Can We Simulate Consciousness Using Artificial Intelligence?

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Introduction

Artificial intelligence (AI) has developed to be a fundamental field for human progression and evolution. Since its roots in the 20th century, it has prospered as a valuable tool, from researching and designing purposes, to recreational and luxury uses. Without a doubt, this technology has proven its benefits, however contesting arguments are being raised about the potential effects after going fully autonomous. The argument further intensifies when talking about creating an AI that can subsidise as a human, introducing a slew of ethical and moral concerns into the mix and blurring the concept we could call reality.

The aim of this report is to vigorously debate the current modern-day AI and judge its extent into how conscious this modern-day AI truly is. To achieve this, the report must identify, discuss and evaluate the necessary elements of consciousness that is required to classify a conscious AI, while analysing feats of engineering that have been achieved over the years with the development of AI as a field. The report will then conclude with the authors personal opinion to successfully answer the question, 'Can we simulate consciousness using AI?'.

What is Consciousness?

As a vital feature all living things experience, consciousness can be a difficult term to explain. Defining consciousness can be rather vague and puzzling, as it is difficult to identify what exactly makes us (humans) conscious. As a broad definition, consciousness is 'the state of being aware of and responsive to one's surroundings' (Google search - Consciousness, n.d.) and revolves around 'everything you experience' (Koch, 2018). This definition does not detail much information of the sub processes, leading us to question what makes up a conscious entity.

To consider how we might begin the construction of a conscious AI, a detailed outline of what makes us conscious must be given to give us the relative starting point of our own human consciousness, and how it has developed over the years. This information will help to identify any vital skills which humans needed to survive, and thus, we can use these skills to define consciousness as a general term, allowing us to work via reverse engineering to achieve a conscious AI.

Before these skills are identified, it is necessary to define a few terms first, which are given below:

- Self – A part of the universe that can sustain itself and reproduce (Kurzgesagt, The Origin of Consciousness – How Unaware Things Became Aware [Video], 2019) .
- Intelligence – The ability to acquire and apply knowledge and skills (Google search - Intelligence, n.d.). This is an important biproduct of consciousness since it is used in problem solving where logical steps must be laid out to complete a task.
- Mind – A functional entity that can think, and thus support intelligent behaviour (Laird, Lebiere, & Rosenbloom, 2017)

What are the Skills Required for Consciousness?

To provide a self the awareness it would need and eventually develop over time, the following factors are required (Kurzgesagt, The Origin of Consciousness – How Unaware Things Became Aware [Video], 2019):

- A physical sense of the world around the self. This allows the self to explore its surroundings to begin taking in information, a vital step required for consciousness and intelligence later. This can include the five senses shown:

    - Sight
    - Smell
    - Touch
    - Listening
    - Taste
- Memory
- Time awareness
- Comprehension of other selves/mind-reading/empathy
    - Communication – the ability to communicate is a direct result of comprehension. Given a self's ability to communicate means an increase in productivity through collaboration, ingenuity, intelligence/knowledge, and culture through expressing opinions and facts limitlessly.

Intelligence is also required for consciousness since a typical self requires a mind for problem solving. The following provides the skills required for intelligence (Kurzgesagt, What Is Intelligence? Where Does it Begin? [Video], 2020):

- Basic skills – the ability for a self to develop its intelligence must originate from consciousness, since problem solving skills are necessary for awareness. The following are generic skills that every self must use to develop and learn:
    - Gathering information
    - Memory
    - Learning
- Advanced skills – these skills are the result of the basic skills discussed above. These allow a self, mainly humans, to diversify by developing unique characteristics accustomed to their individual experience, events, and preferences. These can include:
    - Knowledge
    - Creativity
    - Planning

These skills allow humans to become diverse, possessing capabilities involving 'autonomy, resilience, phenomenal experience, learning and attention' (Chella & Manzotti, 2007) which represent the culmination of our most advanced skillset. We desire artificial intelligence to reach this level of self-awareness and independence. The significance of outlining these cognitive qualities follows as self-awareness cannot be fully achieved without intelligence as a tool for guidance and processing thought.

The qualities mentioned here are vital for the classification of a truly conscious being. As a necessity for a conscious AI, these skills must be demonstrated to some calibre to provide sufficient evidence to back the existence of a conscious AI with human characteristics. These major qualities lead to the development of other skills, serving to diversify the AI in terms of personality.

What is Artificial Intelligence?

Before we can establish ideas and theories, it is necessary to identify what is classed as an AI. Artificial intelligence (AI) is the 'science and engineering of making intelligent machines, especially intelligent computer programs' (Education, What is artificial intelligence?, 2020). There are two main types of AI that can vary according to the requirements of an objective. This includes (Education, What is artificial intelligence?, 2020):

- ‘Weak AI’ also known as Artificial Narrow Intelligence (ANI) is designed to control closed-end, specific operations. The complexity of creating this form of AI is relatively low compared to a strong AI and can essentially act primarily as an aid to humans.
- ‘Strong AI’ involves the use of Artificial Super Intelligence (ASI) and Artificial General Intelligence (AGI) to create an AI that can perform a wide variety of tasks, all unrelated to each other. Such development of an AI this powerful is what is required for consciousness, allowing the AI to build upon the knowledge it gains. The development of strong AI is at a theoretical stage but has received heavy investment from large technology companies such as IBM and Google. The purpose of ASI and AGI are as follows:
    - Artificial Super Intelligence (ASI) – creates a form of superintelligence, capable of ‘surpassing the intelligence and ability of the human brain’.
    - Artificial General Intelligence (AGI) – combines the ideas of intelligence and consciousness to create an AI that can ‘solve problems, learn, and plan for the future’.

Fundamentally, AI is divided into a subfield, which divides into another subfield of itself. The development of deep learning is critical for constructing machines that can think, and will be developed on further in the essay

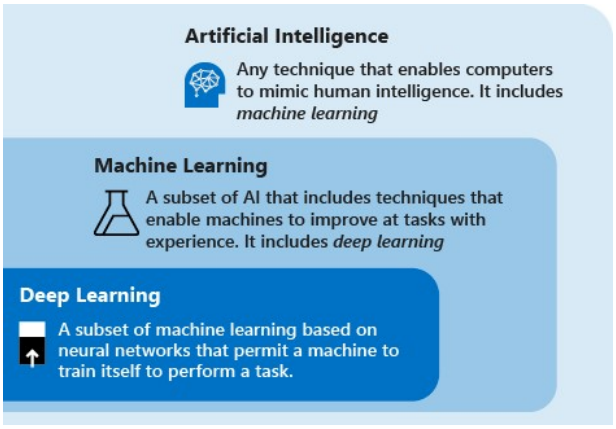

Figure 1, a depiction of AI into Machine Learning into Deep Learning (Lazzeri, et al., 2021)

Can we create a conscious AI?

The Analysis of the Question

To begin considering potential viewpoints for the question stated above, the project title must be called into examination to determine the direction of this active debate. When the idea of 'simulating consciousness using AI' comes into question, the idea of simulation refers to 'a model that mimics the operation of an existing or proposed system' (What is simulation? What does it mean?, n.d.), ideally the 'system' referring specifically to human consciousness. Due to the nature of human psychology and the idea that every person is different, proposing the idea of a simulation is more accurate than an emulation, since a simulation can closely examine and exhibit certain key qualities of a conscience (learning, knowledge, etc.), without completely copying the personality traits of an actual human mind (the idea of emulation, duplicating something from real life) (Sreerangaraju, 2020).

Although this path could lead to show that consciousness in an AI is feasible, it would be in form of a type of 'synthetic consciousness', which this report is not interested in due to the doubt for this 'synthetic consciousness' to exhibit true conscious behaviour (the predesignated data of each scenario could influence the outcome, creating a 'psychological clone' of a person). The need to be able to train it to think and operate like a human from scratch I believe is a necessity, which involves the potential of influence from external factors that encourage different yet accurate behavioural patterns over time (like the influence of a child from the parent and the child's surroundings).

With the title explored to a suitable degree, it is now appropriate to discuss the potential of different viewpoints on the matter. To begin this debate, key viewpoints for the statement will be considered, arguing for and against according to today's era of technology, and any promising ideas that have been theorised but not fully developed. This will derive knowledge from the information stated above and any external theories provided by the researching community. A conclusion will then be offered for both the present and future to answer the question successfully and clearly, 'Can we simulate consciousness using AI?'.

What are the Physical Commonalities Between the Brain and the Computer?

For the statement, it is helpful to consider the physical commonalities between man and machine. The need to consider these hardware differences provides the required schematics to map our ideas of consciousness in a comparable way so consciousness can be simulated to a suitable level of satisfaction.

The ideas of consciousness and AI come together nicely as we can assume we, the human and the machine, are correlated by many common physical traits that relate back to consciousness. It is not far off to consider the potential of mapping our ideas of consciousness to be similar in operation for a computer system. Comparing and contrasting these correlating features, we can observe the following in these fields:

How is Storage Similar?

In terms of storage (the idea of the retention of retrievable data for use in a system (ideally the data consisting of skills and knowledge) (Google search - Storage definition, n.d.)), the average computer is limited by the estimated storage capacity of the human brain (1TB vs 1PB (a size comparison of 1:1000 respectively)). Although this storage can be expanded, it can become costly, slow, and hard

to maintain in terms of cooling and storing safely in a compatible case, not to mention the problem of read/write sequences causing fragmentation of the drives. Evidently, the brain exceeds expectations in this case, where the brain can store more information about the key skills related to consciousness, thus beating out the typical computer in ease and efficiency.

How is Memory Similar?

In terms of memory (a device or system that is used to store information for immediate use by a processing device (Computer memory, 2022), A human can set priorities on memorable events (like a wedding day) and can link memorable events together, calling upon this with relative ease in terms of time to find and recall information. This ability to call upon associated events brings the ideas of self-awareness perfectly, as the human mind can think and assess each individual memory with a key role, to construct a bigger, accurate sequence of pictures, sounds and more which provides meaning and depth to the human. Overall, this quality helps to differentiate a conscious being, by actively demonstrating self-awareness in a more passive manner (almost done without us thinking about relating events). This however is not always true, as the chance of corruption or loss of the memory is more common in a human mind than a computer, due to the idea of forgetfulness of more redundant information (Sharma, 2020).

While the human mind can demonstrate consciousness among every action we do, A computer is able to call upon, transfer information and thus compute faster than the average human, while being able to set priorities between data using multitasking software built into the operating system, exhibiting an ability to multitask and assign priority to which memory comes next (Computer multitasking, 2022). The downside of this type of storage is the memory only operates to just store 'simple' information and not truly think in the case of whether memory has successfully retrieved for all the data to be fully processed (Sharma, 2020). This theory arises due to the ideas of error, where the computer cannot think for itself on how to rectify the situation as it has not been told how to.

How are Transfer Speeds Similar?

In terms of transfer speeds and rate, the computer is faster due to its simpler architecture and use of electrons, compared to the electrochemical transmissions that occur with biological neurons in the brain and the body (Why do scientists say brains are faster than computers?, 2014). This allows for faster reaction times during cause and effect, allowing the computer to react (in theory) faster than the human, which is beneficial to being self-aware.

How is Physical Awareness Similar?

In terms of self-awareness, sensory peripherals can be attached to the computer to achieve a physical analysis with its surroundings, providing the computer with the detection of objects and analysis of the situation. By allowing the computer to use AI to identify different objects in its visual area begin to create the essence of consciousness in the same way consciousness was theorised with humans and other 'selves'. Though this initial endeavour may seem promising, the architecture for the neural network still requires a lot of development since these pieces of hardware, although having the ability to provide full sensory range in 360^{o}, requires refined software that can analyse the entire situation in terms of perfect image recognition. We are unable to pursue this goal due to the lack of substantial multitasking abilities. Due to our understanding both psychologically and physically of our existence, humans have already had the strongest foothold in self-awareness, passively using our five senses and other cognitive skills to get through daily life.

How is Processing Power Similar?

Though many of the components have been covered, the most vital component – the CPU or central processing unit – is yet to be analysed. The following consists of a table, comparing the different properties of the human brain with a computer.

Properties	Computer	Human Brain
Number of Basic Units	Up to 10 billion transistors	~100 billion neurons; ~100 trillion synapses
Speed of Basic Operation	10 billion/sec.	< 1,000/sec.
Precision	1 in ~4.2 billion (for a 32-bit processor)	~1 in 100
Power Consumption	~100 watts	~10 watts
Information Processing Mode	Mostly serial	Serial and massively parallel
Input/Output for Each Unit	1–3	~1,000
Signaling Mode	Digital	Digital and analog

a) Based on personal computers in 2008.

b) The number of transistors per integrative circuit has doubled every 18–24 months in the past few decades; in recent years the performance gains from this transistor growth have slowed, limited by energy consumption and heat dissipation.
References: John von Neumann, The Computer and the Brain (New Haven: Yale University Press, 2012); D. A. Patterson and J. L. Hennessy, Computer Organization and Design (Amsterdam: Elsevier, 2012).

Figure 2, a table showing a general analysis of the computer vs the human brain. (Luo, 2018)

The study, although devised in 2008, provides a clear and concise distinction for each characteristic between the two, showing the human brain superior with its massive processing power due to its parallel processing, extraordinary number of neurons and synapses and increased efficiency in terms of power consumption. Though the use of neurons makes the brain slow in comparison to the computer, the brain still has 'superior flexibility, generalizability, and learning capability than the state-of-the-art computer' (Luo, 2018), due to the ability to process more information simultaneously than the computer. It can be said that the human brain acts as several neural networks operating slowly but simultaneously, giving the human the ability to learn and practice different skills continuously without pausing other activities, training our thoughts and emotions for every unique scenario.

This contrasts with the role of a computer, which at its current stage in development, is more suited to solve more complex yet straightforward programs, calculations, and algorithms. This uses its profound processing speed, low chance for error, and serial processing modes to follow through with cohesive instructions with relative ease and efficiency compared to the human brain. Here the computer is not suited to process information like the brain, since parallel processing is required to run the multiple required ANI's together.

Overall, in terms of physical properties, a computer is currently not outfitted to successfully replicate any form of consciousness, since the processing architecture between the two is specified for different tasks (computers focus on programming and arithmetic, whereas the human brain focuses on different skills and knowledge to operate daily).

How is the Architecture Similar?

Deep learning is a sub-branch of machine learning, focusing mainly on the development of artificial neural networks (ANN's). It investigates the specific input, output and hidden layers of the algorithm and the specific parameters associated with each, which follow the components of machine learning (Lazzeri, et al., 2021).

Such an example of deep learning uses Artificial Neural Networks (ANN's). These consists of the following to serve as a construct for any learning algorithm with ANI properties (3Blue1Brown, But what is a neural network? | Chapter 1, Deep learning [Video], 2017):

- Neurons – similar to the human brain, these are used as a stimulus to a certain event, given its input data. Each neuron carries its own 'activation', a representation on how much the neuron will influence the next stage of processing.
- Layers – an array of neurons used for input, output and processing information. Useful for the decomposition of a problem into small pieces, piecing them together to form an understanding of an object.
- Connections – links each neuron in one layer to another neuron in the next. Each connection has an associated weight (a value representing how much a neuron should affect the activation of the next) and a potential bias (a value representing the threshold at which the neuron can activate based on data fed prior). These weights and biases (parameters) are taken along with the neurons activation to calculate the activation of the next neuron to be used for processing.

In theory, this cohesive structure for a deep learning algorithm has its similarities with the human brain, where the brain has the ability to think and perform actions based of the firing and linkage of biological neurons. It is believed however the brain creates the perfect architecture due to the use of many more neurons and the integrated ability of feeling and emotion when developing with age.

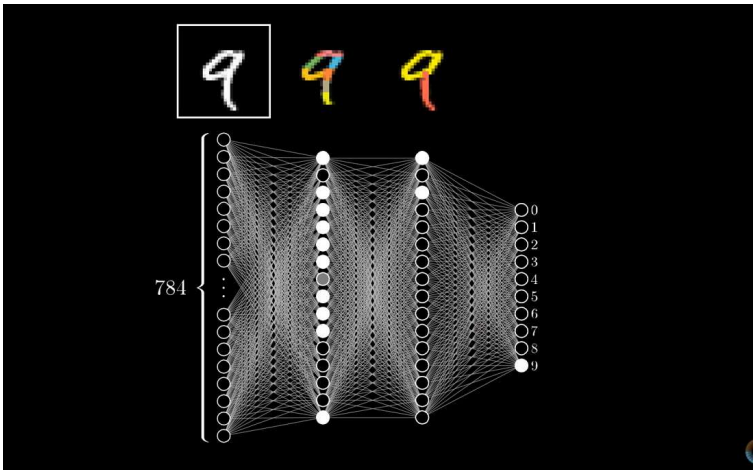

Figure 3, a picture showing the visual construction of an ANN, where the circles represent neurons with a brightness respective to their relative activation, in columns to represent a layer, where each neuron has a line representing a connection with certain weights and biases. (3Blue1Brown, But what is a neural network? | Chapter 1, Deep learning [Video], 2017)

What are the Psychological Commonalities Between the Mind and an AI?

Like the identification of physical traits between man and machine, this section will delve into the psychological effects displayed from both entities and examine any potential signs of consciousness within an AI that can relate to a human.

How can we Determine what is Conscious?

One main key point highlights the potential of never knowing what consciousness is or who possesses it, making the question difficult to answer. As established above, consciousness involves the state of being self-aware. By being unable to establish what this can classify as, since consciousness is more of an experience than a fact, we are unable to venture out to identify what classifies as a conscious self.

The Turing test is a proposal to solve this problem (Turing, 1950). Created by Alan Turing in collaboration with a group of scientists who were proposing ideas whether an artificial brain could be developed (History of artificial intelligence, 2021), he discussed a theory to test a conscious AI using 'The Imitation Game' using people to communicate with the AI to tell who isn't a human. The development of this paper had founded the prospect of AI and inspired the theory as to how this could be achieved, influencing the creation of the first ever AI known as the logic theorist, which was used to compute and prove numerous complex mathematical algorithms with great speed and efficiency (Gugerty, 2006).

Although the Turing test can be used to test for consciousness, the result is down to perspective only, which can be biased and unreliable since the human mind is chaotic (uncontrollably random). There may never be a clear solution to this problem, since 'artificial consciousness will only be accessible to us from the third-person perspective' (Hildt, 2019), leaving us only able to speculate and 'guess' who is conscious.

One solution (the solution being used within this essay) is to take a strict, narrow definition of consciousness, focusing only on the skills and attributes of being self-aware. In a sense, we want to 'have a general agreement about what we mean by consciousness' (Hildt, 2019), which can be achieved by focusing on these skills.

What are the Cognitive Capabilities of an AI?

It can be debated that the common AI is able to demonstrate some form of cognitive ability to a certain extent, exhibiting the ideas of learning, thought and self-awareness when running through machine learning algorithms. Typically, machine learning and thus deep learning has three main parts involving (Lazzeri, et al., 2021):

1. An input process where training data is given to the AI to recognise and process
2. A process and comparison step where the training data is processed and compared to the true value
3. A self-reflection step where the AI uses gradient descent to identify what parameters need to change, so that when the same or similar data is fed back in as an input, the accuracy of the AI would improve.

Analysing this process clearly reveals a method of learning and storing information/parameters. This is an algorithm that can work to potentially a flawless standard, producing the most optimum parameters and thus results. However, it is important to acknowledge the third step in the list. By using gradient descent and backpropagation (algorithms used to ultimately derive an AI's near perfect parameters (3Blue1Brown, Gradient descent, how neural networks learn | Chapter 2, Deep learning [Video], 2017) (3Blue1Brown, What is backpropagation really doing? | Chapter 3, Deep learning, 2017)), we can provide the computer the ability to self-reflect and in a way, become aware of the machine's actions and how it must improve (albeit in a more specific task with today's

technology). This information is vital, as it provides the neural network guidance on what steps need to be taken to ensure each parameter tends towards its most optimum value (its local or global minimum), thus leading to a better ANN. Such abilities of learning and cognition show evidence for a form of self-awareness, and is a key role for any conscious being, thus therefore support the statement.

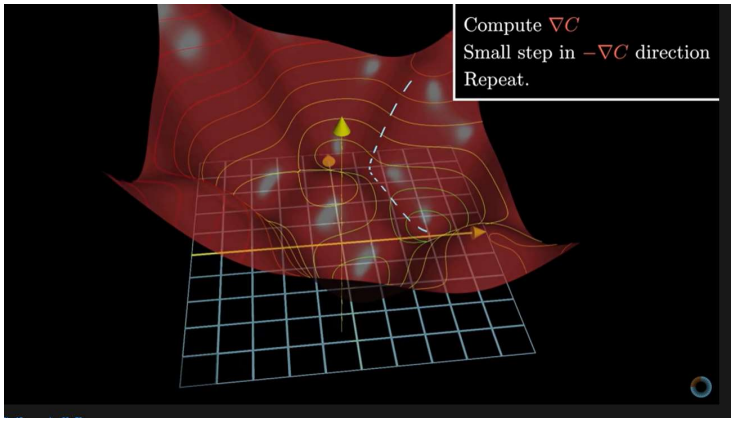

Figure 4, a graphical representation of gradient descent, where the local minimum is defined by the lowest peak in which the dotted line ends, and highest possible refined parameters are achieved. The method of calculating this is given in the top right, where ∇C is a vector symbol for the cost function. (3Blue1Brown, Gradient descent, how neural networks learn | Chapter 2, Deep learning [Video], 2017)

However, a contrasting argument consists of the idea that an AI can possess some human characteristics, but not all the necessary ones to suggest it can act like a human with human behaviour. While today's machines can exhibit learning and knowledge characteristics, AI is currently unable to take results from ANN's and combine them together to create thoughts and emotions. In essence, the typical AI is not aware of what it processes, what information is outputted and its overall existence, and relies upon us to dictate via programs how the data must be guided to produce useful results (Hildt, 2019). The type of data it can process remains within the scope of purpose for the AI as an ANI and cannot produce results outside of this expected result range, as it is not trained how to focus on said range. To such an extent, there is a high probability that an AI cannot compare to human levels of consciousness, therefore not supporting the question.

To what extent can Social Robotics simulate Consciousness?

A social robot is an autonomous robot that interacts and communicates with humans by following social behaviours and rules attached to its role (Social robot, 2022). Essentially, they are a culmination of chatbots and physical robots that can interact with people in a friendly and social way (Wood & Dillenbeck, n.d.). One type of robot involved in mainstream media involves Sophia, a humanoid developed by Hanson robotics.

While this robot successfully displays elements of human consciousness such as spatial awareness, recognition of objects and emotions, and the display of facial expressions to represent emotion, the 'consciousness' behind the humanoid is essentially misleading. Due to the more 'staged' appearances and the analysis of the source code, it is widely believed that this robot is capable of human-like intelligence, where it really is not. Ben Goertzel, the former chief scientist for Hanson robotics, has even acknowledged that it is "not ideal" to compare with human intelligence mainly due to the hardcoded source code and no ability to show psychological self-awareness within the robot (Sophia (robot), 2022). As such, these types of robots are essentially ANI designed to falsely

show AGI properties, and overall cannot show the same properties of human consciousness as we do.

Figure 2, a picture of Sophia and her expression for happiness

The ideas of Ethics and Morals

Let us assume the construction of a 'strong AI' was completed and perfected to choose the most beneficial solution. Building a strong AI capable of human consciousness can consist of many small ANI's, which take in information for different processes, however a major obstacle standing between this, and overall succession involves the use of ethics and morals, which need to be considered in all situations. The idea of 'thinking about the thought' comes into play, where the strong AI would need to analyse the situation, its options, which is right or wrong and balance these as effectively as possible to respond appropriately. Improvements that the AI can make are 'senseless' without the implementation of morals, ethics, and emotions. Though thought could come with the implementation of backpropagation, it may not lead to the correct decision as the AI would need to pick between the right, unbiased outcomes (without thought of morals), or the most advisable (taking into consideration of morals) (Hildt, 2019).

Hardcoding morals and ethics to a mind is, I believe, essentially impossible, since this depends on everyone's stake/role in a situation, ideology, the actual situation, the potential aftermath of the situation and much more. The idea would, in theory, involve another ANI to substitute in as the role for ethics and morals, however this can prove to be a downfall, since all situations must be executed safely and with due regard of human life, while the situations are always different for each case. For these types of events, creating an ANI that bases every solution on probability is not acceptable, especially when complex decisions must be made that go against the trained ethics and morals. These decisions would be hard to make, and due to our innate sense of right and wrong, are made more easily using context, previous experiences and other factors that make our decision making the best. An AI today currently does not possess these abilities, and thus cannot support intelligent behaviour.

Can a Conscious AI be Created in the Future?

Although the reality of consciousness using AI is not possible in today's era, there are potential opportunities to develop on this field. This section will briefly dictate what opportunities there are and how this can be used to achieve a mind within a machine.

Theory of the Mind and its Architecture in Classical Computers

Since the ideas of consciousness using AI has been a debatable concept for little time, research has been conducted to propose distinct types of architecture that can be used to produce conscious within a machine. The paper *A Standard Model of the Mind: Toward a Common Computational Framework Across Artificial Intelligence, Cognitive Science, Neuroscience, and Robotics* (Laird, Lebiere, & Rosenbloom, 2017) puts forward schematics that represent a theory for the standard model of the mind, with close reference to the human brain. The paper was created with the incentive to encourage more research in the field, and thus provides a basis of ideas that the researching community can investigate for feasibility, development, and improvements.

Creating the Mind based on Quantum Computing

The field of quantum mechanics and computing is a confusing field, one that may, at current understanding, be the solution to this debate. Quantum computing is a proposed new revolution of computing as computers reach their physical limits in processing power, where quantum computers take advantage of quantum physics to compute and simulate different outcomes given a scenario. This section will mainly involve these components of quantum mechanics, which consists of (Kurzgesagt, Quantum Computers Explained – Limits of Human Technology [Video], 2015):

- Superposition – the idea that a quantum bit (or qubit) can exhibit properties representing both the binary number 0 and 1 at the same time. Superposition is based on the probability of these two states, and the state of superposition collapses once the qubit has been read from. The idea of superposition is useful to exponentially increase processing power.
- Entanglement – the idea of connecting two or more qubits together. This property is useful as this link allows for cause-and-effect actions, where affecting the state of one qubit can have an effect on the other(s) instantaneously. It is also useful for deducing the state of a series of qubits, since measuring the state of one qubit can be used to measure the state of all qubits via entanglement.

The combination of these can be used to compute and simulate many different potential outputs given a certain situation, which is comparable to the human brain can when faced with a challenge.

The Quantum Theory of the Mind

Many researchers believe the reason we are unable to create a mind is due to the quantum theory of the brain. Rather than taking a concrete solution to the theory of consciousness, quantum theory can help to suggest why a humans decision making is superior. Theoretically, the human mind is based along the idea of chaos (uncontrollable randomness), which is reasonable to assume since the psychology of every individual is unique and different, and the firing of each neuron in the brain is virtually unpredictable. The paper *From Quantum Physics to Quantum Hypnosis: A Quantum Mind Perspective* identifies this, saying 'brain activity and consciousness represents a chaotic complex system, ruled by the probability principle' (Benedittis, 2020) which is similar to the ideas of quantum mechanics.

A personal theory dictates that this chaotic feature can be reversed engineered to create a kind of 'quantum matrix' which works interchangeably to replicate the chain of neurons in the brain. The way this could work is by assigning different sets of qubits that are entangled with each other to compute scenarios and emotions (like the ANI's mentioned above) and using those results to create the basis of thought and opinion as it simulates every potential scenario, due to superposition. Due to entanglement, the ideas of thought and emotion can be linked to the scenario, allowing the computer to formulate ideas and prepositions as to what it may think should be the solution. The construction of this form of ANN can also support the ideas or morals and ethics into a situation since the chaotic nature of the mind and quantum computing are similar. While this idea holds potential validity, quantum computing is still a difficult subject to understand since research in the

field is relatively new and the scale for research is primarily limited to large tech companies such as Google and IBM in which with time, progress could exceed expectation.

Conclusion

After considering all of the suggested viewpoints from the debate, I believe today's culmination of the field of AI has not reached the necessary standard we require to successfully simulate consciousness due to the severe lack of psychological and physical commonalities between man and machine.

In terms of the analysis of the physical comparisons, the position proved to contain some strong fields, the main one consisting of sensory peripherals to help with analysis of the surroundings, a necessity when comparing to the ideas of a 'self' and its navigation to a more beneficial place. The major development more specifically in sight and audio reception and output allows us to communicate in a way to the computer, where the machine would essentially process and respond accordingly. The fields of memory, storage and transfer speeds are also some strong fields to consider, where calling upon memory required for a task is both related and quick to access from the library of knowledge that can be stored. However, in comparison to the human brain and mind, these effects are dwindled by the processing format and overall complexity yet efficiency in both power consumption and processing power of the human brain, allowing humans to, as a key difference, multitask more efficiently than many machines and ANN's (even though the ANN shares much of its architecture with the brain). This is due to the vast amount of parallel processing that the brain can do compared to the serial processing power of the traditional computer. The significance of this achievement is substantial, as it can be assumed that humans are good at learning and performing tasks with relatively high performance due to the many ANI's that we possess and utilise daily, even though the overall processing speed can be quite slow compared to a computer. There are also the limitations within the fields of memory and storage, where it is estimated the human brain can store up to one petabyte of information compared with the one terabyte average household computer nowadays. Memory is also not where it needs to be, since current computer memory does not possess the general ability to think about what has been called and link such events together to produce depth and meaning. Overall, some of the physical comparisons were strong to support the idea, but the many disparities in other sections lead to the conclusion stated above.

As for the psychological abilities, the main comparison between the mind and an AI comes in the form of learning, a key feature when considering consciousness in general. Due to the uses of backpropagation to perfect the parameters that an ANN possesses, the computer gains the ability to self-reflect and develop upon itself to its greatest possible accuracy. This however falls off when analysing the scope of the particular AI, since thoughts and emotions are not feasible given an AI's output, the AI lacking the role of self-independence since it cannot think for itself, and the specific task the AI is limited to due to the parameters given for only a specific task, compared with the human brain that can cope with many tasks at once. There is also the problem of dealing with sensitive situations since an AI lacks the ability to use ethics and morals within a situation which in itself, has its own slew of challenges that need to be overcome including the rendering of every scenario to pick the best choice, a resource intensive task. Modern day robots such as Sophia have proved disappointing and misleading to say the least, proving to be nothing more than a typical combination of ANI's which attempt to show AGI properties. Overall, many of the skills have been identified throughout the report such as learning, physical awareness, memory and more, therefore supporting a theory of an AI possessing a form of 'necessary consciousness', however all of the

advanced skills of intelligence were not found throughout the essay, leading to believe that AI has reached a substantial foothold, but not far enough to support a conscience equal to humans.

For the future theories, it is important to state that these are mainly theoretical and does possess the ability to fail. With that said, the 'Theory of the Mind' stands out purely for the proposed architecture that was supplied with the paper. The ideas behind the architecture seem plausible to an extent but will obviously require further development and analysis from the scientific community to reach fruition. As for 'Creating the mind based on quantum computing', this holds the least chance for success due to the immature field of quantum physics, however, holds the greatest potential, fixing the ethical and moral concerns that come with an AGI in a classical computer, along with the inhibiting theory of the quantum mind.

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