Notes from How Computers Work: Computation (Part II)

A computer consists of electronic circuits. These are transistors, all connected and grouped to represent, process, and store data. These groups of transistors are called LOGIC GATES.

Transistors – each a tiny on/off switch – are grouped together into units/logic gates that can perform calculations, make decisions, and remember information. There are three types of logic gates in a computer:

1. AND
2. OR
3. NOT

An AND gate has 2 inputs and 1 output. If both of the inputs are one (input 1 AND input 2 are both one), then the output is also one. If the inputs are both zero, then the output is zero. If the inputs are different (a one and a zero) then the output is zero.

An OR gate also has 2 input and 1 output. If 1 input is one or both inputs are 1, then the output is 1. The output of an OR gate is one when one or the other input is one. If both inputs are zero or both outputs are one, then the output is 0.

A NOT gate has only one inputs and one outputs. Think of it as a flipper – when a one comes in, a zero goes out. When a zero goes in, an one goes out. The output is the opposite of the input. The output is not the same value as the input.

Believe it or not, these three simple logic gates, AND, OR, NOT can be combined to create any and all calculations and processes used in a computer! A computer is actually a simple machine that combines AND, OR, and NOT logic gates.

Remember that when using binary numbers, we only have oness and zeros. You may recall that, in binary numbers, 1+1 equals 10 (1 two and 0 one -- we "carried" the one to the 2 column) Our logic gates and computes use only binary numbers.

A computer has an ADDER circuit of logic gates to add numbers. There are different circuits for all the math and other operations a computer performs on binary numbers. All of these circuits are made of combinations of the three types of logic gates: AND, OR, NOT

Computers combine logic gates to create units that can add, subtract, multiply, divide, count up or down, compare 2 numbers, and store information.

The brain of a computer is its MICROPROCESSOR or CENTRAL PROCESSING UNIT (CPU). It runs the software applications and directs all other systems of a computer.

The electronic data in a computer moves along circuits that connect of the computer's parts. We call these BUS PATHS or BUSSES. A bus path acts as a wire and conducts electricity.

A computer microprocessor or CPU operates on a 4-STEP CYCLE consisting of:

1. FETCH
2. DECODE
3. EXECUTE
4. STORE

FETCH begins with the The computer's clock telling the program counter which step it is on and it uses the bus path to get information from memory.

DECODE translate our binary data so that the machine can "understand" the instruction from FETCH.

EXECUTE performs the instructions that are passed to it from the decode step

STORE saves results from the execute step in memory and then the microprocessor gets ready for the next 4-step fetch-decode-execute-store cycle.

Modern computers operate each 4-step fetch-decode-execute-save cycle extremely fast. Today's machines have speeds of 3 GHz or 3 billion fetch-decode-execute-store cycles each second! These processing speeds continue to get faster and faster.