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Annotated Bibliography

Primary

Images

"25 year-old Shannon in NYC." Digital image. Ca. 1940. Accessed on February 23, 2021. https://thebitplayer.com/.

This is an image of Claude Shannon in New York. Shannon, as a very shy person, did not often like to be photographed.

"Alan Turing." Digital image. Turing Archive. Accessed January 26, 2021. http://www.turingarchive.org/about/.

This is a photograph of Alan Turing. Shannon and Turing were interested in each other's work and took inspiration from each other.

"Bounce Juggler." Digital image. MIT Museum. 2007. Accessed February 14, 2021. https://webmuseum.mit.edu/detail.php?term=shannon%2C+claude&module=objects&type=keyword&x=0&y=0&kv=75605&record=12&module=objects.

This juggling machine was built by Shannon to juggle balls by bouncing them on the ground. This machine shows Shannon's passion for juggling, and how he could combine his interests. I learned from this image that Shannon did not create machines to make the advancements that he ended up making, but for his own enjoyment.

"Bush's Analog Solution." Digital image. Computer History Museum. Ca. 1930. Accessed January 26, 2021. https://www.computerhistory.org/revolution/analog-computers/3/143.

This is a photograph of Vannevar Bush standing next to his Differential Analyzer. This is the system that inspired the first of a long line of Shannon's discoveries.

"Chess game, Claude Shannon playing Soviet international grandmaster and three-time world champion, Mikhail Botvinnik." Digital image. Chess.com. Ca. 1965. Accessed January 26, 2021. https://www.chess.com/article/view/the-man-who-built-the-chess-machine.

This image shows Shannon playing against a world champion of chess. Although Shannon lost this game, it was very important to him that he played. This taught me about what Shannon valued. Shannon loved chess and playing against the grandmaster was important to him outside of his research of chess.

"Claude Shannon's 100th birthday." Digital image. Google. April 16, 2016. Accessed January 26, 2021. https://www.google.com/doodles/claude-shannons-100th-birthday.

This animated image was created by Google to honor Shannon's achievements on his 100th. birthday. It was put in place of Google's logo on their website and provided a brief description of Shannon and his work.

"Claude Shannon " Digital image. Estate of Francis Bello. Accessed January 26, 2021. https://www.sciencephoto.com/media/228556/view/.

This is an image of Claude Shannon. Behind him are computing devices.

"Claude Shannon filming for CBS telecast 'The Thinking Machine'." Digital image. MIT Museum. Accessed February 16, 2021. https://webmuseum.mit.edu/media.php?module=people&type=popular&kv=12372&media=2.

This is an image of Claude Shannon on set for "The Thinking Machine". Shannon rarely agreed to be interviewed as he was extremely shy. His interviews were important because of how few of them there are.

"Claude Shannon in 1952 With Theseus, His Electromechanical Mouse, Which Could Navigate a Maze." Digital image. *Nature*. 1952. Accessed January 26, 2021. https://www.nature.com/articles/547159a?WT.mc_id=TWT_NatureNews&sf97576985=.

This is an image of Claude Shannon holding Theseus the mouse in his maze. This image clearly displays what the outside of the maze and mechanical mouse look like.

Eisenstaedt, Alfred. "Claude E. Shannon." Digital image. Getty Images. Accessed February 14, 2021. https://media.gettyimages.com/photos/mathematician-computer-scientist-claude-shannon

-picture-id50529934?k=6&m=50529934&s=612x612&w=0&h=k1QjRQchzcJ9mq78nLcKeWDcRLUThH3D8b5xT79x924=.

This is an image of Claude Shannon sitting near machinery.

Eisenstaedt, Alfred. "Mathematician Claude E. Shannon." Digital image. Getty Images. Ca. 1963. Accessed February 14, 2021. https://media.gettyimages.com/photos/mathematician-claude-e-shannon-inventor-of-information-theory-which-picture-id92926324?k=6&m=92926324&s=612x612&w=0&h=rUKwb5hGQLqQKz_SLapSBvh6PIOA4IrstPdPqdDhKGU= .

This is a photograph of Shannon working at a machine. Much of Shannon's work involved computers as he often utilized their processing power as it was superior to that of the human brain.

Eisenstaedt, Alfred. "Mathematician Claude E. Shannon, inventor of information theory." Digital image. Getty Images. CA 1963. Accessed January 26, 2021. https://www.gettyimages.com/detail/news-photo/mathematician-claude-e-shannon-inventor-of-information-news-photo/92926328?.

This is a photograph of Shannon standing in front of telephone switches. Shannon applied many of his discoveries to the telephone switches as he worked at Bell Labs, a telephone company, for most of his work.

"Employed by Bell Labs during World War II, Claude Shannon [at chalkboard] still found time to work on his own research." Digital image. *IEEE Spectrum.* https://spectrum.ieee.org/geek-life/history/a-man-in-a-hurry-claude-shannons-new-york-years.

This is a photograph of Claude Shannon and Dave Hagelbarger in front of a chalkboard. On the chalkboard, Shannon is writing mathematical equations that he studied.

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" ENIAC components on exhibit in Information Age." Digital Image. Smithsonian Institute National Museum of American History, 1947. https://americanhistory.si.edu/collections/search/object/nmah_334742.

This is a photograph of the ENIAC, which was the first digital computer. This computer was a large advancement, and it used the concepts that Shannon created and described. Even though it uses these concepts, Shannon was not directly involved and therefore did not take any credit.

"George Boole." Digital image. *Britannica*. Accessed January 26, 2021. https://www.britannica.com/biography/George-Boole/images-videos.

This is a drawing of George Boole. Shannon built on a lot of Boole's work throughout his life.

Hemsey, Yvonne. "Deep Blue in IBM's headquarters in Armonk, N.Y." Digital image. *IEEE Spectrum.* February 16, 1996. Accessed February 28, 2021. https://spectrum.ieee.org/the-institute/ieee-history/how-ibms-deep-blue-beat-world-champion-chess-player-garry-kasparov.

This is an image of IBM's deep blue, which is a chess machine that can beat grandmasters. It was created long after Shannon created his chess machine. It shows how far computer chess and computers as a whole have come. Shannon was a major part in this advancement.

"Hendrik Bode." Digital image. Bell Labs. Accessed January 26, 2021. https://www.bell-labs.com/claude-shannon/#math.

This is a headshot of Hendrik bode. Bode worked with Shannon on his research, and they collaborated on a paper.

"Inevitable Advantage." Digital image. *Scientific American.* 1950. Accessed January 26, 2021. http://www.paradise.caltech.edu/ist4/lectures/shannonchess1950.pdf.

This drawing displays a person playing chess against a machine. It was included in Shannon's article about his chess machine in Scientific American. It is meant to show the

reader that the human can predict what the machine will do in a given situation giving them an advantage.

"Maze Solving Mouse." Digital image. Cybernetic Zoo. 1952. Accessed January 26, 2021. http://cyberneticzoo.com/mazesolvers/1952-%E2%80%93-theseus-maze-solving-mouse-%E2%80%93-claude-shannon-american/.

This is an image of Shannon next to his maze. In this photograph, Shannon has opened the maze for the viewer to see the inner workings. It shows the complexity and simplicity of his creation

Mittman, Benjamin. "Betty and Claude Shannon With Various Instruments on Display." Digital image. 1980 ca. Computer History Museum. https://www.computerhistory.org/collections/catalog/102665758.

This is an image of Betty and Claude Shannon with instruments that they worked on. Both of them enjoyed tinkering together. They also enjoyed creating music. This image helped me understand Betty Shannon, who is not often in sources about Claude Shannon even though she was a large part of his life.

"MIT Professor Claude Elwood Shannon seated at a desk with an unidentified individual." Digital image. MIT Museum. Accessed February 17, 2021. https://webmuseum.mit.edu/media.php?module=people&type=popular&kv=12372&media=3.

This is a photograph of Claude Shannon sitting at a desk with another person. There is a telephone behind him which is symbolic for his work at bell telephone labs that influenced communication.

"Numbered Chess Board." Digital image. *Scientific American.* 1950. Accessed January 26, 2021. http://www.paradise.caltech.edu/ist4/lectures/shannonchess1950.pdf.

This is a drawing of a chess board with numbers. It was Shannon's idea to number all the spaces and pieces to have a unique way of representing each one to the machine.

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"Remote Bus." Digital image. MIT Museum. 2007. Accessed February 14, 2021. https://webmuseum.mit.edu/detail.php?term=shannon%2C+claude&module=objects&type=keyword&x=0&y=0&kv=76067&record=1&module=objects

This is a remote bus that Shannon built. Shannon loved to create toys or fun machines and this is only one example of this. This taught me that Shannon used his talents not only for the benefit of his field of study, but also to have fun.

Rowin, Stanley. "Claude E. Shannon." Digital image. IEEE Spectrum. Accessed February 20 2021. https://spectrum.ieee.org/tech-history/cyberspace/claude-shannon-tinkerer-prankster-and-father-of-information-theory.

This is an image of Claude Shannon holding bowling pins. The image was taken of Shannon when he was older, but he still loved juggling.

"Rubik's Cube Manipulator." Digital image. MIT Museum. Accessed February 14, 2021. https://webmuseum.mit.edu/detail.php?module=objects&type=related&kv=75599.

This is a machine that Shannon built to solve Rubik's cubes. Shannon's wife donated this to the M.I.T. Museum. This creation helped me understand that Shannon liked to create machines like this one for fun and enjoyment.

"Schematic diagram of a general communication system." Digital image. Bell Labs. 1948. Accessed February, 12, 2021. http://people.math.harvard.edu/~ctm/home/text/others/shannon/entropy/entropy.pdf.

This is a visual representation of the Shannon-Weaver communication model. It is a simple diagram to represent all the components of successful communication. If any one of these goes wrong or is not present, communication will not be successful. Although this model was meant to apply to transmitting signals, it can also apply to the meaning of words.

Shannon, Andrew and Peggy Shannon. "Betty and Claude Shannon." Digital image. *Scientific American.* Accessed February 20, 2021. https://blogs.scientificamerican.com/voices/betty-shannon-unsung-mathematical-genius/.

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This is an image of Claude and Betty Shannon Standing next to each other. Betty often helped Shannon organize his work, and helped build his inventions including Theseus the mouse.

"Shannon Juggling." Digital image. International Jugglers Association. Accessed January 26, 2021. https://www.juggle.org/claude-shannon-mathematician-engineer-genius-juggler/.

This is an image of Shannon juggling while riding a unicycle. Shannon not only enjoyed juggling and unicycle riding because it was fun, but also because it was mathematical, and he could create machines to do similar things.

"Shannon's Chess Machine." Digital image. Chess.com. Ca. 1949. Accessed January 26, 2021. https://www.chess.com/article/view/the-man-who-built-the-chess-machine.

This is an image of Shannon's machine that could play a game of chess with six pieces against a human. This image was not popular among other sources which shows how little Shannon publicized his work.

"SIGSALY." Digital image. Cryptography Museum. Accessed January 26, 2021. https://www.cryptomuseum.com/crypto/usa/sigsaly/index.htm.

This is an image of the SIGSALY which was a system of communication that enabled Roosevelt to communicate with Churchill during WWII

"Theseus the Mouse." Digital image. Bell Labs. Ca. 1950. Accessed February 20, 2021. https://www.bell-labs.com/claude-shannon/.

This is a close up image of a mouse used in Shannon's Maze. Although the mouse itself did not hold the mechanisms of the maze, it communicates with the maze to identify the correct path.

"Thornton Fry." Digital image. Bell Labs. Accessed January 26, 2021. https://www.bell-labs.com/claude-shannon/#math.

This is an image of Thornton Fry who was the leader of the mathematics department at Bell Labs. He allowed Shannon to explore questions and was supportive of Shannon's methods of research.

"THROBAC." Digital image. MIT Museum. 2007. Accessed February 14, 2021. https://webmuseum.mit.edu/detail.php?term=shannon%2C+claude&module=objects&type=keyword&x=0&y=0&kv=75603&record=10&module=objects.

This machine was created to calculate with roman numerals. Modern calculators use binary numbers, which is attributed to Shannon himself. This machine taught me that Shannon loved to explore boundaries in engineering and mathematics.

"Vannevar Bush" Digital image. Acquisition Talk. Accessed February 14, 2021. https://acquisitiontalk.com/2020/10/vannevar-bush-argued-for-a-wholly-top-down-approach-to-military-rd/.

This is a photograph of Bush with the differential analyzer. The differential analyzer greatly inspired much of Shannon's work.

"Vannevar Bush with his Differential Analyzer." Digital image. *Encyclopaedia Britannica*. Ca. 1935. Accessed January 26, 2021. https://www.britannica.com/biography/Vannevar-Bush.

This is an image of Vannevar Bush with his differential analyzer. The abundance of images of Bush and his machine helped me understand that he was praised for his work.

Articles

Shannon, Claude. "A Chess-Playing Machine." *Scientific American.* February, 1950. Accessed November 28, 2020. http://www.paradise.caltech.edu/ist4/lectures/shannonchess1950.pdf.

This source explains how a machine that could play chess against a human would work. It was written by Claude Shannon, and it is his explanation of how he would build and code this machine. It helped me understand the process he used to think through information processing, and it gave me a lot of historical context about the technology Shannon was working with.

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Shannon, Claude. “A Mathematical Theory of Communication.” *The Bell System Technical Journal* 27. October, 1948. http://people.math.harvard.edu/~ctm/home/text/others/shannon/entropy/entropy.pdf.

In this journal article, Shannon describes how language could be recreated using the probability of words in relation to each other. Although Shannon uses complex equations to reach his outcome, he also explains the general idea of what he is doing. This helped me understand how complex Shannon’s work was. I used what I learned from it to explain Shannon’s impact on both communication and mathematics.

Shannon, Claude. “A Mathematical Theory of Cryptography.” *The Bell System Technical Journal.* Sept 1, 1945. https://bell-labs.com/claude-shannon/assets/images/discoveries/1945-09-01-TM45-110-92-math-theory-of-cryptography-single-document.pdf.

This formerly classified paper by Claude Shannon explains how sentences could be created by probability. Instead of randomly outputting a string of letters based on their frequency, Shannon’s model would form words by choosing a letter (or word), and then choosing the next letter by what letters commonly came after the previous one. This helped me understand the complexity of Shannon’s work and how it benefited communication.

Shannon, Claude. “A Universal Turing Machine with Two Internal States.” Accessed February 14, 2021. https://www.wolframscience.com/prizes/tm23/images/Shannon.pdf.

In this paper, Shannon explains how his peer Alan Turing’s machine concept could be executed differently. Alike to much of his work, Shannon wanted to represent everything with two states, usually the binary digits one and zero. In this paper Shannon explains some complex mathematical equations that would make this possible.

Shannon, Claude. “Communication Theory of Secrecy Systems.” *Bell Systems Technical Journal*. 1949, vol 28-4: 656-715.. Accessed February 17, 2021. http://netlab.cs.ucla.edu/wiki/files/shannon1949.pdf.

This paper explains many important aspects of communication through encrypted systems. Claude Shannon did this research to help the United States in WWII, but including this, much of his work was not published until afterward. This source helped

me understand the complexity of some of Shannon's work compared to his simple groundbreaking work which he cared most about.

Shannon, Claude. "Programming a Computer for Playing Chess." *Philosophical Magazine*. Vol. 41, No. 314. 1950. Accessed March 8, 2021. https://vision.unipv.it/IA1/ProgrammingaComputerforPlayingChess.pdf.

This is a paper that Claude Shannon wrote about his own chess machine. In the paper, Shannon discusses how the machine could calculate a move, and how it could run with the technology available at the time. Shannon explains a lot of complex equations that he used to understand this.

"Youthful Instructor Wins Noble Award." *The New York Times*. January 24, 1940: 8.

This article explains that even though Shannon was the youngest awardee of this prize at the time he won it, his paper was extremely remarkable. The content of this paper vastly influenced technology.

Interviews

Horgan, John. "Profile of Claude Shannon, Inventor of Information Theory." *Scientific American.* July 27, 2017. https://blogs.scientificamerican.com/cross-check/profile-of-claude-shannon-inventor-of-information-theory/.

This interview was mainly about information theory, but Shannon explained a lot of his motivations and reasons for his research. He explains that his main interest wasn't information theory, but intelligent machinery. Information theory was but a product of his research.

Shannon, Claude. Interview by Robert Price. The Institute of Electrical and Electronics Engineers. July 27, 1982. https://ethw.org/Oral-History:Claude_E._Shannon.

This interview covers a broad area of Shannon's life and he answers many questions about his work. This interview was conducted right before Shannon developed Alzheimers. It helped me put together his motivations with the work he did throughout his life.

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Other

Friedman, William. William Friedman to Claude Shannon. May 1954. https://archive.org/details/41790479082947.

This letter is from William Friedman to Claude Shannon and discusses Shannon's involvement with national security through his work with the SIGSALY. It helped me understand how Shannon's work with encryption of messages was beneficial to national security enough that Shannon's work was classified and important.

"United States Patent Office, Alexander Graham Bell, of Salem, Massachusetts, Improvement in Telegraphy." Google Patents: United States Patent Office. February 14, 1876. Accessed on February 11, 2021.https://patents.google.com/patent/US174465.

This is the patent for the telephone given to Alexander Graham Bell. This is an important milestone in both communication and Shannon's work in audio communication. Shannon worked at Bell Laboratories, named after Alexander Graham Bell, which directly connected him to Bell's discovery in multiple ways.

Secondary

"Alfred Noble Prize Past Award Winners." American Society of Civil Engineers. Accessed February 16, 2021. https://www.asce.org/templates/award-detail.aspx?id=1497&all_recipients=1

This is a list of the people that the Alfred Noble prize has been awarded to. Shannon won this in 1939, even though it was before a lot of his work, he was already very accomplished.

"A Brief History of Computer Chess." March 23, 2020. Accessed Jan 14, 2021. https://thebestschools.org/magazine/brief-history-of-computer-chess/#:~:text=This%20was%20the%20famous%20Mechanical,Maria%20Theresa%20of%20Austria%2DHungary.

This article is about the many discoveries that went into modern chess games which allow you to play against a computer. It provides images of different advancements towards a chess playing machine, which Shannon was one of the first to actually build. It

helped me put Shannon's discoveries about chess in context with many other chess related innovations.

"Claude Elwood Shannon." Last modified June 25, 2014. The History of Computing Project. https://web.archive.org/web/20201030224900/http://www.thocp.net/biographies/shannon_claude.htm.

This source provides a general overview of Dr. Shannon's life and his work. It explains the machinery that he used to solve equations and make discoveries, and it explains his discoveries about storing data in switches that represent only true and false. It helped me to place his work in historical context as it provides a timeline in chronological order of many important events in his life.

"Claude E. Shannon." Nokia Bell Labs. Accessed November 26, 2020. https://www.bell-labs.com/claude-shannon/.

This web page provides a lot of information about the many people who worked with Claude Shannon in his studies of information theory, in addition many documents written by Shannon are embedded in the web page. This page was created by Nokia's Bell Labs, which Claude Shannon worked at, and they have access to many images and documents of his. This source helped me develop my understanding of how Shannon and the people he worked with worked toward their discoveries of information theory and data processing.

"Claude Shannon." Information Theory Society. Accessed January 15, 2021. https://www.itsoc.org/about/shannon#:~:text=in%20mathematics%20from%20M.I.T.%20in,Churchill%20communicated%20during%20the%20war.

This article gives a general overview of Shannon's achievements and awards. It explains how he began with simple circuits and alluded that to information theory, which he had created. The article helped me generally understand what Shannon researched and the impact it made on the world.

"Claude Shannon: The Juggling Unicyclist Who Peddled Us Into the Digital Age." *Time Magazine.* April 29, 2016. Accessed February 20 2021. https://time.com/4311107/claude-shannon-100-years/.

This article discusses many aspects of Shannon's curiosity and learning. It explains how Shannon created so many different machines and inventions which he kept in his “toy room”. This article was made by *Time Magazine* for what would have been Shannon’s 100th birthday. It helped me understand how Shannon’s tinkerings and inventions were seen by others.

Effros, Michael, and H. Vincent Poor. “Claude Shannon: His Work and Its Legacy.” European Mathematical Society Newsletter, 2017, 3(103):29-34. Accessed February 19, 2021. https://www.researchgate.net/publication/318765641_Claude_Shannon_His_Work_and_Its_Legacy.

This article explains all the advancements that Shannon made to contribute to modern technology. The article was created by Dr. H. Vincent Poor who researches information theory at Princeton University. It helped me understand Shannon’s legacy and all the contributions he has made to technology and communication.

Hamkins, Jon. “Claude Shannon, Father of Information Theory.” NASA. Last Modified July 15, 2016. https://coding.jpl.nasa.gov/shannon.html.

This source explains Shannon’s accomplishments and his impact on information processing and transmission. It was written by Dr. Jon Hamkins, who worked with NASA’s Information Processing group at their Jet Propulsion Laboratory. This source helped me recognize the magnitude of Shannon’s discoveries, and how his work effects data processing an information theory today.

Hilbert, Martin. “Rant in the Defense of Shannon's Contribution: the Father of the Digital Age.” July 18, 2015. Youtube Video. 7:04. https://www.youtube.com/watch?v=z1rF9Yq4zC0.

This video explains how the Role of Warren Weaver in the Shannon-Weaver communication model was more focused on promotion, and Shannon did the vast majority of the work. This video was made by Martin Hilbert who is a professor at the University of California. It helped me understand how Shannon did not work for fame or credit, but he did his research for his own curiosity and learning.

“The History of the Telephone.” Mitel. Accessed February 14, 2021. https://www.mitel.com/articles/history-telephone#:~:text=1876%3A%20Since%20comin

g%20to%20America,worked%20to%20improve%20his%20invention.&text=The%20first%20phones%20were%20radio,were%20fading%20and%20interference%20issues.

This website gives a detailed timeline of all the advancements made relating to telephones. It is from the Canadian telecommunications company, Mitel. This timeline helped give me context to the other events that happened around Shannon who worked at Bell Telephone Laboratories.

Horgan, John. "Claude Shannon: Tinkerer, Prankster, and Father of Information Theory." IEEE Spectrum. Last modified April 29, 2016. https://spectrum.ieee.org/tech-history/cyberspace/claude-shannon-tinkerer-prankster-and-father-of-information-theory.

This article provides an in depth explanation of Claude Shannon's work with electrical engineering and information theory. The Institute of Electrical and Electronics Engineers is an institution run by engineers which provides information about electrical engineering and its history. I used this source to further understand Shannon's impact in the fields of electrical engineering and information theory.

Klein, Daniel. "Mighty Mouse." Technology Review. *MIT News Magazine.* December 19, 2018. https://www.technologyreview.com/2018/12/19/138508/mighty-mouse/.

This source explains how Shannon created a mouse which could learn to solve a maze, and provides a video of Shannon demonstrating its capabilities. This article was published by MIT's News Magazine as Shannon's mouse, though it no longer functions as it used to, is in MIT's museum. This article helped me understand how Shannon's mouse actually worked, and how it incorporated his other discoveries with switches and information theory.

Narins, Bringham, ed. "Claude Shannon." Biography in Context. *Gale.* July 1, 2008. https://link.gale.com/apps/doc/K1619002662/BIC?u=nysl_me_polyprep&sid=BIC&xid=c71254e6.

This article provides an overview of Shannon's life and work. It explains his main discoveries, papers, and awards. It was published in Gale's Biography in Context encyclopedia. It helped me to understand how many discoveries he made about information theory.

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Norman, Jeremy. “Turing Plays the First Programmed Chess Game on Paper as a ‘Human Computer’. ” History Of Information. Accessed January 15, 2021. https://www.historyofinformation.com/detail.php?id=3905.

This article about Alan Turing helped me put Shannon’s work with his chess machine in context. Alan Turing had embarked on a similar mission to create a machine that could play chess against a human, and possibly win. This article helped me understand the technology that they had access to, was nowhere near the technology that was needed to make this program. They were both ahead of their time.

“The President's National Medal of Science: Recipient Details.” Accessed February 14, 2021. https://www.nsf.gov/od/nms/recip_details.jsp?recip_id=317.

This is the page of an award that Shannon received in 1966. It is from the United States National Science foundation. The award helped me understand that although Shannon did not want to celebrate his work, others still wanted to honor him with awards.

Roberts, Siobhan. “Claude Shannon, the Father of the Information Age, Turns 1100100.” *The New Yorker*. April 30, 2016. Accessed March 8 2021. https://www.newyorker.com./tech/annals-of-technology/claude-shannon-the-father-of-the-information-age-turns-1100100.

This article discusses how the ‘tinkering’ that Shannon did was not only fun for him, but also used many of the fundamentals of both information theory and electrical engineering. It was written by Siobhan Roberts, who researches technology related histories. It helped me understand how Shannon not only made groundbreaking discoveries, but created the field of information theory.

Soni, Jimmy and Rob Goodman. “A Man in a Hurry: Claude Shannon’s New York Years.” *IEEE Spectrum*. July 12, 2017. https://spectrum.ieee.org/geek-life/history/a-man-in-a-hurry-claude-shannons-new-york-years.

This article highlights many of Shannon’s personal interests outside of information theory, and it explains his work during WWII. The two authors also wrote a book called *A Mind At Play* about Shannon. This article helped me understand Claude Shannon as a person outside of his fascination with tinkering.

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Soni, Jimmy, and Rob Goodman. *A Mind at Play: How Claude Shannon Invented the Information Age*. New York, NY: Simon & Schuster, 2017.

This book explains many aspects of Shannon's work and life. It goes into great detail about the projects that Shannon did and the impact he had. It is by the biographers Soni and Goodman who have also collaborated on another biography. I learned many different perspectives and facts about Shannon from this book.

Soni, Jimmy and Rob Goodman. "Betty Shannon, Unsung Mathematical Genius." *Scientific American*, July 24, 2017. Accessed February 17, 2021. https://blogs.scientificamerican.com/voices/betty-shannon-unsung-mathematical-genius/.

This article explains the importance that Betty Shannon, Claude Shannon's second wife, had on him. Betty was another mathematician who was interested in similar fields to Claude. While Shannon liked to research for himself, Betty wrote down his ideas and helped him organize them into a paper he could publish. This article was created by Jimmy Soni and Rob Goodman who were the authors of *A Mind at Play,* an autobiography about Claude Shannon. This article helped me understand that even though Claude Shannon was an independent person, his wife still assisted him in his research and was important to his success.

Soni, Jimmy. "It's Claude Shannon's 104th Birthday. To Celebrate, We Give You 104 Of His Best Quotes and Quips." August 30, 2019. Accessed February 11, 2021. https://medium.com/the-mission/on-claude-shannons-103rd-birthday-here-are-103-memorable-claude-shannon-quotes-maxims-and-843de4c716cf.

This is a compilation of quotes by Claude Shannon which were impactful to Jimmy Soni, who created this source. Soni wrote *A Mind At Play* which was a biography of Shannon. These quotes helped me to get a sense of Claude Shannon's great intellect, and his playfulness.

"T1 T2 T3 Speed Comparisons." January 12, 2020. Accessed February 27, 2021. https://r12hiw.netlify.app/t1-t2-t3-speed-comparisons.html.

This website explains how digital telephones were created and used by Bell Telephone Labs. Even though telephones are still often analog, digital telephone lines can be useful in many different ways. This helped me understand how telephone lines have evolved, even though they still may look the same.

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"Tech Icons: Claude Shannon." AT&T, April 19, 2011. YouTube video, 8:23. https://www.youtube.com/watch?v=z7bVw7lMtUg.

This YouTube video shows many experts discussing Shannon's legacy, and explains some of his mathematical theories. It was created by AT&T who formerly owned Bell Labs, where Shannon conducted a great amount of research. It helped me understand what Shannon actually studied in addition to his legacy and how much he has affected modern technology.

"World Chess Championship 1948 FIDE Title Tournament." Mark Weeks The World Chess Championship. 1997-2020. Accessed on February 11, 2021. https://www.mark-weeks.com/chess/48$c$wix.htm.

This is the score from the 1948 FIDE chess tournament. It shows that Botvinnik, who was from Russia, won which played into Russia's dominance over chess. This helped me understand other reasons why Shannon might want to join the race to make a chess playing machine.

Tertiary

"Claude Elwood Shannon." In *The Scribner Encyclopedia of American Lives.* Detroit, MI: Charles Scribner's Sons, 2004. *Gale In Context: Biography*. Accessed November 27, 2020. https://link.gale.com/apps/doc/K2874900277/BIC?u=nysl_me_polyprep&sid=BIC&xid=68a1dde0.

This source explains Shannon's fascination with engineering and information theory. It also explains how when he became famous for his discoveries and creations, he was nervous when speaking to large crowds, and did not enjoy public speaking. This source was created by The Scribner Encyclopedia of American Lives. It helped me to understand his motivations to learn more about electrical engineering and information theory.

"Information and information theory." In *World of Computer Science*. Detroit, MI: Gale, 2007. *Gale In Context: Biography.* Accessed November 27, 2020. https://link.gale.com/apps/doc/CV2424500316/BIC?u=nysl_me_polyprep&sid=BIC&xid=cf8cd46d.

This source explains Shannon's discoveries and equations for information theory from a mathematical perspective. It was created by Gale's encyclopedia to explain Dr. Shannon's work. It helped me better understand Shannon's work from a mathematical perspective which helps me understand his work further.

Markowsky, George. "Information theory." *Encyclopedia Britannica*. 2017. Accessed February 19, 2021. https://www.britannica.com/science/information-theory#ref710423.

This is a general overview of the history of Information Theory. Although there were many factors that played into the creation of Information Theory, Shannon's work was the main foundation. This Britannica Article was written by George Markowsky, who is a professor of computer science at the University of Maine. It helped me understand the history of the methods of communication that Shannon worked on.

Swaine, M. R. and Freiberger, Paul A. "ENIAC." *Encyclopedia Britannica.* May 27, 2020. https://www.britannica.com/technology/ENIAC.

This encyclopedia article is about the ENIAC, which was one of the first machines to be digital, or using binary. It was created by Encyclopedia Britannica, which describes the components and electronics that went into making the ENIAC. This helped me understand the advancement of technology, and helped me place Shannon into that story.