Alan Mathison Turing – A Biography of a Software Engineer

I have always been fascinated by movies which depict real-life events, so when the opportunity came to discuss the impact and work of a key software engineer, I saw my chance to write about the 'father of Computer Science', Alan Turing. My favourite movie of all time is called 'The Imitation Game', a movie which depicts a newly created British Intelligence agency, MI6 recruiting Cambridge mathematics alumni to crack Nazi codes during World War II. Alan Turing being among these few mathematicians.

Alan Turing was born June 23rd, 1912, in London. He attended the University of Cambridge (1931), where he achieved a distinction in his study of mathematics (1934), he was then elected for a fellowship at King's College in recognition of his dissertation which proved the fundamental results on probability theory, more specifically the central limit theorem. In 1936, Turing delivered a paper "On Computable Numbers, with an Application to the Entscheidungsproblem", this paper presented the notion of an abstract and universal machine which we now recognise as a "Turing machine". Turing originally referred to this machine as an "a-machine" or an "automatic machine". A Turing machine is a computational model that performs calculations by reading and writing to an infinite tape. The Turing machine can simulate any computer algorithm, regardless of the complexity of the problem, it became the basis for all subsequent digital computers.

In the September of 1936, Turing left London to spend two academic years studying under Alonzo Church, an American mathematical logician at Princeton University, returning to England in the July of 1938. Turing moved to Princeton University to study for a Ph.D in mathematical logic under Church's direction. In addition to Turing's study in mathematical work, he also studied cryptology and built three of four stages of an electro-mechanical binary multiplier. Alan Turing's doctoral dissertation, "Systems of logic based on ordinals," dealt with the undecidability of transfinite sequences of certain formal systems

In 1939, Turing was recruited to work at the British Government Code and Cypher School at Bletchley Park, which was a small code-breaking organization apart of MI6. Alan Turing was one of few (13 Oxford academics and 24 Cambridge) recruited and sent on a training course to learn about codes and the Enigma machine. The Enigma machine was a type of enciphering machine used by the German armed forces to send encrypted messages securely. In 1938, the year prior to Alan Turing's recruitment to Bletchley, Polish mathematicians and cryptologists created a special purpose machine called 'The Bomba', by 1938, Polish cryptographers were reading some 75 percent of intercepted German radio transmissions enciphered using the Enigma machine, and the information was shared with the British. In 1940, the Germans increased its security by changing the cipher system daily, the change meant that the loophole the Polish had discovered to find the starting positions of the wheels had been eliminated, 'The Bomba' was now practically useless to these new ciphered messages.

In March 1940, Turing created a code-breaking machine called "The Bombe" which was an electromechanical machine, the name being very similar to that of the Polish Bomba as it took inspiration from this machine. In the August improvements were made to the British Bombe incorporated from British mathematician, Gordon Welchman. This machine consisted of approximately 100 rotating drums, 10 miles of wire and about 1 million soldered connections. Turing's machine, Bombe searched through different possible positions of Enigma's internal wheels, looking for connections that would turn coded letters into plain German. It is important to note that the codes being decrypted by the Bombe in the mid-1940's were those of the Germain Air Force. Turing had to further work to decrypt the more complex German naval communications as the German U-boats were inflicting heavy losses on the Allied ships and the need to understand their signals was growing crucial. Turing created a cryptanalytic process called 'Banburismus', by using this technique and the captured Enigma material, 'Hut 8' were able to decrypt and understand naval

messages from 1941. This meant that Allied ships could be directed away from the U-boat 'wolf-packs'. Turing's role was pivotal in helping the Allied U-boats.

In the July of 1942, Turing created yet another code-breaking technique called 'Turingery' or 'Turing's method'. The method was created for use in cryptanalysis of the Lorenz cipher, a cipher which was produced by one of the Germans' secret writer machines, which the British codenamed as 'Tunny' machines. The Lorenz cipher contained German strategic messages of extremely high importance. Turing was sent to the United States in the November of 1942, he was sent to ultimately lie to the Americans about the progress they had made, also to take notes on the different machines that they were developing. Whilst in Washington D.C, one machine in particularly caught Turing's eye, a speech encryption system. Taking inspiration from this machine, Turing returned to Bletchley in March 1943 and started work on a new speech scrambling device which he named as 'Delilah'. Delilah was a portable device for speaking securely with another individual, it could be used to scramble a telephone or radio conversation, this system was extremely effective as it proved very hard to break.

Ultimately, the war ended 1945 with the win on the Allied side, due to the major contributions and machines created by Alan Turing and his team, hut 8. It is believed the operations at Bletchley, ultimately the contributions from Alan Turing during World War II are said to have shortened the war by as many as two to three years, and that Turing's work ultimately is estimated to have saved two million more lives.

After the war, between 1945 and 1947, Alan Turing worked at the National Physical Laboratory, here he was working on the design of an Automatic Computing Engine (ACE), he presented a paper 19 February 1946, which was one of the first designs and a ground-breaking blueprint for a stored program at the same time. A complete version of the ACE was never completed; however, its concept has been used as a model by tech corporations worldwide. It influenced the design of the English Electric DEUCE and the American Bendix G-15 – credited by many in the tech industry as the world's first personal computer. In 1948, Turing helped to develop the Manchester computers at the Victoria University of Manchester, here he worked o software for one of the earliest stored-program computers known as the 'Manchester Mark 1'. Turing wrote the first version of the Programmer's Manual for this machine.

Whilst working in the National Physical Laboratory in 1948, Turing wrote a report entitled "Intelligent Machinery". In his report Turing stated that a thinking machine should be given a blank state of mind of an infant instead of an adult mind filled with opinions and ideas. This is where Turing's study of mathematical biology came into play as he began to discuss neural networks. Turing believed that a team of programmers could bring this learning machine from childhood to adulthood maturity in fifty years.

In 1950, Turing published "Computing Machinery and Intelligence", in this paper Turing addressed the problem of artificial intelligence and proposed an experiment that became known as the "Turing test". The Turing test would determine whether a machine could be considered "intelligent". The idea behind the Turing test is that a computer is said to be able to "think" if a human interrogator could not tell it apart, through conversation, from a human being. Turing predicted that machines would eventually be able to pass the Turing test, he estimated that by the year 2000, machines with around 100MB of storage would be able to fool 30% of human judges in a five-minute test, and that people would no longer find the phrase "thinking machine" contradictory.

Although Turing was engaged to a fellow mathematician and cryptanalyst, Joan Clarke, their engagement was short-lived as Turing admitted his homosexuality and decided he could not go through with the marriage. In January 1952, Turing started a relationship with Arnold Murray, on 23rd of January, Turing's house was burgled by his partner Arnold Murray and once the police arrived at the scene, Turing acknowledged being involved in a sexual relationship with the perpetrator.

Homosexuality was illegal in the United Kingdom, as a result Turing was charged with gross indecency. Following his arrest, Turing was stripped of his security clearance and forced to choose between temporary probation on the condition he receive hormonal treatment for libido reduction, or imprisonment. Turing chose the first option and soon was a victim to chemical castration, receiving injections of synthetic oestrogen hormone for a year, which ultimately rendered him impotent. Turing was barred from continuing his work with cryptography at the GCCS.

Turing died June 7th, 1954, ages only 41, it is determined however disputed as being a suicide via cyanide poisoning.

Although during Turing's lifetime he did not receive the recognition he deserved for his work throughout World War II, his work for the mathematical industry, computer science industry and many more industries. Over the decades after his passing, Turing's work is being recognised globally for the importance it holds. Queen Elizabeth II granted Alan Turing a rare mercy pardon which came into effect December 24th, 2013, she also granted a law in his name, which pardoned men convicted in the past for homosexuality, this law came into full effect in 2017.

I chose Alan Turing was for obvious reasons, he is known as the founding father of computer science, but he also not only changed the academic worlds but also the modern world. His discoveries in mathematics, computer science and artificial intelligence are not only ground-breaking but life changing. Turing's paper in which he published in 1936 is now recognised as the foundation of computer science. He changed the world of academics, but he also begun the conversation of homosexuality in men. Alan Turing grew up in a failed society and was ultimately failed by the government he served. Alan Turing is not only just an icon for homosexual men, but a role model for the entire LGBTQ community.

As a software engineer, Turing's mathematical work not only had a significant impact on the defeat of Enigma, but it is also the foundations of modern computing. The modern world of laptops, Instagram, mobile phones are all based on his ideas. I believe it is safe to say, if we did not have the discoveries of Alan Turing, the world as we know it could be very different to how we know it modern day. In practise, Alan Turing was an engineer in the development of his early computing machines.

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