Abstract

This essay will serve as a biographical study on Alan Turing and his numerous contributions to the field of computer science. Often revered as the “founder of computer science,” Turing made significant impacts on the field that led to many future technological innovations and events. Additionally, much of his work played a pivotal role in altering the course of history, including his contributions to the American war effort during World War II. A portion of this essay will focus on Turing’s childhood and early life, demonstrating his upbringing and the path which led him to his successful career as a computer scientist. The academic work he completed while studying at King’s College, Princeton University, and Cambridge University will also be discussed. His other professional work outside of these universities will be examined. Turing’s two most important contributions (breaking the Enigma code and developing the Turing Test for machine intelligence) will be studied at length and further explained. Lastly, Turing’s unfortunate death (and the reasons behind it) will also be included. The essay will show the myriad of ways in which Turing contributed to computer science and changed history as a whole.

Though each field and subject area boasts numerous experts and geniuses, few shall ever achieve as much as Alan Turing. Bestowing Turing with a title such as “mathematician” or “computer scientist” proves to be an impossible task due to the variety of science-, math-, and technology-based tasks he performed throughout his work. Turing used this knowledge to produce innovative work that shaped the course of history and altered the technological world for years to come. The myriad of groundbreaking feats performed by Alan Turing make his contributions some of the most important to the fields of computer science, mathematics, and cryptology, among others.

Alan Mathison Turing was born on June 23, 1912 in London, England (*Alan Turing: The Turing Archive*). Turing and his older brother, John, suffered at the hands of relatively absent parents. Their father served as the Government of the Madras Presidency, an administrative subset of British India, and left them in the care of a retired Colonel in Hastings, England during his absence. At the age of nine, the Colonel sent Turing to a preparatory boarding school by the name of Hazelhurst, located in Sussex. After several years of private education, he began attending a public school known as the Sherborne School in Dorset. Throughout these years in his academic career, Turing received a multitude of criticisms from his teachers, who cited him as “ludicrously behind” and his work as poor and inconsistent (*Alan Turing: The Enigma*).

Despite Turing’s seemingly poor experience at these schools, the education he received while there ignited his interest in mathematical and scientific matters. It was in one of these science courses where he first met Christopher Morcom who shared his love for science and general worldview. This friendship proved to be Turing’s first homosexual experience as he fell into deep love for his peer. Unfortunately, this love proved unrequited and painful when Morcom passed away suddenly in February of 1930 (*Alan Turing: The Enigma*).

Turing’s upper-level academic endeavors began when he received a prestigious scholarship to study at King’s College of Cambridge University, which continues to serve as the storage site of his papers even today. As an undergraduate, he studied mathematics and further explored the works of mathematicians Roger Penrose, Stuart Hameroff, John von Neumann, and Bertrand Russel, among many others (*Alan Turing: The Enigma*).

In 1935 (at the age of 22), Turing received the honor of being elected a Fellow of King’s College. During that same year, he worked tirelessly on researching computing machines. Known today simply as “Turing machines” after the man who helped create them, these machines served as precedents by which all subsequent digital computers have been modeled. Turing’s work proved that his machine could be “programmed to stimulate any other Turing machine.” Turing worked closely with American logician Alonzo Church to develop the Church-Turing thesis, a piece that explained and defended the concept that all mathematical concepts could be executed by this Turing machine (*Alan Turing: The Turing Archive*).

Turing continued his studies at Princeton University, earning his PhD in mathematical logic under the direction of Alonzo Church. While at Princeton, Turing examined “the notion of ‘intuition’ in mathematics and developed the concept of oracular computation,” which has become a fundamental aspect of mathematical recursion theory (*Alan Turing: The Turing Archive*). After earning his doctorate degree, he received an offer for a post-doctoral position from John von Neumann that would have allowed him to remain in the United States; however, Turing elected to return to Great Britain (*Alan Turing: The Enigma*).

Turing returned to Cambridge and set to work designing detailed physical machines. This work, combined with his prior interest in cryptography, helped him achieve a position with the British government during World War II. His job was to decipher top-secret German codes that had been used in communications between the Axis Powers. These codes had been developed by a machine known as the Enigma (*Alan Turing: The Enigma*). Working at the Government Code and Cypher School at Bletchley Park, he designed machines that could decipher the Enigma codes (*Alan Turing: The Turing Archive*). One such machine, co-designed by Turing and Cambridge mathematician Gordon Welchman, was known as the Bombe and could decipher any Enigma-produced code as long as “the hardware of the Enigma was known and that a plain-text ‘crib’ of about 20 letters could be guessed accurately” (*Alan Turing: The Enigma*). According to historical data, Turing’s ability to break the Enigma code shortened the duration of the war by over two years and saved an estimated 14 million lives (*The* *Imitation Game*).

In the post-war world, Turing was recruited to the National Physical Library in London with the goal of designing an electronic computer based off of the universal Turing machine. His plans outlined a design for a machine known as the Automatic Computing Engine (ACE), cited as “the first relatively complete specification of an electronic stored-program general-purpose digital computer.” Unfortunately, Turing’s peers believed that the work required to build the ACE would prove too difficult and instead built a smaller machine known as the Pilot Model ACE. The Pilot Model ACE would go on to hold the record for the fastest computer in the world for some time after its creation (*Alan Turing: The Turing Archive*).

Throughout Turing’s time at the National Physical Library, the organization remained in a tense competition to build the first working digital computer in the world. Unfortunately, due to delays which Turing had no control over, the National Physical Library did not receive this honor. Instead, the Royal Society Computing Machine Laboratory of Manchester University achieved this feat in June 1948. Becoming fed up with the delays that led to this loss for the National Physical Library, Turing moved on to work at the Royal Society Computing Machine Laboratory in an administrative position. While there, he designed the programming system for the world’s first commercially available electronic digital computer, known as the Ferranti Mark I. Turing would go on to spend the remainder of his career at Manchester, receiving several prestigious honors along the way, such as his election to a Fellow position at the Royal Society of London in 1951 (*Alan Turing: The Turing Archive*).

Turing also devoted much of his career to the extensive study of artificial intelligence. In 1951, he published a paper that proposed a test known as the “Imitation Game.” An article from the University of Toronto describes the test in detail, explaining how it is used to study machine intelligence:

“The first version of the game, he explained, involved no computer intelligence whatsoever. Imagine three rooms, each connected via computer screen and keyboard to the others. In one room sits a man, in the second a woman, and in the third sits a person – call him or her the “judge.” The judge’s job is to decide which of the two people talking to him through the computer is the man. The man will attempt to help the judge, offering whatever evidence he can (the computer terminals are used so that physical clues cannot be used) to prove his manhood. The woman’s job is to trick the judge, so she will attempt to deceive him and counteract her opponent’s claims, in hopes that the judge will erroneously identify her as the male.” (The Turing Test)

Though this initial proposal has seemingly little to do with artificial intelligence, Turing then developed a modification of the game in which the judge competed against a human (of either gender) and a computer. The judge then had to decide which one was a machine. Turing proposed that “if, under these conditions, a judge were less than 50% accurate, that is, if a judge is as likely to pick either human or computer, then the computer must be a passable simulation of a human being and hence, intelligent” (The Turing Test). This test remains relevant decades later in today’s world as humans face intimidating technological developments and relate them to issues of identity and intellect.

Despite his numerous invaluable contributions to the success of technology within his country and throughout the world, Turing faced a harsh demise. During his life, homosexuality remained a crime in Great Britain and in March 1952, he was prosecuted for being homosexual. His sentence included twelve months of hormone therapy which proved destructive to his health and contributed to his early death (*Alan Turing: The Turing Archive*). Such mistreatment for a man like Turing has been regarded as unjust throughout history, leading to a postmortem pardon by the Queen of England in 2014 (Mullen).

Alan Turing’s variety of impressive innovations and contributions to the worlds of computer science, mathematics, and cryptography make him worthy of continued outstanding recognition. Although the end of his life came in an untimely and unfair manner, his suffering at the hands of a homophobic government should not define his legacy; rather, Turing should continue to be known as the man who helped to end one of the most destructive wars in history and devoted his life to technological progression.

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