History of Computing

Stephen Roberts
Hilary Term

The abacus

- First used in China in around 1300 A.D.
- 500 B.C. - The abacus was first used by the Babylonians as an aid to simple arithimetic
- As such it consitutes the oldest *mechanical* computing device

Algorithm 820 (?)

- Arab mathematician, *al-Khoverarizmi*
- Considered in a classic text (now lost) how to draw up tables of figures for navigation and astronomy
- Process based on a series of mathematical steps
- Algorithms

Calculating Clock 1623

- Wilhelm Schickard
- Add / Sub 6 digit numbers
- Overflow indicated with a bell
- Cogs and wheels design
- Machine reconstructed in 1960 - it worked
- Ratchet and cog technology

Stepped Reckoner 1671

- Gottfried Liebniz
- First machine able to multiply
- Multiply numbers A, B : A < 5 digits, B < 12
- 16 digit operand
- Notion of Mult as successive Add

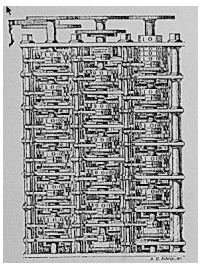
Calculating machines

- Mainstay of machine arithmetic throughout 18th century
- Add / Sub (/ Mult) as basic operations on 4-6 digits numbers
- Fuelled by economics of trade
- No considerations of *computing*

Charles Babbage

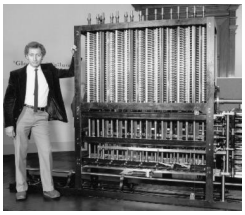
- 1792-1871
- General purpose computing
- Notions of ROM and i/o
- Programming
- CPU

The Difference Engine



- 1828 D.E. I
- 1832 D.E. II
- Design for 6th-order differences, 20 digit numbers
- Notion of *carry*, *full-adder*

Finally built



- The simpler difference engine was finally built in the Science Museum in 1991
- Apart from 2 minor mistakes, Babbage's huge design worked first time!

The Analytic Engine

- Program stored on punch cards
- 40 digit CPU (the "mill") with 2 accumulators!
- "Store" to hold 100 numbers
- Reading of code & data - modern!
- Conditional jumps
- Add/Sub in 3s, Mult in 2-4 minutes

The first Programmer

- Babbage's friend, Lady Ada Lovelace
- Designed codes for program & data manipulation
- First to consider computation as a model of the brain

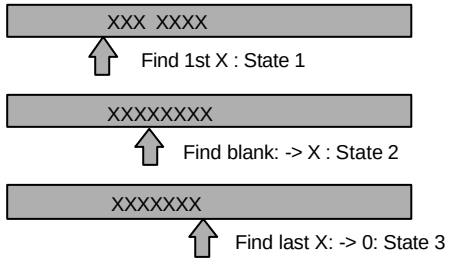
Notable dates

- 1848 George Boole - binary algebra
- 1896 IBM founded
- 1906 Electronic valve developed by Lee De Forest
- 1901 IBM 601 - punch card storage, relays & valves: Mult in 1s
- 1937 Shannon - symbolic logic with relays

Alan M. Turing

- 1937 - paper on *computable numbers*
- Universal Turing Machine
- Computing on principled basis
- Pioneer of *first generation* computers

Universal Turing Machine



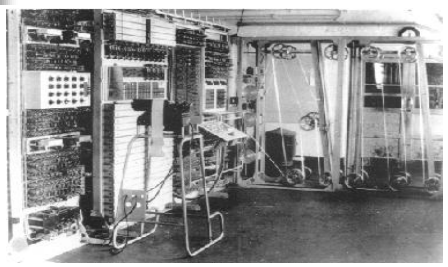
First Generation Computers

- Mid 1940s - late 1950s
- Based on valves, relays & wires for CPU
- Punch cards for program storage
- Capacitance based data storage
- *"I think there is a world market for maybe 5 computers"*, Thomas Watson, IBM (1943)

Bletchley Park 1939-1945

- Decoding the German Enigma machine
- Development of world's first electronic *programmable* computer
- COLOSSUS

Colossus



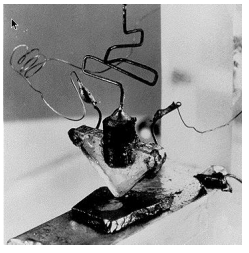
Colossus

- Input: punched paper tape: 5000 char/s by optical reader
- Output: Buffered onto relays - typewriter printing onto paper roll.
- Clock speed 5kc/s using 2,500 valves.
- +200v to -150v at up to 10A. 4.5 KW
- Two banks of racks 7' 6" high x 16' wide
- *Speed of P200 for specific task!*

1946-1948

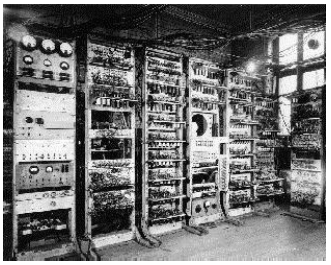
- ENIAC - first totally electronic computer (1946). Weighed 30 tonnes & used 18,000 valves. 100,000 comp/s
- Manchester Mark I (1948) - world's first *stored program* computer.
- 1947: Invention of the transistor

The transistor



- 1947 at Bell labs
- Shockley, Bardeen & Brattain - later to be given Nobel prizes
- Direct, high-speed, low-power replacement for valves
- Can amplify & switch

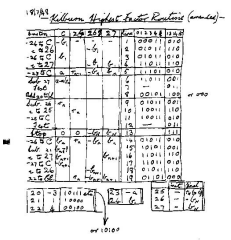
Manchester Mark I



Manchester Mark I prototype

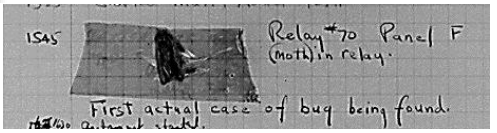
- First *stored program* computation - 21st June 1948
- 2048 bits storage as charge on CRT
- Different programs could be entered - no need for physical changes to electronics
- A true *Universal Turing machine*

First program



- Determine the highest factor of a number
- 52 minutes, involving about 2.1 million instructions
- "…and nothing was ever the same again." *(MMI researcher)*

The first BUG



- Moth found in ENIAC relay (1946)
- Relay was part of program electronics
- Hence "bug in the program"

1950s

- First commercial electronic computers
- 100 computers in world!
- FORTRAN & LISP developed
- EDVAC (1952) - Von Neumann *et al.*
- Magnetic memory developed
- First dot-matrix printer
- *Still based on valve-relay methods*

Second generation 1959-1964

- September 12, 1958: invention of the *integrated circuit* (Jack Kilby)
- Intel develops the transistor *microprocessor*
- Computers based on the *transistor* and *printed circuit boards* e.g. DEC PDP-8
- Huge rise in computer usage

Third generation 1964-1972

- Based on *transistors* within *integrated circuits*
- 1965 - invention of the mouse (not used until 1983!)
- 1965 - BASIC
- 1969 - first computer networks
- 1970 - UNIX
- 1971 - First true microprocessor (Intel)

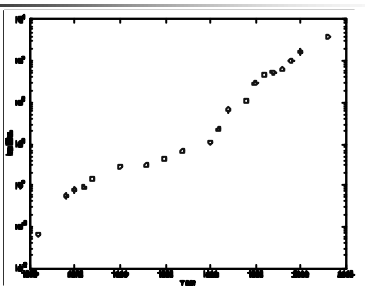
Fourth generation

- Based on *Large Scale Integration* (LSI)
- leading to *VLSI*
- and to *ULSI*
- Development of PC and peripherals
- Development of the WWW (1990-)

1980s, 1990s

- Exponential growth of industry
- Standardisation due to dominance of small number of suppliers
- Peripherals: CD-ROM, high-density 3.5” discs, printers and network
- Huge growth in distributed IT (WWW)
- Portable computing

Speed of ‘PCs’



The future

- >>GHz CPUs
- Ultra-fast WWW – distributed clusters
- Full circle: 1998 - molecular abacus
- DNA computing
- Quantum computing: 1999 first program to ‘run’ on a QC - a string search