**Grace Murray Hopper** (December 9, 1906 – January 1, 1992) was an American [computer scientist](http://en.wikipedia.org/wiki/Computer_scientist) and [United States Navy](http://en.wikipedia.org/wiki/United_States_Navy) [Rear Admiral](http://en.wikipedia.org/wiki/Rear_admiral_(United_States)). A pioneer in the field, she was one of the first programmers of the [Harvard Mark I](http://en.wikipedia.org/wiki/Harvard_Mark_I)computer, and developed the first [compiler](http://en.wikipedia.org/wiki/Compiler) for a computer programming language.[[1]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-Wexelblat81-1)[[2]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-Spencer85-2)[[3]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-Laplante01-3)[[4]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-Bunch93-4)[[5]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-Booss03-5) She conceptualized the idea of machine-independent programming languages, which led to the development of [COBOL](http://en.wikipedia.org/wiki/COBOL), one of the first[modern programming languages](http://en.wikipedia.org/wiki/High_level_programming_language). She is credited with popularizing the term "[debugging](http://en.wikipedia.org/wiki/Grace_Hopper#Anecdotes)" for fixing computer glitches (inspired by an actual [moth](http://en.wikipedia.org/wiki/Moth) removed from the computer). Owing to the breadth of her accomplishments and her naval rank, she is sometimes referred to as "Amazing Grace".[[6]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-urlCyber_Heroes_of_the_past:_Amazing_Grace_Hopper-6)[[7]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-urlGrace_Murray_Hopper-7) The U.S. Navy destroyer [USS *Hopper* (DDG-70)](http://en.wikipedia.org/wiki/USS_Hopper_(DDG-70)) is named for her, as was the [Cray XE6](http://en.wikipedia.org/wiki/Cray_XE6) "Hopper" supercomputer at [NERSC](http://en.wikipedia.org/wiki/NERSC).

Early life and education[[edit](http://en.wikipedia.org/w/index.php?title=Grace_Hopper&action=edit&section=1)]

Hopper was born **Grace Brewster Murray** in [New York City](http://en.wikipedia.org/wiki/New_York_City). She was the oldest in a family of three children. She was curious as a child, a lifelong trait – at the age of seven she decided to determine how an alarm clock worked, and dismantled seven alarm clocks before her mother realized what she was doing (she was then limited to one clock).[[8]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-8)For her [preparatory school](http://en.wikipedia.org/wiki/University-preparatory_school) education, she attended the [Hartridge School](http://en.wikipedia.org/wiki/Wardlaw-Hartridge) in [Plainfield, New Jersey](http://en.wikipedia.org/wiki/Plainfield,_New_Jersey). Rejected for early admission to [Vassar College](http://en.wikipedia.org/wiki/Vassar_College) at age 16 (her test scores in Latin were too low), she was admitted the following year. She graduated [Phi Beta Kappa](http://en.wikipedia.org/wiki/Phi_Beta_Kappa_Society) from Vassar in 1928 with a bachelor's degree in mathematics and physics and earned her Master's degree at [Yale University](http://en.wikipedia.org/wiki/Yale_University) in 1930.

In 1934, she earned a Ph.D. in mathematics from Yale under the direction of [Øystein Ore](http://en.wikipedia.org/wiki/%C3%98ystein_Ore).[[9]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-greenladuke09-9)[[10]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-10) Her [dissertation](http://en.wikipedia.org/wiki/Dissertation), *New Types of Irreducibility Criteria*, was published that same year.[[11]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-11) Hopper began teaching mathematics at Vassar in 1931, and was promoted to associate professor in 1941.

She was married to [New York University](http://en.wikipedia.org/wiki/New_York_University) professor Vincent Foster Hopper (1906–1976[[12]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-12)) from 1930 until their divorce in 1945.[[9]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-greenladuke09-9) She never remarried, and she kept his surname.

### World War II[[edit](http://en.wikipedia.org/w/index.php?title=Grace_Hopper&action=edit&section=3)]

In 1943, Hopper obtained a leave of absence from Vassar and was sworn into the [United States Navy Reserve](http://en.wikipedia.org/wiki/United_States_Navy_Reserve), one of many women to volunteer to serve in the [WAVES](http://en.wikipedia.org/wiki/WAVES). She had to get an exemption to enlist; she was 15 pounds (6.8 kg) below the Navy minimum weight of 120 pounds (54 kg). She reported in December and trained at the Naval Reserve Midshipmen's School at [Smith College](http://en.wikipedia.org/wiki/Smith_College) in [Northampton, Massachusetts](http://en.wikipedia.org/wiki/Northampton,_Massachusetts). Hopper graduated first in her class in 1944, and was assigned to the [Bureau of Ships](http://en.wikipedia.org/wiki/Bureau_of_Ships)Computation Project at [Harvard University](http://en.wikipedia.org/wiki/Harvard_University) as a lieutenant, junior grade. She served on the [Mark I computer](http://en.wikipedia.org/wiki/Harvard_Mark_I) programming staff headed by [Howard H. Aiken](http://en.wikipedia.org/wiki/Howard_H._Aiken). Hopper and Aiken coauthored three papers on the Mark I, also known as the Automatic Sequence Controlled Calculator. Hopper's request to transfer to the regular Navy at the end of the war was declined due to her age (38). She continued to serve in the Navy Reserve. Hopper remained at the Harvard Computation Lab until 1949, turning down a full professorship at Vassar in favor of working as a research fellow under a Navy contract at [Harvard](http://en.wikipedia.org/wiki/Harvard_University).[[13]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-KBW-13)

### UNIVAC[[edit](http://en.wikipedia.org/w/index.php?title=Grace_Hopper&action=edit&section=4)]

In 1949, Hopper became an employee of the [Eckert-Mauchly Computer Corporation](http://en.wikipedia.org/wiki/Eckert-Mauchly_Computer_Corporation) as a senior mathematician and joined the team developing the [UNIVAC I](http://en.wikipedia.org/wiki/UNIVAC_I). In the early 1950s the company was taken over by the [Remington Rand](http://en.wikipedia.org/wiki/Remington_Rand) corporation and it was while she was working for them that her original [compiler](http://en.wikipedia.org/wiki/Compiler) work was done. The compiler was known as the A compiler and its first version was [A-0](http://en.wikipedia.org/wiki/A-0_programming_language).[[14]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-mcgee2004-14):11

In 1952 she had an operational compiler. "Nobody believed that," she said. "I had a running compiler and nobody would touch it. They told me computers could only do arithmetic."[[15]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-15)

In 1954 Hopper was named the company's first director of automatic programming, and her department released some of the first compiler-based programming languages, including [ARITH-MATIC](http://en.wikipedia.org/wiki/ARITH-MATIC), [MATH-MATIC](http://en.wikipedia.org/wiki/MATH-MATIC) and [FLOW-MATIC](http://en.wikipedia.org/wiki/FLOW-MATIC)

### COBOL[[edit](http://en.wikipedia.org/w/index.php?title=Grace_Hopper&action=edit&section=5)]

In the spring of 1959 a two-day conference known as the Conference on Data Systems Languages [CODASYL](http://en.wikipedia.org/wiki/CODASYL) brought together computer experts from industry and government. Hopper served as the technical consultant to the committee, and many of her former employees served on the short-term committee that defined the new language [COBOL](http://en.wikipedia.org/wiki/COBOL). The new language extended Hopper's FLOW-MATIC language with some ideas from the [IBM](http://en.wikipedia.org/wiki/IBM) equivalent, [COMTRAN](http://en.wikipedia.org/wiki/COMTRAN). Hopper's belief that programs should be written in a language that was close to English rather than in [machine code](http://en.wikipedia.org/wiki/Machine_code) or languages close to machine code (such as [assembly language](http://en.wikipedia.org/wiki/Assembly_language)) was captured in the new business language, and COBOL would go on to be the most ubiquitous business language to date.[[16]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-KWB-16)

From 1967 to 1977, Hopper served as the director of the Navy Programming Languages Group in the Navy's Office of Information Systems Planning and was promoted to the rank of captain in 1973.[[13]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-KBW-13) She developed validation software for COBOL and its compiler as part of a COBOL standardization program for the entire Navy.[[13]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-KBW-13)

### Standards[[edit](http://en.wikipedia.org/w/index.php?title=Grace_Hopper&action=edit&section=6)]

In the 1970s, Hopper advocated for the Defense Department to replace large, centralized systems with networks of small, distributed computers. Any user on any computer node could access common databases located on the network.[[14]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-mcgee2004-14):119 She pioneered the implementation of [standards](http://en.wikipedia.org/wiki/Standardization) for testing computer systems and components, most significantly for early [programming languages](http://en.wikipedia.org/wiki/Programming_languages) such as [FORTRAN](http://en.wikipedia.org/wiki/Fortran) and COBOL. The Navy tests for conformance to these standards led to significant convergence among the programming language dialects of the major computer vendors. In the 1980s, these tests (and their official administration) were assumed by the National Bureau of Standards (NBS), known today as the [National Institute of Standards and Technology](http://en.wikipedia.org/wiki/National_Institute_of_Standards_and_Technology)(NIST).

## Retirement[[edit](http://en.wikipedia.org/w/index.php?title=Grace_Hopper&action=edit&section=7)]

Hopper retired from the Naval Reserve at age 60, in accordance with Navy attrition regulations, with the rank of [commander](http://en.wikipedia.org/wiki/Commander_(United_States)) at the end of 1966.[[17]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-urlAttrition.2FRetirement-17) She was recalled to active duty in August 1967 for a six-month period that turned into an indefinite assignment. She again retired in 1971, but was asked to return to active duty again in 1972. She was promoted to [captain](http://en.wikipedia.org/wiki/Captain_(U.S._Navy)) in 1973 by [Admiral](http://en.wikipedia.org/wiki/Admiral_(United_States)) [Elmo R. Zumwalt, Jr.](http://en.wikipedia.org/wiki/Elmo_R._Zumwalt,_Jr.)[[18]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-navybio-18)

After Rep. [Philip Crane](http://en.wikipedia.org/wiki/Philip_Crane) saw her on a March 1983 segment of [*60 Minutes*](http://en.wikipedia.org/wiki/60_Minutes), he championed [H.J.Res. 341](http://hdl.loc.gov/loc.uscongress/legislation.98hjres341), a joint [resolution](http://en.wikipedia.org/wiki/Resolution_(law)) in the [House of Representatives](http://en.wikipedia.org/wiki/United_States_House_of_Representatives) which led to her promotion to [commodore](http://en.wikipedia.org/wiki/Commodore_(USN)) by special Presidential appointment.[[18]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-navybio-18)[[19]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-19)[[20]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-20)[[21]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-DavidLetterman86-21) She remained on active duty for several years beyond mandatory retirement by special approval of the President.[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)] In 1985, the rank of commodore was renamed [rear admiral, lower half](http://en.wikipedia.org/wiki/Rear_Admiral_(lower_half)). She retired (involuntarily) from the Navy on August 14, 1986. At a celebration held in Boston on the [USS *Constitution*](http://en.wikipedia.org/wiki/USS_Constitution) to celebrate her retirement, Hopper was awarded the [Defense Distinguished Service Medal](http://en.wikipedia.org/wiki/Defense_Distinguished_Service_Medal), the highest non-combat award possible by the Department of Defense. At the time of her retirement, she was the oldest active-duty commissioned officer in the United States Navy (79 years, eight months and five days), and aboard the oldest commissioned ship in the United States Navy (188 years, nine months and 23 days).[[22]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-22)

She was then hired as a senior consultant to [Digital Equipment Corporation](http://en.wikipedia.org/wiki/Digital_Equipment_Corporation), a position she retained until her death in 1992, aged 85.

Her primary activity in this capacity was as a goodwill ambassador, lecturing widely on the early days of computers, her career, and on efforts that computer vendors could take to make life easier for their users. She visited a large fraction of Digital's engineering facilities, where she generally received a standing ovation at the conclusion of her remarks. During many of her lectures, she illustrated a nanosecond using salvaged obsolete Bell System 25 pair telephone cable, cut it to 11.8 inch (30 cm) lengths, [the distance that light travels in one nanosecond](http://en.wikipedia.org/wiki/Light-nanosecond), and handed out the individual wires to her listeners. Although no longer a serving officer, she always wore her Navy full dress uniform to these lectures.

The most important thing I've accomplished, other than building the compiler, is training young people. They come to me, you know, and say, "Do you think we can do this?" I say, "Try it." And I back 'em up. They need that. I keep track of them as they get older and I stir 'em up at intervals so they don't forget to take chances."[[23]](http://en.wikipedia.org/wiki/Grace_Hopper#cite_note-23)

She was interred with full military honors in [Arlington National Cemetery](http://en.wikipedia.org/wiki/Arlington_National_Cemetery).