<u>ROBOTS IN ACTION</u>

ARTIFICIAL INTELLIGENCE

Before we can even begin to discuss Artificial Intelligence, it is essential to define what we mean by the word ‘intelligence’ itself. Loosely, in humans and animals, it can be said to be the ability to absorb information, to understand its meaning, and make decisions based upon that.

Artificial Intelligence (AI) is the creation of machines intended to mimic the functions of the human brain – using computers to do the arithmetic.

There are two fundamental approaches to AI, known as ‘bottom-up’ and ‘top-down’. The first is based on building electronic replicas of the brain’s networks of cells, known as neurons. The second consists of creating computer programs aimed at imitating the actual behaviour of the brain.

Two scientists – Warren McCullloch, a qualified doctor, and Walter Pitts, a mathematician, theorized that neurons might operate on the basis of binary numbers – which also happen to be used in computer calculations. In simple terms, the binary system uses only two numbers: ‘1’ and ‘0’, which means that all sums can be simplified to represent a switch being either on or off. The number ‘1’ represents ‘on’, and ‘0’ represents ‘off’.

McCulloch and Pitts made some electronic replicas of these networks – proposing that they could be used to learn and recognize pattterns. Their researches showed some success, but the complexity of the networks required impractically large computers, and although the method has not been adopted in full, elements of it have been incorporated into other systems.

The top-down approach is more generally applied to AI, which work by a process of deduction – by sifting thorugh information and discarding inappropriate data, to arrive at a conclusion.

Computer-based chess domonstrates well the difference between the way that the human brain works in contrast to Artificial Intelligence. A computer is able to make rapid mathematical calculations, far beyond human capability. Therefore, when confronted with a move, a computer can look at every one of millions of possibilities for the entire board in a very short time. A human can only look at a small area around a piece, and consider only one or two moves ahead. However, a computer has no intuition, and is less able to predict its opponent’s next moves on any level other than the mathematical, or to exploit his or her mistakes. In 1997, IBM’s Deep Blue computer played against the then world chess champion, Gary Kasparov, and won.However, the Deep Blue had to be programmed by humans – chess experts, in fact – before it could operate, and in doing so, they took into account Kasparov’s style of play, and likely tactics. So the contest was, strictly speaking, not just between one human and one machine. Six years later, the champion played against another computer, Deep Junior, and drew – a feat he then repeated a few monts later against X3D Fritz.

The most common application of AI is what is known as ‘expert systems’. These store data, based on human knowledge, turn it into digital code, then apply it to functions such as diagnosing faults in machinery, in the human body and so on – often more efficiently than live human beings, since they work purely on facts, and there is less margin for error, or for overlooking possibilities.

The compter expert Marvin Misky pointed out the paradox that the earliest AI programs could easily compete with college students at advanced mathematical problems, yet it was not until the 1972 that a robot using AI could be programmed to carry out simple tasks that a toddler can manage, such as carrying and stacking toy bricks.

This is because such activities require planning, the ability to respond to random conditions, to assess and learn from new conditions, and so on – in other words, spontaneity. Everything that a compter does is a calculation of figures that it has received. AI takes this further, by gathering a variety of data, and using it to make assessments and making the best decisions based on that – for this reason it is ideal for tasks suh as organizing complex air traffic control systems, which would test to the limit the skills of large numbers of humans all working together.

But its rigid logic can also produce absurd results. Take, for example, threatening letters that come for debts of £0.00. To a human, these seem ridiculous, but to a computer, they are perfectly logical. The amount owed is £0.00, and therefore must be paid at once.

This ability to recognize patterns is also applied to image scanning. For instance, millions of images of fingerprints can be scanned into a computer, and when needed, the computer can sift through millions of them in a very short time, and recognize a match. In the same way, a scanner can record patterns of colour and light from a piece of paper, translate them into digital data, and reproduce them again as pictures on a screen. It can then follow a similar procedure to instruct a printer to fire dots of ink at a piece of paper to create a picture.

In a similar way, A1 can be used to recognize sounds, turn it into digital data, which can then be utilized to give insructions to a computer. This process is known as speech recognition, and it enables machines to accept instructions, and also to reply. As robots become more sophisticated, this could lead to the impression that they are actually understanding what is being said to them, and from that, to the impression that they may have consciousness.

In fact, it is the questions of consciousness and intelligence in machines that generate the most speculation in the study of robotics. In 1950, the mathematician Alan Turing – generally recognized as the father of AI – proposed a test (though not actually carried out), which would determine whther a machine could be regarded as intelligent. He suggested a situation in which a computer and a person were interrogated, using typed messages. If the interrogator could not tell which was which from the replies, Turing argued, the computer could be considered to be intelligent.

However, the day when robots can truly imitate humans is still a long way off. But it is progressing. And until then, we will have to learn to be patient when they send us stupid bills. They are only quasi-human,, after all.

FACT FILE

Brain Power

Until recently, computers were no competition for the human brain when it came to processing power. But that is about to change, since the announcement that the IBM corporation has won a contract to build a pair of computers that will give humans a run for their money –$290 million, in fact, for the work. Together, the computers, known as ASCI Purple, will have the capability to make 500 trillion calculations per second, compared with the human brain's paltry 100 trillion-per-second capability.

FACT FILE

The One That Got Away

Anyone doubting that robots are catching up ith humans might have been swayed by the story of Gaak the robot. In fact, humans had a job to catch up with this robot when he took made a break for freedom after being left unattended for 15 minutes at the Magna science cetnre in Rotherham, England. After creeping along a barrier, Gaak found a hole in a fence, crossed a car park and made it to the centre's exit beside the M1 motorway before being apprehended.

FACT FILE

Data mining

AI is especially good for work that involves recognizing patterns. It is particularly useful for spotting credit card fraud, and can even predict events, due to its ability to observe changes in behaviour patterns from the data constantly flowing through the system. This 'data mining' saves millions of dollars per year for large corporations such as Wal-Mart, and is also invaluable for the US National Security Agency in assessing terrorist threats. For this kind of work to be done by humans would require specialist personnel to trawl repeatedly through massive amounts of data, looking for abnormalities.

FACT FILE

Much of the data assessment methods used in AI are based on the work of the 19th-century mathematician George Boole. He come up with a system of logic – known as Boolean algebra – based on binary mathematics, in which 'ON' is represented as 'TRUE' and 'OFF' as 'FALSE', and using AND, OR and NOT as conditions.

This could be applied to statements, in which 'TRUE' represents 'ON' and False represents 'OFF'.

For example:

Grass is green = TRUE

Grass is green AND sky is pink = FALSE

Grass is green OR sky is pink = TRUE

Grass is green AND sky is NOT pink = TRUE

If light switches were to be used in this method, the AND condition would mean that both switches have to be on for the light to come on. OR would mean that one or other switch would need to be on to conduct electricity. NOT would be represented by a switch that when pressed, it would break the current, makng the light go off. When applied to computing, this has proved an efficient way to sort data.