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# CI6228 Managing Information Systems

NANYANG TECHNOLOGICAL UNIVERSITY -  
WEE KIM WEE SCHOOL OF COMMUNICATION AND INFORMATION



## **Title: *Artificial Intelligence***

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A Report of

Artificial Intelligence

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## **Abstract**

Artificial Intelligence (AI) has become more prevalent nowadays due to rapid technological advancements like increasing storage of data volumes, advanced algorithms and improvements in information computing. The ideal AI is its ability to rationalise situations and reacts to achieve a specific goal that mimics the behaviour of the human brain such as in gaining knowledge via processing experiences and also resolving obstacles. This report aims to offer a comprehensive perspective for the human-like interactions and the directions of AI in the near future.

## **What is Artificial Intelligence**

### **Artificial Intelligence vs Cybernetics**

Artificial Intelligence was initially originated by computer scientist, John McCarthy, in 1955 to differentiate itself from the field of Cybernetics by mathematician, Norbert Wiener (McCarthy, 1988). Although AI and Cybernetics are often interchangeably used, they are actually different thinking of intelligent systems acting towards achieving a goal.

Cybernetics preceded AI and it focuses on how systems process information and adapt themselves to react based on changes from the environment for better functioning. Hence, the study mainly encompasses on information processing, feedback control and decision making. A good example would be Automatic Pilot whereby during the process, Cybernetic systems have to regulate themselves in accordance to the environment to in order not to go off course such as by maintaining flight dynamics and governing the speed of an engine. Apart from computational and mechanical, Cybernetics can also include biological like preserving body temperature, social like administering a broad community, and economic like governing a civil economy system (Wiener, 1961).

AI on other hand, some may suggest that it brought Cybernetics onto other level as it constitutes more towards human intelligence, rather than the parameters of the ecosystems. The primary concern of AI is to formulate computers and stimulate patterns of human intelligent created from a massive amount of data of representations of the world in order to react like humans (Khillar, 2020). With the accumulation of various experiences acquired through data mining by machine learning technology, it allow machines to outperform human intelligence. A good example would be Text Prediction or Smart Compose whereby AI predicts the next word that a user would likely use after a specific word or suggest a words that the user often used when the first few alphabet is entered, these could be names or addresses.

Ultimately, even though both AI and Cybernetics are two distinctive but associated fields that consider how systems acquire information and learn; Either from the science of training to perform human tasks or the science of reaction to employ regulated feedbacks, controls and communications respectively (Dubberly and Pangaro, 2015).

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## How Artificial Intelligence Works

AI gives machines human-like properties without exhibiting fatigue. It performs repetitive, large volume, computerised tasks accurately and reliably. AI usually adds value onto existing products and good example would be Siri which comes as a feature of Apple products and is always improving with AI capabilities every update (SAS, 2020).

With the increasing numbers of continuous streaming of information by Internet of Things (IoT), it gives us the ability to understand our surroundings much more intimately than we could ever before. As IoT penetrates the industry, they generates massive amount of unanalysed data and AI gets the most usage out of it. For example, a data collected can be simply John turning off his lights at 11pm one night. In the subsequent nights, when John continues to turn off his lights on around 11pm sharp, AI would see a pattern of the gathered data and would suggests John if he would like to turn off his lights on 11pm the next time he plans to re-automate his lights.

AI works by gathering granular, large volume of data and extremely diverse data to rapidly process and find the patterns that allow applications to learn automatically from the data. The more data being processed, the more accurate the AI would become, as shown in Figure 1, a chess-playing AL defeats world chess champion, Garry Kasparov.



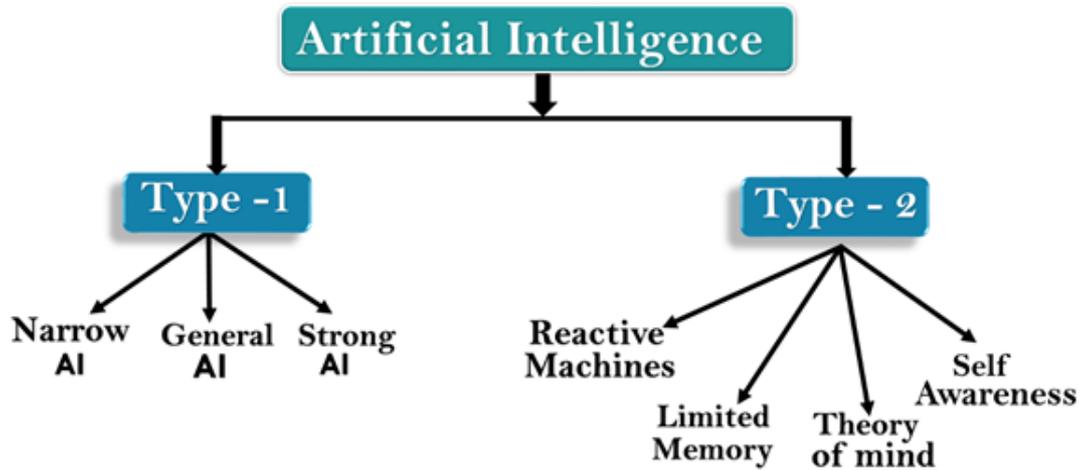
*Human vs Deep Blue AI in Chess, 1997*

The formation and regularities that AI finds in the data patterns allows its algorithm to acquires skill and becomes a classifier or a predictor. With that, the algorithm can teach itself how to play chess, or what advertisement or product to push to their users. Data itself could one day become a highly sorted intellectual property when algorithms develop self-learning skills (SAS, 2020). With the answers hidden within all the data, one just have to apply AI to retrieve them out.

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## Types of Artificial Intelligence

There are various ways to categorise Artificial Intelligence. The two common ways to define the types of AI are either according to the capability or functionality of AI. The chart below has explained the common types of AI.

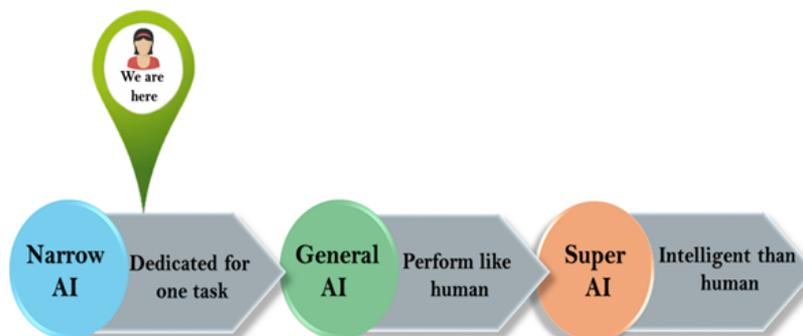


*Artificial Intelligence: Type - 1 and Type - 2*

### Artificial Intelligence Categorisation One - Capability

#### Weak AI

It can also be named as “narrow AI”. This type of AI can only focus on one specific task. The actors or computers are not intelligent enough to complete the overall workflow. For instance, Go Game playing with Google AI robot, AlphaGo, customer purchase behaviors research, self-driving cars, Common voice assistants, facial recognition.



*Current Stage of Artificial Intelligence*

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## **General AI**

The definition is similar to “general intelligence” which means the actor or intelligences are able to perform a wide range of tasks as intelligent human beings. There is no successful examples of general AI in the real world yet.

## **Super AI**

Super AI is a level of Intelligence of Systems which the AI entity is able to transcend the intelligence and wisdom of human beings. It can achieve goals and work on tasks much more sufficient and effective in certain area. While this type of AI is just a concept and will take a long way to go to achieve it (Types-of-artificial-intelligence, 2019).

## **Artificial Intelligence Categorisation Two - Functionality**

### **Reactive Machine**

This the fundamental type of AI which only act on the current situations and respond to them with its best performance. It does not store any memory and process the history data to predict the next action. For instance, the GO-game.. and Deep Blue system invented by IBM.

### **Limited Memory**

This kind of AI machine is able to store and process history data with boundary's on time limitation. The best example we can refer is the automotive-car technology which store the most recent data like the speed of surrounding vehicles, the distance estimation, speed limitation, and navigation road information.

### **Theory of Mind**

This type of AI is able to recognise the emotions, cognitions, behaviours of human beings, and also behave and communicate like real person. So far there is no such kind of AI machines are developed successfully yet. It is still under research stage.

### **Self Awareness**

This is an ideal type of Artificial Intelligence which is very similar with the concept of “Super Artificial intelligence”. And it should be able to perform more efficient and smarter than human beings which is under hypothetical concept stage (Kumar, 2018). This may lead to a utopia or dystopia society.

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# Development of Artificial Intelligence

## Timeline and Applications of Artificial Intelligence

According to Marsden, P (2017), the introduction of Artificial Intelligence was commenced in 1950 when a computer scientist, Alan Turing, suggested having a "Turing Test" to validate if machines have the intelligence to deceive humans into thinking they are actually indeed interacting with a human, and not a computing machine.

### **1950 Turing Test**

Alan Turing proposed a test to see if a machine can trick humans into thinking it is human. If it succeeded, then the machine has intelligence.

### **1955 - AI Born**

John McCarthy coined the term "Artificial Intelligence" to describe "the science and engineering of making intelligent machines".

### **1961 - Unimate**

The first industrial robot that replaces humans on the assembly line.

### **1964 - ELIZA**

The pioneer chatbot that holds conversations with humans..

### **1966 - Shakey the Robot**

The general-purpose mobile robot that reasons about its own action.

### **1970 to 1990 - AI Winter**

Marsden, P (2017) highlighted that the development progress came to a stagnation between the year of 1970 and 1990. The stagnation period was named "AI Winter", the industry slashed the funding sum when millions of dollars had been spent, and negligible progression was made.

### **1997 - Deep Blue**

A chess-playing computer by IBM defeats world chess champion, Garry Kasparov.

### **1999 - AIBO**

Sony's first consumer robot pet dog with skills and personality that develop over time.

### **2011 - Siri**

Apple's intelligent virtual assistant with a voice interface.

### **2014 - Alexa**

Amazon's intelligent virtual assistant with a voice interface that completes shopping tasks.

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### **2017 - AlphaGo**

It beats world champion Ke Jie in the complex board game of GO.

### **2019 - Deepfake**

A system that can transform facial images into video sequences. Launched by Samsung.

### **2019 - AI-Generated Synthetic Text**

OpenAI released a model called Generative Pre-Training (GPT) to generate synthetic text automatically. On writing a few sentences, the model perfectly picked the context and generated text on its own.

## **Case Study of Artificial Intelligence - Alexa**

Alexa is a digital voice assistant launched by Amazon in 2014, she relies on two subsets of Artificial Intelligence – (1) Natural Language Generation and Processing and (2) Machine Learning (Marr, n.d.).

Marr (n.d.) explained that humans writing and speaking have always been a challenge for systems to truly understand us. Therefore, natural language generation and processing is developed to process humans' language that sounded if a human were actually speaking. Natural language processing (NLP) allows systems to understand the content produced by humans. Natural language generation (NLG) is system's abilities to generate content in words or language so that humans could understand it.

Secondly on machine learning, it is a subset of artificial intelligence which systems have access to the data collected and have the ability to learn from the data, the systems have the capability to learn and improve without being programmed. Every time the system made a response to the user's request, the system would capture the data, learn from the response's reaction and would then improve the response that is given to the user on the next request.

Since 2014 Alexa was introduced, she has learnt to response to follow-up questions over the past few years. Working along with a smart-home connected devices, Alexa has the ability to inform user when a regular pattern is not followed. For example, when user accidentally left the lights on, Alexa would spot the different pattern and offer to turn off the lights for the user.

Therefore, both data and machine learning are the key elements to the positive growth of digital voice assistants. These algorithms help the systems to improve when more experiences and data are accumulated.

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## Benefits of Using Artificial Intelligence

Kaja. P (2019, July 18) highlighted some important benefits that an Artificial Intelligence system that can bring to business (Kaja, 2019).

1. Reduce time spent and money expenses: Systems can work for the entire day without any sleep or rest. Systems can replace humans on repetitive and routine work which freed up humans' time to work on more valuable tasks.
2. Generate business insights: Systems can assist humans with data-mining and to provide predictive analytics to aid management with decision-making.
3. Enhance customer experience: Systems have the ability to recommend movies on Netflix, to personalize music playlists in Spotify, to prepare shopping list on Amazon.

## Challenges of Using Artificial Intelligence

The power of Artificial Intelligence sounds to be limitless, however, the statement is not true. In this section, we will try to understand the limits of Artificial Intelligence.

SAS (2020) believed that Artificial Intelligence is ultimately a machine, a system, that is designed by humans. Similarly, to computer roles in today's society, Artificial Intelligence systems are trained to perform a clearly defined task. The intelligence that an Artificial Intelligence system has is very specialized, for example, when the system is equipped with the capabilities to detect healthcare fraud, it does not own the ability to detect tax fraud or warranty claims fraud. The job that the system focused on is a single task and could not multitask like a human.

Lastly, the only way to incorporate knowledge into Artificial Intelligence is from the data that is input into the system. Therefore, the results or predictions from the system might be incorrect when there are inaccuracies or hidden biases in the stored data. Nevertheless, the systems are getting better at exploring complex data and perfecting the specific task that is assigned to them.

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# **Artificial Intelligence in Information Systems**

## **Ethical Issues of Artificial Intelligence**

Probably the biggest problem facing the future of the development and adoption of AI is its ethical issues. As the use of AI has become more mainstream over the past few years, there has been more cases of AI being used in ways that are questionable, and in some cases, malicious.

One ethical issue with AI comes with the autonomy it provides. In the case of an accident involving an autonomous car, there is an issue on whose fault it was, be it the driver, the car company, the government or the other party.

The next ethical issue that comes with AI is the problem of privacy. Due to the constant improvements to AI, it enhances the ability to be able to use personal information to the point where it encroaches into our privacy (Kerry, 2020). However, the flip side to the argument is that it enables the government to identify people of interest for the greater good of the society, an example being the use of facial recognition technology in contact tracing possible COVID-19 patients.

Thirdly, unknown biases can creep into AI systems due to possible biased human decisions used in training data (Manyika, Silberg, & Presten, 2019). For example, it was found that Amazon was using an AI tool to screen applicant resumes, and that it was discriminating against women due to the word choices made in their resumes.

The last major ethical issue is the possibility of malicious use of AI. There has been a recent trend of 'deepfakes', which are videos that are modified by replacing someone's likeness with another. This brings up possible issues such as fake news being propagated by political parties in order to push their agenda.

## **Artificial Intelligence Governance**

Thus, to establish the ethical use and development of AI, there is a pressing need for a global set of AI governance to mitigate possible unethical uses of AI in the near to long-term future. This is a responsibility among all involved stakeholders of AI, namely: Government, Industry, Academia and Consumers.

Firstly, the government plays a role by setting a framework around the fair and ethical use and adoption of AI. One of the earliest countries to do that is Singapore, with its Model AI Governance Framework. This framework, launched in 2019, helps to translate 'ethical principles into practical recommendations that organisations could readily adopt do deploy AI responsibly ( Info-Communications Media Development Authority, 2020).

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Next, companies in the industry play the key role by ensuring the ethical use of AI. Many tech giants have taken steps to ensure the ethical and responsible use of AI. For example, Microsoft has set up an Office of Responsible AI which administers, implements, and maintains Microsoft's commitment to responsible AI governance. Similarly, Google has shared a whitepaper on their perspective on AI Governance, where they made suggestions on the right levels of user explainability standards to ensure accountability of the AI systems, and showed its support towards having discussions with insurers on appropriate legislative models to account for liability frameworks.

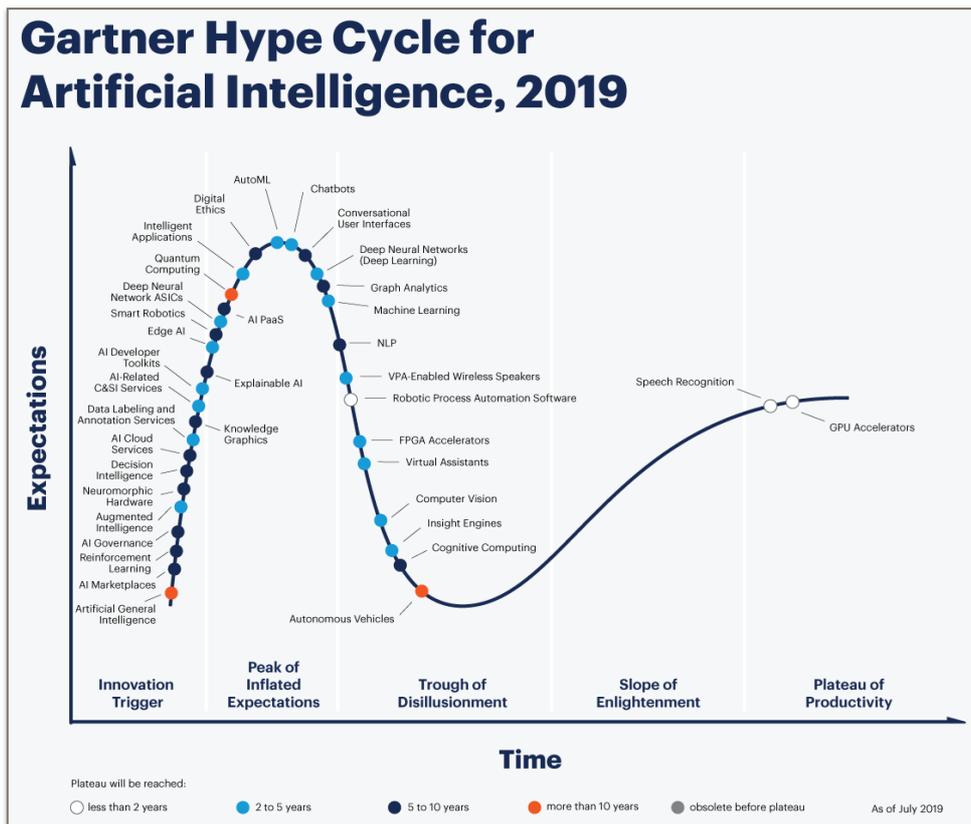
Thirdly, academia plays a part in ensuring the ethical use of AI through AI governance research and thought leadership. Currently, academics are working on issues such as the liability framework for autonomous vehicles, and cross-border data transfer issues as well. These inputs are invaluable in ensuring the ethical use of AI.

Finally, consumers are needed to ensure that they do not use AI for unethical purposes, some of which were mentioned earlier. The government and the industry can teach the populace through ethical AI awareness programmes and messaging.

Overall, we see a need for a set of AI governance to be built involving all related stakeholders, from the government, to companies, academia and consumers as well. This is so that we can ensure that AI can be used for the good of the people in general, instead of simply being used to maximise profits for companies, at the expense of other stakeholders. There is a need for the government to step in and ensure that the AI is being used in accordance to the stakeholder and social contract theory of business ethics, as opposed to simply the stockholder theory.

## **Future of Artificial Intelligence**

Assuming that the ethical ramifications of AI are continued to be well-addressed in the short-term future, we can see that the potential for AI is close to limitless. However, when it comes to talking about the future of AI, the current literature is filled with a vast set of predictions of what AI can do, covering a wide scope of industries and time ranges. For this paper, we will centre our discussion around a framework known as the "Hype Cycle", a tool created by research company Gartner to represent the common life cycle stages of a technology (Bradley, 2019).



*Gartner Hype Cycle for Artificial Intelligence, 2019*

As we can see, the list of possible applications of AI over the next few decades is endless, and is likely to be more and more entrenched in our everyday lives. One of the technologies plateauing in the shorter term (less than 2 years) is speech recognition, which is a technology that we are experiencing quite often with Siri, Google Home and Cortana.

Also, possibly the most 'long term' technology in this Hype Cycle is Artificial General Intelligence. This is defined as machine intelligence which is able to 'perceive and master anything that a human being can' (Bradley, 2019). This is in contrast to today's form of AI, known as Specialised Intelligence. However, while this is categorised as 'more than 10 years' away in the Hype Cycle, it is likely to be far longer as it is still a speculative concept which may not have much scientific grounding yet.

## Conclusion

In conclusion, Artificial Intelligence is nevertheless one of the most intriguing technologies today and the future, with increasing widespread use in businesses and among consumers. Additionally, the potential of AI in the future is virtually limitless, due to the speed of innovation in the technology and its underlying infrastructure. However, in order for humans to achieve our goals regarding AI, it is important to disentangle not only the technical challenges facing us, but also the ethical challenges as well, in order to ensure the fair development and use of AI for everyone in the future.

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