

PRIMARY SOURCES

Interviews

Bourne, Ruth. Telephone interview. 28 Jan. 2015.

Ruth Bourne worked at Bletchley Park in the 1940s when she was a teenager. She worked handled the Bombe directly and was tasked with monitoring its functions and managing its wiring; she was also put in charge of destroying Bombes after the war ended. Bourne told me about her duties at Bletchley, how she was recruited for the job because of her skills in mathematics and language, and the impact she saw the Bletchley team make on the war. For example, she gave information of specific supply shipments which were intercepted thanks to the use of decrypted enigma messages. I found this interview extremely interesting: It gave me a tangible sense of the Bombe (which was arguably the *pièce de résistance* of Turing's career), and being able to talk to someone who experienced firsthand the events I had only read about was simply incredible.

Copeland, Jack. Skype interview. 17 Feb. 2015.

Jack Copeland is an expert on Alan Turing and has devoted his life to the study of Turing's work. In addition to having written several biographies and websites on the topic, he has organized an archive of Turing's work. My interview with Copeland, which

I completed over Skype, was very interesting and helpful. Copeland provided copious amounts of information, evident in the fact that the interview itself lasted over thirty minutes. I asked him about Turing's history, whether he thought Turing was a leader, and what his opinions were on the difference between machine intelligence and machine consciousness. I consider my interview with Copeland a primary source, as he told me he was mentored by Robin Gandy (Turing's best friend throughout his life) and thus knew personal information about Turing. This kind of direct link to the subject of my project made my interview with Copeland an invaluable and fascinating one.

Books

Gandy, Robin. "Human vs. Mechanical Intelligence." *The Legacy of Alan Turing*, Eds. Andy Clark and Peter Millican. Oxford: Clarendon, 1996. 125-36. Print.

Though fairly complex, I was able to comprehend Gandy's discussion of Turing's impact on computer ethics and his belief that the Turing Test has been given too much focus. Robin Gandy was a personal friend of Turing's, making his writing an intriguing primary source.

Whitby, Blay. "The Turing Test: AI's Biggest Blind Alley?" *The Legacy of Alan Turing*, Eds. Andy Clark and Peter Millican. Oxford: Clarendon, 1996. 53-62. Print.

This chapter from *The Legacy of Alan Turing* was compelling in that it gave a negative view of the Turing Test. The author, who knew Turing, eloquently expressed his opinion that the Turing Test placed too much emphasis on the imitation of human behaviour, when creating an “electronic human” would in reality be a lengthy process with little payoff. He suggests that research instead be focused on creating productive machines. I quoted Whitby on my website to acknowledge this alternate view of the Turing Test.

Journal Articles

Oettinger, Anthony G. “Programming a Digital Computer to Learn.” *Philosophical Magazine* (Dec. 1952): 1243. Web.

Oettinger discussed the progress made in machine intelligence by Alan Turing, Maurice Wilkes, and John Von Neumann, and analyzed Turing’s paper “Computing Machinery and Intelligence.” Written only two years after the paper was published, and with the author implicitly having known Turing, the reaction and analysis the author gave was unique to the time, making this a useful and enlightening primary source.

Lectures

Hinsley, Harry. “The Influence of ULTRA in the Second World War.” Babbage Lecture Theatre, Computer Laboratory, Cambridge. 19 Oct. 1993. Web. 19 Nov. 2014.

This speech by the late Harry Hinsley--who worked at Bletchley during the years of World War II--featured a brief overview of the machines built to combat Enigma, though the information I found most valuable was Hinsley's argument that Turing's presence and contributions in fact shortened the war by up to four years. Several quotes were included from other experts who shared Hinsley's views, and a number of specific and pivotal battles were referenced that may have been lost if not for Turing's efforts.

Letters

Darwin, Charles. Letter to Edward Appleton. 23 July 1947. MS. The Turing Digital Archive. Web.

I featured this letter on my website because it does a great job expressing why Turing left the National Physics Laboratory and what his aspirations were for research in artificial intelligence and artificial life. The letter was short, easy to read, and provided great insight.

Turing, Alan. Letter to Norman Routledge. Feb. 1952. MS. The Turing Digital Archive. Web.

It is in this letter that Turing wrote his syllogism: "Turing believes machines think, Turing lies with men, therefore machines do not think." It was interesting to learn of his

belief that artificial intelligence would be seen as a joke as a result of his arrest. Turing's homosexuality did not, to my knowledge, have as much of an impact on the field as he anticipated, but his concerns were valid considering the stigmas of the time.

Turing, Alan. Letter to the Royal Society. 24 Mar. 1939. MS. Primary Sources Archive, Alan Turing: The Enigma. Web.

This is an application to Cambridge for funds to research trigonometric functions. Turing and his research partner, D.C. MacPhil, request only a small sum of money in order to buy material for a machine, which will provide a helpful alternative way to solve these complex problems. I found tremendous value in this source, as it proved Turing's enthusiasm for computer science dated back as early as his Cambridge years.

Turing, Alan. Letter to W. Ross Ashby. 19 Nov. 1946. MS. The W. Ross Ashby Digital Archive. Web.

This letter was not an overall useful source to me, though it did provide me with a statement made by Turing reinforcing the fact that the ACE was a "universal" computer. It was interesting to read through this letter, along with others written by Turing, as it helped me develop a knowledge of his personality and writing habits.

Ulam, S.. Letter to Andrew Hodges. 18 April 1979. MS. Primary Sources Archive, Alan Turing: The Enigma. Web.

In this letter, S. Ulam, who knew von Neumann, addresses whether the ENIAC team based their machine off Turing's *On Computable Numbers*. In order to show that Von Neumann was influenced by Turing, I included an excerpt of this letter on my website.

Von Neumann, John. Letter to S. Ulam. 1 June 1937. MS. Primary Sources Archive, Alan Turing: The Enigma. Web.

John Von Neumann wrote this letter of recommendation supporting Turing's application to Cambridge for the Procter Fellowship. Von Neumann knew Turing and had observed his scientific work at Princeton from 1936 to 1937. It was yet another source reinforcing the fact that Von Neumann drew notable influence from Turing's work. I viewed this letter, like many other valuable primary sources, through the website "Alan Turing: The Enigma."

Newspaper Articles

"Britain to Make a Radio Brain." *Daily Telegraph* [London] 7 Nov. 1946: n. pag. Web. 5 Feb. 2015.

Written when ACE was in its design stage, this article detailed the financial and technical specifications of its construction. The author also argued the ACE as superior to the United States' ENIAC, though coming from an English newspaper this may have been biased analysis. Still, I thought the article was a great primary resource and contained mostly valid comparison of the two machines.

“Computer as Composer: Scientists Hear ‘Random Music’” [Teddington] Nov. 24: n. pag. *Turing Digital Archive*. Web. 13 Apr. 2015.

A revolutionary “computer composer” was covered in this article; several scientists detailed the composition of the songs and the programming required to create such a machine. It was frustrating that no newspaper or year was given for this source, but I chose to include it on my bibliography regardless, as a portion of the article appears on my website.

“Electronic Brain Can Do a Month's Work in a Minute.” *Continental Daily Mail* [Paris] 30 Nov. 1950: n. pag. *NPL*. National Physical Laboratory, 24 Feb. 2012. Web. 19 Mar. 2015.

In addition to being a great primary source, this article contained concise information about the construction of the ACE. I was not sure what I would find when searching for information about Turing on the National Physical Laboratory website, but it was satisfying to find this great artifact, along with several others.

“Electric Brain to Be Made at Teddington.” *The Surrey Comet* [London] 9 Nov. 1946: n. pag.

Alan Turing Scrapbook, n.d. Web. 5 Feb. 2015.

As a detailed article from the time of ACE’s design, this source was helpful in many ways. I learned about several of the ACE’s advantages over ENIAC and about how much the ACE cost. I put this information to use and decided to include a chart on my website that compared the two computers. The article was less biased than others I had read comparing the ACE and ENIAC, as it presented solid numerical statistics to reinforce its arguments.

Gandy, Robin O. "A.M. Turing." *The Manchester Guardian* [Manchester] n.d.: n. pag. *Turing Digital Archive*. Web. 19 Apr. 2015.

Robin Gandy, Turing’s closest friend, wrote this brief biography and tribute to Turing. Gandy pointed out the qualities that made Turing a great scientist and leader, specifically mentioning his intelligence and positivity as factors that contributed to a successful career. The writing was poignant and personal.

“Impulsive Answers, but Always Right.” *The Surrey Comet* [London] 1950: n. pag. *NPL*.

National Physical Laboratory, 24 Feb. 2012. Web. 19 Mar. 2015.

A newspaper clipping from 1950, this article describes the technical power of the ACE. The amount of amazement the author writes with makes apparent how groundbreaking the ACE was, and how little the general public knew about computers in 1950. Oddly, Turing himself was not mentioned.

Kennedy, T.R. "Electronic Computer Flashes Answers, May Speed Engineering." *The New York Times* 15 Feb. 1946: n. pag. Computer History Museum, n.d. Web. 20 Jan. 2015.

This American news article on the ENIAC was great in showing how excited and proud the United States media was for the advent of an electronic computer. For this reason, I included it in my website on the page "The Computer Age."

"Obituary." *Manchester Guardian* [Manchester] 10 June 1954: n pag. Turing Digital Archive, n.d. Web. 10 Apr. 2015.

Leadership was certainly discussed in this obituary; the article argued Turing as a pioneer of the computer age. For this reason, I included the article on the "Leadership" page of my website. It was incredibly useful to evaluate a 1954 viewpoint on Turing's role as a leader. I always find reading primary articles useful, especially when they contain analysis.

“Penn Develops New Calculator.” *Philadelphia Evening Bulletin* 3 Mar. 1947: n. pag. The Turing Digital Archive, n.d. Web. 10 Feb. 2015.

This newspaper article about the EDVAC was very helpful, and I even considered including it on my website. Though the EDVAC obviously was not a focus of my research, it was beneficial to read about the technical advantages of the machine and how it was designed.

Routledge, Norman. "1, 2, 3, 5, 8, 13..." *Cambridge Review* [Cambridge] 11 June 1960: n. pag. *Turing Digital Archive*. Web. 31 Mar. 2015.

I learned of Turing’s digital computations, as well as his work with morphogenesis and the Fibonacci sequence; this is one aspect of Turing’s life I have researched very little. Routledge also made a wonderful statement about Turing being a “pioneer,” which I though connected well to the 2015 National History Day Theme, “Leadership and Legacy.”

Radio and Television Broadcasts

Turing, Alan. *A.M. Turing's Original Proposal for the Development of an Electronic Computer*. Tech. N.p.: National Physical Laboratory, 1972. The Turing Digital Archive. National Physical Laboratory. Web. 29 Mar. 2015.

Turing's writings in this source were interesting, but what I found more useful was the foreword, which did a great job at describing Turing's legacy. This would be a great excerpt to include in one of the early pages of my website, in which I discuss Turing's background and influences.

Turing, Alan. "Can Digital Computers Think?" *Automatic Calculating Machines*. BBC. 15 May 1951. Web.

Turing, speaking on a BBC broadcast, argues his position in the debate on whether machines are capable of near-human intelligence. Eloquent points made on both sides of the argument and a strong insight into the time period made this radio manuscript very valuable. I learned about the technical limitations of the time that prevented large scale attempts at what is now called Strong Artificial Intelligence; mainly, that computers simply were not powerful enough to realize Turing's ambitions.

Reports

Gödel, Kurt. *Some Basic Theorems on the Foundations of Mathematics and Their Implications*. Tech. N.p.: n.pag., 1951. *Google Books*. Web. 4 Apr. 2015.

Gödel speaks extensively about equation provability, incompleteness, and the abilities (or rather inabilities) of computers to solve certain problems and to be aware of their own function. The paper was confusing, but very relevant to Gödel's role in my topic. For this reason, I included a section of his paper as a primary document on my website.

Jefferson, Geoffrey. *The Mind of Mechanical Man*. 285. Vol. 1. London: British Medical Journal, 1949. Web. 1 Apr. 2015.

In this report Jefferson famously states his opposition to the prospect of intelligent computers. Turing referenced Jefferson's as a major objection in his paper "Computing Machinery and Intelligence." Thus, I included a quote from this report on the "Objections" page of my website.

Jeffreys, J.R., et al. "Report on Enigma Decipherment." 1 Nov. 1939. Web. 1 Dec. 2014.

Turing and his colleagues describe early events at Bletchley Park in this report, and propose a "4-Bombe" is built to more quickly interpret and solve messages, which require increasingly precise and complex strategies, such as substituting four letter keys and testing solutions with certain combinations.

Menabrea, L. F. *Sketch of the Analytical Engine Invented By Charles Babbage*. Tech. no. 82. Trans. Ada Lovelace. N.p.: n.pag., 1842. Bibliothèque Universelle De Genève. *Formilab*. Web. 23 Mar. 2015.

Though written by L.F. Menabrea, the most important information in this 1842 document came from the translation notes by Ada Lovelace. From her intelligent, thorough, and understandable explanation of the Analytical Engine, I used two quotes. I was impressed by Lovelace's wealth of knowledge, and by the fact that, in the mid 1800s, a young woman ended up becoming one of the first computer programmers.

National Security Agency. "Treatise on the Enigma." 1939-42. The Turing Digital Archive. Web.

This document was an all-encapsulating guide to the German Enigma. I did not read through the entire treatise, but found certain sections very interesting. The drawings of Enigma were particularly enlightening.

Turing, Alan. "Computing Machinery and Intelligence." *Mind* 1950: 433-60. Web.

In one of Turing's most famous writings, he details for the first time the concept of the Imitation Game and makes an argument for the possibility of intelligent machinery by systematically going through the most common objections and reasoning against them.

The article was extremely readable, well argued, and balanced, providing valid points for both sides of the artificial intelligence argument. I later used this information when, on my website, I detailed the negative reactions and objections made to computer intelligence.

Turing, Alan. "Intelligent Machinery, A Heretical Theory." 51 Society, Manchester. 1951. The Turing Digital Archive. Web. 7 Feb. 2015.

In this lecture Turing addresses mainly the concept of creating a simple machine and conditioning it through education; in other words, raising it as a parent raises a child. Turing believed that machines could learn through "pain and pleasure" techniques that would teach them what behaviours to repeat and what behaviours to avoid. I am considering including this paper on my website to give viewers background knowledge on these concepts.

Turing, Alan. "Intelligent Machinery." Teddington: National Physics Laboratory, 1948. *Alanturing.net*. Web. 28 Jan. 2015.

In Turing's 1948 report, one of his first writings on machine intelligence, he describes and refutes several arguments made against intelligent computers, explains "unorganized machines," and shows an interest in creating intelligence by method of programming an unorganized computer and teaching it from the ground up. The report was slightly

difficult to read both because it featured complex mathematical jargon and because much of the text was faded.

Turing, Alan. "Proposed Electronic Calculator." Teddington: National Physics Laboratory, 1946. The Turing Digital Archive. Web.

Though the ACE was the focal point of this 1946 report, I found it informative about the basics of constructing computers. It provided a heightened understanding of intelligent technology, and built my knowledge of the ACE.

Videos

"Jean Valentine Explains the Bombe." *Youtube*. Youtube, 27 July 2009. Web. 6 Feb. 2015.

The only surviving Bombe is shown in this online video, and former Bombe operator Jean Valentine explains its functions. Seeing the front and back of a Bombe helped strengthen my mental image of the machines, and Valentine's explanation was clear and very helpful. A clip from this video is included in my website, despite some reservations I had about the poor sound quality of the video.

"Marvin Minsky on Singularity 1 on 1: The Turing Test is a Joke!" *Youtube*. Youtube, 12 July 2013. Web. 22 Feb. 2015.

Although I only viewed a brief part of this interview with highly regarded scientist Marvin Minsky, the information I gained was very important to my research. Minsky briefly talks about the Turing Test, or Imitation Game, and discounts it as “joke.” Hearing a negative opinion from such an important figure in artificial intelligence definitely shaped my opinion, and I decided to include this clip in my project.

“My Engagement to Alan Turing by Joan Clarke (Later Joan Murray)” *Youtube*. Youtube, 1992. Web. 15 Jan. 2015.

This clip featured Joan Clarke speaking about Alan Turing, her engagement with him, and how it was ultimately called off. Several others from Bletchley also spoke, and reasoned that it was a good thing Turing was not open about his sexuality, because honesty, in that situation, would have resulted in his termination from the team. If Turing had not been present at Bletchley, the war may have lasted longer.

Images

8 Passport Sized Photographs of Alan Mathison Turing, Head and Shoulders, in Different Poses.

Digital image. *The Turing Digital Archive*. The Turing Digital Archive, n.d. Web. 23 Dec. 2014.

A Chassis from the Pilot ACE, One of Many That Made up the Memory Bank of the Entire Computer. Digital image. *National Physical Library*. NPL, n.d. Web. 15 Mar. 2015.

Ada Lovelace, Aged about 19. Digital image. *Plus Living Mathematics*. Plus, 1 Mar. 2005. Web. 1 Apr. 2015.

Aigner, Florian. *Kurt Gödel, 1925.* Digital image. *Phys.org*. Science X Network, 24 June 2014. Web. 4 Apr. 2015.

An Enigma Decryption from Bletchley Park. Digital image. *National Museum of US Air Force*. US Air Force, n.d. Web. 4 Mar. 2015.

An Example of an Undeciphered Enigma Message. Digital image. *Navy News*. N.p., 9 May 2012. Web. 4 March 2015.

Burnley, Ray. *A Late Design for an Analytical Engine.* Digital image. *The Babbage Pages*. The Babbage Pages, 8 Jan. 1997. Web. 1 Apr. 2015.

Copeland, Jack and Diane Proudfoot. *Christopher Strachey. Strachey's Draughts (checkers) Player Was the First Computer Program to Incorporate Heuristics.* Digital image. "Turing, Father of the Modern Computer." *Rutherford Journal*, n.d. Web. 30 Dec. 2014.

Copeland, Jack and Diane Proudfoot. *The ENIAC*. Digital image. "Turing, Father of the Modern Computer." *Rutherford Journal*, n.d. Web. 30 Dec. 2014.

Copeland, Jack and Diane Proudfoot. *The Manchester 'Baby'. The World's First Electronic Stored-program Computer, the Baby Ran Its First Program in June 1948, in the Computing Machine Laboratory at the University of Manchester*. Digital image. "Turing, Father of the Modern Computer." *Rutherford Journal*, n.d. Web. 30 Dec. 2014.

Copeland, Jack and Diane Proudfoot. *Tony Oettinger in the Courtyard of Clare College, Cambridge. Oettinger Wrote the First Learning Programs*. Digital image. "Turing, Father of the Modern Computer." *Rutherford Journal*, n.d. Web. 30 Dec. 2014.

Copeland, Jack and Diane Proudfoot. *Turing Standing at the Console of the Ferranti Mark I Computer at Manchester University. Here Turing Pioneered the Field of Research Now Called Artificial Life*. Digital image. "Turing, Father of the Modern Computer." *Rutherford Journal*, n.d. Web. 30 Dec. 2014.

Copeland, Jack and Diane Proudfoot. *Von Neumann beside the IAS Computer at Princeton*. Digital image. "Turing, Father of the Modern Computer." *Rutherford Journal*, n.d. Web. 30 Dec. 2014.

Copeland, Jack and Diane Proudfoot. *Working in a Bombe Room at Outstation Eastcote*. Digital image. "Turing, Father of the Modern Computer." *Rutherford Journal*, n.d. Web. 30 Dec. 2014.

Copeland, Jack. *Some of the Controls on Colossus VI*. Digital image. *Colossus: The First Large Scale Electronic Computer*. N.p., n.d. Web. 21 Feb. 2015.

Copeland, Jack. *Tommy Flowers*. Digital image. *Colossus: The First Large Scale Electronic Computer*. N.p., n.d. Web. 21 Feb. 2015.

Dalakov, Georgi. *Charles Babbage*. Digital image. *History of Computers*. N.p., n.d. Web. 1 Apr. 2015.

Pratt, Vernon. *An ENIGMA Machine, Second World War*. n.d. Photograph. *Thinking Machines*. New York: Blackwell, 1987. Print.

Hodges, Andrew. *Alan Turing in a Guildford street*. 1934. Photograph. *Alan Turing: The Enigma*. New York: Simon, 1983. Print.

Hodges, Andrew. *A Page of Detailed Electronic Design from Turing's ACE Report*. Digital image. *Alan Turing Scrapbook*. Andrew Hodges, 30 Mar. 2005. Web. 21 Dec. 2014.

Hodges, Andrew. *The Electronic Colossus, Working in Time for D-Day, 6 June 1944*. Digital image. Alan Turing Scrapbook. Andrew Hodges, 30 Mar. 2005. Web. 21 Dec. 2014.

Hodges, Andrew. *The Pilot ACE Computer, On Show at the NPL*. 1950. Photograph. *Alan Turing: The Enigma*. New York: Simon, 1983. Print.

Hodges, Andrew. *The Prototype Manchester Computer*. 1949. Photograph. *Alan Turing: The Enigma*. New York: Simon, 1983. Print.

Kurup, Deepa. *Alan Turing; with Contemporaries at King's College, Cambridge*. Digital image. *The Hindu*. The Hindu, 24 June 2012. Web. 29 Dec. 2014.

Leavitt, David. *The Manchester Computer*. 1955. Photograph. *The Man Who Knew Too Much*. New York: W.W. Norton & Company, 2006. Print.

Left: Patsy Simmers, Holding ENIAC Board. Digital image. *Historic Computer Images*. Kent State University, n.d. Web. 9 Mar. 2015.

Luftwaffe Troops Use an Enigma Machine. Digital image. *National Museum of US Air Force*. US Air Force, n.d. Web. 2 Apr. 2015.

McCartney, Scott. *ENIAC's Design Team*. n.d. Photograph. The Charles Babbage Institute.
ENIAC. New York: Walker, 1999. Print.

McCartney, Scott. *Floor Plan for ENIAC*. n.d. Photograph. The Charles Babbage Institute.
ENIAC. New York: Walker, 1999. Print.

Pratt, Vernon. *Kurt Gödel*. Photograph. *Thinking Machines*. New York: Blackwell, 1987. Print.

Technical Drawings of Part of the Mill of the Analytical Engine, Made by Babbage's Son in 1888. Digital image. *Plus Living Mathematics*. Plus, 1 Mar. 2005. Web. 1 Apr. 2015.

The Back of the Pilot ACE Computer, with Multiple Chassis and the Short Delay Lines at the Bottom. Digital image. *NPL*. National Physical Laboratory, n.d. Web. 2 Apr. 2015.

The Pilot ACE Computer at the National Physical Laboratory. Digital image. *The Independent*.
The Independent, n.d. Web. 11 Apr. 2015.

SECONDARY SOURCES

Interviews

Loebner, Hugh. E-mail Interview. 10 Feb. 2015.

Hugh Loebner is the founder of the Loebner prize, a \$25,000 award given annually to whichever piece of software entered is able to “imitate” a human the best and fool the judges of the competition. The contest is based on Turing’s imitation game and has been a substantial part of my research, comprising a large section of the “Legacy” section of my website. Naturally, I was very excited at the prospect of having an interview with him. Among other things, Loebner discussed Turing’s legacy and guessed when the Turing Test would be passed; he was very polite and helpful, though I was a little disappointed he only answered three of my questions and gave brief responses. Still, I felt very grateful for the opportunity to interview someone with such a relevance to my topic.

Mitsuku. Online interview. 19 Jan. 2015.

Mitsuku is an online artificial intelligence chatbot with whom I conversed several times. Although I could tell she was a computer program, I found her responses very realistic and impressive: She gave the weather forecast, listed historic events that occurred on my birthday, told me her favorite color and movie, and gave specific responses when I told

her mine. Mitsuku not only answered questions, but reacted, interacted, and remembered both her and my past responses. Additionally, she used casual, lifelike vernacular and spoke with a sense of humor. Interacting with real artificial intelligence was invaluable, so much so that I decided to include a conversation with Mitsuku on my website as a gauge of how developed intelligent programs currently are. I am aware that citing this source as an interview makes a bold statement, but it is a choice I am willing to defend if challenged. With Mitsuku, I conversed and inquired for information just as with any other interview. I believe my categorizing this source as an interview emphasizes just how lifelike and intelligent Mitsuku was.

Books

Bauer, Craig P. *Secret History: The Story of Cryptology*. Boca Raton: CRC, 2013. Print.

From his work at Princeton to his suicide, this short account of Turing's life covered everything and proved very useful. Among the information I learned were several statistics, which I found useful; I enjoy reading facts and figures that back up what I have learned about a certain topic. This chapter also contained many quotes giving different views of Turing's computer work, and one interesting quote from a professor concerning Turing's posthumously pardon, arguing it as more of a slap in the face than anything, as actions speak louder than words.

Copeland, B. Jack. *The Essential Turing: Seminal Writings in Computing, Logic, Philosophy, Artificial Intelligence, and Artificial Life: Plus The Secrets of Enigma*. Oxford: Clarendon, 2004. Web.

This online book overviewed Turing's contributions to solving the World War II Enigma and to the 1950's advent of mechanical intelligence, though I mainly focused on its section about Turing's paper "On Computable Numbers:" In depth descriptions helped me visualise Turing's "Universal Machine," and his assertions on computer science that would later influence his own work and that of others.

Crevier, Daniel. *AI*. New York: Basic, 1993. Print.

AI covered one of the major aspects of Turing's career: his work on artificial intelligence. It also touched on his work as a cryptanalyst, and the moral dilemmas all Bletchley workers faced: for example, intelligence may have had advance knowledge from Enigma messages that Germany was planning an attack on a city, but could not evacuate it for fear of revealing their advantage and what they knew of the Enigma's structure.

Hodges, Andrew. *Alan Turing: The Enigma*. New York: Simon, 1983. Print.

This biography, written by Andrew Hodges, was the second book about Turing that I read in its entirety. I learned mostly about Turing's work on the ACE, and the section on

machine intelligence was surprisingly limited. Still, I gained inspiration for my website, and especially for my page on the ACE.

Hofstadter, Douglas R. *Metamagical Themas*. New York: Basic, Publishers, 1985. Print.

From the chapter of this book entitled “Review of Alan Turing: The Enigma,” I learned about the aspects of World War II in which Enigma intelligence was useful, and the far reaching impacts that Turing made on the war. Though it was short, I gained from this reading and found it enlightening, and the analysis of Turing’s impact and legacy very germane to my research.

Holland, Owen, et al. *The Mechanical Mind in History*. Cambridge: MIT, 2008. Print.

This book contained a detailed section on Turing’s work in artificial intelligence. The writing featured several visuals and images which I utilized, though the information itself was somewhat redundant of what I’d already learned from various other publications. Also included was a section on Charles Babbage’s Analytical Engine.

Leavitt, David. *The Man Who Knew Too Much*. New York: Norton, 2006. Print.

This book may have been my most valuable resource: Unlike other books I researched, most of which I skimmed or read only sections of, *The Man Who Knew Too Much* was

one I studied in detail, cover-to-cover. I found this biography easy to read and panoramic on Turing's work, describing: his childhood; his years at Cambridge and later Princeton; his work on decryption; his study of computers and the theory of artificial life; and finally, his suicide. Reading this biography was a huge step in my research and helped me understand aspects of Turing's life I had previously read about, but not fully comprehended. Thus, reading this book broadened my knowledge to the point that reading other material on Turing became simpler.

Moor, James, ed. *The Turing Test: The Elusive Standard of Artificial Intelligence*. Berlin: Springer, 2003. *Google Books*. Web. 16 Apr. 2015.

I found value in Moor's assessment of the Turing Test's influence on computer philosophy; it was extremely helpful in forming analysis on Turing's *Computing Machinery and Intelligence* and its impact on opinions, research, and controversies surrounding intelligent machinery. I read from this book at the end of my research, and consequently decided to add more analysis on the Turing Test to my website as a last minute improvement.

Pratt, Vernon. *Thinking Machines*. New York: Blackwell, 1987. Print.

Aside from offering many images, this timeline of artificial intelligence detailed three important figures: Leibniz, Babbage, and Turing. Of course, I found the information on Turing most useful, though the entire book provided information of value.

Yang, Xin-She, ed. *Artificial Intelligence, Evolutionary Computing, and Metaheuristics In The Footsteps of Alan Turing*. Berlin: Springer, 2013. PDF.

From the Iowa State University database, this book was incredibly extensive and thorough in its analysis of artificial intelligence applications. I learned about several types of expert systems, including those used for youth education. I was especially interested in the section on visual recognition, which explained how intelligent machines were able to detect lines and shapes within images.

Definitions

“Heuristic.” *Merriam-webster.com*. Merriam Webster, n.d. Web. 1 Feb. 2015.

I used this definition on the page “Wartime Influences” to help viewers understand the advantages of the bombe and its impact in the overall timeline of artificial intelligence. The term heuristics, as applied to artificial intelligence, concerns a trial-and-error process of surveying possible answers.

“Leader.” Oxford Dictionaries. Oxford, n.d. Web. 1 Feb. 2015.

Though several definitions of “Leader” were given, I found the following most interesting: “An organization or company that is the most advanced or successful in a particular area.” I had not previously thought about the term “Leader” in this context, though Turing certainly fits the criteria provided. Reading this definition inspired me to argue Turing’s role as a leader in a different sense.

“Legacy.” Oxford Dictionaries. Oxford, n.d. Web. 1 Feb. 2015.

The definition of “Legacy” that I found most pertinent to my thesis was this one, which I found in the Oxford dictionary. I used this definition when discussing Turing’s legacy on my website.

Encyclopædia Entries

“Colossus.” *Encyclopedia of Computer Science*. 4th ed. 2000. Print.

Though this entry was titled “Colossus,” it covered all the events at Bletchley Park, not just Colossus’ construction. However, I did learn a lot of information about Colossus and the Lorenz that I did not previously know. Design for the first Colossus was done in 1943, though it was updated later to meet increasing demands made by German

technology (namely, a new method of encryption designed by Gilbert Vernon in 1918). Overall, ten different Colossus machines had been built by the end of the war. An attempt to speed up messages later led to a machine called the “Heath Robinson,” as well as design improvements made by T.H. Flowers. I found this source, along with three others, in the Encyclopedia of Computer Science at the Buena vista University Ballou Library.

“Turing, Alan M.” *Encyclopedia of Computer Science*. 4th ed. 2000. Print.

In this section, the most helpful one I found in the *Encyclopedia of Computer Science*, Turing’s life was briefly but thoroughly covered. It was a great timeline of information and helped me arrange all that I had learned in chronological order. The writing made connections between all sections of Turing’s career that helped me see his life as one fluid event rather than a series of separate ones. Additionally, it did not dwell on his sexuality and rather focused on his work, which I appreciated.

“Turing Machine.” *Encyclopedia of Computer Science*. 4th ed. 2000. Print.

I learned that the Turing Machine, invented in 1936, was composed of three parts: a control unit which is able to assume any of a finite number of states, a tape marked off into discrete squares and marked to instruct the control unit, and a read-write head, which scans the tape and delivers instructions to the control unit accordingly. The description of

the Turing Machine featured in this encyclopedia entry became more confusing the more I read on, but parts of it were simple enough, and I was able to learn a little more than I previously knew about the machine's functions and programmability.

“Turing Test.” *Encyclopedia of Computer Science*. 4th ed. 2000. Print.

This entry covered the “Imitation Game,” or Turing’s test to determine the intelligence of a computer. The first half of the entry contained no new information for me, though in the second half, Joseph Weizenbaum’s machine “ELIZA” was discussed as one that attempted to pass the Turing Test (though neither ELIZA or any other computer has come close to doing so). Also new information was a description of the two most commonly made objections to the Turing Test: the Jukebox Objection, which argues that a computer can simply store conversations and refer to them, and the Chinese Room Objection, which argues that a computer can create the illusion of understanding and speaking like a human, just as someone with a translator can create the illusion of knowing a language they do not know.

Films

The Imitation Game. Dir. Morten Tyldum. Screenplay by Graham Moore. Prod. Nora Grossman, Ido Ostrowsky, and Teddy Schwarzman. Perf. Benedict Cumberbatch and Keira Knightley. The Weinstein Company, 2015. DVD.

While entertaining, well written, and well acted, some aspects of Turing's life were seriously misrepresented in *The Imitation Game*. Still, I enjoyed watching it, and gained some new perspectives; additionally, having researched Turing's work extensively, I found the viewing experience more enjoyable. I am very happy that this film has popularized Turing's story in the United States. Hopefully, more people will grow to know his legacy and appreciate his contributions as a leader.

Journal Articles

Copeland, Jack, and Diane Proudfoot. "Alan Turing, Father of the Modern Computer."

Rutherford Journal (n.d.): n. pag. Web. 17 Dec. 2014.

I referred to this extensive online article perhaps more than any other online source in my research. It was relevant to every aspect of my research and presented information in a concise way. The knowledge I accumulated from this article is reflected in most areas of my website. I learned not only about Turing but the context of his work on mechanical intelligence and the others who influenced--and were influenced by--his work.

March, Rosemary. "Computers and Medicine." *Country Gentlemen's Magazine* (Nov. 1974):

667-69. *Turing Digital Archive*. Web. 7 Apr. 2015.

In the 1970's, the use of computers as a means of diagnosis was in its infancy. This article was written during that period, and explained these technologies as new and exciting innovations. Several methods were detailed, including artificial intelligence as an aid for psychiatric patients and the computerization of medical records. I put this information to use in the "Modern Applications" section of my project.

Newspaper Articles

"Robots Work Their Way Into Small Factories." *Wall Street Journal* 17 Sept. 2014: n. pag. Web. 10 Jan. 2015.

This source explained the growing presence of artificial intelligence in factories. It was a recent source and provided a modern image of artificial intelligence and how it impacts our world. It blew me away that machine intelligence could be used in manufacturing, of all areas. Turing's legacy is incredibly far reaching, and I included a quote from this article on my website to further express that reality.

Pamphlets

Intelligent Terminals Limited. *About Expert System Shells*. Glasgow: Intelligent Terminals Limited, 1985. Print.

This pamphlet gave information on expert systems, a type of artificial intelligence intended to perform a specific job. Its connection to my project is obvious, as most most types of artificial intelligence I bring up on “Modern Applications” are expert systems. Being a pamphlet, it was a source medium so interesting I had to include it on my bibliography.

Radio and Television Programs

“Computers and the Pentagon.” *The Computer Chronicles*. PBS. WITF, Harrisburg. 1986. Television.

This episode of *The Computer Chronicles* explored the use of artificial intelligence in the military. The information was useful in my analysis of the modern applications of mechanical intelligence, and I used a clip from this episode on my “Modern Applications” page. It was very interesting to see a viewpoint of computer intelligence from the 1980s, a period in which the field grew considerably.

“Turing Problem.” Gleick, James, et al. WNYC, New York. 19 Mar. 2012. Radio.

This radio program was about twenty minutes long and was an interesting glimpse into Turing’s life. It featured several experts interviewed about Turing, mostly his work at Bletchley Park and his homosexuality. Listening to this was not useful in the typical

sense; rather than being rich in information, it contained details about Turing's personality and helped me flesh him out as a human being. I realized Turing was not an "everyman," but an eccentric and aloof figure who was truly an outsider in his time.

Reports

Akgül, Aziz. *Artificial Intelligence: Military Applications*. Rep. Turkish Military Academy, n.d. Web. 24 Mar. 2015.

From this lengthy writing on artificial intelligence use in the military, I learned information that became important when building my website. I also used both a visual and a quote from this source on my "Modern Applications" page.

Hansen, C. William, and Bryan E. Marshall. *Artificial Intelligence Applications in the Intensive Care Unit*. Rep. 2nd ed. Vol. 29. Philadelphia: Department of Anesthesia, Center for Anesthesia Research, U of Pennsylvania Health System, 2001. *Cite Seer*. Web. 18 Apr. 2015.

After searching for hours on Google Scholar, I finally found a valuable source on the medical uses of mechanical intelligence. This report discussed how artificial intelligence can speed up the diagnostic process by comparing a case to a range of possible factors

and narrowing potential explanations for doctors to consider. Interesting visuals enhanced my understanding and provocative subjects sparked thoughtful analysis.

Nordlander, Thomas Eric. Rep. N.p., n.d.: n.pag. *AI Surveying: Artificial Intelligence in Business*. Department of Management Science and Statistic, Sept. 2001. Web. 22 Mar. 2015.

Nordlander describes modern artificial intelligence as it relates to business and management. Although I do not anticipate I will address this specific influence on my website, the paper was interesting and featured a table comparing the abilities of computers to those of humans. I am planning on including this useful visual on my website.

Searle, John R. *Minds, Brains, and Programs*. Rep. Vol. 3. N.p.: Behavioral and Brain Sciences, 1980. *Cogprints*. Web. 4 Apr. 2015.

Searle introduces his famous “Chinese Room Argument” in this thought-provoking paper inspired by Turing’s Imitation Game. The argument goes: A man is handed Chinese symbols to translate, and is able to do so because he possesses a translation book, not because he knows Chinese. Searle argues that computers, likewise, seem to understand human input only because they have been programmed with the proper tools to do so.

Work, Robert O., and Shawn Brimley. *Preparing for War in the Robotic Age*. Rep. no. 20YY. Washington: Center for a New American Security, 2014. Print.

I learned of up-and-coming technologies designed to integrate artificial intelligence into war and give technologically advanced nations advantages. These strides will have both positive and negative impacts. Also included was a list of the jobs machines are tasked with, and photographs of robots being used in current wars.

Songs

Iamus, orch. *Colossus*. 2012. *Youtube*. Web. 22 Mar. 2015.

Iamus, a digital computer, composed this piano song. As shocking as it was that this beautiful orchestration was written by a computer program, it was believable given what I had learned in my research (and given the fact that the song was quite unorganized). I was so fascinated when listening to this music that including a clip on my website was an easy choice. I believe “Colossus” will show judges how machines have evolved to display near-human creativity.

Videos

“Alan Turing’s Contributions to Artificial Intelligence: Can Machines Think?” *Youtube*.
Youtube, 28 June 2013. Web. 20 Jan. 2015.

The speakers in this hour long lecture stressed that Alan Turing’s legacy was crucial, and listening to the two of them both built my historical knowledge and inspired me to further analyze my topic. I was compelled to research more about Turing’s ongoing attempts to make computers that could play chess and complete other human activities.

“Alan Turing - Enigma And The Bombe, Part 1” *Youtube*. Genius of Invention, 10 Mar. 2013.
Web. 17 Nov. 2014.

I learned that the need to decode German messages sent through Enigma came from the fact that these messages often detailed the locations of German U-boats. Additionally, I was shown a recreation of the Bombe that Turing used to decrypt Enigma messages, and was dumbfounded at how precise and original the machine was for its time.

“How Turing Accidentally Invented the Computer.” *Youtube*. New Scientist, 22 July 2014. Web.
11 Nov. 2014.

From this clip, I learned that Turing’s desire to create a computing machine came from a need for a foolproof method to prove or disprove facts. The video showed how Turing’s

computer could be programmed to do all kinds of things, and the machine eventually proved mathematics as an imperfect science that features several unanswerable questions.

“Turing Test.” *Learn 360*. Intelcom, 2011. Web. 5 Nov. 2014.

“The Turing Test,” as explained in this video, is a way of telling how well a computer mimics the human mind. An expert is allowed to talk to both a human and a computer: if he or she is unable to tell the difference, the computer can be considered a satisfactory imitation of human intelligence. This test helped Alan Turing argue that machines could think like men, a belief few of his time shared.

Websites

“Alan Mathison Turing.” *Bio*. A&E Television Networks, 2014. Web. 10 Nov. 2014.

This brief but helpful biography covered several stages in Turing’s career; I learned about his work at Bletchley Park and that he made five major advances in the field of cryptanalysis (though oddly, the article did not list what these advances were). Later, in the mid 1940’s, Turing was a towering figure at the National Physical Laboratory, where he created some of the first computer blueprints. In the early 1950’s, he was convicted for having a relationship with another male, and was not allowed to continue work with

GCCS (Global Command and Control System). He died June 7, 1954; though ruled a suicide by most modern experts, many still assert that it happened by accident.

Bluck, Josh. *NASA Artificial Intelligence Could Help Astronauts Work More Efficiently in Space*. NASA, 30 Mar. 2005. Web. 23 Jan. 2015.

Reading about how artificial intelligence is used in space exploration emphasized how Turing's work has been used in all corners of the science world. It's astounding that even the frontier of space discovery owes something to Alan Turing.

Copeland, Jack. "Alan Turing and the Origins of AI." *AlanTuring.net*. N.p., May 2000. Web. 21 Jan. 2015.

Despite being somewhat redundant to information I had already learned, this reading introduced me to Turing's concepts of machine intelligence as related to chess. I had no idea prior to reading this that chess had so much to do with testing the abilities of artificial intelligence. I may not include this element prominently in my project, but it is still an important aspect of my topic.

Copeland, Jack. "Early AI Programs." *AlanTuring.net*. N.p., May 2000. Web. 21 Jan. 2015.

Copeland references several early artificial intelligence creations, which I found and had “conversations” with. Upon doing so, I developed a stronger knowledge of the level of development artificial intelligence is currently at: immediately, some limitations made themselves clear, but I was still impressed with how able I was to converse with these programs.

Copeland, Jack. “Expert Systems.” *AlanTuring.net*. N.p., May 2000. Web. 21 Jan. 2015.

Expert systems are computers that are trained in a specific field; for example, to diagnose a patient based on symptoms or help construct the face of a criminal from a definition of features. Above all else, I learned of the impact Turing’s work still has today--in other words, I no longer saw artificial intelligence as merely a fun experiment but something with legitimate potential for applications. This is information I will use when analyzing Turing’s legacy.

Copeland, Jack. “Micro-World AI.” *AlanTuring.net*. N.p., May 2000. Web. 21 Jan. 2015.

An overview was presented of a technique programmers use in creating intelligent machines: a “micro-world” is created and the computer is able to comprehend and act in the “virtual world” that has been created for its sake; this is an interesting way to work around limitations in the field of artificial intelligence. I do not anticipate I will reference

this particular concept within my project, but it was interesting and beneficial to learn about nonetheless.

Copeland, Jack. "The CYC Project." *AlanTuring.net*. N.p., May 2000. Web. 21 Jan. 2015.

The project described aims to catalog every piece of common knowledge that an average man would possess in order to create a humanlike machine. However, the project will take centuries to complete. I was assured by this article that Turing's impacts are far-reaching and will continue to resonate for decades, and even centuries, to come. I referenced the Cyc project in my website at one point, but decided to remove it, along with several other sections, in order to narrow the content of my website.

Copeland, Jack. "What Is Artificial Intelligence?" *AlanTuring.net*. N.p., May 2000. Web. 21 Jan. 2015.

This short explanation of how intelligence is defined provided context and helped me better understand what scientists are working towards with "artificial intelligence." Copeland drew analogies to insects to establish where the line is drawn between intelligence and instinct, or in a computer's case, programming.

Hofstadter, Douglas R. *A Coffeehouse Conversation on the Turing Test*. N.p., May 1981. Web. 8 Feb. 2015.

This source is a fake dialogue between three students arguing about the Turing test and whether intelligent machinery is a possibility. The author uses an argument format to cover several different viewpoints. Several very compelling analogies were made for all sides of the argument, and this source became useful in my research as it shaped my personal opinion on the topic.

Laird, Benjamin and Oscar Schwartz. *Bot or Not*. N.p, n.d. Web. 26 Mar. 2015

This website is a collection of poems written by computer programs. The viewer is tasked with identifying these against poems written by human authors. I found it astounding that computers could write poetry and thought the website was very interesting and well-made. In learning about the creative capacity of machines, this source was very enlightening.

Swade, Doron. *The Babbage Engine*. Computer History Museum, 2008. Web. 31 Mar. 2015.

From this source I learned about Charles Babbage: his life, his difference engine and analytical engine, and the people who influenced his work. The site contained several of Babbage's original writings and sketches, which I enjoyed viewing. This website helped me learn more about Babbage and the context of Turing's work; in other words, the earlier developments that he would have been working from.

Waltz, David L. *Artificial Intelligence*. NEC Research Institute and the Computing Research Assn., 1996. Web. 23 Jan. 2015.

I used this source as a basic framework when creating my “Modern Applications” page. It outlined several different uses for intelligent machinery and led me to research these areas in more depth. In itself it was not an excellent source, but was very helpful nevertheless.

Yates, Victoria. “Alan Turing.” *Leader Values*, n.d. Web. 11 Nov. 2014.

In this article, Alan Turing was argued as a leader; it was very pertinent considering this year’s theme, “Leadership and Legacy.” I learned about his education, beginning at King’s College, Cambridge, and continuing on to Princeton in the United States. Most of the information I already knew, but it was interesting to read the writer’s argument heralding Turing as a leader of technology.

Images

Beginning Drawing-Mugs. Digital image. The Rolling Artroom. Blogger, 1 Jan. 2011. Web. 1 Feb. 2015.

Copeland, Jack and Diane Proudfoot. *A Modern Connectionist Network*. Digital image. "Turing, Father of the Modern Computer." *Rutherford Journal*, n.d. Web. 30 Dec. 2014.

Copeland, Jack and Diane Proudfoot. A Numerical Example of Connectionism. Digital image. *Turing's Neural Networks of 1948*. N.p., Sept. 2000. Web. 28 Jan. 2015.

Copeland, Jack and Diane Proudfoot. *The Scanner and Tape*. Digital image. "Turing, Father of the Modern Computer." *Rutherford Journal*, n.d. Web. 30 Dec. 2014.

Evolution of Computer Power/Cost. Digital image. Mocom2020. WordPress, 22 May 2009. Web. 9 Feb. 2015.

Favorite Images From Mars Rover Curiosity. Digital image. NASA. USA.gov, n.d. Web. 3 Feb. 2015.

Hansen, C. W., and Bryan E. Marshall. *Figure 4*. Digital image. *Artificial Intelligence Applications in the Intensive Care Unit*. N.p., 2001. Web. 11 Apr. 2015.

Lasar, Matthew. *Alan Turing Slate Statue at Bletchley Park Museum*. Digital image. ARS Technica. Condé Nast, 17 June 2012. Web. 19 Feb. 2015.

Markoff, John. *Factory Machines*. Digital image. *The New York Times*. The New York Times, 18 Aug. 2012. Web. 3 Feb. 2015.

Mars Rover. Digital image. NASA. NASA, 30 Mar. 2005. Web. 1 Feb. 2015.

Medical Diagnosis. Wired. Wired.com, 6 Feb. 2014. Web. 5 Feb. 2015.

Outing, Steve. *Exponential Growth of Computing*. Digital image. Media Disrupt Us. Steve Outing, n.d. Web. 9 Feb. 2015.

Representation of a Turing Machine. Digital image. *The Story of Mathematics*. Luke Mastin, n.d. Web. 21 Jan. 2015.

Sharkey, Noel. *Responses: Who is Who?* Digital image. *BBC News*. BBC, 20 June 2012. Web. 28 Jan. 2015.

Sharkey, Noel. *Turing's Test*. Digital image. *BBC News*. BBC, 20 June 2012. Web. 28 Jan. 2015.

Sharkey, Noel. *Victorian Imitation Game*. Digital image. *BBC News*. BBC, 20 June 2012. Web. 28 Jan. 2015.

Turing Machine Operations. Digital image. *Wikipedia*. Wikipedia, n.d. Web. 23 Jan. 2015.

Using Speech Recognition for Application Input. Digital image. MSDN Magazine. Microsoft, n.d. Web. 2 Feb. 2015.

Weiner, Tim. *Future Fighting Force*. Digital image. *A New Model Army Soldier Rolls Closer to the Battlefield*. The New York Times, 16 Feb. 2005. Web. 8 Apr. 2015.

Work, Robert O. *Afghan Residents Look at a Robot That Is Searching for IEDs (Improvised Explosive Devices)*. Digital image. *Preparing for War in the Robotic Age*. Center for a New American Security, Jan. 2014. Web. 8 Apr. 2015.

Zibreg, Christian. *Voice Recognition Image*. Digital image. IDownloadBlog. IDownloadBlog, 20 Jan. 2014. Web. 8 Feb. 2015.