COM304 Foundation Computing
Early Computing History

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Foundation computing

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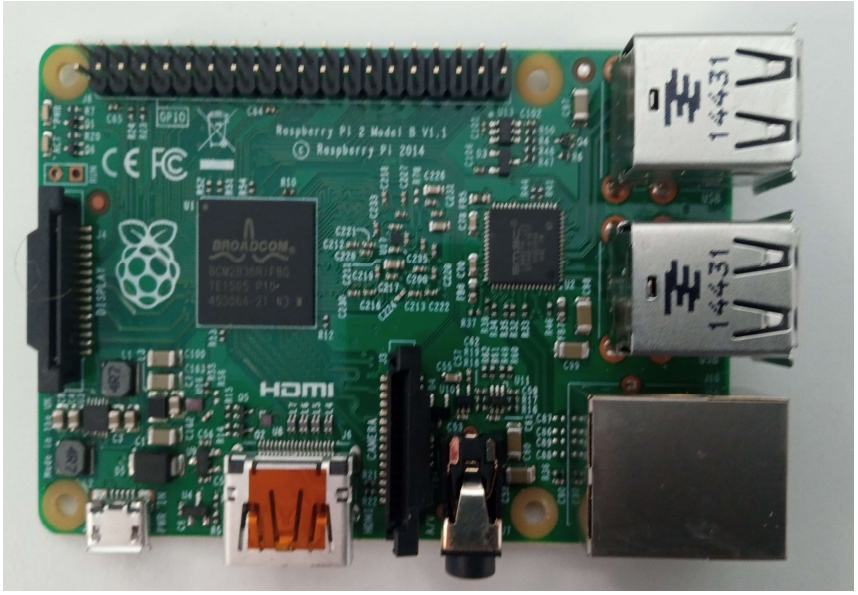
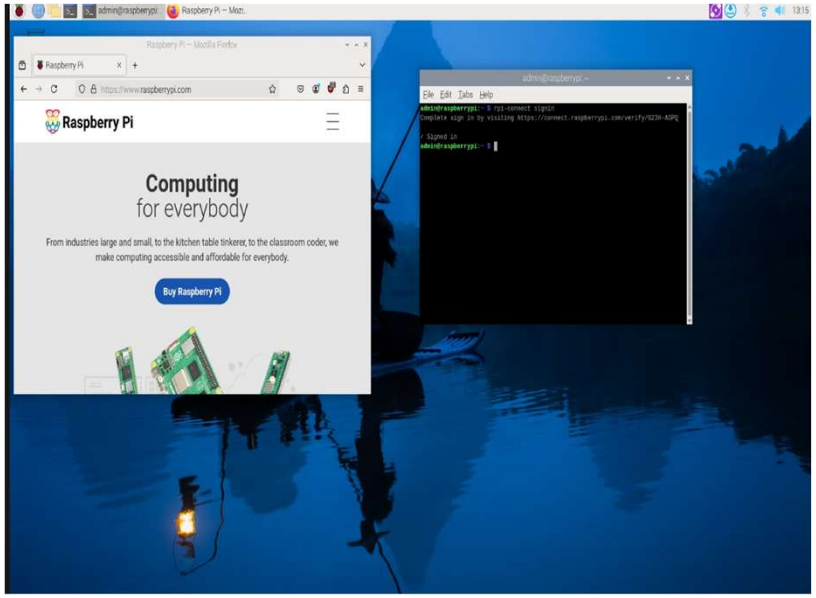
- **A broad introduction**
  - No / or limited prior knowledge
  - You can follow up topics at depth
- **Theoretical Foundation**
  - **History**
  - **Components: CPU / Memory / Peripherals**
  - Programming languages
  - Operating Systems : Linux / Unix
    - How Linux works
    - Basic commands
  - Security
  - Networking
  - Cloud
- **Practical Fun examples**
  - Raspberry Pi
  - Linux
  - Assembler / C
  - Simple hardware
- **Assessment**
  - Personal learning record
    - (Evidence of progress)





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A Short History of the short history of computing…

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Mechanical Calculators

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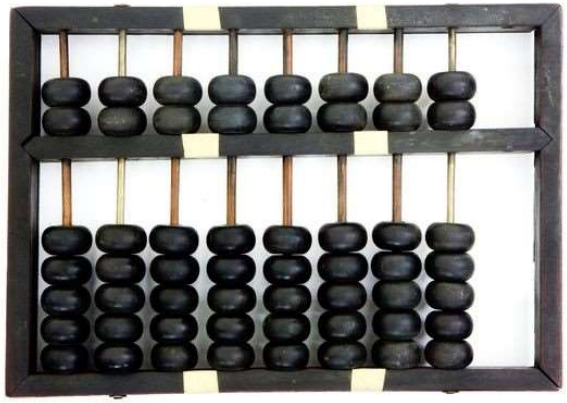

Abacus
https://www.computerhistory.org/revolution/calculators/1/41

Slide Rule
https://en.wikipedia.org/wiki/Slide_rule_scale

Ohdner (<1900)

By Post Office Savings Bank (UK) 1930's
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https://commons.wikimedia.org/wiki/File%3ABlythe_House_preparing_totals_for_daily_balance_1930s.JPG

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Mechanical Computers

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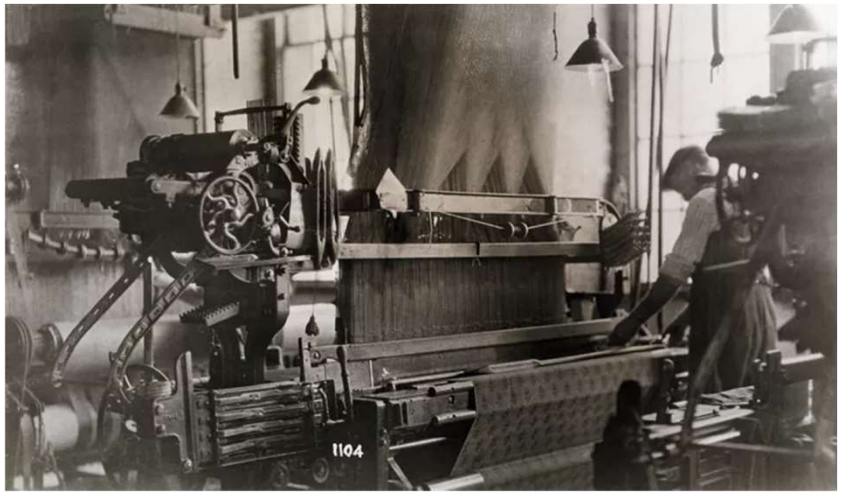
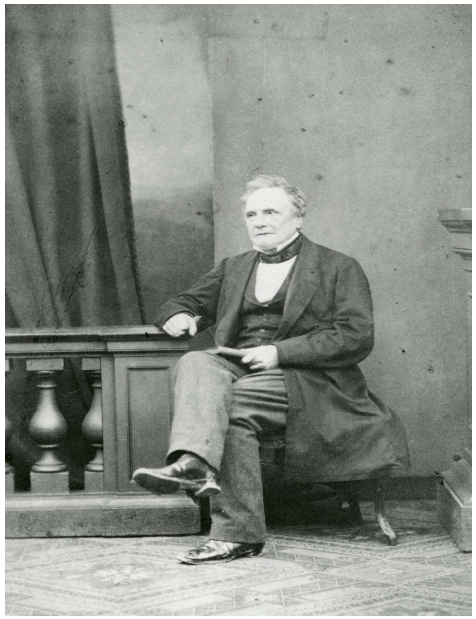
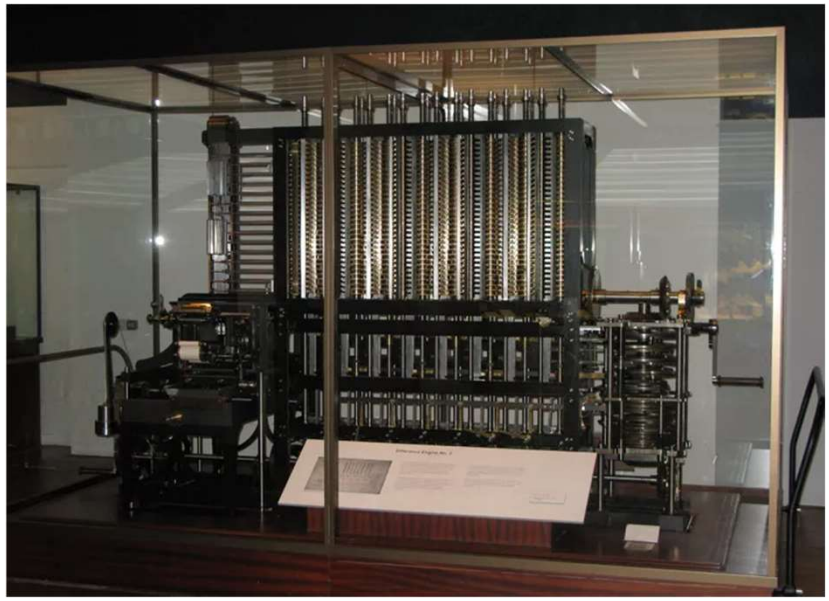
- **Charles Babbage 1791-1871**
  - British mathematician. known as "the father of computers". Difference engine inspired by punch card based Jacquard loom https://en.wikipedia.org/wiki/Charles_Babbage
- **Ada Lovelace 1815-1852**
  - Augusta Ada King, Countess of Lovelace only legitimate child of poet Lord Byron
  - long working relationship and friendship with Babbage







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Analogue computers

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- **Gaudi Sagrada Familia Cathedral Barcelona**

- **Gaudí's upside-down physical models**
  - http://dataphys.org/list/gaudis-hanging-chain-models/
  - Gaudí's upside-down physical models took him years to build but gave him more flexibility to explore organic designs, since every adjustment would immediately trigger the **"physical recomputation"** of optimal arches

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Analogue computers

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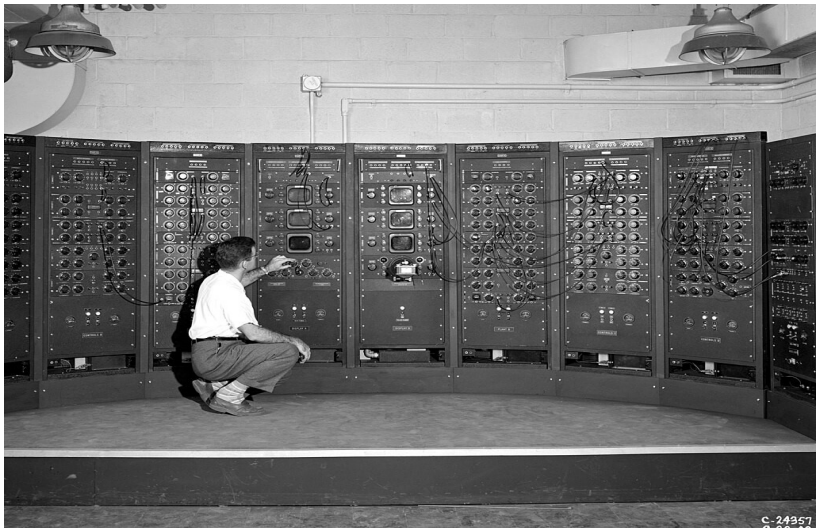
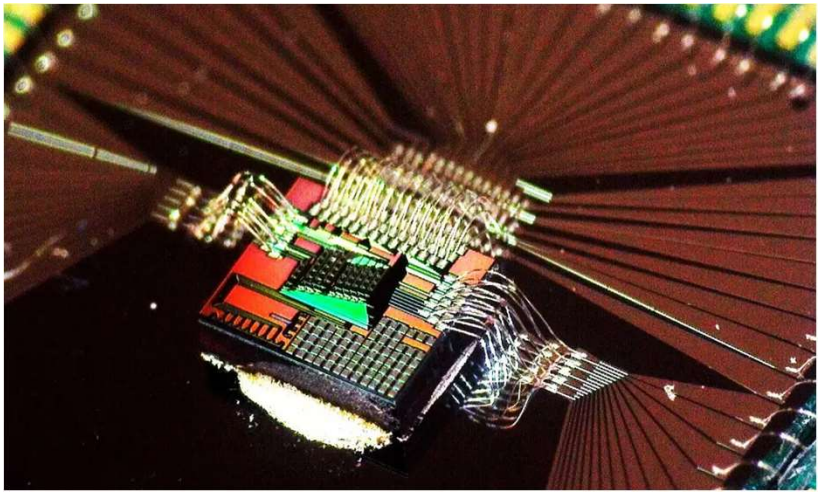
- **Analog computing machine at the Lewis Flight Propulsion Laboratory c. 1949.**



- **May make a come back**
  - Optical computing – weighted optical guides on a chip simulate neurons
  - https://www.technologyreview.com/2019/06/13/867/ai-chips-uses-optical-semiconductor-machine-learning/
  - Quantum computing



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Digital Computers

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- **Boolean Algebra**
  - George Boole Jnr
  - first professor of mathematics at Queen's College, Cork in Ireland. is best known as the author of The Laws of Thought (1854), which contains Boolean algebra. Boolean logic, essential to computer programming
  - https://en.wikipedia.org/wiki/George_Boole
  - https://en.wikipedia.org/wiki/Boolean_algebra

  - Boolean Functions
    - AND, OR, NOT etc
    - See https://www.electronics-tutorials.ws/boolean/bool_1.html

AND Function Truth Table

Switch A	Switch B	Output	Description
0	0	0	A and B are both open, lamp OFF
0	1	0	A is open and B is closed, lamp OFF
1	0	0	A is closed and B is open, lamp OFF
1	1	1	A is closed and B is closed, lamp ON
Boolean Expression (A AND B)			A . B

2-input AND Gate

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Alan Turing

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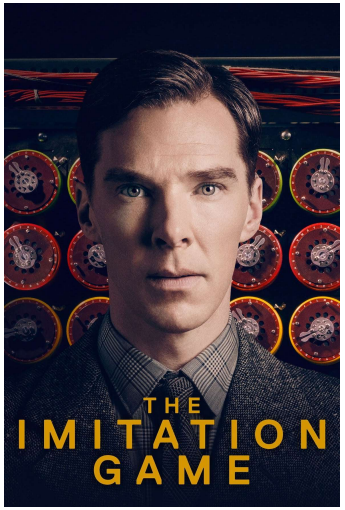
Alan Turing

- WW2 – invented the Bombe which could decode enigma machine messages through a bruit force attack - Bletchley Park in Buckinghamshire



Turing Machine

- Invented the Turing machine 1936 – core concepts for a modern computer
- The stored program is one of the primary defining characteristics of the Universal Turing Machine
- A Turing machine is an idealised model of a central processing unit (CPU) that controls all data manipulation done by a computer,

Turing Complete

- In colloquial usage, the term "Turing-complete" is use to mean that any real-world general-purpose computer or computer language can approximately simulate the computational aspects of any other real-world general-purpose computer or computer language.
- In real life, this leads to the practical concepts of computing virtualization and emulation

https://en.wikipedia.org/wiki/Turing_machine
https://en.wikipedia.org/wiki/Turing_completeness

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Electronic Computers

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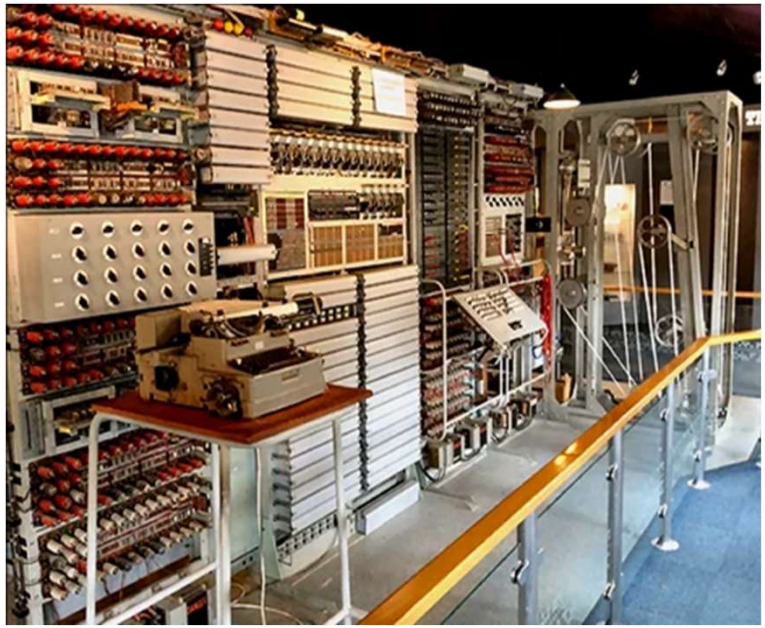
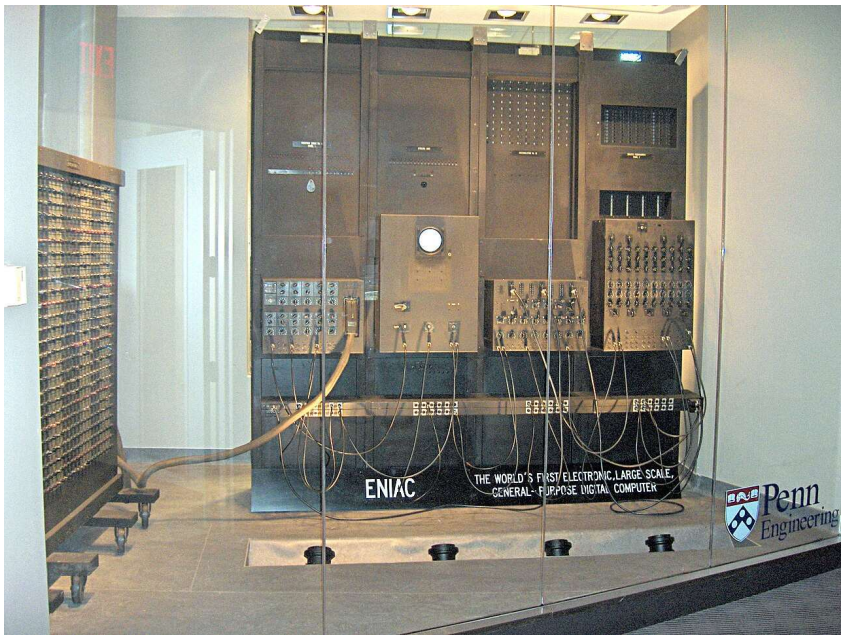
- **Colossus 1943**
  - World's First Programmable Computer
  - It was designed to decode the encrypted transmissions from the German teleprinter Lorenz cipher
  - https://historicengland.org.uk/listing/what-is-designation/heritage-highlights/worlds-first-programmable-computer/
  - Used Valves and tape readers



- **INIAC 1945**
  - ENIAC (Electronic Numerical Integrator and Computer) was the first programmable, electronic, general-purpose digital computer.
  - It was Turing-complete and able to solve "a large class of numerical problems" through reprogramming
  - 18,000 vacuum tubes
  - Several tubes burned out almost every day,



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Transistors and Integrated circuits

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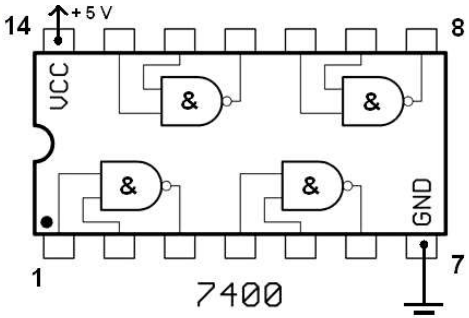
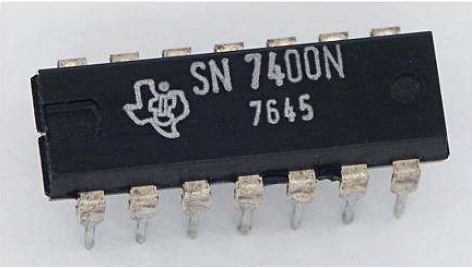
- **Bell Laboratories 1947**
  - Bipolar "Transistor," name coined by John R. Pierce
  - https://en.wikipedia.org/wiki/History_of_the_transistor

- **The world's first transistor computer was built at the University of Manchester in November 1953.**
  - https://www.youtube.com/watch?v=hJ2WW__czHI Manchester University Transistor Computer

- **Integrated circuits**
  - 1964 Diode Transistor Logic DTL Faircild 930-series
  - 1966 Transistor Transistor Logic TTL SN7400 series Texas Instruments

- **MOSFET 1959**
  - Metal Oxide Silicon Field Effect Transistor
  - Low power and simple design
  - CMOS complimentary Metal Oxide Silicon
  - Still use in all CPUs





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Early Short term memory

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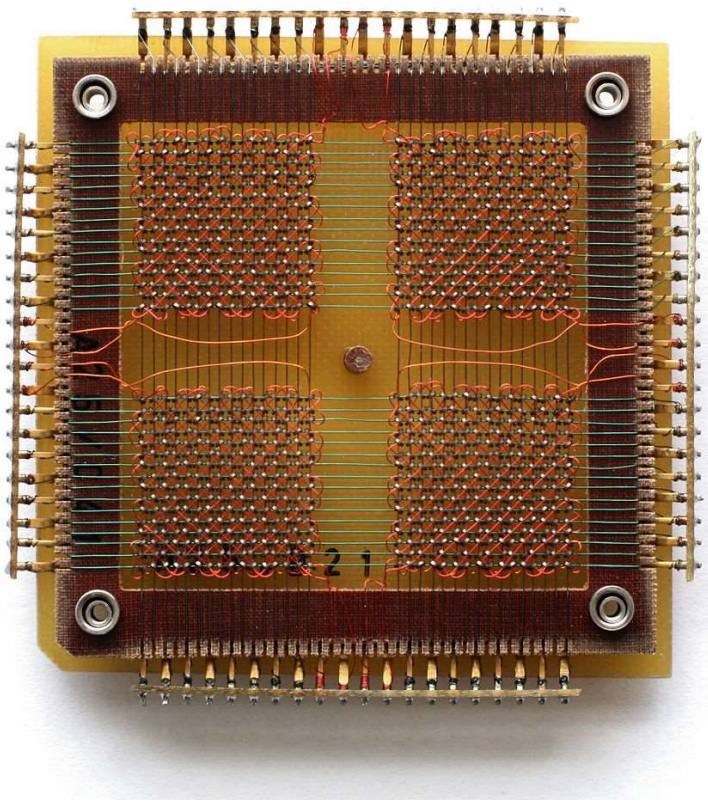
- https://www.computerhope.com/history/memory.htm

- **1955 Magnetic core memory**
  - A 32 × 32 core memory plane storing 1024 bits (or 128 bytes) of data
- **1964 SRAM**
  - Intel released its first product, the 3101 Schottky TTL (transistor-transistor logic) bipolar 64-bit SRAM (static random-access memory).
- **1970 DRAM**
  - Intel released its first commercially available DRAM, the Intel 1103, in October 1970. It was capable of storing 1024 bits or 1 kb of memory.
- **1970 ROM**
  - In the same year, Intel released the 3301 Schottky bipolar 1024-bit ROM (read-only memory).
- **1971 EPROM**
  - Intel erasable programmable read-only memory



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Early Long term Memory

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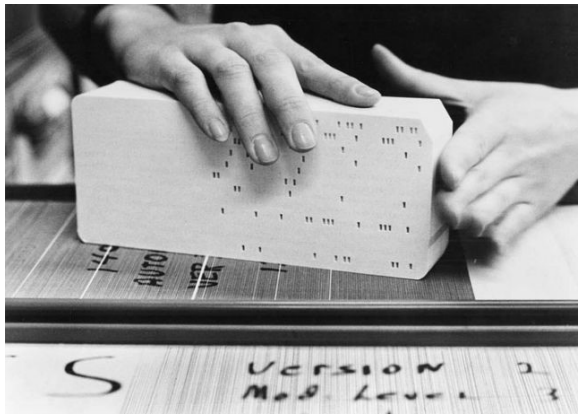
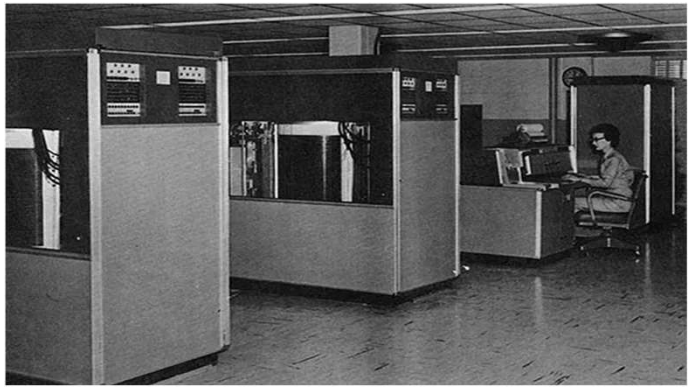
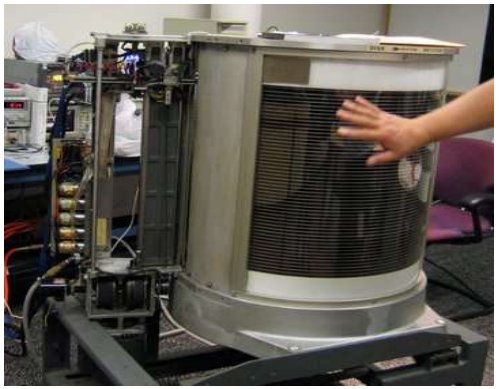
- Punched Tape
- Punched cards



- Drum
- Disk IBM350 3.75mb





- Tape

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Atlas computer

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- **Manchester Atlas**
  - was one of the world's first supercomputers, in use from 1962 (when it was claimed to be the most powerful computer in the world) to 1972.
- **Introduced new design concepts now known as**
  - Multiprogramming
  - Job scheduling,
  - Spooling
  - Interrupts
  - Pipelining
  - Interleaved Storage
  - Virtual Storage
  - Paging
  - Autonomous transfer units
- **References**
  - https://curation.cs.manchester.ac.uk/digital60/www.digital60.org/birth/manchestercomputers/museandatlas/index-2.html
  - https://en.wikipedia.org/wiki/Atlas_(computer)

- 48 bit word
- 16K core memory
- 4 drums – 24k 12ms revolution time

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Computer Languages

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- **Machine code**
  - Raw binary code used by CPU's

- **Assembly language**
  - Human readable version of machine code
  - Very efficient to run but time consuming to code.
  - just under 2% of version 4.9 of the Linux kernel source code is written in assembly; more than 97% is written in C

- **High level languages (still used today)**
  - Fortran 1954 IBM - *Formula Translating System*, written to support scientific and engineering applications
  - LISP (1958) LISt Processor quickly became a favored programming language for artificial intelligence (AI) research.
  - COBOL (1959) - common business-oriented language – still used in banks
  - BASIC (1964) - BASIC (Beginners' All-purpose Symbolic Instruction Code)
  - C – A general purpose programming language originally developed at Bell Labs by Ritchie between 1972 and 1973 – used to implement Unix kernel (also Linux)

  - https://en.wikipedia.org/wiki/History_of_programming_languages
  - https://www.computer.org/publications/tech-news/insider-membership-news/timeline-of-programming-languages

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Programming - Hidden figures 1961

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- **Mary Jackson**
  - obtained her engineering degree and became NASA's first female African American engineer;
  - https://en.wikipedia.org/wiki/Mary_Jackson_(engineer)

- **Dorothy Vaughan**
  - continued as NASA's first African American supervisor
  - https://en.wikipedia.org/wiki/Dorothy_Vaughan

- **Katherine Johnson,**
  - In 2015, she was awarded the Presidential Medal of Freedom
  - https://en.wikipedia.org/wiki/Katherine_Johnson

https://en.wikipedia.org/wiki/Hidden_Figures

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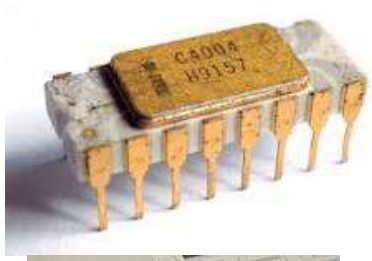
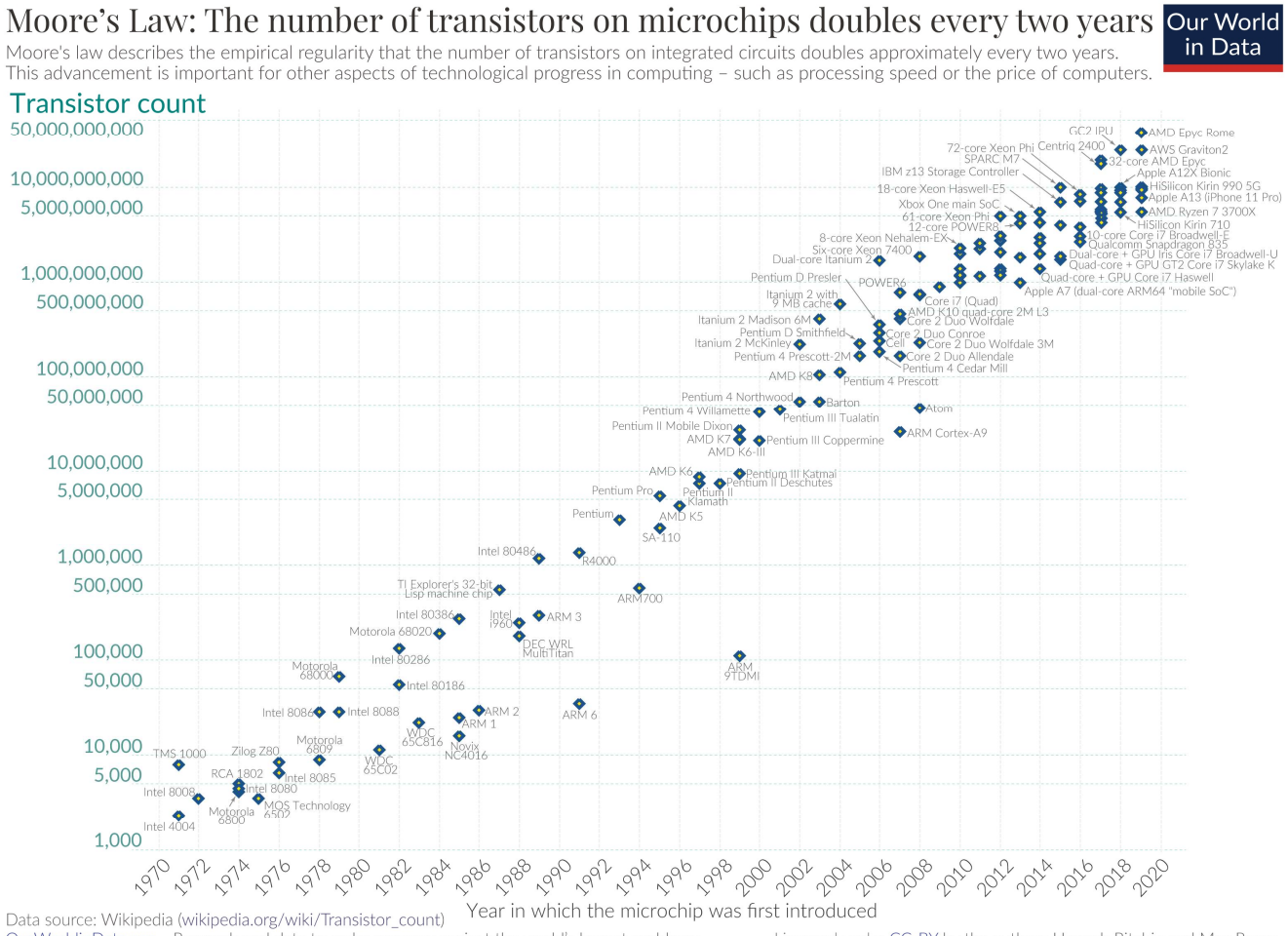
Microchips

- 1971 Intel invents 4004
- 4 bit microprocessor
- Gordon Moore Intel – Moores Law





1980's – Personal Computers

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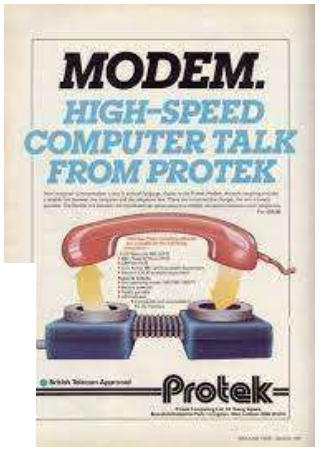
- Computers
  - home computer
  - Sinclair ZX80 (Z80)
  - PC – IBM / Microsoft (Intel)
  - Apple II (Motorola M6805)

- Phones
  - digital lines / analogue phone
  - Modems

- Private networks – hobby
  - AOL etc



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1990s – emergence of smart phones

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- **Digital mobile**
  - 1987 GSM Technical Specification
  - 2000 General Packet Radio Service (GPRS)
  - 2001, UMTS (W-CDMA) 3G 1990's

- **Personal Assistants**
  - PDA – Palm pilot, Psion
  - Apple Neuton, Apple Ipod
  - Blackburry

- **Smart Phones**
  - 2007 Iphone
  - 2008 Android 1.0

Phones and mobile compute merged

HTC Dream – first android

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Mainframe Evolution

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1970's

Dumb Text Terminals (VT100)

'Thin Clients'

ASCII / RS232

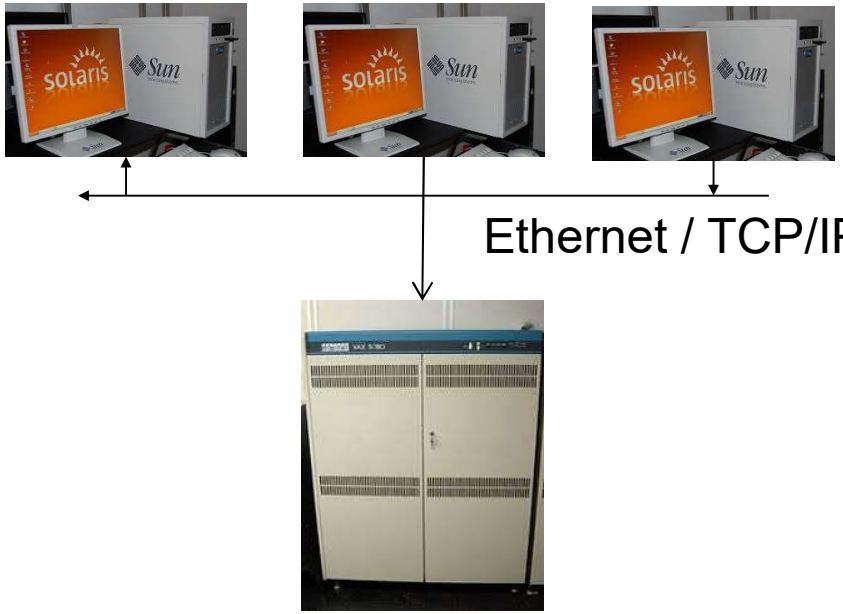
Mainframe
e.g. IBM 360

1980-90's

Client Server Architecture

Workstations Hosting X-windows

'Thick Clients'



Mini computer
e.g. DEC VAX 11

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Converged Virtualised Services (Cloud)

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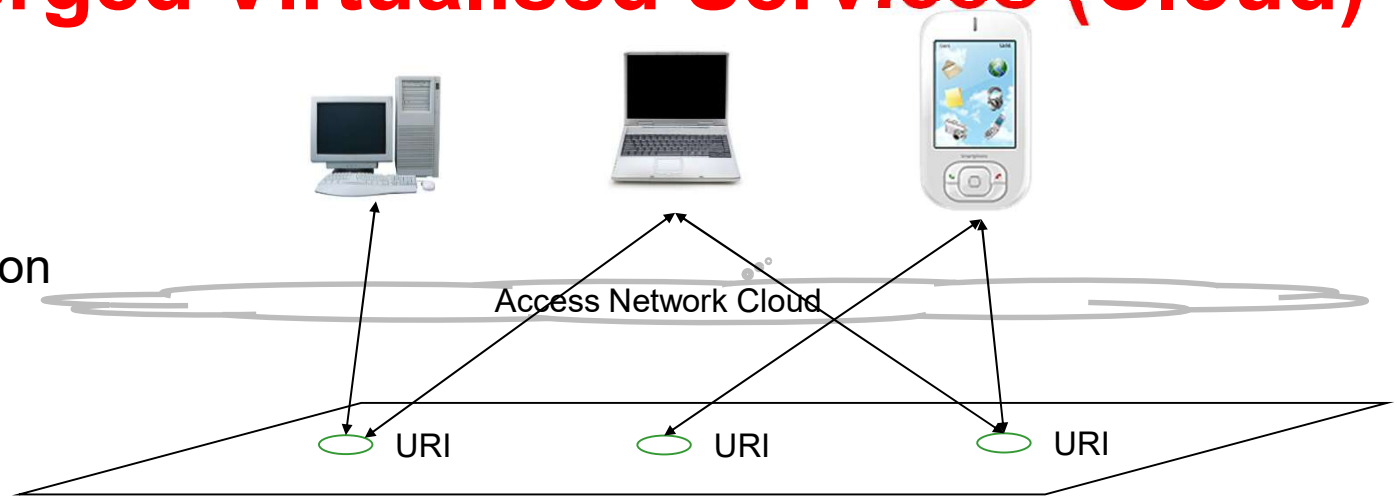
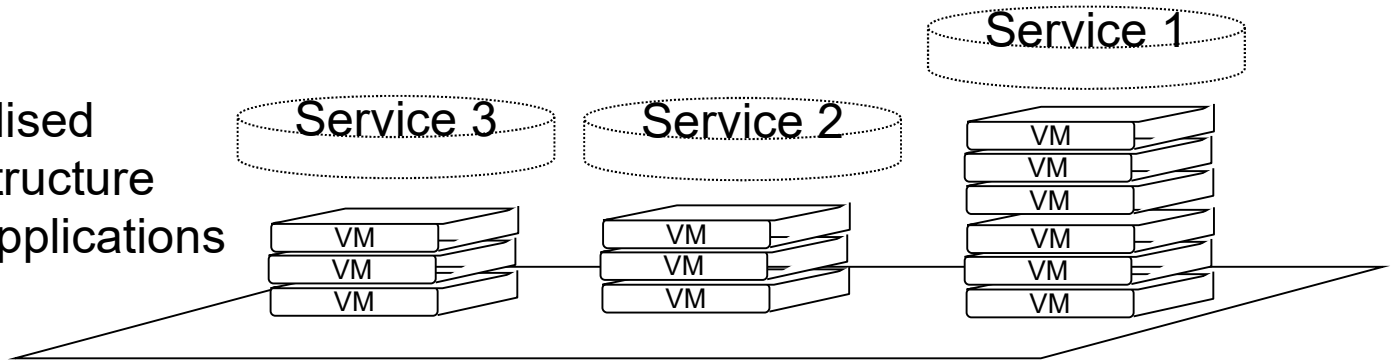
Application Space



End user Services (Apps) are a mash-up of web services accessed through standard and proprietary protocols;

- HTTP, REST, SOAP, JSON, RSS,
- **Open Data / RDF etc.**
- **'Internet of things'**

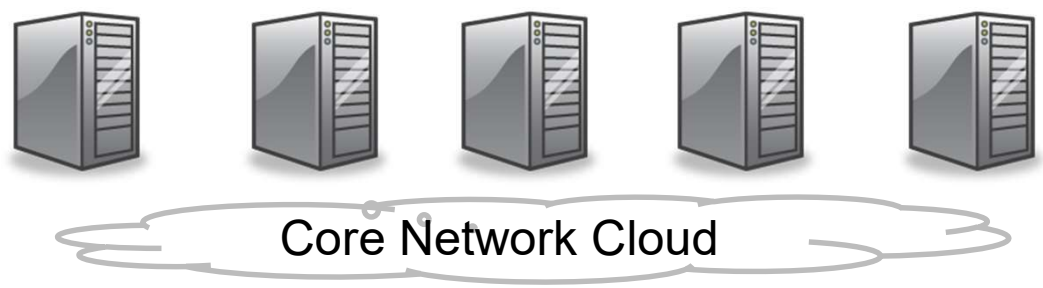
Virtualised Infrastructure And applications



Services hosted in 'Cloud' designed to scale through addition of VM resources

'cloud bursting'
'cloud brokering'

Physical Infrastructure



Underlying physical infrastructure
•Commodity hardware
•Geographical Diversity
•Rapid Churn
•Network Connectivity

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