

Margret Hamilton

Claire McNamara | Software Engineering | 24/10/2019

Table of Contents

**Introduction1**

**Biography1**

Early Life and Early Career1

SAGE Project2

Apollo 112

Software Design3

Later Career3

**Discussion3**

**Sources4**

Introduction

Margret Hamilton is, without a doubt, one of the most influential Software Engineers of the 20th Century. Her legacy includes coining the term Software Engineer, writing the software that successfully landed the Apollo 11 astronauts on the moon and being a major contributor to the development of modern programming. Incredibly, she did all this at a time where women were not allowed do simple things like get a credit card, serve on a jury, get the birth control pill or get an Ivy League education. She is without a doubt, one of the most talented Software Engineers to ever live and a true pioneer in the field.

Biography

### Early life and Early Career

Margret Hamilton was born August 17th, 1936 in Paoli, Indiana. She earned a BA in mathematics with a minor in philosophy in 1958. In an interview by Verne in 2014 she says that “software during the early days...was regarded as an art and as magic, not a science” however, she, Margret, “had always believed that both art and science were involved in its creation”. It is clear that she not only had appreciation for the scientific and mathematical aspect of programming but also the creativity involved which is reflected in her degree choice.

Following her graduation from Earlham College, she moved to Boston and began working in the meteorology department at MIT under Edward Lorenz, the founder of chaos theory. It was here that sure first truly began developing software. During this time, people’s view of software was radically different their view of it today (except for the fact it is still considered to many “magic”). It was not something that was well respected and was if anything, considered secretarial in nature, a job for women. This is due to the way that programming was done, i.e. that the way computers were given instructions was through punch cards and the act of punching the holes into the cards was seen as very similar to typing. When it came to getting the punch cards to work correctly on a computer, or, simply getting the computer to work at all, it meant a lot of trial and error and getting hands-on with the machines themselves. The computer Margret herself worked on was the LGP-30 which weighed 370kg “so it didn’t move too much”. In 1961 she left the project with Lorenz and moved to a different one within MIT.

SAGE Project

This was the project that showed her to be the ideal candidate to be the lead developer for the Apollo 11 flight software. SAGE stood for the Semi-Automatic Ground Environment project that was taking place at the MIT Lincoln Lab. It initially was supposed to be used for weather prediction however, it then was taken on by the military for anti-aircraft defense for use during the cold war.

Apollo 11

To set the scene, in modern times, if we want to learn how to do something we can simply just “Google” our question and more than likely someone has already answered it on stack overflow, or there is a reference to a useful textbook. When Margret was writing the software for a space mission, there was nothing like that in existence. The entire concept of computer science did not even really exist yet which meant that again, it was simply a case of learning as you went along. This is especially incredible when you realise that the Apollo 11 mission was the first space mission that had software that was a critical component with regard to mission-critical and real-time tasks. It was up to Margret to come up with and implement a robust design that was going to enable the spacecraft to reach and land on the moon.

Something of note is that, at the time of the creation of the code, her daughter was playing with a simulation of the program and managed to break it. Margret managed to account for this possible error and then insisted on having everything built as foolproof as possible against the wishes of some of the other people involved in the project who insisted that that particular use-case would never happen. Later on, when the moon landing was in progress, a problem occurred. One of the switches was placed in the wrong position meaning it was sending error signals to the computer. As a result, the computer was being asked to perform all the normal landing functions while also getting an extra load of data that used up 15% of its time. Due to Margret’s foresight, not only did the computer recognise that it was being overloaded but it was also programmed to handle situations such as that. This was done was using priority scheduling, something she was instrumental in developing. The computer was able to get rid of the low priority extra task and continue on the landing as planned. This is yet an example of another major contribution she had to the world of software engineering – the concept that humans will be using the system and that the system needs to account for this.

Software Design

Prior to Margret, software was written in a build first, test later mindset. Had she stuck with that methodology, there is a high chance the moon landing would not have taken place that day. She managed to categorize interference errors which led development of the Universal Systems Language (USL) and Development Before the Fact (DBTF) paradigm.

Later Career

Margret Hamilton did not stop at landing astronauts on the moon or writing airplane tracking software, she founded and co-founded a number of businesses also. Along with Saydean Zeldin, she co-founded Higher Order Software (HOS) that aimed to further the work she had done in relation to error handling on the Apollo program. In 1985, she left HOS and founded Hamilton Technologies, Inc. A company that dealt with the Universal Systems Language that was mentioned above and the development environment, the 001 Tool Suite.

Discussion

I am going to repeat the statement I made in the introduction, that Margret Hamilton is without a doubt, one of the most influential Software Engineers of the 20th Century. However, I will now take it a step farther and say that to me, Margret Hamilton is the most incredible Software Engineer to ever live. Both she and Grace Hopper paved the way for women in STEM at a time when women did not get the same respect as their male counterparts. She legitimized Software Engineering as an actual discipline, “assisted in the creation of the core principles in computer programming as she worked with her colleagues in writing code for the world's first portable computer”, developed the concept of error prediction/handling, and became a very successful entrepreneur. Thanks to GitHub, it is possible to actually see the code that she developed for the Apollo 11 mission. I have spent a lot of time just simply marveling at how, with the very limited resources she had both hardware and prior knowledge alike, she was able to create code that would successfully take people into space and land them on a giant rock orbiting the earth. That concept in itself it mind-blowing and then, on top of that, it is important to remember that this is not all she has done. Her contributions to the development of Software Engineering are immense – a discipline that, without her, may not exist in the form it does today.

Sources

<https://www.britannica.com/biography/Margaret-Hamilton-American-computer-scientist>

<https://www.theguardian.com/technology/2019/jul/13/margaret-hamilton-computer-scientist-interview-software-apollo-missions-1969-moon-landing-nasa-women>

<https://medium.com/a-computer-of-ones-own/margaret-hamilton-coding-to-the-moon-6ba70b7e6b43>

<https://github.com/chrislgarry/Apollo-11/tree/master/Comanche055>

<https://edition.cnn.com/2014/08/07/living/sixties-women-5-things/index.html>

<https://www.computer.org/publications/tech-news/events/what-to-know-about-the-scientist-who-invented-the-term-software-engineering>

<https://futurism.com/margaret-hamilton-the-untold-story-of-the-woman-who-took-us-to-the-moon>