The Apollo Guidance Computer

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Overview

The Apollo Guidance Computer(AGC) was the main computer system of the Apollo program that successfully landed 12 astronauts on the Moon.

Responsible for almost all guidance, navigation and control. This includes: orbiting earth, navigating to the moon, orbiting the moon, landing on the surface, returning to orbit , reconnecting modules, navigating back to earth, and then re-entry.

The same component was used in both the Command and Lunar Modules with different pre-configured software.

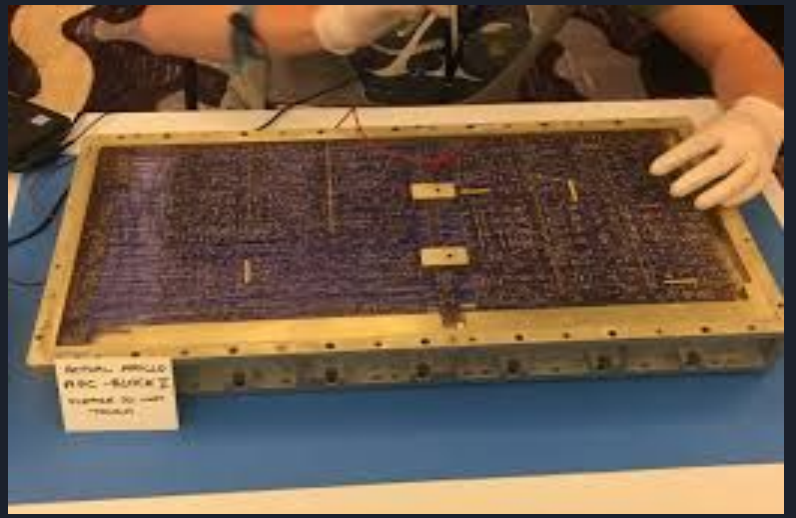
It was designed by NASA and MIT Instrumentation Laboratory. Development started around 1961-62 and was decommissioned when the Apollo program concluded in December 1972.

The State of Computers during Apollo Missions

- Operating Systems at this time
  - Unix started development in 1969
  - MS-DOS was introduced in 1981
  - Macintosh in 1984.
- Power and Size
  - 50 to 100 thousand instructions a second, now over a million
  - Computers occupied entire rooms
- Memory Extremely limited
  - About 64kB total
- Software Development
  - Low-level languages like Assembly
  - No or few debug tools

Apollo Guidance Computer

- 1 cubic foot, 32kg
- 55 watts to power
- 50-100 thousand instructions/sec
- RAM: 2kilowords 2048 words
- ROM: 36kwords, 36000 instructions
  - Core rope memory



AGC Operating System

- Real-Time Executive System (RTOS)
- Specialized System
- Priority-Based Task Management
- Interrupt-Driven Processing
- Limited User Interaction(DSKY)
- No traditional file system
- Parity checking

Some quirks of the OS

- 15-bit word size
- 1’s complement for integers (-0 and +0)
- No floating point numbers
- Special memory locations - used for functions like bit shifting

Software

Software was highly optimized and compact written in assembly language

Software divided into discrete modules or programs for specific functions like guidance, navigation and control

Software had to “hand woven” into memory, literally running wires through specific holes to signify 1 or 0, this is known as core rope memory

Core rope memory was incredibly reliable and robust. It was resistant to radiation, extreme temperatures, and the harsh conditions of space.

Thank you!

Demo at https://svtsim.com/moonjs/agc.html