Sissejuhatus infotehnoloogiasse

Loengu ülevaade

Kordamine:

- II maailmasõja aegsed esimesed arvutid
- Raadiolampide tööpõhimõte

1947–1960

- Transistor
- Arvutite tööstuslik tootmine, IBM-i domineerimine
- Kõvakettad
- Integraalskeemid
- SAGE: sõjaväe radarivõrk
- Fortran

1961-1970: Kaasaegse tehnoloogia sünd

- Programmeerimiskeeled: Cobol, Lisp (Fortran paar aastat varem)
- Dec, PDP ja miniarvutite teke
- IBM System 360 mainframed
- Integraalskeemide tootmise algus
- Engelbart, hiir ja aknad
- Esimene mikroprotsessor
- UNIX
- Laserprinter

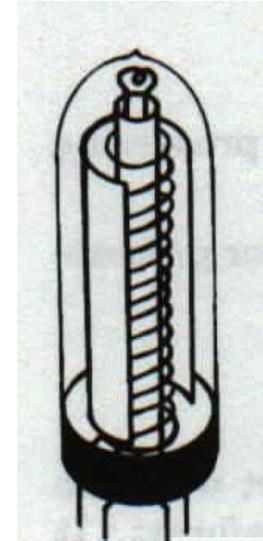# First operative digital computers

Five first operative digital computers

Computer	Shown working	Binary	Electronic	Programmable	Turing complete
Zuse	May 1941	Yes	No	By punched film stock	Yes (1998)
Atanasoff–Berry Computer	Summer 1941	Yes	Yes	No	No
Colossus	1943 / 1944	Yes	Yes	Partially, by rewiring	No
Harvard Mark I – IBM	1944	No	No	By punched paper tape	Yes (1998)
ENIAC	1944	No	Yes	Partially, by rewiring	Yes
	1948	No	Yes	By Function Table ROM	Yes

Kordamine: raadiolambi tööpõhimõte

- **Vacuum Tube** (1906, Lee Deforest)

  Three elements device used as electronic switch and amplifier: two electrodes separated by a grid in a vacuum glass enclosure.
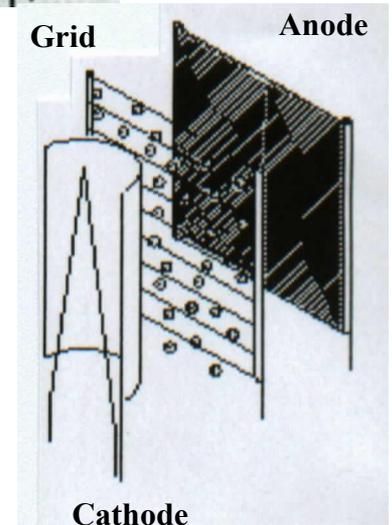
- **Principle**

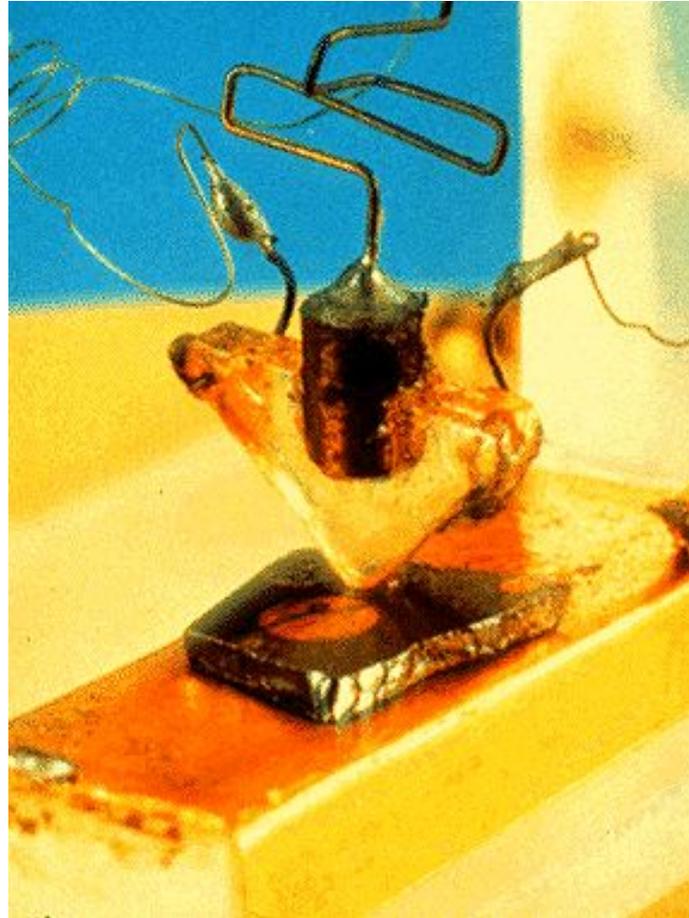 *Cathode* – emits electrons;

  Plate (anode) – receives the electrons;

  Grid – with negative bias voltage repels some of the electrons and prevents them from reaching the plate, resulting in less current flow. A changing negative charge on the grid modulates the plate current.

Grid **Anode**

Cathode

1947

■ Three scientists at **Bell Telephone Laboratories**, William Shockley, Walter Brattain, and John Bardeen demonstrate their new invention of the point-contact transistor amplifier.

Transistori tööpõhimõte

- ### Transistor

  Three elements solid-state device for amplifying, controlling electrical signals.
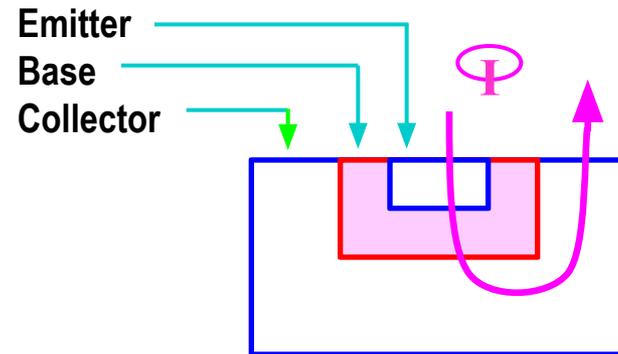
  N P N

- ### Principle

  Current flows from emitter through base into collector;

  Switching - Base current on, collector current flows - Switching;

  Amplification - Base current regulates large amount of collector current.

  Emitter
  Base
  Collector

1949

■ **Maurice Wilkes** assembled the **EDSAC**, the first practical **stored-program computer**, at Cambridge University. His ideas grew out of the Moore School lectures he had attended three years earlier. For programming the EDSAC, Wilkes established a library of short programs called subroutines stored on punched paper tapes.
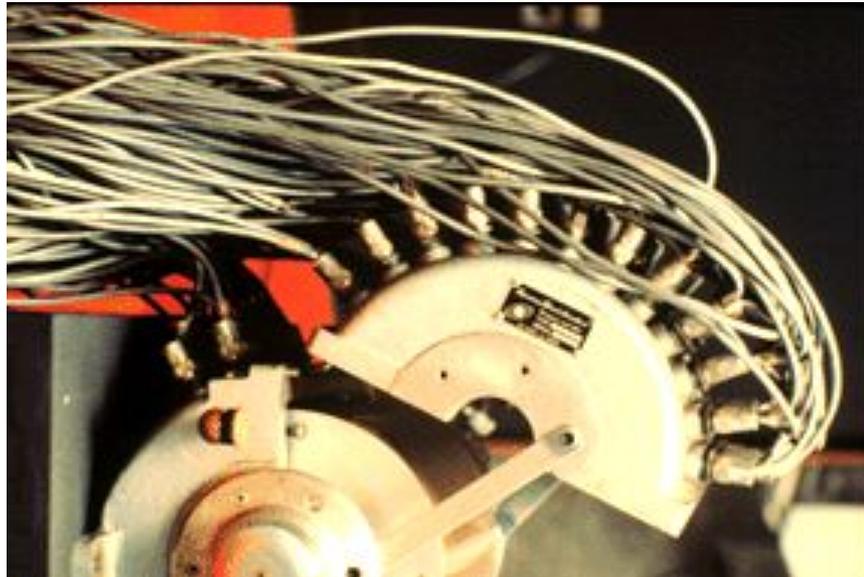
TECHNOLOGY: vacuum tubes

MEMORY: 1K words, 17 bits, mercury delay line

SPEED: 714 operations per second

1950

- Engineering Research Associates of Minneapolis built the **ERA 1101, the first commercially produced computer**; the company's first customer was the U.S. Navy.

  It held 1 million bits on its **magnetic drum**, the earliest magnetic storage devices. Drums registered information as magnetic pulses in tracks around a metal cylinder. Read/write heads both recorded and recovered the data. Drums eventually stored as many as 4,000 words and retrieved any one of them in as little as five-thousandths of a second.

1951

- The **UNIVAC I** delivered to the U.S. Census Bureau was the first **commercial computer to attract widespread public attention**. Although manufactured by Remington Rand, the machine often was mistakenly referred to as the "IBM UNIVAC." Remington Rand eventually sold 46 machines at more than $1 million each.

SPEED: 1,905 operations per second

INPUT/OUTPUT: magnetic tape, unityper, printer

MEMORY SIZE: 1,000 12-digit words in delay lines

MEMORY TYPE: delay lines, magnetic tape

TECHNOLOGY: serial vacuum tubes, delay lines, magnetic tape

FLOOR SPACE: 943 cubic feet

COST: F.O.B. factory $750,000 plus

Early AI programs: checkers, chess (Britain)

■ Strachey wrote a **checkers program** for the Ferranti Mark I at Manchester (with Turing's encouragement and utilising the latter's recently completed [Programmers' Handbook](#) for the Ferranti computer). By the summer of 1952 this program could, Strachey reported, "play a complete game of Draughts at a reasonable speed".

■ Prinz's **chess program**, also written for the Ferranti Mark I, first ran in November 1951. It was for solving simple problems of the mate-in-two variety. The program would examine every possible move until a solution was found. On average several thousand moves had to be examined in the course of solving a problem, and the program was considerably slower than a human player.

■ Turing started to program his **Turochamp chess-player** on the Ferranti Mark I but never completed the task. Unlike Prinz's program, the Turochamp could play a complete game and operated not by exhaustive search but under the guidance of rule-of-thumb principles devised by Turing.

Early AI programs: checkers (USA)

■ The first AI program to run in the U.S. was also a checkers program, written in 1952 by **Arthur Samuel** of IBM for the IBM 701.

■ Samuel took over the essentials of Strachey's program (which Strachey had publicised at a computing conference in Canada in 1952) and over a period of years considerably extended it.

■ In 1955 he added features that enabled the program to learn from experience, and therefore improve its play. Samuel included mechanisms for both rote learning and generalisation. The program soon learned enough to outplay its creator. Successive enhancements that Samuel made to the learning apparatus eventually led to the program winning a game against a former Connecticut checkers champion in 1962 (who immediately turned the tables and beat the program in six games straight).
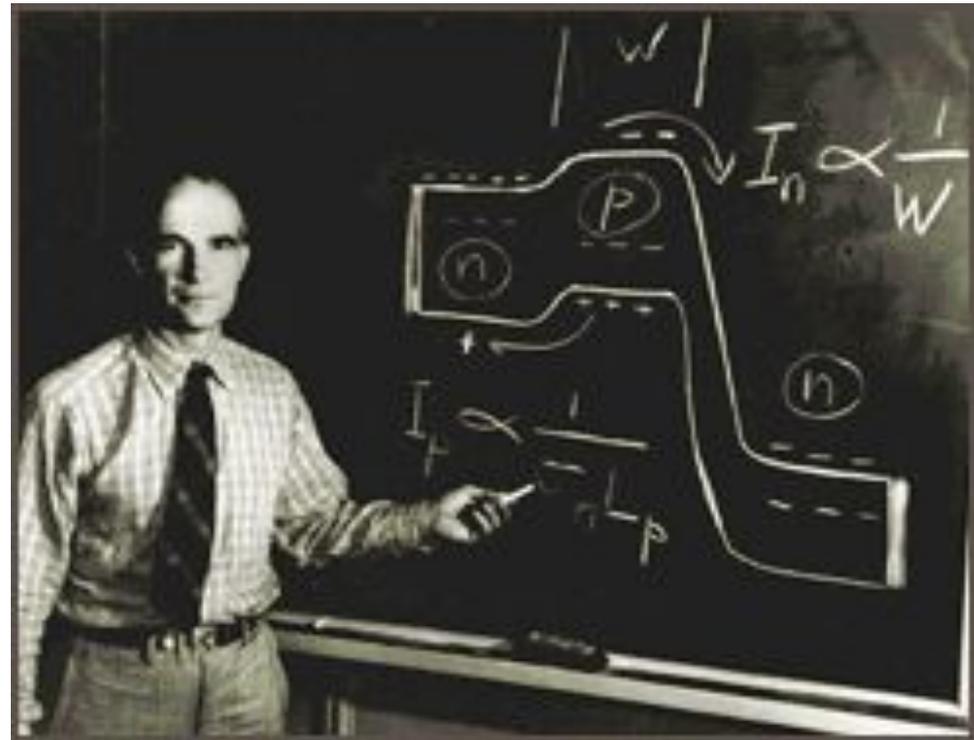
1952

- Heinz Nixdorf founded **Nixdorf Computer Corp**. in Germany. It remained an independent corporation until merging with Siemens in 1990.

- A complaint is filed against IBM, alleging **monopolistic practices** in its computer business, in violation of the Sherman Act.

- G. W. Dummer, a radar expert from Britain's Royal Radar Establishment presents a paper proposing that **a solid block of materials be used to connect electronic components**, with no connecting wires.

1953

- **IBM** shipped its first **electronic computer**, the 701.

- Speedcoding: John Backus.

1954

- **Texas Instruments** announces the start of **commercial production on silicon transistors**. [110]

- Herbert Simon and Allen Newell unveiled **Logic Theorist software** that supplied rules of reasoning and proved symbolic logic theorems.

- The Logic Theorist, as the program became known, was the major exhibit at a conference organised in 1956 at Dartmouth College, New Hampshire, by John McCarthy, who subsequently became one of the most influential figures in AI.

- Newell, Simon and Shaw went on to construct the General Problem Solver, or GPS. The first version of GPS ran in 1957 and work continued on the project for about a decade. GPS could solve an impressive variety of puzzles, for example the "missionaries and cannibals" problem.

1955

■ William Shockley founds **Shockley Semiconductor** in Palo Alto, California

However, the venture did not go well, partly because of Shockley's managerial style, and partly because he diverted resources away from transistor technology and into the creation of a 4-layer switching diode, a device which he had conceived whilst still at Bell.

Side note: Stanford University in Palo Alto

Side note: Hewlett Packard

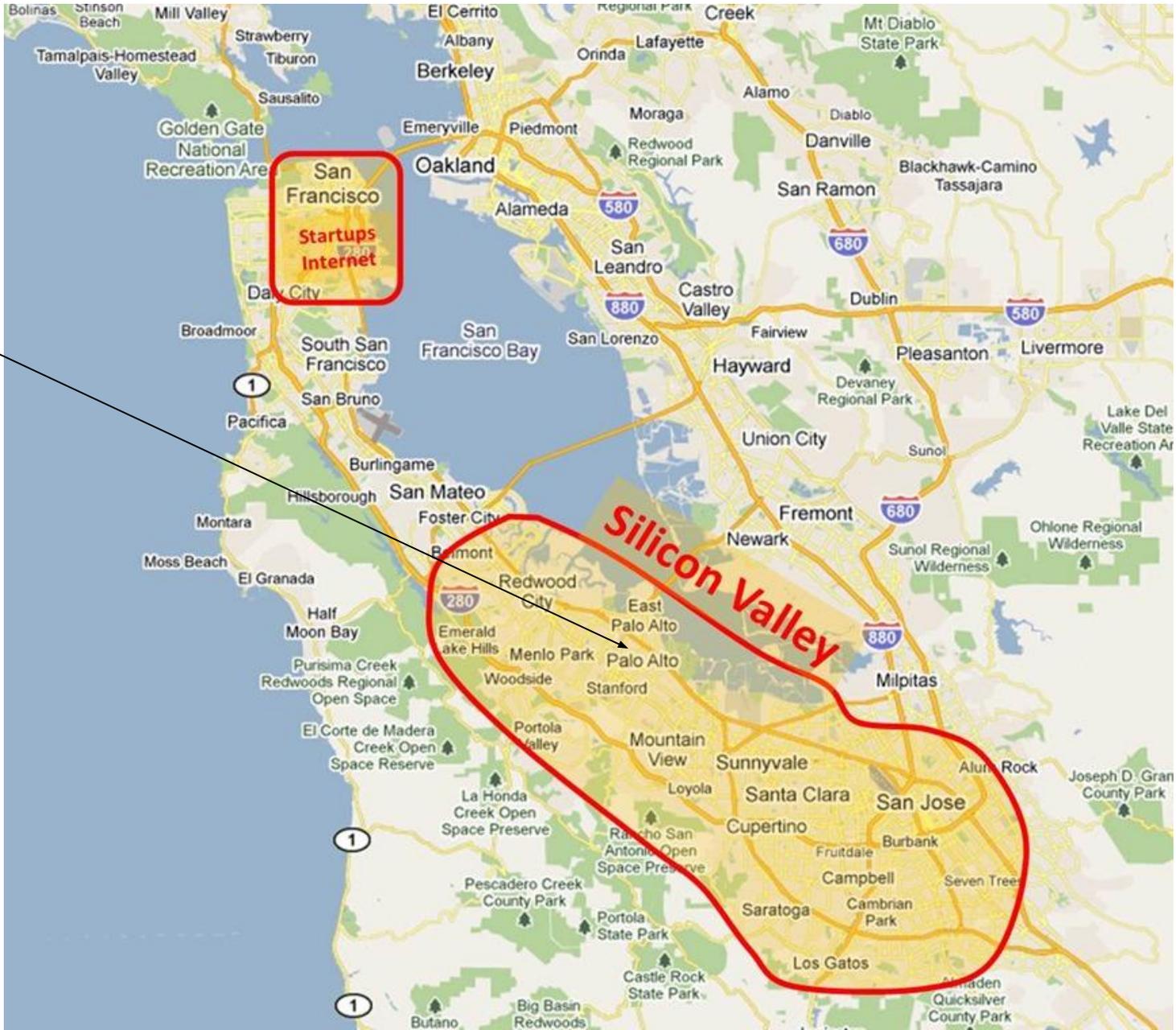■ HP is recognized as the symbolic founder of Silicon Valley

Started in this garage in Palo Alto
In 1939

Oscillator HP200A was the first
product of HP

Palo
Alto

1956

- A U.S. District Court makes a **final judgement on the complaint against IBM** filed in January 1952 regarding monopolistic practices. A "consent decree" is signed by IBM, placing limitations on how IBM conducts business with respect to "electronic data processing machines".

- **IBM** develops **the first hard disk**, the RAMAC 305, with 50 two-foot diameter platters. Total capacity is **5 MB**. (350 Disk Storage Unit)

- **The first transistorized computer** is completed, the TX-O (Transistorized Experimental computer), at the Massachusetts Institute of Technology.

The Nobel Prize in physics is awarded to John Bardeen, Walter Brattain, and William Shockley for their **work on the transistor**.

1957…

■   A new language, **FORTRAN** (short for formula translator), enabled a computer to perform a repetitive task from a single set of instructions by using loops.

The first commercial FORTRAN
 program ran at Westinghouse,
producing a missing comma
 diagnostic.

A successful attempt followed.

Programmer's
Reference Manual
October 15, 1956

**THE FORTRAN
AUTOMATIC CODING SYSTEM
FOR THE
IBM 704 EDPM**

This manual supersedes all earlier information about the FORTRAN system. It describes the system which will be made available during late 1956, and is intended to permit planning and FORTRAN coding in advance of that time. An Introductory Programmer's Manual and an Operator's Manual will also be issued.

APPLIED SCIENCE DIVISION
AND PROGRAMMING RESEARCH DEPT.
International Business Machines Corporation
590 Madison Ave., New York 22, N. Y.

- A group of eight engineers leaves Shockley Semiconductor to form **Fairchild Semiconductors**.

- Kenneth Olsen founds

Digital Equipment Corporation.

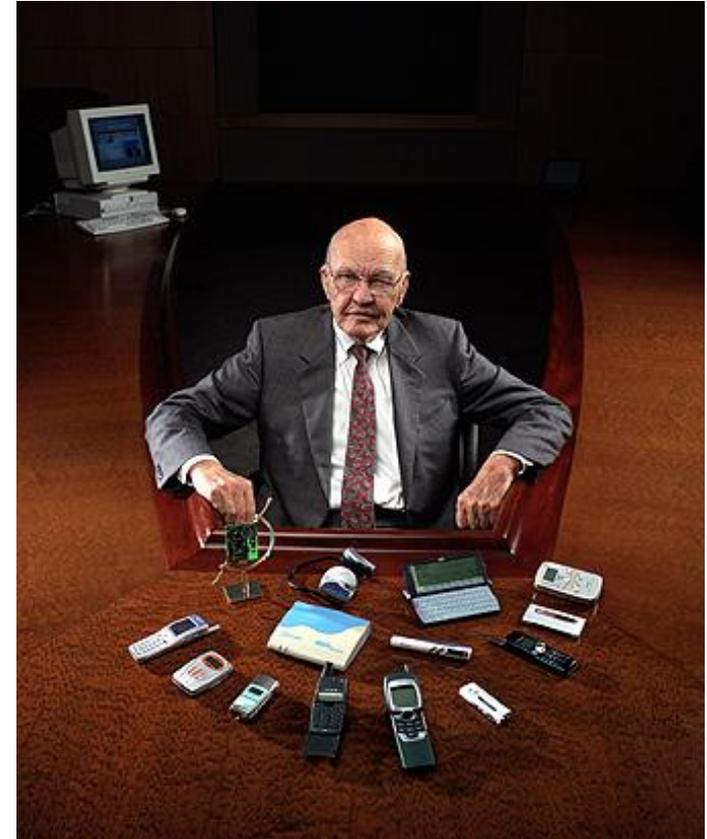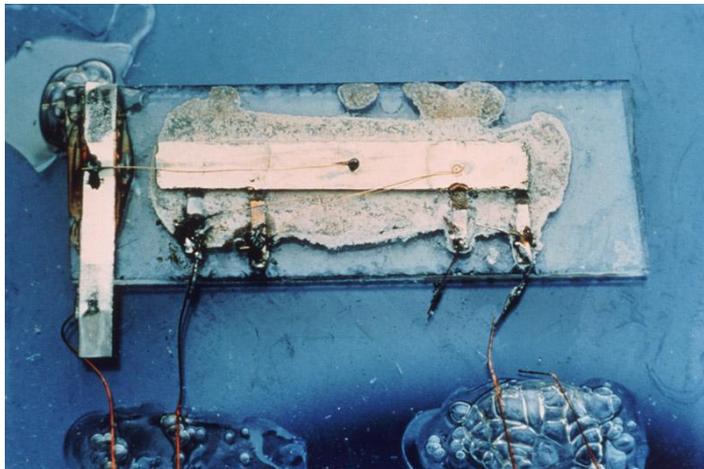Left to right: Moore, Roberts, Kliner, Noyce, Ginrich, Blank, Hoerni, Last

1958

- **SAGE** -- Semi-Automatic Ground Environment -- linked hundreds of radar stations in the United States and Canada in **the first large-scale computer communications network.**

1958

- At **Texas Instruments**, **Jack St. Clair Kilby** comes up with **the idea** of creating a monolithic device (**integrated circuit**) on a single piece of silicon.
- Later (in 2000) Kilby receives Nobel price in physics

- **Jack Kilby completes building the first integrated circuit**, containing five components on a piece of germanium half an inch long and thinner than a toothpick.
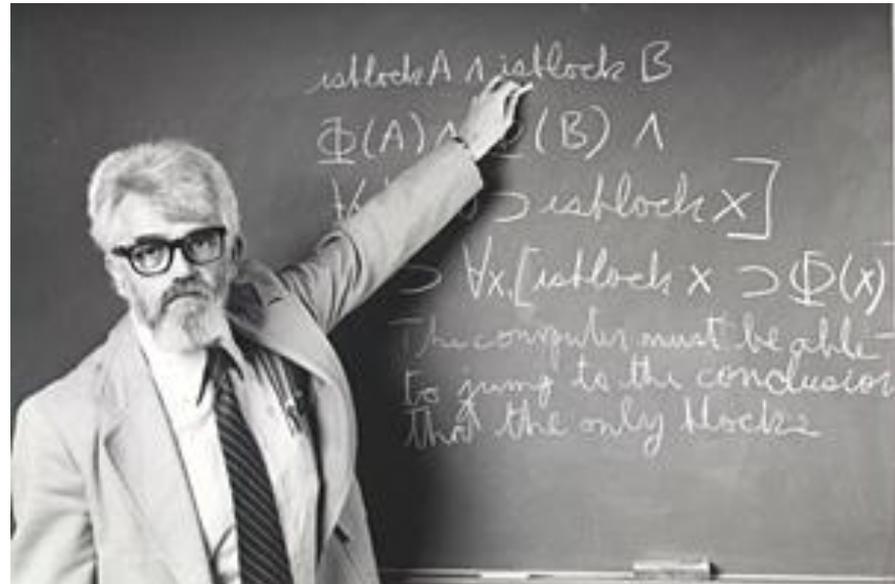
1959

- **Fairchild Semiconductor files a patent application for the planar process for manufacturing transistors**. The process makes commercial production of transistors possible and leads to Fairchild's introduction, in two years, of the first integrated circuit.

- Texas Instruments **announces the discovery of the integrated circuit**.

- At Fairchild Semiconductor, **Robert Noyce constructs an integrated circuit** with components connected by aluminum lines on a silicon-oxide surface layer on a plane of silicon.

- Fairchild Semiconductor announces **their independent discovery** of the integrated circuit.

1960

■   **IBM** develops the first **automatic mass-production facility** for transistors, in New York.

■   AT&T designed its Dataphone, **the first commercial modem**, specifically for converting digital computer data to analog signals for transmission across its long distance network
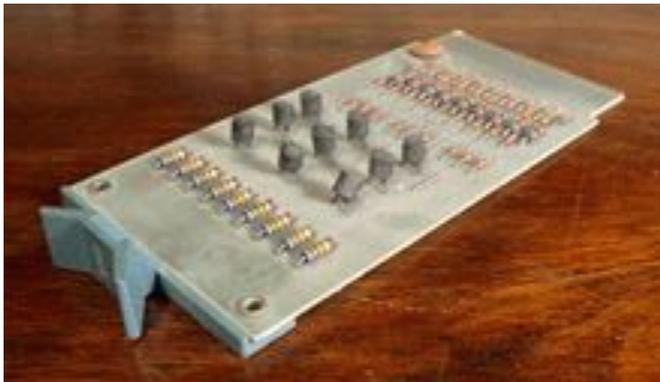
1960

■   A team drawn from several computer manufacturers and the Pentagon developed **COBOL**, Common Business Oriented Language. Project leader: Grace Hopper.

■   **LISP** made its debut as the first computer language designed for writing artificial intelligence programs. Inventor: John McCarthy.

1960 DEC PDP-1: MIT TX project aftermath

- The PDP-1 sold for $120,000. MIT wrote the first video game, Space War! for it. A total of 50 were built. Each had a cathode ray tube graphic display.

- No real commercial success

1961

■ Fairchild Semiconductor releases **the first commercial integrated circuit**.

■ According to Datamation magazine, **IBM had an 81.2-percent share** of the computer market in 1961, the year in which it introduced the 1400 Series.

The 1401 mainframe, the first in the 1400 series, used transistors instead of vacuum tubes, and had a magnetic core memory. More than 12,000 of the 1401 computers were sold.

1962

- **Teletype** ships its Model 33 keyboard and punched-tape terminal, used for input and output on many early microcomputers.

- Ivan Sutherland creates a graphics system called **Sketchpad**.
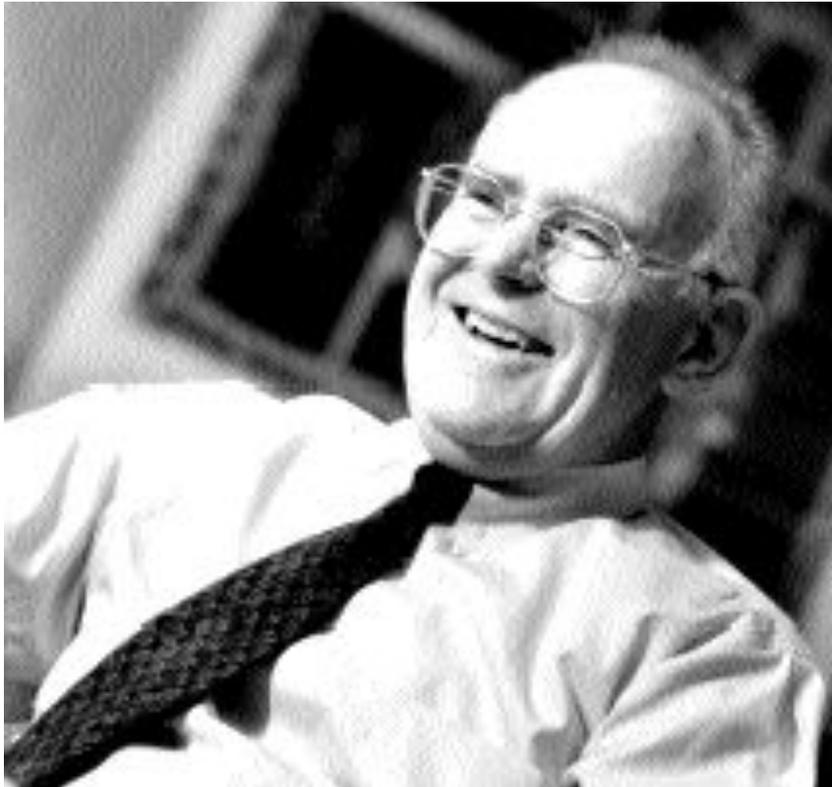
1963

- **Douglas Engelbart** receives a patent on the **mouse** pointing device for computers.

- **ASCII** -- American Standard Code for Information Interchange -- permitted machines from different manufacturers to exchange data

- Digital Equipment **sells its first minicomputer**, to Atomic Energy of Canada.

1964 ...

- Ian Sharp and others found I.P. **Sharp Associates**, in Canada.

- IBM announced **System/360**, a family of six mutually compatible computers and 40 peripherals that could work together.

- Gordon Moore suggests that integrated circuits would double in complexity every year. This later becomes known as **Moore's Law**.

Gordon E. Moore

1929 –

1950 B.S. in Chemistry

1954 Ph.D. from Cal Tech

1954-1957 *Shockley Semiconductor*

1957 Co-Founder of *Fairchild Semiconductors*
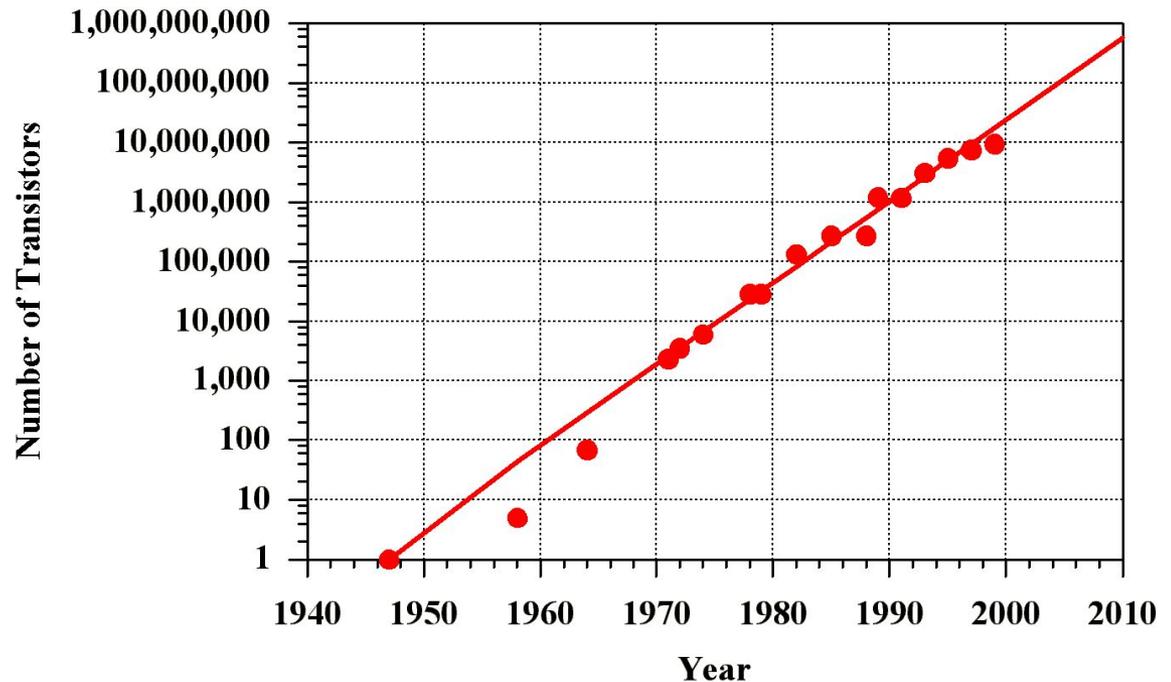
1965 Moore's Law

1968 Moore, Noyce and Grove left *Fairchild Semiconductors* and founded **Intel Corp.**

1968-1997 Intel's president President

Moore's Law (1965)

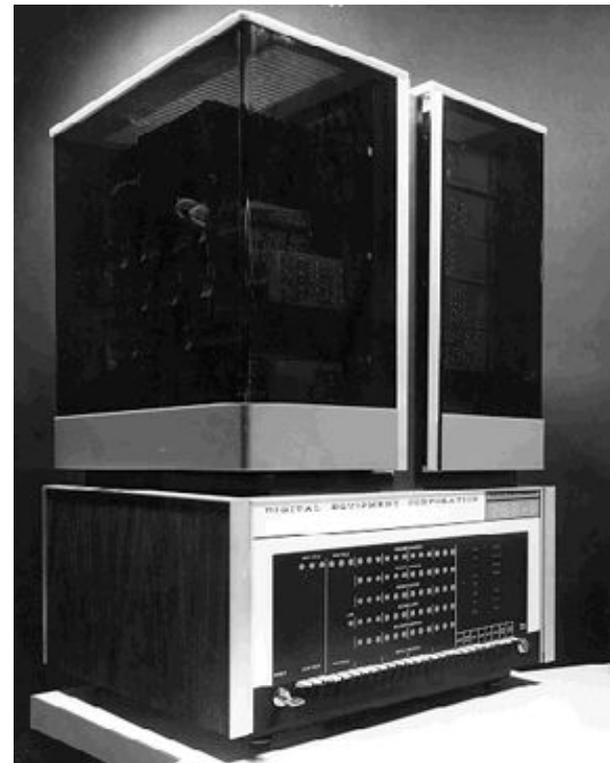Circuits per chip
$$= 2^{(\text{year}-1975)/1.5}$$

"Each new chip contains roughly twice as much capacity as its predecessor, and is released within 18-24 months of the previous chip."

- **CDC's 6600 supercomputer**, designed by **Seymour Cray**, performed up to 3 million instructions per second -- a processing speed three times faster than that of its closest competitor, the IBM Stretch.

- John Kemeny and Thomas Kurtz develop the **BASIC** programming language at Dartmouth College. BASIC is an acronym for Beginners All-purpose Symbolic Instruction Code.

- **Texas Instruments** receives a **patent on the integrated circuit**.

1965

■   Digital Equipment Corp (abbreviated DEC) introduced the **PDP-8**, the first commercially **successful minicomputer**. The PDP-8 sold for $18,000, one-fifth the price of a small IBM 360 mainframe. The speed, small size, and reasonable cost enabled the PDP-8 to go into thousands of manufacturing plants, small businesses, and scientific laboratories.

1966

- Steven Gray founds the **Amateur Computer Society**, and begins publishing the ACS Newsletter. Some consider this to be the birth-date of personal computing.

- **International Research Corp**. is incorporated by Wayne Pickette as a one man, California corporation. Purpose, to research educational resources and technological improvements for education

1967...

- The first Consumer Electronics Show is held in New York City.

- International Research applies for a patent for a method of constructing double sided magnetic tape utilizing a MU-Metal Foil Inter layer. Legal problems with a professor at the University of North Carolina, cause Wayne Pickette to drop the quest for that patent. Wayne Pickette makes acquaintence with the famous entrepreneur Arthur Rock of San Francisco.

- IBM builds the **first floppy disk**.

...1967

■ Seymour Papert designed **LOGO** as a computer language for children.

1968...

- **Edsger Dijkstra's "GO TO considered harmful"** letter, published in Communications of the ACM, fired the first salvo in the **structured programming** wars.

- International Research Corp., in San Martin, California, develops the architecture for a computer-on-a-chip modeled on an enhanced PDP-8/S concept.

- Wayne Pickette proposes to Fairchild Semiconductor that they develop his design for a computer-on-a-chip. Fairchild turns down his offer.

- Wayne Pickette works for IBM during the Summer as a Logic Designer on Project Winchester, the enclosed flying-head disk drive.

- Robert Noyce and Gordon Moore leave Fairchild Semiconductors.

- Robert Noyce and Gordon Moore found **Intel Corporation**.

- Ed Roberts and Forest Mims found Micro Instrumentation Telemetry Systems (**MITS**).

- IBM scientist John Cocke and others complete a prototype scientific computer called the ACS. It incorporates some **RISC concepts**, but the project is later canceled due to the instruction set not being compatible with that of IBM's System/360 computers.

...1968

■ **Douglas C. Engelbart**, of the Stanford Research Institute, demonstrates his **system of keyboard, keypad, mouse, and windows** at the Joint Computer Conference in San Francisco's Civic Center. He demonstrates use of **a word processor, a hypertext system, and remote collaborative work with colleagues**.

1969

■ AT&T Bell Laboratories programmers Kenneth Thompson and Dennis Ritchie developed the **UNIX** operating system on a spare DEC minicomputer.
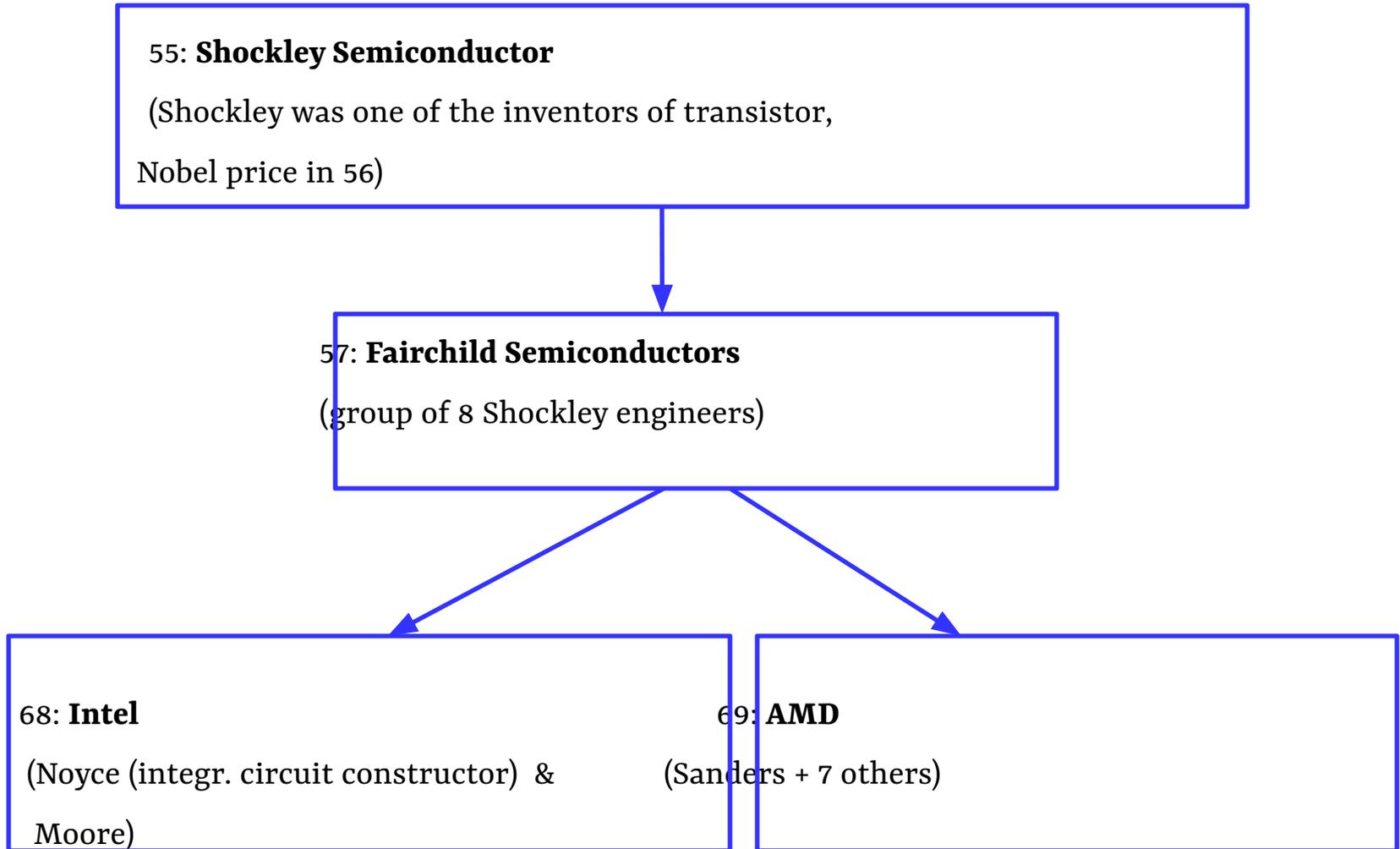

■ Thompson re-wrote Space Travel game in assembly language for Digital Equipment Corporation's PDP-7 with help from Dennis Ritchie. This experience, combined with his work on the Multics project, led Thompson to start a new operating system for the PDP-7.

1969

- **Advanced Micro Devices** Incorporated is founded. [141]

- Intel's Marcian (Ted) Hoff designs an integrated circuit chip that could receive instructions, and perform simple functions on data. The design becomes the **4004 microprocessor**.

- Intel announces a **1 KB RAM chip**, which has a significantly larger capacity than any previously produced memory chip.

- **Bill Gates and Paul Allen**, calling themselves the "Lakeside Programming Group" sign an agreement with Computer Center Corporation to report bugs in PDP-10 software, in exchange for computer time.

- Gary Starkweather, at Xerox's research facility in Webster, New York, demonstrates using a laser beam with the xerography process to create **a laser printer**.

State of the art: software and hardware

■ **In 1967 MacHACK VI became the first program to beat a human (rate 1510) at a competition**, at the Massachussets State Championship.

■ **In 1968 International Master David Levy made a $3,000 bet that no chess computer would beat him in 10 years. He won his bet**. The original bet was with John McCarthy, a distinguished researcher in Artificial Intelligence

■ Processors at 1968 were solded together **from a large number of single transistors and a number of small chips containing relatively small amounts of transistors each**

Roots and birth of Intel and AMD

55: **Shockley Semiconductor**

(Shockley was one of the inventors of transistor,

Nobel price in 56)

↓

57: **Fairchild Semiconductors**

(group of 8 Shockley engineers)

68: **Intel**

(Noyce (integr. circuit constructor) &

Moore)

69: **AMD**

(Sanders + 7 others)

1970

- **Xerox** opens the Palo Alto Research Center (**PARC**).

- Intel creates the 1103 chip, **the first generally available DRAM memory chip.**

- **Wayne Pickette takes his computer-on-a-chip design to Intel**, and is hired, began working for Dr. Ted Hoff.

- At Intel, Wayne Pickette proposes to Ted Hoff the idea of building a computer-on-a-chip for the Busicom project.

- **Gilbert Hyatt** files a patent application entitled "Single Chip Integrated Circuit Computer Architecture", **the first basic patent on the microprocessor.**

- Work begins at Intel on the layout of the circuit for what would be the 4004 microprocessor. Federico Faggin directs the work.

- **Intel creates the first 4004 microprocessor**.

First microprocessor: Intel 4004

1969

The first microprocessor – CPU

1971

The first commercial 4-bit microprocessor 4004:

-2,300 transistors
-10 µm features
-10 mm^2 die
-108 kHz **kHz**