



# ACS-1803

# Introduction to Information Systems

Instructor: Trevor Nadeau

## Introducing the Computer

Lecture Outline 9-1



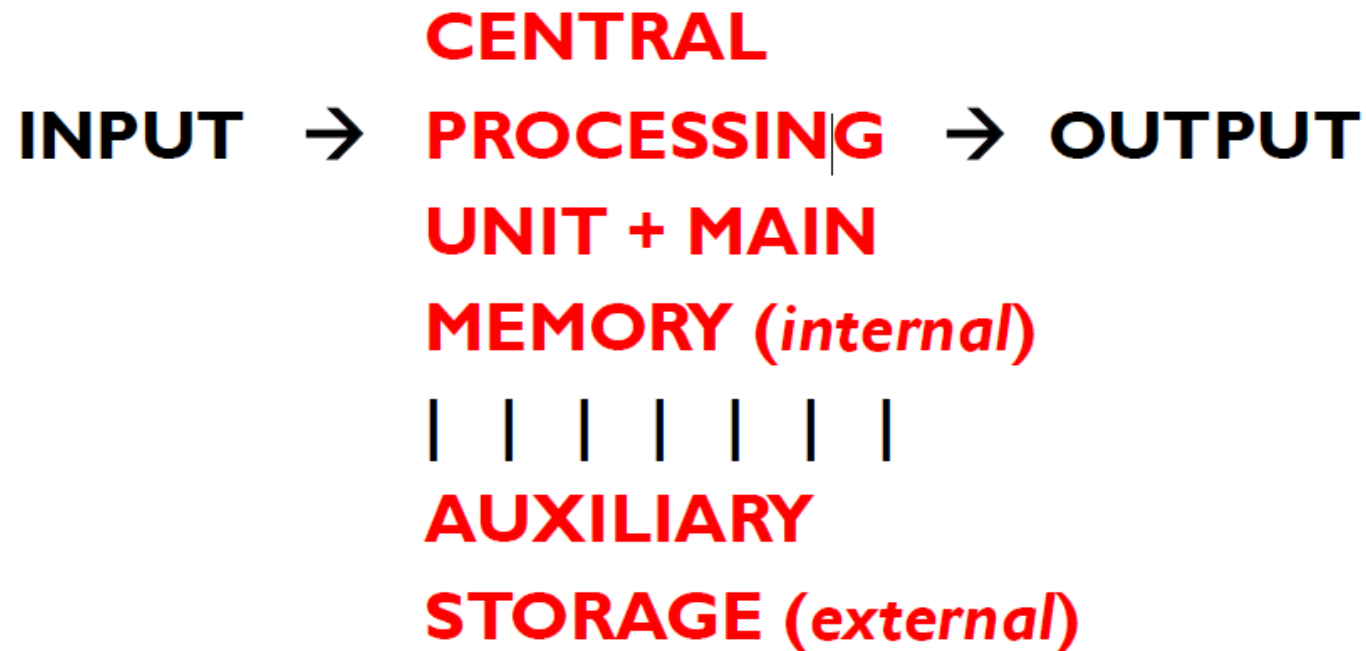


# Computer Components and Processing Functions

# Introduction to the Computer\*

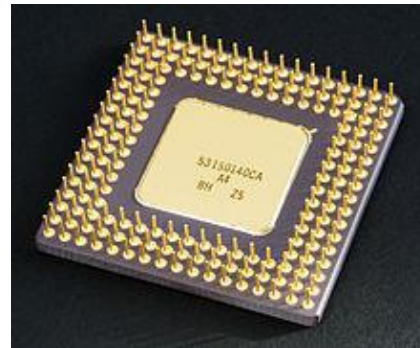
Information processor capable of performing electronically substantial computations including numerous arithmetic or logical operations without intervention by a human operator

Basic architecture:

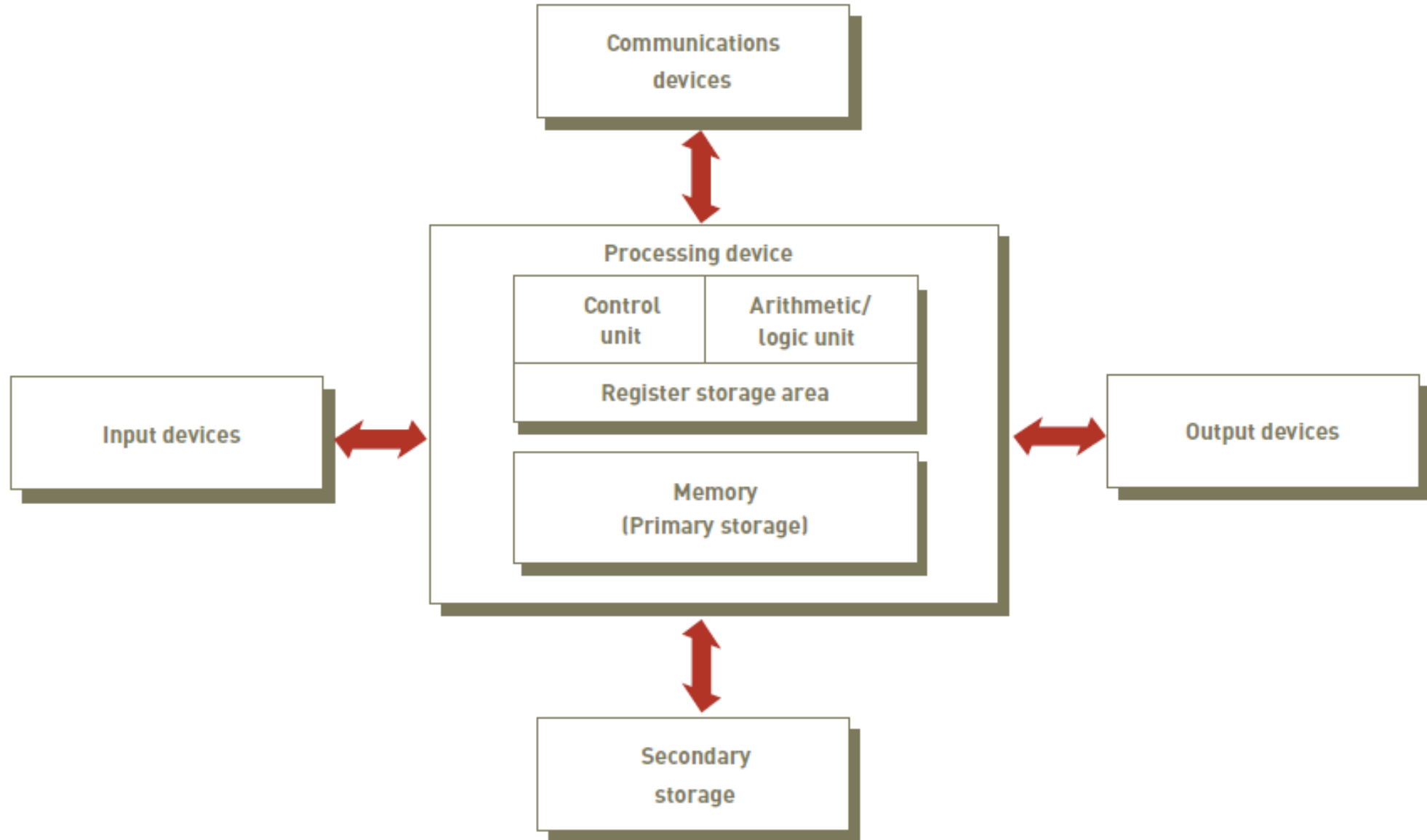


# Computer Components\*

- Central processing unit (CPU):
  - Arithmetic/logic unit (ALU): Performs mathematical calculations and makes logical comparisons
  - Control unit: Sequentially accesses program instructions, decodes them, and coordinates the flow of data in and out of the ALU, registers, primary storage, and even secondary storage and various output devices
  - Register: Small memory location where instructions to be processed are stored.



# Computer Components\*



# Processing Characteristics and Functions

- Clock speed:
  - Series of electronic pulses produced at a predetermined rate that affects machine cycle time
  - Often measured in:
    - Megahertz (MHz): millions of cycles per second
    - Gigahertz (GHz): billions of cycles per second
- Physical characteristics of the CPU
  - Most CPUs are collections of digital circuits imprinted on silicon wafers, or chips, each no bigger than the tip of a pencil eraser

# Memory Characteristics and Functions\*

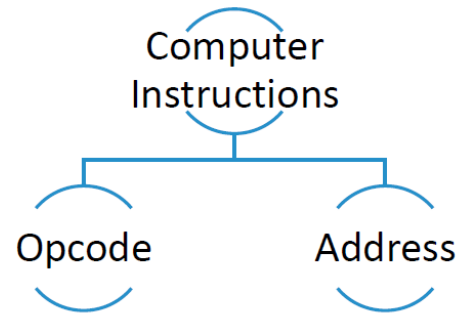
- Memory:
  - Provides the CPU with a working storage area for programs and data
  - Rapidly provides data and instructions to the CPU
- Storage capacity:
  - Eight bits together form a *Byte*

# Main Memory and Instructions

- Cells in main memory hold
  - *instructions* and *data* for the instructions
  - both in electronic form
- Instructions for the CPU
  - tell it to perform sequences of very basic operations
  - e.g., *add, subtract, multiply, divide, move, store* these are the only kind of instructions that the computer can actually execute
- Every major problem that we want the computer to solve must be broken down into a series of instructions at this simple level



# Sample Machine Level Program



- Instruction for a computer: **opcode + address**
- Opcodes (engineers decide on these):
  - 008 - clear accumulator and add to it the contents of the main memory address that follows this opcode
  - 009 - add to the accumulator the contents of the main memory address that follows this opcode
  - 010 - store the result from the accumulator in the main memory address that follows this opcode
- example of an instruction: **008 003**

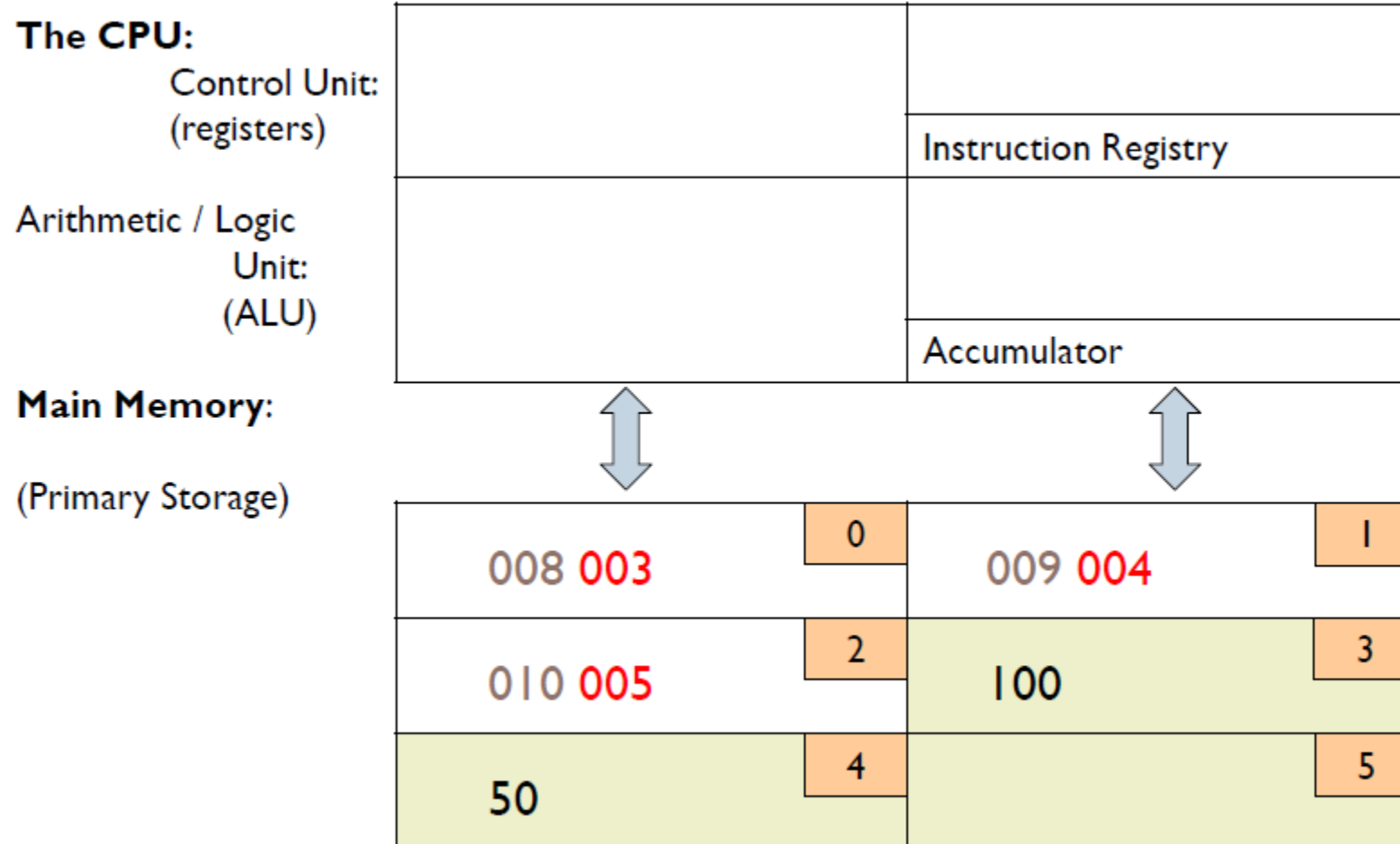
# Machine Level Program – 1st Generation

- **Instruction is : 008 003**
- 008 - load into accumulator in ALU
- 003 - **whatever is in address (cell) 3 in memory**

<b>program:</b>	memory cell	0:	008 003
		1:	009 004
		2:	010 005
<b>data:</b>	memory cell	3:	000 100
	memory cell	4:	000 050

Instructions are transferred, from memory into the CPU's control unit, one by one, where they are placed in a register and decoded by "wires"

# Basic Instruction Process



# Basic Instruction Process

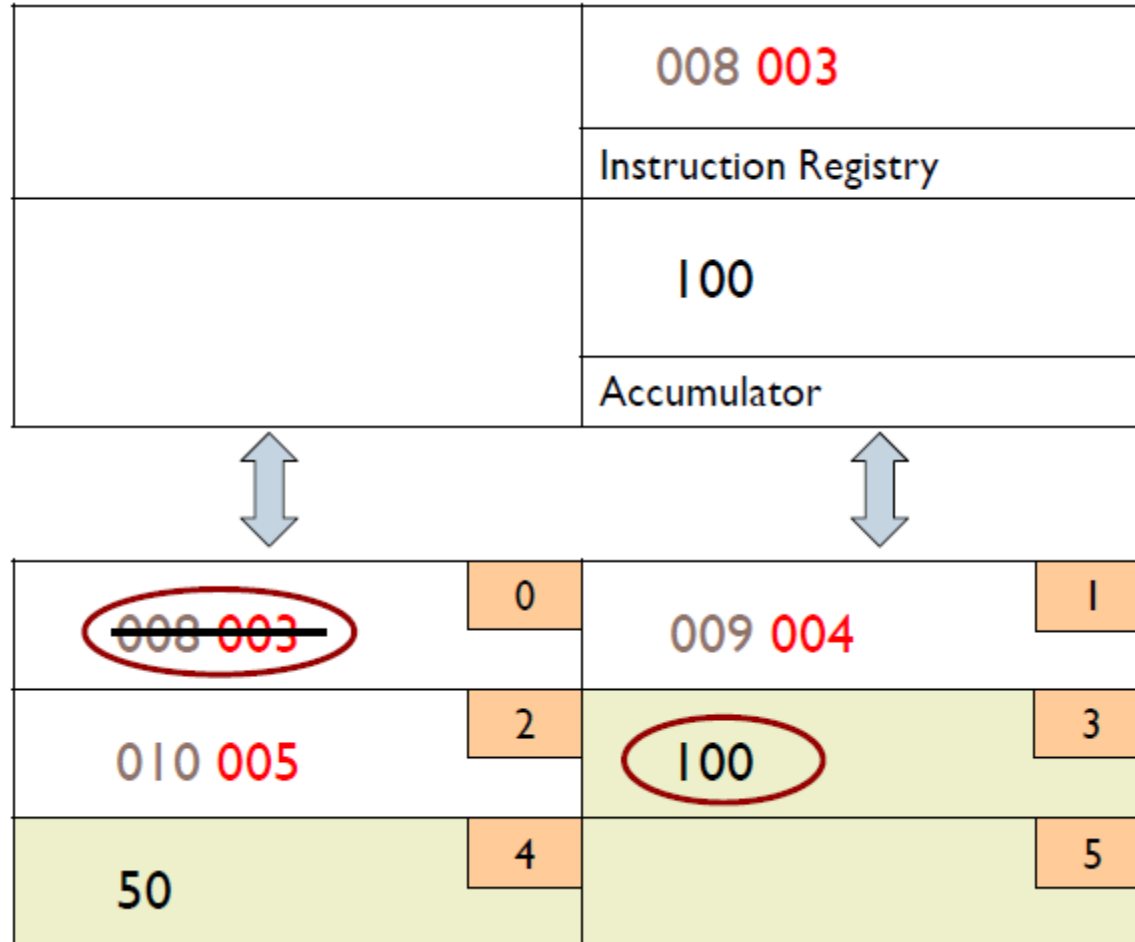
**The CPU:**

Control Unit:  
(registers)

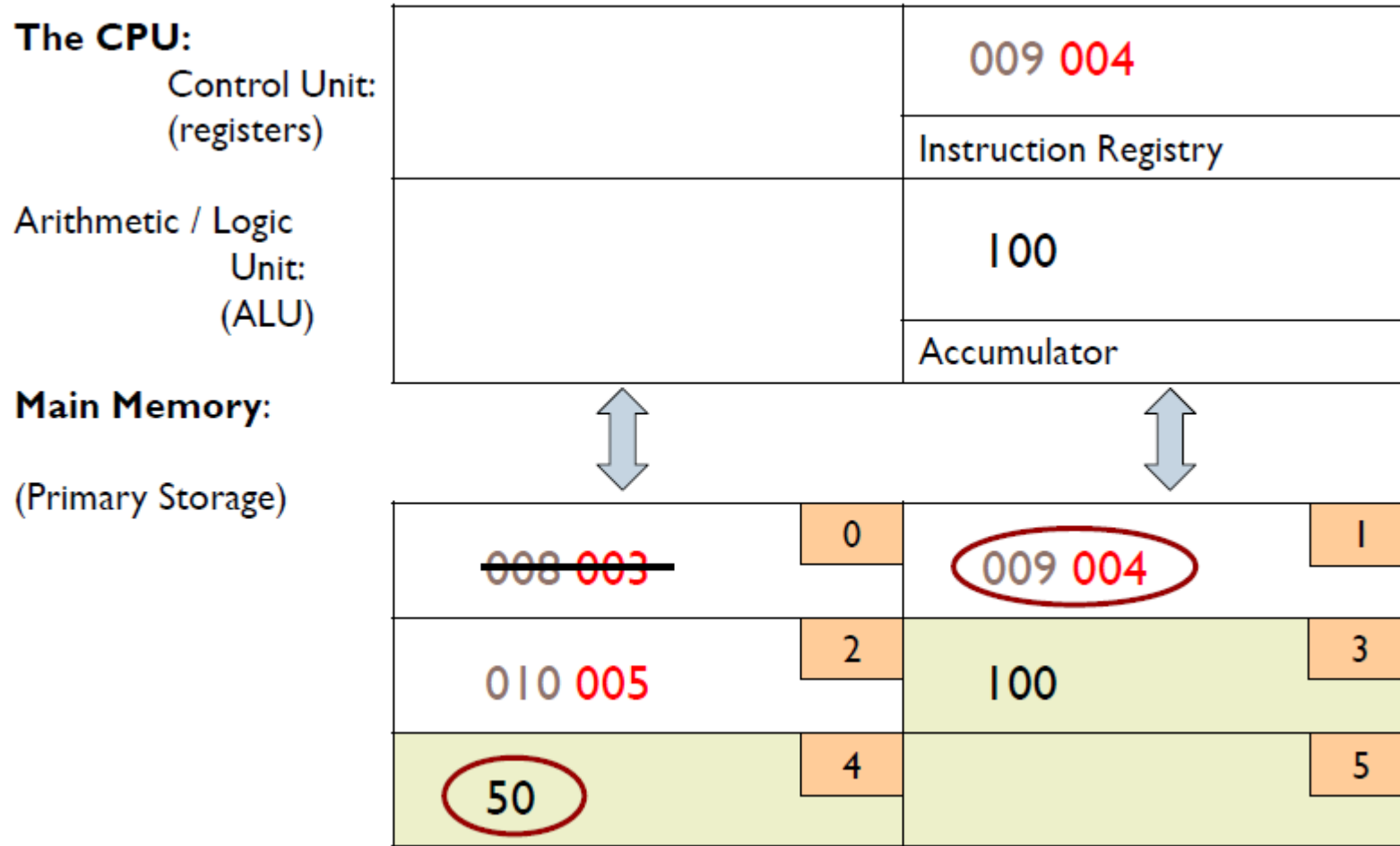
Arithmetic / Logic  
Unit:  
(ALU)

**Main Memory:**

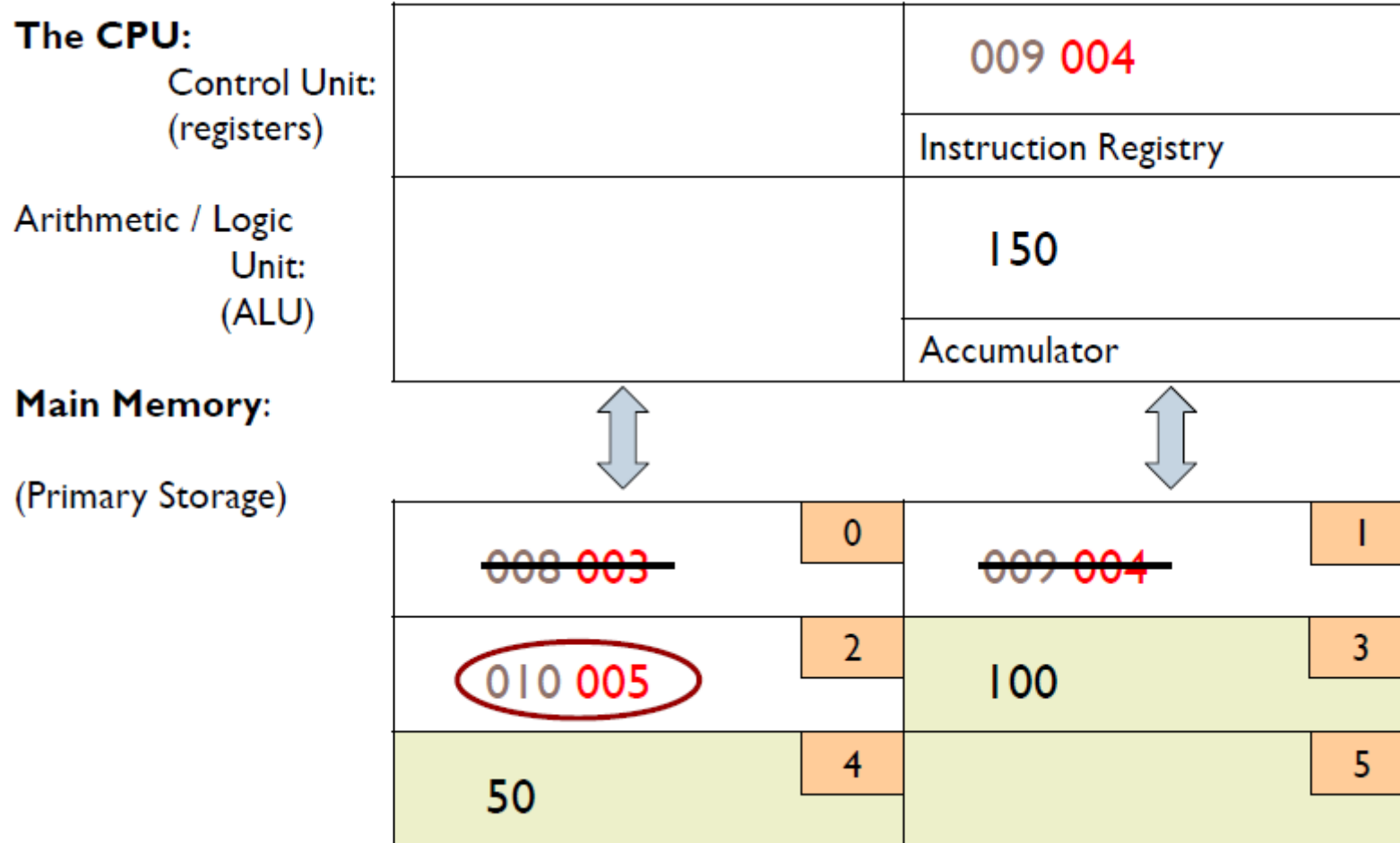
(Primary Storage)



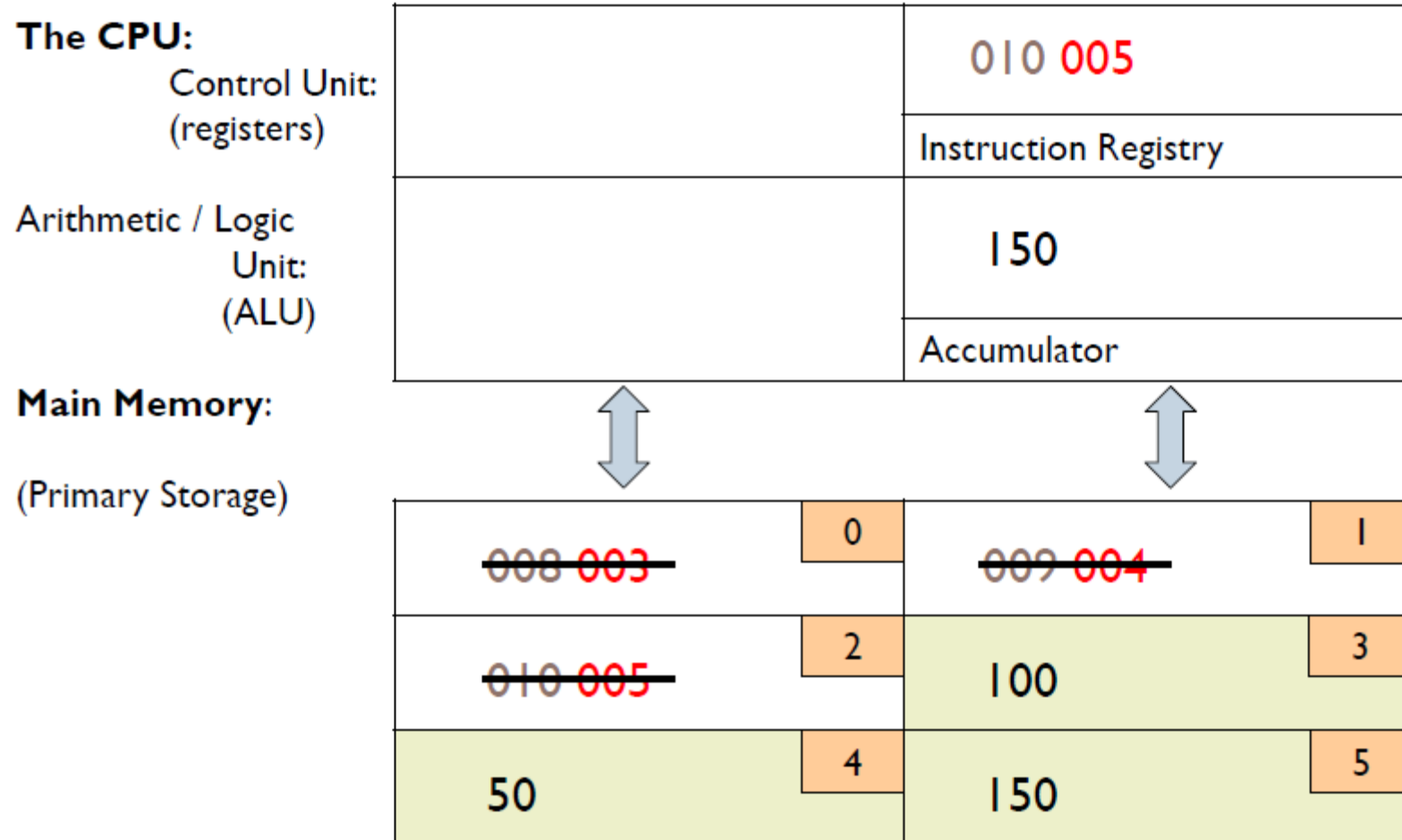
# Basic Instruction Process



# Sample Machine Level Program



# Sample Machine Level Program



# How the Computer Understands Instructions

- The machine fetches instructions (from memory), decodes and executes (in CPU) and stores results of the execution (in memory)
  - example of an instruction for CPU: 008 003
- However, such an instruction must be represented electronically, ONLY in terms of + or -
  - 008 003 (base 10)
  - 1000 0011(base 2) +--- --++ (electronic form)
    - This is how the instruction looks in the machine



# How the Computer Understands Instructions

## ► Base 10

### Decimal pattern

0

1

2

3

4

5

6

7

8

9

## Base 2

### Binary numbers

0

1

10

11

100

101

110

111

1000

1001

### Electronic form

-

+

+ -

+ +

+ - -

+ - +

+ + -

+ + +

+ - - -

+ - - +

# How the Computer Understands Instructions

- Base 10 -> Use 10 different digits to represent numbers
- Base 2 -> Use only two digits to represent numbers

$$\begin{array}{r} \color{red}{11111} \quad \text{(carried digits)} \\ 01101 \quad (13) \\ +10110 \quad (23) \\ \hline 100100 = 36 \end{array}$$

Binary is a base-2 system, each digit represents an increasing power of 2, with the rightmost digit representing  $2^0$ , the next representing  $2^1$ , then  $2^2$ , and so on.

To determine the decimal representation of a binary number simply take the sum of the products of the binary digits and the powers of 2 which they represent.

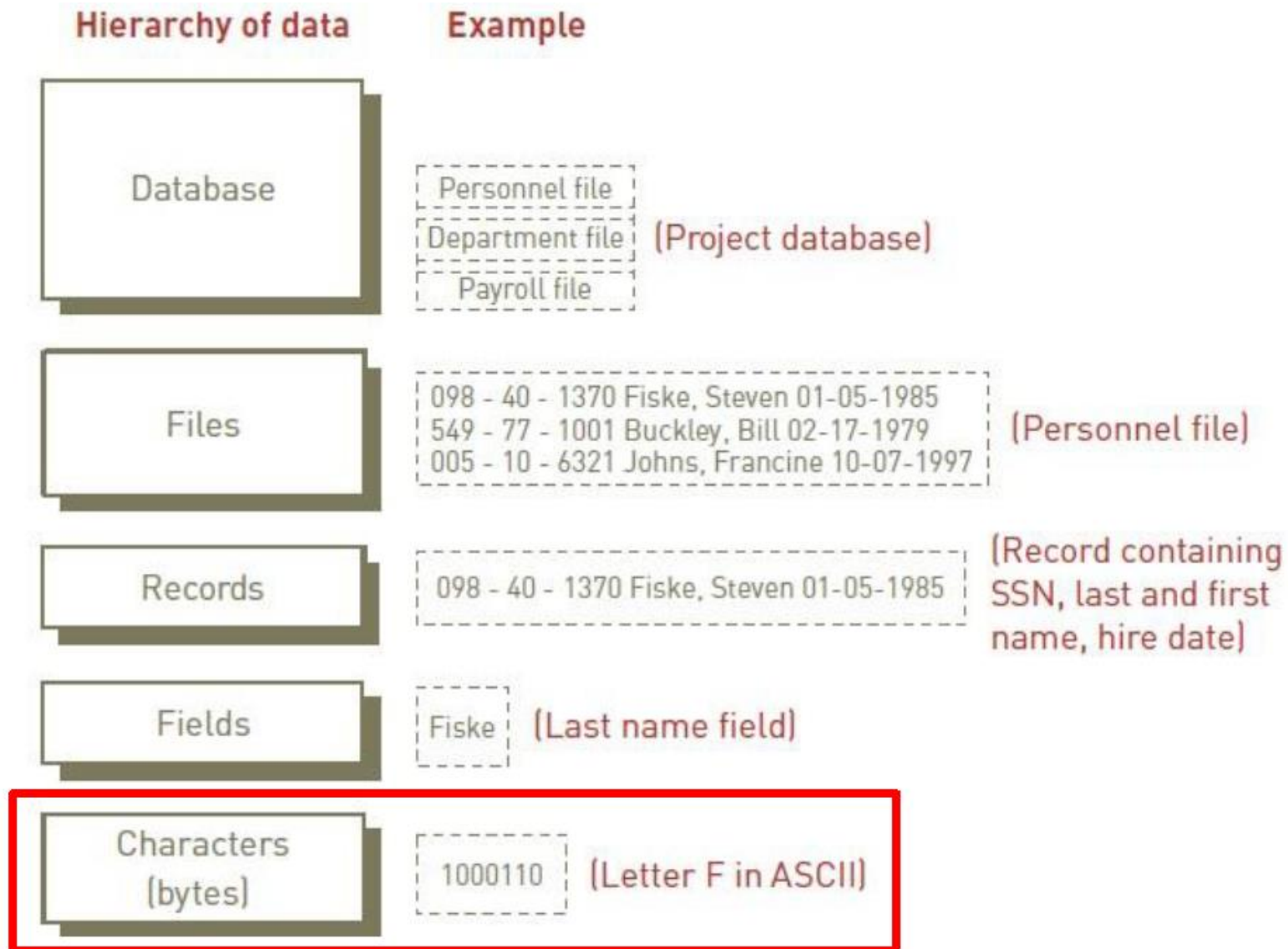
For example, the binary number **100100** is converted to decimal form as follows:

$$= [(1) \times 2^5] + [(0) \times 2^4] + [(0) \times 2^3] + [(1) \times 2^2] + [(0) \times 2^1] + [(0) \times 2^0]$$

$$= [1 \times 32] + [0 \times 16] + [0 \times 8] + [1 \times 4] + [0 \times 2] + [0 \times 1]$$

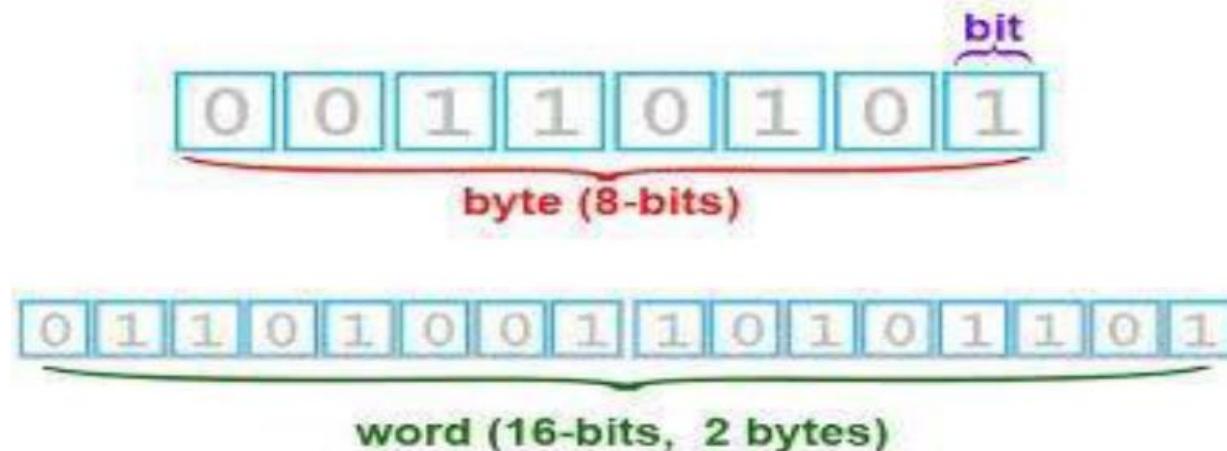
$$\mathbf{100100_2 = 36_{10}}$$

# Hierarchy of Data



# Unit of Digital Measure

- ▶ Bit (a binary digit):
  - ▶ Circuit that is either on (1) or off (0)
- ▶ Byte:
  - ▶ Made up of eight (8) bits
- ▶ Character:
  - ▶ Basic building block of information – two (2) or more bytes



# Memory Characteristics and Functions\*

Name	Abbreviation	Number of Bytes
Byte	B	1
Kilobyte	KB	$2^{10}$ or approximately 1,024 bytes
Megabyte	MB	$2^{20}$ or 1,024 kilobytes (about 1 million)
Gigabyte	GB	$2^{30}$ or 1,024 megabytes (about 1 billion)
Terabyte	TB	$2^{40}$ or 1,024 gigabytes (about 1 trillion)
Petabyte	PB	$2^{50}$ or 1,024 terabytes (about 1 quadrillion)
Exabyte	EB	$2^{60}$ or 1,024 petabytes (about 1 quintillion)
Zettabyte	ZB	$2^{70}$ or 1,024 exabytes (about 1 sextillion)
Yottabyte	YB	$2^{80}$ or 1,024 zettabytes (about 1 septillion)

# How the Computer Understands Instructions

- Instructions at this level (+ and -) are said to be in machine language
- Earliest programs were written in machine language (first generation language)
- Then, a coding system was developed
- Each character on keyboard is represented by a specific sequence of 0s and 1s
- **ASCII or EBCDIC – agreed upon coding schemes**

# Processing – Language\*

## American Standard Code for Information Interchange (ASCII)

Character	ASCII-8 Binary Code	Character	ASCII-8 Binary Code
A	0100 0001	S	0101 0011
B	0100 0010	T	0101 0100
C	0100 0011	U	0101 0101
D	0100 0100	V	0101 0110
E	0100 0101	W	0101 0111
F	0100 0110	X	0101 1000
G	0100 0111	Y	0101 1001
H	0100 1000	Z	0101 1010
I	0100 1001	0	0011 0000
J	0100 1010	1	0011 0001
K	0100 1011	2	0011 0010
L	0100 1100	3	0011 0011
M	0100 1101	4	0011 0100
N	0100 1110	5	0011 0101
O	0100 1111	6	0011 0110
P	0101 0000	7	0011 0111
Q	0101 0001	8	0011 1000
R	0101 0010	9	0011 1001

### Types of Binary

#### Micro Computers

- ASCII - 8 bit
- Extended – 8 bit

#### Mainframe Computers

- EBCDIC – 8 bit
- Extended Binary Coded Decimal Interchange Code

#### Other Types

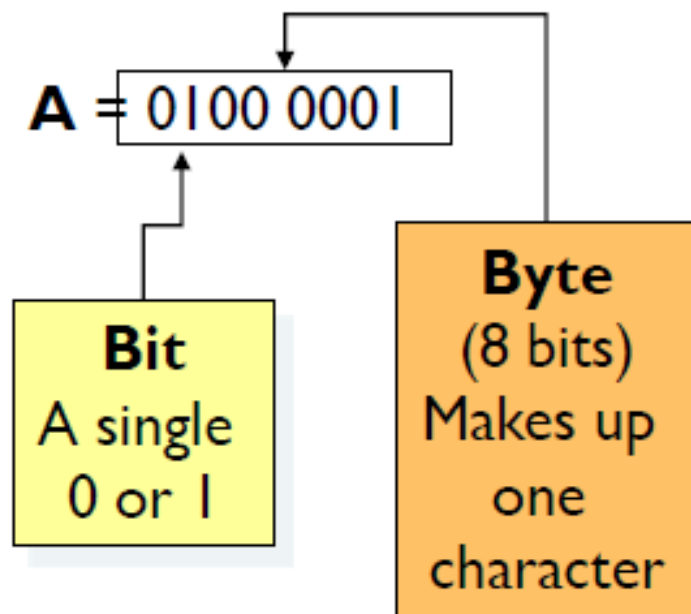
- Unicode – 16 bit
- Universal Character Set
- Used for international languages

# Processing – Language

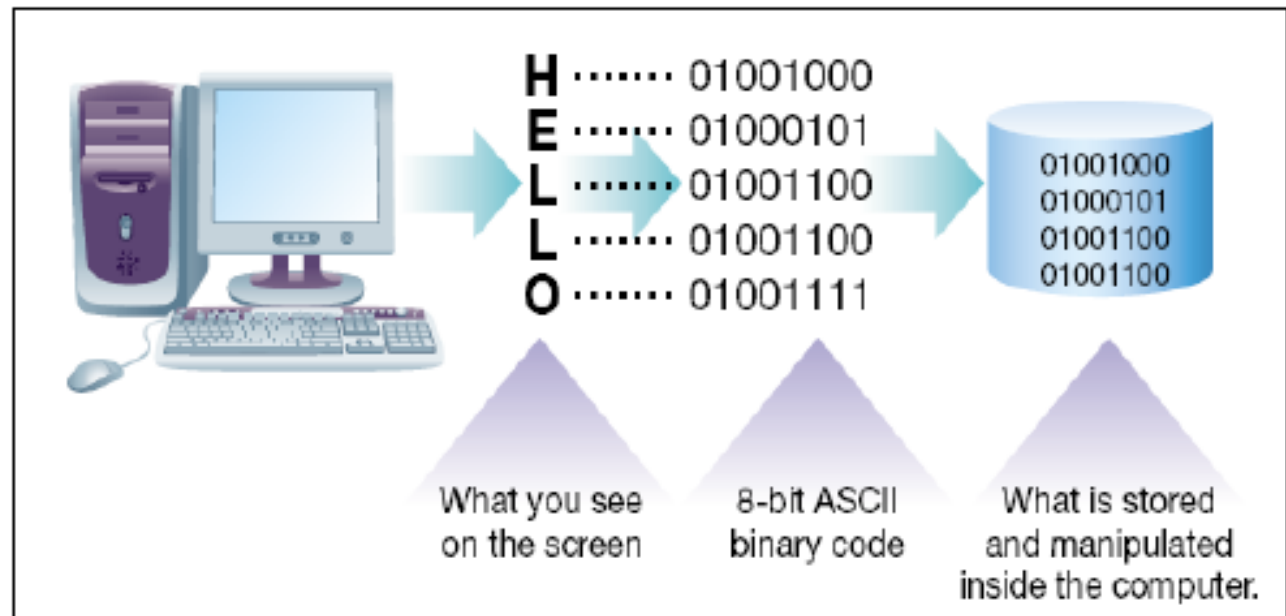
## Binary or Machine Language (First General Language)

- The language that all computers use
- IT is expressed in 0s or 1s only (see below)
- Binary utilizes Base-2 math to convert from normal characters to binary code (e.g. A = 0100 0001 in binary)

## Binary Example



## How a Computer Uses it





# How did a coding system make programming easier?

Now **programs could be written in symbolic machine language** (assembly language) **because *letters could be entered into a computer in 0s and 1s***

**How would you write your first name in Binary?**

# Assembly Language – Second Generation

e.g.,

```
CLA X  
ADD Y  
STO Z  
X  
Y  
Z
```

(second generation language)

- ADDING TWO NUMERS IN ASSEMBLY LANGUAGE
- A translation program [assembler], itself in machine language, would translate this code into actual machine language for the CPU

# Translating Assembly Language

- Programmer writes CLA X  
Machine receives

0100 0011 0100 1100 0100 0001 0101 1001  
C L A X

*(if there was no ascii we couldn't get this in)*

- Assembler program translates this to:  
1000 0011 (008 003) [equivalent machine language instruction]

# Higher Level Languages

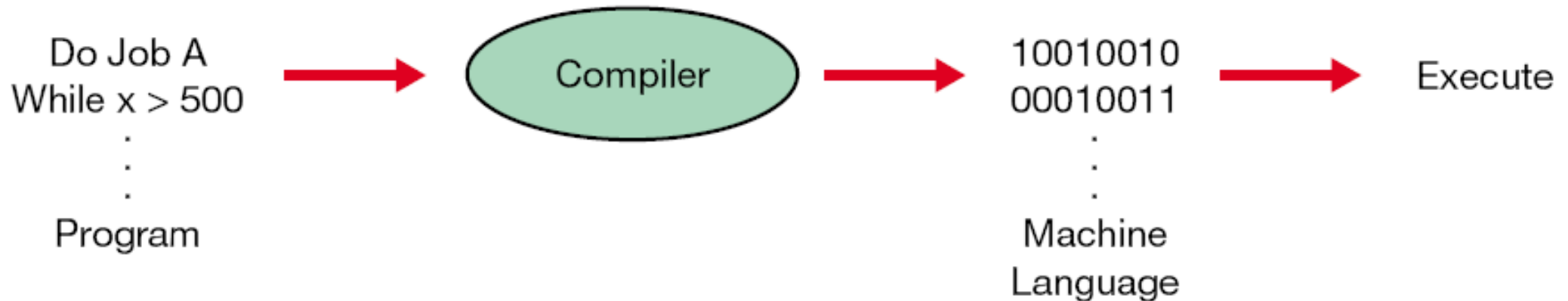
- Assembly language [second generation] - low level:
  - **one** statement in assembly language
  - translates into
  - **one** statement in machine language
- **A complicated, "real world" problem, still had to be broken down into small steps for the CPU**
- Then came third generation languages (high-level)
  - **one** statement in 3GL
  - translates into
  - **many** statements in machine language

# Compilers and Interpreters

- **Compilers**

- Highly-specialized software applications are used to convert program instructions (source code) into the machine code (object code) prior to being loaded into a computer's secondary storage

## Compiler Example



# Program to Add Two Numbers

First GL

Machine Language:

1000 0011

1001 0100

1010 0101

Second GL

Assembly Language:

CLA X

ADD Y

STO Z

X

Y

Z

# Program to Add Two Numbers

- FORTRAN 3rd Generation Language:

$$Z = X + Y$$

(will be translated to mach. language by FORTRAN compiler)

- COBOL 3rd Generation Language:

**ADD Y TO X GIVING Z.**

(will be translated to machine language by COBOL compiler)

# Third Generation Languages

- Not necessary to think at the level of a machine
- Translation program [compiler or interpreter] translates 3GL to machine language
- However, in a 3 GL, we still have to tell the computer both
- **WHAT** to do and **HOW** to do it.
- We call this **PROCEDURAL** Language
- Different 3 GL's:
  - COBOL(business)
  - FORTRAN(scientific), BASIC, PASCAL C, C++, C#, JAVA

Each 3GL has different grammar; suited to different problems



# Fourth Generation Languages\*

- Much more user-friendly
- Tell the computer **WHAT** to do but not **HOW** to do it: **NON-PROCEDURAL**
- Eg: average <list of numbers> - exist only for specific problems / uses
- Different 4GLs:
  - DOS
  - dBASE
  - SQL
  - PowerBuilder

# Fourth Generation Computing

- We can also call common application software –
  - Word processing
  - Spreadsheets
  - Web browsers
  - Multimedia programs
- Fourth generation (non-procedural) software [WHAT to do; not HOW]  
*but they are **not, properly, languages***
  - Sometimes called productivity tools
  - They use a **GRAPHICAL USER INTERFACE**

# Procedural and Non-procedural Computing

- **PROCEDURAL (3<sup>rd</sup> Generation Language)**
  - Need to tell the computer **WHAT** you want **and HOW** to do it (how to *proceed*)
  - Need to **have an *algorithm*** for the problem  
(sequence of logical steps necessary to solve the problem)
  - Need to **code the algorithm** in a procedural (3rd Gen) language
- **NON-PROCEDURAL (4<sup>th</sup> Generation Language)**
  - Tell the computer what to do, **but not** how to do it.

# Finding the Average of Numbers

- **AVERAGE: 232, 452, 554, 667, 932, 122;**
- **The Algorithm:**
  - $NNum = 0; SumNum = 0$
  - While there are numbers to read
    - Read a number
    - Add 1 to  $NNum$
    - Add the number to  $SumNum$
  - End While
  - $Average = SumNum / NNum$
  - Print "Average is: ", **Average**

# Coding the Algorithm

- The algorithm (set of steps) will now be coded in a procedural language: C language?
- This program tells the computer HOW to find the average
- The program will be compiled to machine language and run on a computer

# Finding Average in Non-procedural Language

- **AVERAGE: 232, 452, 554, 667, 932, 122;**
  - that's it!
  - who told the computer how to do this??
- **OR**
  - Type in the numbers into a box
  - **Click a button for "Average"** (using GUI)

# First to Second Generation Languages

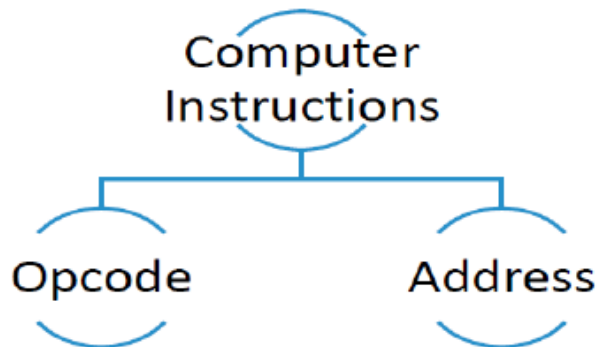
1<sup>st</sup> GL

Machine Language:

1000 0011

1001 0100

1010 0101



Binary Code Table

Character	ASCII-8 Binary Code	Character	ASCII-8 Binary Code
A	0100 0001	S	0101 0011
B	0100 0010	T	0101 0100
C	0100 0011	U	0101 0101
D	0100 0100	V	0101 0110
E	0100 0101	W	0101 0111
F	0100 0110	X	0101 1000
G	0100 0111	Y	0101 1001
H	0100 1000	Z	0101 1010
I	0100 1001	0	0011 0000
J	0100 1010	1	0011 0001
K	0100 1011	2	0011 0010
L	0100 1100	3	0011 0011
M	0100 1101	4	0011 0100
N	0100 1110	5	0011 0101
O	0100 1111	6	0011 0110
P	0101 0000	7	0011 0111
Q	0101 0001	8	0011 1000
R	0101 0010	9	0011 1001

2<sup>nd</sup> GL

Assembly Language:

CLA X

ADD Y

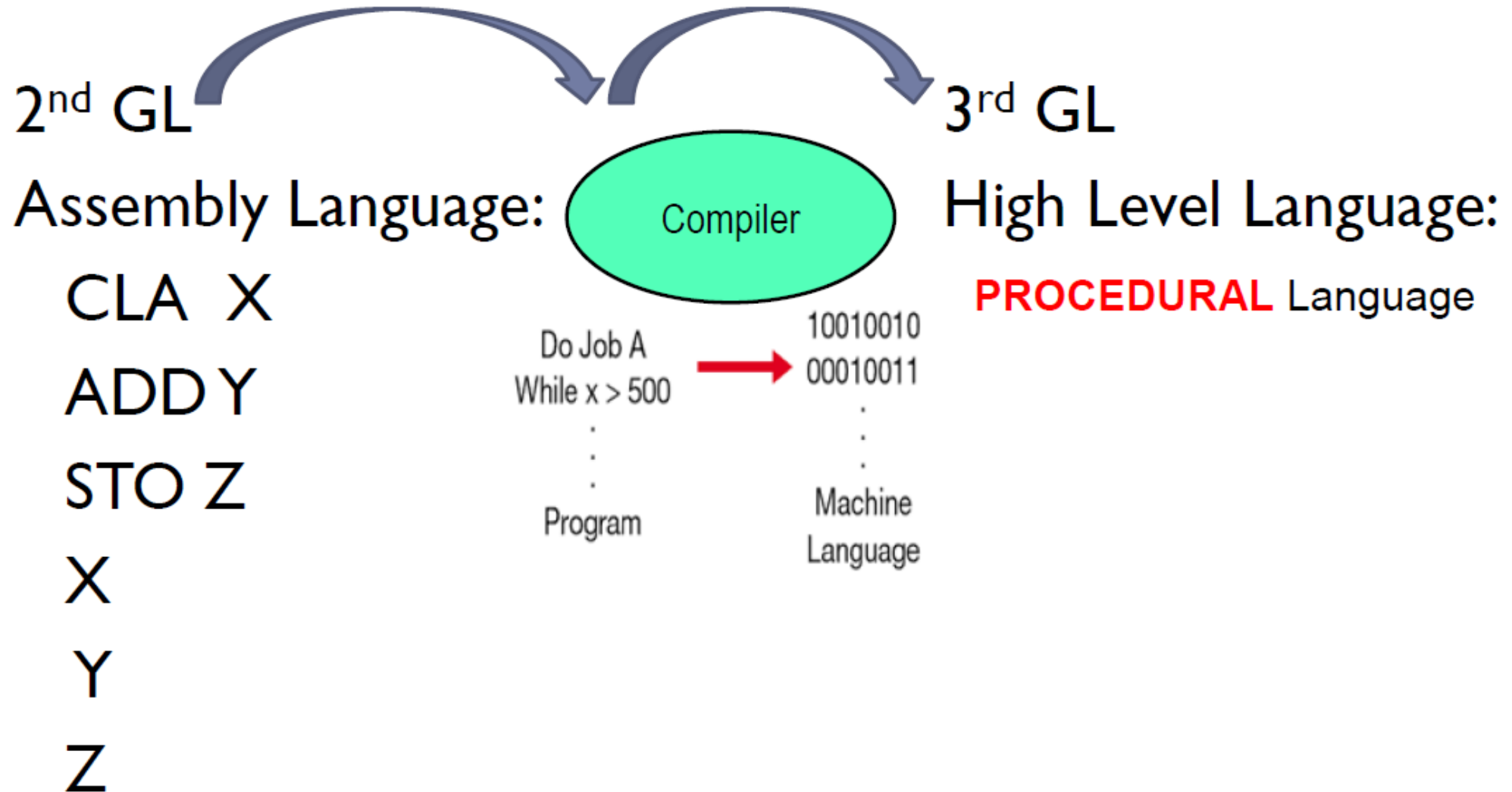
STO Z

X

Y

Z

# Second to Third Generation Languages





# Third to Fourth Generation Languages

3<sup>rd</sup> GL

High Level Language:

**PROCEDURAL** Language

- ▶ **The Algorithm:**
  - ▶ `NNum = 0; SumNum=0`
  - ▶ While there are numbers to read
    - ▶ Read a number
    - ▶ Add 1 to NNum
    - ▶ Add the number to SumNum
  - ▶ End While
  - ▶ `Average = SumNum / NNum`
  - ▶ Print "Average is:", **Average**

4<sup>th</sup> GL

High Level Language:

**Non-PROCEDURAL** Language



- Type in the numbers into a box
- **Click a button for "Average"** (using GUI)

# Generations of Programming Languages

- **Programming Languages** Used to generate program instructions and have evolved over time making them more powerful, easier to read and write, and more natural language-focused

Generations of Programming Languages				
1940s	1950s	mid 1950s	1970s	1990s
1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>
<u>Machine</u> Binary	<u>Symbolic</u> Use of symbols	<u>High-Level</u> Use English like words for procedures	<u>Outcome Oriented</u> Use outcome focused words	<u>Artificial Intelligence</u> Natural language (spoken English)



# Computer Hardware

# Computer Hardware

**Output Device**  
Monitor



**Input Device**  
Keyboard



**Processing Device**  
The System Unit



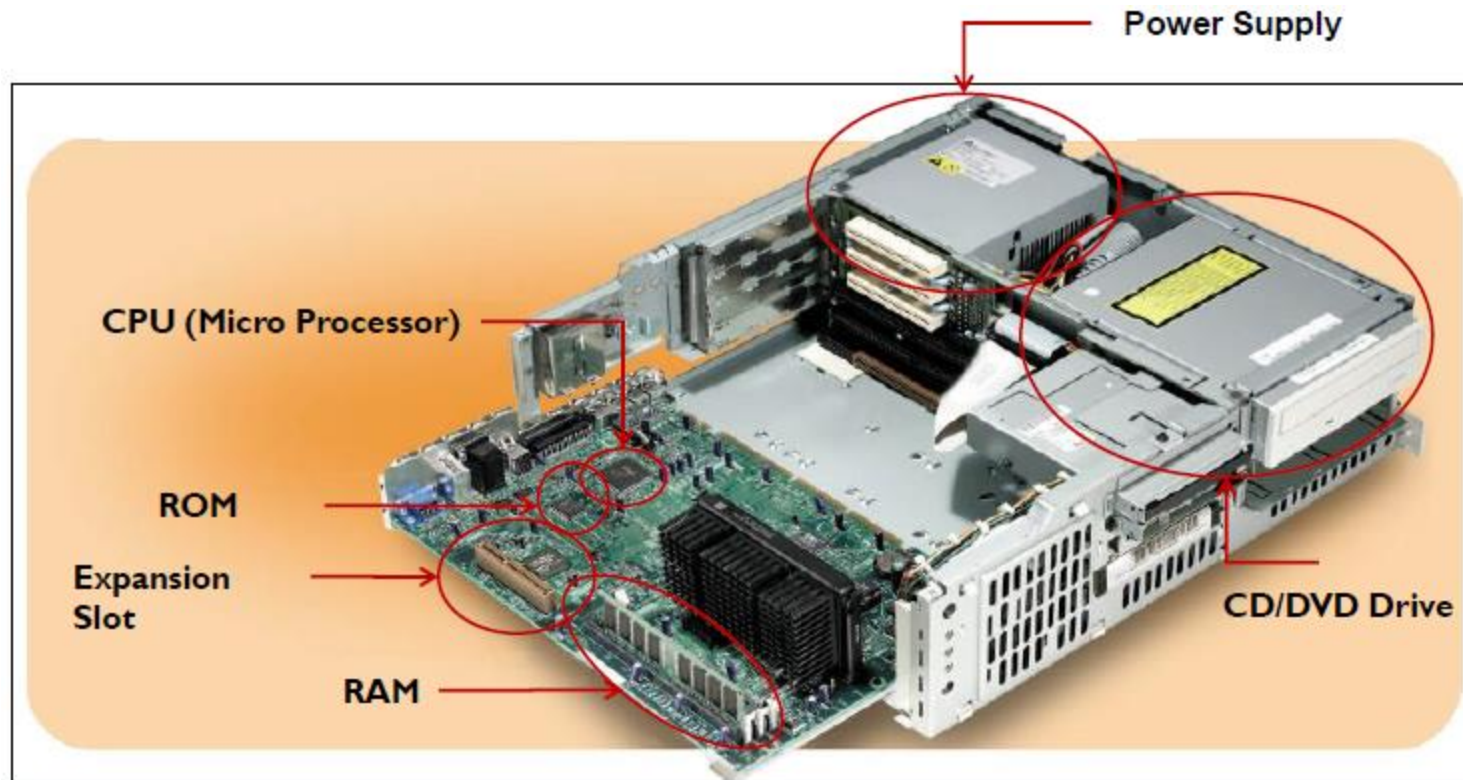
# The Microcomputer

- **PC or Apple**
- **How, specifically, are the computing principles that we saw here, implemented in a PC?**
  - microprocessor (chip) is the CPU
  - much elaborate, user-friendly software
  - consists of: **system unit (box), monitor (screen), keyboard, mouse, printer**
- **In the system unit:**
  - **motherboard, disk drives, CD-ROM drive, cards, cables, power supply**

# Motherboard

- Main circuit board: **microprocessor (CPU chip), RAM (Random Access memory - main memory)**, buses, cards
- Intel microprocessor chips (past and present):
  - 8088, 8086, 80286, 80386, 80486, Pentium+++
  - speed in MegaHertz (Million of vibrations per second) or GigaHertz (1024 MHz)
  - all processing (calculations) done in the microprocessor

# Processing – Mother Board Example



A computer's Motherboard holds or connects to all of the computer's electronic components

# Ram/Rom /Expansion Cards\*

- **RAM:** main memory chips: 2-8 GB +.
  - Into RAM goes the **Operating System, Application Software, Data**
- **ROM** (Read Only Memory) – burned-in programs to start up the computer
- **Buses** (multi-lane highways) carry instructions from memory to microprocessor and back
- **Expansion Cards:** circuit boards that plug into expansion slots on the motherboard;
  - Link peripheral equipment (printers, disks) with motherboard at the back of the cards are **ports**

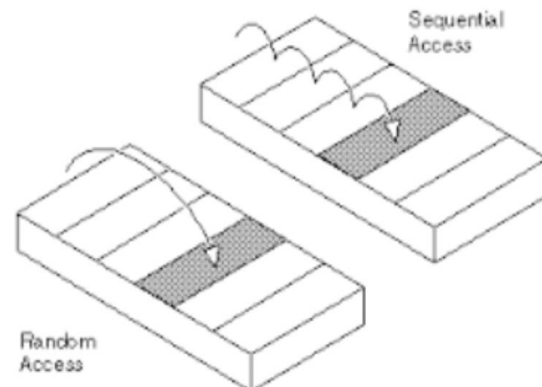


# Computer Storage – Primary/Secondary

- Computer Storage
  - Primary (Internal) Storage:
    - main memory
    - stores **instructions** and **data** that are being worked on by the CPU
    - contents erased when power off
  - Secondary (External) Storage:
    - Devices that store large amounts of data, instructions, and information more permanently than allowed with memory
      - Nonvolatility
      - Greater capacity
      - Greater economy
    - Most common forms
      - Magnetic disk, tape
      - Optical Storage
      - Solid state

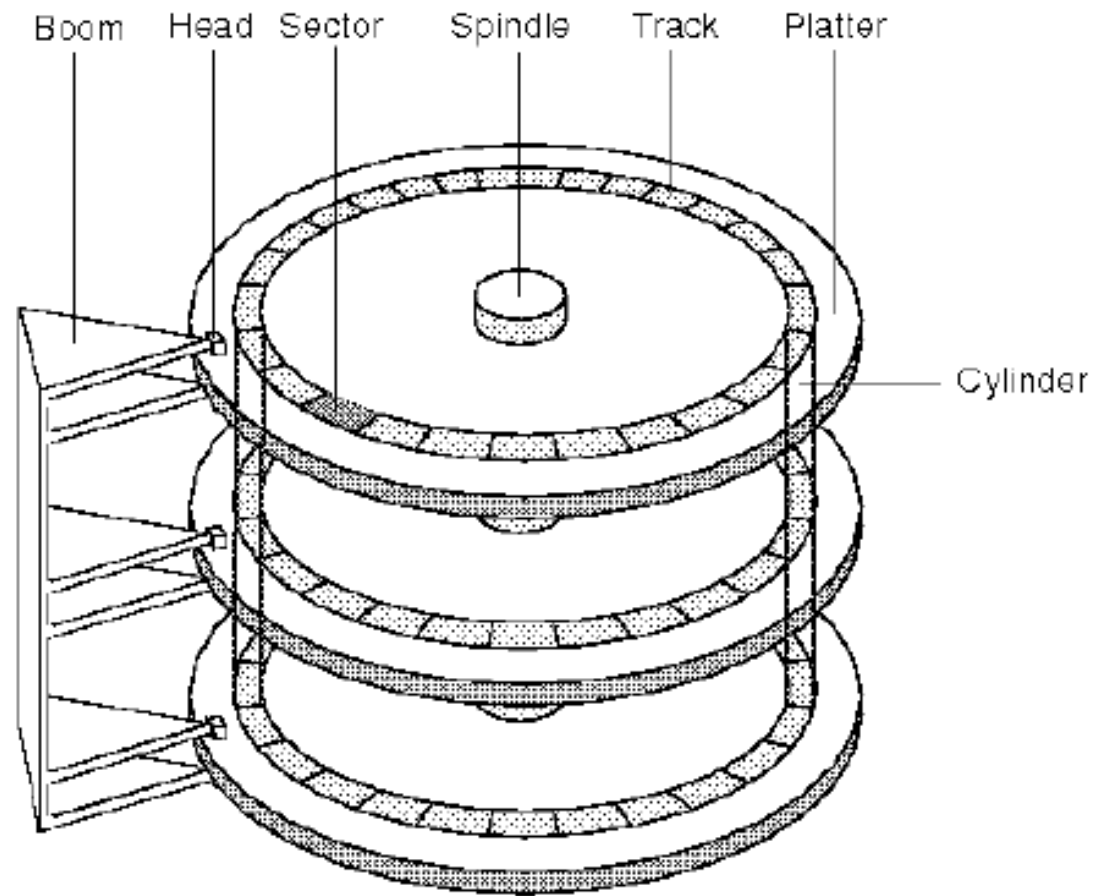
# Secondary Storage Devices

- Sequential Access
  - Data must be retrieved in the order it was stored
  - Devices used are called sequential access storage devices
- Direct Access
  - Records can be retrieved in any order
  - Devices used are called direct access storage devices (DASDs)



# Magnetic Disk

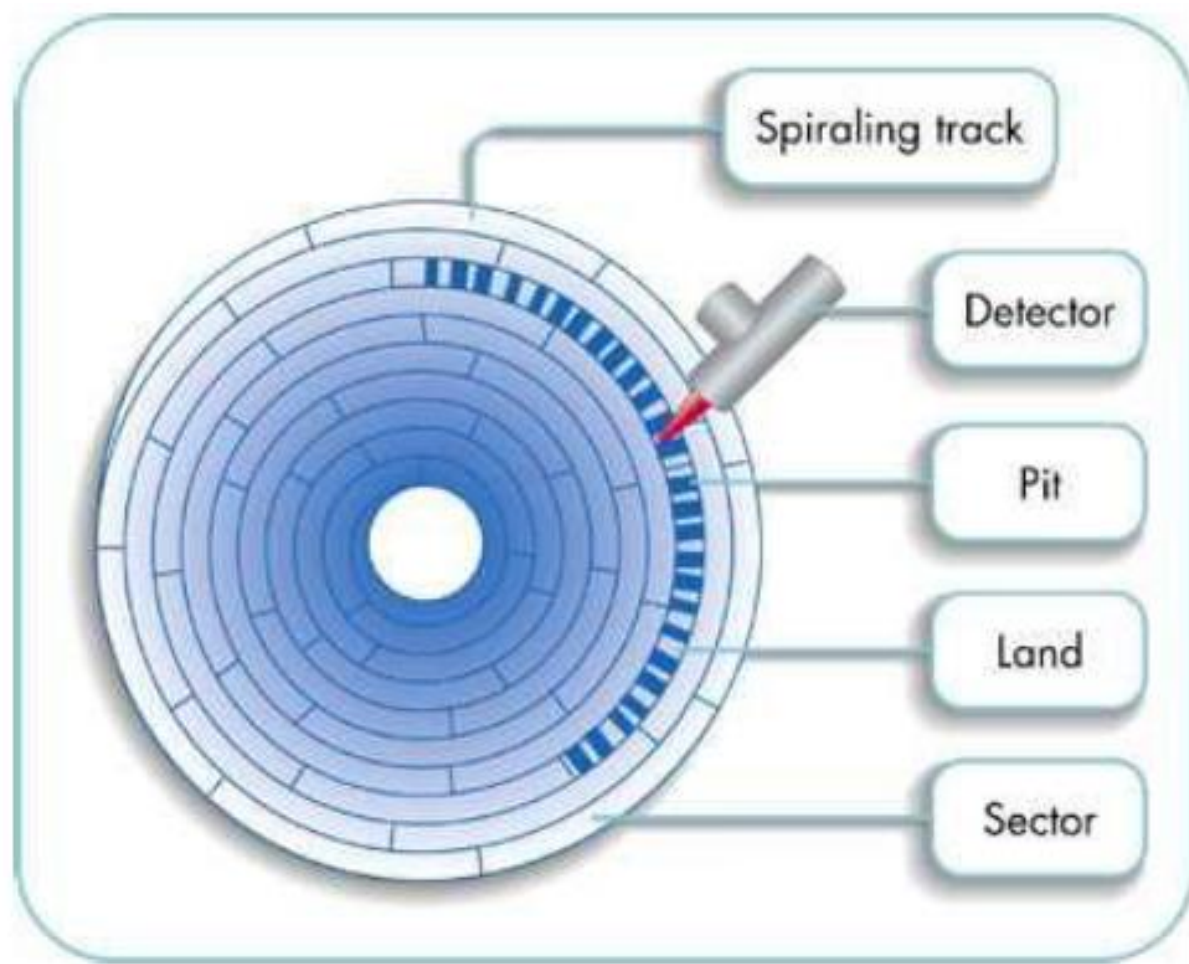
- floppy or hard disk
- platters one below other
- each platter has tracks
- data stored along tracks
- info. picked up by read / write heads
  
- software and data taken from disk to main memory
  
- disk allows direct access as opposed to tape which is sequential



# Optical Storage

## CD ROM

- laser light instead of magnetic form
- can store much more data in same amount of space

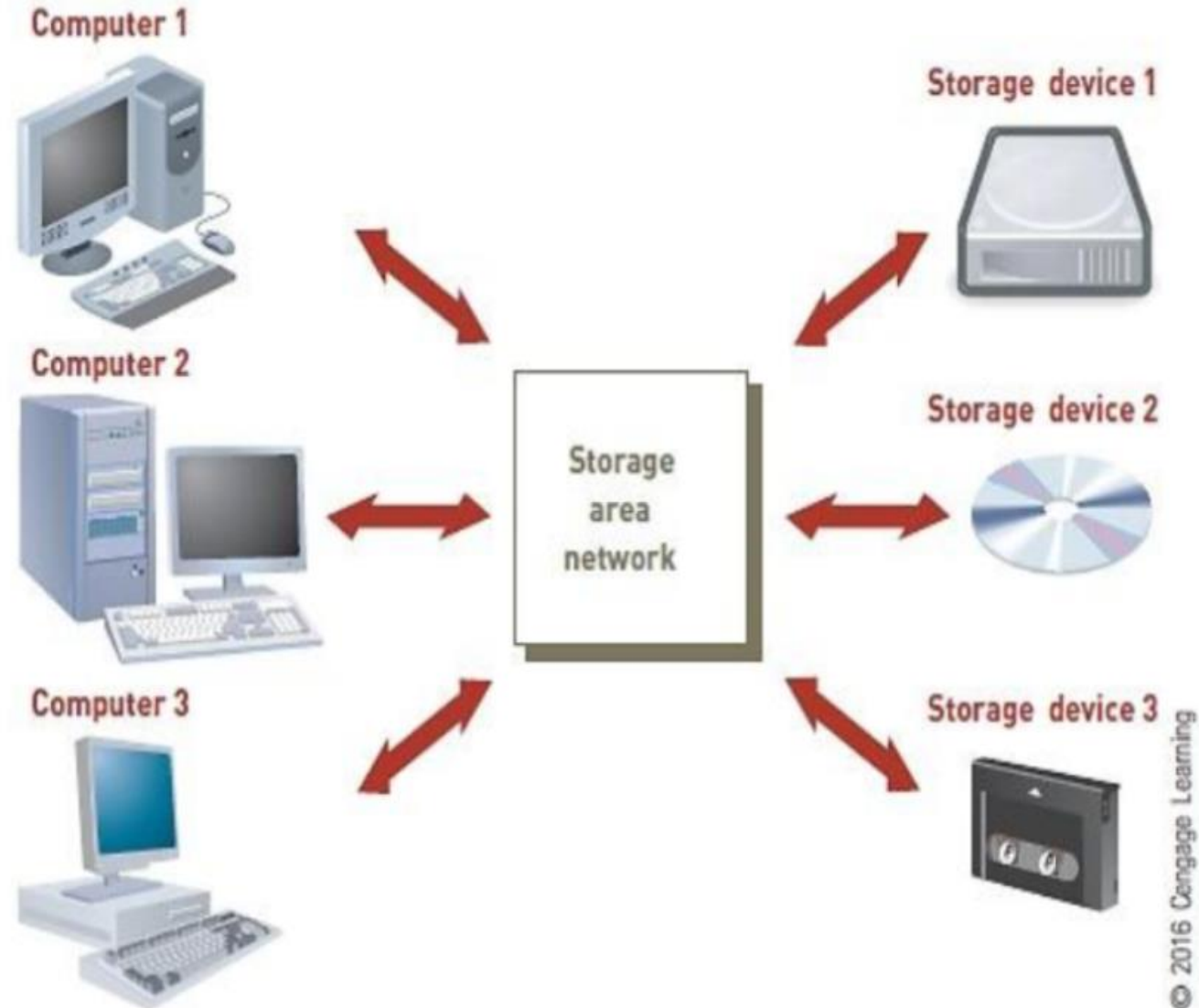


# Secondary Storage Devices

- Digital video disc (DVD):
  - Storage medium used to store software, video games, and movies
- Solid state secondary storage devices:
  - E.g. USB Flash Drives
  - Store data in memory chips rather than magnetic or optical media
  - Have few moving parts, so they are less fragile than hard disk drives
  - High cost per GB of data storage
  - Lower capacity compared to current hard drives

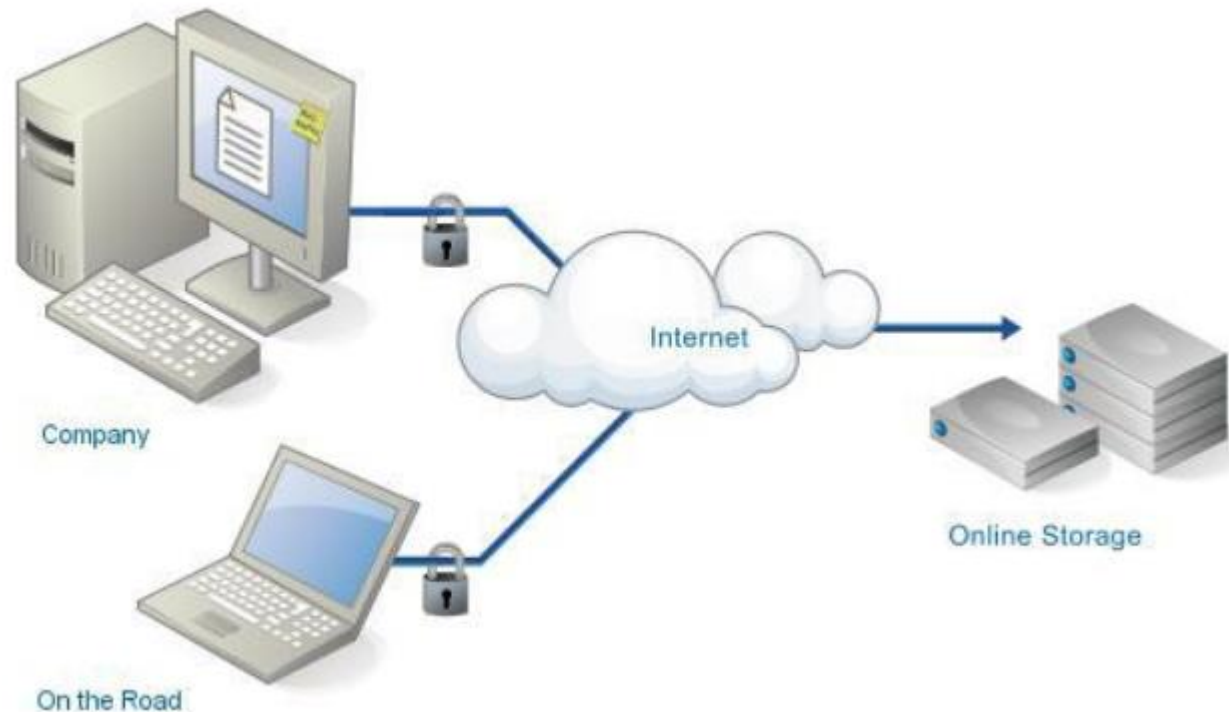


# Storage Area Network (SAN)



# Secondary Storage Devices

- Storage as a Service:
  - Data storage service provider rents space to people and organizations
  - Users access their rented storage space via the Internet



# Outside of the System unit

- Keyboard:
  - press key, the character's ASCII code is sent down
- Monitor:
  - CRT, VDT (video display terminal)
  - had CGA, EGA, VGA, Super VGA
  - more colors, dots closer together
- Printer: - Impact or non-impact
  - Dot matrix (old)
  - Ink jet
  - Laser
- Mouse:
  - for use with Graphical User Interfaces (GUIs) on the screen



# Input Devices

- Devices used to input general types of data:
  - Personal computer input devices
  - Speech recognition technology
  - Digital cameras
  - Touch-sensitive screens
  - Barcode Readers
  - Pen input devices
  - Magnetic stripe card
  - Radio Frequency Identification

# Input Devices (continued)



**Figure 2.6**

## RFID Tag

An RFID tag is small compared to current bar-coded labels used to identify items.

[Source: Courtesy of Intermec Technologies Corporation.]

# Output Devices

- Display monitors:
  - Used to display the output from the computer
  - Plasma display:
    - Uses thousands of smart cells (pixels) consisting of electrodes and neon and xenon gases that are electrically turned into plasma to emit light
  - LCD displays:
    - Flat displays that use liquid crystals
  - Organic light-emitting diodes (OLEDs):
    - Use a layer of organic material sandwiched between two conductors



# Output Devices (continued)

- Printers and plotters:
  - Two main types of printers are laser printers and inkjet printers
  - Plotters are a type of hard-copy output device used for general design work
  - Multi-Function printers
  - 3D printers
- Digital audio player:
  - Can store, organize, and play digital music files
- E-books:
  - Digital media equivalent of a conventional printed book



# Computer System Types

- Computer systems can range from desktop or portable computers to massive supercomputers
- Two major groups of general-purpose computers
  - Single-user computers with portable and non-portable option
  - Multiple-user computers

# Portable Single User Computers

- **Handheld computer** a compact computing device
  - Typically includes a display screen with stylus or touch screen input along with a compact keyboard or numeric keypad
  - Applicable as POS devices
  - Rugged versions are available for military applications
- **Laptop computers** are designed for use by mobile users
  - Notebook and ultrabook computers are smaller than laptop computers
  - Tablet computers are portable, lightweight computers with or without a keyboard

# Non-Portable Single-User Computers

- **Handheld computer** : a compact computing device
  - A thin client is a low-cost, centrally managed computer with no internal or external attached drives for storage
  - Desktop computers are single-user computer systems that are highly versatile



# Non-Portable Single-User Computers

- A nettop computer is an inexpensive desktop computer
  - Smaller, lighter, and consumes much less power than a traditional desktop computer
- Workstations are more powerful than personal computers but still small enough to fit on a desktop





# Multi-User Computer Systems

- A server is employed by many users to perform a specific task, such as running network or Internet applications
- Server systems consist of multiuser computers, including supercomputers, mainframes, and other servers
- Blade server: a server that houses many individual computer motherboards



# Classification of Computers

- Supercomputers: largest, most powerful, \$\$\$;
  - perform parallel processing (Big Blue)
- Mainframes: central, many dumb terminals
- Minicomputers: smaller mainframes
- Microcomputers: can be networked; others: {e.g., portable computers, laptops, tablets, etc.
- Next: Quantum Computing



# Data Centers

- Data center: a climate-and-access-controlled building or a set of buildings that houses the computer hardware that delivers an organization's data and information services



# Computer Software

## Operating Systems and Applications

# Overview of Software

- **Computer programs:** sequences of instructions for the computer
- **Documentation:** text that describes program functions to help the user operate the computer system
- Types of software
  - Systems software
  - Application software
- **Application Software**
  - Helps users solve particular problems
  - In most cases, resides on the computer's hard disk
  - Can be stored on CDs, DVDs, or USB flash drives

# System vs Application Software

- **Systems Software**

- The set of programs that coordinates the activities and functions of hardware and other programs
- Each type of systems software is designed for a specific CPU and class of hardware

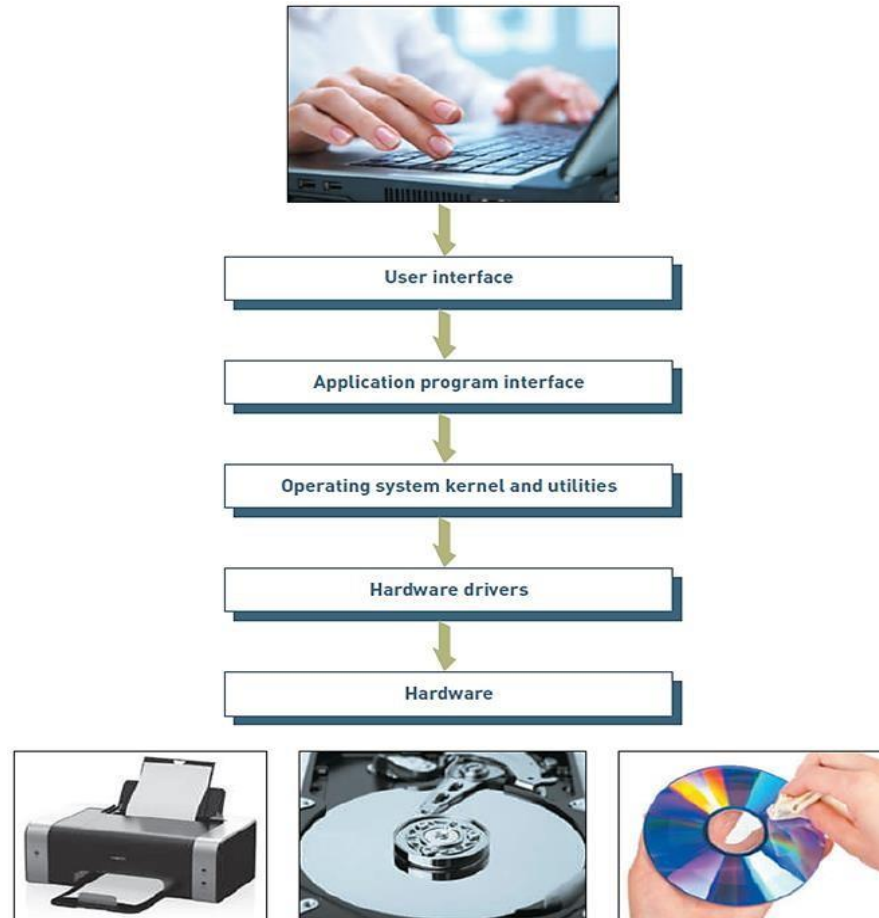
- **Application Software**

- Helps users solve particular problems
- In most cases, resides on the computer's hard disk
- Can be stored on CDs, DVDs, or USB flash drives



# Operating Systems

- A set of programs that controls computer hardware and acts as an interface with application programs



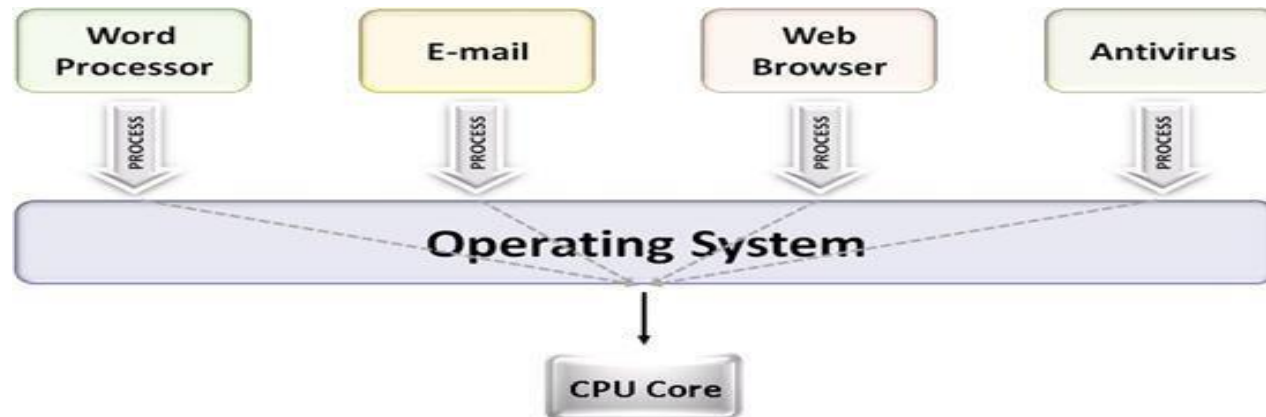
# Operating System Activities

- Activities performed by the operating system:
  - Perform common computer hardware functions
  - Provide a user interface and input/output management
  - Provide a degree of hardware independence
  - Manage system memory
  - Manage processing tasks
  - Provide networking capability
  - Control access to system resources
  - Manage files



# Operating Systems: Processing Tasks

- Five basic task management techniques
  - Multiuser: allows two or more users to run programs at the same time on one computer
  - Multiprocessing: supports running a program on more than one CPU
  - Multitasking: allows more than one program to run concurrently
- Multithreading: allows different threads of a single Program to run concurrently
  - A thread is a set of instructions within an application that is independent of other threads
  - Real time: responds to input instantly



# Current Operating Systems

- Microsoft PC operating systems

- Windows
- Windows 95
- Windows XP
- Windows Vista
- Windows 7
- Windows 8
- Windows 10



Windows 1  
1985



Windows 3.1  
1992



Windows 95  
1995



Windows XP  
2001



Windows  
Vista 2006



Windows 7  
2009



Windows 8  
2012

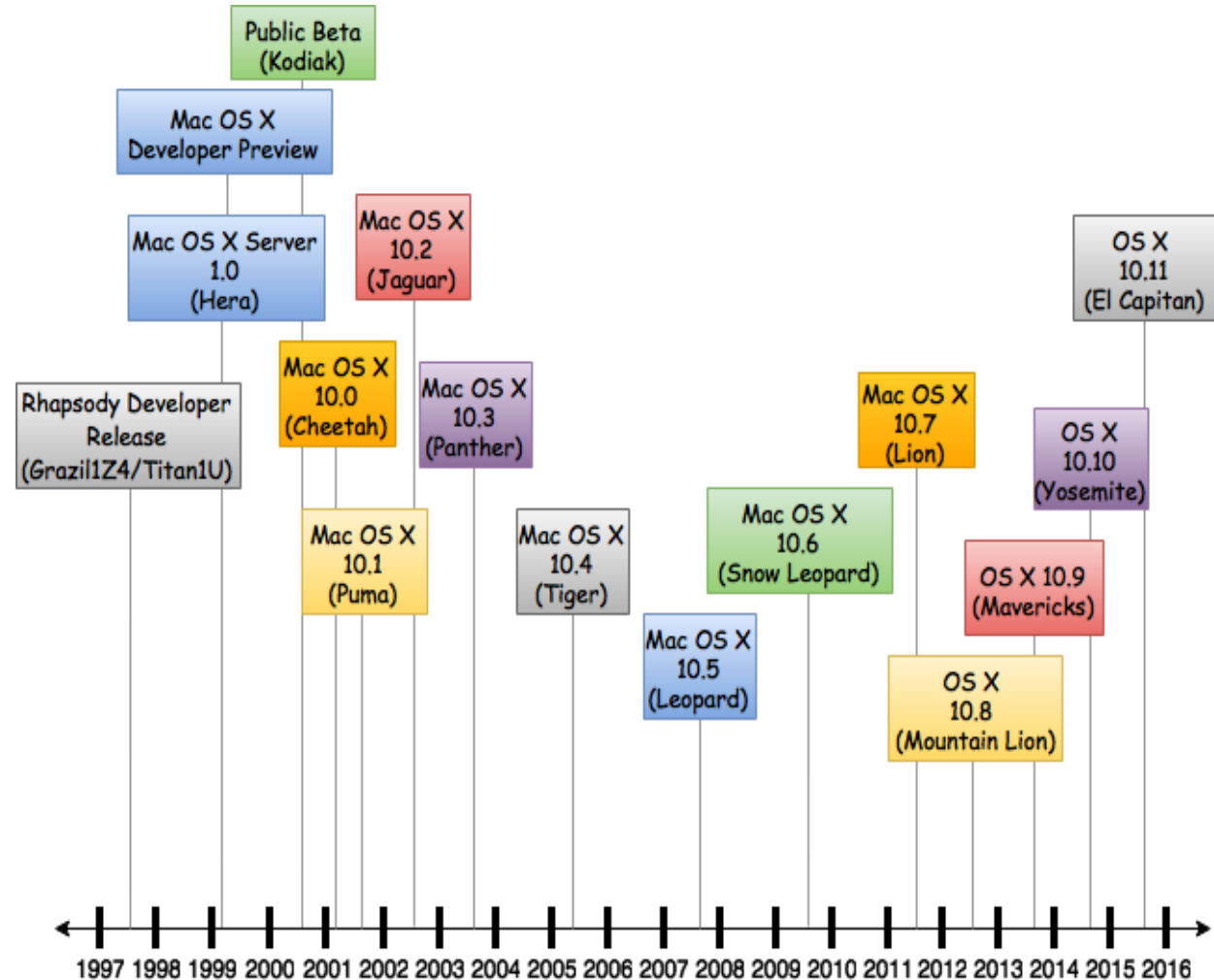


Windows 10  
2015

# Current Operating Systems

- Apple Computer Operating Systems

- 4.7 Mac OS X 10.5 Leopard.
- 4.8 Mac OS X 10.6 Snow Leopard.
- 4.9 Mac OS X 10.7 Lion.
- 4.10 OS X 10.8 Mountain Lion.
- 4.11 OS X 10.9 Mavericks.
- 4.12 OS X 10.10 Yosemite.
- 4.13 OS X 10.11 El Capitan.
- 4.14 macOS 10.12 Sierra.



# Operating System(continued)

- Linux

- Open-source operating system
- Red Hat (most common)

- ▶ Chrome OS

- ▶ Linux-based operating system designed
  - for netbooks and nettops
- ▶ Designed to run on inexpensive low-power computers
- ▶ Chromium OS: an open-source version of Chrome OS
- ▶ Android-based apps are made available on Chromebooks which makes the platform more general-purpose than a typical thin client.
- **Android:** an operating system for mobile devices



# Mobile Operating Systems

Smartphone Operating System	Worldwide Market Share of Sales during 2Q 2013	Estimated Total Number of Applications Mid-2013	Estimated Rate of Increase in Number of New Applications
Google Android	56.5%	>1,000,000	800/day
Apple iPhone OS	39.6%	900,000	600/day
Microsoft Windows Mobile	3.3%	145,000	130/day
Blackberry Limited, Blackberry	2.9%	120,000	NA

# Operating Systems - Utilities

**Utilities:**  
Programs that manage **computer resources** and **files** and may be included in the **operating system** or purchased **separately** as needed

Utility	Description
Backup	Archives files from the hard disk to a diskette or to tapes
File defragmentation	Converts a fragmented file stored on your hard disk (one not stored contiguously) into one that will load and be manipulated more rapidly
Disk and data recovery	Allows the recovery of damaged or erased information from hard and floppy disks
Data compression	Compresses data by substituting a short code for frequently repeated patterns of data, much like the machine shorthand used by court reporters, allowing more data to be stored on a disk
File conversion	Translates a file from one format to another, so it can be used by an application other than the one used to create it
Antivirus	Monitors and removes viruses—lines of code designed to disrupt the computer's operation and make your life miserable
Device drivers	Allows new hardware added to your computer system, such as a game controller, printer, scanner, and so on, to function with your operating system
Spam blockers	Monitors your incoming e-mail messages and filters or blocks the message from arriving
Spyware detection and removal	Monitors and removes spyware from your computer (see Chapters 4 and 9)
Media players	Allows music in formats such as MP3, WMA, or WAV or video in formats such as MPEG, AVI, ASF to be listened to or watched on a computer

# Utility Programs

- ▶ Help to perform maintenance or correct problems with a computer system
- ▶ Some can help computer systems run better and longer without problems
- ▶ Can help to secure and safeguard data

Personal	Workgroup	Enterprise
Software to compress data so that it takes less hard disk space	Software that maintains an archive of changes made to a shared document	Software to archive contents of a database by copying data from disk to tape
Software that assists in determining which files to delete to free up disk space	Software that monitors group activity to determine levels of participation	Software that monitors network traffic and server loads
Antivirus and antispyware software for PCs	Software that reports unsuccessful user logon attempts	Software that reports the status of a particular computer job

# Application Software

- ▶ Application programs that:-
- ▶ Interact with systems software and the systems software directs computer hardware to perform necessary tasks
- ▶ Help you perform common tasks, such as:
  - ▶ Creating and formatting text documents
  - ▶ Performing calculations
  - ▶ Managing information
  - ▶ Some applications are more specialized



# Application Software

- ▶ Proprietary software:
  - ▶ One-of-a-kind program for a specific application, usually developed and owned by a single company
- ▶ Off-the-shelf software: aka Commercial Off The Shelf – “COTS”
  - ▶ Existing software program that is purchased
  - ▶ Application service provider (ASP):
    - ▶ Company that can provide software, support, and computer hardware on which to run the software from the user’s facilities over a network

# Overview of Application Software

Proprietary Software		Off-the-Shelf Software	
Advantages	Disadvantages	Advantages	Disadvantages
You can get exactly what you need in terms of features, reports, and so on.	It can take a long time and significant resources to develop required features.	The initial cost is lower because the software firm can spread the development costs over many customers.	An organization might have to pay for features that are not required and never used.
Being involved in the development offers control over the results.	In-house system development staff may become hard pressed to provide the required level of ongoing support and maintenance because of pressure to move on to other new projects.	The software is likely to meet the basic business needs—you can analyze existing features and the performance of the package before purchasing.	The software might lack important features, thus requiring future modification or customization. This can be very expensive because users must adopt future releases of the software as well.
You can modify features that you might need to counteract an initiative by competitors or to meet new supplier or customer demands. A merger with or acquisition of another firm also requires software changes to meet new business needs.	The features and performance of software that has yet to be developed present more potential risk.	The package is likely to be of high quality because many customer firms have tested the software and helped identify its bugs.	The software might not match current work processes and data standards.

# Overview of Application Software

- ▶ Software as a service (SaaS):
  - ▶ Allows businesses to subscribe to Web-delivered business application software by paying a monthly service charge or a per-use fee
  - ▶ Can reduce expenses by sharing its running applications among many businesses
- ▶ Cloud computing:
  - ▶ Use of computing resources, including software and data storage, on the Internet (the cloud) rather than on local computers

# Computer Systems

End of Lecture 9