Biography of Margaret Hamilton

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Overview: Margaret Hamilton was most notably the director of the Software Engineering Division of the MIT Instrumentation Laboratory, where they worked on the computer code for the lunar and command modules that were used on the Apollo missions to the moon. Most importantly she was the head of software engineering during the famous Apollo 11 mission that saw humans land on the moon for the very first time. She also coined the term 'Software Engineer' and pushed for its use.

Biography: Margaret was born in Indiana on August 17th 1936 and grew up in a family of 5. She studied mathematics at the University of Michigan and later transferred to Earlham College where she got her bachelor of arts in mathematics. Her early work already hinted at a future in the area of space exploration when in 1959 she began working in the meteorology department in M.I.T. Here she developed software for predicting weather, working on an 800-pound computer called the LGP-30. This was her first experience with programming. According to her, she would "take steps that would be called 'tricky' programming today". An example of this being with debugging, where at the time in order to debug, one would feed a long sheet of paper that held an incorrect program back through the machine. Margaret chose to bypass this by learning binary code and editing the sheet herself by poking holes in the paper to turn 0's into 1's, and using a small piece of tape to turn 1's into 0's.
Following this job, Margaret again looked to the skies and joined the programming staff at the MIT Lincoln Lab to work on the Semi-Automatic Ground Environment (SAGE) project. There, she wrote software for a prototype computer used by the US Air Force whose purpose was to detect unfriendly aircraft. According to her the computer took up a whole warehouse and made "foghorn and fire engine sounds" when it crashed.
Finally, Margaret began working at the Charles Stark Draper Laboratory in M.I.T where they were working on the software used on space missions. She began as a programmer and eventually became the head of all command module software which specialized in space navigation and lunar landing guidance.

An image can be seen here of Margaret next to stacks of code used on the Apollo program: https://cdn.technologyreview.com/i/images/margarethamilton_0.jpg?sw=700&cx=146&cy=34&cw=534&ch=712

For the Apollo mission Margaret's team worked on in flight programs which were built on algorithms. These algorithms were used for error detection, recovery software and the software she designed and developed: Priority displays. These would prove to be essential to the success of the Apollo 11 mission.
At the crux of the Apollo 11 mission, minutes before landing, the astronauts were interrupted with Margaret's 1201 and 1202 priority display alarms, and given a go/no-go decision. An interesting note about the design of these alarms is that when they were set into action and the normal displays were replaced by the priority displays, the programs that were being switched behind the scenes would take slightly longer than the display would, so that if the astronauts reacted to the priority display too quickly and pressed a button, they might still get a normal response rather than one dictated by the priority software. Margaret's solution to this was for the astronauts to wait for five seconds after the priority display alarms triggered before pressing anything.
The error that caused these alarms to trigger came from the astronaut checklist, which dictated the actions they took before landing. The checklist instructed them to set the rendezvous radar hardware switch in the wrong position which overloaded the central processing unit (CPU) during landing. This resulted in the program alarms indicating "executive overflows", meaning that the guidance computer could not complete all of its tasks in real time and had to postpone some of them. However, The priority display failsafe cleared out its entire queue of processes, restarted its functions and then assigned a unique priority to each process the software needed to execute for landing, and ordered them in a way that all the processes would take place at their correct time. This failsafe resulted in a decision being made at that moment to proceed with the landing, and paved the way for 5 more successful Apollo missions. Margaret wrote on the priority display failsafe in a letter in 1971: "Actually, the computer was programmed to do more than recognize error conditions. A complete set of recovery programs was incorporated into the software. The software's action, in this case, was to eliminate lower priority tasks and re-establish the more important ones ... If the computer hadn't recognized this problem and taken recovery action, I doubt if Apollo 11 would have been the successful moon landing it was."

In a time before software engineering courses, Margaret Hamilton was always looking to innovate and develop new software that could be used to complete tasks that humans couldn't. It is innovations like these that define the advancement of the human race and directly influence more modern breakthroughs such as the recent very first image of a black hole.

Sources:

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