Report for Fall 2020 EE 343L Lab Assignment 0

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Abstract: Claude Shannon was a very important figure in the world of communication theory. His numerous contributions, such his paper "A mathematical theory of communication" relating mathematics and information theory for the first time and his discovery of being able to use Boolean algebra in circuit design, still apply to modern communication theory as well as electrical engineering.

1 Introduction

Claude Shannon has been an important figure in the progression and development of communications theory. His numerous contributions spanning from his research to the students he impacted he taught later in life has proven that Shannon is integral in the advancement of many technological systems we use today. Section 2 will detail Claude Shannon's life. Section 3 will go over his achievements and Section 4 will go over his impact on communication theory today.

2 Life

Shannon was born on April 30, 1916 in Petoskey Michigan. As a child, he enjoyed playing with radio kits and erector sets given by his father and solving mathematical puzzles given by his sister. One of his favorite stories was “The Gold Bug” by Edgar Allan Poe which deals with a hero finding buried treasure by decoding a mysterious map. His interests as a child aligned with his passion for solving and creating systems in communication. In 1936, he received his bachelor’s in mathematics and electrical engineering at University of Michigan . He would later receive his masters and doctorate at the Massachusetts Institute of Technology (MIT) in 1940. Besides building gadgets, Shannon also enjoyed other hobbies such as juggling, unicycling and playing chess. He often created inventions stemming from his hobbies such as a juggling W.C. field robot which he stated to be one of his favorites. Later in life, he would return to MIT as a professor and would teach until 1978.

3 Contributions

Shannon made numerous advancements towards communication technology. His master's thesis at MIT linked a theory created by George Boole that could represent switches and relays in electronic circuits. His thesis received an award from the American Institute of Electrical Engineers. In 1941, he started working at Bell Laboratories where he would later publish a paper in the Bell System Technical Journal called "A Mathematical Theory of Communication". While serving at the National Defense Research Committee, Shannon invented signal-flow graphs and wrote a paper in 1949 called "Communication Theory of Secrecy Systems", which detailed his cryptography work during the war. Shannon also contributed in other advancements than communication. Shannon created "Theseus" a mechanical mouse which was able to travel through a maze by learning. He is also credited with creating a computer chess program that chose the best moves by learning through the positioning of the pieces inputted by a human opponent. His contributions were honored through multiple awards such as the IEEE Medal of Honor (1966), National Medal of Science (1966), Harvey Prize (1972), and the Kyoto Prize (1985). He was a member of IEEE and the National Academy of Sciences. As of today, there are 6 statues that have been erected to commemorate and celebrate Shannon's contributions to science.

4 Impact

Claude Shannon's many contributions to communications theory are still used today. His master's at MIT, which showed that Boolean algebra could be applied to switches and relays, is still used as the basis of modern circuit design. This system was expanded upon and led to the creation of logic gates which are widely used in many of our systems today. Our computers,

communication systems, and coding all use Boolean algebra at the basis of their functions to perform complex tasks. His paper “A Mathematical Theory of Communication” created the foundations for information theory which shows that information could be transmitted reliably through communication channels such as phone lines or wireless even if these channels are unreliable. This led to the Shannon limit which shows that any communication channel has a maximum capacity for reliably transmitting information. By proving that information could be transmitted, we have improved communication channels in which we now use wireless communication through our phones and computers. Shannon’s Limit created the noisy-channel coding theorem which provided a value to the reliability of a communication channel. The signal-flow graph was further expanded by Samuel Jefferson Mason which we now use to represent a physical system and its controllers through the use of nodes and branches. These graphs have helped users to present their systems in a logical and clear manner. Shannon’s contributions from his hobbies have also created impacts today. “Theseus” is credited as one of the first AI systems and has been used to teach students how to program AI. University of UH Manoa has a project that allows students to create their own “Theseus”. His computer program that played chess is also widely used to train chess players to expand and find the most optimal move. This has been further expanded by all the other systems for games that work on finding the best moves in order for the user to win. This research has been integral in the improvement of games today and in the improvement of the user’s skill in that game.

5 Conclusion

The research in this report successfully shows why and how Claude Shannon was important to the advancement of information theory. From his life, we can see how much of his time was

spent doing activities relating to cryptography, engineering, and mathematics which would eventually lead to not only his masters and doctorates, but also his discoveries and innovations. From his contributions, we can see how much he has achieved in his field with his papers and theses on the topic. From his impact, we can see how much of what we learn today in communications is built off of what Claude Shannon has discovered and innovated. Modern communication theory may actually not be what it is if it wasn't for Claude Shannon's work.

References

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