Title:
How Computers Add - A Logical Approach

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Summary:
We looked at Number Systems and counting (see It’s a Binary World - How Computers Count) last

You probably realise that the...

Keywords:

Article Body:
We looked at Number Systems and counting (see It’s a Binary World - How Computers Count) last

You probably realise that the ’standard’ PC code is in 8 bit bytes taking the hex system a sta

OK now to the Math - cringe time! It’s a little more complicated than last time, but if you th

We take a break here to look at a bit of math you may not have heard of - Boolean Algebra. Onc

Boolean Algebra is named after George Boole, an English Mathematician in the 19th Century. He

In Boolean Algebra, instead of + and - etc. we use AND and OR to form our logic steps.
For example:-

x OR y = z means if x or y is present, we get z.
However,
x AND y = z means that both x and y need to be present to get z.
We can also consider an XOR (eXclusive OR).
x XOR y=z means that x or y BUT NOT BOTH must be present to get z.

That’s it! That’s all the math you need to understand how a computer counts. Told you it was s

How do we use this logic in the computer? We make up a little electronic circuit called a Gate

When we add in decimal, for example 9+3 we get 2 ’units’ and carry one to the 10s, giving 10+2

Remember the binary bit values in Decimal 1,2,4,8 etc? We start at 0 then 1 in the first bit p

To make an adder we must duplicate with a logic circuit the way we add in binary. To add 1+1 w

Now we go another step, and forget about gates, because now we have a Logic Block, an ADDER. C

Our ADDER block takes one bit (0 or 1) from each number to be added, plus the Carry bit (0 or

With no Carry in:

A	B	c	O	C
0	0	0	0	0
1	0	0	1	0
0	1	0	1	0
1	1	0	0	1

With Carry in:

A	B	c	O	C
0	0	1	1	0
1	0	1	0	1
0	1	1	0	1
1	1	1	1	1

This is known as a Truth Table, it shows output state for any given input state.

Let’s add 2+3 decimal. That is 010 plus 011 binary. We will need 3 ADDER blocks for decimal bi

The first ADDER takes the Least Significant Bit (decimal bit value 1) from each number. Input

From the truth table this gives an output of 1 and a carry of 0 (3rd row). BIT 1 RESULT = 1

At the same time the next ADDER (decimal bit value 2) has inputs of 1, 1 and a carry of 0, giv

The next ADDER (decimal bit value 4) has inputs of 0, 0 and a carry of 1, giving an output of

So we have bits 4,2,1 as 101 or 4+1=5.

It seems like a laborious way to do it, but our computer can have 64 adders or more, adding si

Next time we will get to how a computer performs more complcated operations, and it’s simple!