# MODULE 1 UNIT 1.2

## Human and Machine Intelligence

Ver. 1.0

# Table of contents (M1U2)

# 1. Machine versus human intelligence

The term "artificial intelligence" (AI) was officially coined by John McCarthy in 1956, and has since grown into a fascinating field of science and engineering (Russell & Norvig).

## The Turing Test

In his seminal text, Computer Machinery and Intelligence (1950), Alan Turing gives serious consideration to the relationship between machines and intelligence. He begins by asking the question, "Can machines think?" (1950:433), but then reformulates it, arguing that the question requires definitions and discussions of the words "machine" and "think". Thus, to avoid pre-defining these words, Turing proposes the famous Turing test as a vehicle to deliberate machine intelligence.

The test has been widely interpreted, but is presented here in its original form. The Turing test was originally known as the imitation game. It is played by three people: a man (Player A), a woman (Player B), and an interrogator (Player C), who may be of either sex. The interrogator is in a different room, and can ask questions to the two respondents, whom they know only as X and Y. Through the answers the interrogator receives (in typewritten form), they must try to determine which of the two players is the woman and which is the man, and thus, by the end of the game, say either "'X is A and Y is B' or 'X is B and Y is A'" (Turing, 1950:433). However, the object of the imitation game for Player A is to give the interrogator the incorrect answers, whereas the object for Player B is to help the interrogator.

After introducing the imitation game, Turing asks: "What will happen when a machine takes the part of A in this game?" (1950:434). The intention of swapping Player A with a machine is deliberate, as the object of the game is for the machine to convince the interrogator that it is human, just as Player A's objective is to convince the interrogator that he is the woman. Would the interrogator be able to tell the difference between a human and a machine? Therefore, the question is no longer whether machines can think, but rather whether machines can simulate intelligence that is indistinguishable from human intelligence.

In Figure 2, notice that the machine has taken the place of Player A, a woman assumes the role of Player B, and there is an interrogator in the role of Player C. The interrogator poses questions to Player A (machine) and Player B (woman). Under these conditions, using only the answers submitted by the respondents, the interrogator needs to determine which player is a human and which is a machine.


**Figure 1.2.1:** The Turing test. (Adapted from: Rouse, 2017)

## Objections and responses to the Turing test

In unit 1.1 you learned about John Searle's Chinese room argument, which was an attempt to refute the Turing test. Searle argued specifically against the idea that machines could have minds like humans. While Turing never responded to Searle's objection, he did catalogue, discuss, refute, and pre-empt nine potential objections to the notion that a machine may someday be able to think. These nine objections, of which Table 1 provides an overview, include arguments that have been raised against AI since the publication of Turing's seminal text (Teahan, 2010:20).

 

**Table 1.2.1:** Turing's pre-emptive responses to nine objections.
(Adapted from: Turing, 1950:443-453)

| Objection | Argument | Turing's response |
|---|---|---|
| Theological objection | Thinking is a function of a human's immortal soul. God has only given an immortal soul to humankind. Therefore, no machine can think. | Turing stated it is not outside of God's power to create souls for machines. |
| Head-in-the-sand objection | The consequences of machines that can think are frightening. Therefore, it is better to hope and believe that they cannot think. | Turing believed this objection was not sufficiently substantial to require refutation. |
| Mathematical objection | Mathematical theorems, such as Gödel's theorem, demonstrate that there are limitations to discrete-state machines (also known as finite-state machines), such that there are statements that even infinitely powerful discrete-state machines are unable to prove or disprove. | Turing acknowledged that there were limits to machines. However, he contended that these limitations would also apply to human intellect. |
| Argument from consciousness | Thinking is a consequence of consciousness. Machines do not have consciousness; therefore, machines cannot think. | Turing argued that the only way to know if someone thinks is to be that particular person. He stated that instead of continually arguing over this, it is convention to assume that everyone thinks. |
| Argument from various disabilities | While machines can perform activities, there are still activities that a machine will never be able to do, such as fall in love or have a sense of humour. | Turing stated that the argument that machines do not have diversity of behaviour is just a way of saying that they cannot possess much storage capacity. He then highlights the tremendous growth of machine storage capacity in the years leading up to 1950. |

| | | |
|---|---|---|
| Lady Lovelace's objection | Machines can only do what they are ordered to perform. Therefore, they cannot originate anything. | Turing argued that Lady Lovelace's objection did not preclude the possibility that machines could eventually think on their own, just that the machines in her time could not. |
| Argument from continuity in the nervous system | A discrete-state system cannot be expected to mimic the behaviour of a nervous system. | Turing agreed that there is a difference between a continuous system and a discrete-state system. However, he argued that it is possible for a machine to mimic the necessary outputs required for a continuous system. |
| Argument from informality of behaviour | It is impossible to outline a set of rules detailing how to behave in every conceivable situation, so machines cannot act like humans. | Turing stated that this argument claims that machines are thus governed by predictable behaviour and are therefore not intelligent. However, he also stated that machines do not always behave in predictable ways. |
| Argument from extrasensory perception | Unlike machines, humans possess extrasensory perception. Specifically, telepathy, clairvoyance, precognition, and psychokinesis. | Turing argued that there are many scientific theories that have not been disregarded, despite their clash with extrasensory perception. Thus, neither should the notion that machines can think. |

When Turing wrote his text, only four electronic computers existed, namely Manchester Mark I and Cambridge EDSAC in Great Britain, and ENIAC and BINAC in the United States (Copeland, 1993:9). The press had dubbed these computers "electronic brains", reinforcing the idea that machines could think (Copeland, 1993:9). One of Turing's colleagues at the time, Sir Geoffrey Jefferson, dismissed the idea that machines could think as not worthy of discussion. Thus, Turing's text ignited an impactful debate that still holds weight today.

Turing concludes his paper by asking, "May not machines carry out something which ought to be described as thinking but which is very different from what a [human] does?"

(Turing, 1950:435). In other words, he suggests that machines do not necessarily have to think in the same way humans do for them to be thinking; they just need to display intelligent behaviour.

So what does it mean when a machine can pass the Turing test? This depends on whether you are a proponent of the weak AI hypothesis or strong AI hypothesis. The claim that machines could act as if they were intelligent is known as the weak AI hypothesis, and the claim that machines are actually demonstrating intelligence, not merely simulating intelligence, is known as the strong AI hypothesis (Russell & Norvig, 2016:1020).

Turing's response to the tension between the weak AI and strong AI hypotheses was to suggest that the gap between these two hypotheses will eventually dissolve as machines reach a certain level of sophistication (Russell & Norvig, 2016:1027). However, as Russell and Norvig (2016:1027) argue, the issue at stake is whether machines have real minds that can exhibit intelligence like humans can.

# 2. Human versus machine intelligence

Since the early 1950s, AI has been an active scientific discipline associated with:

## The seven forms of intelligence

Recall that strong AI assumes that intelligence is a physical process that can be replicated in machines, whereas weak AI views machines as a means to simulate and understand intelligence (Friedenberg, 2008:110). There are important implications from this debate that impact how intelligence is viewed in the context of AI. Specifically, whether intelligence is a single capacity or made up of multiple abilities.

Historically, intelligence was considered a single unitary ability that could be quantitatively measured by tests such as the Binet-Simon Scale (Friedenberg, 2008:110). The Binet-Simon Scale measures five aspects of cognitive ability to ascertain intelligence: working memory, comprehension, attention, judgement, and reasoning (Valencia & Suzuki, 2001:5). However, Howard Gardner's theory of multiple intelligences (MI) argued that intelligence is not made up of a single intelligence that consists of different abilities, but that there are instead different types of intelligence (Gardner & Hatch, 1989:5).

 

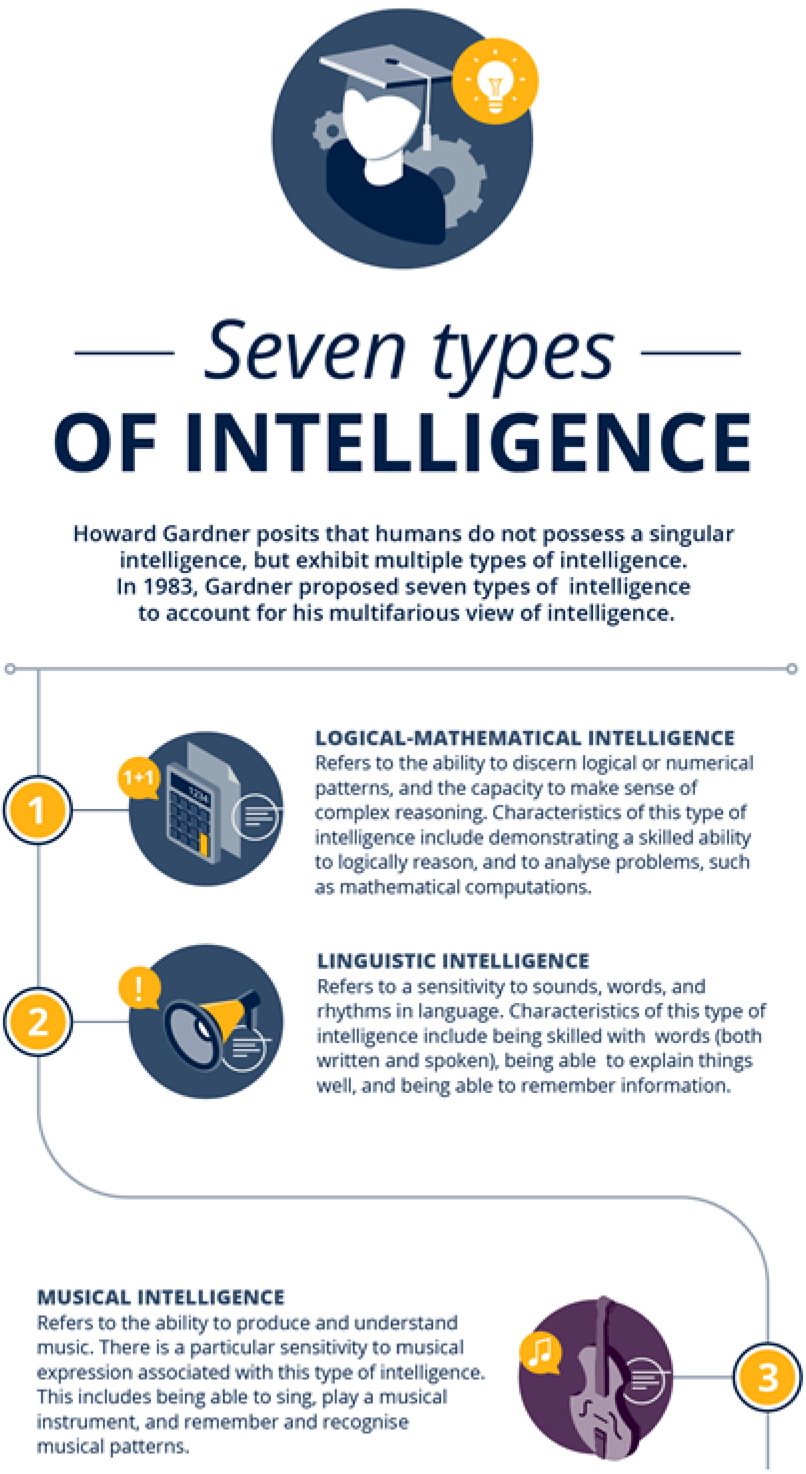


**Figure 1.2.2:** Howard Gardner's seven types of intelligence (part 1)

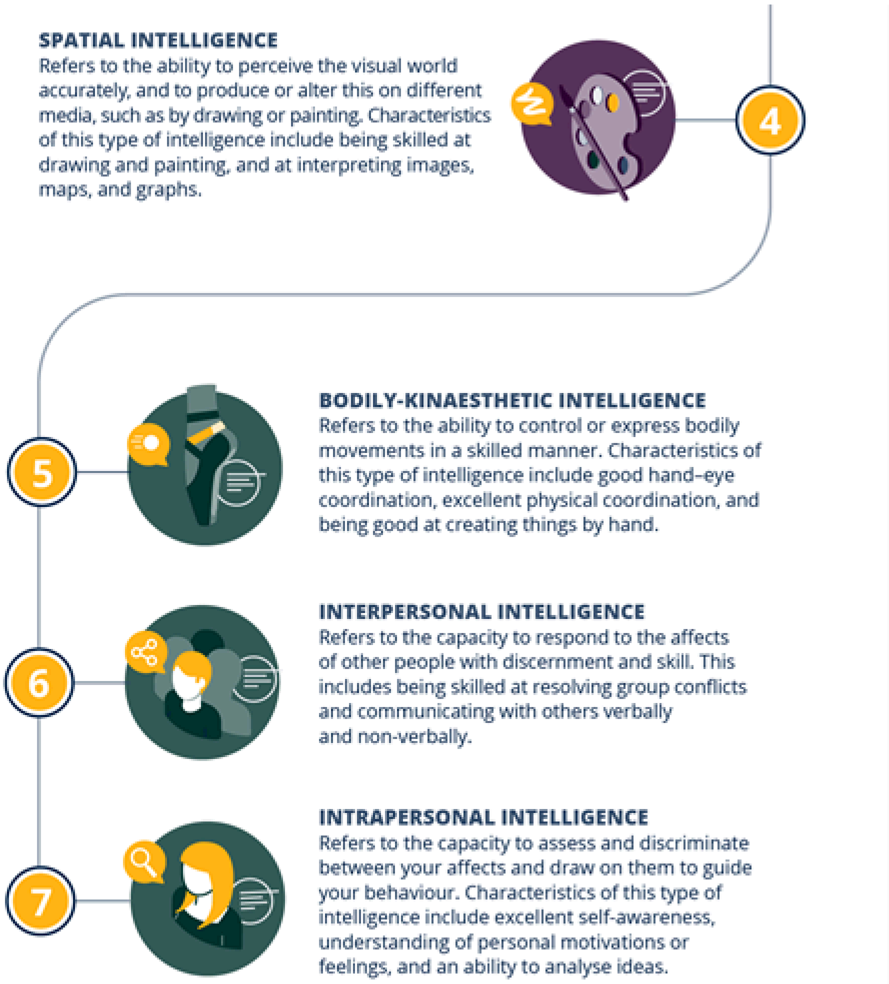


**Figure 1.2.3:** Howard Gardner's seven types of intelligence (part 2)

While quantifying intelligence in seven forms may itself be problematic, Gardner's theory of MI is useful for distinguishing between human and machine intelligence. It signals the types of intelligence that AI is equipped to handle and those it is not. The next section deliberates the types of intelligence that are unique to humans This is followed by a reflection on the current capabilities of AI.

## Intelligence unique to humans

What are the consequences of Gardner's theory of machine intelligence (MI) for AI? Gardner argues that AI is a powerful influence against the view that intelligence is single and unitary. He supports this claim by arguing that those working with AI have found it easier to build specific types of skills and knowledge into machines than to build a general problem-solving capacity (Gardner, 1999:21).

Using Gardner's language from the multiple intelligence theory, AI can be considered as clustering around five types of intelligence:

1. Logical-mathematical: People who display logical-mathematical intelligence are skilled at discerning logical or numerical patterns. Similarly, machines have demonstrated an impressive ability to excel at logical-mathematical reasoning. Google's AlphaZero and MuZero are illustrations of how AI can excel at problem-solving, planning, and reasoning.

2. Linguistic: People that display a high linguistic intelligence possess a sensitivity to reading and writing. Machines have also demonstrated an intelligence in natural languages. For example, for the 2022 Grammy Awards, IBM Watson analysed over 20 million web posts so that it could give fans fun facts about each artist.

3. Musical: People with musical intelligence have a sensitivity to sounds and music. For example, Magenta is an open-source research project that uses machine learning to create music and art.

4. Spatial: People who have high spatial intelligence are considered skilled at exercising spatial judgement and visualising the world accurately. While artistic expression has been considered uniquely human, Google's Deep Dream, for example, has produced impressive artworks using neural networks.

5. Bodily-kinaesthetic: Those who possess bodily-kinaesthetic intelligence are considered skilled at expressing and controlling bodily movements. Robots have now reached a level of sophistication where they are able to perform high-level mobility and manipulation tasks.

(Etlinger, 2017:5; Wooldridge, 2018:10; Roberts, 2018)

What types of intelligence are specific to humans? If we regard the list of AI's current competencies in intelligence, the two types of intelligence that remain unique to humans are interpersonal and intrapersonal intelligence. These two types of intelligence are encompassed by what is commonly known as emotional intelligence (EQ).

Salovey and Mayer (1990:5), forerunners in EQ literature state that "emotional intelligence refers to the ability to monitor and discriminate among emotions, and to use the information to guide thought and action". They argue, like Gardner, that the sensitivity to your own and other's emotions is not merely a "valued social trait", but also constitutes a type of intelligence in its own right (Salovey, Brackett & Mayer, 2004; Mayer & Salovey 1997:32).

Thus, it is clear that while other intelligences can, to varying degrees, be automated (even though they were historically considered to be uniquely human), it continues to be difficult for AI to automate emotions, feelings, intuition, and empathy (Beck & Libert, 2017).

# Appendices

## Appendix 1: Reference List

AI Programme (2025). Course notes. University of Oxford, Saïd Business School.

Bloggs, J. (2013). 'The key issue'. [Cartoon]. The Times, 20 January, p.56.

British Standards Institution (2008). BS 8498:2008: British Standards for screw threads and screw gauges : introduction and guidance. London: British Standards Institution. Available at: British Standards Online (Accessed: 26 March 2021).

Bureau van Dijk (2013). 'BSkyB plc company report'. Available at: http://fame.bvdep.com/

(Accessed: 8 January 2013).

Custer, C. M. (2018). 'Annual Variation Birds as indicators of contaminants in the Great Lakes'. doi.org/10.5066/F7SB452P

 