

## Problem Solving and Programming Concepts

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### Overview

- Problem Solving in Everyday Life
- Types of Problems
- Problem Solving with Computers
- Difficulties with Problem Solving

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### Problem Solving in Everyday Life

1. Identify the problem.
2. Understand the problem.
3. Identify alternative ways to solve problem.
4. Select best alternative.
5. List solution steps for alternative chosen
6. Evaluate solution.

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### Problem Solving with Computers

Definitions:

Solution  $\Leftrightarrow$  instructions followed to produce best result

- Result  $\Leftrightarrow$  outcome, computer-assisted answer
- Program  $\Leftrightarrow$  instructions for solution using computer language

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### Types of Problems

Problems with ...

- Algorithmic solutions
- Heuristic solutions
- Combination of algorithmic, heuristic solutions

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### Difficulties with Problem Solving

- Lack of problem solving experience
- Inadequate solution steps
- Incorrect problem definition
- Alternatives chosen incorrectly
- Invalid logic
- Incorrect solution evaluation

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## Programming – Why?

- Computers are used for many different purposes in many different situations.
  - But, how can they be so versatile?
    - Answer: They can be programmed
- The ability for a computer to be programmed allows it to do whatever their programs tell them what to do.
- A program is a set of instructions that tell a computer what to do.
- A computer cannot do anything unless it has a program to tell it what to do.

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## Programming – What?

- Programs are used to operate the components of a computer, solve problems or satisfy a want/need.
  - How long will it take me to get home if I drive  $x$  miles per hour?
  - I want to be able to tell my friends what I am doing right now.
- Computer Programming is both an Art and a Science
  - Every aspect of a program must be carefully designed
- As an art, programming takes creativity and problem solving.
  - There is often no one correct way to solve a problem.
- As a science, there are formal and proven methods to go about creating a programming.
- In this course, you will learn both the art and science of programming.

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## Hardware and Software

- Programs can also be called software.
  - Software refers to the computer programs that a computer uses to complete a task.
- Hardware refers to the physical components that a computer is made of.
  - A computer is not one device, but a system of devices working in tandem.
  - Each device plays a part.
  - Major components:
    - Central Processing Unit
    - Main Memory
    - Secondary Storage Devices
    - Input Devices
    - Output Devices

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## Expansion of computer

- C - Common  
 O - Operating  
 M - Machine  
 P - Purposely  
 U - Used for  
 T - Technological and  
 E - Educational  
 R - Research

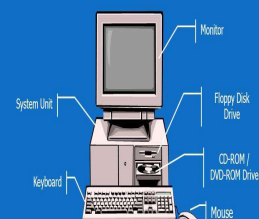
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## Definition of computer

A **programmable electronic device** designed to accept data, perform prescribed mathematical and logical operations at **high speed**, and display the **accurate** results of these operations.

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## What is a computer?



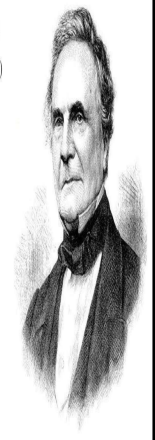
A computer is an electronic machine that accepts information (Data), processes it according to specific instructions, and provides the results as new information.

## Charles Babbage

(December 26, 1791 – October 18, 1871)

Father of Computer

Inventor & Founder  
of Computers



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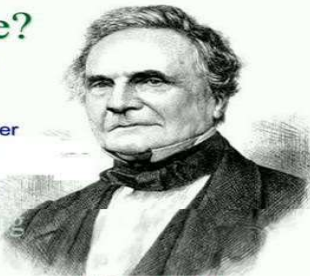
### Father of Computer

Father of Computer  
Charles Babbage

## Who was he?

- Mathematician,
- Inventor
- Philosopher
- Mechanical engineer

Inventor of the first mechanical computing machine in 1821.




(1791 - 1871)

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### History of Computers

- First counting device
- They used sticks, stones and bones as counting tools.
- As human mind and technology improved with time more computing devices were developed.




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### History of Computers

## Abacus

- ❑ Was invented approximately 3000 BC
- ❑ Can do X, /, +, -
- ❑ Is still in use today in parts of the world

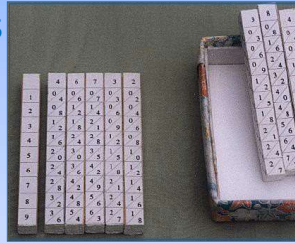


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### History of Computers

## Napier's Bones

- ❑ Was invented in 1500's by John Napier
- ❑ Can do X, /, +, -
- ❑ Is able to do multiplication much faster than abacus

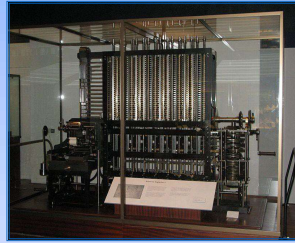


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### History of Computers

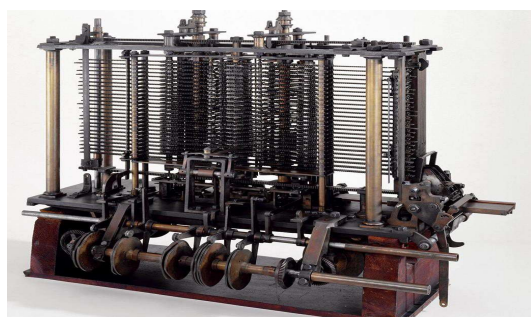
## Difference Engine

- ❑ Was invented in 1842 by Charles Babbage
- ❑ Would be able to do +, -, X, / as well as solve polynomial calculations and logarithms



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### Analytical Engine

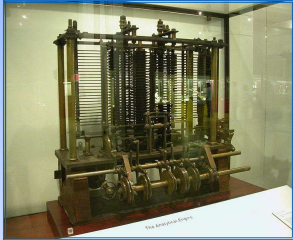


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## History of Computers

### Analytical Engine

Charles Babbage began working on it in 1848  
 This was the world's first truly programmable device, and therefore the world's first true computer



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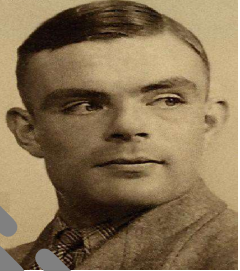
## Father of Modern Digital Computer

# ALAN TURING

### FATHER OF COMPUTER SCIENCE

JUNE 23 1912 - JUNE 7 1954

Turing imagined a machine of extreme purity and simplicity. It would be able to compute anything using only two symbols arranged in a potentially infinite one-dimensional sequence. He created this machine in his mind, as a thought experiment. Today we are surrounded by Turing machines.



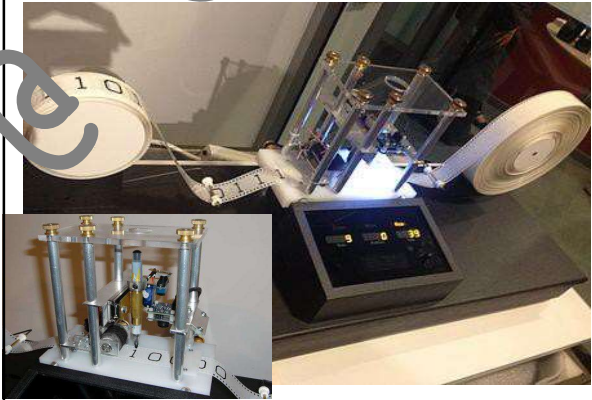
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## Alan Turing

- English Mathematician
- Logician
- Cryptanalyst and
- Computer Scientist
- Father of Computer Science and Artificial Intelligence

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## Turing machine



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- ADA



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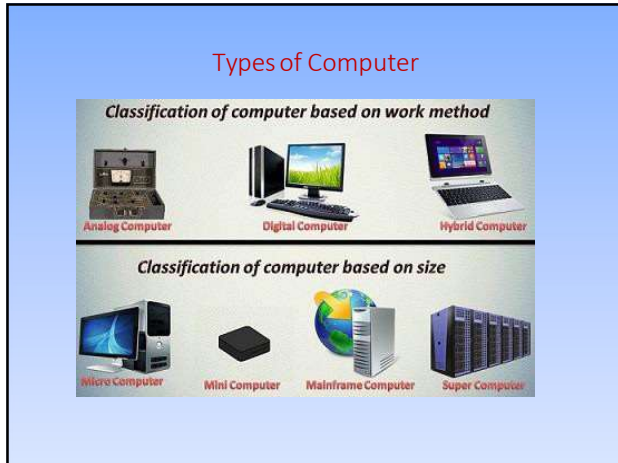
## Generations of Computers

First, Second, Third, Fourth & Fifth  
From 1940 to 2020

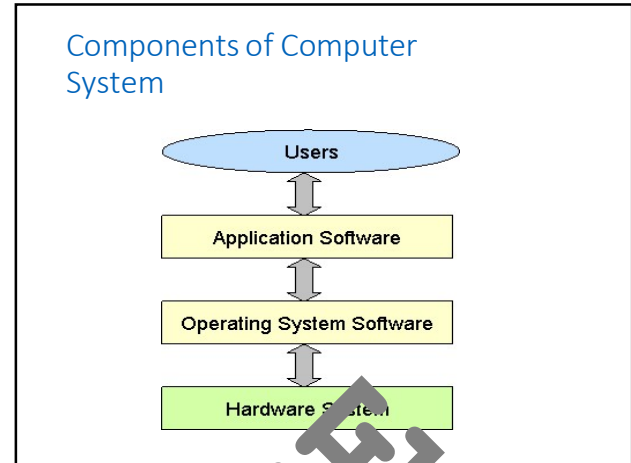
<b>First Generation Computers</b> From 1940 - 1956 Vacuum Tubes	<b>Second Generation Computers</b> From 1956 - 1963 Transistors
<b>Third Generation Computers</b> From 1964 - 1971 Integrated Circuits	<b>Fourth Generation Computers</b> From 1972 - 2010 Micro Processors
<b>Fifth Generation Computers</b> From 2010 Artificial Intelligence	

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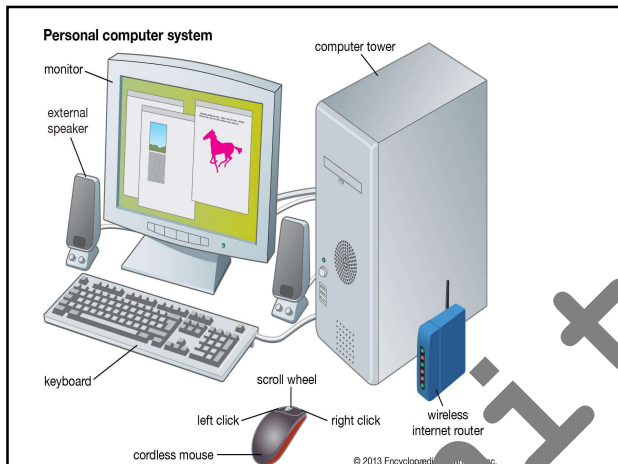




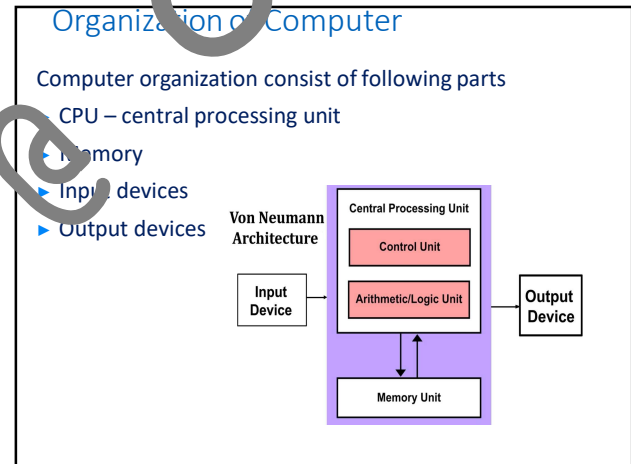
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### Central processing unit

- Alternatively referred to as the **brain of the computer**, processor, central processor, or microprocessor, the CPU
- first developed at Intel in the early 1970's
- The computer CPU is **responsible for handling all instructions** it receives from hardware and software running on the computer
- CPU **performs all types of data processing** operations.
- It **stores data**, intermediate results and instructions
- It **controls the operation** of all parts of computer

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### CPU itself has following three components

- 1. ALU (Arithmetic Logic Unit)**  
All arithmetic calculations and logical operation are performed using the Arithmetic/Logical Unit or ALU
- 2. Memory Unit**
  - A memory is just like a human brain.
  - It is used to store data and instruction Computer memory is use to Stores information being processed by the CPU
- 3. Control Unit**  
unit help to perform operations of input unit, output unit, Memory unit and ALU in a sequence.

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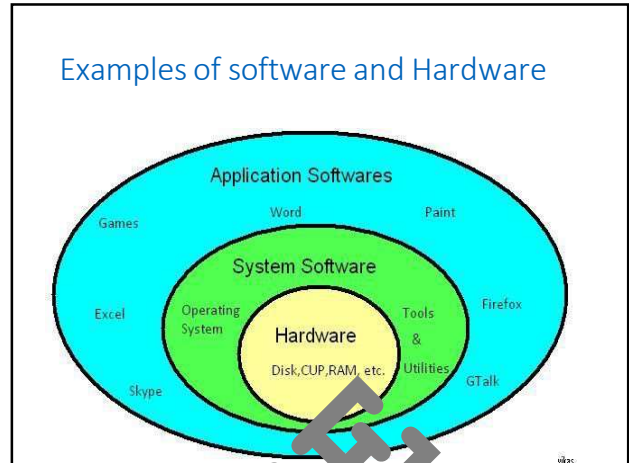
**Input Devices**

- A device that can be used to insert data into a computer system is called as input device.
- Examples : Keyboards, mouse, scanners and digital cameras

**Output Devices**

- A device which is used to display result from a computer is called as output device
- Examples: Printer, Scanner, Monitor, etc.

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Hardware	Software
Hardware is further divided into four main categories: •Input Devices •Output Devices •Secondary Storage Devices •CPU	Software is further divided into two main categories: •Application Software •System Software
Developed using electronic and other materials	Developed by using a programming language
When damaged, it can be replaced with a new component	When damaged it can be installed once more using a backup copy
Hardware is physical in nature and hence one can touch and see hardware	The software cannot be physically touched but still can be used and seen
Hardware cannot be infected by Viruses	The software can be infected by Viruses

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Types of Computer Language

- Computer language is defined as **code or syntax** which is used to write programs or any specific applications
- The computer language is used to communicate with computers
- Three categories assembly language, machine language, and high-level language

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**1. Machine Language**

- The Machine language is considered a low-level language
- Other name -machine code, object code
- Which is set of binary digits 0 and 1
- These binary digits are understood and read by a computer system
- Example of machine language for the text "Hello World".  
01001000 0110101 01101100 01101100 01101111 00100000  
01010111 01101111 01110010 01101100 01100100

**2. Assembly Language**

- Intermediate-level language for microprocessors
- It is second-generation language

**3. High-Level Language**

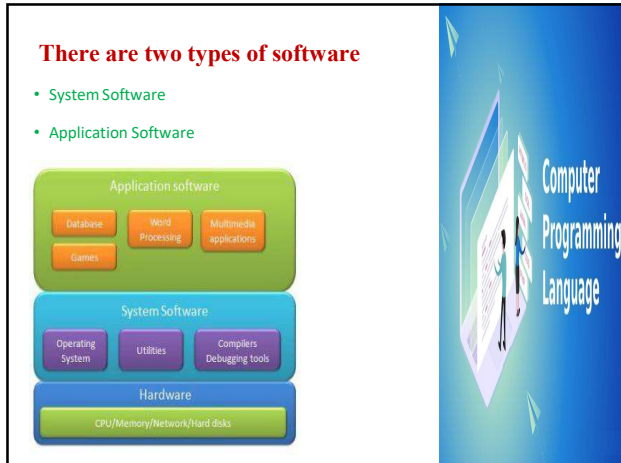
- The high-level language is easy to understand and human-readable program
- Examples: C++, C, JAVA, FORTRAN, etc..

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**Computer – Software**

- Software is a set of programs, which is designed to perform a well-defined function.
- A program is a sequence of instructions written to solve a particular problem.

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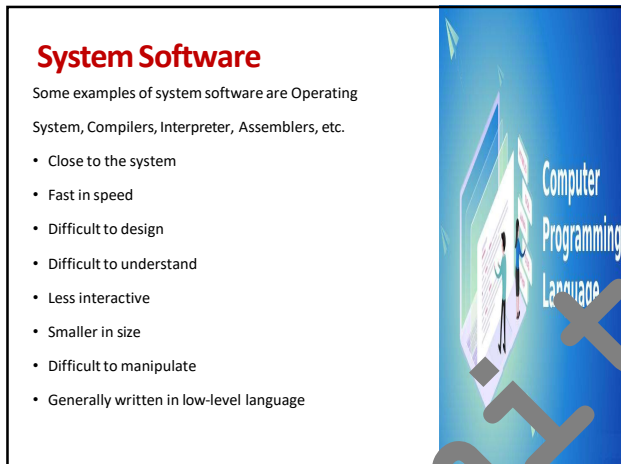


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## System Software

- The system software is a **collection of programs**
- designed to **operate, control, and supports the process of computer**
- System software –**Inbuilt in System**
- System software written in **low-level languages**
- Use to **Interact** with the hardware and software
- It Serves as the **interface between** the hardware and end users
- Examples: **Operating System, Compilers, Interpreter, Assemblers, etc..**

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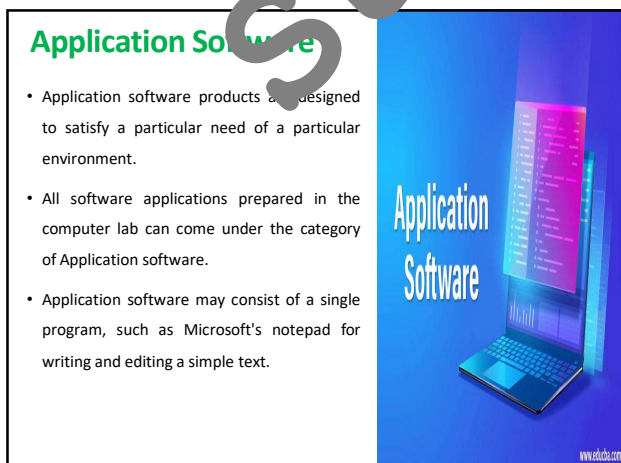


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## Application Software

- Application software products are designed to satisfy a particular need of a particular environment
- It is a collection of programs, often called a software package, which work together to **accomplish user tasks**, such as a spreadsheet package
- Some examples: Payroll Software , Student Record Software , Income Tax Software and Railways Reservation Software

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## Application Software

Examples of Application software are the following –

- Payroll Software
- Student Record Software
- Inventory Management Software
- Income Tax Software
- Railways Reservation Software
- Microsoft Office Suite Software
- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint



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Key	System Software	Application Software
Definition	System Software is the type of software which is the interface between application software and system	Application Software is the type of software which runs as per user request. It runs on the platform which is provide by system software
Development Language	low level language	high level language
Usage	System software is used for operating computer hardware	Application software is used by user to perform specific task
Installation	Installed on the computer when operating system is installed	Application software are installed according to user's requirements
Dependency	System software can run independently, It provides platform for running	Application software can't run independently. They can't run without the

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## Central Processing Unit (CPU)

- The CPU is the heart and brain of the computer.
- The CPU continuously does the following things:
  1. Fetch an instruction
  2. Follow the instruction
  3. Produce some resulting data
- The CPU has two parts:
  - Control Unit
    - Coordinates the computer's operations
    - Determines where to get the next instruction
    - Regulates the other major components of the computer
  - Arithmetic and Logic Unit (ALU)
    - Designed to perform mathematical operations

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## Main Memory

- Main memory holds information that the CPU needs to access quickly.
  - Namely, the instructions to be executed.
- When a program is running, some or all of its instructions are in main memory.
- Memory is divided into sections called bytes that hold equal amount of data.
- Each section is made up of 8 bits.
  - A Bit is the most basic unit of information a computer can hold. It is a switch that is either on (1) or off (0)
- Each byte is assigned and can be accessed by its address.
  - A Memory Address is a unique identifying number associated with a byte in memory.
- Main memory typically is volatile.
  - Volatile Memory – is memory that when it loses power, the contents are erased.

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## Secondary Storage

- Secondary Storage is memory that can hold data for a long period of time.
- Programs are usually stored in secondary storage and loaded into main memory as needed.
- This forms a hierarchy typically called the memory hierarchy.
- Common forms of secondary storage:
  - Hard Drive
    - Disk Drive
    - Solid State Drive
  - Removable Storage
    - Floppy Disk
    - CD-ROM
    - USB Drives
- Other files can be stored in secondary storage:
  - Documents
  - Pictures
  - Whatever else you save on your computer

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## Input Devices

- Input is any data the computer collects from the outside world.
- An Input Device is anything that collects data and sends it to the computer.
- Common Input Devices:
  - Keyboard
  - Mouse
  - Scanner
  - Digital Camera
  - Disk Drive
  - USB Drive

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## Output Devices

- Output is any data the computer sends to the outside world.
- An Output Device formats data and presents it to the outside world.
- Common Output Devices:
  - Monitor
  - Printer
  - Disk Drive
  - USB Drive

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## Software

- Software refers to the programs that run on a computer.
- Two main categories (for this class):
  - Operating System (OS)
    - A set of programs that manages a computer's hardware devices and controls their processes.
    - Most modern operating systems are capable of running multiple programs at once.
    - UNIX, Linux, Mac OS X, and Windows are examples
  - Application Software
    - Programs that make the computer useful for the user
    - Solve specific problems or supply a service
    - Word processors, spreadsheets, databases, etc.
    - This is what we will be developing in this class.

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