

Technology Companies

Hardware and software houses of the microcomputer age

James Tam

Recall: Computers Before The Microprocessor

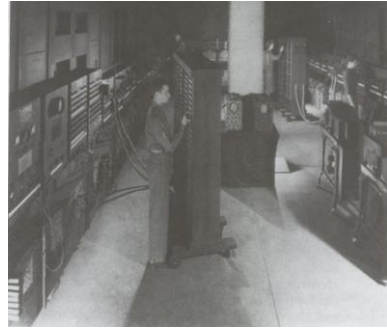


Image: "A History of Computing Technology" (Williams)

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The Microprocessor^{1, 2}

- Intel was commissioned to design a special purpose system for a client.
 - Busicom (client): A Japanese hand-held calculator manufacturer
 - Prior to this the core money making business of Intel was manufacturing computer memory.
- "Intel designed a set of four chips known as the MCS-4."¹
 - The CPU for the chip was the 4004 (1971)
 - Also it came with ROM, RAM and a chip for I/O
 - It was found that by designing a general purpose computer and customizing it through software that this system could meet the client's needs but reach a larger market.
 - Clock: 108 kHz²

¹ <http://www.intel.com/content/www/us/en/history/museum-story-of-intel-4004.html>

² <https://spectrum.ieee.org/tech-history/silicon-revolution/chip-hall-of-fame-intel-4004-microprocessor>

³ <http://www.intel.com/pressroom/kits/quickstart.htm>

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The Microprocessor^{1,2} (2)

- Intel negotiated an arrangement with Busicom so it could freely sell these chips to others.
 - Busicom eventually went bankrupt!
 - Intel purchased the rights to the chip and marketed it on their own.

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The Microprocessor (3)

- 8080 processor: second 8 bit (data) microprocessor (first was 8008).
 - Clock speed: 2 MHz
 - Used to power the Altair computer
 - Many, many other processors came after this:
 - 80286, 80386, 80486, Pentium Series I – IV, Celeron, Core
- The microprocessors development revolutionized computers by allowing computers to be more widely used.
 - Compact
 - Cheap (eventually)

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What Is Microcomputer?

- A computer that uses a microprocessor as it's main processor.
- Sometimes it's referred to as a 'PC' (Personal Computer).
 - Designed for use by only one person at a time.
 - Unfortunately this term has taken on multiple meanings.
 - PC = IBM PC (a model produced by IBM)
 - PC = A computer running a Microsoft operating system.
- Consequently the less ambiguous term 'microcomputer' will be used.

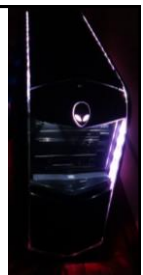


Image courtesy of James Tam

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The Altair 8800

- Created by Ed Roberts in 1974.¹
- The Altair was one of the most popular of the first set that was targeted towards home users.



<http://www.guardian.co.uk>

- It was marketed as a mini-computer (less than a expensive mainframe) but Roberts was often credited as "... the inventor of the personal computer" (Ceruzzi p. 226).

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¹ "A History of Modern Computing" (2nd Edition) Paul E. Ceruzzi

The Altair (2)



Images © Mark Richards from www.computerhistory.org

Note: Most Computer Users At The Time Were Extremely Technically-Oriented

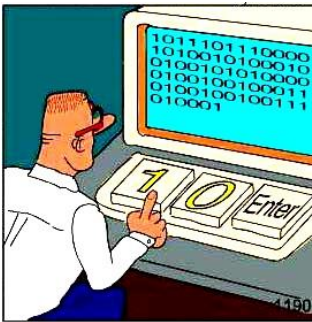


Image by Chris Kania
<http://www.kaniamania.com>

REAL Programmers code in BINARY.

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Bill Gates



<http://www.syllablesoup.com>

- His family was successful.
 - Banking
- His family with also involved in the community and government.
 - Philanthropy e.g., United Good Neighbors (pred. United Way).
- William Henry Gates III born October 28, 1955.
 - Nicknamed 'Trey' by his father.
- Avid reader:
 - World book (A-Z) at age 7 or 8
- Known mannerism



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Bill Gates (2)

- Known for his tenacity, even as a child.



www.cartoonists.com

- First use of a computer was in school.
 - A teletype connected to mini computer.
 - Young Bill typed in a command.
 - Seconds later the computer responded.
 - "It was better than science fiction [for Bill]"¹

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¹ "Hard Drive: Bill Gates and the making of the Microsoft Empire" (Jim Wallace & Jim Erickson: Harper Business 1993)

Bill Gates (3)

- His other classmates were similarly excited, among which was a young Paul Allen (who along with Bill) would found Microsoft.



www.digitaltrends.com

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Steve Ballmer



Image copyright unknown

- Hired by Microsoft in 1980 after dropping out of the MBA program.¹

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<https://www.forbes.com/profile/steve-ballmer/?h=1e30632e4818>

Steve Ballmer, Bill Gates

- Both Ballmer and Gates were very intense.
- They would often engage in heated debates about various topics well into the night.
 - “High bandwidth communication” (- Bill Gates)
 - They were described by others as being like “...two computers connected by modem”¹
- They were inspired by the sight of the Altair computer in Popular electronics.

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¹ “Hard Drive: Bill Gates and the making of the Microsoft Empire” (Jim Wallace & Jim Erickson: Harper Business 1993)

Steve Ballmer & Bill Gates (2)

- Their first project was to create a BASIC translator for the 8080-driven Altair.
 - They were still undergraduate students (Harvard).
 - It was believed to be impossible to cram the complexity of this language into such limited hardware (limited memory - 4 KB! -for the interpreter plus room was needed for application programs to run).
 - It also had to run fast.
 - They didn’t have access to an Altair (emulated on another computer PDP-10).
 - They worked at a frantic pace in the lab often with only a hour of sleep for eight weeks.
 - They succeeded!
 - “It was the coolest program that I ever wrote.”¹
 - First instruction given to Microcomputer BASIC: $2 + 2 = 4$
- It eventually became Microsoft Basic.

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¹ “Hard Drive: Bill Gates and the making of the Microsoft Empire” (Jim Wallace & Jim Erickson: Harper Business 1993)

Microsoft: Beginnings

- *Microcomputer-software.*
- Because Gates completed most of the work on BASIC there was a 64/36 split in ownership of the new company.
- Initial funds: royalties from the use of their version of BASIC (included with each Altair computer).
 - \$30/computer (4 KB)
 - \$35/computer (8 KB)
 - \$60/computer (extended version of BASIC, required external storage)
- Also funds came from licensing of the BASIC source code.
 - Developers could modify the translator as they saw fit (!!!)



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Microsoft: Beginnings (2)

- The company had humble beginnings: a section of the office was given to Microsoft by MITS (manufacturer of the Altair).
 - Gates still continued his workaholic coding schedule.



www.colourbox.com

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Microsoft: Beginnings (4)

- To help promote the Altair (and the BASIC that came with it) Gates toured with MITS to meet with computer clubs which included: engineers, technicians, hobbyists, hackers, electronicphiles etc.
 - Eventually BASIC became the standard for computers.

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Microsoft: Beginnings (5)

- One of these computer clubs (“Homebrew”) started in Menlo Park (next to Palo Alto and Stanford university).
- More than 30 people came out for the first meeting including Steve Wozniak (who was then working in the calculator division of Hewlett-Packard).
 - Within a year of this first meeting: Wozniak along with Steve Jobs would build a personal computer of their own: Apple I.
- Although Microsoft got its start through its relationship with MITS it eventually was hobbled by it.
 - Microsoft could not license BASIC to MITS competitors.
 - At first there were no competitors (no problem).
 - In a few years dozens of other companies manufactured their own microcomputers: Commodore (PET), Radio Shack (TRS-80), Apple (Apple I).

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Microsoft: Beginnings (6)

- After a long and complex legal proceedings Microsoft won the rights to sell BASIC as they saw fit.
- BASIC was licensed to many other computer manufacturers: Radio Shack (TRS-80), Apple (Apple II)
- But throughout the legal battle the company still worked on other programming languages: COBOL, FORTRAN as well as developing BASIC for chips other than the 8080.
- Gates and Ballmer were frequently underestimated by their business rivals (“who are these kids?”)



<http://www.syllablesoup.com/>

- But they were more than able to hold their own.

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Microsoft: Beginnings (7)

- However Gates still made time for programming:
 - Competitions were held with employees to see who write a program in the fewest lines of code.
 - In the early years Gates himself indicates that he was heavily involved in all projects and there wasn't a line of code that he didn't personally look over (or even recode).

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Commodore Business Machines



- Founded by Jack Tramiel
- Around 15, Jack Tramiel (then named Idek Tramielski) and his parents were shipped with other Jews from Lodz, Poland to Auschwitz in 1939
- He and his mother survived the months till Auschwitz' fall in 1944.
- After emigrating to America, Jack Tramiel enlisted and served four years in the U.S. Army.
 - At Fort Dix, Jack showed a talent for un-jamming typewriters.
- When Tramiel left the army, he started work at a typewriter repair shop and then later set up his own typewriter repair business in the Bronx.

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Image: <http://www.commodore.ca>

Commodore Business Machines (2)

- 1955: Jack moves to Toronto, Canada and founds Commodore International Limited to assemble typewriters in Canada.
- C. Powell Morgan, the head of the Atlantic Acceptance Company financially back his business.
- 1965: Atlantic goes bankrupt and C. Powell Morgan is indicted by the Canadian government amid charges of fraudulent financial statements, dummy companies, and propped stock prices.
 - Tramiel was considered suspect as well, but was never charged.
 - 1966: To keep the struggling Commodore afloat, Jack gave partial control (17%) of Commodore to a new investor, Irving Gould for \$400,000.

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Commodore Business Machines (3)



www.awesomepet.me

- 1976:
 - Commodore sets up shop on Palo Alto California
 - Commodore unveils the Commodore PET microcomputer.
 - About the same time the Apple II and TRS-80 are also unveiled.
 - 4 KB or 8 KB of 8 bit RAM.
 - Unlike many of the companies Commodore is able to start world wide distribution in months instead of years.



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Commodore Business Machines (4)

- 1981:
 - Commodore unveils the Commodore VIC-20 aka "the Friendly Computer" the first color microcomputer to sell for under \$300 (299.95).
 - Specification:
 - 5k RAM expandable to 32k
 - A 22 column x 23 row 8/16 color display



www.gamesgroundbase.com

Vic20?



www.colourbox.com

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Commodore Business Machines (5)

- 1982:
 - Commodore introduces the VIC Modem, a 300 baud cartridge modem for US\$110.
 - Commodore 64: 64KB RAM & Microsoft BASIC \$600
- 1985: [July]
 - Commodore unveils the new Amiga 1000.
 - It features a multitasking, windowing operating system.
 - Specifications 7.14 MHz 68000 CPU, 256KB RAM, and 880KB 3.5-inch disk drive (\$1300).
 - 4096 color display



www.theclatercomputermuseum.com

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Commodore Business Machines (6): HAM Graphics (Simulation)

- Commodore (4096 color) HAM graphic
- Microsoft VGA/EGA (256/16 color) graphic



en.wikipedia.org



256 colors

16 colors

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Commodore Business Machines (7)

- 1987:
 - Commodore launches its first IBM PC-compatible machines.
- 1990:
 - NewTek releases the Video Toaster, a professional quality hardware/software video effects tool for the Commodore Amiga 2000 (1 MB RAM), for US\$1600.
 - The toaster allowed for professional quality video editing and the creation of special effects.



Babylon 5 © Warner Brothers

Other notable uses of the VideoToaster:

- The Tonight Show
- SeaQuest DSV

• A later version was co-developed by actor Wil Wheaton



Star Trek © Paramount

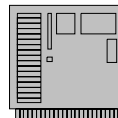
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Commodore: Market Share

- Apple Computer shipped 600,000 Apple II computers
- Commodore:
 - Commodore has shipped 750,000 VIC-20 computers .
 - Commodore 64 sales 17-22 million (total) units, the most sales for a particular model of computer.

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Birth Of The Microsoft OS



Clipart: Microsoft



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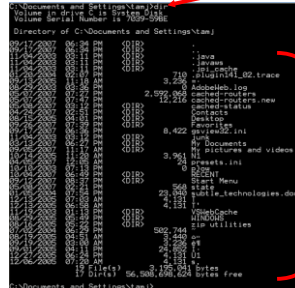
Birth Of The Microsoft OS (2)

- IBM approached two companies as possible vendors of an operating system to run it's computers:
 - Digital Research (CP/M operating system was standard for Intel 8080 based systems)
 - (There soon to be a 16 bit extension coming but not far enough in development).
 - Microsoft (never wrote operating system software just a BASIC interpreter).
 - Microsoft: 7 million in annual sales
 - IBM: 30 billion in yearly revenues.
- IBM and Microsoft worked out an arrangement to have a version of Microsoft's DOS (Disk Operating System) run IBM computers: PC-DOS.
- MS-DOS was based on 86-DOS an OS written by Tim Paterson of Seattle Computer products (later Q-DOS)

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Birth Of The Microsoft OS (3)

- The interface of PC/MS-DOS has been criticized as being user-unfriendly.



Effect of the command

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Birth Of The Microsoft OS (4)

- However the interface of PC/MS-DOS was a significant improvement over other operating systems.
CP/M operating system



Clipart: Microsoft

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Birth Of The Microsoft OS (5)

- However the interface of PC/MS-DOS was a significant improvement over other operating systems.
PC/MS-DOS operating system



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The IBM PC (Personal Computer: 1981)



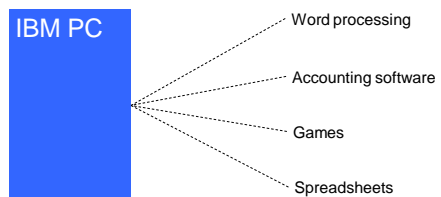
www.computerhistory.org

- IBM was a large company but a late comer into the microcomputer market.
- As mentioned its machines used an operating system produced by Microsoft.

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The IBM PC (Personal Computer: 1981): 2

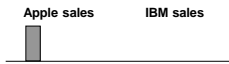
- With the entry of IBM in the microcomputer market, many developers produced a plethora of software.



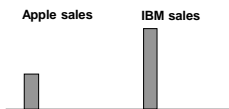
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The IBM PC (Personal Computer: 1981): 3

- Apple entered the microcomputer market sooner and already had an established market when IBM began to first market the PC.



- Because of the prevalence of so much software the IBM-PC soon overtook Apple (and other vendors) in sales.



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Radio Shack (TRS Computers)¹

- TRS-80 (1977)
 - ROM: startup routine and (non-Microsoft) Basic
 - Programs could be loaded from cassette or disk into RAM



www.pc-history.org

- One version of TRS-80 was an early laptop



<http://www.pugo.org>

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¹"A history of modern computing (2nd Ed)" Paul E. Ceruzzi no. 263 - 264

The History Of Apple Computers: Steve And Steve

- Apple was founded by Steven Jobs and Steve Wozniac in a Silicon Valley garage.



Steven Jobs



Steve Wozniac

James Tam

Images © Apple Computer, Inc. from www.computerhistory.org

Apple: Steve And Steve

- Bill Fernandez (Wozniac's neighbour in Santa Clara California) introduced the 'Steves'.¹
 - Stephen Gary Wozniac (16)
 - Steven Paul Jobs (21)
- They built their first computer out of parts that were discarded (for 'cosmetic' reasons) by computer manufacturers.
 - Named after their favourite drink: "The Cream Soda computer".
 - Jobs was marketing, Wozniac was the Engineer,

James Tam

¹"Corporations that changed the World: Apple Inc." (Jason D. O'Grady; Greenwood Press 2009)

Steve Jobs

- Born Feb 24, 1955 in San Francisco.
- Age 23: Made his first million
- Age 25 (1980): Worth approximately 100 million
- 2009: Worth approximately 6 billion
- Even at an early age he showed an aptitude for business and people over engineering.
 - "...he wasn't interested in getting his hands dirty", "...he was more interested in wondering about the people that owned the cars."¹

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¹"The little kingdom: The private story of Apple Computer" (Michael Moritz; William Morrow p. 38)

Steve Wozniak

- Born August 11 1950
- Commonly known by an abbreviation of his surname "The Woz"
- "Prolific tinkerer"¹
- "From a technical standpoint, Woz was literally Apple Computer"²

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¹"Corporations that changed the World: Apple Inc." (Jason D. O'Grady; Greenwood Press 2009)

²"Woz: From Computer Geek to Cult Icon: How I Invented the personal computer, Co-founded Apple, and had Fun Doing It" (Steve Wozniak with G. Smith; W.W. Norton 2006)

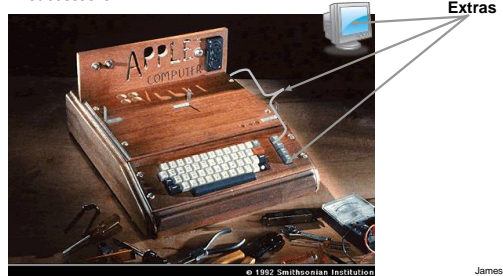
Apple I

- 1976: Wozniak completed a prototype and took it to the Homebrew Computer club.
- Jobs saw its immediate potential.
- It used a standard TV as a monitor.
- Due to Wozniak's design genius it used a minimal number of chips (to keep costs and complexity down).
- Boot code was in ROM.
- Data was saved on cassette tapes.

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Apple I (2)

- The first Apple computer: significantly different from its successors.



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Apple I: Marketing

- A local electronic shop owner immediately put in for an order of 50 computers.
- Cash was so tight for 'Apple' that payment for the parts had to be made on credit.

– Even then personal sacrifices had to be made.



– Wozniak's friend: Ronald Wayne helped him assemble the computers in Wozniak's living room.

- Even this preassembly process the machine still required some assembly by the end customers.

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Clipart:www.colourbox.com

Apple II

- Proceeds from the sale of the predecessor machine financed the construction of its successor.
- At this point Wayne sold his stake in company.
- The 'Steves' had trouble raising money.
 - Banks would not grant loans because they were skeptical of the marketability of a computer for the average person.
 - Finally after another person agreed to co-sign the bank loan (\$250,000) there was enough capital to fund production of the Apple II and Apple Computer was formed April 1, 1976.
- Released in 1977.
- Initially it ran a version of BASIC written by Wozniak.
- Later it used a licensed version of Microsoft BASIC.
 - The \$10,000 fee was said to have saved Microsoft from insolvency.¹

¹ "A History of Modern Computing" (Paul Ceruzzi: MIT Press 2003)

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The Apple II (2)



Images
Apple II:
www.computerhistory.org
Donkey Kong:
www.donkeykong.gamebub.com

- It was a simpler and more powerful design than the Altair
- The color graphics were superior to larger and more expensive computers
- Strong selling points
 - Name
 - Appearance

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Side Note: VisiCalc

- Visible Calculator was the first electronic spreadsheet.
- Dan Brickling conceived of the idea while he was a first year student at Harvard Business school.
- Enlisted the aid of a Harvard graduate and using a borrowed Apple II computer a working version was produced in 1978.

James Tam

The Apple II & VisiCalc



- VisiCalc: *"It was the software tail that wagged the hardware dog"*

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Apple Goes Public

- IPO: December 12, 1980 (Open \$22 per share, close at \$29)
 - Apple raised more money that day than any company except for Ford.

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Apple III



- Customers flocked to (the IBM PC):
 - Apple became known for poor reliability.
- The Apple III failed as a product:
 - IBM 'smelled blood' and quickly released the IBM PC (Personal Computer).
 - The PC design opened up the market for clones (more later).
- Wozniak claimed it was a failure because marketing rather than engineering had designed it.

image: www.vintage-computer.com

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Jacky Scully

- Recruited from Pepsi to work as CEO for Apple in 1983 by Steve Jobs.
 - At Pepsi he spearheaded a successful marketing campaign to challenge Coke: the "Pepsi challenge"
 - It was reputed however that Scully picked Coke over Pepsi in the challenge.
 - What finally motivated the transfer was a plea by Jobs.
 - "Do you want to sell sugared water for the rest of your life? Or do you want to come with me and change the world?"¹
- He was responsible for many changes:
 - A decision to compete directly against IBM in the business computer market (Apple III)
 - Removing Steve Jobs from development of an Apple microcomputer project.

¹ Triumph of the Nerds: The Transcripts, Part III

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Lisa



Image © Mark Richards from www.computerhistory.org

- (1983).
 - 5 MHz 68000 processor
 - 1 MB RAM
- Unlike other Apple computers which were text-based, this one would employ a GUI.
 - It was inspired by a tour of the Xerox PARC (Palo Alto Research Center) laboratories.
 - It cost \$1 million in Apple stock for a 3 day tour of Xerox.
 - It was a failure but laid the ground work for the successful Macintosh.
 - The Lisa (1983) incorporated many of the features of the Xerox Star.
 - Like the Star it was expensive (\$10K) and sales were weak

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The Apple Macintosh (1984)



Image © Mark Richards from www.computerhistory.org

- Apple's next computer was the Macintosh
- It incorporated many of the best features of the Lisa but was sold at a substantially lower price.
- Also features not present in the Lisa were added to the Macintosh
- Compared to the IBM-PC it was a speed vs. ease of use tradeoff

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Macintosh



- To prevent a repeat of the failures with the Apple III Jobs was diplomatically removed from this project.¹
 - He eventually resigned and formed his own computer company NeXT
- Goal: produce an easy to use, inexpensive computer with all the features could need all in one package.
- Specifications:
 - Processor: ~7 MHz 68000 Motorola
 - Memory: 128 KB (upgradable – with some difficulty - to 512 KB)

James Tam

¹ "Corporations that changed the World: Apple Inc." (Jason D. O'Grady, Greenwood Press 2009)

Macintosh (2)

- It incorporated the best features of the Lisa but was sold at a substantially lower price.
- Also features not present in the Lisa were added to the Macintosh
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Xerox Star

- 1981: Xerox introduced a microcomputer, 8010 Star Information System (Short form: Xerox Star).

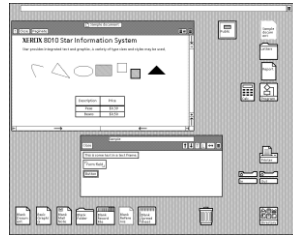


<http://www.digibarn.com>

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Xerox Star (2)

- The first GUI-driven microcomputer (1981 for the Xerox Star vs. 1984 for the Apple McIntosh and 1985 for the Commodore Amiga 1000).

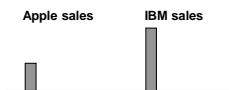


<http://www.aresluna.org>

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The Attack Of The Clones

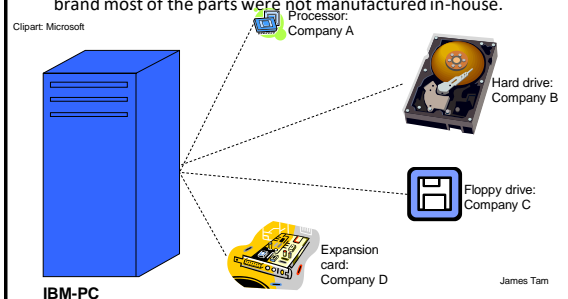
- Although it was a late entry into the microcomputer market IBM eventually dominated.



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The Attack Of The Clones (2)

- Although the IBM-PC was marketed and sold under the IBM brand most of the parts were not manufactured in-house.



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The Attack Of The Clones (3)

- The parts manufacturers were free to sell their components to other companies.
- About the same time that the IBM-PC was sold, three ex-employees of Texas Instruments founded their own company: Compaq.
 - They conceived of producing their own copy of the IBM-PC under their own brand name.
 - It would run under MS-DOS and be 100% compatible with other software
 - The first IBM-PC clone was delivered by Compaq in 1983.



IBM-PC



Compaq clone

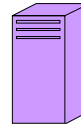
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The Attack Of The Clones (4)

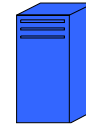
- This opened the flood gates for other computer manufacturers to produce their own clone computers.



Compaq clone



Dell clone



IBM-PC

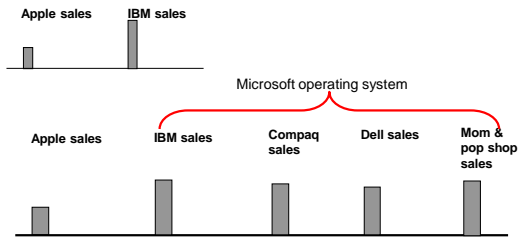


Mom and pop shop clone

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The Attack Of The Clones (5)

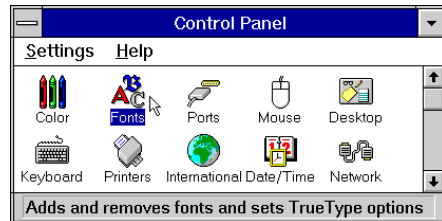
- The result was that IBM eventually lost control over the computer architecture that it developed and marketed.



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The Attack Of The Clones: The Rise Of Microsoft

- The loser of the clone war was IBM.
- The real winner of the clone war was Microsoft.
- By the 1990s Microsoft developed an interface for MS-DOS that incorporated some of the features of the MAC GUI.



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Steve Jobs: Redux

- Jobs eventually returned to Apple after Apple bought NeXT in 1996.
- The NeXT operating system would become the foundation for Mac OS8.
- Apple sales and share prices continued to drop.
- Finally Steve Jobs was reappointed CEO.

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Changes Under Jobs II

- Changes that turned Apple around:
 - A (much-needed) infusion of \$150 million from Microsoft.
 - Microsoft Office for MAC
 - Discontinuing of license agreements of Apple ROM and Apple OS to clone makers.
 - Release of the iMac computer.
 - All in one (like the Macintosh that he designed earlier).
 - A bright eye catching design (computers were not just beige clones).



www.imacworld.com

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Changes Under Jobs II (2)

- (Changes that turned Apple around continued)
 - Release of the iBook (first Mac with wireless support).
 - Release of a new professional desktop computer: Power Mac G4.
- Major changes which are regarded as leading to Apple's resurgence:
 - Mac OS X
 - Apple retail stores
 - iPod (JT: and the whole "eye" series that followed and preceded it).

James Tam

Timelines

- 1974
 - MITS: Altair 8800
- 1976
 - Commodore: PET
 - Radio Shack: TRS-80
 - Apple I
- 1977
 - Apple: Apple II
- 1981
 - Commodore VIC-20
 - IBM PC

James Tam

Some Important Microcomputer Timelines

- 1983
 - Compaq IBM-clone
- 1984
 - Apple Macintosh
- 1985
 - Commodore Amiga 1000

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References

- The Intel website: <http://www.intel.com>
- "A History of Modern Computing" (2nd Edition) Paul E. Ceruzzi
- "Hard Drive: Bill Gates and the making of the Microsoft Empire" (Jim Wallace & Jim Erickson: Harper Business 1993)
- "Corporations that changed the World: Apple Inc." (Jason D. O'Grady: Greenwood Press 2009)
- "The little kingdom: The private story of Apple Computer" (Michael Moritz: William Morrow p. 38)
- "iWoz: From Computer Geek to Cult Icon: How I Invented the personal computer, Co-founded Apple, and had Fun Doing It" (Steve Wozniak with G. Smith: W.W. Norton 2006)

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References (2)

- Triumph of the Nerds: The Transcripts, Part III

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After This Section You Should Now Know

- General knowledge
 - The general time that significant events (such as the creation of different computer models or technologies) occurred
 - The people and organizations/companies behind these events/technologies and their background
 - What companies produced which computers
 - The names, general appearance and basic technical specifications of the computers of this time
 - What were the specifications of the technologies of the day (such as the number of colors available with different graphical modes)
 - What (if any) were the distinguishing feature or features of a computer
 - How were these technologies or computers used

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After This Section You Should Now Know (2)

- How the invention of the microprocessor revolutionized computing
- What was the first computer that was targeted specifically for the home user
- What was the influence of Microsoft on microcomputers
- The history of the IBM-PC
- The foundation of Apple Computers
- The history of some of Apple's early computers: Apple I, Apple II, Lisa, Macintosh
- How IBM lost control over a computer architecture that it developed through the rise of clone computers

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After This Section You Should Now Know (3)

- How the rise of clone computers lead to the market dominance of Microsoft in the microcomputer market
- When the Xerox Star was made available as well it's influence on microcomputers

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