Computer History

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1904

- John Ambrose Fleming invents the electronic valve

1906

- Lee de Forest invent the triode by adding a metal gate to the diode

1937-41

- The ABC electronic calculator

1941

- Konrad Zuse builds Z3, the first programmable electromechanical calculator

1946

- Eckert and Mauchly complete the ENIAC (Electronic Numerical Integrator and Computer). 18000 electronic valves over 167 m^2. It executes 5000 op/s and can store 200 numbers. The total cost is $500K

1947

- From November 17, at Bell Laboratories, a division of the telephone corporation AT&T, physicists Walter Brattain and John Bardeen push experiments to figure out what was preventing the device imagined by William Shockley from amplifying. On December 23, all them three present the point-contact transistor (they called it the "crystal triode"), the first working solid state amplifier. Actually Shockley missed the crucial discovery (therefore he was excluded by the patent) but a month later, after days of an intense intellectual work self isolated in a hotel room in Chicago, he came up proposing the sandwich-like junction transistor, that will succeed in the industry
- A governative agency Is created in Britain, the NRDC (National Research Development Corporation), to promote the development of a computer industry

1949

- During a visit in Olivetti, Enrico Fermi suggests to Adriano Olivetti to invest in computer science

1951

- Eckert and Mauchly build UNIVAC (Universal Automatic Computer). 9500 electronic valves, 125kW, 13 tons, 2MHz clock. UNIVAC was a commercial product used by the US Census Bureau. Eckert and Mauchly found the Eckert-Mauchly Computer Corp.
- Magnetic core memories are developed and patented by MIT and by RCA
- Ferranti and the Manchester University release Ferranti Mark I, the first general purpose computer

1952

- Olivetti Corporation of America is established with office in NY

1953

- Olivetti, the Italian company worldwide known for his mechanical typewriters and calculators, establishes a small laboratory in New Canaan, Connecticut, were Dino Olivetti, Adriano's brother moved with is family during the IIWW, because of the ratial laws. Dino is a student at MIT. The lab, headed by Mario Canepa, is aimed to drain knowledge on the emerging market and technology of electronic calculators and to build

a transistorized computer. Apart from Adriano Olivetti and his son Roberto, few others in Ivrea see electronics as a potential business (mechanical calculators allow profit margin as high as 10:1 for the Divisumma 24). The lab will employ about 40 people in 1960. It will be operative until 1962

- CBS television broadcasts UNIVAC 1 predicting the outcome of presidential election

1954

- Following the advice of Enrico Fermi, the University of Pisa uses Lire 150M initially intended to create a synchrotron (built elsewhere) to develop an electronic calculator, the CEP (Calcolatore Elettronico Pisano). Mauro Picone, chairman of INAC, asks Olivetti to get involved in the project

1955

- Physicist William Shockley leaves Bell Laboratories to establish the Shockley Transistor Laboratory at 391 San Antonio Road, Mountain View (CA), supported by Arnold Beckman, of Beckman Instruments Inc., to work on diffused base Ge transistors
- Remington Rand merges with Sperry Corporation to become Sperry Rand. Their business model is built around the UNIVAC division
- Olivetti establishes in Barbaricina, in a historical villa in via delle Capannine (near Pisa) the Laboratorio di Ricerche Elettroniche (LRE). Soon the original intent (giving support to the construction of CEP) is displaced in the development of a commercial mainframe. To lead LRE, Adriano Olivetti chooses Mario Tchou, son of Yin Ychou, a Chinese diplomat in Vatican. Mario, born and educated in Rome, enrols the faculty of Electrical Engineering at the University of Rome La Sapienza in 1942, gets the Bachelor degree from the Catholic University of Washington in 1947. In 1949 he achieves the M.S. in Physics from the Polytechnic Institute of Brooklyn. In 1952 he is associate professor of Electrical Engineering at the Columbia University. In 1954 Olivetti calls him to join the Italian company. Tchou had strong technical skills as well as managerial attitude
- Olivetti's job announcements for LRE appearing on main Italian newspapers

1956

- William Shockley recruits 3 engineers and 5 scientists at the Shockley Transistor Laboratory. One of them is PhD Robert Noyce, who quits Philco to join the Lab. Shockley believed in the "mental temperature", a measure of intelligence and creativity, which could be determined using psychological tests, and found high in "hot minds". Shockley turned out to be a micromanager down to the level of specifying the kind of screw it had to be used. Shockley follows the Ahab-like obsession of the Four Layers Diode, a kind of bistable solid state relais which requires two simultaneous and identical diffusions (the breakdown voltages had to be equal)
- November 1st. William Shockley, John Bardeen and Walter Brattain win the Nobel Prize in Physics for the invention of the transistor

1957

- IBM releases FORTRAN (FORmula TRANslation), a programming language for treatment of scientific and engineering problems. The principal contributor is John Backus
- September 19, Fairchild Semiconductors is founded by Julius Blank, Victor Grinich, Jean Hoerny, Eugene Kleiner, Jay Last, Gordon More, Robert Noyce, Sheldon Roberts. They had resigned en mass by Shockley Transistor Lab to produce diffused base Si transistors (called MESA, because they recall the characteristic flat mountains of Arizona). Bankers Bud Coyle and Arthur Rock assist them for the financial part. Millionaire Sherman Fairchild's Camera and Instrument loans the new startup $1.38 million over 18 months. The new company starts operations in a building at 844 Charleston Road, Palo Alto.
- Olivetti LRE develops the first commercial electronic calculator called ELEA. The ELEA 9001 (or "Macchina Zero") is almost entirely built with vacuum tubes. When the first prototype of the ELEA 9002 (or "1V") is nearly in completion, Mario Tchou decides to build a fully transistorized model, the ELEA 9003 (or "1T"), a decision not so obvious at

a time where transistors are still unreliable and expensive (at the time a sharp tap of a pencil against the transistor's body makes it stop working). The principal hardware design engineer is Giorgio Sacerdoti

- Pier Giorgio Perotto (1930-2003) leaves Fiat joining Olivetti LRE, where Mario Tchou assign him the development of CBS (Convertitore Banda-Schede). By 1958 CBS will be used on different machines (Audit family) to convert punched tapes into punched cards. Perotto will leave Olivetti this n 1993
- Virgilio Floriani of Telettra (a telecommunication company) and Olivetti set up SGS (Società Generale Semiconduttori), now STMicroelectronics, to produce diodes and transistors, pursuing the vertical integration approach to the Italian mainframe industry. In 1960 Fairchild will join the partnership
- DEC (Digital Equipment Corporation) is founded by Kenneth H. Olsen

1958

- October, NASA operations began
- Olivetti moves LRE from Pisa to Borgolombardo (near Milano) were the group of engineers from New Canan joined. Employees of LRE will increase up to a thousand. In Borgolombardo the project of ELEA 9003 is initially devised.
- Sperry Rand starts to develop a full solid state mainframe
- IBM works to the 7070, fully transistorized computer series, launched in 1960
- In February Federico Faggin is hired by Fairchild Semiconductors
- Fairchild Semic has an order for 100 state-of-the-art Si transistors from IBM
- Jack Tramiel and Manfred Kapp set up CBM (Commodore Business Machines) in Toronto. They import, repair and resell Czechoslovakian typewriters
- ALGOL (ALGOrithmic Language)

1959

- COBOL (COmmon Business Oriented Language)
- Robert Noyce sketches on his notebook how to connect more transistors on a single chip. His solution exploits the planar process developed by J.Hoerni in 1958 or the idea to cover the junction area with a thin layer of SiO2, which made possible batch production of clean, reliable and high performance transistors (patent 3025589)
- Two months later Jack Kilby announces TI has created the first IC with 8 components (patent 3138743). However the assembly is hand made using thin wires of gold, a solution quite impractical for mass production. Kilby had showed his first working prototypes on 1958 September, 12
- 30 of July, R. Noyce patents his invention of the IC (patent 2981877). At that time it was not at all obvious ICs would be a good business (if 50% is of the transistors on a given wafer are good, putting together any two of them yields 25% of working ICs. Even a 90% of working transistors would result in 12% overall yield for a 20-transistor IC). Noyce's IC used Si instead of Ge, used by Kilby. Si is better of Ge for many reasons
- R. Noyce is nominated general manager of Fairchild Semic., G.Moore took over him as R&D director
- September, Olivetti acquires 34% of shares of Underwood for $8.7M, a big American manufacturer of typewriters
- April, at Fiera di Milano, Olivetti presents ELEA 9003 (1T), one of the first commercial mainframes fully transistorized. The ELEA project started in Barbaricina in 1957 with a team of young researchers (the "Barbaricina group") headed by Mario Tchou. The 9003 1T is completed in Brorgolombardo in 1959. In 1959 Elserino Piol sells the first system to textile industry Marzotto in Valdagno. Until 1968 43 systems would be sold to Monte dei Paschi, ENI, FIAT, Credito Italiano among others. Ge diodes and transistors assembled on cards made the control logic. There were many different kind of memories, punched tapes output from the teletypewriter, magnetic tape drives as a secondary memory (13MB each), matrices of wired ferritic cores as the main memory (10kB each module, up to 160kB). The ferritic core memories were introduced by Jay Forrester at MIT. The clock period was 10us. ELEA 9003 could perform 5000 additions/s, exactly how the giant ENIAC did. Multiprogramming capacity allowed ELEA to run three programs

concurrently. The ELEA was fueled with 4.5kW. No OS inside. According to the original design of Ettore Sottsass the cables run over suspended rails called blindosbarre (not buried under the floor as used then) and the racks height get reduced allowing human operators to be in sight. Other less expensive and performant models would follow like ELEA 6001 (well suited for scientific applications), 4001 and the smaller GE-115, GE-130. The ELEA system used COBOL and FORTRAN. IBM was the main direct competitor on the Italian market.

1960
- February 27, at age of 59, Adriano Olivetti dies for a heart attack during a train trip taking him in Switzerland. The family counts the rise of Roberto Olivetti.
- May, Olivetti è quotata in borsa
- Olivetti LRE starts working on ELEA 6001
- November, Federico Faggin, then 19, gets hired in Olivetti to work on a experimental computer with 4096x12-bit magnetic core memory and 1000 logic gate CPU. Working alongside four technicians he completes the project for the end of 1961
- DEC commercializes PDP-1, fully transistorized and compact minicomputer with time-sharing OS. The PDP (Program Data Processor) series targets scientific and engineering domains.

1961
- Steve Russel at MIT creates Spacewars for PDP-1
- March, Fairchild Semic. starts Micrologic, his first commercial IC line
- The Olivetti's Lab in New Canaan, directed by Mario Canepa, is shut down
- at Fiera di Milano, Mario Tchou presents Olivetti ELEA 6001, first of a cheaper and smaller series of ELEA for technical and scientific applications. About 100 were sold until 1968. The 6001 used FORTRAN. In this moment the LRE counts 300 researchers
- November 9, at age 37 Mario Tchou perishes in a car accident on the Torino-Milano highway. He saw the limitations of FORTRAN, used by ELEA 6001 and by IBM mainframes. New languages like Algol and Simula seemed more flexible, then he probably was moving from Borgolombardo to Ivrea to meet Mauro Pacelli, head of the software team, to push the research in these new directions. Pacelli had developed Palgo, a language inspired to Algo. Giorgio Sacerdoti was called to take over Tchou
- Federico Faggin leaves Olivetti to get a M.S. in Physics at the University of Padova
- November 13, CEP is officially presented at the University of Pisa
- David Allison, David James, Lionel Kattner, Mark Weissenstem and two others leave Fairchild to set up Signetics, an all-IC company.
- Feb, Jay Last, Sheldon Roberts and Jean Hoerni resign from Fairchild to start the Amelco division of Teledyne

1962
- Giorgio Sacerdoti takes over Tchou in the direction of LRE
- Eugene Kleiner quit Fairchild
- October. Sperry Univac releases UNIVAC 1107, the first solid-state member of c's UNIVAC 1100 series of computers. Unlike previous two-address machines, UNIVAC 1107 is a single-address machine with up to 65,536 words of 36-bit core memory.

1963
- November. Giuseppe Pero, Olivetti's CEO, dies
- Olivetti moves LRE (now called Electronic Division Olivetti, DEO) from Borgolombardo to Pregnana Milanese. Ottorino Beltrame is now responsible for the DEO. Le Corbusier is called to design the new center, which would occupy an area of about 250000 mq.
- Olivetti gets into financial problems. Bruno Visentini is asked to search Italian investors. New share holders came in DEO, the so called gruppo di intervento, including Mediobanca, Fiat, Pirelli, la Centrale, IMI, IRI leaded by Enrico Cuccia.

1964

- First commercial graphics computer - IBM 2250 console, $125000
- IBM 360 is announced. The IBM System 360 (S/360) family of mainframe computers would be delivered until 1978. They cover the complete range of applications, from small to large, both commercial and scientific. To research, develop, build and market this product, IBM spent $5 billion
- December, RCA announces the Spectra series of minicomputers, compatible with IBM 360
- April, the Fiat manager Vittorio Valletta says that "Olivetti è strutturalmente solida e potrà superare senza grosse difficoltà il momento critico. Sul suo futuro pende però una minaccia, un neo da estirpare: l'essersi inserita nel settore elettronico, per il quale occorrono investimenti che nessuna azienda italiana può affrontare".
- GE aquires Compagnies des Machines Bull becoming Bull General Electric
- August, 75% of Olivetti Electronic Division is sold to GE for $12M becoming OGE (Olivetti General Electric) on July 1st 1965. Until 1968 **OGE** continues to play an important R&D activity under the direction of Visentini. In particolare Marisa Bellisario riesce a mantenere l'elaboratore 4035, un derivato della serie Elea 4000, che verrá lanciato come **GE115 (1965)**, GE105 and GE130, of which about 5000 were sold worldwide.
- To stimulate IC demand Robert Noyce decides to sell its low-end FF IC for less than it would cost Fairchild to produce the device. This strategy payed off. Within a year after the price cut, IC sales had raised 150%
- Kurtz and Kemeny introduced the Dartmouth Time Sharing System (DTSS), a novel technique to distribute computer processing in time slices. At that time computers where gigantic and expensive so that only big companies or universities could afford one. People were assigned a batch of time during which they were the sole user of the computer. However this led to inefficiencies due to the frequent thinking, reading or printing activities of the user, which meant downtime for the central processing unit. With the Time Sharing methodology many users were able to interact at the same time with the central unit. Actually the computer, after a small portion of program execution on one problem, quickly switched its focus to another one, and so forth in a cyclic timely way. Kurtz and Kemeny developed also a programming language called BASIC (Beginner's All-purpose System Instruction Code).

1965

- DEC presents PDP-8, the first minicomputer, created by a team leaded by Edson de Castro. It was the first real commerciai success of the PDP series.
- CBM is involved in the financial scandal of Atlantic Acceptance Corp.
- Spring, R.Noyce pushes the semiconductor device demand by making the announcement that Fairchild would sell his IC for 1$, less than the production cost
- AT&T dismisses the Shockley Transistor Laboratory
- At Bema Show (NY) Olivetti presents the Programma 101 (P101), the first desktop computer with program and data stored in memory, also called "Perottina", by the name of his inventor Pier Giorgio Perotto. It had 16 instructions. 40000 units were sold for $3200. La Perottina anticipò di quasi dieci anni l'uscita sul mercato dell'analogo progetto della Hewlett Packard (HP 9100), la quale fu poi costretta a pagare $900K per aver violato alcuni brevetti della P101, in particolare la cartolina magnetica. La memoria era realizzata adattando una linea magnetostrittiva.
- Gordon More establishes the Moore's Law
- Analog Devices is founded by Ray Stata in Cambridge, Massachusetts

1966

- IBM introduces magnetic disk drive for mass storage. The random access to a disk drive exceeds immensely the sequential access to a tape drive. DOS (Disk Oriented System) starts to replace TOS (Tape Oriented System)
- Eliza, a AI chatbot ante-litteram, runs on PDP-10 simulating a psychiatrist during a analytical session

1967

- First Consumer Electronic Show (CES)
- Commodore gets in troubles in Canada and goes into bankrupt. Irving Gould, a Canadian financier, acquires Commodore and became the president. He instructs Jack Tramiel to take the company into the fast growing calculator business
- Charles Sporck and two others leave Fairchild to set up National Semiconductors
- Federico Faggin starts work at SGS-Fairchild in Agrate Brianza
- Minicomputer market get expanded. By 1967, some 95% of all banks in the US would use computers to handle their checking accounts

1968

- R.Noyce and G.Moore quit Fairchild Semiconductors. On July 18, they found Intel (Integrated Electronics) in Middlefield Road, Santa Clara, Mountain View. They are going to develop semiconductor memories to counter magnetic core memories. Few weeks later also Andy Grove and Leslie Vadasz quits Fairchild to join Intel
- Data General is founded by Edson de Castro and Herb Richman.
- Federico Faggin, then an SGS employee, is called in Fairchild, where Vadasz asks him to work to MOS Silicon gate technology, in which a self aligned gate (made out of p-type poly-Si instead of Al) would result in much less parasitics. This technique would replace the metal gate technology, becoming the standard process in the 40 years to come, yielding three times faster and two times denser ICs since its early adoption (Vg becomes as low as 0.4V). On July 1 Faggin gets hired in Fairchild.
- Faggin develops 3708, the first analog IC using the Silicon gate technology
- SGS is acquired by IRI. Few years later it will join Thomson Semiconducteurs becoming SGS Thomson, and later STMicroelectronics.
- Olivetti sells to GE the remaining 25% of OGE, with becomes General Electric Information Systems Italia (GEISI).
- Sharp asks Rockwell to design a set of IC for its calculators with display
- John Schroeder and Jack Schmidt leave Fairchild to set up Computer Microtechnology
- HP presents HP9100A, the desktop programmable calculator inspired to Olivetti Programma 101. To make use of the magnetic card, HP was ordered to pay $900k in royalties to Olivetti

1969

- May, Intel introduces the 3101, 64-bit Schottky Bipolar SRAM
- Intel 1101 256-bit SRAM uses the MOS p-channel process and relies on silicon rather than metal gates. Access time is 1.5 us, three times the ferritic memories
- Busicom (formerly Nippon Calculating Machine Corp) asks Intel to produce 7 custom ICs to be used in a set of different calculators (141-PF ?). Three of them had similar functions, then Ted Hoff came up with the idea to replace hard-wired logic with a single programmable IC working as a general purpose minicomputer, like those he saw at Stanford Univ. Instead of shift registers he proposes to adopt DRAM, with a simpler cell structure. R.Noyce encourages Hoff to make progresses in that direction. Stanley Mazor defines the 45 instructions set. The project is then passed to Les Vadasz, head of MOS division, but gets delayed
- Data General presents NOVA minicomputer
- MITS is founded in Albuquerque
- Xerox Parc starts operations in Palo Alto
- Lee Boysel and Jack Faith leave Fairchild to set up Four Phase
- W.J.Sanders III leaves Fairchild to set up Advanced Micro Devices
- UNIX is released by Ken Thompson and Dennis Ritchie of Bell Laboratories. It will be the OS most used on mainframes in the 70s. The first assembly version run on a PDP-7. Few principles drove the design: each program shall do one single job well, the output of a program can be the input of another one. Between 1969 and 1979, UNIX went through 6 releases, or editions.

- May, GE cede a Honeywell la GE Information System, nata per sviluppare la serie NPL per fronteggiare IBM. La nuova società viene chiamata Honeywell Information Systems. GEISI becomes Honeywell Information System Italia (HISI)
- Telnet is developed beginning with RFC 15. The name stands for "teletype network". It is based upon the notion of a virtual teletype

1970

- Intel 1103 1024-bit DRAM MOS (p-channel) IC. It shows a real competitive advantage over ferritic memories
- Intel's dynamic shift register ICs can work over a wider range of frequencies, due to the Silicon gate. National Semiconductor well established market of metal gate ICs is progressively eroded
- CMOS, Bi-CMOS
- April, Federico Faggin is asked to move from Fairchild to Intel, where Leslie Vadasz assign him the Busicom project. Vadasz decides to reduce the 4004's pin count from 40 to 16, this choice will slow down performances by a factor of 3, because address, instructions and data bus must be multiplexed.
- MOS Technologies is founded in Valley Forge
- Garret AiResearch Corp releases MP944, the first MOS/LSI integrated Microprocessor chip set, for the US Navy F14A "Tomcat" fighter jet. The project started in 1968
- Xerox PARC is founded in Palo Alto by Jack Goldman, Xerox Corporation's chief scientist. They wanted to dominate the "paperless office" of the future. Much of PARC's early success in the computer field was under the leadership of Bob Taylor, who guided the lab from 1970 to 1983. "The atmosphere was electric – there was total intellectual freedom. There was no conventional wisdom; almost every idea was up for challenge and got challenged regularly" (John Warnock). Unfortunately Xerox management, just focused on photocopiers, never understood the revolutionary value of PARC's vision and creations
- In 1970 GE sells its computer business to Honeywell. GEISI is acquired by Honeywell. It becomes Honeywell Information Systems Italia (HISI)

1971

- Busicom manager M.Shima gets sick for the delay of the 4000 project. February, after 11 months of 80-hours-per-week hardworking, Federico Faggin completes Intel 4004, the first 4-bit microcontroller, 2300 transistor, 750kHz, 60$, 15V, 750mW, 8 clock per instruction; 4001: 2048-bit ROM; 4002: 320-bit DRAM; 4003: 10-bit shift register for IO. The 4004 required 5 masks. The 4004 will be protected by two patents (3821715, 3753011). The rights of use of 4004, initially an exclusive ownership of Busicom, are transferred to Intel in exchange of the development costs ($65k)
- April, the first Busicom calculator kit is ready. 100000 will be sold
- June, the Silicon gate technology is patented by Faggin and Thomas Klein (3673471). This invention will make the MOS technology to supersede the bipolar technology in mass production of complex ICs
- Alan Shugart at IBM invents the floppy disk drive
- Intel releases 1702, the first 2038-bit PROM. Dov Frohman discovered that a floating

Silicon gate can accumulate electrons for years. UV rays can reach the gates through a Quartz window, getting bits erased.

- November, Intel announces publicly the 4004 chipset to the general market with the name MCS-4 (Micro Computer System 4-bit), advertising it on Electronics News magazine n.15
- Intel moves headquarters in Bowers Avenue, Santa Clara
- June, TI announces TMS1802 NC on Electronics magazine
- RCA sells its computer business to Sperry
- In the 60's IBM had 7 major competitors in US: Burroughs, Sperry Rand, NCR, CDC, Honeywell, GE, RCA. They were called "IBM and the Seven Dwarfs". In the 70's IBM has only 5 major competitors: Burroughs, UNIVAC, NCR, CDC, Honeywall. They are called "BUNCH"
- April 16. The original specification for the File Transfer Protocol (FTP) is written by Abhay Bhushan and published as RFC 114

1972

- F.Faggin designs Intel 1201, subsequently renamed 8008, the first 8-bit uP. It has 3500 transistor, 800kHz,$120, 18-pin package. Intel is still reluctant to use 40-pin packaging, a significant limiting factor. The 1201 project was initially assigned to Hal Feeney, in 1971, based on the specifications of CTC, a startup recently established in San Antonio (Texas) focused on the intelligent computer terminals. Also Seiko, printers manufacturer that wants to develop a desktop calculator, is interested in the 1201. Feeney and Faggin completed the project in April 1972.
- Mostek releases Micro8, a 8-bit uP developed with Olivetti. Micro8 will be used for the TC800
- Atari Corporation is founded by Nolan Bushnell and Ted Badney
- Pong is created by Allan Alcorn in Atari
- C language is created by Dennis Ritchie at Bell Laboratories. It pushes the concept of pointer, a direct incarnation of CPU's indirect addressing
- IBM pioneered a fast n-channel DRAM MOS process for its System 370 Model 158
- Gary Kildall creates PL/M, a programming language based on COBOL, FORTRAN, ALGOL60

1973

- Atari PONG, by Al Alcorn, is released
- R2E, a Bull company, presents Micral-N, a programmable microcomputer built around Intel 8008
- Intel 2102 1024-bit the first 5V Silicon gate n-channel fast SRAM MOS (n-channel) IC. The 5V working voltage allows TTL compatibility
- Mostek releases the first 5V Silicon gate n-channel MOS SRAM IC with depletion mode FET loads, which allows the gate output to reach the full supply voltage, then providing a constant current
- Intel will reply to Mostek releasing the 2102A, four times faster than 2102.
- Xerox PARC releases Alto, considered the first friendly PC. Alto was not freely available on the market. Alto features mouse, ethernet and a bit-oriented graphics on a portrait oriented screen. What you see onto the screen is what you get printed onto the paper
- The UNIX kernel, 4th edition, is moved to the PDP-11 and is almost entirely rewritten in C

1974

- Intel releases the 4040, an extended version of the 4004. It can interface more easily with PROMs and other standard memories.
- Federico Faggin, supported by Shima, designs Intel 8080A, 4500 transistor, 2MHz, 350$, 150$, 8-bit. The package is 40-pin, so that address, instructions and data bus are not multiplexed. 8080 is code compatible with 8008.
- Tomoshiro Nishikado (?) creates Wester Gun Arcade game using TTL ICs
- Stewart Brand, in his book Two Cybernetic Frontiers, firstly uses the term Personal

Computer
- Federico Faggin and Ralph Ungermann leave Intel to set up Zilog in Campbell to focus on making microprocessors
- Gwary Kildall creates CP/M (Control Program Monitor) for the 8080, the first OS for microcomputer. It will inspire MS-DOS
- July, the share price of Intel stock fell 30% overnight. The contraction of memory market brought the termination of roughly 30% of Intel's 2500 employees.

1975
- Jan, Altair 8800, 8080-based, by MITS (Micro Instrumentation & Telemetry Systems, Inc.) of Ed Roberts. It is presented over Popular Electronics of January. Sold for 375$. Altair 8800 was built around S-100, the 100 lines bus that allowed expansion of the system with user's boards
- Motorola 6800, 8-bit uP, $175, 72 intructions, 64K addr space. Chuck Peddle and Charlie Melear are the designers
- MOS Technology 6502, 3510 transistor, $25, by Chuck Paddle, RRIOT 6530 (64B Ram, 1KB Rom,IO port,Timer 8-bit), Very easy to use, internal clock, 64K addr space, 56 instructions
- Feb, Bill Gates and Paul Allen write for 8080 a BASIC interpreter. It is considered the first programming language written for a personal computer. They sold the BASIC interpreter to MITS until 1977. Ed Roberts had scheduled a meeting with Allen and Gates in March 1975
- Steve Bourne developed the Bourne Shell

1976
- Steve Wozniak Apple 1 (6502-based)
- Apple Computer is founded by S.Jobs, S.Wozniak, Ronald Waynej
- Mike Markkulla invests $250000 in Apple. He brings Regis McKenna into the company
- Commodore takes over MOS Technology Inc, with a IC manufacturing plant in Valley Forge, Pennsylvania privately owned and valued at around $12 million. In 1976 CBM was, not for the first nor the last time, struggling mightily. Texas Instruments had virtually destroyed their calculator business by introducing machines priced cheaper than Commodore could possibly match. The reason: TI owned its own chip-fabrication plants rather than having to source its chips from other suppliers. It was a matter of vertical integration, as they say in the business world
- Zilog Z80: 8-bit, 64K addr space, 2.5-4Mhz. Faggin co-designed the Z80 with Shima, who joined him from Intel. The Z80 was software compatible with the 8080 but was faster and had double the number of registers and instructions
- Bill Gates wants to sell BASIC to Jack Tramiel 3$ per copy. Tramiel replies "I've already get married" and got the licence for $50k
- First 16kbit RAM IC
- Fairchild releases VES (Video Entertainment System), based on F8 microprocessor. It will be replaced by Atari VCS (Via deo Computer System) in 1978
- Warner Communications acquires Atari
- Micro-Soft co-founder Bill Gates, in response to the habit of copying his BASIC for ALTAIR 8800, he discloses an open letter to hobbyists in defence of proprietary software. In his opinion the software must be payed, as it is for the hardware.
- Richard Stallman, a researcher at the AI Lab of MIT, faces the ethical problem of being impeded to modify a proprietary source program unless he accepted to not disclose his work with others. He perceive the limits imposed by intellectual property as limitation of freedom

1977
- Commodore PET 2001 (595$), by Chuck Peddle and others, (6502-based), 6540 Rom, 4KB 6550 Ram, Micro-Soft BASIC (with floating point arithmetic). Jack Tramiel ebbe l'idea vincente di accettare preordini, cioè incassare i soldi e consegnare il PET a 90 gg
- Apple 2 (6502-based). It has an Integer BASIC version. The 4KB version is sold for

$1300. Apple 2 is presented at the West Coast Computer Faire by Jobs
- Tandy TRS-80 ($600) (Z80-based), 4KB Ram, 4KB Rom, a monitor and a cassette recorder. Initially it ran the Tiny BASIC. By one year it was replaced with the Micro-Soft BASIC. The Tendy's Radio Shack distribution promotes its diffusion
- Byte magazine later dubbed the three competitors the "1977 Trinity"
- Apple incorporated. At the end of the year it had sales of $775000
- Albert Charpentier designs VIC (6560/6561) in MOS Technologies, a single-chip graphic controller and sound generator. He hoped Atari would use it, but they didn't
- Atari VCS 2600 (6507, 8KB address space) 128B Ram. Come chip VDP ha il TIA (Television Interface Adapter), creato da Jey Mayner. Il TIA generava grafica sfruttando il raster del TV. The killer app will be the porting of Space Invaders, an Arcade game published in 1978
- RSA (Ron Rivest, Adi Shamir, Leonard Adleman)
- Kazuhiko Nishi is an engineering student in Tokyo who wants build his version of Pong using a microprocessor. He drop university and founds ASCII Corporation and starts the I/O magazine. In August he calls Bill Gates. They are the same age and like each other. Key made a special trip to the US and made the case to Gates and Paul Allen that he should start an Asian arm of Microsoft operated by ASCII Corp.

1978
- DEC VAX 11/780 5 mhz 16 kb RAM chip ($500)
- Intel 8086 uP: the first x86, 16-bit, 1MB address space, organized in 16 pages
- Intel 8088, 29000 transistor, 10MHz
- Starts Apple Lisa project under the direction of Jeff Raskin (6809-based)
- June, the Japanese Tayto (?) releases Space Invaders, an Arcade game by Tomoshiro Nishikado (?). It is a program for 8080. La grafica, in raster, non è generata da un VDP ma dalla stessa CPU. Questo faceva sí che al diminuire del numero degli alieni essi avanzano più velocemente. Un limite tecnico che divenne una design feature. Per l'alieno si ispira ai tripodi del film La guerra dei mondi. La dinamica del gioco (gameplay) è un fixed shooter ispirato a Breakout.
- March, Olivetti's business model evolves towards IT with the Gruppo Informatica Distribuita, headed by Marisa Bellisario
- June, Visentini chiama Carlo De Benedetti, principale azionista di Olivetti, a esserne nuovo CEO e vice presidente. Inizia una nuova fase positiva. Elserino Piol ritiene, contrapponendosi a Marisa Bellisario, che il TC 800 e i piccoli BCS non possono evolvere granchè, ma necessita una nuova linea di prodotti più general purpose, poi chiamata Linea 1 (L1)
- Kazuhiko Nishi is Vice President of Microsoft subsidiary in Japan. He brings the BASIC language in Japan
- Nolan Bushnell quits Atari. Raymond E. Kassar is the new CEO..

1979
- January, the 7th edition of UNIX is released. From this point, UNIX diverged into two important variants: BSD (Berkeley Software Distribution) and System V
- Motorola 68000: 32-bit, 16MB addr space, 56 instructions
- Zilog Z8000: 16-bit, 110 instructions. Due to 16-bit address space and incomplete compatibility with Z80 it lost
- Intel 8088 uP, 16-bit
- Atari 400/800 8-bit computers
- IBM 3279 color terminal
- TI T99/4A, home computer. It will be a flop for its high cost. The TMS9900, 16-bit, 3Mhz CPU had many bugs
- October, VisiCalc released for the Apple II by VisiCorp. The creator is Daniel Bricklin
- David Crane left Atari and co-founded Activision, along with Miller, Jim Levy, Bob Whitehead, and Larry Kaplan. His games won many awards while he was at Activision.
- SQL
- A group of Apple engineers visits the Xerox's PARC. Steve Jobs has the opportunity to

appreciate the Alto's networking, OOP and GUI. Adele Goldberg was told to give a demo of Alto to Steve and Bill Atkinson
- SQL language is released

1980
- Sinclair ZX80, 4KB Rom 1KB Ram, £99.95
- Pac-Man an arcade game is developed by Namco. The designer is Tour Iwatani
- Wilfred Corrigan leaves Fairchild to set up LSI Logic
- Zilog becomes and Exxon subsidiary
- Olivetti develops Linea 1, a new industrial software development platform, based on Unix-like OS (MOS, or COSMOS IV), email and file transfer. Concurrent Pascal is the language of choice. L1 is based on Zilog Z8000
- July, William Lowe of IBM presents the feasibility for a IBM PC. The project is assigned to Don Estridge. The first decision is to use Intel 8088. For the OS they ask to Bill Gates of Microsoft, who grabs the deal and buys the OS from Seattle Computer Company for $75k. The new OS is called MS-DOS
- Elserino Piol meets Mike Markulla proposing Olivetti as a european partner of Apple. During the next meeting Michael Scott reported that Jobs and Wozniak had rejected the deal

1981
- Sinclair ZX81, con basic FP, 8KB Rom
- In MOS Technologies Al Charpentier rilascia il VIC-II, chip grafico (VDP) ispirato al TMS9918. La logica degli sprite occopa 2/3 del chip
- Gordon Campbell and George Perlegos leave Intel to set up SEEQ
- Robert Swanson and Robert Dobkin leave National Semiconductors to set up Linear Technology
- Commodore VIC-20 by Yash Terakura (first released in Japan as VIC 1001)(6502-based), 3.5/5KB Ram, 8/20KB Rom, very low price (299$); 6560, or VIC (Video Interface Chip, audio e video), grafica gestita a caratteri (8x8) e modalità multicolor per avere più colori anche se con meno risoluzione; 22 columns
- Satori Uata (oggi CEO Nintendo) inizia sui Commodore PET e crea nella sua HAL Laboratories i primi giochi per il VIC20. Capolavori come una conversione di Pacman
- August, IBM launches the first PC, the 5150. Existing and current home machines contained 8-bit processors, but the IBM 5150's Intel 8088 processor was a 16-bit part. Even though the 5150 had been designed for business users, it was seen by many observers as the beginning of the end of the era of 8-bit microcomputing.

1982
- Sinclair ZX Spectrum
- Commodore 64, $595 (6510-based, very similar to 6502); 6581, o VIC2 (video): Grafica gestita a bitmap e sprite. Era stato progettato per una game console (Commodore Max); Palette di 16 colori, 40 colonne; La generazione del segnale era YC (composito), e in NTSC vi era una resa migliore rispetto a PAL; SID (audio): con envelope generator progettato da un musicista Bob Yannes; 3 canali indipendenti; Micro-Soft Basic 2.0 (MBasic) in 8kB ROM; OS in 8kB ROM; Inaugura l'informatica di massa o personale
- DongeyKong (?) is released by Nintendo
- Adobe is founded in 1982 by John Warnock and Charles Geschke. At PARC John had invented the laser printer, which allowed to print the graphic features you got on the screen. It was the beginning of word processing and desktop publishing
- August. Simple Mail Transfer Protocol (SMTP) is defined in RFC 821

1978-83
- Apple Lisa (68000-based). It was not a commercial success mainly because too expensive. Since 1981 Microsoft works on Lisa software, and Bill Gates conceives the big gamble. Job's fights IBM, but Bill was the true enemy

1979-84

- Sinclair QL, (68008-based)
- Apple Macintosh, for the "Person In The Street" (PITS). Dal 1981 JS subentra a Jef Raskin, che dal 1979 lavorava a un computer da meno di $1k, sostituendo il 6809 con il 68000. The team: Steve Jobs, Andy Hertzfeld, Joanna Hoffman, Susan Kare, Burrell Smith, Bill Atkinson, Chris Espinosa, Bud Tribble, Howard, Steve Capps, George Crow, Bruce Horn, Bob Belleville, Donn Denman, Larry Kenyon, Caroline Rose. Mac is presented on January 24. Sales were strong from its initial release on January 24, 1984, and reached 70,000 units on May 3, 1984. In the long run it failed the competition with PCs, because of its cost $1k more than a PC and scarcer software. MacPaint and MacWrite were bundled with the Mac, while PCs had also spreadsheets, word processing and databases
- Susan Kare fu la grafica che dal 1982 disegnò molte icone del Mac. Il cestino e il simbolo del tasto Command sono suoi. Fu tra i primi 10 dipendenti della NeXT

1982

- Intel 80186, 55000 transistor, 25MHz
- Intel 80286, 134000 trans, 25MHz, 16MB
- Atari 5200
- Olivetti M20 PC. The OS is PCOS
- Billy Joy founds Sun Microsystems
- US antitrust legislation forced the breakup of AT&T and Bell Laboratories, with the consequence that, since it no longer held a monopoly on the telephone system, the company was permitted to market UNIX
- The surge of interest in the IBM PC quickly led to compatible machines from rival vendors, who took Microsoft's own-brand version of the operating system, licensed to IBM, and combined it with Intel processor technology and a compatible third-party Bios to produce "IBM clones" that would run applications and utilities written for the 5150.

1983

- VIC-20 reaches 1 million units sold
- Commodore cuts the price of C64 to $200 to beat TI
- A large scale recession in the video game industry begins and will last until 1985, primarily in North America. The crash was attributed to several factors, including market saturation in the number of game consoles and available games, and waning interest in console games in favor of personal computers.
- T.J.Rodgers and Lowell Turiff leave AMD to set up Cypress
- June, Microsoft Japan announces MSX, a computing platform aimed for standardization of the 8-bit home computer market. Nishi's relationships with industrial Japanese giants (Canon, Hitachi, NEC, Sony, Toshiba, etc.) would become important in the mid-1980s, as a number of them were looking for a way to enter the home computer market. The idea to standardize came from the home video market, where the bruising battle between VHS and Betamax was proving the value of consistency. The standard was based on HW (Zilog Z80, Texas Instruments TMS9918 video chip, cartridges as a mass storage system) and SW (Microsoft BASIC)
- Domain Name System (DNS) is developed. It will be revised numerous times since its inception

1984

- Jack Tramiel quits Commodore. Inizia il declino. In the same year 35 employees left the company. Commodore sells 500000+ computers per month. Marketshare 2500000, IBM 1500000, Apple 300000
- Warner sold the home computing and game console divisions of Atari to Jack Tramiel, under the name Atari Corporation for $240 million
- Olivetti M24 compatible PC. Processor is Intel 8086 and operative system is Microsoft MS-DOS

- Bernard Vonderschmitt leaves Zilog to set up Xilinx
- AT&T is broken in 7 baby-bells
- UNIX sources royalty-free sharing ends. The UNIX System V becomes a commercial product. Only Berkeley University continues to develop his licensed version called BSD (Berkeley Software Distribution)
- Richard Stallman of MIT announces the GNU ("GNU's Not Unix") Project. He set to work on creating a Unix-compatible OS that assured software freedom for all. Stallman's outlook was a moral one, and *free* was defined in a legal sense (as in *freedom*), rather than a financial sense (as in *price*). At the time the use of BSD still required a license from AT&T, and users could not freely modify and redistribute the AT&T code that still formed part of BSD OS
- Billy Joy created SunOS from BSD

1985

- Intel 80386, 32-bit, 275k trans, 40MHz, 4GB addr
- S.Jobs ousted by Apple
- Amiga 1000
- Commodore 128, the last 8-bit uComputer, 8502 (primary cpu, an enhanced version of 6510) plus Z80, 128MB, 88 column graphics, BASIC 7.0, 5.7M sold. "Go 64" or by pressing the commodore key at power-up you can enter the C64 mode. The Z80 allows running CP/M OS.
- S.Jobs founded NeXT
- George Perlegos and Tsung-Ching Wu leave SEEQ to set up Atmel
- After leaving Zilog, Faggin creates his second startup, Cygnet Technologies, Inc. There he conceived the Communication CoSysten, a device which sat between a computer and a phone line and allowed transmission and receipt of both voice and data
- Richard Stallman starts the Free Software Foundation (FSF). Software Free is software that grants users freedom to run, modify and redistribute copies of it, either for commercial or noncommercial purposes

1986

- Federico Faggin and Carver Mead set up Synaptics. Initially, they did R&D in artificial neural networks and in 1991, produced the I1000, the first single-chip optical character recognizer. In 1994 they introduced the touchpad, followed by early touchscreens.
- Olivetti develops L2, based on Motorola 68000
- The partnership of Kazuhiko Nishi and Bill Gates dissolves and Microsoft set up its own Japanese software subsidiary

1987

- Amiga 500, 2000
- PERL, an interpreted and dynamic high level language, is created by Larry Though. Code, borrowing elements from C and UNIX scripting languages, looks complex but it is compact and powerful.
- Honeywell Information Systems Italia (HISI) becomes Honeywell Bull
- Richard Stallman releases GCC, the GNU Compiler Collection
- MS spreadsheet Excel's initial release

1988

- NeXT cube
- R.Noyce directs the American semiconductor industry association, to overwhelm the threatening Japanese semiconductor industry. Also he heads SEMATECH, a big consortium of 14 American semiconductor manufacturers plus the Department of Defense
- First version of the POSIX standard, aimed to promote application portability at the source code level of the UNIX system call and C library function API

1989
- Intel 80486, 150MHz, 4gb
- Guido Van Rossum starts an open, object oriented, high level language, called Python
- September, NeXT presents NeXTSTEP 1.0
- Honeywell Bull becomes Bull Italia
- American National Standards Institute (ANSI) C standard (X3.159-1989)
- January. The FSF announces the release of GNU GPL (General Public Licence) version 1

1990
- Microsoft Windows 3.x is released. It makes INM PC and clines more easy to use than the Mac. 30 million copy were sold in the first year.
- Robert Noyce, at age 62, dies for a heart attack
- By Christmas 1990, physicist Berners-Lee has built all the tools necessary for a working Web: the HTTP protocol, the HTML markup language, the first Web browser, the first HTTP server, the first Web server, and the first Web pages

- Panasonic releases FS-A1ST MSX TurboR, the second-to-last MSX device ever produced

1991
- Apple, IBM and Motorola (AIM) alliance is established to create PowerPC RISC microprocessor architecture. The first implementation was PPC 601 in 1992. At the time, most of the PC industry was based on Windows OS and Intel 80386 and 80486. PowerPC initiative tried to counter the growing WIntel dominance of the PC market.
- MS-DOS 5.0 (verificare)
- The Linux kernel is created by Linus Torvalds, a Finnish student at the University of Helsinki, for his Intel 80386 PC. Torvalds had had started with Minix, a small UNIX-like OS developed in the mid-1980s by Andrew Tanenbaum, a university professor in Holland. Over a few months, Torvalds is able to compile and run various GNU programs. By the early 1990s, the GNU project had produced a system that was virtually complete, except for one important component: a working UNIX kernel. Because a significant part of what is commonly known as a Linux system actually derives from the GNU project, Stallman prefers to use the term *GNU/Linux* to refer to the system
- The FSF announces the release of GPLv2. It will last 16 years

1992
- Windows 3.1 is released in US. The new GUI based OS is still launched with a DOS command. The decline of DOS, now At version 6.0, has started

1993
- Intel 80501 (Pentium), 3.3 m tr, 66mhz, 4gb
- AT&T sells UNIX copyright to Novell

1994

- PHP (Hypertext Preprocessor) free server-side language is created by R.Lerdorf
- March, Linux 1.0 is released

1995
- NeXT releases NeXTSTEP 3.3
- March, Linux 1.2 is released
- August 24, Windows 95 is released
- MSX TurboR is discontinued in Japan. This marks the end of MSX
- SSH protocol is released

1996
- S.Jobs returns to Apple
- June, Linux 2.0 is released

1997
- Intel Pentium II, 7.5 m tr, 300 mhz, 64gb
- February, NexT is bought by Apple Computer for $400M.
- Apple NeXTSTEP, based on Mach microkernel and Objective-C language
- Apple Rapsody (never released to public)
- The google's first web page starts to live

1998
- Tim Cook is hired in Apple as operation executive. He reorganizes the global supply chain. By shrinking planning an execution cycles, he collapsed the inventory from 5 weeks to 2 days
- The first Apple iMac
- Carlo De Benedetti leaves Olivetti
- September, Google is founded by Larry Page and Sergey Brin, then students at Stanford
- OSI (Open Source Initiative) is formed. They chose the term "open source" to dump the moralizing and attitude that had been associated with "free software" and instead promote open source ideas on pragmatic, business-case grounds. The political differences between the Free Software and the Open Source movements are documented on FSF's Web site at http://www.fsf.org/licensing/essays/free-software-for-freedom.html.

1999
- Intel Pentium III, 9.5 m tr, 600 mhz
- June, Linux 2.2 is released

2000
- Intel Pentium 4, 42 m tr, 2ghz
- TI's Jack Kilby wins Nobel Prize in Physics for the invention of IC

1984-2000
- Mac OS Classic 1,..,9. This is a cooperative (non-preemptive) multitasking environment
- from 2001: Mac OS X 10.x.y, based on Darwin x+4.y. This is a preemptive multitasking environment.

2001
- January, Linux 2.4 is released
- Intel net revenues falls from $33.7M to $26.5M
- Microsoft releases Windows XP, the successor of Windows 2000
- The first Apple iPod, with 5GB HD

2003
- USB 2.0

- Skype service allows free voice calls, messaging and file sharing through a P2P connected PC
- December, Linux 2.6 is released

2004
- Mac OS X becomes intel x86 compatible (universal binary)
- Ubuntu Linux distribution first appearing
- February 4. Facebook is founded by Mark Zuckerberg and his college roommate and fellow Harvard University student Eduardo Saverin

2005
- Xbox 360 is released by Microsoft
- Intel i3, i5, i7
- Intel Tick-Tock policy. Tick: new manufacturing process, Tock: new microarchitecture
- S.Jobs announces Apple migration to x86 platform

2006
- The first Apple MacBook 1Pro
- March 21. Twitter is founded by Jack Dorsey, Evan Williams and Biz Stone

2007
- The first Apple iOS and iPhone
- The FSF announces the release of GPLv3

2008
- Apple introduces the App Store
- Spotify AB, a Swedish company, launches Spotify, the audio streaming platform
- Bill Gates leave his role at Microsoft

2012
- October, Google leapfrogs Microsoft in market value ($249,19 billion)

2013
- Apple iBeacon
- March, Kali Linux 1.0, the most advanced, robust, and stable penetration-testing distribution to date, is released by Offensive Security

2014
- Windows ends security updates for Windows XP

2015
- August, Google creates a new public holding company, Alphabet Inc.
- August, Kali Linux 2.0 is released by Offensive Security

2018
- Apple announces the A12X microprocessor for mobile products. 64-bit, 7-core GPU, 8-core CPU, Neural Engine; 10 billion transistors; 7 nm process, 120 mm2

Olivetti origina Omnitel e Infostrada
Linea LSX basata su Intel 486
The new economy

Sprite: caratteri programmabili sovrapposti alla bitmap e controllati totalmente in hardware. Avevano 15 colori più il trasparente. Nel 1979 il TMS9918 è il chip video di TI che introduce gli sprite

Vi erano due tipi di sprite, player e missile

Color Clash: artefatti cromatici grafica in modo bitmap dovuto al fatto che in una cella 8x8 nn puoi mettere più di due colori

?: Atari 10444D, aka. TIA (Television Interface Adapter)
?: DCS evoluzione del TIA, avevano 256 colori e sprite
?: Nintendo NES

Digital Equipment Corporation (DEC)
Since 1962: PDP-1,8,11,34,70: minicomputers

Motorola: 6800 – 6809 – 68000 – 68040
MOS: 6502 – 6507 – 6510
Intel: 4004 – 8008 – 8080 – 8085 - 8086 – 80186, x286
Zilog: Z80 – Z8000 – Z80000 – Z380

68008: 32b internal, 8b external
68000: 32b internal, 16b external
68020: 32b internal, 32b external

Jack Tremiel
Motivatore incredibile
Vede in giappone le prime calcolatrici e si butta in quel business
Stanno arrivando i giapponesi
Yash Terakura crea il VIC-20
I primi videogiochi furono creati da giapponesi

Breakout è, dopo Pong, l'arcade game più popolare. È il muro di mattoncini. Ci lavorò anche S.Jobs

p–n junction isolation is a method used to electrically isolate electronic components, such as transistors, on an integrated circuit (IC) by surrounding the components with reverse biased p–n junctions.
Mos vs bipolar
Epitaxy