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Title of Essay: Can a machines think?

I explore the question of if a computing machine can think which was famously asked by Alan Turing in his 1950 paper, and has be a subject of active debate in philosophy since. The question I am exploring is more precisely formulated as “can a computing machine think on the level that a human can?”. I will explore various philosophical argument on the subject matter while using insight from theoretical computer science and mathematics. My ultimate stance will be that the answer to the question I am proposing is a negative. This argument will be constructed by using some fundamental results in logic, theoretical computer science and mathematics.

Hoffmann, Achim. “Can Machines Think? An Old Question Reformulated.” Minds and Machines, vol. 20, no. 2, 13 June 2010, pp. 203-212, https://doi.org/10.1007/s11023-010-9193-z. Accessed 21 June 2019.

In this article Dr. Peter J. Denning, a renowned computer scientist, address the question of “Can Machines Think?”. Dr. Denning took a different approach in addressing this question. Dr. Denning suggested on redefining the notion of “machine” we are considering therefore redefining the question. In mathematics and computer science computing machine is used synonymously with algorithm which is just defined as a Turing machine. Dr. Denning argued that this notion of a computing machine is not suitable for the question of if a machine can think and suggest to look at a restricted question. As Dr. Denning puts it “The qualitative question of whether intelligent behavior is algorithmic should be replaced by a new, rather quantitative, question allowing a more fruitful discussion.” “Can a given task be accomplished by a given Universal Turing machine U

running a program of length at most k?" This redefines the problem and give a more analytic formulation of the problem which can be analyzed more quantitatively.

Lampert, Timm, and Anderson Nakano. "Explaining the Undecidability of First-Order Logic". Humboldt-Universität zu Berlin Computer- und Medienservice, 2021, https://www2.cms.hu-berlin.de/newlogic/webMathematica/Logic/undecidability_phil_publication.pdf.

This is and article by Dr. Anderson Nakano who is a professor at Pontifícia Universidade Católica de São Paulo in Departamento de Filosofia, and Dr. Dr. Timm Lampert who is a professor in Humboldt University Berlin at the Department of Philosophy. Dr. Nakano and Dr. Lampert explored the undecidability of Predicate logic, then went over and cited Turing proof of the undecidability of predicate logic by showing the undecidability of the Halting problem which he showed in his 1936 paper "on computable numbers, with an application to the entscheidungsproblem". Then Dr. Nakano and Dr. Lampert goes onto show that the most popular automated theorem proving techniques fails when they are applied to design a a theorem prover for Predicate logic. This shows a limitation in capabilities of algorithms, and thus computing machinery.

Wasilewska, Anita. Logics for Computer Science : Classical and Non-Classical. Cham, Springer International Publishing, 2018.

This book is by Dr. Anita Wasilewska who is a mathematician and a professor in Department of Computer Science at Stony Brook university on Logic. She introduced many fundamental concepts in logic and gives proofs and formulation of various mathematical results. We are interested in chapter 9 of this book titled "Hilbert Proof Systems Completeness of Classical

Predicate Logic" where Dr. Wasilewska shows various proof of Completeness of predicate logic. This is useful to us as we have that every true statement in predicate logic can be proven, this shows that an argument can be made that theoretically it is possible for a human to prove every true statement in predicate logic, which comments on the capabilities of human intelligence.

Lucas, J. R. "Minds, Machines and Gödel." Philosophy, vol. 36, no. 137, 1961, pp. 112–27. JSTOR, http://www.jstor.org/stable/3749270. Accessed 21 Nov. 2023.

This is a famous paper by Dr. John Randolph Lucas a renowned 20^{th} century philosopher. He argued that Gödel's incompleteness theorem shows that a machine cannot think on the level a mind can or that mind is not a machine. Dr. Lucas supports his claim by arguing that for every machine, by using Gödel's incompleteness theorem we can construct a statement such that the machine cannot prove that statement to be true while the human mind can observe it to be true. This supports the claim that a machine cannot think on the level that a human can.

Denning, Peter J. "The Science of Computing: Is Thinking Computable?" American Scientist, vol. 78, no. 2, 1990, pp. 100-02. JSTOR, http://www.jstor.org/stable/29773938. Accessed 21 Nov. 2023.

This is an article Dr. Peter J. Denning who is a renowned computer scientist famous for his work on virtual memory. In this article Dr. Denning looking to the debate of is thinking algorithmic or can a machine think. Dr. Denning first reviewed the argument by Dr. Paul Churchland and Dr. John Searle who both possess thought on the matter that can a machine think. Dr. Searle belong to the school of thought that believes that thinking is not algorithmic and a machine cannot think while Dr. Churchland argues that a sufficiently powerful computer can simulate the human brain and therefore think. Dr. Denning pointed out that both sides dismiss a very important question

that is “what is thinking?”. Dr. Denning argues that we regard thinking as a phenomenon that happens before the articulation of language and therefore machine that are programmed using the said language are inside the language and cannot think. He then goes over Dr. Roger Penrose’s argument he made in his famous book “The emperor’s new mind” and points out how he agree with Dr. Penrose’s claims.

Shieber, Stuart M. “The Turing Test as Interactive Proof.” Noûs, vol. 41, no. 4, 2007, pp. 686-713. JSTOR, http://www.jstor.org/stable/4494555. Accessed 20 Nov. 2023.

This is a paper by Dr. Stuart M. Shieber who is a professor of computer science at Harvard University and works in the area of computational linguistics. In this paper Dr. Shieber argues against the stance that the Turing test is not a valid criteria to determine if a machine is thinking. He mainly targets and refutes the arguments made by Dr. Ned Block about how passing the Turing test is not sufficient evidence that the machine is thinking. Dr. Shieber argues that instead of looking at the problem deductively or inductively the problem is better formulated as an Interactive proof. He then redefines the Turing test as and Interactive proof (a concept taken from computational complexity theory) and argues that this reformulation is sufficient to show that passing the Turing test is evidence that the machine is thinking.