1: The difference between AI and General AI

AI also known as Narrow AI is created to solve one given problem, for example, a chatbot, or face recognition bot. Basically any AI that can outperform a human in a narrowly defined and structured task can be categorised as Narrow AI. The applications of narrow AI are basically mimicking human behaviour in the meaning that the behaviour of the AI is based on a set of rules, parameters, and context that they are trained with. Some of these learning techniques can be, computer vision, natural language processing and machine learning.

When talking about artificial general intelligence, or general AI, people are referring to the theoretical application of a generalized artificial intelligence. Which is it applying AI into any domain, and solving any problem. Artificial General Intelligence allows machines to apply knowledge and skills in many different contexts. Where Narrow AI applications can run single, automated, and repetitive tasks, the objective of General AI is to create machines that can reason and think just like a human is capable of thinking. (Z. Larkin 2022)

2: Turing Completeness

Turing completeness is the ability to perform any arbitrary finite computation. In other words something is Turing complete if given some finite input, and after some finite about of time or steps, it produces some finite output and that this output is the same for its associates input. Although the input, output and computations performed are finite, the set of possible inputs and the set of possible outputs can be infinite.

This is often used alongside a theoretical model of a computer theorised by Alan Turing, known as the Turing Machine. A Turing Machine is a mathematical model of computation that defines an abstract type of machine (hence these machines do not actually exist, but just a model that manipulates symbols on a strip of table). Despite the simplicity of the model of this machine, a Turing machine is capable of representing any arbitrary function.

Therefore, a programming language or system is Turing complete if it can compute all things that a Turing machine can compute, e.g. it is able to decide any decidable language (a language for which membership or non-membership can be decided by an algorithm that halts on all inputs in a finite number of steps, also known as a recursive language). It also means that these languages/systems can simulate a universal Turing machine, which is a Turing machine able to simulate any arbitrary Turing machine by reading input tapes with both a description of the original Turing machine, and the input from the original machine. Note not all languages used are Turing complete, particularly data languages such as CSS and HTML.

3: Discuss whether Bitcoin is Turing Complete

As Turing completeness requires the ability to perform any computation, Bitcoin is not Turing complete sue to its scripting language. This was intentionally designed to be Turing incomplete as like HTML/CSS it serves a particular purpose and does not need this increased complexity. By keeping the scripting language simple the developers are able to predict with

high accuracy as to how it is going to react given the finite number of situations it will encounter.

An example of how this is not Turing complete is that Bitcoin scripts are not able to represent loops. This means that the types of algorithms that Bitcoin scripts can execute are limited to linear instructions, or tree-like instructions. Therefore, by Satoshi choosing not to represent loops, or even possibly infinite loops, they are keeping in mind the intended applications and valuing efficiency of the current functionality, maximising performance by minimizing complexity. (Farhan A., 2021).

4: Discuss what role blockchain might play working with AI in the future

Blockchain is a system in which a record of transactions made in cryptocurrency are maintained across several computers that are linked in a peer-to-peer network. The key takeaway from this is that blockchain is maintained across several networks, and thus is decentralised. This decentralised element of blockchain can be used to create decentralised artificial intelligence systems. The power of decentralised AI is that these devices and systems would be able to learn through not only the data and knowledge in their local network, but also be able to leverage knowledge gathered by other systems on the network. This, along with the distributed computing which helps to increase the speed at which systems can learn would create a faster and more powerful AI system. (Anon, 2021).

AI and blockchain can be a particularly powerful combination in cyber security. As blockchain and its consensus protocols act to effectively remove bugs and fraudulent data, new patterns can be identified through blockchain consensus by artificial intelligence techniques to help identify new categories of fraudulent transactions. The real-world application of this is also not isolated to blockchain but can be used in retail, or banking industry to predict fraudulent card activity more accurately. This would also provide a more secure storage of digital monetary assets, allowing AI to create seamless data insights from these networks.

Finally, AI when combined with blockchain, in particularly cryptocurrencies that work on Proof-of-Work consensus algorithms, like Bitcoin, can help to optimize the calculations performed to reduce the miners load, resulting in faster transactions. This, due to the increased efficiency of solving these puzzles, would also have the side effect of reducing the carbon footprint of cryptocurrency mining as it would require less energy to add a block to the chain. As well as reducing the work done by miners, AI data pruning techniques can be applied to the data structures in blockchain to ensure that the algorithms used for automatically pruning the data which is not in use anymore, are also more efficient. (Pujahnp 2019).

References:

Zoe Larkin (2022) levity.ai. (n.d.). *General AI vs Narrow AI*. [online] Available at: https://levity.ai/blog/general-ai-vs-narrow-ai.

Binance Academy. (n.d.). *Turing Complete*. [online] Available at: https://academy.binance.com/en/glossary/turing-complete.

Farhan Aly. (2021). *Turing Completeness, Go, Ethereum and Bitcoin*. [online] Available at: https://aly.arriqaaq.com/turing-completenes-ethereum-bitcoin
[Accessed 26 Apr. 2022]

Anon, (2021). *The Potential of Decentralized Artificial Intelligence in the Future*. [online] Available at: https://www.analyticsinsight.net/the-potential-of-decentralized-artificial-intelligence-in-the-future/
[Accessed 26 Apr. 2022].

Pujahnp (2019). GeeksforGeeks. *Integration of Blockchain and AI*. [online] Available at: https://www.geeksforgeeks.org/integration-of-blockchain-and-ai/.