

## **Week 1 Summary**

### **General idea of this paper:**

This paper is a very important milestone of computer science. It introduced a universal computing machine, the famous “Turing Machine” and build the foundations of today’s computers. This paper introduced the mathematic model of Turing’s universal computing machine and proved the possibility of creating such a machine. His thoughts about Turing Machine become truth nowadays and his theory about computing machines are widely used in computer architecture design and many other computer science fields like AI.

### **Details about the paper:**

At the beginning, Alan Turing briefly introduced his thoughts about the definition of computable numbers and pointed out Hilbertian Entscheidungsproblem can have no solution. Then, Alan Turing introduced the automatic machine, which cannot go on while it meets ambiguous configurations until some arbitrary choice has been made. He further gave the concept of computing machine. Turing made an analogy between this machine and scanning a tape with different automatic operations. Then, Turing separate this kind of computing machine into two kinds, circular and circle-free machines. The circle-free machine just displays the feature of “computability”.

In the middle, Turing illustrates the basic concepts and detailed algorithms of his universal computing machine. It can scan and visit anywhere of an infinite tape via a limited scope. To be specific, Turing use a tape head to point at the a certain point in a tape and the machine can only read and write the status of this point. After each operation, the tape head can move one step either to right or the left.

In the last part, Turing talks about the extent of the computable numbers and applications to the entscheidungsproblem, which corresponded to the beginning part of the paper.

### **My Personal Thoughts:**

During my undergraduate years, I have learned about the digital electronics and theory about sequential logic circuits. With a combination of TTL or CMOS circuits, we can realize calculation modules like adder and multiplier, etc. Their outputs not only rely on its current state, but also depend on its previous states. CPU is just an integration of a large number of calculation modules. The basic functions of CPU include fetch, decode, execute, visiting the memory write back and update the PC. It is kind of similar to Turing Machine’s working logic including reading the tape, find the correct state transfer rules, execute the rules, write back to the tape, update the value and move right/left for the next step. I think the basic logic behind the CPU is Turing Machine and we developed modern CPU with his theory and the progress of the electronics. I believe more interesting applications are still waiting us to find with Turing’s brilliant ideas.