

## How Computers Work: Programming (Part III)

Computers need programs, instructions that tell the microprocessor/central processing unit (CPU) what to do. Computer programs are a list of instructions that the microprocessor/CPU follows to complete tasks.

Each computer program consists of a set of steps -- instructions that are a series of numbers that the microprocessor/CPU recognizes as having some specific meaning. Microprocessors do not understand language and text. They only understand MACHINE LANGUAGE based on numbers. Different makes and models of microprocessors/CPU use different machine languages.

All machine languages, however, have a similar structure. The machine language that a microprocessor/CPU uses has three parts:

1. CODE
2. MNEMONIC
3. DESCRIPTION of what each code does.

Computers only understand the code. Microprocessors/CPU only work with numbers. Human computer programmers know each computer code by its Mnemonic -- abbreviations in text that describe what each number code does. This is easier to remember than computer code (string of numbers).

Computer programmers begin writing programs by identifying sequential steps to complete a task or operation. Programmers write descriptions for what each step must do. Then, we can substitute machine language number codes for each description so that the computer understands the program in machine language.

If we understand machine language code, mnemonic and the description of a microprocessor's machine language, we can write computer programs. In addition to number codes for instructions, computer programs can use VARIABLES -- number values that are added into our program. These are usually values used for calculations, comparisons, or decisions.

While computers work with binary code -- ones and zeros -- this is very hard for humans to read. Instead of working-with and displaying long strings of ones and zeros, we display machine language as HEXADECIMAL numbers -- a system of base-16 notation.

Using base-16 hexadecimal numbers shortens strings of binary numbers and makes them easier to read (NOTE: hexadecimal numbers are different than the base-10 numbers we commonly use).

Computer programming in machine language (binary or hexadecimal numbers) is not easy. This is why computers are programmed in programming languages that are based on mnemonics which are easier to read and work with than machine language (either binary or hexadecimal numbers).