**What does it do? 600**

Machine learning is a sub-concept of artificial intelligence and essentially refers to a computer program with in-built functions that allow it to learn through experience rather than needing to be programmed by a human. To put it simply – the computer learns by itself.

“Why do we need the computer to do the learning for us?” – you might ask. Well, traditional programming takes time and lots of it. Working out what to make, how to make it, writing the code and debugging can take months, even years to do on large projects. This has been the tried and true method since the beginning of computing and has helped us to evolve technology to where it is today. But now we have an alternative – machine learning.

Machine learning takes the arduous and time-consuming task of writing large amounts of code and puts it on the computer to work it out itself. This is called “training” and requires the user to input usually massive amounts of “training” data into a human-made program. In more complex machine learning algorithms, the programs can generate their own methods or programs through experience, but that’s starting to move toward more advanced areas of artificial intelligence.

Machine learning works by taking in information through an initial set of data nodes known as “neurons” that analyse the data’s qualities. It is then passed down through sequential “layers” of neurons until enough is identified about the data to make a prediction on what the program believes is the desired result. Over time the program refines its ability to define the correct answer by improving its ability to make informed guesses based on previous successes and failures. That is where the term “learning” originates.

A common way to do this is by the user entering in an example of the desired result and distinguishing it from the other possible, incorrect outcomes. The program then processes the input and analyses it to find comparisons between the data, examples of the correct result and what the program has learnt so far through previous analysis. The program uses this analysis to guess the correct result and is given feedback by the program on its accuracy. The program then records the results and uses them to improve its ability to make correct choices in the future.

A good example is a commonly used program designed to identify hand-written characters like the letter ‘A’. Even though it is easy for a human to understand what the letter ‘A’ represents, there is actually an incomprehensible amount of subconscious processes that have to take place in order for our eyes and brains to inform our conscious mind of what ‘A’ actually means. A program also requires a complex method of analysing and storing data to be able to recognise ‘A’, but the way it works it out can be completely different from the way we do.

Often, handwritten characters are processed as an image in machine learning. The program can use the values of the pixels to identify patterns in the image. In the case of the letter ‘A’ the program might recognise a small horizontal line in the centre and two, sloping, vertical lines on either side that meet at a tip. It could then compare those shapes to known shapes of corrects answers and find similarities between them. But the letter ‘E’ also has a small horizontal line, so the program needs a way to differentiate between characters that share qualities.

To do this, in the first layer the program might look for horizontal lines and pass the input to neurons attributed to a small horizontal line in the centre. Then in the second layer, it might look for vertical lines. When it notices that the input image doesn’t have a single, straight, vertical line on the left side but the diagonal lines of the letter ‘A’ it may then stop looking for the letter ‘E’, confirm more information about the symbols that compare to the letter ‘A’ in subsequent layers and make a guess that the answer is ‘A’. The program is then given feedback, records the results and runs the program again with the new information until it is eventually able to guess the correct answer nearly every time.

This is a fairly basic example of machine learning. In reality the amount of data, research and processing power required to process even basic examples of artificial intelligence make it a difficult field to research and as such we have only begun to scratch the surface of its potential.

Established global tech giants like Amazon, Google, Facebook, Twitter and Uber have lead the charge in artificial intelligence development but other non-household-name companies like QBurst and Skytree (who literally call themselves “the Machine Learning Company”) have also been key players in the advancement of machine learning (Andy Patrizio, *datamation.com*, 2018).

Ride-sharing giant, Uber, have invested huge recourses into researching artificial intelligence. They use it to predict ride times, delivery times for UberEATS, set surge pricing during peak times and many more functions that help Uber offer the premium ride-sharing app on the market. In fact, Uber faced difficulty in creating machine learning programs finding they were “limited to what a few data scientists and engineers could build in a short time frame with mostly open source tools.” (Jeremy Hermann and Mike De Balso, eng.uber.com, 2017).

To combat this Uber have developed their own machine-learning-as-a-service platform called “Michelangelo” that offers their in-house engineers an end-to-end service to develop, evaluate and eventually launch machine learning programs on one convenient platform. Uber have speculated over releasing Michelangelo to the public, but they have not confirmed a date or how they plan to launch.

Other, less-known, companies are taking advantage as well. For example, PlantVillage, a company that specialises in open-source information on plant health and farming practices that assists farmers in developing countries to improve their crop health and eventually, yield, have developed an app called “Nuru” (Swahili for light), that gives farmers in isolated areas, and without access to good quality internet, the ability to diagnose disease in Casava, a plant that is “tolerable to droughts but susceptible to disease and pests” (Fred Alcober, *blog.google*, 2018)

Nuru uses machine learning to identify trends in plant-related health issues. Because of poor internet in isolated areas, Nuru has been designed (once downloaded) to be used offline and will be scaled to not only detect ill-health in Casava, but eventually to be used to diagnose countless types of crops in countries all over the world. It has been a boon to small-industry farmers and is a commonly used app for farmers in African countries today.

These are only a few examples of established machine learning companies, but there are countless other companies trying to get ahead of the pack and develop machine learning-based programs to lead them into the future. As of June 2019, Aptiv and Lyft celebrated successfully completing 50,000 driverless rides in Las Vegas (Kyle Hyatt, *cnet.com,* 2019). Apple have been using machine learning in Siri to “do more than call someone on your contact list” (Andy Patrizio, *datamation.com,* 2018) for years already and have formulated an enormous pool of Apple user data. Machine learning has even been used to combat COVID-19. Earlier this year “300 data scientists and health care professionals held a COVID-19 Datathon to see what insights they might uncover [in-regards-to COVID-19]” (Kim Martineau, *news.mit.edu,* 2020).

The potential for artificial intelligence and machine learning is difficult to describe because we just don’t know how far it will eventually take us. We do know, though, that it is one of the most prolific and powerful forms of computing to date and is likely to reach soaring heights within our lifetimes.

**What is the likely impact? 300**

We are only in the budding stages of understanding machine learning but the potential for this type of programming is almost limitless. There are three levels of artificial intelligence programs cognitive capability, all of them refer to a computer programs ability to replicate natural human intelligence.

The three levels of artificial intelligence are:

1. Artificial Narrow Intelligence. This refers to a computer being able to perform specific tasks extremely well, for example, chess (astutesolutions.com, “ANI: Artificial Narrow Intelligence”, *viewed 9th July 2020*). Currently all forms of artificial intelligence that exist in the world fall under this category.
2. Artificial General Intelligence. At this stage artificial intelligence will have reached a comparable cognitive ability to a human. It will be able to “independently build multiple competencies and form connections and generalizations across domains, massively cutting down the time needed for training.” (Naveen Joshi, forbes.com, 2019).
3. Artificial Super Intelligence. This is when AI surpasses humankind in intelligence. When this happens, artificial intelligence will begin to evolve at a rate that humankind will struggle to comprehend. This is often called the “singularity” and specifically refers to the point when the exponential growth of intelligence drawn against time as a line on a graph becomes vertical. Meaning a programs intelligence increases infinitely, irrelative of time (instantly).

Machine learning is more present in day-to-day life than most people expect. Whenever you scroll through Facebook, for example, a data mining program is paying attention to which posts you like, spend time on and how long, which advertisements you click on and a plethora of other information to do with your activity. The data is then fed into a machine learning program which analyses it to learn about how you react to certain content and what you are likely to spend your money on. This helps Facebook improve the quality of their advertising programs and therefore the amount of revenue they can generate from it. This is pretty common practice in social media companies and raises a host of ethical and legal problems.

In the case of Facebook, a company called Cambridge Analytica used data mining and machine learning programs to extract the personal information of not only the 300,000 users that accessed a link with in-built data-raking protocols, but also their friends, giving Cambridge Analytica the personal information of tens of millions of users without any of them ever opting in. According to Joel Rosenblatt (Bloomberg.com, 2019) in May 2019 Facebook was forced to pay $5 billion to a U.S. Federal trade commission over the investigation.

Another of the key issues with artificial intelligence is deciding who is responsible for legal breaches made by the program. It is arguable that a program with artificial intelligence capabilities is able to have agency over its own decisions and therefore responsible, especially as the cognitive ability of artificial intelligence edges closer to human capability. Others claim that the companies who develop the programs are responsible, much like a child and a guardian.

This is not the only ethical problem artificial intelligence faces though. According to Jonathan Shaw (harvardmagazine.com, 2019), “AI systems can reinforce what they have learned from real-world data, even amplifying familiar risks, such as racial or gender bias”. In the military, drones are already being tested using artificial intelligence removing the human element of empathy, mercy and the ability to make situational choices, and raises possible human rights questions and even potential war-crimes.

Before long, machine learning will affect every faucet of life. The amount of funding and research being thrown at machine learning indicates that there is a large interest from industry and when industry wants to get something done, it doesn’t often fail.

Although all artificial intelligence programs sit under the ”Artificial Narrow Intelligence” umbrella, it is believed with confidence that we will achieve “Artificial General Intelligence” possibly within a few decades. At this stage computers will be able to interact with humans on an equivalent level and be able to “learn, perceive, understand, and function completely like a human being.” (Naveen Joshi, *forbes.com,* 2019). When this happens computers will likely be given rights and agency the same as a person, and we will interact with them as equals.

Eventually though, if we continue to develop artificial intelligence (which we likely will), computer programs will reach “Artificial Super Intelligence” level of cognition. When that happens, we will no longer be the most intelligent species on planet Earth and will be overtaken by a new type of intelligence – like a parent being overtaken by the next generation of their offspring. Like us and the chimpanzee.

**How will this affect you? 300**

You can already clearly see the effects of machine learning programs in your personal life.

Whenever you interact with an advertisement on a social media website like Facebook or Instagram, it has in-built machine learning programs that analyse how long you spend on the ad, whether you put an item in your cart or navigated to a certain category, if you have bought items similar to it in the past and how your interests, search results and other information relates to the ad, among other information.

This is the process what allows targeted advertisement through millions of tiny data transactions every minute. That is why when you search for “how do I buy a new wallet” your feed is filled up by ads for wallets, or if you hover over a post for too long in regards to stand-up comedy, you see nothing but ads for stand-up comedy show tickets for weeks afterwards. Because of this, companies can target consumers based on their proven interests and maximise revenue generated from a marketing campaign. As of 2016 it is believed that global mobile advertising funding surpassed $100 billion for the year (Anastasiia Minak, *linkedin.com,* 2016), a number that would have grossly increased since then. Even if machine learning counts for a small portion of this funding, that is still an unbelievable amount of recourses, and translates to exorbitant profits.

Machine learning is only going to continue to become more and more prevalent in our every-day lives. As further development is put into “the Internet of Things” (IoT), it will begin to involve more and more artificial intelligence, meaning every time we use our household items that are connected to our Wi-Fi network, even the tv, toaster or microwave, we will be giving data to one, if not many, machine learning programs.

Eventually, when all of our possessions are connected to the internet and artificial intelligence becomes the dominant form of programming, it is likely our entire experience will be targeted towards us in some way or another. For example, you might walk down the street and advertisements in the windows of shops you pass may change what product they are advertising, or even the look of the ad itself, thanks to a giant database of information that thousands of artificial intelligence programs have compiled about your character over decades of interacting with technology. It is not unbelievable that the rooms in your house change colour, temperature or music depending on your mood at the time. In fact, that is already possible in a primitive form.

Artificial intelligence will eventually exist side-by-side with human intelligence and be given rights the same as us. One day, it may overtake us, and become something much greater than anything we can imagine today.

Either way, it is here to stay, and something we will all have to accept eventually.

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