

Unit 3: Data and logic

What is data?

Ultimately everything in a computer is reduced to either the presence or absence of an electrical charge. This electrical charge inside transistors is scaled up to form basic circuits that can be used to remember information (ie: act as memory) and perform calculations.

At the heart of it all is the transistor which is a simple electrical switch that can be turned on or off via an electrical signal. A modern Intel CPU has about 1.75 billion transistors in a piece of silicon the size of a fingernail, or 17.185 million transistors per square millimetre. (1)

Bits and bytes

This presence of absence of electricity needs to be simplified for computer scientists to effectively scale it to the complexity of modern computers. For this reason we think of it as **True** and **False** which is then further simplified into **1** and **0**.

This most simple form of data, that is a **1** or **0** is known as a bit.

Again, dealing with thousands of bits at a time isn't practical, so we scale again. The first level of complexity introduced is to group 8 bits together into a **byte**.

If a bit has two possible values, 0 and 1, and a byte consists of 8 bits, how many possible values does a byte have?

The answer, of course, is 256. But did you get there the easy way or the hard way? How long until you worked out the pattern?

Number of bits	Possible values	Total possibilities	Also known as
1	0 1	2	2^1
2	00 01 10 11	4	2^2
3	000 001 010 011 100 101 110 111	8	2^3
4	0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111	16	2^4

Binary use in registers

16, 32, 64 bit computing

Converting between denary and binary

Hexadecimal numbers

Reasoning for hex notation

Convert hex and denary

Convert hex and binary

Common uses of hex in computing

HTML colours

MAC addresses

Assembly languages

Debugging

Logic circuits

The logic gates

And, or, not, nand, nor, xor

Truth tables

Produce truth tables for various circuits

Logic circuits

Produce circuit diagrams from equation

References

1. <https://www.quora.com/How-many-transistors-are-in-i3-i5-and-i7-processors>