Apprenticeship:
60 years of computing experience

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One man's journey
(1958 - 2018)

... a dozen computing generations …

from chaos and primitive systems
to incredible power
and effective standards

My Timeline

- 1958-62 UK Atomic Energy Authority, Risley
- 1962-65 Detroit Edison Co (APDA), USA
- 1966-71 Stanford University, Palo Alto, USA
- 1971-76 CERN, Geneva
- 1977 Bell Northern Research, Palo Alto, USA
- 1978-now CERN, Geneva

1958-62 UKAEA

(Physics design of Fast Breeder nuclear reactors)

I was not a programmer but used:

- **Ferranti Mercury**
- **IBM 704 / 709**

➔ used a FORTRAN code "CRAM" for core design ➔

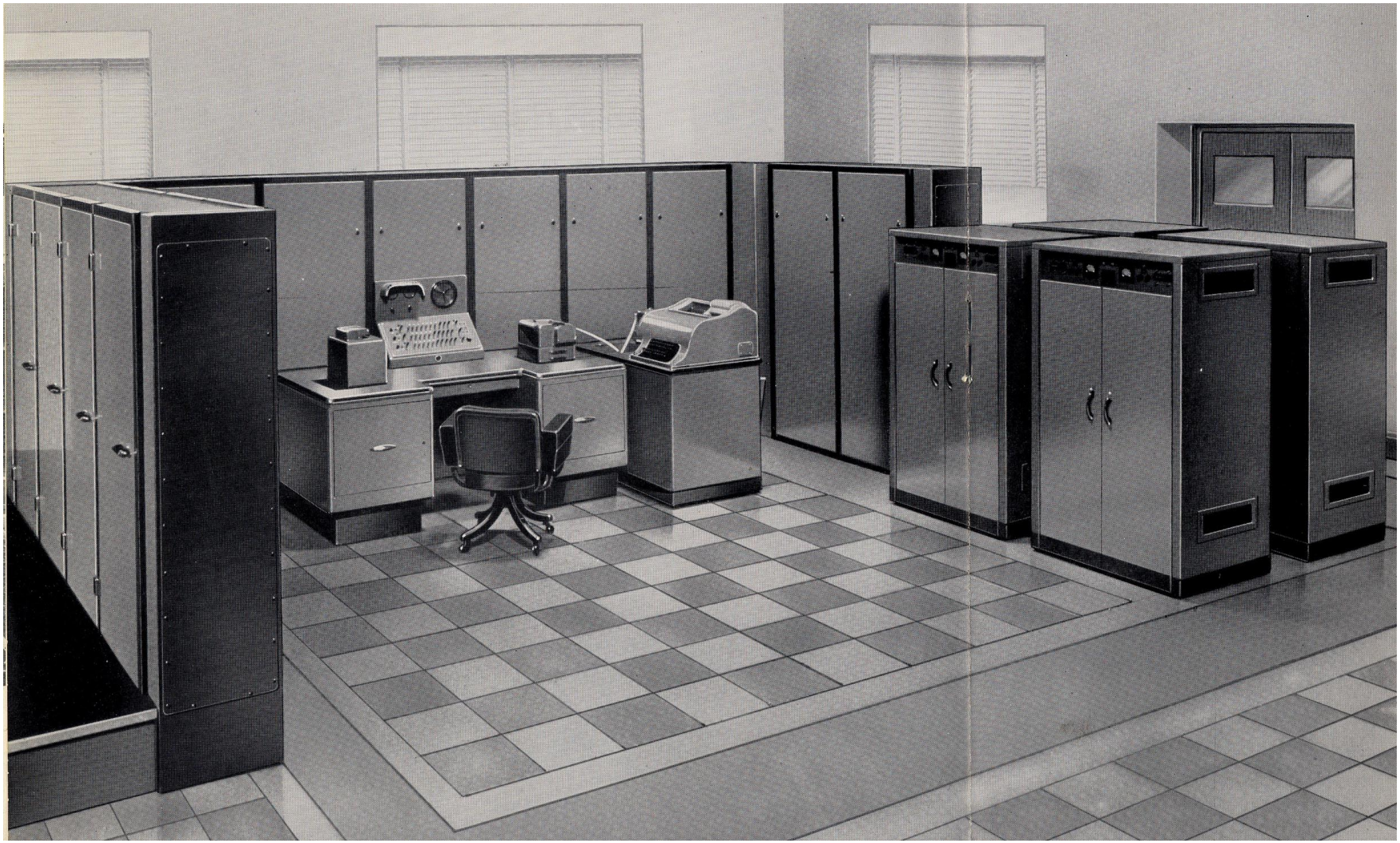
(a finite difference setup for neutron diffusion in 2D)

➔ Fast but approximate solutions ➔

I became an expert in this code, working with its creator, (Tony Hassitt)

Ferranti Mercury, 1960

(1K 40-bit words of RAM, 4X4K word drums, << 1MHz cycle time)



IBM 709, 1961-62

1950-60s electric calculator (Marchant Transflo)

1962-65 APDA, Detroit

(Physics commissioning of a Fast Breeder reactor)

… still not a programmer but used …

- **IBM 709 / 7090**

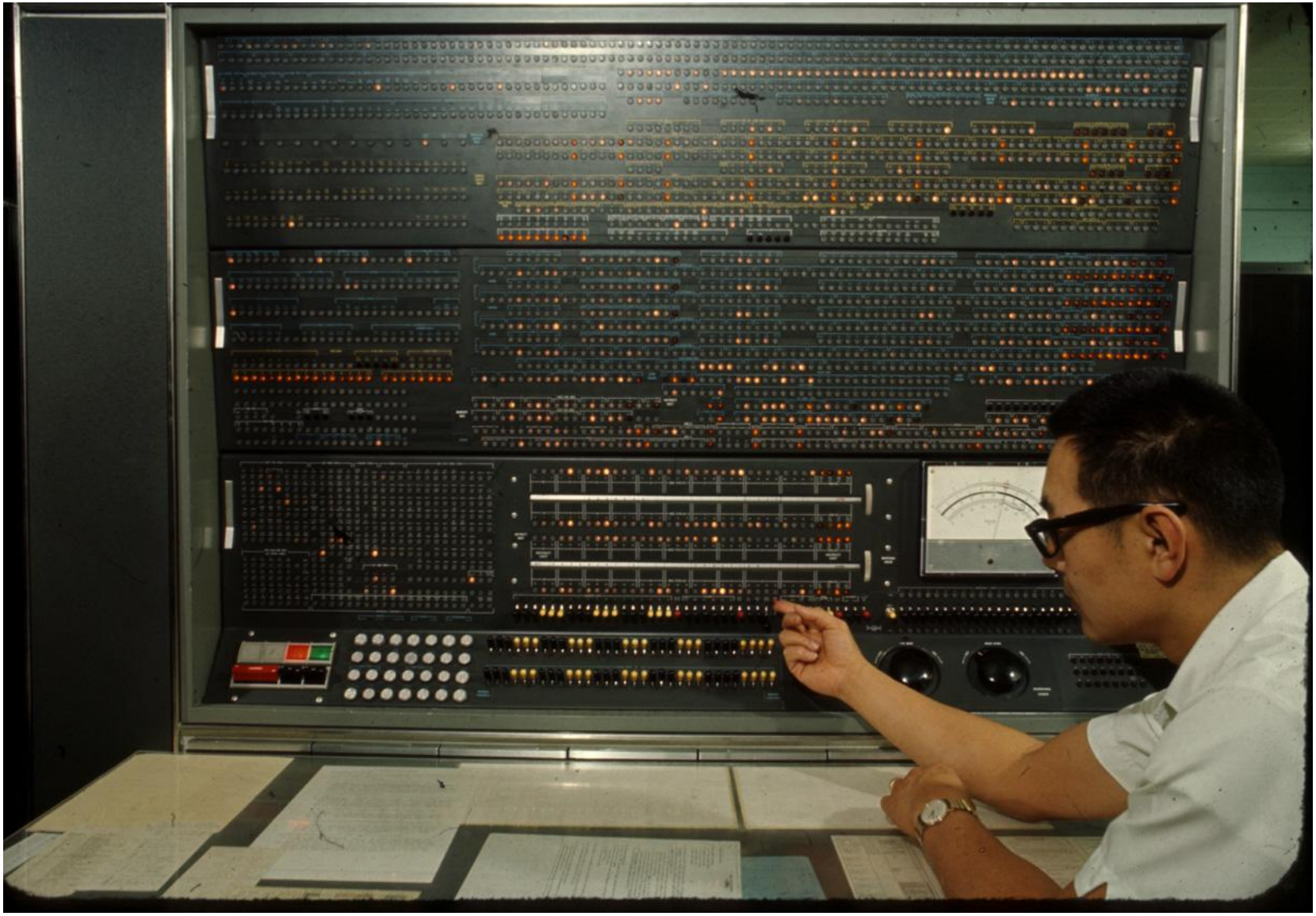
- ***Introduced FORTRAN code "CRAM" for core design and supported it in collaboration with its creator in the UK***

- ***Ran it at an oil company site in Philadelphia (after midnight!)***

- ***Exchanged it for a more accurate but much slower code with the Los Alamos National Laboratory in 1963***

Los Alamos – Fuller Lodge, 1960's

Los Alamos - IBM 7030 "Stretch"



1966-71 Stanford University PhD

➔ *My thesis required computing* ➔

I learned ALGOL60 and FORTRAN II-IV and used:

- ***Burroughs 9000***
- ***IBM 360/67***

- ***Received and further developed a FORTRAN code from Prof. Donald Anderson / Harvard for nonlinear PDF integration.***

- ***I had a total of 1 hour of computer time on the 360/67 so ran it after midnight at 1/3rd of daytime rates.***

- ***Checked my results against a Monte Carlo code running on the ILLIAC IV at NASA Ames Research Center.***

1971-76 Beginnings at CERN

I was hired "informally"…

… but fortunately assigned to my first MENTOR …

Mark Palandri

in the area of:

Computer Networking ("Data Communications")

- ***1971: first project - REMOTE I/O Stations (RIOS)***

- ***1974: second project - SUPERMUX***

1971-74 RIOS Project

- 12 stations around CERN, some with operators
- Emulated CDC's Remote Job Entry terminal
  - but much cheaper and faster
- Used a UK minicomputer: *CTL Modular One*
- 16 Kbytes of RAM, no disk or tape !!
- Own architecture, (cross-)assembler coding
- CERN choices of Card Reader and Line Printer
- I was able to emulate a human operator
  - using space gleaned from poor original code
- I had to manage everything alone…

CERN RIOS station, 1976

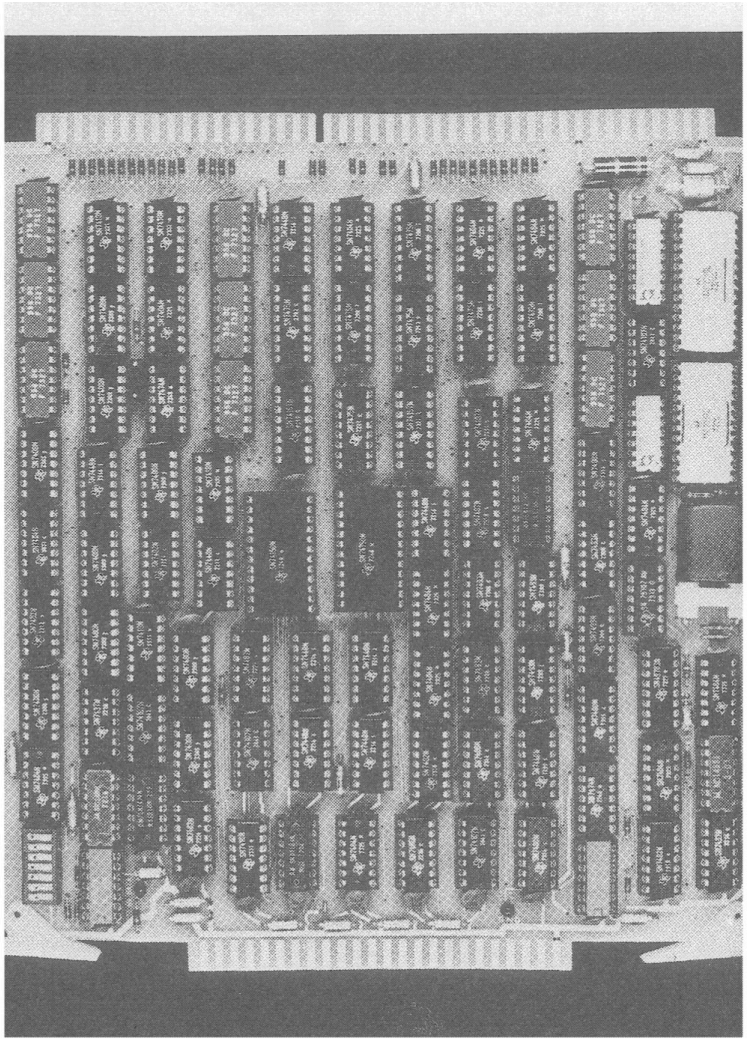
1974-76 SUPERMUX project

- **Supported "interactive mode" of computing with ("dumb") asynchronous ASCII terminals - much cheaper than companies' own synchronous models.**
- **Used an HP 2100 minicomputer but all the other hardware was CERN-designed and CERN-built:**
  - ***Channel coupler to mainframe (CDC 6x00)***
  - ***Terminal serial interface cards (36 per mux)***
  - ***Serial lines to terminals (via a central switch)***
- **CERN-written software used in both HP and CDC**
  - ***All code written in assembler language***
  - ***User level HP microcode for character handling !***

A "dumb" terminal

SUPERMUX project:

CERN-built serial async terminal interface card



1977 Bell Northern Research

- **Sabbatical leave from CERN (in Palo Alto)**
- **Software development for a PABX project**
- ***Everything was proprietary* (PL language, etc.)**
- **Programming team supported by a UNIX system:**
  - **Early BSD version, complete with "guru"**
  - **Team of 20 supported by one *PDP 11/70***
- **Also discovered ARPAnet by chance:**
  - **Could dial a local TIP and "chat" with CERN**
  - **In this way I was recruited for my next project…**

1978-83 STELLA Project

- ***Project leader*: Mervyn Hine (ex-CERN Research Director)**

- **Project to distribute CERN data via satellite to five partner European laboratories:**

  RAL, DESY, CNUCE-Pisa, UC-Dublin, U-Graz

- **Used spare satellite capacity from ESA-ESTEC**
- **Bare satellite channel *(with our own TDMA scheme)***
- **2 Mbit/sec speed *(but 50% lost for error correction)***
- **Could transmit a full 9-track tape in 10 minutes**
- ***All 6 sites had different host computer types !!***

1978-83 STELLA Project

- **Portable language used on the 6 host computers:**

  BCPL – ***precursor of B and C languages***

- **our own *Time Division Multiplexing scheme* and**
  our own *Network Protocols* (*not TCP/IP…*)
- **hardware & software for 6 adaptable host-to-modem**

  Communication Interface Modules (CIMs):

  - custom wire-wrap boards with 8bit Motorola 6800
  - programmed I/O and DMA to host minicomputers
  - coded 100% in assembler with a small boot monitor
  - code assembled & loadable from host computer

Antenna on the roof of B513

Discussing the details…

1982 Workstation Project

***Project leader*: Ian Willers**

- **A real revolution in power + memory + graphics**
- **An evaluation project = loose collaboration**
- **Leading machine was the *Apollo:***
  - **UNIX-like, M68000 based**
  - **Networked nodes - shared Virtual Memory and FS !!**
  - **FORTRAN, C and Modula2 compilers**
  - **Colour bit-mapped screens**
  - **Full screen editor, scrolling PAD, etc.**
- **Apollo became the preferred platform for *PAW:* the *Physics Analysis Workstation* (René Brun et al.)**

1983-89 CN-SW Group

***CN-SW Group Leader*: Les Robertson**

- ***my primary activity from 1984-89:***

TCP/IP Coordination within CERN

(… Sorry but don't have time to discuss that here …)

1983-89 CN-SW Group

***CN-SW Group Leader*: Les Robertson**

- ***my activities in* *Distributed Computing:***
  - **Remote Procedure Call** (***helped Tim Berners Lee***)
  - **Apollo to CERNET File Transfer Gateway**
  - **TCPAW package – portable socket library in C**

1983-89 CN-SW Group

***CN-SW Group Leader*: Les Robertson**

- ***my activities in*** ***Cray System Security:***
  - **First Cisco routers in Europe**
    - **… for a filtered Cray Ethernet segment**
  - **SecurID system ported for Cray XMP login**
    - **(System still used today by UBS e-banking)**

End of first talk

See you Friday 11th

(PART 2):

- **No more mainframes at CERN**
- **Launching Grid computing**
- **Volunteer computing and virtualisation**
- **Reflections of a retiree**
- **Conclusions**