

# CSC 170 – Introduction to Computers and Their Applications

## Lecture #4 – Digital Devices

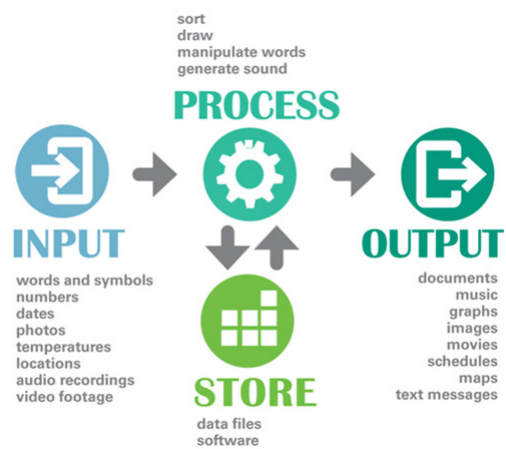
### Computers

- At its core, a **computer** is a multipurpose device that accepts input, processes data, stores data, and produces output, all according to a series of stored instructions.
- **Input** is whatever is typed, submitted, or transmitted to a computer.
- **Output** is the result produced by a computer.

# Computers

- Computers *process data* by performing calculations, modifying documents and pictures, drawing graphs, and sorting lists of words or numbers.
- Processing is handled by the computer's *central processing unit* (CPU).

# Computers



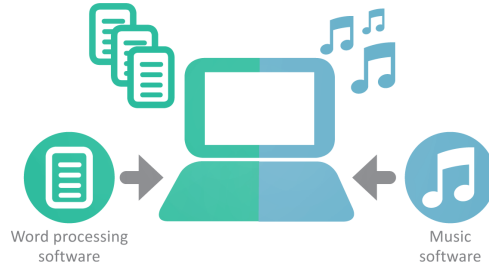
## Computers

- The instructions that tell a digital device how to carry out processing tasks are referred to as a ***computer program***, or simply a program.
- Programs form the ***software*** that sets up a computer to do a specific task.

## Computers

- When a computer “runs” software, it performs the instructions to carry out a task.
- The first computers were “programmed” to perform a specific task by connecting wire circuitry in a certain way.
- The term ***stored program*** means that a series of instructions for computing a task can be loaded into a computer’s memory.

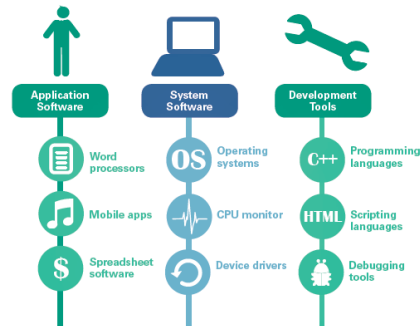
# Computers



The stored program concept allows you to use a computer for one task, such as word processing, and then easily switch to a different type of computing task, such as editing a photo or playing music. It is the single most important characteristic that distinguishes computers from other simpler and less versatile digital devices, such as digital clocks, calculators, and cameras.

# Computers

- Computers run three main types of software:
  - Application software
  - System software
  - Development tools



## Computers

- *Application software* is a set of computer programs that helps a person carry out a task.
- The primary purpose of *system software* is to help the computer system monitor itself in order to function efficiently (an example of system software is a *computer operating system* or OS).
- *Development tools* are used for creating software applications, Web sites, operating systems, and utilities.

## Circuits and Chips

- The small circuit boards and integrated circuits you see when you open up a digital device are the essence of digital electronics
- Digital electronics represent data bits as electrical signals that travel over circuits in much the same way that electricity flows over a wire when you turn on a light switch

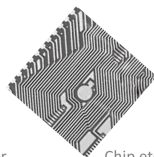
## Circuits and Chips

- An *integrated circuit* (IC) is a set of microscopic electronic circuits etched onto a thin slide of semiconducting material
- The terms *computer chip*, *microchip*, and *chip* are commonly used to refer to integrated circuits
- *Semiconductors*, such as silicon and germanium, are substances with properties between those of a conductor (like copper) and an insulator (like wood)

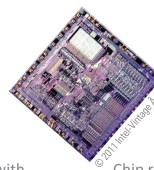
## Circuits and Chips



Blank semiconductor chip



Chip etched with circuits



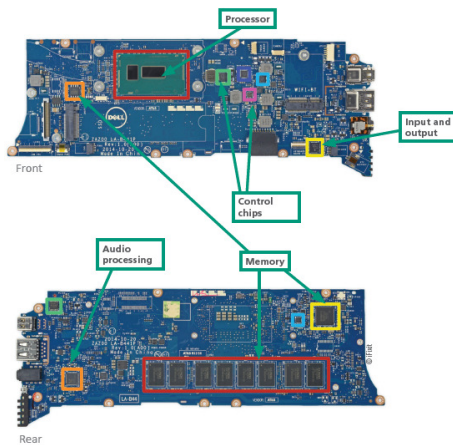
Chip ready for packaging



## Circuits and Chips

- The electronic components of most digital devices are mounted on a circuit board called a *system board*, *motherboard*, or main board.
- The system board houses all essential chips and provides connecting circuitry between them.

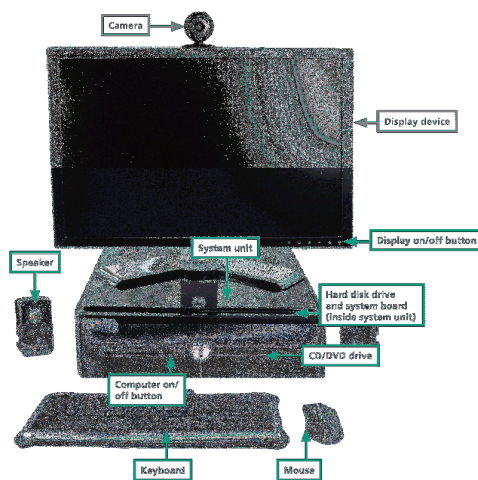
## Circuits and Chips



# Components

- In the computer industry the term *form factor* refers to the size and dimensions of a device or components, such as circuit boards and system units.
- The term *system unit* is tech speak for the part of a digital device that holds the system board.
- Some popular form factors include: component, clamshell, and slate

# Components

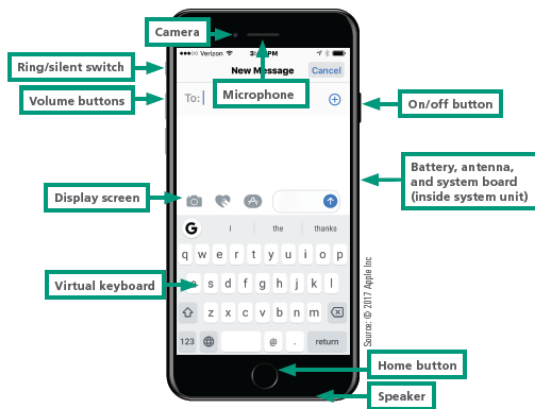




# Components



# Components



## Enterprise Computers

- The most powerful computers are generally used in businesses and government agencies
- These computers have the ability to service many simultaneous users and process data at very fast speeds
- Types of “Big” computers are:
  - Supercomputers
  - Mainframes
  - Servers



Supercomputer



Mainframe



Servers

## Enterprise Computers

- **Supercomputers** - considered the fastest computers in the world at the time of construction; can tackle complex tasks other computers cannot; typical use includes breaking codes, modeling weather systems, and simulating nuclear explosions.
- **Mainframes** - a large and expensive computer capable of simultaneously processing data for hundreds or thousands of users; looks like a closet-sized cabinet; used to provide centralized storage, processing, and management for large amounts of data.
- **Servers** - “serves” data to computers in a network; Google search results are provided by servers; about the size of a desk draw and mounted in racks of multiple servers.

## Personal Computers

- A personal computer is designed to meet the computing needs of an individual
- The term *personal computer* can be abbreviated as PC
- Personal computers can be classified as:
  - Desktops
  - Portables
  - Laptops
  - Tablets
  - Smartphones

## Personal Computers

- **Desktops** - fit on a desk and run on power from a wall outlet; keyboard is typically separate from the monitor; popular in offices and schools
- **Portables** - run on battery power; their components are contained in a single case for easy transportation
- **Laptops** - also referred to as a notebook computer; small and lightweight with a clamshell design and keyboard at the base



Desktop



Laptop

## Personal Computers

- **Tablets** - a *tablet computer* is a portable computing device featuring a touch-sensitive screen used for input and output; uses a specialized OS; a *slate tablet* configuration has a narrow frame screen that lacks a physical keyboard; Apple iPad is a slate tablet
- **Smartphones** - mobile devices with features similar to a tablet computer; provide telecommunications capabilities over cell phone networks

## Niche Devices

- Niche devices all have one thing in common: They contain a microprocessor
- **Raspberry Pi** - Just a tad larger than a deck of cards; the Raspberry Pi can be connected to a keyboard and screen for a full computer experience
- **Portable media players** - are handheld devices that can store and play music; iPod touch is a portable media player



Raspberry Pi



Videogame console

## Niche Devices

- **Smartwatches** - multifunctional devices that include a camera, thermometer, compass, calculator, cell phone, GPS, media player, and fitness tracker
- **Activity trackers** - monitor your steps and heart rate
- **Smart appliances** - modern refrigerators, washing machines, and other appliances are controlled by integrated circuits called microcontrollers that combine sensors with processing circuitry



## Choosing a Digital Device

- The following activities can get you started on choosing the right digital device:
  - Consider how you plan to use your device
  - Choose the type of device
  - Decide on a budget and stick to it
  - Select a platform
  - Check out the device's specifications

# Choosing a Digital Device

Usage Plan	Purchase Recommendation
You plan to use your computer for email and Facebook, browsing the Web, playing games, managing finances, downloading digital music, and writing school papers.	A mid-priced computer with standard features might meet your needs.
You're buying a new computer to replace an old one.	If you have a big investment in software, you should select a new computer that's compatible with the old one.
You plan to work on accounting and budgeting for a small business.	Consider one of the business systems offered by a local or an online computer vendor.
You spend lots of time playing computer games.	Buy a computer with the fastest processor and graphics card you can afford.
You plan to work extensively with video editing or desktop publishing.	Select a computer system with a fast processor, lots of hard disk capacity, a large screen, and a graphics card loaded with memory.
Someone who will use the computer has special needs.	Consider purchasing appropriate adaptive equipment, such as a voice synthesizer or onehanded keyboard.
You plan to use specialized peripheral devices.	Make sure the computer you purchase can accommodate the devices you plan to use.
Your work at home overlaps your work at school or on the job.	Shop for a computer that's compatible with the computers you use at school or work.
You want to work with specific software, such as a 3-D graphics tool.	Select a computer that meets the specifications listed on the software box or Web site.

# Choosing a Digital Device

- The most popular digital devices are desktops, laptops, tablets, and smartphones.

**Desktop**

- Most power per dollar
- Can make repairs and upgrade components yourself (except for all-in-one units)
- Full-size keyboard with numeric keypad for data entry
- Large screen for multiple windows and detail work
- Adjustable placement of components means less strain on eyes, back, and wrists

**Bottom line**

The choice for dedicated gamers, software designers, desktop publishers, and video editors

**Laptop**

- All components in one unit
- Easy to move
- Battery powered for portability
- Energy efficient means low operating cost
- Connects to Wi-Fi networks for Internet access
- Lightweight models have higher price tags and may not have a CD/DVD player

**Bottom line**

Adequate for most digital tasks that are not dependent on cellular connections

The choice for students and on-the-go professionals who want to create content and be productive, in addition to consuming content

**Tablet**

- Small and easy to carry
- Battery powered
- Connects to Wi-Fi networks
- Cellular data plans available for mobile Internet access
- Convertible units with keyboards available for writing long documents and creating other content
- Might not use software designed for desktop and laptops
- Small screen limits multitasking

**Bottom line**

Great for consuming content, such as eBooks, music, and videos

Adequate for browsing the Web and managing social media

Works for some specialized tasks, such as business presentations

**Smartphone**

- Cellular connection for voice and texting
- Add a cellular data connection for Internet access
- Connects to Wi-Fi networks
- Longer battery life than tablets and laptops
- Larger sizes offer bigger, easier-to-read screens

**Bottom line**

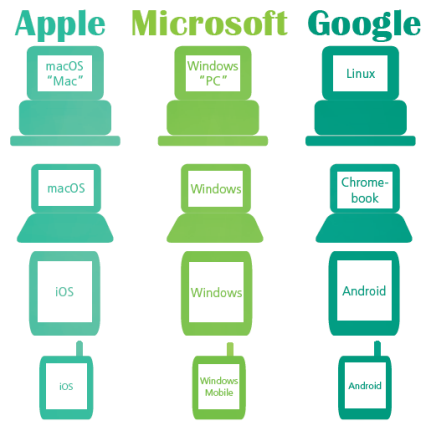
Great for communications and mobile apps

Adequate for watching occasional video and for mobile access to social media

Not optimal for creating text-based content, but excellent for voice calls, texting, and Web browsing

## Choosing a Digital Device

- Computers that operate essentially the same way and use the same software are said to be **compatible** or having the same “platform.”
- You can assess whether two computers are compatible by checking their operating systems.



## Choosing a Digital Device


- Prices for digital devices can vary and depend on screen size, microprocessor size, and memory:
  - The price tag for a smartphone is \$200–\$900
  - Tablet computer prices range from \$200 and \$1,200
  - Desktop and laptop computers usually cost a little more, with price points roughly grouped into three categories:
    - Above \$1,200
    - \$500 – \$1,200
    - Under \$500

## Choosing a Digital Device

- Computer ads are loaded with jargon and acronyms, such as RAM, ROM, GHz, GB, and USB.

**POWERFULLY LIGHT**  
DO EVERYTHING YOU LOVE.

- 7th Generation Intel Core i7 processor 3.5 GHz 1066 MHz FSB
- 4 MB cache
- 8 GB DDR3 1866 MHz RAM
- 512 GB solid state drive
- 13" high QHD LCD display screen
- Intel integrated graphics
- Integrated speakers
- Integrated 1080p megapixel webcam
- 1 USB 3.0 port
- 1 USB 3.0 port with PowerShare
- 1 USB Type C port
- Thunderbolt 3 port
- SD card reader
- Wireless networking 802.11 BGN
- 52 Wh, 4-cell battery
- Windows 10 64-bit operating system
- Home/small business software bundle
- 2.7 pounds
- 1-year limited warranty



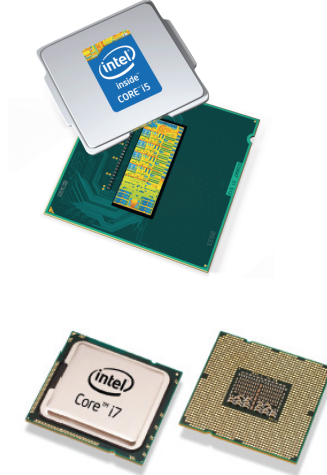
## Microprocessors

- A *microprocessor* is an integrated circuit designed to process instructions.
- It is the *most important*, and usually the most expensive, component of a digital device.
- Intel Corporation is the world's largest chipmaker and supplies a sizeable percentage of the microprocessors that power desktops and laptops.



## Microprocessors

- Intel's 8086 family of microprocessors powered the original IBM PC.
- The 8086 chip family set the standard for processors used today.
- This standard is sometimes referred to as **x86**.
- Processors found in today's desktops and laptops are x86 compatible.

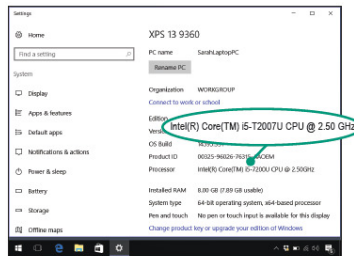


## Microprocessors

- Processors based on **ARM** technology dominate tablet computers and smartphones.
- ARM technology was originally designed by ARM Holdings, a British technology company founded by Acorn Computers, Apple Inc., and VLSI Technology.
- ARM processors are energy efficient — an important characteristic for battery-powered devices.
- ARM processors are found in Microsoft's Surface tablets, Apple's iPads and iPhones, and Samsung's lineup of Galaxy phones.

# Microprocessors

- Finding the microprocessor that's best for you depends on your budget and the type of work and play you plan to do.
- If you know the make and model of a digital device, you can generally find processor specifications by searching online.

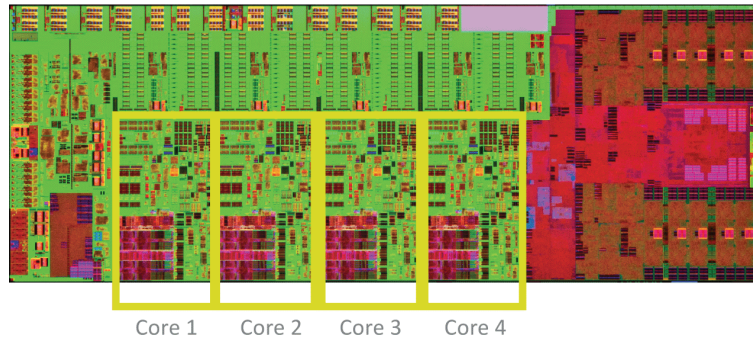


# Performance

- A microprocessor's performance is affected by several factors, including clock speed, number of cores, processing techniques, cache size, word size, and instruction set.
  - A processor specification, such as 3.4 GHz, indicates the speed of the **microprocessor clock** — a timing device that sets the pace for executing instructions.
  - A cycle is the smallest unit of time in a microprocessor's universe; every action a processor performs is measured by cycles.
  - **Gigahertz (GHz)** means a billion cycles per second

## Performance

- A microprocessor that contains circuitry for more than one processing unit is called a ***multi-core processor***.

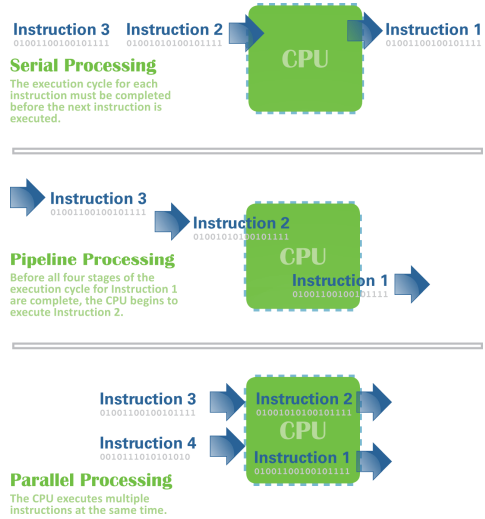


## Performance

- Some processors execute instructions “serially” — or one instruction at a time.
- With ***serial processing***, the processor must complete all steps in the instruction cycle before it begins to execute the next instruction.
- When a processor begins to execute an instruction before it completes the previous instruction, it is using ***pipeline processing***.
- ***Parallel processing*** executes more than one instruction at a time and works well with today’s multi-core microprocessors.

## Performance

- Pipeline and parallel processing offer better performance than serial processing.



## Performance

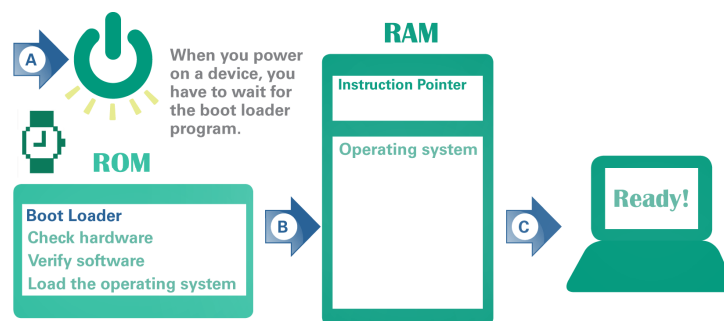
- What affects performance?
  - **CPU cache** (pronounced “cash”) is a special high-speed memory that allows a microprocessor to access data more rapidly
  - **Word size** refers to the number of bits that a microprocessor can manipulate at one time; it limits the amount of memory that the processor can access
  - A **RISC** (reduced instruction set computer) processor performs instructions faster than a **CISC** (complex instruction set computer) processor

## Random Access Memory

- **RAM** (*random access memory*) is a temporary holding area for data, application program instructions, and the operating system
- Higher RAM capacity adds to the expense of a device
- In RAM, microscopic electronic parts called **capacitors** hold the bits that represent data
- Most RAM is **volatile**, meaning it needs electrical power to hold data

## Read-only Memory

- **ROM** (read-only memory) is a type of memory circuitry that is housed in a single integrated circuit on the system board.
- ROM contains a small set of instructions and data called the **boot loader** that tell a digital device how to start.



# Read-only Memory

- There are several reasons why you might want to change the contents of ROM and boot loader instructions, including:
  - Repair
  - User modification
  - Forensics
  - Updates

