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Teaching computers to count

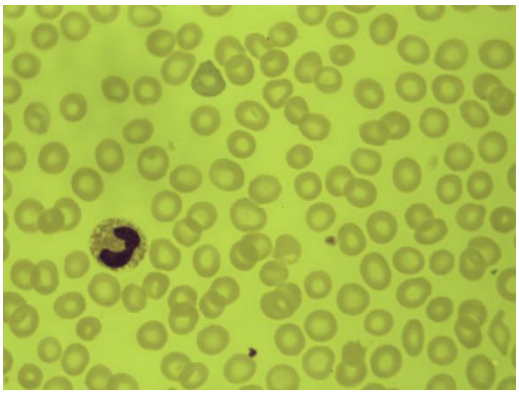
The human brain is excellent at quickly finding patterns and generalizing from them. We do it every day, constantly, without noticing - if we see a pattern of floor tiles where one tile is slightly out of place, our eyes are immediately drawn to it. It is largely this analytical ability to notice patterns and when they are broken that has led to the evolutionary success of the human race - noticing the stripes of a tiger amongst the high grass can be the difference between life and death.

However, when it comes to taking in a lot of detail at once, humans tend not to do so well. An example of this sort of situation would be eye witness accounts of crime - humans tend not to be able to process such a quantity of information in a short amount of time, which is why witnesses often have a hard time remembering what they saw and what the robber looked like. If we instead turn our eyes to computers, we can see that the opposite is true. Computers are excellent at dealing with a lot of detailed information at once, but do not innately have the pattern-finding ability of humans - they must be taught. This is where *artificial neural networks* come into play.

Artificial neural networks take their name from their similarity to a biological neural network, in that they are built up of neurons in which information is processed, connected by nerve fibers (or in the case of artificial neural networks - weights) through which the information is transported. By feeding such an artificial network with a lot of examples and giving it feedback on its performance, the network can be taught to recognize patterns in images, telling cats apart from dogs, or counting the number of cells in a microscopic image.

Counting, in the philosophical sense that humans do it, after all has a lot to do with the relationship of numbers, pattern recognition and deduction - when you throw a die and get a five, you do not start counting the dots one by one. Instead, you instinctively exclude the low outcomes of the die, and through pattern recognition notice the unique pattern of the five to determine the outcome of the die. At least, this is how it works for lower numbers under 10. When the number of objects increase beyond this point, this method of counting fails, as the human brain cannot process that much detailed information at once. We then go into some sort of basic mode, where we instead start to physically add up and check off the objects, working our way through the set.

The computer, however, does not suffer from the same restrictions. Using artificial neural networks, we can combine pattern recognition with the computer's incredible attention to detail, teaching the computer to identify and count objects in an image at an incredible speed. One of the fields where this can be of particular use is within the field of blood analysis, where blood-cell counting is a time-consuming manual labour (see figure). By instead teaching a neural network to detect and classify blood-cells it can count thousands in the same time it takes for you and me to realize that we have thrown a five on the die, enabling amazing feats of image analysis.



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