Diabologic: Grace

by Frank Dolinar

We've all heard the phrase "the program has a bug in it". There aren't real bugs wandering around in our computers, and even if there were, they'd have scant effect on the program. So what does this mean?

Sixty-eight years ago (1939), while working on his Ph.D. in Physics from Harvard, Howard Aiken began to think about constructing a machine to help tedious calculations. He eventually succeeded in convincing IBM to fund his project, the Harvard Mark I, eventually known as the IBM Automatic Sequence-Controlled Calculator.

It had 3300 relays, 750,000 parts, was 50 feet long, weighed five tons, and could perform a blazing three operations per second. Given the technology, the machine also made a lot of noise, and it was constantly having problems with one or another physical or electrical component failing.

In the midst of this cacophony, someone had to "program" this behemoth (and its successors).

That someone was Grace Murray Hopper, a Midshipman in the US Naval Reserve, whose first assignment was with (Commander) Howard Aiken at the Bureau of Ordinance Computation at Harvard University. She became the third programmer on the Mark I.

The computer was used to calculate aiming angles for Naval guns in varying weather conditions. Because the results of these calculations were so significant to the war effort, Grace and her assistants often worked on the system twenty-four hours a day. They spent countless hours transcribing and entering codes for Mark I and its successors, Mark II and III. (In 1946, she received the Naval Ordnance Development Award for this work.)

One day, while trying to determine why one of her Mark II program's didn't work, she actually found a moth caught in one of the relays – which caused that particular relay to fail to make its intended electrical connection and the program to malfunction. ***Note: This is no myth. Grace pasted the moth into the logbook of the Mark II (now at the Smithsonian). Hence the name computer "bug".***

Grace Hopper's career was full of achievement.

From 1946 to 1949 she worked as a civilian research fellow at Harvard in Engineering Sciences and Applied Physics. Then she joined the Eckert-Mauchley Computer Corporation as a senior mathematician. This work helped make possible the first commercial computers, the UNIVAC I and II. (Eckert-Mauchley was bought, in 1950, by Remington Rand, which itself subsequently merged with the Sperry Corporation.)

In the early 1950s, she developed the first compiler (a program to take the instructions written by a human and turn them into something usable by the computer's hardware). It was the first step on the road to what we think of today as programming languages, such as Algol, Basic, C/C++, or Fortran.

Her next achievement was, by the standards of the day, a radical departure. She suggested that computers could be programmed to recognize commands provided to them in English (or something that a human would recognize as English-like). Although this suggestion was ridiculed by the experts of the day, it didn't slow her down. By the end of 1956, she had taught the Univac computers to understand twenty English-like statements. This led the way to the subsequent creation of the COBOL programming language and, eventually, programming language standards across many commercial makes of computer hardware.

My favorite story, however, is one she told on herself.

In the early 1970s, the clock cycle (aka the processor speed) of the mainframe computers (the ones that took up whole rooms) had reached the nanosecond range. Grace said she didn't understand what this meant and, in frustration, asked one of her staff to "bring me a nanosecond". After an initial bit of surprise, followed by some serious thought, she was presented with a plain piece of copper wire, 30cm (11.8 inches) long, because at the speed of light in copper, that's how far an electron will travel in one nanosecond.

She admitted she still didn't understand and asked for a microsecond. Shortly thereafter, she was given a large wreath of the same kind of wire, only this time the length was 300 meters. This time, she got it. Not just that they were different lengths, but the more fundamental truth that with very high clock speeds in a computer, the lengths of the connections have to be carefully calibrated or the signals you're working with won't arrive together, and your program won't work. The updated equivalent of a "bug" in the processor.

When she spoke to professional groups in the computer sciences, she would hand out "nanoseconds" to the audience. (I have one.)

After forty-three years in the Navy, she retired with the rank of Rear Admiral. Thereafter, she spent the rest of her life as a senior consultant to Digital Equipment Corporation.

She was a pioneer and an innovator who took on the established system and won on her own terms.

Grace Murray Hopper was the 20th century's premier woman computer scientist.