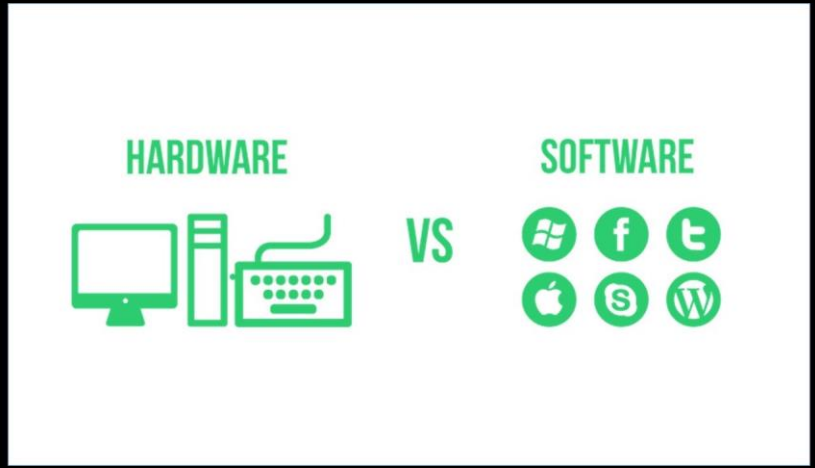
Programming

Introduction to Programming and Problem Solving

Computer Concepts

- Hardware
  - Electronic Devices
- Software
  - Instructions and Computer Programs



Computer Hardware vs Robotic Hardware

- Input
  - Keyboard
  - Mouse
  - Microphone
  - Camera
- System Unit
  - Random Access Memory (RAM)
  - Central Processing Unit (CPU)
- Output
  - Monitor
  - Printer
  - Speaker
- Mass Storage
  - Hard Drive
    - Flash, Solid State, Disk Drive
  - Cloud and Virtual Drives

- Input
  - Controllers
  - Sensors
  - Camera
- System Unit
  - Random Access Memory (RAM)
  - Central Processing Unit (CPU)
- Output
  - Motors
  - Servos
  - Radio
- Mass Storage
  - Hard Drive
    - Flash

Software

- Instructions for the hardware
  - Actions to be performed
- A set of instructions is called a program
  - Driving force behind a computer
  - Without a program – What is a computer?
    - Collection of Useless Hardware
- Purpose of Software
  - Tell the computer what to do

CPU

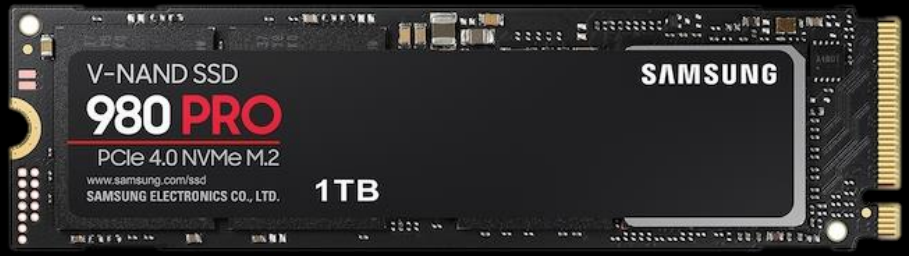
- The central processing unit (CPU)
- The “brain” of a computer
- Retrieves instructions from memory and executes them

Memory

- Stores data and program instructions for CPU to execute
  - A program and its data must be brought to memory before they can be executed
- Stores intermediate and final results of processing.
- Volatile
  - Contents are erased when computer is turned off or reset.
- A memory unit is an ordered sequence of bytes, each holds eight bits. A byte is the minimum storage unit. No two data can share or split the same byte.

Storage

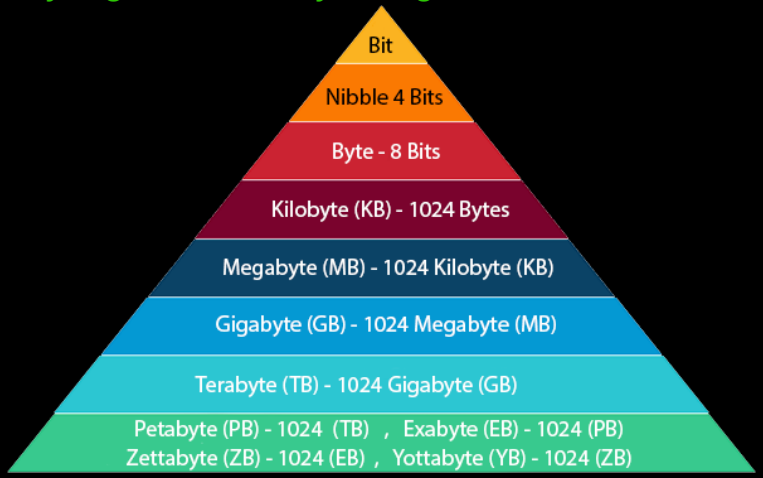
- Hard Drives, Solid State Drives, NAND Flash Drives, CDs/DVDs, Flash Drives, etc
- Non-Volatile or Permanent Storage
- Programs and data are permanently stored on storage devices and are moved to memory when the computer actually uses them



Units of Measure for Digital Information

Not getting too in depth, since this isn't CS215, storage and memory units of information can be expressed with 1 and 0, a binary language

- Machine Language
  - Two stable states, which are referred to as zero and one by convention
  - A single digit (0 or 1) is called a bit, short for binary digit. Electricity being sent, on and off, 1 and 0
  - 10101110 10001101
- Expressing in values
  - bit – smallest capacity
  - byte = 8 bits
    - storage for one character
  - 1 kilobyte (KB) = 1024 bytes
  - 1 megabyte (MB) = 1024 KB
  - 1 gigabyte (GB) = 1024 MB



Programming Languages

- Computers can not use human languages, and programming in the binary language of computers is a very difficult, tedious process
- Therefore, most programs are written using a programming language and are converted to the binary language used by the computer
- Three major categories of programing languages:
  - Machine Language
    - Natural language of a computer. Binary.
  - Assembly Language
    - Used to convert High Level Language into Machine Language. Also called a Compiler
  - High Level Language
    - Easy to learn and program. C, C++, Java, Python...

Block-based Programming

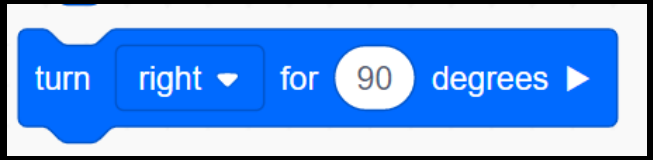
Understanding Programming Basics Using Simplified Instructions

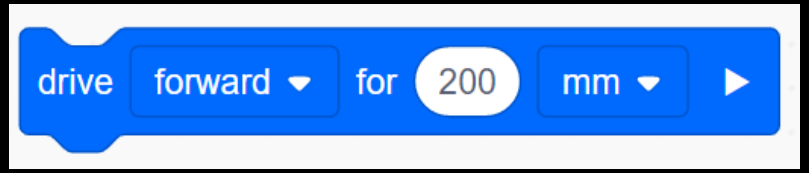
Grouping declarations and statements together in a graphical interface

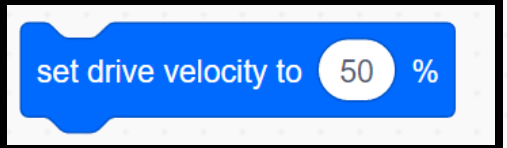
Combining multiple blocks to achieve a set of tasks

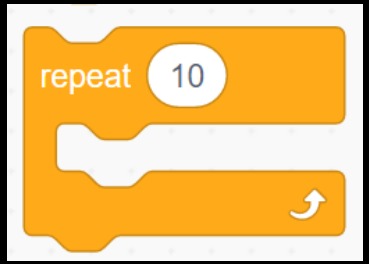
C++ Programming - Block-based & Text-based

- In programming, a statement is simply a directive that tells the computer to do something. Think of it as a command or an instruction.
- For programming a robot, we use Python and Block-based Python



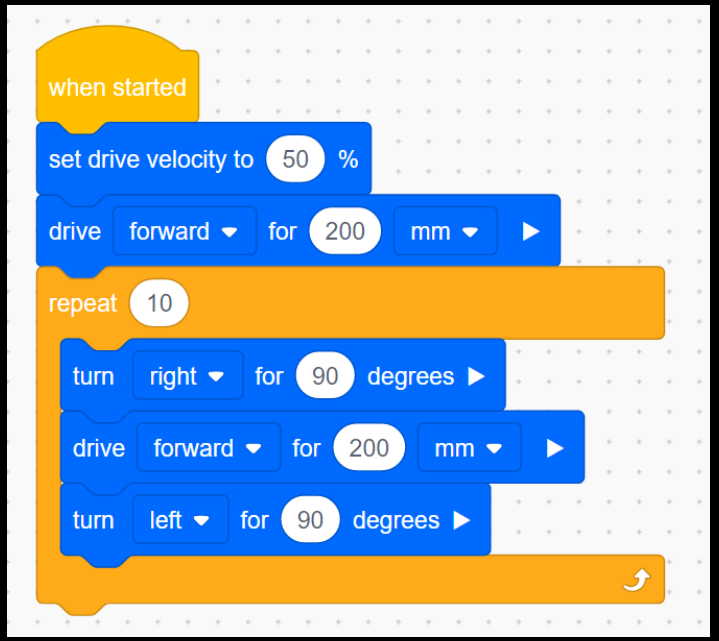







```
int whenStarted1() {
  Drivetrain.setDriveVelocity(50.0, percent);
  Drivetrain.driveFor(forward, 200.0, mm, true);
  repeat(10) {
    Drivetrain.turnFor(right, 90.0, degrees, true);
    Drivetrain.driveFor(forward, 200.0, mm, true);
    Drivetrain.turnFor(left, 90.0, degrees, true);
  }
}
```

C++ Programming - Block-based & Text-based



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