Grace Murray Hopper – Programming Pioneer

Grace Brewster Murray was born on December 9, 1906 in New York City, USA. She was a very good student at school and was always at the top of her class. She graduated from Vassar College in 1928 with a BA in mathematics and physics. She earned an MA in mathematics from Yale University in 1930 and married Vincent Hopper. She continued her studies and obtained a PhD in 1934. She joined Vassar as an instructor during her postgraduate studies and remained there till 1943 when she became an associate professor.

Hopper's great grandfather was a Rear Admiral in the U S Navy and was her personal hero. So when the United States entered World War II, she wanted to join the Navy but was not able to, as women were not accepted by US Navy. By 1943 there was a shortage of men and the Navy started accepting women into 'Women Accepted for Voluntary Emergency Service' (WAVES). She was accepted in WAVES, and after training, assigned to work at the Bureau of Ordinance Computation Project at Harvard University under the direction of Howard Aiken. Her first job was to program Harvard Mark I to compute firing tables for weapons. Programming this electro-mechanical relay computer was laborious as there was no concept of languages and all programming was a sequence of bits. She continued to work at Harvard on Mark II and III. She is credited with coining the term 'debugging of programs'. Once while working on the machine a recurring error occurred and its origin was obscure. She detected the problem as that arising due to a moth which was stuck between relay contacts which she promptly removed and thus 'debugged' the system!

Hopper always felt that computers should not be the private preserve of mathematicians and engineers and wanted to develop programming methodology which would allow a much wider group of persons to use computers. In order to fulfill this vision she joined Eckert Mauchly Computer Corporation which had designed and built one of the first stored program electronic computer which used vacuum tubes. The commercial version of the machine was called Univac I (Universal Automatic Computer). Here she initiated work on compilers, which she called 'A-0'. The A-0 series of compilers translated symbolic mathematical codes (which were written using mnemonics instead of binary codes for instructions) into machine code and assigned call numbers to each routine and stored them on a magnetic tape. By combining a sequence of call numbers, the routines could be brought from the tape, placed in main memory at appropriate addresses and executed. Hopper called it the first 'compiler'. This work convinced her of the possibility of developing user-friendly computer languages to program computers. In fact she went one step further and developed an 'English like' language to write programs. Moving ahead with this vision she headed a team to develop Univac B-0 compiler, which was later, called FLOW-MATIC. It was designed to translate a language that could be used for typical business tasks such as billing, inventory and payroll computation. The FLOW-MATIC made Univac I and II 'understand' and translate twenty statements written using English words. This was the forerunner of the next major development in computer languages, namely COBOL (Common Business Oriented Language).

Hopper actively participated in the meetings of a group called CODASYL (Committee for Data Systems Languages), which was set up to develop COBOL specifications. COBOL design was greatly influenced by FLOW-MATIC and the first COBOL specifications appeared in 1959. Hopper spent considerable time and effort to convince managers that it would be wise to use higher level languages such as COBOL to ensure machine independence of programs. She led an effort to standardise COBOL and persuaded the entire United States Navy to adopt COBOL for their data processing. Another major effort she initiated was to validate COBOL compilers for the Navy to ensure that they adhered to standards. The idea of validation of compilers had widespread impact on standardising other programming languages such as FORTRAN.

In 1966 Hopper was promoted by the Navy to commander and as she had crossed the legal age of retirement, she retired on December 31, 1966. Soon the Navy wanted her back to work on COBOL and put her on 'temporary duty' which was later changed to 'indefinite'. In 1985, Hopper was appointed Rear Admiral by President Reagan. In 1986 she retired for good again from the Navy (at the age of 80) and was the United State's oldest military officer 'in uniform'. After her retirement from the Navy she accepted a position with the Digital Equipment Corporation as senior consultant where she remained until her death in 1992.

Grace Murray Hopper received several awards during and after her lifetime. In 1969, she was awarded the first 'Computer Science Man-of-the-Year' by Data Processing Management Association, USA. She was elected Fellow of the Institution of Electrical and Electronic Engineers and named a distinguished fellow of the British Computer Society. In 1979 President Bush awarded her the National Medal of Technology, the first individual to receive it. After her death, the US Navy announced that they would name a guided missile destroyer USS Hopper.

In retrospect, Hopper's perseverance and vision benefited development of data processing in many ways. Her work encompassed programming languages, software development, compiler verification and standardization. Her early recognition that computers have a major role to play in commercial applications spearheaded rapid adoption of computers by business and industry and consequently massive investments and rapid developments of information technology.

Suggested Reading

[1] Nancy Whitelaw, '*Grace Hopper Programming Pioneer*', W H Freeman and Co., NY, USA, 1995.
[2] Proceedings 1994 ACM Conference 'Grace Hopper – Celebration of Women in Computing'.

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