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Tools of the Trade

Today, what we think of as the digital computer is something like a laptop. However, almost everything now relies on them. For example, your phone, watch, clocks (maybe), chargers, lights, and so much more. It helped put people on the moon, it helps you drive, and even helped the allies win world war 2.

For hundreds of years, we had computers, but they probably aren't what you think. One of the most common examples of an old computer is the abacus. This is an analog computer; a computer that uses moving parts to compute. The abacus used multiple sliders to compute, allowing for basic math. It had 10 beads per rung, that you could slide. The 1st rung represented the 1s, the 2nd represented the 10s, 3rd was the 100s, and so on. However, in 1947, John Bardeen, Walter Brattain, and William Shockley at Bell Labs invented the transistor. A simple way to think about what a transistor is is a light switch. It has two prongs that power the light switch, and 1 prong that switches it on when given power, and off when there is none. Similar to the abacus, it can perform basic math, just in a different way. The transistor invented in 1947 was very large and bulky, and broke often.

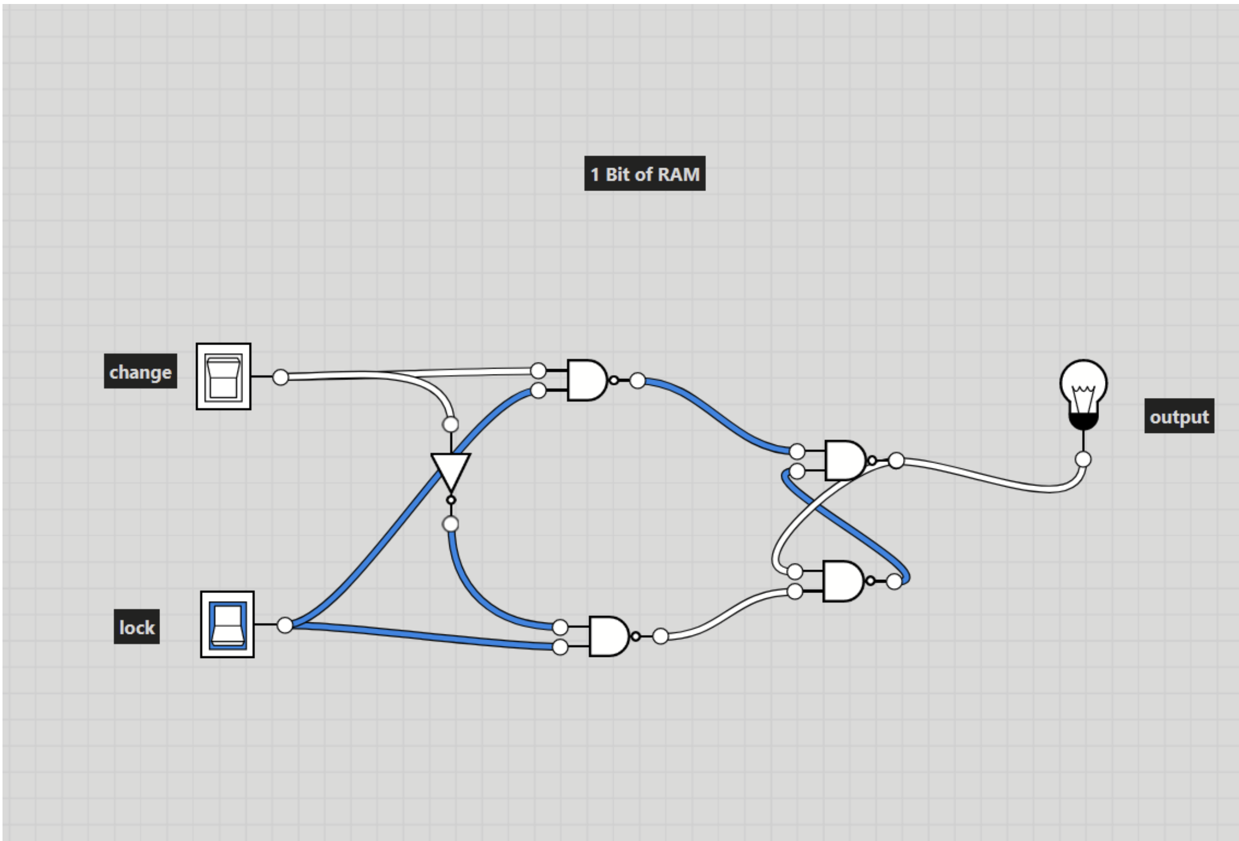
The way most English speaking people do math is in base 10. We have digits that go from 0 to 9, but then we run out, so we add a 1 to the beginning, to represent one 10. After we keep counting and get to 99, we run out again, and add a 1 to represent a 100. However, transistors only have 2 states, on and off. Base 10 doesn't work on them, because we only have 2 digits, off (0), and on (1). This means that the math we do with transistors is going to be in base 2, or binary. Just like in base 10, we start with 0 (off), and count to 1 (on). But now, we have run out of digits, so we do the same thing we do in base 10, add a 1 to the beginning to represent the amount of 2's, and so on. At first, this seems very counter-intuitive. However, this allows for really simple logic.

The next step was to make logic gates. The two most simple gates being the AND and OR gates. Instead of having on or off, or 1's and 0's, we have TRUE and FALSE. For an AND gate, it takes 2 inputs, and returns TRUE if both of the inputs are TRUE. For the OR gate, it takes two inputs, and if either of them are TRUE, it returns TRUE. With these gates, we can start building more complicated gates, like XOR (one or the other, not both) , TRI-STATE's (three different states), FLIP-FLOPS (greater than or less thans), and so much more. Then, by having gates linked to one another, we can make a half-adder, something that gives a sum and a carry. And with two of those, we can make a full adder. Sinse subtraction is the reverse of addition, we can make a subtractor. Then, by linking full adders, we can make a multiplier, a divider, and so on. With all these parts, we can write code for the computer to carry out, where we give it some inputs, and gives us an output. This is a digital computer.

The first example of a digital computer was the Electronic Numerical Integrator and Computer (ENIAC). ENIAC was used during World War 2, as it was able to carry out 5,000 additions per second. It was used to generate artillery firing tables, ultimately allowing for more planes to be shot down with less rounds. This greatly lowered the cost of the war, and sped it up. However, ENIAC was flawed, as the transistors regularly broke. Since the only way they work is with a perfect vacuum, any flaw in the construction or use of them would cause a break. And with thousands of transistors, they would be replaced very frequently. This caused the invention of what we now think of as a normal transistor, a simple switch. This greatly increased the redundancy, causing it to break less often, to the point of almost never having to replace one.

Over time, the transistor got smaller and smaller. What once took up an entire building then took up a room, then a wall, then shelf, and eventually, something small enough to carry with you. Modern day computers have millions of transistors inside them, with sizes on the order of 3 nanometers.

Because of the innovations, more and more of our world has changed. Nowadays, everything is stored in digital computers, from entire libraries, documents that could change our world forever, and billions of dollars. The ability for us to find where we are on planes, boats, cars, or even on a walk, is all thanks to computers. We quite literally have hundreds of computers in space, allowing us to predict the future, and searching the universe. One commonly said thing is "We have more processing power in our pockets than they did on Apollo 11. Although overused, it is true. The amount of computational power in our pockets is strong enough to calculate things once unheard of. And soon, we might even see life in them.



Here, we can see a representation of 1 bit of ram (1 bit (0 or 1), or Random Access Memory). It consists of two inputs; a lock to prevent change, and a switch to alter the state. In order for a change to take place, there is a NAND gate from the lock and change switch. This means that if both of them are pressed it turns off, but otherwise it is on. We do the same thing again, but with the inverse of the change output, into two intertangled NAND gates. If the lock is pressed, it means that no matter what happens to the change switch the output will not change. However, if the lock switch is released, the change switch can freely change the output.

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