Grace Hopper

To produce a short (2-4 page) biography of a key software engineer, discussing the work and impact of the individual.

Rear Admiral Grace Hopper was an early and influential software engineer. She is credited with the invention of the first linker, paving the way for compilers, a crucial development in the world of software engineering. Trained in mathematics, Hopper joined the US Navy in World War 2 and worked on the earliest [] computers. Known for her common sense attitude towards dealing with computers, she worked to simplify computers and make the process of programming easier for everyone, leading her to be one of the first to advocate and later create an english-based programming language. Thus, I would argue that not would was Hopper an extremely impactful software engineer but also a practical one.

Grace Murray was born in New York City on December 9, 1906, the eldest of three children. Attending Vassar College, she graduated Phi Beta Kappa with a B.A. in Mathematics and Physics in1928. Hopper had wished to follow her grandfather's footsteps and become an engineer. However, when deciding her future, she realised there was no place at all for women in engineering and settled to pursue an academic career in mathematics. Hopper earned an M.A. and PhD in mathematics at Yale University. In 1931, she joined the Vassar faculty as an associate professor – just a year after she married Vincent Foster Hopper, a doctor of comparative literature and instructor at New York University. Hopper spent the next twelve years teaching at Vassar. Later in life, when asked what the most important things she achieved in life, her answer was "training young people".

When World War 2 began, Hopper decided it was time to serve her country. She tried and failed to enlist several times, but at the age of 34, she was deemed too old. However, she was finally accepted in Women Accepted for Volunteer Emergency Service (WAVES) programme. In 1944, Hopper was commissioned Lieutenant in the Naval Reserve and was assigned to the Bureau of Ships Computation Project at Harvard University. There she programmed one of the first program-controlled computers ever built: the Navy's electromechanical Automatic Sequence Controlled Calculator. The behemoth (55 feet long, 8 feet high) is known to the world as the Mark I computer.

The Mark I was tasked to work out calculations for various war projects, including the Manhattan Project. Surprisingly, Hopper had never heard of a computer before being thrown in the deep end. After the war, Hopper continued working on the Harvard Mark series, working on both the Mark II and Mark III.

Famously, on September 9, 1945, the computer that Hopper was working on stopped. When the team investigated the problem, they discovered a moth was trapped in the machine. Hopper removed and taped in the logbook, adding the caption “First actual case of bug being found,”. This incident is often credited as the first time anyone used the word bug to describe a computer glitch. Naturally, the term debugging followed.

It was around this time, Hopper began formulating one of her major contributions to software engineering. Hopper was well-known for explaining things to people without necessarily using technical vocabulary. This skill was extremely useful in the military and illustrated her innate nature as a teacher. Crucially, this skill granted her the insight that the majority of people will struggle to use computers due to symbol and mathematical based coding languages. Even skilled programmers made errors due to these difficult languages. Thus, Hopper wanted to create a user-friendly English-language programming language.

Her idea was laughed at, since "computers don't speak English". However, she continued to develop and push the concept. In 1949, her three-year fellowship at Harvard ending, she decided to join the Eckert-Mauchly Computer Corporation to help design and program UNIVAC I, the first commercial electronic computer. Her job; collecting and gathering a library of subroutines.

Hopper recognised two issues that were the efficiency of computers and programming. The first problem; programmers copied code from others often but were poor at copying. Essentially confusion and errors arose when programmers, with handwritten programmes, struggled to differentiate their symbols for code. An example of this could be as simple as their deltas looking like fours or their Bs looking like 13s.

The other issue was that writing programs, at that time, still involved plenty of arithmetics which programmers often struggled with and made mistakes. Hopper’s solution to these problems was common sense. In her own words, Hopper explained that “There sat that beautiful big machine, whose sole job was to copy things and do addition, why not make the computer do it?”. Thus Hopper began research compilers.

In 1952, Dr Hopper developed the first compiler, A-O, a mathematically oriented single-pass Compiler. More similar to what we now call a Linker, Hopper had put all the subroutines she had been collecting over the years on tape. Each routine was given a call number, so that it the machine could find it on the tape. This greatly reduced the slow progress of giving computers operating instruction every single time. She and her team continued to develop compilers in the A-1 and A-2. In fact, the A-2 source code was given to UNIVAC customers for feedback and this is one of the first cases of Open-Source software development.

The compiler could time to catch on among the programming community. However, Hopper didn’t let that slow her down. She continued her compiler research and operating under her theory that english-based programming was possible, created the B-O compiler, the first English-like data processing language, later know as Flow-Matic, a precursor to COBOL.

In 1959, Dr Hopper and colleagues among users, educators, and vendors began their push for a common language for business applications and hence, greater compatibility among vendor systems. They organised CODASYL, the Conference on Data Systems Languages, forming a committee tasked with creating COBOL (Common Business Oriented Language). Hopper used as a technical advisor of the committee. She later stated that the first version of COBOL was “95% FLOW-MATIC”, and while later versions involved features from other languages, FLOW-MATIC was its greatest inspiration. She also developed validation software for COBOL and its compiler as part of a COBOL standardization program for the entire Navy.

Hopper retired from the Naval Reserve with the rank of Commander in 1966, when she reached the mandatory retirement age of 60. Commander Hopper was recalled to active duty in 1967 for a six-month assignment requested by Norman Ream, Special Assistant to the Secretary of the Navy for Automatic Data Processing. However, Ream had the length of her assignment changed to “indefinitely” – this, because he wanted her to execute her proposal: the development of testing and validation procedures to enforce standards and hence, ensure portability. At this point, vendors had so hampered portability among systems that conversion costs were exploding.

She would remain with the Navy for 19 years. From 1967 to 1976, she served as director of Navy programming languages and language standards, and from 1976 to 1986 she was Special Advisor to the Commander of the Naval Data Automation Command, heading the Training and Technology Directorate. The ultimate Navy honour came in 1985 when she was promoted to Rear Admiral, a historical first for a woman. In 1986, Rear Admiral Hopper, the oldest serving officer, retired for the final time and was honoured in a ceremony on the USS Constitution.

Rear Admiral Grace Murray Hopper died on January 1, 1992, and was laid to rest at Arlington National Cemetery. In her lifetime, Hopper oversaw the massive boom of computer technology, starting back she was coding behemoth machines in Harvard to the 1980s when she worked on standardisation of programming languages. Her work and advocacy for user-oriented english-based languages directly lead to the development of COBOL, in which her work is extremely presented. Today, COBOL at over 50 years old, is still used in 95% of ATM swipes and COBOL systems handle €3 trillion in commerce each day. Aside her contribution to COBOL, Hopper also was a pioneer in creating the compiler, a massive step forward in software engineering. Therefore, I believe that Grace Hopper was an extremely brilliant and impactful software engineer and programmer.