# **INTRO 😊**

# **Margaret Hamilton (scientist)**

* **Woman who got man to the Moon.**
* American [computer scientist](https://en.wikipedia.org/wiki/Computer_scientist), [systems engineer](https://en.wikipedia.org/wiki/Systems_engineer), and business owner**.**
* Director of the Software Engineering Division[]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-DrLouieNASASED-3) of the [MIT Instrumentation Laboratory](https://en.wikipedia.org/wiki/MIT_Instrumentation_Laboratory).
* Founder and CEO of Hamilton Technologies, Inc., in [Cambridge, Massachusetts](https://en.wikipedia.org/wiki/Cambridge,_Massachusetts).

## Early life and Education

## Born Margaret Heafield on August 17, 1936 in [Paoli, Indiana](https://en.wikipedia.org/wiki/Paoli,_Indiana).

## Graduated from Hancock High School in 1954

## Earned a B.A. in mathematics with a minor in philosophy from [Earlham College](https://en.wikipedia.org/wiki/Earlham_College) in 1958

## Moved to [Boston, Massachusetts](https://en.wikipedia.org/wiki/Boston), with the intention of doing graduate study in [abstract mathematics](https://en.wikipedia.org/wiki/Abstract_mathematics) at [Brandeis University](https://en.wikipedia.org/wiki/Brandeis_University).

## In 1960 took an interim position at [MIT](https://en.wikipedia.org/wiki/MIT) to develop software for predicting weather on the [LGP-30](https://en.wikipedia.org/wiki/LGP-30) and the [PDP-1](https://en.wikipedia.org/wiki/PDP-1) computers (at [Marvin Minsky](https://en.wikipedia.org/wiki/Marvin_Minsky)'s [Project MAC](https://en.wikipedia.org/wiki/MIT_Computer_Science_and_Artificial_Intelligence_Laboratory#Project_MAC)).

## From 1961 to 1963, worked on the [SAGE Project](https://en.wikipedia.org/wiki/Semi-Automatic_Ground_Environment) at [Lincoln Lab](https://en.wikipedia.org/wiki/MIT_Lincoln_Laboratory).

## Wrote software for the first [AN/FSQ-7 computer (the XD-1)](https://en.wikipedia.org/wiki/AN/FSQ-7_Combat_Direction_Central), to search for unfriendly aircraft.

## Wrote software for the [Air Force Cambridge Research Laboratories](https://en.wikipedia.org/wiki/Air_Force_Cambridge_Research_Laboratories).`

## Personal life

* She met her husband James Cox Hamilton while at Earlham College.
* They married in the late 1950s after Hamilton earned her bachelor's degree.
* They had a daughter together named Lauren, who subsequently married the billionaire, actor, dancer, and choreographer [James Cox Chambers](https://en.wikipedia.org/wiki/James_Cox_Chambers).
* During the weekends she would often take Lauren to the lab to spend time with her daughter and simultaneously "code away creating routines that would later be added to Apollo's command module computer".
* Margaret Hamilton and James Cox Hamilton eventually divorced.[[60]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-JCH_obit-60)

## NASA

* Joined the [Charles Stark Draper Laboratory](https://en.wikipedia.org/wiki/Charles_Stark_Draper_Laboratory) at MIT, which at the time was working on the Apollo space mission.
* Eventually led a team credited with developing the software for Apollo and Skylab.
* The team was responsible for developing in-flight software, which included algorithms designed by various senior scientists for the Apollo command module, lunar lander, and the subsequent [Skylab](https://en.wikipedia.org/wiki/Skylab).
* Another part of her team designed and developed the systems softwarewhich included the error detection and recovery software such as restarts and the Display Interface Routines (AKA the Priority Displays)
* Worked to gain hands-on experience during a time when computer science courses were uncommon and software engineering courses did not exist.
* Apollo 11 one of the critical moments of the [Apollo 11](https://en.wikipedia.org/wiki/Apollo_11) mission, the [Apollo Guidance Computer](https://en.wikipedia.org/wiki/Apollo_Guidance_Computer) together with the on-board flight software averted an abort of the landing on the Moon.
* Three minutes before the [Lunar lander](https://en.wikipedia.org/wiki/Apollo_Lunar_Module) reached the Moon's surface, several computer alarms were triggered. The computer was overloaded with interrupts caused by incorrectly [phased](https://en.wikipedia.org/wiki/Three-phase_electric_power) power supplied to the lander's rendezvous radar.
* The program alarms indicated "executive overflows", meaning the guidance computer could not complete all of its tasks in real time and had to postpone some of them.
* The asynchronous executive designed by [J. Halcombe Laning](https://en.wikipedia.org/wiki/J._Halcombe_Laning) was used by Hamilton's team to develop asynchronous flight software:
* Because of the flight software's system-software's error detection and recovery techniques that included its system-wide “kill and recompute” from a "safe place" restart approach to its snapshot and rollback techniques, the Display Interface Routines (AKA the priority displays) together with its man-in-the-loop capabilities were able to be created in order to have the capability to interrupt the astronauts' normal mission displays with priority displays of critical alarms in case of an emergency.
* This depended on our assigning a unique priority to every process in the software to ensure that all its events would take place in the correct order and at the right time relative to everything else that was going on.
* Hamilton's priority alarm displays interrupted the astronauts' normal displays to warn them that there was an emergency “giving the astronauts a [go/no go](https://en.wikipedia.org/wiki/Go/no_go) decision (to land or not to land)”.
* [Jack Garman](https://en.wikipedia.org/wiki/Jack_Garman), a NASA computer engineer in mission control, recognized the meaning of the errors that were presented to the astronauts by the priority displays and shouted, "Go, go!" And on they went.
* Dr. Paul Curto, senior technologist who nominated Hamilton for a NASA Space Act Award, called Hamilton's work "the foundation for ultra-reliable software design.

ACHIEVMENTS

* Hamilton made up the term "[software engineering](https://en.wikipedia.org/wiki/Software_engineering)" during the Apollo space mission days.
* During this time at MIT, she wanted to give their software “legitimacy”, just like with other engineering disciplines, so that it (and those building it) would be given its due respect.
* When Hamilton started using the term "software engineering",[[45]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-50th-45)[[46]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-46)[[47]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-47) software engineering was not taken seriously compared to other engineering, nor was it regarded as a science.
* She began to use the term "software engineering" during the early Apollo missions in order to give software the legitimacy of other fields such as hardware engineering.
* Over time the term "software engineering" has gained the same respect as any other discipline.[[48]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-48)
* "At MIT she 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".[[49]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-wired.com-49)
* Hamilton's innovations go beyond the feats of playing an important role in getting humans to the moon.
* Hamilton, along with many other female engineers alike, challenged the male dominated technology field of their time, to allow for women to enter in these [STEM](https://en.wikipedia.org/wiki/STEM) fields for many years to come.
* In 1986, received the [Augusta Ada Lovelace Award](https://en.wikipedia.org/wiki/Augusta_Ada_Lovelace_Award) by the Association for Women in Computing.[[8]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-earlham-8)
* In 2003, was given the NASA Exceptional Space Act Award for scientific and technical contributions.
* In 2009, received the Outstanding Alumni Award by [Earlham College](https://en.wikipedia.org/wiki/Earlham_College).[[8]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-earlham-8)
* In 2016, received the [Presidential Medal of Freedom](https://en.wikipedia.org/wiki/Presidential_Medal_of_Freedom) from Barack Obama, the highest civilian honor in the United States.[[54]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-54)[[55]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-BBC23112016-55)[[56]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-56)
* In 2017, received the "Computer History Museum Fellow Award" that honors exceptional men and women whose ideas have changed the world
* In 2017, a "Women of NASA" [LEGO](https://en.wikipedia.org/wiki/LEGO) set went on sale featuring (among other things) mini-figurines of Hamilton, [Mae Jemison](https://en.wikipedia.org/wiki/Mae_Jemison), [Sally Ride](https://en.wikipedia.org/wiki/Sally_Ride), and [Nancy Grace Roman](https://en.wikipedia.org/wiki/Nancy_Grace_Roman).[[59]](https://en.wikipedia.org/wiki/Margaret_Hamilton_(scientist)#cite_note-59)

***Cytats***

*Hamilton said,*

*“What they used to do when you came into this organization as a beginner, was to assign you this program which nobody was able to ever figure out or get to run. When I was the beginner they gave it to me as well. And what had happened was it was tricky programming, and the person who wrote it took delight in the fact that all of his comments were in Greek and Latin. So I was assigned this program and I actually got it to work. It even printed out its answers in Latin and Greek. I was the first one to get it to work”*

*“The computer was smart enough to recognize that it was being asked to perform more tasks than it should be performing. It then sent out an alarm, which meant to the astronaut, I'm overloaded with more tasks than I should be doing at this time and I'm going to keep only the more important tasks; i.e., the ones needed for landing”*

*"When I first came up with the term, no one had heard of it before, at least in our world. It was an ongoing joke for a long time. They liked to kid me about my radical ideas. It was a memorable day when one of the most respected hardware gurus explained to everyone in a meeting that he agreed with me that the process of building software should also be considered an engineering discipline, just like with hardware. Not because of his acceptance of the new 'term' per se, but because we had earned his and the acceptance of the others in the room as being in an engineering field in its own right recognize error conditions.*

*“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”*

***Her areas of expertise include***[***systems design***](https://en.wikipedia.org/wiki/Systems_design)***and***[***software development***](https://en.wikipedia.org/wiki/Software_development)***,***[***enterprise***](https://en.wikipedia.org/wiki/Enterprise_modelling)***and***[***process modelling***](https://en.wikipedia.org/wiki/Business_process_modeling)***, development paradigm, formal***[***systems modeling***](https://en.wikipedia.org/wiki/Systems_modeling)***languages, system-oriented objects for systems modelling and development, automated life-cycle environments, methods for maximizing***[***software reliability***](https://en.wikipedia.org/wiki/Software_reliability)***and***[***reuse***](https://en.wikipedia.org/wiki/Software_reuse)***,***[***domain analysis***](https://en.wikipedia.org/wiki/Domain_analysis)***,***[***correctness***](https://en.wikipedia.org/wiki/Correctness_(computer_science))***by built-in language properties, open-architecture techniques for robust systems, full life-cycle automation,***[***quality assurance***](https://en.wikipedia.org/wiki/Quality_assurance)***, seamless integration,***[***error detection and recovery***](https://en.wikipedia.org/wiki/Error_handling)***techniques,***[***man-machine interface***](https://en.wikipedia.org/wiki/Man-machine_interface)***systems,***[***operating systems***](https://en.wikipedia.org/wiki/Operating_system)***, end-to-end testing techniques, and life-cycle management techniques.***