Brain and Turing Machine

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Introduction

- Since decades scientists have been working on perfecting an artificial brain that can give consciousness to machines.

- For this a lot of research has been done and debates are going on to see if the brain is a turing machine?

- So, here we are discussing that whether the brain is a computer?

It all began….

- During the early half of 20th century mathematicians came up with the formal definitions of "computer" and "algorithm".
- During one of his famous lectures David Hilbert challenged the mathematicians with 23 unsolvable math problem and the 10th problem was concerned with determining whether a polynomial had roots made up of solely integers.

- But what Hilbert thought was a simple unsolvable problem lead him onto a very deep problem.

- Mathematician took up this challenge but had a very hard time coming up with the solution and they began to ask that if some problems were simply unsolvable.
- But as they were mathematicians they wanted a proof for "algorithms do not exist for these problems."
- But the issue was that there was no formal definition of algorithm existing at that time.

Church-Turing Thesis

- So, Alonzo Church and Alan Turing set out to find a formal definition of algorithm, though both of them worked independently and came up with different solutions it was later found that the solution given by both of them was mathematically equivalent.
- **"An algorithm is anything that a turing machine can do."**

Other inspired definitions

- Computable Function: any task that can be solved using an algorithm.
- Computer: any physical machinery that can solve a computable function via algorithm.
- Turing Complete: a mathematical tool that can be proven to be capable of implementing any algorithm.
- At this time computers were people whose job was to sit down with pencil and paper and use an algorithm to solve computable function.
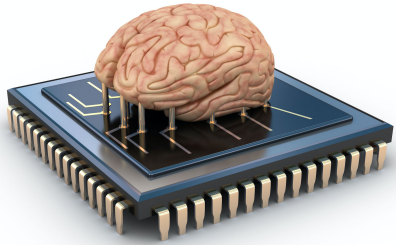
Turing Machine
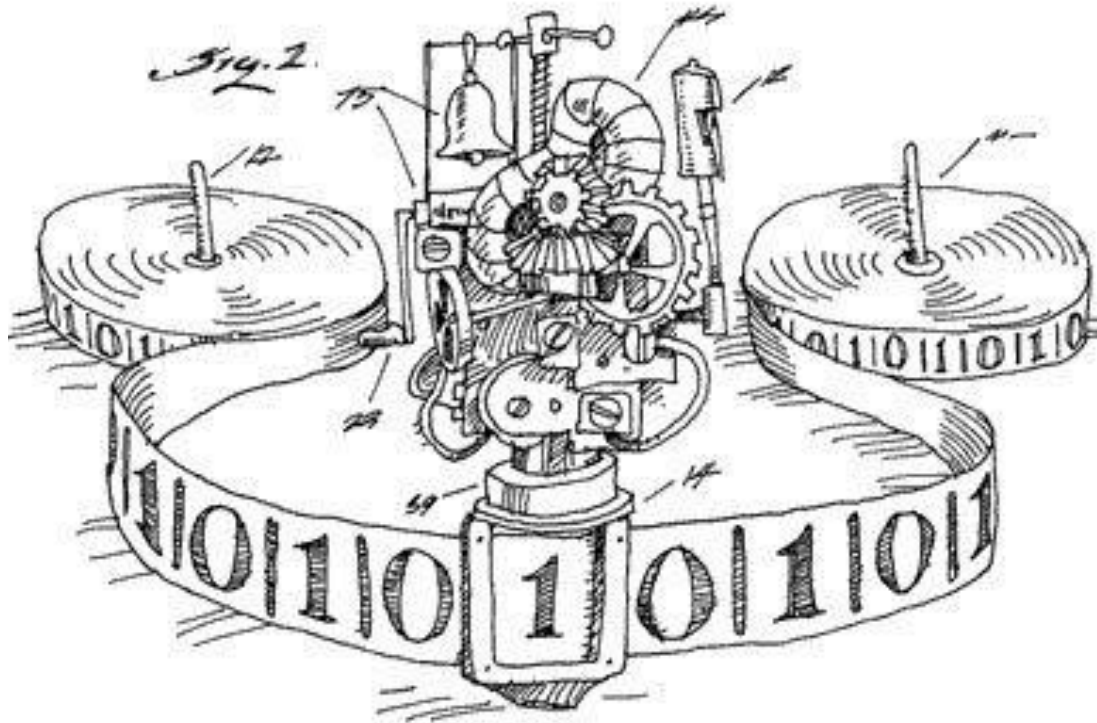
- A turing machine is a mathematical model of computation that defines an abstract machine, which manipulates symbols on a strip of tape according to a table of rules.

- It is used to accept Recursive Enumerable Languages (generated by Type-0 grammar).

- An important thing to keep in mind is that turing machine is not a machine but merely a mathematical tool.

Few questions arises

- If a turing machine implements anything that can be written by a discrete step-by-step value, does that mean a turing machine cannot implement analog system?
- Is everything a computer?

Brain

- As it can be easily assumed that internal working of brain is nothing like the working of turing machine yet why are they so similar?

1. With no more than a pencil and paper any human is arguably capable of running any program that has been programmed in any language e.g python.

2. Computer scientists have been able to implement multilayer and recurrent artificial networks that are turing complete.

3. A brain has 10^{14} synapses and there is a surprising amount of flexibility in how those synapses are set.

Objections

1. Just because you can stimulate the brain with a Turing machine doesn't mean make the brain a computer.
2. Brains can implement non-computable functions, therefore brain is not a computer.

Conclusion

- Hence, we can say that in many ways the brain is like a turing machine but yet there are some unanswered questions which cannot be further solved until we get a better understanding of the working of both brain and a turing machine.

Questions?