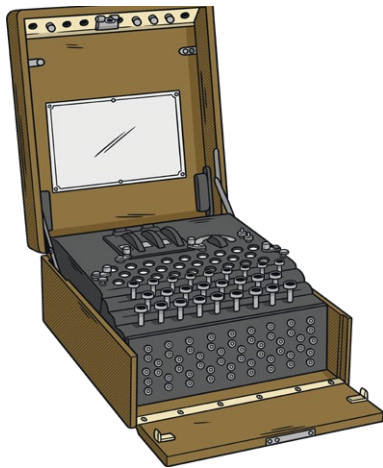


Artificial Intelligence

The concept of using machines to intelligently solve problems is not new. The ancient Greeks were known to use robots called 'automatic servants'. Using a clever combination of pneumatics and articulation, these robots would pour wine into a cup and then dilute it with water. However, the use of artificial intelligence didn't progress much until the 1950s due to limitations with computer technology. Until this point, computers were able to carry out commands but they could not store them. Computers were also very expensive, costing around \$200 000 a month to use. This meant their use was limited to large organisations, such as universities.



The need for intelligent machines became paramount during the Second World War. It was vital for Allied forces to be able to decipher instructions sent between German troops. These messages were encoded using a device called the Enigma machine, which used a cipher system that changed daily. A team of codebreakers housed at Bletchley Park in England could not crack the code quickly enough to be useful. In 1940, the team, led by Alan Turing, created the Bombe machine. This device searched for possible solutions to the German code by carrying out a series of logical comparisons to words likely to appear within it. This machine helped prevent the destruction of large numbers of Allied ships and maintained supply chains that were crucial to the war effort.

Following the Second World War, Alan Turing worked at the National Physical Laboratory and, in 1946, became the first person to describe a detailed design of a computer that could store programs as well as execute them. In 1950, he introduced the Turing test. This was designed to determine if a machine could think and respond in a way believed by an observer to be human. A reverse format of the Turing test, known as CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) is still used today where humans are required to prove they are not a machine.

The term artificial intelligence was first used in 1950 by computer and cognitive scientist John McCarthy. McCarthy presented his definition of artificial intelligence at a conference at Dartmouth College, USA in 1956, which brought about the start of major research into this field.

What Is Artificial Intelligence?

Artificial intelligence refers to the ability of computers and machines to solve complex problems in the same way that humans can. Machine learning is a branch of artificial intelligence which allows the computer to learn from past data without needing input from the programmer. It can be used to enable a machine to carry out a specific task with increasing accuracy over time. An example of machine learning in action is seen in online television streaming services. Recommendations on what you might enjoy watching next are made using data collected from other people's viewing history. Over time, the recommendations become more tailored to your preferences.

There are four types of artificial intelligence: reactive machines, limited memory, theory of mind and self-awareness.

Reactive Machines

The most basic application of artificial intelligence is a reactive machine. Reactive machines receive data, process it, and provide an output. Reactive machines cannot use what they have learnt to complete future tasks because they cannot store memories or experiences. The supercomputer Deep Blue is an example of a reactive machine. In 1997, it beat world champion Garry Kasparov at chess, becoming the first computer to do



so. Deep Blue was programmed to identify the individual chess pieces and their potential moves, allowing it to make predictions about what might be likely to happen next. However, it could not learn from its success, or tailor its gameplay towards a specific opponent.

Limited Memory

When a machine can make and use observations in addition to preprogrammed data to make decisions, its artificial intelligence is described as the limited memory type. Data can be stored and used to make better predictions in the future using machine learning. Limited memory artificial intelligence is being used to create driverless cars. The cars are pre-programmed with information like speed limits and road markings, and they also make use of observations over time like the speed, direction and proximity of other vehicles during the journey. This data is then combined to make decisions about which route the car should take and helps it to avoid collisions along the way. Modern uses of artificial intelligence have not progressed further than limited memory machines.

Theory of Mind

Being human brings with it the ability to recognise that others have emotions and memories that affect the decisions they make and the way they interact with the world around them. Psychologists describe this as the theory of mind. Artificial intelligence which can recognise and respond to the thoughts and feelings of others has not yet successfully been developed. Theory of mind machines would be able to learn from their experiences and apply them to different situations, which could be useful in the future in ways including supporting disabled people to complete everyday tasks or providing emotional support for lonely people.

Self-Awareness

Theoretically, the most advanced artificial intelligence would be self-aware. Being self-aware would mean that the machine could understand its own needs and reason for existence. It would be able to make decisions for itself, as well as carry out tasks for humans, and it would be able to learn from the experiences it had. While some people are excited at this prospect, others have concerns around the ethical implications of self-aware technology.



Artificial Intelligence Questions

1. Name the machine developed during the Second World War to crack the Enigma code.

2. State the type of artificial intelligence used to develop driverless cars.

3. Describe what is meant by the term 'artificial intelligence.'

4. Give **two** reasons why research into the use of artificial intelligence increased after the 1950s.

5. Explain why Deep Blue might not be able to beat Garry Kasparov in a chess rematch.

6. Evaluate the potential development of self-aware machines in the future.

7. Suggest an example of machine learning not already mentioned in the text.



Artificial Intelligence **Answers**

1. Name the machine developed during the Second World War to crack the Enigma code.

the Bombe

2. State the type of artificial intelligence used to develop driverless cars.

limited memory

3. Describe what is meant by the term 'artificial intelligence.'

The ability of machines to solve complex problems in the same way that humans can.

4. Give **two** reasons why research into the use of artificial intelligence increased after the 1950s.

Responses could include:

- **Until the 1950s, computers could carry out commands but not store them (they had limited memory).**
- **The term artificial intelligence was not used until 1950 (by John McCarthy).**
- **The first major conference about artificial intelligence happened in 1956. This brought about the start of major research into this field.**
- **Computers became cheaper to run after this time, meaning their use was more widespread. Before this, they were only used by large organisations.**

5. Explain why Deep Blue might not be able to beat Garry Kasparov in a chess rematch.

Deep Blue is an example of a reactive machine. This means it could not store or learn from each of its matches with Kasparov. Kasparov could eventually beat Deep Blue by learning from previous matches.



6. Evaluate the potential development of self-aware machines in the future.

Student responses will vary but should include a benefit and a problem relating to the development of self-aware machines.

Benefits could include:

- Self-aware machines could make decisions for themselves and learn from their experiences.
- This means they could solve more problems for humans without being specifically programmed to do so.
- An example of where this could be useful is to deliver intuitive and personalised care for patients in hospitals or residential settings.

Problems could include:

- Self-aware machines understand their own needs and reason for existence.
- The line between human and machine would be blurred, and some people might think that self-aware machines have rights.
- There would be the potential for machines to make the wrong decision. This could cause harm to humans.
- Self-aware machines might replace humans in the workplace leading to increased unemployment.

7. Suggest an example of machine learning not already mentioned in the text.

Any example of a machine learning from user data should be credited.

Answers could include:

- adverts on social media, tailored to your shopping or scrolling preferences
- vouchers being sent to you as a result of using a loyalty card in a supermarket
- email spam filters
- facial recognition software