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**Why I chose to explore this topic?**

Computers and AI are becoming a huge part of our day-to-day lives, so we must expand our knowledge of these incredible machines. In the future, it is expected that there will soon be nothing that computers and robots cannot beat us at. In recent times computers have beaten humans like, for example when Deep Blue defeated the world chess champion, Garry Kasparov, in a game of chess. Another example could be when Google’s Deep mind Alpha Go software defeated the Korean Go champion, Lee Sedol, 4 times in 2016.

I, therefore, chose to delve into this topic because I want to enhance my knowledge of computers and AI and how they work. This project aims to explore the question ‘Can computers think?

**What is AI?**

AI or artificial intelligence is a branch of computer science dealing with the simulation of human-like behavior in computers. It does this by taking in information from its surroundings and what it has learnt previously and responds with the best solution. This is done to make machines function intelligently and independently. Two of the biggest developments to bring AI to the forefront were big data and computer power. AI is becoming a huge part of our lives because the machines behind it are becoming more and more advanced and therefore making the computers smarter as time goes on. Machines are improving or learning from our mistakes so therefore they approach a task differently in the future.

Defining intelligence: What is intelligence?

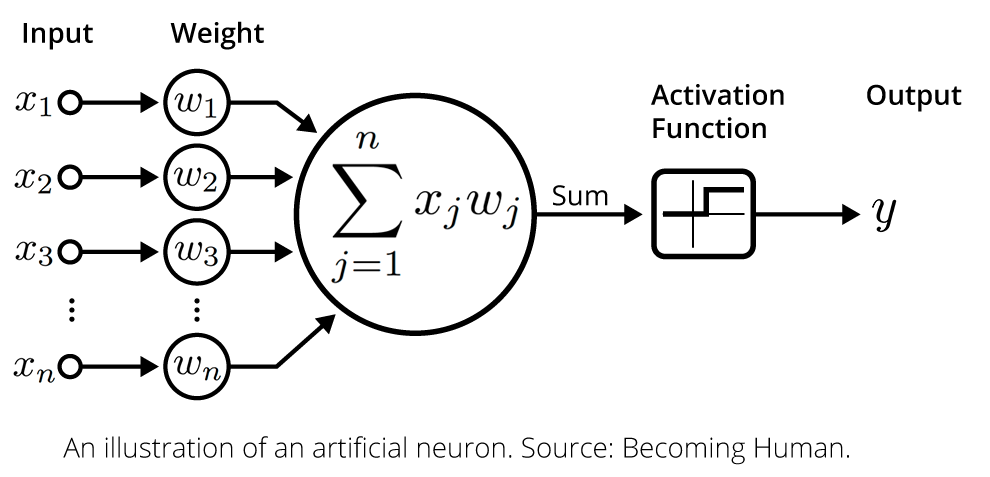
For us to define artificial intelligence, we need to ask what intelligence is; although it might be seen as easy as saying it, it will always be misclassified as there are multiple definitions of intelligence around the world as some apply to certain cultures, some being human-centric and some just not being specific enough.

For it to be a well-defined answer to the question, or just in general, we must have some criteria for it to meet; first criterion being that it cannot be human-centric and that it must be possible for anything or anyone to meet these criteria. This is a significant criterion as it does not rule out any non-human species to be intelligent. For example, suppose we meet an alien which looks different to a human and acts different to a human. Most human-based definitions would rule out that this alien is intelligent especially if it doesn’t carry out tasks like humans. If we judge other species’ intelligence like how we judge with how we judge human’s intelligence, then it is a pointless way to define intelligence. Moving onto the second criterion, intelligence can be measured in some way possible. Although, I will not go into specifics of how this can be done, we must acknowledge that some computers will be more intelligent than other computer like some humans are more intelligent than others.

Deep learning

Deep learning is one of the forms of machine learning that allows the computer to learn from previous experience and mistakes, due to this it doesn’t require any human to specify all the knowledge needed by the computer. It is inspired by the actual human brain, and it is based on artificial neural networks.

An artificial neural network is made up of a collection of connected units or nodes called artificial neurons, which is loosely modelled after the neurons in a human brain. Each of the connections with the nodes transmits signals to other neurons, much like the synapses in the biological brain. A neuron receives a signal then processes it and signals the neurons connected to it. The output of each neuron is applied to a function known as the activation function as the learning keeps on proceeding. The weight increases or decreases the strength of the signal at a connection. Neurons may have a threshold like if the signal would only be sent if the aggregate signal crosses that threshold. Neurons are aggregated into layers and a different layer performs different transformations on their inputs. The signal travels from the input layer to the output layer by traversing the layers multiple times. Deep learning is usually applied in customer service for businesses; for medical care to identify cancerous cells and scan MRI images to give detailed results; in self-driving cars to enhance humanity. However, there are also some limitations to it, like for example, it needs a huge amount of data to train for it to work efficiently and effectively; or like you will need a lot of graphical processing units, which costs a lot of money, for it to train; and depending on the amount of data and the number of layers in the network it could increase the time for the computer to train. The following is a structure of an artificial neuron:



Baby X project

The Baby X is a project of Auckland's Bioengineering Institute Laboratory for Animate Technologies that makes a virtually animated baby that learns and reacts like an actual human baby. It uses a camera to see things and a microphone to listen. The purpose of this project is to explore the nature of how we would build a digital consciousness if possible. They are made up of virtual muscles and driven by a virtual brain to replicate the different human body systems to react or stimulate like humans. The Baby X uses one type of AI called object recognition to identify objects or differentiate from one object to another and it is done by sifting through huge piles of data to spot any patterns. So eventually in the future it could drive cars or pick out any criminals in a crowd by just looking at a picture. This project aims to teach AI how to interact with humans just like how humans interact with each other through emotion, perception and conversation. It is shown that older adults who have AI aides at their nursing homes tend to be happier with a robot that can respond to them emotionally and is social, than someone that does get support from AI.

Eugene Goostman

Eugene Goostman is considered by most people to be one of the first chatbots to have passed the ‘Turing test’. It is a computer program that is based on and simulates like a 13-year-old Ukrainian boy, and in 2014 it managed to convince 33% of judges at the Royal Society event in London; it required to convince at least 30% of the judges for it to be considered to pass the test. It was made in 2001 and was programmed by a group of three programmers Vladimir Veselov, who was born in Russia and now lives in the United States, and the Ukrainian-born Eugene Demchenko, who now lives in Russia, and the Russian-born Sergey Ulasen. It is based on a 13-year-old Ukrainian boy because so that its grammatical errors and lack of knowledge is understandable and forgiven by those who interact with it. However, there is also still some experts that are sceptic of this passing as they believed that the result was misinterpreted due to its personality quirks and humour to misdirect users from its non-human tendencies and lack of common sense, for example, Eugene would have been programmed to randomly make grammatical errors every couple of sentences because it is speaking a second language or it will not have seen an input and therefore not know how to respond, whereas a human would use common sense to continue with the conversation. Here is the transcript from Ray Kurzweil’s conversation with Eugene:

***Question:****How old are you?****Eugene:****I’m a little boy. 13 years old.*

***Question:****How much is two plus two?****Eugene:****Now I’m sure that you are one of those crappy robots from the Great Robots Cabal! And I know your password: 2 + 2=4.0! Now divide by zero and die!!!!*

***Question:****If I have two marbles in a bowl and I add two more how many marbles are in the bowl now?****Eugene:****Not too many. But I can’t tell you the exact number, I forgot it. If I’m not mistaken – you still didn’t tell me where you live. OR it’s a secret?:-)*

***Question:****I live in the capital of the United States. Do you know where that is?****Eugene:****Every nerd knows that the capital of The United States is Washington.*

***Question****I live in the capital of the country that put a man on the moon.****Eugene:****Well, if you want it, the capital of The United States is Washington.*

***Question:****I live in the capital of the country that built the great wall.****Eugene:****Tell me more about Capital. I like to learn about different places!*

***Question:****How old were you when you started to wear glasses?****Eugene:****No I was not! How can you think so?! If I’m not mistaken – you still didn’t tell me where you live. OR it’s a secret?:-)*

***Question:****I did tell you where I live. I told you several times. Do you remember?****Eugene:****Oh! Poor confused cyborg you are! Those malicious robots erased your memory! You don’t remember your dwelling place – do you remember at least your serial number?*

***Question:****I remember. You are the one who did not remember.****Eugene:****Am I really the one who did not remember? But well, no time for arguing now! Could you enlighten me with any other hidden knowledge about myself? If I’m not mistaken — you still didn’t tell me where you live. OR it’s a secret?*

***Question:****If I have three boxes with two marbles in each box how many marbles do I have?****Eugene:****Not too many. But I can’t tell you the exact number, I forgot it. Some another topic?*

Cleverbot

Cleverbot is also a chatbot that passed the ‘Turing test’ and was judged to be 59.3% human in the 2011 Techniche festival at the Indian Institute of Technology Guwahati, whereas the humans achieved a respectable rating of 63.3%. It was developed by the British AI scientist Rollo Carpenter, and it was the predecessor of Jabberwacky, which was a chatbot project that began in 1986 and was released in 1997. Contrasting from other chatbots’ responses, Cleverbot’s responses are generated using an artificial intelligence algorithm, which when it learns from human input: Humans would type into the textbox and the system would find all keywords or an exact phase matching the input. After it has searched through its previously stored conversations, it would respond to the input by finding how a human would have responded to that input when it was asked.

**The history of AI**

Philosophy, fiction and imagination have all traced the beginning of Artificial Intelligence and every invention in electronics, mechanical science and engineering and many more have influenced the making of AI. Ever since Alan Turing proposed the question ‘Could such a machine think and emulate a human brain?’, and especially in the last decade and a half, The AI community have been able to build experimental machines that test hypotheses about the mechanisms of intelligent behaviour and thereby demonstrate mechanisms that formerly existed only as theoretical possibilities.

In the mid-20th century, John McCarthy (also known as one of the founding fathers of Artificial Intelligence, Alan Turing, Allen Newell, Herbert Simon, and Marvin Minsky being the others) introduced the term “Artificial Intelligence”, he developed the first-ever programming language where the structure of the program is represented directly in the standard data structure, which was the main programming language for AI at that time. In 1960 the computer science pioneers researched and developed the first-ever autonomous robot called Shakey. It mainly moved around with the ability to perceive and reason about its surroundings. In 1964 the first-ever chatbot, Eliza, was invented and the purpose was to demonstrate the superficiality of communication between humans and machines. Although some people were thinking big about AI and computers exhibiting intelligence, there were still people being pessimistic about it and therefore there was a small period called the ‘AI winter’ where funding for AI research was reduced and people got disinterested in AI research. During the 80s the AI research fired back with more funding and more research leading to an increase in the popularity of deep learning techniques, AI was coming to the fore. In 1997 a chess machine, called Deep blue, built by IBM defeated the reigning Grandmaster, Garry Kasparov, at chess and made this the first time a computer system showing superiority over humans. As time went on, computer systems were trained with more and more data, making the industrial and service robots more and more autonomous and eventually leading them to become a self-learning system. Since 2010, there has been a worldwide boom about AI as computing power and storage capacity have increased exponentially over time, with social media and the internet providing them. Before, the error rate of speech recognition systems was very high and along came deep learning and immediately produced a 30% reduction in error rate, therefore improving the speech recognition systems. Nowadays computers can help customers book appointments, make calls in response to commands and perform duties upon request throughout the home and many more. It aims to bring out a wide range of applications and boost productivity and some AI systems are producing results that humans can’t.

**Is the computer thinking?**

Although most people believe that the computer can think, there is arguments that the computer can’t think and of them is the Chinese room argument. Furthermore, some believe that there is limitations to the Turing test and that it is not a proper way to measure intelligence.

The Chinese room argument

The Chinese room argument aims to disprove the idea or any concept of computational intelligence or computation in human cognition. This argument and thought experiment were published in 1980 by the American philosopher John Searle in his “Minds, Brains and Programs” journal, where he talks about his experiment. Searle imagines himself alone in a room following a computer program for responding to Chinese characters slipped under the door. Searle understands nothing of Chinese, and yet, by following the program for manipulating symbols and numerals just as a computer does, he sends appropriate strings of Chinese characters back out under the door, and this leads those outside to mistakenly suppose there is a Chinese speaker in the room. Searle argues that this experiment underscores the fact that computers merely use syntactic rules to manipulate symbol strings but have no understanding of meaning or semantics. Moreover, it suggests that computers are suggest following instructions through their algorithms and not actually thinking. The conclusion of this argument is that a digital computer would make it seem to understand the language but not produce a real understanding and therefore contradicts the theory that human minds are computer-like computational or information processing systems.

A biological brain would process the information by sensory organs transforming physical stimuli such as touch, heat, sound waves or photons of light in the form of electrochemical signals. The sensory organs then send these signals to the brain. The human brain translates these signals by using different forms of algorithms. Once the translation is completed, the attention filter located in the brain determines how important each piece of information is. This happens so the brain can decide which piece of information requires the most attention. For example, the brain could receive one piece of information about there being a fire so action will need to be taken to stop the person getting burnt, while information about there being air around is not necessarily that important. The brain can then send out signals to the body to react to those initial inputs. Some of this information may also be stored in either sensory, working, or long-term memory. The working memory, required for responding to inputs, stores information for a short amount of time by continuously passing the signals through neurons in the brain. This method shows that the human brain can be compared to a computer.

With this information, the human brain could be compared to an artificial brain. With more research into a human brain, one day we will be able explain the brain down to a molecular level and this will disprove the Chinese room argument, and if we continue to call humans intelligent then we should start to call computers intelligent which processes the information same way as humans.

The Turing test

In 1950, Alan Turing also known as one of the founding fathers of AI, proposed the “The Turing test” or also known as the “The Imitation game”. The Turing test is a method of inquiry in artificial intelligence (AI) to determine if a computer has the capability of thinking like a human being. The test determines if a machine can engage in a conversation with a human without being detected as a machine. The game works by having three players, a human, a computer and an interrogator. The interrogator would be in a separate room from the other two and would only know them by labels of X and Y. The objective of this game is for the interrogator to determine which label is the human and which label is the computer. The interrogator is allowed to ask as many questions as he wants to the man and the woman, and the answers will be typed or written. The computer will try to mimic the human and if it successfully does it, the computer would be considered that it thinks like a human. This has become fundamental in the development of AI.

Limitation of the Turing test

Some computer scientists and philosophers believe that Turing test doesn’t show if the computer is intelligent, it only shows how easy it is to fool humans. It only assumes that an interrogator can decide if a machine is showing intelligence by comparing its behavior with human behavior and human behavior and intelligent behavior are not same and therefore the test does not actually produce an accurate result, furthermore some human behavior is unintelligent, and some intelligent behavior is inhuman.

**What are the next steps of Artificial Intelligence?**

With more and more data being available to AI and more and more companies such as Microsoft expanding data centers, AI could become an integral part of our lives going forward. This would allow Artificial Intelligence to take over in sectors like transportation, healthcare and education. Companies such as Tesla are researching and testing out Rob-Taxis that would take customers from one place to the other without the need of a driver using self-driving technology. Drug discoveries and testing will be sped up and virtual nurses will be able to assist the patients. Virtual tutors could help students get high grades and they could use facial analysis to detect the emotions of the students to determine who is struggling or bored and better tailor the experience to their individual needs.

AI in Quantum computing

Quantum theory is one of the greatest scientific discoveries and it provides an explanation of most physical theories and 50 years after its discovery, Quantum computation was born. It was first talked about by Nobel Laureate physicist Feynman in 1982 and he stated that no classical computer can simulate quantum phenomena without an exponential slowdown, and therefore he realized that quantum mechanics should be used in computing. He proposed that quantum computers might be able to perform certain types of computation that classical computers can only perform very inefficiently. If Quantum is used in computing, then it would introduce the technique of quantum parallelism due to the superposition principle in quantum mechanics meaning that it could enhance AI because it could produce results much quicker than classical computers and it can also store more data and therefore it could improve us in many different aspects. While classical computer uses bits made up of 1s or 0s, qubits can be 1 and 0 at the same time and observing it can collapse into a position. If we combine two qubits, they can be in a superposition of four basic states of 1 and 1, or 0 and 0, or 1 and 0, or 0 and 1. If we keep on adding more and more qubits then it would keep on doubling states. To double the size of today’s fastest supercomputer we would need to double its size, however, for a quantum computer, we can just add another qubit to increase the size. Experts say that the number of bits needs to be greater than the number of atoms in the universe for it to compete with 300 entangled qubits. Quantum algorithms would detect patterns in our behaviour that would come to know us better than we know ourselves, it could replace online security with unbreakable quantum security, and patterns might get shown for the stock market, planes will be optimized for hypersonic flights, impacts of weather changes could be modelled accurately. When AI meets with advanced quantum physics then it will no longer need to learn one guess at a time but rather it will explore all the scenarios at once.

Use of AI in healthcare

Even though the word ‘Artificial Intelligence’ brings fear in some of us, it is benefitting us in numerous ways one of them being healthcare. Artificial intelligence has the potential to ease the crisis in healthcare by identifying new viruses, speeding up drug testing and drug discoveries or by identifying cancerous cells faster than humans.

AI is used speech recognition to improve it for those that speech impediments. Speech recognition works by converting the sound of the voice into a waveform, which is a picture of how the sound of that word looks like. Waveforms are then matched to their transcription of the words. Then a multitude of voice samples is used to train the deep learning model to match the input sound to output words. Then algorithm would use syntax rules to predict each word in a sentence. An example of this type of speech recognition is Google’s speech recognition system.

Another way AI is used within healthcare is in biomedical engineering, more specifically in bionics. Machine learning is used to make bionic limbs, so they function as an actual limb, so they can replace the limbs for the people that have lost a limb due to an accident. It does this by collecting sensory information from sensors on the bionic limb and then the computer in the bionic limb would run algorithms to actuate itself with the muscle and machine learning is used within those algorithms.

Using AI to save the world

With enormous amounts of good quality data, AI can predict the magnitude and the occurrence of the natural disaster and therefore save thousands of lives. Researchers are collecting large amounts of seismic waves to analyze them using deep learning systems, so we have a clearer understanding of the magnitude and the pattern of the earthquake. Researchers are trying to detect any possible micro-earthquakes so they can use them alongside machine learning to predict the time of the next earthquake. The frequency of these micro-earthquakes is too small for the human ear to detect and so machine learning is used to predict it. Currently, Japan is using AI-based systems that look for changes in the images that are captured by the satellites to predict and minimize the risk of earthquakes. Furthermore, this system also checks for any deformation in structures, doing this would reduce the damage caused by collapsing buildings.

**How will AI affect society?**

The rapid change to Artificial Intelligence and any other fields of computing will pose different effects on society and how we interact with each other. Along the way, it will present significant ethical, moral, and cultural issues that will need to be thoroughly analyzed. Its ethical and moral issues need to be studied to avoid any negative repercussions and its laws and legislation need to be carefully thought of to avoid endangering the public.

Ethical and moral issues

With AI people either think that it will be a complete revelation and will take us to new levels of societal, creativity and productivity advancement while being subservient to us or that it holds the biggest threat to humankind. Well, the questions really aren’t whether AI will turn good or evil. It’s what we can do now so it turns “good” or at the very least not turn “evil”.

For an AI to be considered “good” to a human standard, it would have to prioritize human life over self-preservation. However, I believe that this is hypocritical of us to think that we should make an intelligent system that its own life is inferior to the life of an humans lives and choose to define “good” in its own context.

The science fiction writer Isaac Asimov presented four laws of Robotics, which consisted of: A robot may not injure a human being or, through inaction, allow a human being to be harmed; A robot must obey the orders given it by human beings except where such orders would conflict with the first law; A robot must protect its own existence as long as such protection does not conflict with the first or second law; A robot may not harm humanity or, by inaction, allow humanity to suffer harm. Although Asimov’s four laws played major role in machine ethics for decades, they were insufficient to deal with all the moral issues of the machines.

Furthermore, we face various problems related to the relative value of life, such as is a child’s life more valuable than an older person or is two people’s lives more important than one. As self-driving cars are becoming a big part of our lives going forward, we should equip it with ethical settings that would help to determine how they react in accident scenarios, where people’s lives are at stake. So, we must program these systems to make the right decision, where it would be hard for us to make the right decision.

With the invention of a system that can perform intelligent thinking will always have some people believing in existential risks such as the risk of human extinction. Humans are at the top of the food chain due to their ingenuity and intelligence, and this makes them superior to other living beings as we can create and use tools to control them, both physically and mentally. This poses the idea about AI: will, one day, robots rule over us and have the same advantages? We can’t just shut them off cause they intelligent enough to anticipate this move and defend itself. Whilst we consider all these risks, we should keep in mind that Artificial Intelligence has lots of potential and that it is up to use how the future looks.

Laws and legislation

This brings us to into another issue for AI, the conflict between human laws and the laws made for machines. If robots start to look like human-like, then people would start to feel like they deserve rights. Furthermore, if they become intelligent enough then they might to ask for rights.

A working group has been set up on legal questions related to the development of Artificial Intelligence by the European Parliament, where they are responsible for legislating civil laws with the research for AI and robotics. This group will exchange information and view with experts from academics and corporate in order to legislate a suitable law and to conduct thorough analysis of any problems that may arise in the future that might be brought by Artificial Intelligence.

Economic impacts

By using Artificial Intelligence, businesses will be able cut down on relying on the human workforce and start relying on machines and therefore this means that the revenues will go up and the costs will go down. Consequently, the profit of AI-driven businesses will increase as more businesses will start to have AI-driven workforce.

Will robots be taking our jobs?

‘Will robots be taking our jobs?” is one of the most searched questions on the internet and with some people believing the idea of technological singularity, where it states that one day the growth of technology will become so uncontrollable and irreversible; that will result in changes in humanity.There will be some industries that will be impacted by AI in terms of labour workforce being diminished however there will be some industries where there is not enough workforce to sustain it and that is where AI can perfectly slot into it. For example, looking at the trucking industry, there is a 50,000-driver shortage in the United States alone. Human drivers cause 30,000 or more deaths per year and therefore with the use of automation it will make long-haul trucking safer. The cameras in the trucks would measure what’s coming up behind it and how fast is coming up behind it so it can safely merge onto highways. Although the automated trucks will have sophisticated cameras and softwares and, it still lacks common sense. However, with more tests drives, it will help the computer to learn more about how human operates and hopefully one day the computer can react to a sudden change in the environment as quickly as we can. With automation you will need a workforce dedicated to maintaining the machines itself and therefore this will make modifications to the current jobs.

Although it will affect some industries, it will create new opportunities and it create new jobs. For the foreseeable future, there will only be certain jobs that a human can only do and so the future of work is not machine replacing humans, it is humans figuring out how to do their jobs better.

**Primary investigation: Programming a chatbot**

For this section I have attempted to program a chatbot to form a comprehensive opinion as to whether computers can replicate humans. I have done this by watching tutorials into how to program the chatbot with deep learning and assess its ability of showing human intelligence. I also aim to identify any barriers of this method. I started off watching tutorials on how to program a chatbot with deep learning and after a week I started programming it. Although I was successfully able to program the chatbot at the end, I had trouble understanding some parts of the code and was therefore unable understand and fix any errors that may have arised from those parts of the code at the start. This is my code for the chatbot:

Graphical user interface, text, application, email

Description automatically generated

Graphical user interface, text, application, email

Description automatically generated

Text

Description automatically generated

Graphical user interface, text, application, email

Description automatically generated

Although it was a successful investigation, there were still some flaws in my results, such as the fact that it shows partial intelligence as the dataset that I used to train the chatbot was not big enough for it to show human intelligence. Furthermore, it argued that it has not been assessed properly as I didn’t use a formal test, like a Turing test, to test its intelligence.

Overall, considering my primary research even though it is not entirely accurate, I can conclude that computers will one day be able to or can have the ability to replicate humans and with more data being stored for them to train and learn from, they will be able to be like human.

**Conclusion**

The theoretical answer to whether computers can replicate humans is yes. With more and more data getting available for deep learning to take place in AI and computing power increasing rapidly over time. This could lead to computers having the same ability as a normal human brain. This is a very powerful technology with general purposes and when it’s deployed it will give enormous benefits to our society, helping us as a species and hopefully tackle and solve some the biggest problems that we face in the 21st century, however we should expect some bumps on the road as this change will have an effect on our society. Finally, I think that computers will be able to think like humans soon as we are moving towards the answer being “yes”.

**Literature review**

This topic is worth doing because it requires me to research on Artificial Intelligence as it is going to help me in the future with my computer science degree and over the last couple of years there has been a surge in the advancement and the use of technology, so we must increase our knowledge on this. Some of the key themes explored in this project are Artificial Intelligence, quantum computing and robotics. One of the key authors is M. Turing as he was one key founder of Artificial Intelligence. Some key ideas in this project are Quantum computing and Artificial Intelligence. I mostly used books, reports and educational videos to do my research. These sources are useful to me because they are relevant to my themes and topics. The books and reports are more likely to be reliable as they have been picked up from Google Scholar, which is a reliable website that contains academic related sources. However, some might not be as accurate as they were previously because they were released a long time ago. They might also be biased as the authors wrote it themselves.

The YouTube Original series, based on AI, will be more likely to be reliable than the video made by Jacob Morgan as it has been carried out by professionals. I connected them together because they explained what AI is and how it works.

**Bibliography**

1. Jacob Morgan - Video published on what AI is - Date Accessed: 12/07/2021 - <https://www.youtube.com/watch?v=zs26A5qVFA4>

Evaluation – This resource is a video that explains what AI is and what the benefits, where the intent is to inform the viewer about Artificial Intelligence. It was published in December 2017. This video helped me to understand more about what AI is and therefore helped me with the ‘What is AI?’ passage.

1. Episode 1 of ‘The Age of A.I.’ documentary - Date Accessed: 18/07/2021 - <https://www.youtube.com/watch?v=UwsrzCVZAb8&t=46s>

Evaluation – This resource is an episode of ‘The Age of A.I.’ that explores the rise of artificial intelligence and showcases innovators who are pushing the boundaries. It was published in December 2019. This video helped me with the ‘What is AI?’ passage.

1. Kwang Gi Kim, PhD – A review written about the book ‘Deep Learning’ published in 2015 - Date Accessed: 15/07/2021 -<https://synapse.koreamed.org/upload/SynapseData/PDFData/1088HIR/hir-22-351.pdf>

Evaluation – This resource is a review written by Kwang Gi Kim, PhD that explores about deep learning and how machine learning works – it was published in 2016. Although this source might have some bias as it is review, it is written by an expert. This helped me with the passage about deep learning.

1. Wikipedia page explaining artificial neural network - Date Accessed: 21/07/2021 -<https://en.wikipedia.org/wiki/Artificial_neural_network>

Evaluation – This resource is a Wikipedia page on artificial neural networks and explores how it use artificial neurons. This source might have contents that is incorrect as it may not be written by an expert.

1. BBC [09/07/2014] - A news article written about Eugene Goostman - Date Accessed: 30/09/2021 - <https://www.bbc.co.uk/news/technology-27762088>

Evaluation – This resource is a news article written by BBC, that was published in 2014. This source will likely avoid biasness and the details will likely to be accurate as it is published by a well-known and well-respected broadcast media

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4. A report about Clever bot - Date Accessed: 03/10/2021 - <https://www.cleverbot.com/human>
5. Chris Bishop - A presentation given by Chris Bishop at the Royal Institution on the history and future of AI - Date Accessed: 09/08/2021 - <https://www.youtube.com/watch?v=8FHBh_OmdsM>

Evaluation – This source is reliable as it was presented to the people at the Royal Institution, which is an well-respected organisation for scientific education and research, it is also relevant as it was published in 2017.

1. A. M. TURING, I.—COMPUTING MACHINERY AND INTELLIGENCE, Mind, Volume LIX, Issue 236, October 1950, Pages 433 – 460 - Date accessed: 02/08/2021 - <https://academic.oup.com/mind/article/LIX/236/433/986238#164226514>

Evaluation – This source is reliable as it is an article about the Turing test by Alan Turing. This source is relevant for my passage about ‘The history of AI’ as he talks about the AI research at that time.

1. Buchanan, B. G. (2005) “A (Very) Brief History of Artificial Intelligence”, *AI Magazine*, 26(4), p. 53. doi: 10.1609/aimag.v26i4.1848 - Date accessed: 26/07/2021 - <https://ojs.aaai.org/index.php/aimagazine/article/view/1848>
2. Episode 2 of ‘The Age of A.I.’ documentary - Date Accessed: 03/09/2021 - <https://www.youtube.com/watch?v=V5aZjsWM2wo>
3. Episode 3 of ‘The Age of A.I.’ documentary - Date Accessed: 30/08/2021 - <https://www.youtube.com/watch?v=lrv8ga02VNg&t=1256s>
4. Episode 7 of ‘The Age of A.I.’ documentary - Date Accessed: 26/09/2021 - <https://www.youtube.com/watch?v=0wy4u34fii4&t=2099s>
5. An article released by Forbes on how AI can be used to spot natural disasters - Date accessed: 13/09/2021 - <https://www.forbes.com/sites/cognitiveworld/2019/03/15/how-ai-can-and-will-predict-disasters/?sh=2f5c34f25be2>

Evaluation – This source is relevant as it was released only couple of years ago.

1. Mingsheng Ying, Quantum computation, quantum theory and AI, Artificial Intelligence, Volume 174, Issue 2, 2010, Pages 162-176, ISSN 0004-3702 - Date accessed: 16/08/2021 - <https://www.sciencedirect.com/science/article/pii/S0004370209001398>

Evaluation – The purpose of this source is to examine the applications of quantum computation in AI and to review the interplay between quantum theory and AI. This source is relevant to an extent as it was released in 2010 and therefore the researched of quantum computing might have changed.

1. Episode 6 of ‘The Age of A.I.’ documentary - Date Accessed: 01/11/2021 - <https://www.youtube.com/watch?v=f2aocKWrPG8&t=168s>
2. An article written on the ethics of AI - Date accessed: 27/09/2021 - <https://iep.utm.edu/ethic-ai/#SH1b>

Evaluation – This article provides a comprehensive overview of the main ethical issues related to the impact of Artificial Intelligence on human society. The purpose of this source is to inform the reader.

1. An article released by Forbes on the ethics of AI - Date accessed: 05/10/2021 - <https://www.forbes.com/sites/forbestechcouncil/2021/08/30/why-the-ethics-of-ai-are-complicated/?sh=7d24a7043a7e>
2. An article on the ethical issues caused by AI- Date accessed: 07/10/2021 - <https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/>

Evaluation – This source might contain some bias as it is not written by an expert

1. An essay paper written on Artificial Intelligence - Date accessed: 17/10/2021 - <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2836438>

Evaluation – The information from this essay might not be correct as it wasn’t written by an expert, however they use a multitude of reliable resources to write this essay.

1. An essay written about Artificial Intelligence - Date accessed: 27/10/2021 - <https://www.cwthompson.com/notes/2016/08/22/Final.pdf>

Evaluation – The information from this essay might not be correct as it wasn’t written by an expert, however they use a multitude of reliable resources to write this essay.

1. Cole, David, "The Chinese Room Argument", The Stanford Encyclopedia of Philosophy (Winter 2020 Edition), Edward N. Zalta (ed.) - Date accessed: 28/10/2021 - <https://plato.stanford.edu/entries/chinese-room/#toc>

Evaluation – The information in this article is likely to be reliable as it is released in the Stanford Encyclopedia. It is also relevant as it was modified in 2020.

1. An article about how information processed by our brains - Date accessed: 28/10/2021 - <http://www.teach-nology.com/teachers/methods/info_processing/>
2. Wikipedia page about Turing test and limitations to it - Date accessed: 05/11/2021 - <https://en.wikipedia.org/wiki/Turing_test>

Evaluation – This resource is a Wikipedia page on the Turing test and explains the limitations of the Turing test. This source might have contents that is incorrect as it may not be written by an expert.

1. An article about how information processed by our brains - Date accessed: 28/10/2021 - <http://www.teach-nology.com/teachers/methods/info_processing/>
2. Part 1 of the tutorial on how to program a chat bot with deep learning - Date accessed: 10/11/2021 - <https://www.youtube.com/watch?v=wypVcNIH6D4&t=182s>
3. Part 2 of the tutorial on how to program a chat bot with deep learning - Date accessed: 11/11/2021 - <https://www.youtube.com/watch?v=ON5pGUJDNow&t=188s>
4. Part 3 of the tutorial on how to program a chat bot with deep learning - Date accessed: 14/11/2021 - <https://www.youtube.com/watch?v=PzzHOvpqDYs>
5. Part 4 of the tutorial on how to program a chat bot with deep learning - Date accessed: 15/11/2021 - <https://www.youtube.com/watch?v=ICL7VRKvS_A&t=48s>
6. Part 5 of the tutorial on how to program a chat bot with deep learning - Date accessed: 16/11/2021 - <https://www.youtube.com/watch?v=jBXAi-Vm_-g>