

The History of Computers

You will learn about the developments in computing and other related technologies that were made from the 1940's onward.

James Tam

History Part II: The Electronic Computers

- The ABC
- The ENIAC
- The British code breaking computers
- Stored program computers

James Tam

The People Behind The ABC (Atanasoff-Berry-Computer)

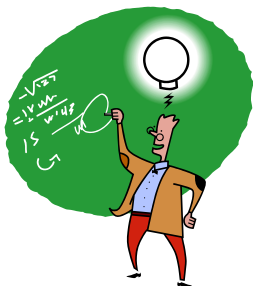
- John Atanasoff
 - A professor at Iowa State College (now Iowa State university)
- Clifford Berry
 - A graduate student studying under Atanasoff

Images from "A history of computing technology" by Michael R. Williams (IEEE Press 1997)

James Tam

Motivations For Developing The ABC

- Atanasoff was researching methods of solving complex mathematical equations.



- He started by modifying the small IBM calculator that was leased to the college to see if it could solve these problems.

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Motivations For Developing The ABC (2)

- His modifications were extensive
- The folks at IBM weren't happy with the modifications



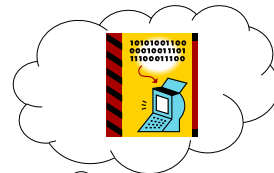
James Tam

Motivations For Developing The ABC (3)

- Atanasoff then decided to build his own machine.
- Unfortunately this proved to be more of a daunting task than he first anticipated.



- After a particularly frustrating night he decided to take a break from the lab.



- This led to an astonishing breakthrough!



Wav file from "James Tam"

James Tam

The First Electronic Computer: The ABC

- After enlisting the aid of Berry and several years of hard work the ABC was *nearly* completed at a cost of \$6000 (including the \$450 paid to Berry) in 1942.
- It was the first *prototype* electronic computer!

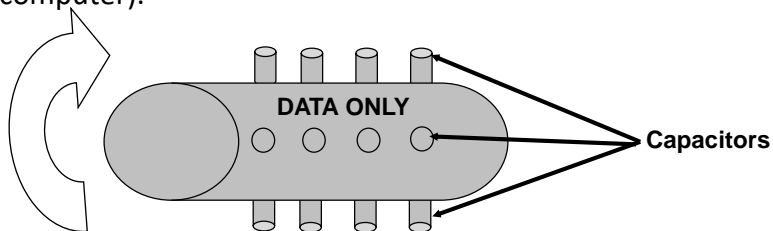


Photo of replica ABC credit to: Bob Elbert / Iowa State University

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The First Electronic Computer: The ABC (2)

- It used a form of regenerative memory that was similar to the kind used in modern RAM.
- But it was not a stored program computer (not modern computer).



- The machine was never fully completed
+/-



James Tam

The Moore School Of Electrical Engineering

- It was a major provider of technical and computing resources for the US arm (Ordinance department, ballistics research lab)



- Current approaches to calculate trajectories were too slow and work on the ENIAC was begun to solve these problems.

James Tam

The People Behind The ENIAC

- John Mauchly
 - A Physics professor at Ursin College.
 - Produced the overall design of the ENIAC



From www.computermuseum.li

- J. Presper Eckert
 - A lab instructor at the Moore School
 - Designed the individual circuits of the ENIAC



Image © Michael Denning from www.computerhistory.org

- Joseph Chedaker
 - Supervised the construction team

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Second Electronic Computer: The ENIAC (Electronic Numerical Integrator Calculator)

- Completed in 1949 for \$500,000
- The machine was huge and required a great deal of resources
 - Filled a room (x100 times bigger than comparable machines of the time)
 - 30 tons
 - 140,000 watts

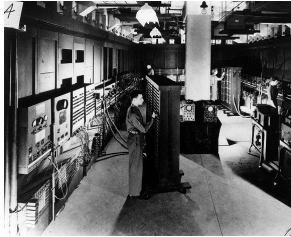


Image © University of Pennsylvania

- "...the most complex bit of electronic ever put together" (Michael R. Williams "A history of computing technology").
 - ~ wiring of the US telephone network

James Tam

Second Electronic Computer: The ENIAC (2)

- Many of the components were just electronic equivalents of the mechanical version.
- E.g., to store a single digit:

Mechanical approach



Image of Leibniz's "stepped drum" calculating machine: courtesy of James Tam

ENIAC approach

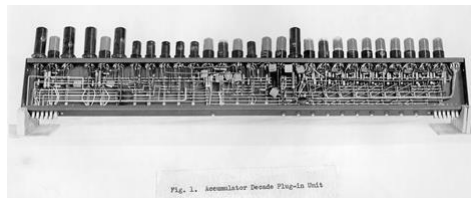


Image © University of Pennsylvania (from <http://www.library.upenn.edu>)

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The ABC And The ENIAC

- The ABC was the first *prototype* electronic computer (not quite completed): 1942.
- The ENIAC was the first *fully operational* electronic computer (finished): 1949.

James Tam

World War II: Code Breaking And Computing

The Allies

- British code breaking machines/projects
 - The machines of Bletchley Park ('bombs')
 - The Robinsons
 - The Colossus (and the Colossi!)

The Axis

- Germany: the enigma machines

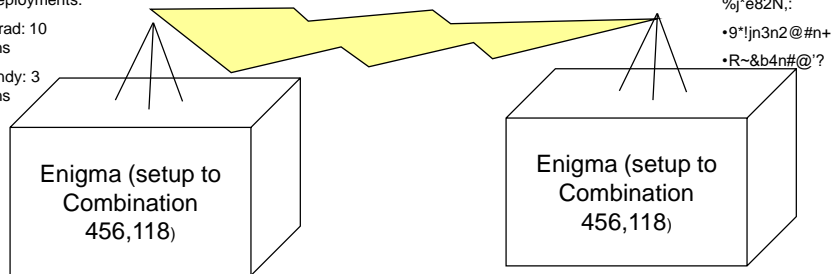
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German Enigma Machines

- The Enigma machines: used before and during WWII by Germany as an encryption device.
- There were two versions: one for the military and one for business.
- The sheer number of possible combinations (100 billion!) made mere possession of the machines useless.

Troop deployments:

- Stalingrad: 10 divisions
- Normandy: 3 divisions



James Tam

An Enigma Machine



Image courtesy of James Tam (Imperial War museum: London England)

James Tam

The British Code And Cipher School

- Worked on deciphering the German codes at Bletchley Park outside of London:

WHERE IS BLETCHLEY PARK?

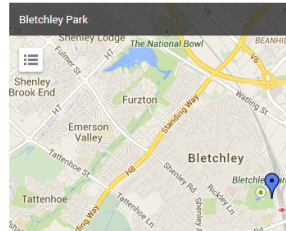
The full address is: **The Mansion, Bletchley Park, Sherwood Drive, Bletchley, Milton Keynes, MK3 6EB**

When using a sat-nav please enter Sherwood Drive, Bletchley, as the postcode may take you to the wrong location.

[Visiting Bletchley Park by Public Transport](#)

[Visiting Bletchley Park By Road](#)

[View Bletchley Park in a larger map](#)



- Intelligence work involved a great deal of secrecy:
 - Information was strictly on a “need to know basis” for the people working there.
 - Even now much of the information is still classified “Official Secrets Act”:
<http://www.legislation.gov.uk/ukpga/1989/6/contents>

Alan Turing



- A distinguished British Mathematician from Cambridge.
- He worked at Bletchley Park as a code-breaker (contributed to the design of the machinery as well as applying his Mathematical knowledge).
- A serious athlete!
 - “Alan Turing achieved world-class Marathon standards. His best time of 2 hours, 46 minutes, 3 seconds, was only 11 minutes slower than the winner in the 1948 Olympic Games. In a 1948 cross-country race he finished ahead of Tom Richards who was to win the silver medal in the Olympics.”

--

From: <http://www.turing.org.uk>

British Code Breaking Machines

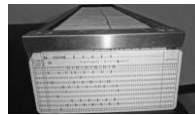
- The 'bombs' were the first set of devices and were based on machines produced by the Poles.
 - The combination of secrecy surrounding the work at Bletchley Park and the code names used, 'work on bombs' resulted in a great deal of confusion.
 - "...but the only thing these bombs destroyed was the German Air Force message security" (Michael R. Williams "A History of Computing Technology").
- (Heath) Robinson machines
 - Unreliable
 - 'Proof of concept': showed that high speed electronic devices could still aid in the decoding process (Enigma)
- The Colossus (eventually "the colossi")
 - Addressed the reliability problem of the Heath Robinson machines
 - Miraculously the first one was completed in less than a year.
 - "Many more" were soon requested (1944)

Before The First Stored Program Computers

- Before these computers were developed existing machines received their instructions from:

- Punch card

Punch card/tape images courtesy of James Tam



- Punch tape



- Complex re-wiring

James Tam

Stored Program Computer (SPC): Originator?

- Why it's important.
 - It's a fundamental part of modern computers and many electronics
- The answer
 - It's shrouded in a great deal of controversy.
- The location where the idea was developed
 - The Moore School (the team that developed the ENIAC)
- The person most widely credited with coming up with the idea
 - John Von Neumann



Image © Alan Richards from www.computerhistory.org

- He received so much notoriety that modern computers are sometimes referred to as "Von Neumann machines".

James Tam

First SPC: The Manchester Machine

- After the end of the war many of the people who worked at Bletchley Park obtained jobs at Manchester university.
- In 1948 the Manchester machine was the first fully electronic machine that operated based on the instructions stored in its memory.
- However the initial machine was extremely limited in its capabilities:
 - The instruction set consisted of subtractions, conditional branches and a 'stop' instruction.

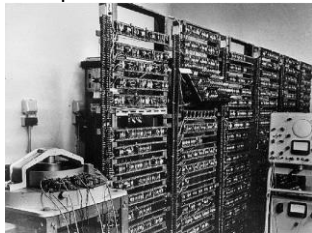


Image © University of Manchester from www.computerhistory.org

James Tam

History Part III: Modern Times

- History of the microcomputer
- History of the Internet
- User interfaces: command line, graphical user interfaces (GUI), the mouse

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History Of The Microcomputer

- The microprocessor
- The first popular microcomputer for home users: Altair
- Microsoft and it's influence on Microcomputers
- The IBM-PC
- History of Apple computers
- The attack of the clones and the rise of Microsoft

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Recall: Computers Before The Microprocessor

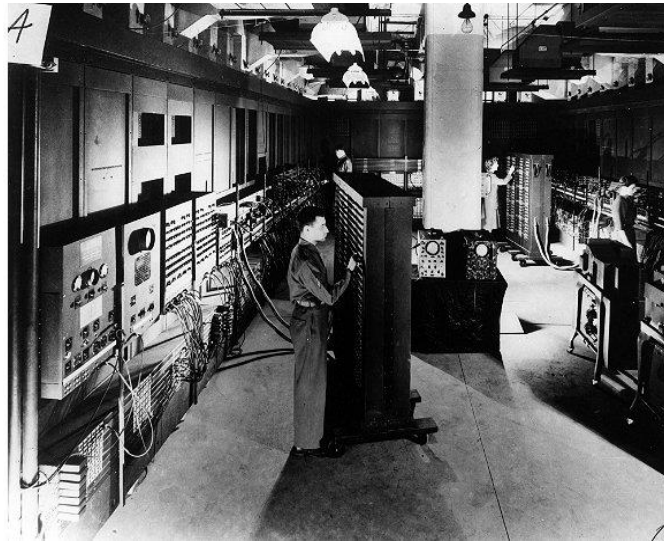
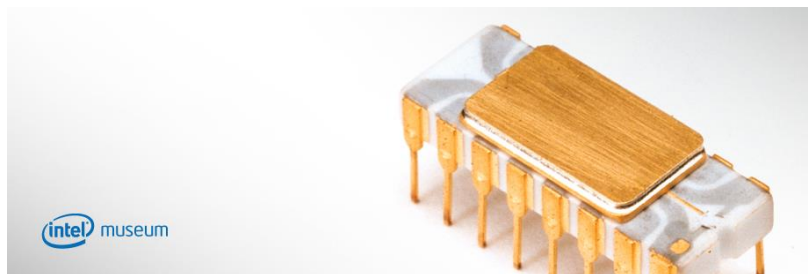


Image © University of Pennsylvania

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The First Microprocessor

- Produced by Intel in the early 1970's
- It's development revolutionized computers by allowing computers to be more widely used.



From the "Intel museum" www.intel.com

James Tam

What Is A Microcomputer?

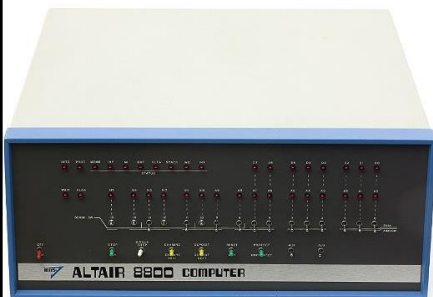
- Sometimes it's referred to as a 'PC' (Personal Computer)



Image courtesy of James Tam

James Tam

The First Popular Computer For Home Users: The Altair



Images © Mark Richards from www.computerhistory.org

James Tam

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

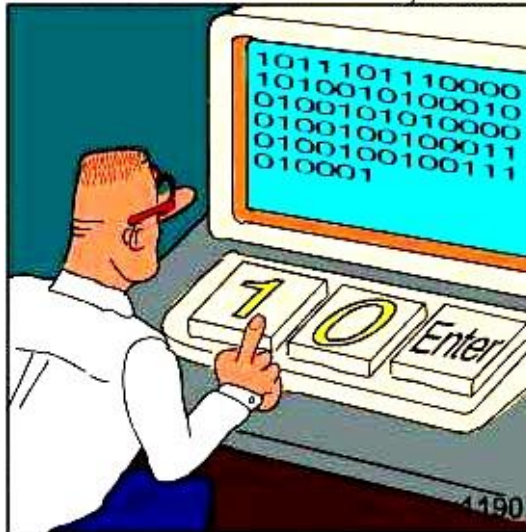
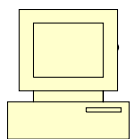
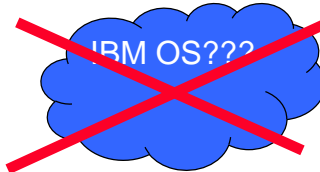
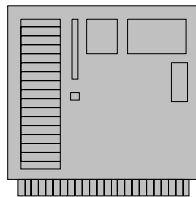


Image by Chris Kania
<http://www.kaniamania.com/>

REAL Programmers code in BINARY.

ames Tam

Microsoft's Influence On Microcomputers



James Tam

Microsoft's Influence On Microcomputers (2)

- IBM approached two companies as possible vendors of an operating system to run its computers:
 - Digital Research
 - Microsoft
- IBM and Microsoft worked out an arrangement to have a version of Microsoft's DOS (Disk Operating System) run IBM computers: PC-DOS.

James Tam

Microsoft's Influence On Microcomputers (3)

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

```
C:\Documents and Settings\tamj>dir
Volume in drive C: is System Disk
Volume Serial Number is 7039-598E

Directory of C:\Documents and Settings\tamj

09/17/2007  06:34 PM    <DIR>      .
09/17/2007  06:34 PM    <DIR>      ..
11/04/2003  03:11 PM    <DIR>      .java
11/04/2003  03:11 PM    <DIR>      .javaws
11/04/2003  03:11 PM    <DIR>      .jpl_cache
01/20/2004  02:07 PM          710 .plugin141_02.trace
02/13/2003  11:18 AM          3,236 AdobeHelb.log
02/29/2003  03:36 AM           0 cached-routers
02/07/2007  07:27 PM    2,592,068 cached-routers.new
02/08/2007  03:42 PM    12,216  cached-status
04/24/2007  02:51 PM    <DIR>      Contacts
04/15/2005  04:01 PM    <DIR>      Desktop
04/26/2007  07:59 PM    <DIR>      Favorites
09/17/2007  06:36 PM    8,422  gsview32.ini
11/04/2003  06:27 PM    <DIR>      junk
02/13/2007  06:27 PM    <DIR>      My Documents
02/05/2007  11:17 AM    <DIR>      My pictures and videos
10/14/2005  11:20 AM    3,961  N1
04/05/2007  12:05 AM          24 presets.ini
10/10/2003  07:43 PM          0 Plog
10/04/2007  06:49 PM    <DIR>      RECENT
09/12/2007  08:37 PM    <DIR>      Start Menu
05/08/2007  02:21 PM    <DIR>      state
12/13/2003  07:03 AM    23,040 subtitle_technologies.doc
11/13/2003  04:13 PM    4,131  I
11/13/2003  04:13 PM    4,131  I
04/25/2003  05:49 PM    <DIR>      VSSubCache
04/25/2003  05:49 PM    <DIR>      WINDOWS
01/02/2004  06:26 PM    <DIR>      zip utilities
02/15/2003  04:51 AM    502,744 ov
02/15/2003  04:51 AM    306,440 e#
02/01/2003  04:11 PM    24,852 e#
12/27/2003  06:24 PM    4,131 U1
12/06/2003  07:30 AM    4,131 s
          19 File(s)    3,195,041 bytes
          17 Dir(s)    56,508,698,624 bytes free

C:\Documents and Settings\tamj>
```

Command

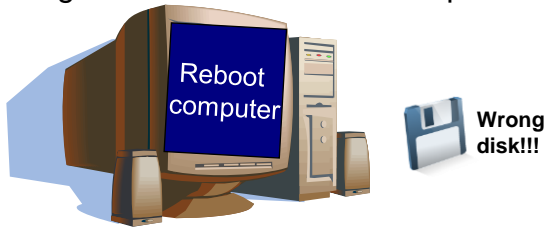
Effect of the command

James Tam

Microsoft's Influence On Microcomputers (4)

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

Digital Research Inc.: CP/M operating system



James Tam

Microsoft's Influence On Microcomputers (4)

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

PC/MS-DOS operating system



James Tam

The IBM PC (Personal Computer: 1981)



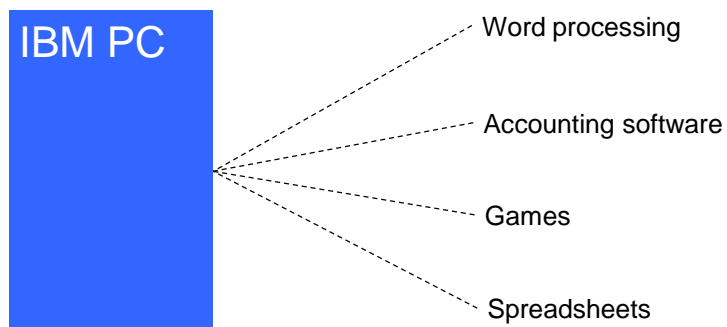
www.computerhistory.org

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

James Tam

The IBM PC (Personal Computer: 1981): 2

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



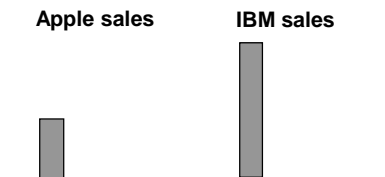
James Tam

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 the Apple in sales.



There many other important microcomputer manufacturers (omitted for brevity)

James Tam

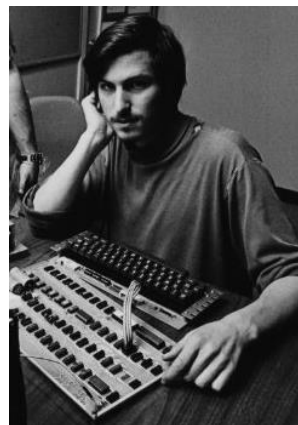
The History Of Apple Computers: Steve And Steve

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

Steve Wozniac



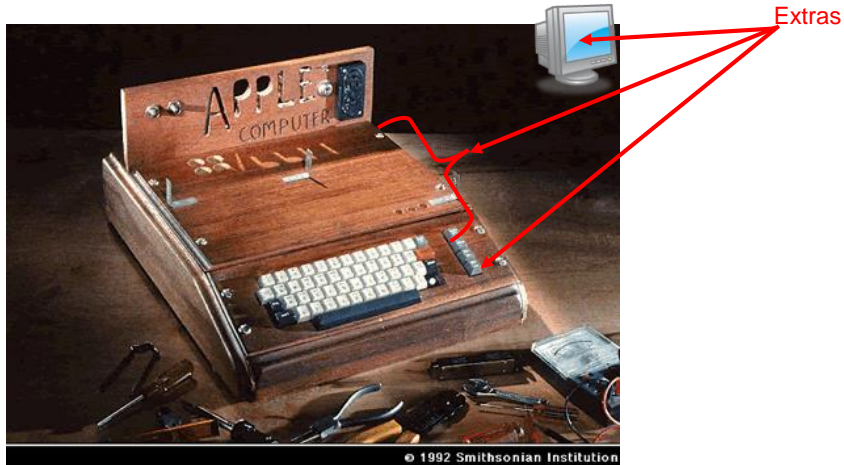
Steven Jobs



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

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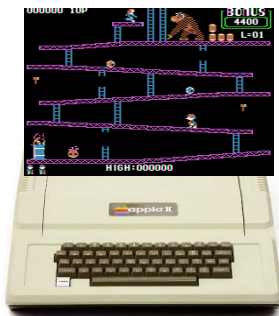
The Apple I Computer (1976)



- It was far from the standard of a modern computer

James Tam

The Apple II Computer (1977)



- 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

Images

Apple II:
www.computerhistory.org

Donkey Kong:
www.donkeykong.gamebub.com

James Tam

The Apple II Computer (1977): 2



- The storage device was primitive by today's standards but actually sufficient to meet the needs of the time
- VisiCalc: *"It was the software tail that wagged the hardware dog"*¹

Images

Apple II:

www.computerhistory.org

Donkey Kong:

www.donkeykong.gamepub.com

¹ "Just for Fun" (Chapters 2,3) by Torvalds and Diamond

James Tam

First Graphical Interface



- Contrary to popular belief it was not invented by Apple.
- Xerox star: pioneered the GUI in 1981:

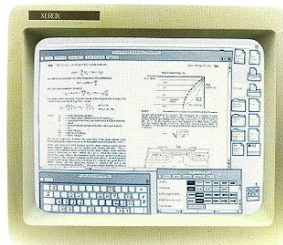


Image of Xerox Star screen from Xerox brochure

- Other GUI-based computers: Apple {Lisa (1983), McIntosh (1984)}, the Commodore Amiga 1000 (1985).
- Although it was a technical innovation the Star was regarded as a business failure.
- It was Apple (and others such as Commodore) who successfully mass marketed a GUI-based computer.

Xerox star hardware picture: www.flickr.com/photos/mwichary

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The Apple Lisa (1983)



Image © Mark Richards from www.computerhistory.org

- The first GUI-based computer produced by Apple: the Lisa 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)



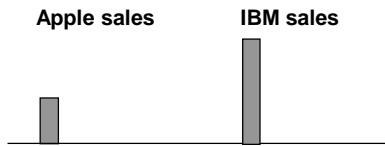
Image © Mark Richards from www.computerhistory.org

- Apple's next computer was the Macintosh
- It incorporated the best features of the Lisa but was sold at a substantially lower price ~\$2.4K
- Compared to the IBM-PC it was a price/performance vs. ease of use tradeoff

James Tam

The Attack Of The Clones

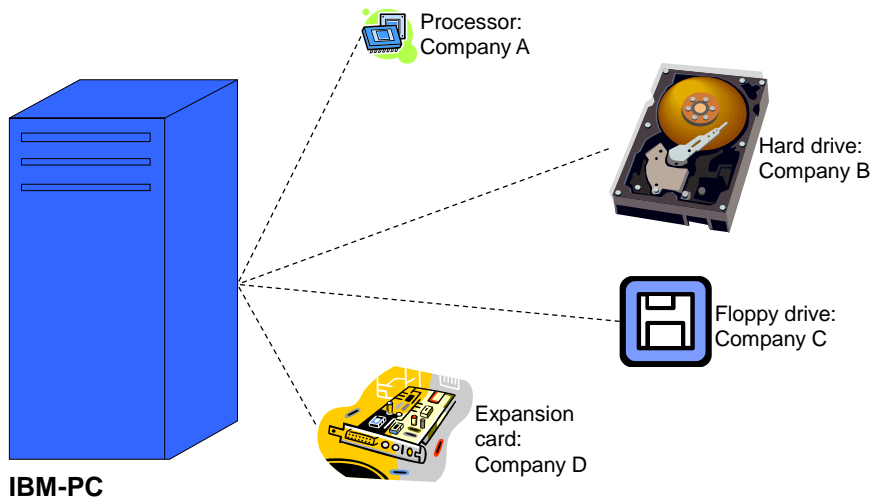
- Although it was a late entry into the microcomputer market IBM eventually dominated.



James Tam

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.



James Tam

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 the idea 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 application software written for the PC.
 - The first IBM-PC clone was delivered by Compaq in 1983.



IBM-PC

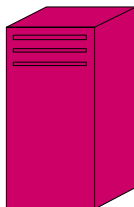


Compaq clone

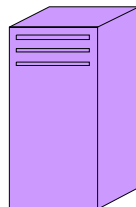
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The Attack Of The Clones (4)

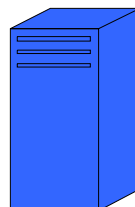
- This opened the flood gates for other computer manufacturers to produce their own clone computers.



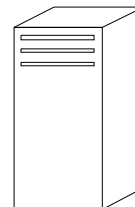
Compaq clone



Dell clone



IBM-PC

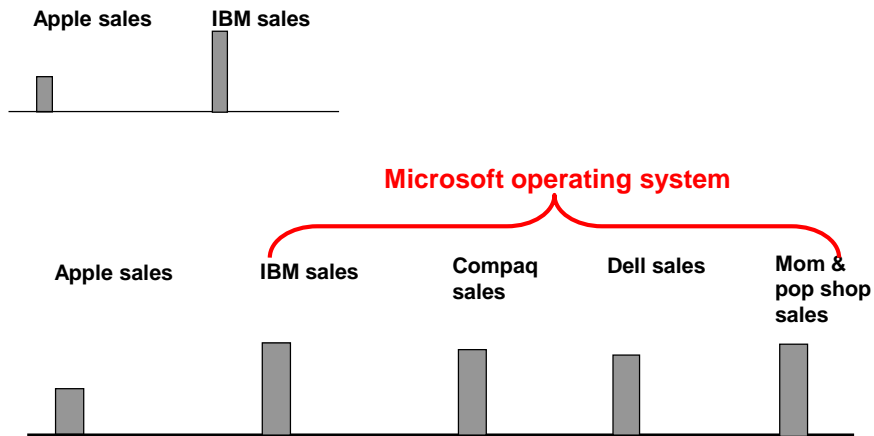


Mom and pop shop clone

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The Attack Of The Clones (5)

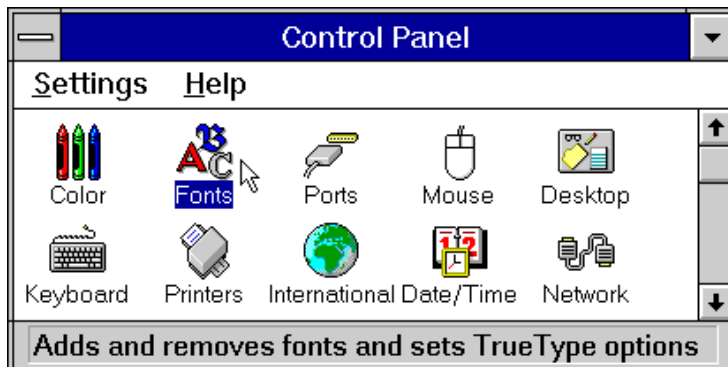
- The result was that IBM eventually lost control over the computer architecture that it was the first one to market.



James Tam

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 1990's Microsoft developed an interface for MS-DOS that incorporated some of the features of the MAC GUI.



Windows 3 image from www.microsoft.com

James Tam

Origins Of The Internet

- What was happening in the 1950's



The Cold War

James Tam

The Cold War And The Space Race

- At the same time that each side (USSR-USA) was trying to be dominant on the ground they also wanted to be dominant in space.
 - Both sides tried to be the first to send a satellite into space.
- In the 1950's it appeared that the USSR had a technological edge:
 - Americans in 1957: A sophisticated three stage rocket was planned as the first human-made vehicle to be sent into space.
 - The USSR in 1957: surprised the world by launching Sputnik I (first artificial satellite).



<http://astroprofspage.com>

- The launch of Sputnik helped motivate the creation of ARPA (Advanced Research Projects Agency) in the US.

The Cold War And The Space Race (2)

- Later in 1957 the USSR launched another satellite carrying the dog Laika “bark/barker” on a one way trip into space :(



<http://news.bbc.co.uk>

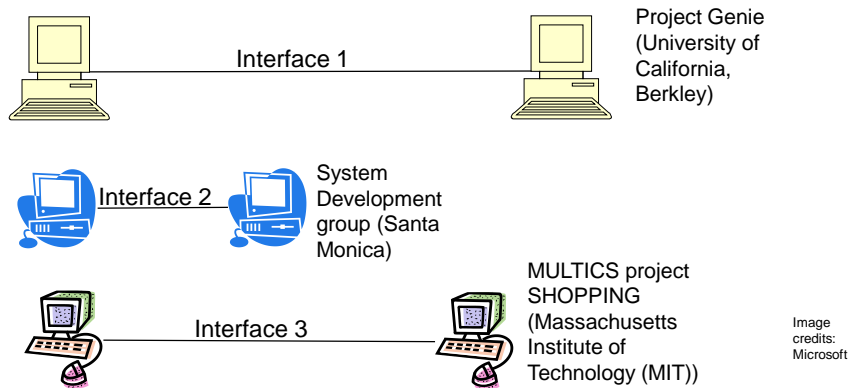
ARPA

- ARPA was a branch of the ministry of defense.
- The focus was on:
 - Getting different types of computers communicating

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ARPA (2)

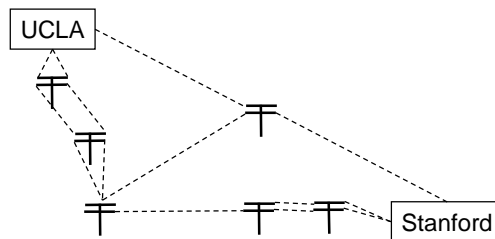
- In the early days of ARPA there 3 separate and incompatible networks to communicate with the 3 different research centers that worked with ARPA.



¹ "A History of the Internet and the Digital Future" (Johnny Ryan, Reaktion

ARPANET

- The first computers were connected via ARPANET (Advanced Research Projects Agency Network).
- The initial ARPANET consisted of 2 host computers which were connected at the start of 1969 (birth of the early Internet!) from the following locations:
 - UCLA
 - Stanford
- A standard protocol was used so the computers could communicate

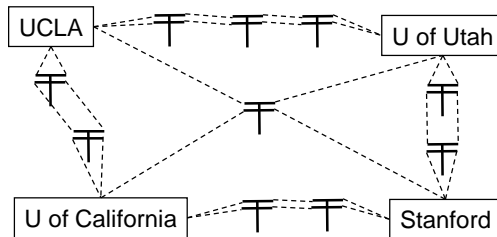


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ARPANET (2)

- Later additional hosts were added to the network (end of 1969) from:

- The University of California (Santa Barbara)
- The University of Utah



James Tam

The First Data Sent On The Internet¹

- Originally the message 'login' was to be transmitted.
- But the transmission stopped (i.e., it "died" after the first two characters).
 - ...and thus 'LO' the Internet was born!

¹ "On the Way to the Web" (Michael A. Banks, Wiley)

Important Milestones Of The Internet

- In 1972
 - The first "hot application" was introduced by Ray Tomlinson.
- 1989:
 - The ideas behind the World Wide Web were first described in a paper.
- 1990:
 - The ARPANET was shut down.
 - The first "Internet" search program Archie was developed at McGill university.
- 1991:
 - The World Wide Web was released to the public.



James Tam

The History Of The World Wide Web



From www.computerhistory.org (2012)

- Designed in 1989 by Tim Berners-Lee and scientists in Geneva who were interested in making it easier to share research documents.
- Documents could be linked through a protocol called http (hyper text transfer protocol).
- Documents were made available for free browsing and downloading from the web (*substantially* easier than the alternative).
- 1990:
 - The first web browser "WorldWideWeb" (later renamed 'Nexus'¹ was written.
- 1993:
 - Mark Andreessen of NCSA (National Center for Super Computing Applications) launched Mosaic X the first popular web browser.

Source <http://www.w3.org/People/Berners-Lee/WorldWideWeb.html>

James Tam

The History Of The World Wide Web (2)



From www.computerhistory.org

- Prior to the advent of the WWW the Internet was largely used by a niche user group.
- The advent of the WWW drastically changed that.
 - Now some people even equate the World-Wide-Web with the Internet itself!

James Tam

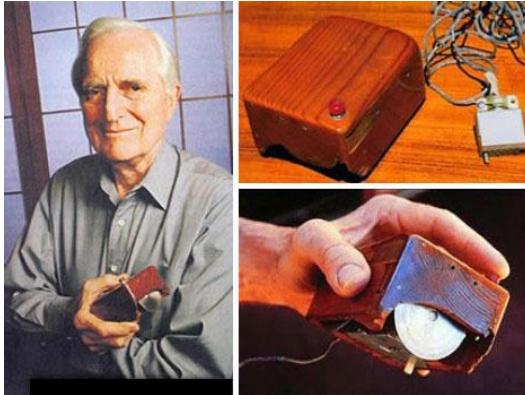
The Mouse

- 1962: ARPA (under JCR Licklider) provided a special fund to realize the vision of a “mechanically enhanced man”.
 - It came out of a paper published by Licklider (before he joined ARPA) where he “...forecast a future that will involve a very close coupling between the human and electronic members of the [human-technology] partnership.”¹
- Douglas Engelbart applied for funding.

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

The Mouse (2)

- Engelbart spent his time studying and experimenting with ways to improve communication between people and computers.
- 1967: he described (his most famous) invention, the mouse.



<http://gajitz.com>

You Should Now Know: History Part II

- When were the different categories of computers completed and what were some of their distinguishing features:
 - The computers of the electronic revolution
 - The first SPC (stored program computer)
- Who were the people who were involved in the creation of these machines.

James Tam

You Should Now Know: History Part III

- How the invention of the microprocessor revolutionized computing
- What was the first computer that was successfully 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
- How the rise of clone computers lead to the market dominance of Microsoft in the microcomputer market

James Tam

You Should Now Know: History Part III (2)

- What was the first GUI-driven computer: Xerox Star
- The early history of the Internet
 - When did it first become operational
 - How it works
 - What were some major milestones and when did they occur
 - When was the WWW invented and who was behind its creation
- Computer Mouse
 - Who invented the device
 - When was it invented
 - What was the motivation for its creation