Graphical user interface (GUI)
  - Most common interface
    - Windows, OS X, Gnome, KDE
  - Uses a mouse to control objects
  - Uses a desktop metaphor
  - Shortcuts open programs or documents
  - Open documents have additional objects
  - Task switching
  - Dialog boxes allow directed input

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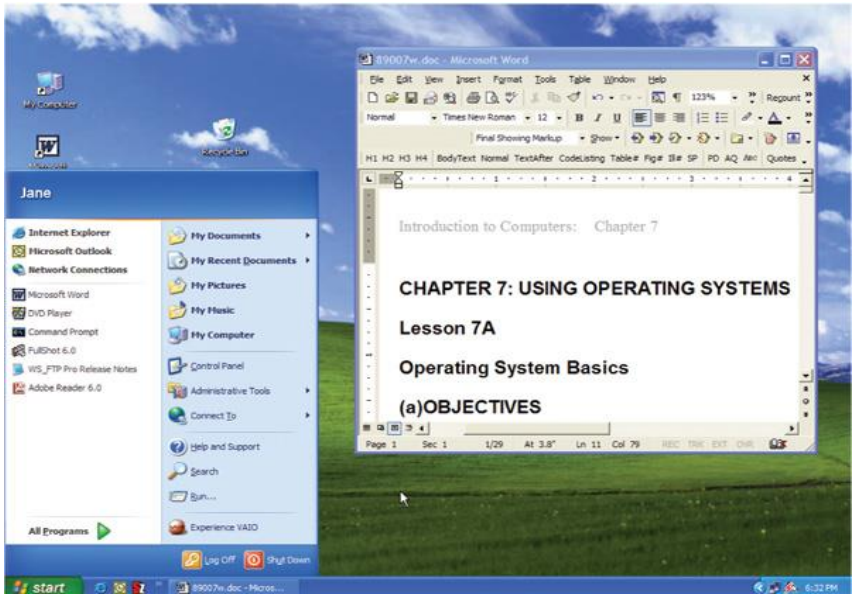
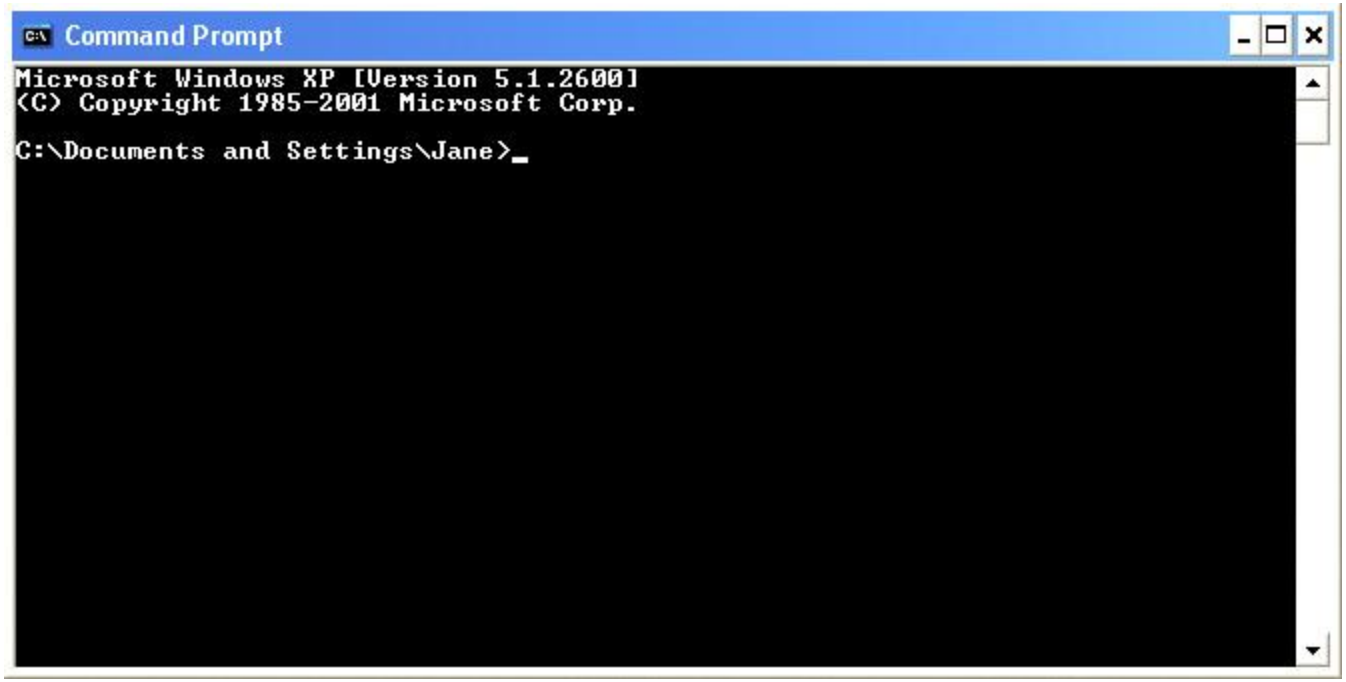


Provide Interface

- Command line interfaces
  - Older interface
    - DOS, Linux, UNIX
  - User types commands at a prompt
  - User must remember all commands
  - Included in all GUIs



Running Programs

- Many different applications supported
- System call
  - Provides consistent access to OS features
- Share information between programs
  - Copy and paste
  - Object Linking and Embedding

Managing Hardware

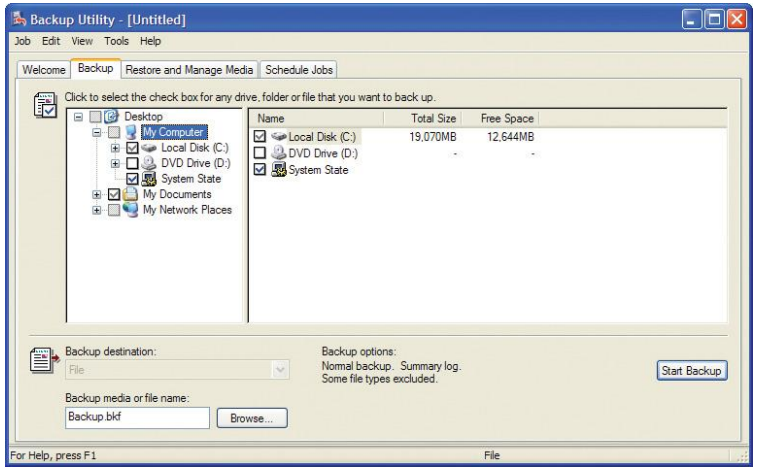
- Programs need to access hardware
- Interrupts
  - CPU is stopped
  - Hardware device is accessed
- Device drivers control the hardware

Organizing Files and Folders

- Organized storage
- Long file names
- Folders can be created and nested
- All storage devices work consistently

Enhancing an OS

- Utilities
  - Provide services not included with OS
  - Goes beyond the four functions
  - Firewall, anti-virus and compression
  - Prices vary
- Backup software
  - Archives files onto removable media
  - Ensures data integrity
  - Most OS include a backup package
  - Many third party packages exist



Enhancing an OS

- Anti-virus software
  - Crucial utility
  - Finds, blocks and removes viruses
  - Must be updated regularly
  - McAfee and Norton Anti-Virus
- Intrusion detection
  - Often part of a firewall package
  - Announces attempts to breach security
  - Snort is a Linux based package
- Firewall
  - Crucial utility
  - Protects your computer from intruders
  - Makes computer invisible to hackers
  - Zone Labs is a home firewall
  - Cisco sells hardware firewalls

Enhancing an OS

- Screen savers
  - Crucial utility for command line systems
    - Prevents burn in
  - Merely fun for GUI systems
  - Screen saver decorates idle screens

Happy Learning