The Institution of Engineering and Technology

Calculators with no equal

25 January 2024

Welcome

The hybrid event will start at **7:00pm** at the Atrium, University of Suffolk and via Microsoft Teams.

Introduction: Kevin Foster FIET, Chairman, IET Anglian Coastal Local Network.

Presenter: Mark Power, Lecturer in Computing, University of Suffolk

Questions: Please type in your questions to the Q&A feature in Teams or be ready to ask them in the Atrium and these will be taken at the end of the presentation.

Close: Approximately 8:15pm

Calculators With No Equal

A Selective History of HP Pocket Calculators

Mark Power

With No Equal Key

- Many HP calculators use RPN
- Reverse Polish Notation
- Pre-fix notation formalised by Jan Łukasiewicz in the 1920s
- Avoids the need for parentheses
- Postfix notation is also used by Forth

Like Yoda, Calculate

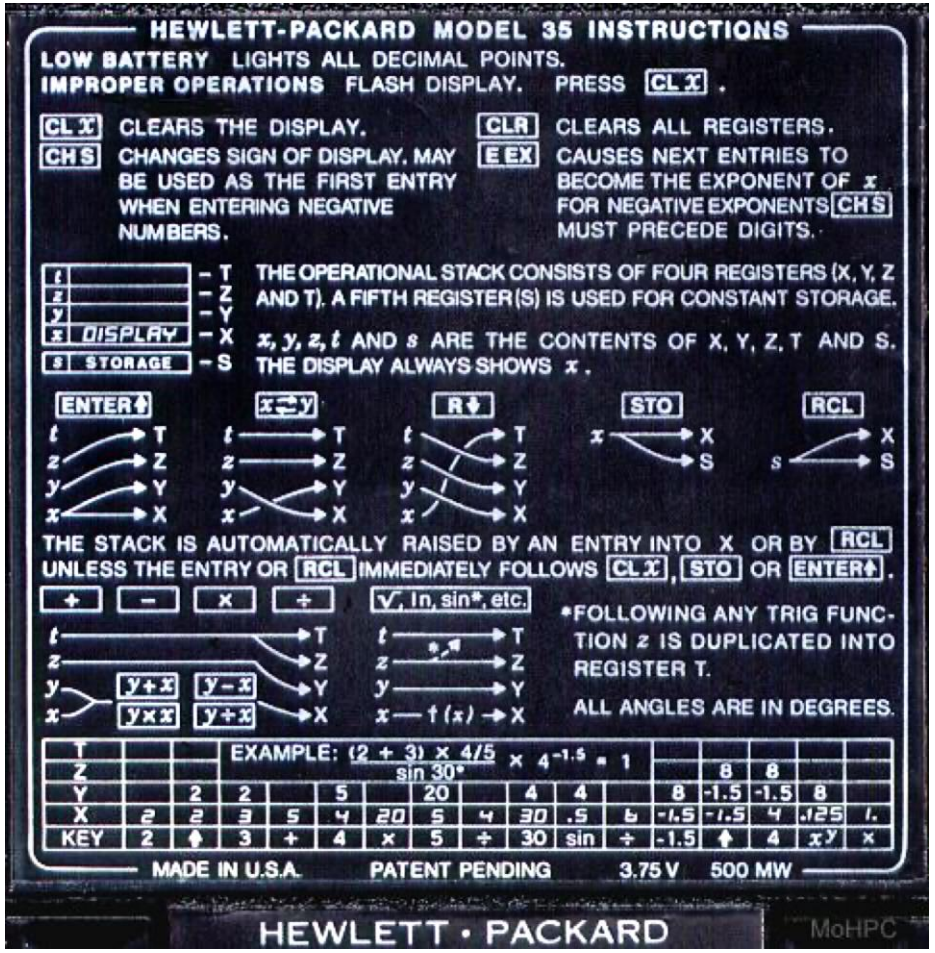
Algebraic or Infix Notation

- 2 + 3 * 4 = 20 or 14 ?
- (2 + 3) * 4 = 20
- 2 + (3 * 4) = 14
- How many levels of parentheses does your calculator support?

RPN or Postfix Notation

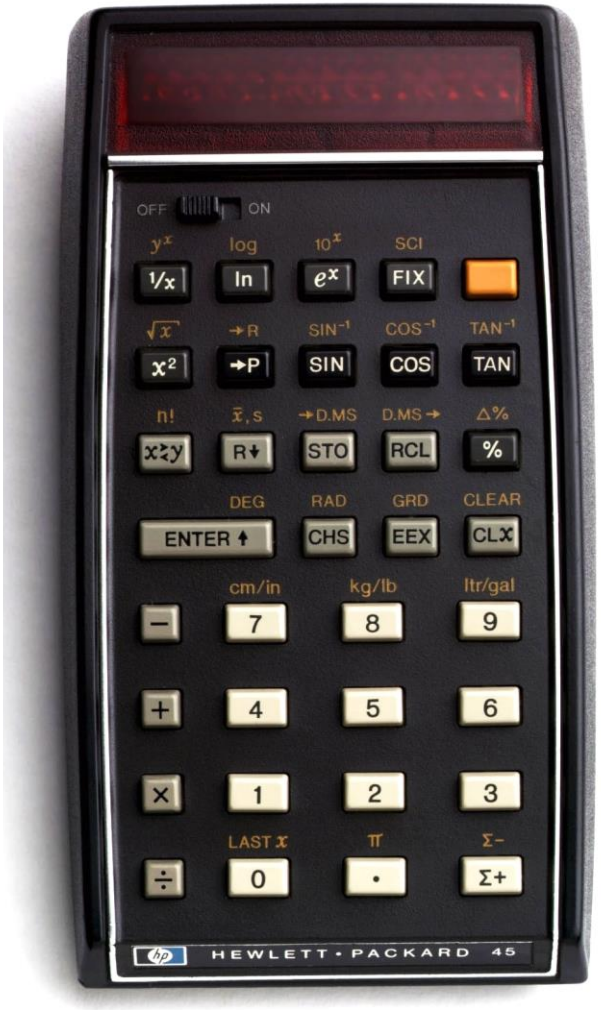
- 2 3 4 * +
- Items are placed on a stack - typically 4 levels
- Operands are known before the operation
- Can support functions with more than 2 parameters

HP-35 The Electronic Slide Rule (1972)



- Bill Hewlett asked for a HP9100 (1968) desktop calculator to fit in his pocket
- Log and trig functions
- Degrees mode only
- x^y key
- $395 at introduction
- Discontinued in 1975 at $195

HP-45 Advanced Scientific (1973)



- HP's third pocket calculator
- HP's second scientific
- y^x and LAST x
- Stats, DRG, Conversions
- 9 Memory registers
- STO and RCL arithmetic
- Hidden feature: Timer
- Advertised as double the power
- SHIFT key - from the HP-80

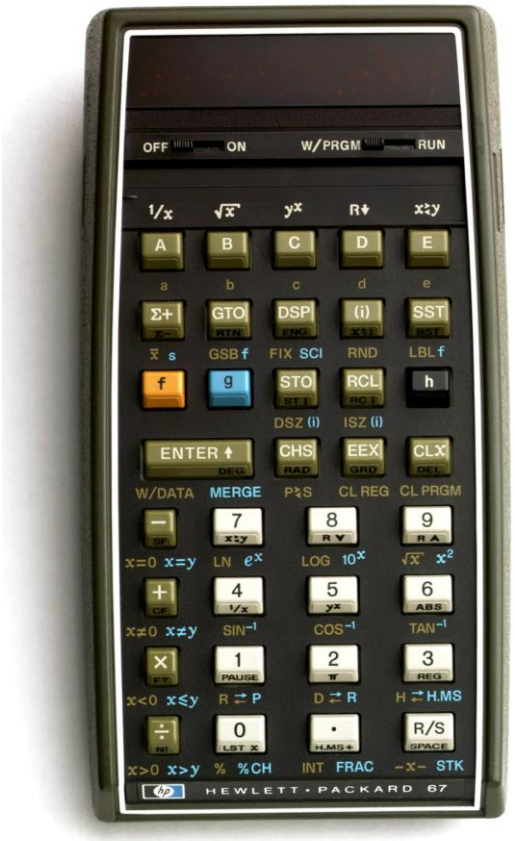
HP-65 Programmable (1974)

- "The world's first handheld computer"
- 100 lines of program memory
- Magnetic card reader to store and load programs
- Program pacs sold for particular topics e.g. Maths, EE, Chemical Engineering, Stats, Surveying, Finance, Navigation, Medical
- Used on the Apollo-Soyuz mission
- Led to the formation of the HP-65 Users Club, later PPC and HPCC

HP-20 Series (1975)

- Cheaper scientific, financial and programmable calculators
- The HP-25C programmable introduced “Continuous Memory”
- HP-29C added more memory and functions
- HP-19C is an HP-29C with a printer

HP-67 and HP-97 Programmables (1976)

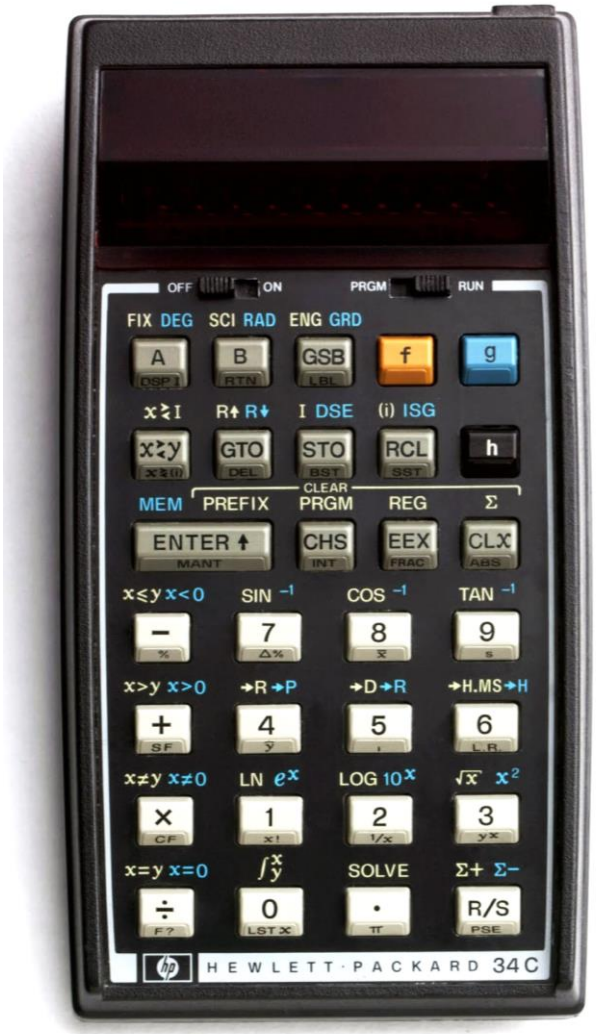


- 224 program steps
- 26 memories
- Magnetic Cards
- Software compatibility
- More program pacs
- Solution books e.g. Astrology, Antennas, Anesthesia, …

HP-01 Watch (1977)

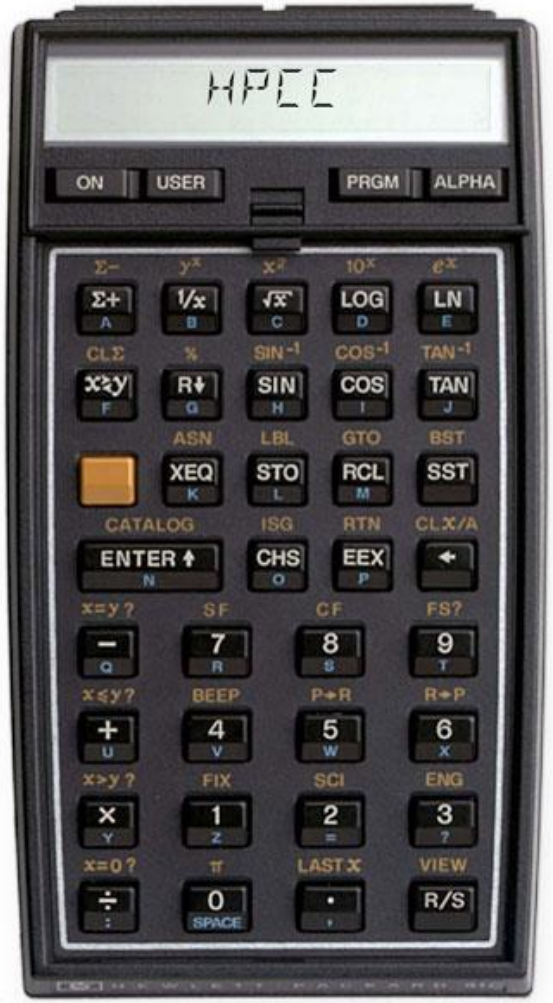
- The first smart watch?
- Included time, a calculator, stopwatch/timer and alarm
- Calibrated to be accurate to within 30 seconds per year
- Date and time arithmetic
- Dynamic calculations
- Quickly superseded by cheaper LCD watches
- Expensive at launch – expensive to buy now

HP-34C Advanced Programmable (1979)

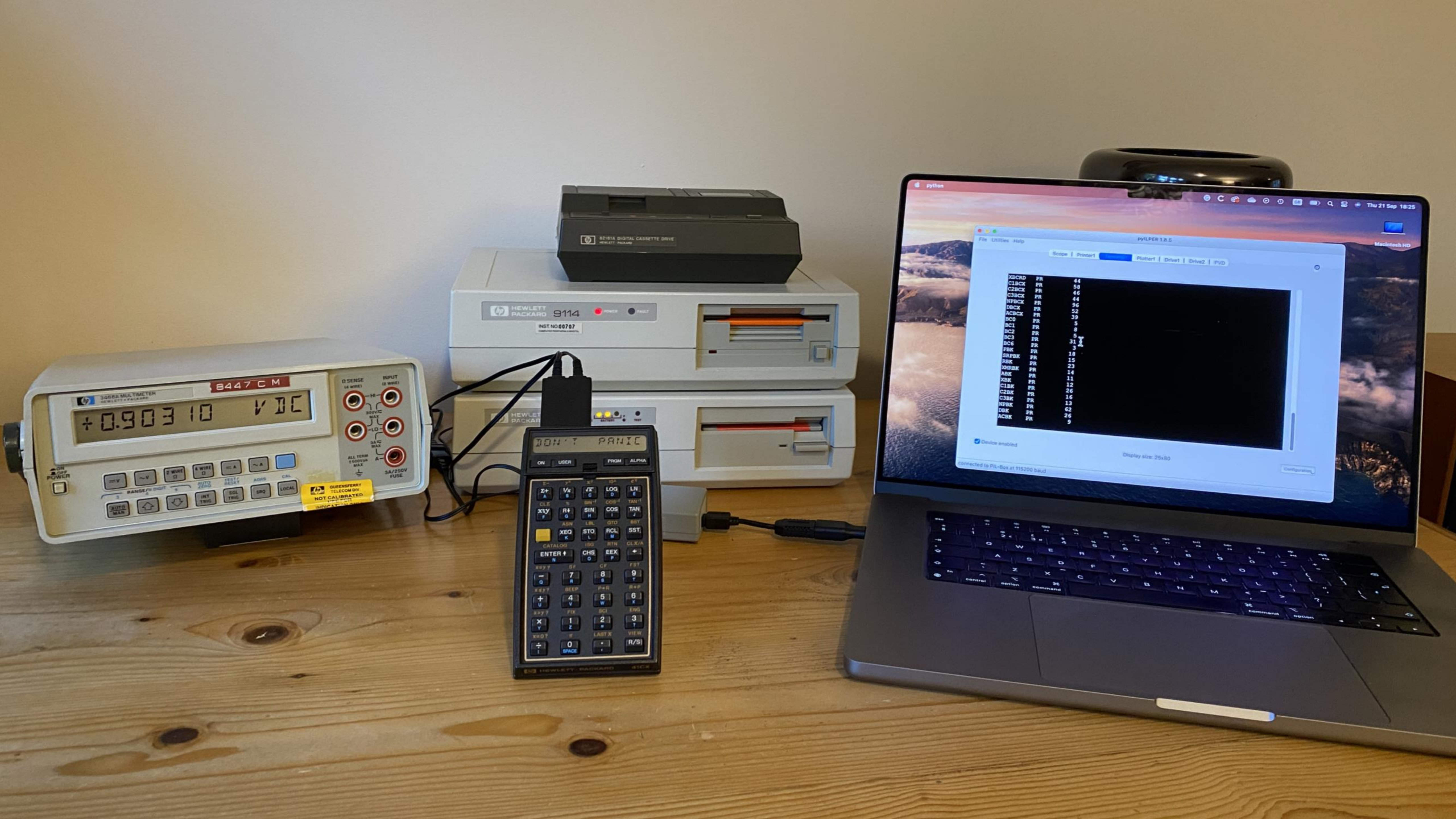


- One of several machines in the 30 series which included scientific and financial models
- Successor to HP-25C/HP-29C with continuous memory
- Gamma function, rather than simple factorial!
- Up to 210 steps or 20 memory registers
- The first calculator to include Solve and Integrate

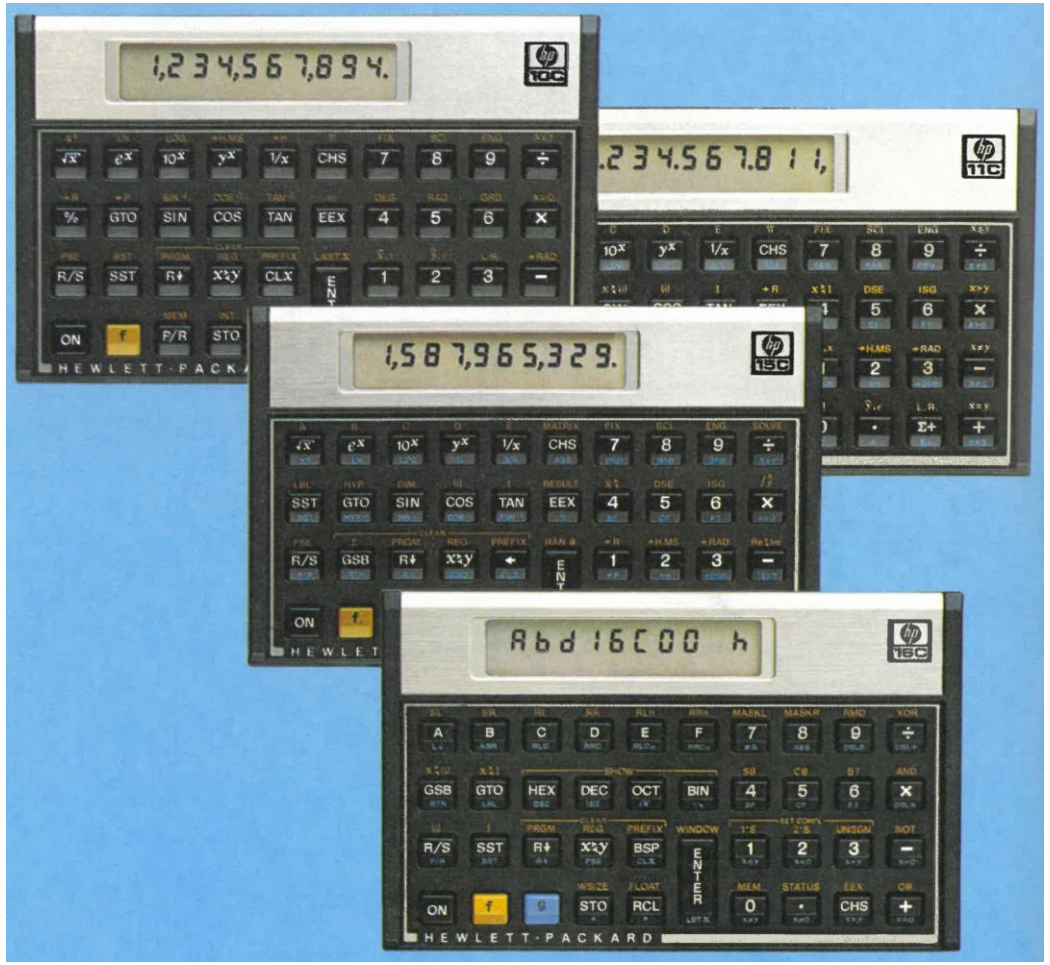
HP-41 Handheld Computer (1979-1991)



- LCD, Alphanumeric, 12K-24K ROM, 0.4K-6.4K RAM
- Expandable: Modules, Magnetic Cards, Barcode Reader, Time Module, Extended Functions (RAM disk), IR Printer Module, …
- HP-IL: Printers, Plotters, Video Interfaces, Modem, Digital Tape, Floppy Disks, RS232, GPIO, HP-IB, Multimeters, …
- Used on the Space Shuttle
- Still being developed: memory modules, CPU board replacements, HP-IL to USB, USB-C charging


3468A MULTIMETER
8447 C M
+0.90310 VDC
82161A DIGITAL CASSETTE DRIVE
HEWLETT PACKARD 9114
DON'T PANIC
HEWLETT PACKARD 41CX
pyILPER 1.8.5

HP-10 Voyager Series Calculators (1981-)

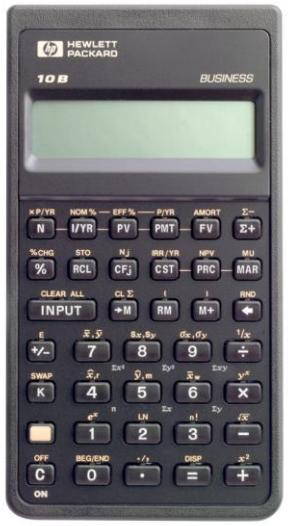


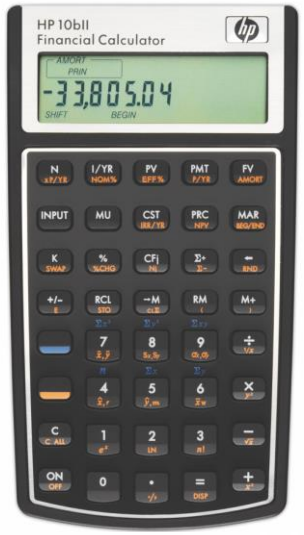
- Non-expandable
- Three Scientific Programmables
- HP-15C
  - Added matrices and complex numbers
  - Reintroduced in 2023
- HP-16C Computer Scientist
  - Binary, Octal, Denary and Hexadecimal
  - One to 64-bit words
  - AND, OR, XOR, NOT, rotates and shifts
  - Unsigned, 1 and 2s complement

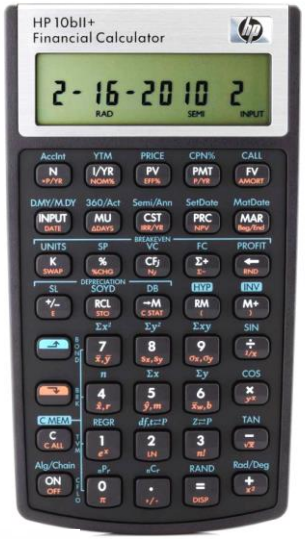
HP-12C Financial Calculator (1981-)

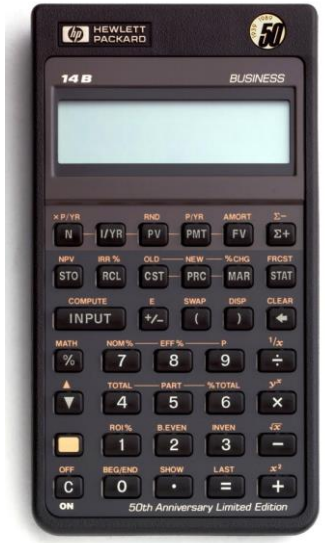
- The gold standard
- Specialist functions for loans, mortgages, bonds, depreciation, stats, dates, …
- And programmable
- Still in production

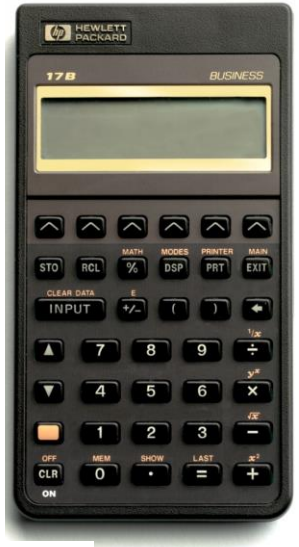
HP-12C Financial Calculators Replacements

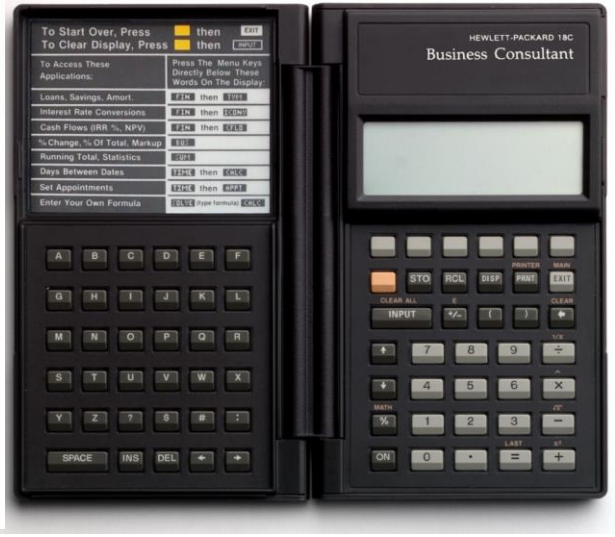


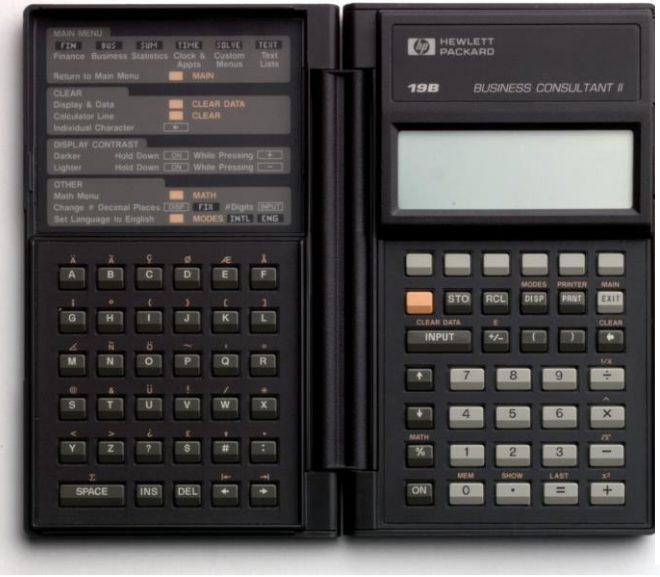


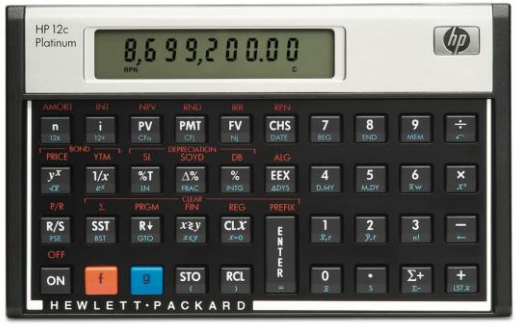












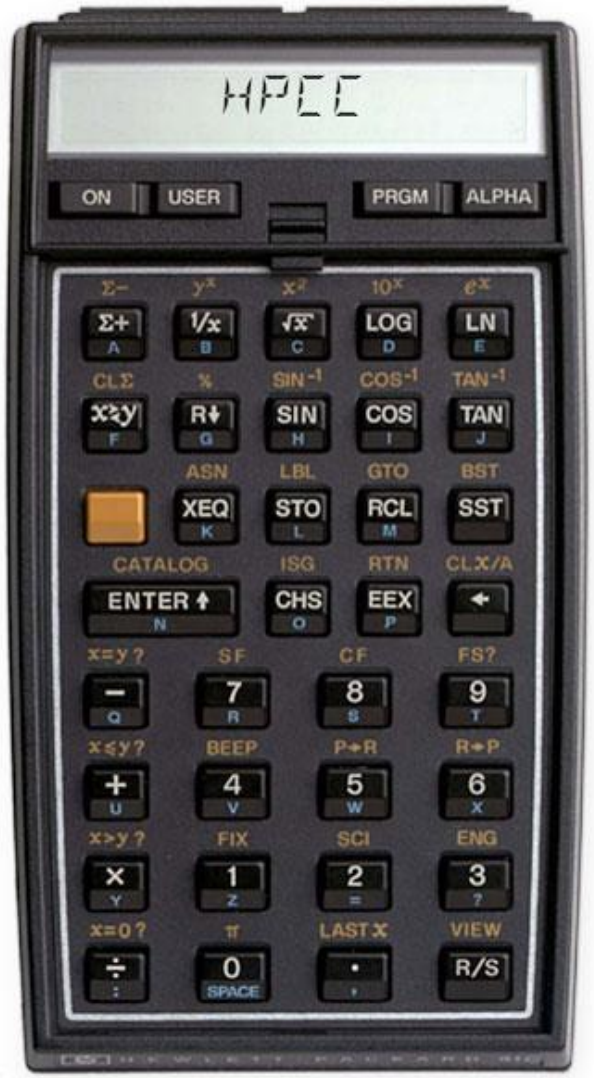
HP-71B Handheld Computer (1984-1989)

- Advanced BASIC
- Assembler and Forth
- 41/71 Translator
- Draft IEEE 754 floating point standard
- One or two HP-IL loops
- Saturn CPU
- Up to 512KB

Reverse Polish Lisp (1986-2015)

- Hidden on HP-18C, visible on HP-28C/S
- Improved with the HP-48/49/50
- RPN combined with Lisp and Forth
- Stack limited by memory
- Object based and unit management (48)
- Enabled symbolic calculation and graphing
- HP48G series, up to 256KB RAM and 4MB storage, added wired and IR file transfers – Kermit
- HP49 series included Computer Algebra System
- HP50g, up to 2GB SD, emulated the Saturn chip on ARM

RPN Lives – HP-42S (1988) HP-41 HP35s (2007)

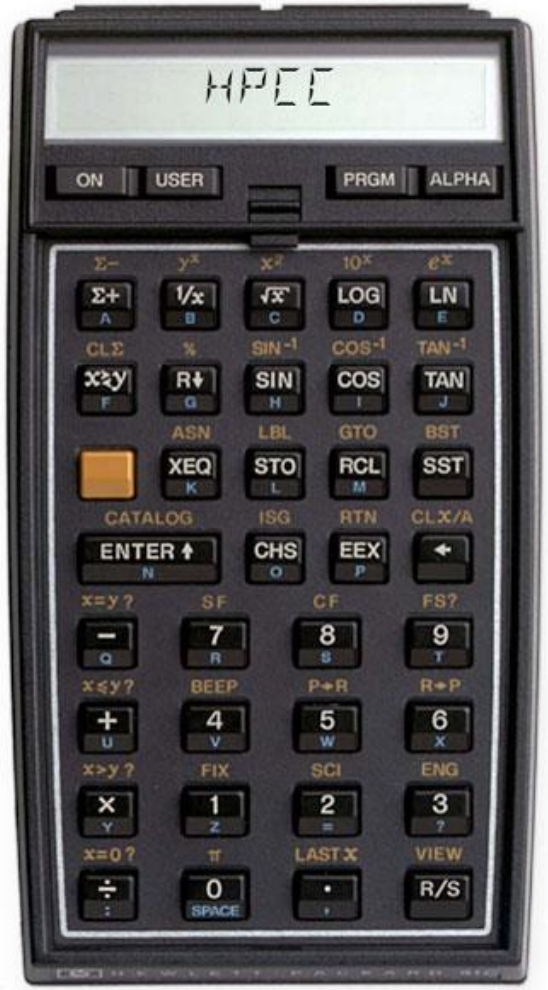


RPN Reborn – SwissMicros DM42 DM41X DM32

HP Prime (2013-)

- 320x240, 16-bit colour touchscreen
- HP PPL Pascal-like language, CAS and MicroPython
- Basic RPN support
- Exam mode (and no SD card, no beeper)
- MicroUSB
- Classroom Wireless Kit
- 2018 G2: 256MB RAM, 512MB Flash, 528MHz

HP Calculators – A history of innovation

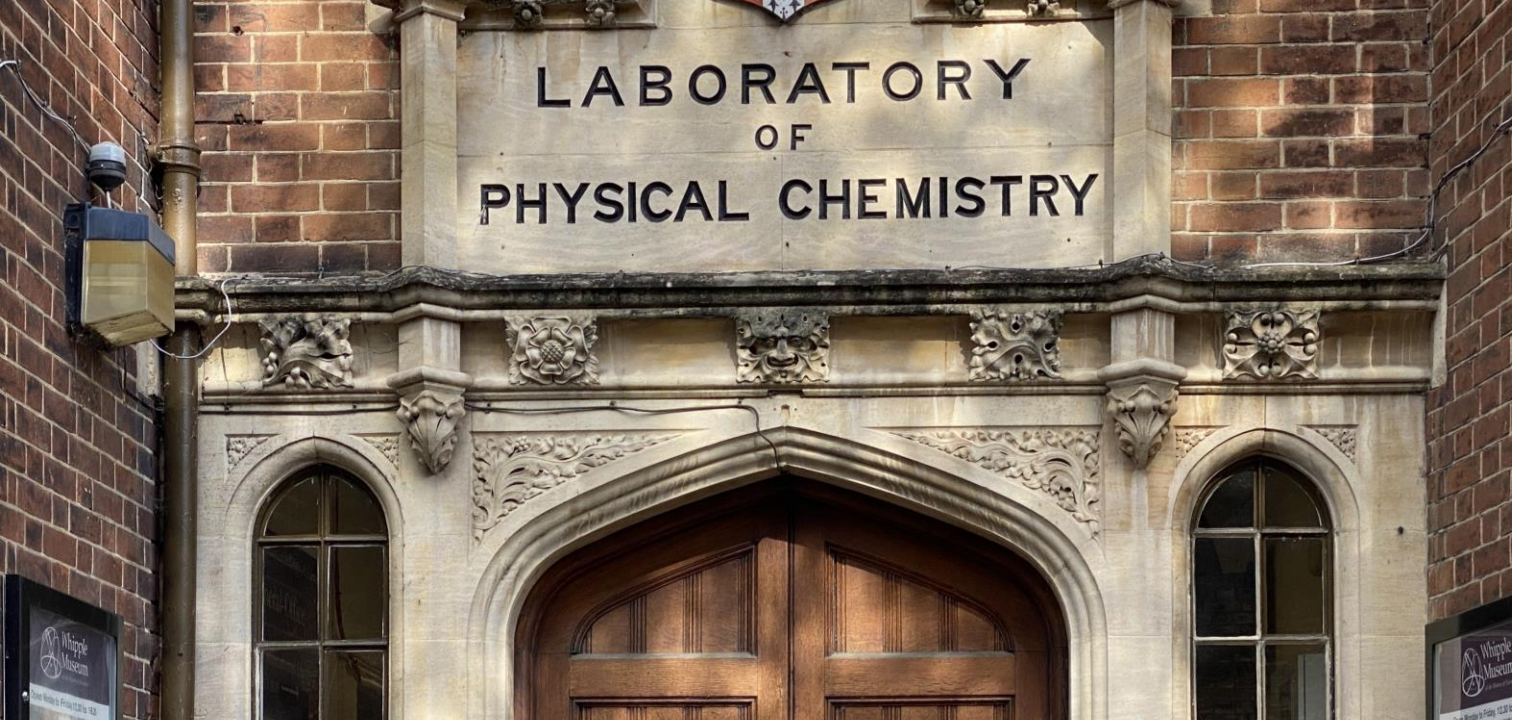


- First pocket scientific
- First pocket programmable
- First smart watch
- First with solve and integrate
- First pocket calculator with wide peripheral support
- First with symbolic algebra
- First with unit management
- First with exam mode, class-wide interactivity
- Longest produced calculator

Disclaimer: other makes of calculator are available

Further Information & Reading

- hpcc.org - Handheld & Portable Computer Club (HPCC)
- hpmuseum.org - Museum of HP Calculators and forum
- hp41.org – Archive of all things HP-41
- hpcalc.org – RPL & Prime Software Archive, manuals, and videos
- RCL40: Recollection, Reinvention and HP Calculators, edited by W.A.C. Mier-Jędrzejowicz, Mark Power & Bruce Horrocks
- Empire of the Sum: The Rise and Reign of the Pocket Calculator, by Keith Houston
- Francis Hookham Calculator Collection at the Whipple Museum of the History of Science, Cambridge University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„ARCHIMEDES“
als Spiel- Lehr- und Lernmittel
DER TEILBARE APFEL
»ARCHIMEDES«
MAX JOOHS - OBERSTEINACH
"Archimedes" apple fractions set
by Max Joohs, Swiss, circa 1930
Wh.6572

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Thank you for your attendance

The following upcoming talks have been secured in our IET ACLN 2024 programme. Please check our IET EngX website for more details of our events and how to register: https://engx.theiet.org/local-networks/ea1

- **New Space, the future of satellite communications**, Prof. Andy Sutton, BT [April date TBC, 7pm, format TBC]

- **Quantum: Game-changer or niche?**, Prof. Andrew Lord, BT [16 May 2024, 7pm, HYBRID]

[HYBRID] events normally run from The Atrium, University of Suffolk, Ipswich and via Microsoft Teams.

For more details and how to register please visit: https://engx.theiet.org/local-networks/ea1

CPD Certificates for today's and previous Anglian Coastal Local Network talks can be found on this site.