

# 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

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## 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

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## Motivations For Developing The ABC

- Atanasoff was researching methods of solving complex mathematical equations.

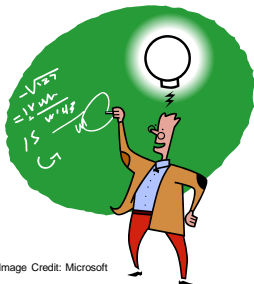


Image Credit: Microsoft

- 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

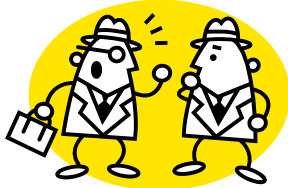


Image Credit: Microsoft

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## 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.



Image credit: Microsoft

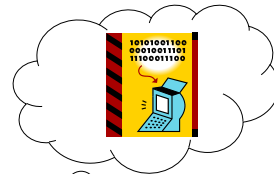
- After a particularly frustrating night he decided to take a break from the lab.



Image Credit: Microsoft



Image Credit: Microsoft



- This led to an astonishing breakthrough!



Wav file from "James Tam"

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## 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 (accessed Dec 2014)

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## 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)



Image Credit: Microsoft

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

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## The People Behind The ENIAC

- John Mauchly

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



From [www.computermuseum.li](http://www.computermuseum.li) (2012)

- J. Presper Eckert

- A lab instructor at the Moore School
- Designed the individual circuits of the ENIAC



Image © Michael Denning from [www.computerhistory.org](http://www.computerhistory.org) (2012)

- Joseph Chedaker

- Supervised the construction team

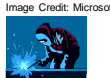


Image Credit: Microsoft

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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

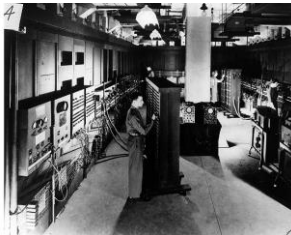


Image © University of Pennsylvania (2012)

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

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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.

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## 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



The enigma machines

Images credit: Microsoft

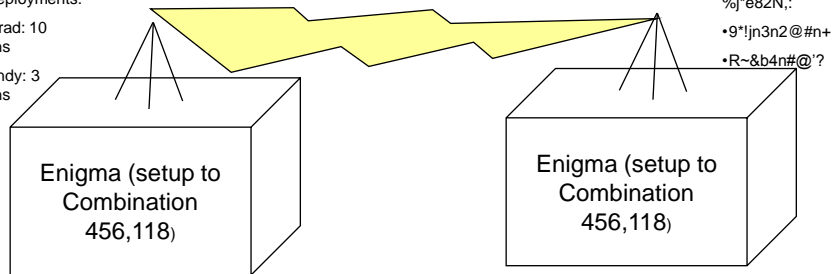
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## German Enigma Machines

- 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



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## An Enigma Machine



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

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## The British Code And Cipher School

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

### WHERE IS BLETCHLEY PARK?

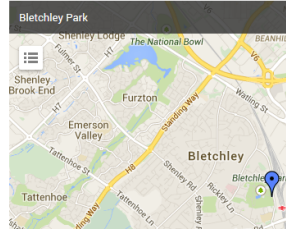
The full address is: **The Mansion, Bletchley Park, Sherwood Drive, Bletchley, Milton Keynes, MK3 6EB**

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



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## 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](http://www.computerhistory.org) (2012)

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

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## 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.

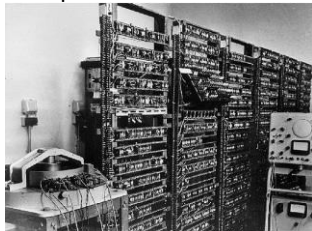


Image © University of Manchester from [www.computerhistory.org](http://www.computerhistory.org) (2012)

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## **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

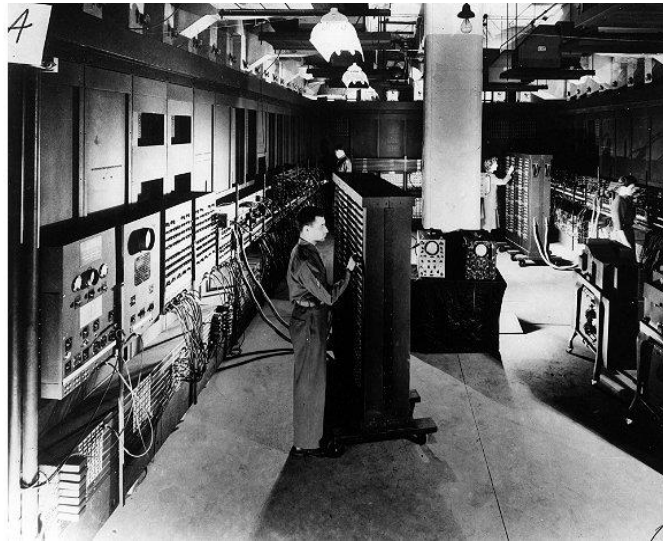
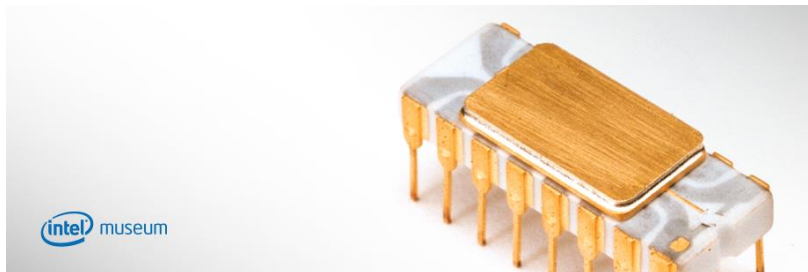


Image © University of Pennsylvania (2012)

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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](http://www.intel.com) (2012)

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## What Is A Microcomputer?

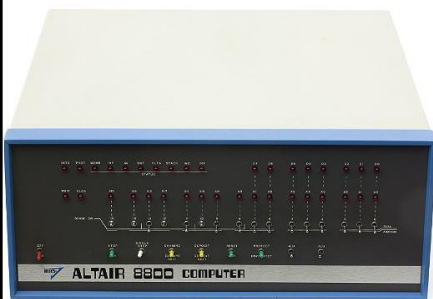
- Sometimes it's referred to as a 'PC' (Personal Computer)



Image courtesy of James Tam

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## The First Popular Computer For Home Users: The Altair



Images © Mark Richards from [www.computerhistory.org](http://www.computerhistory.org) (2012)

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

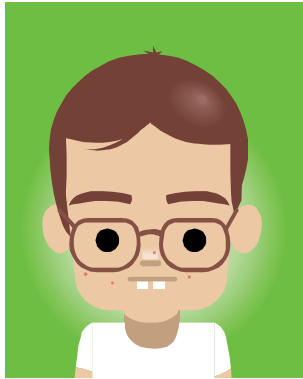
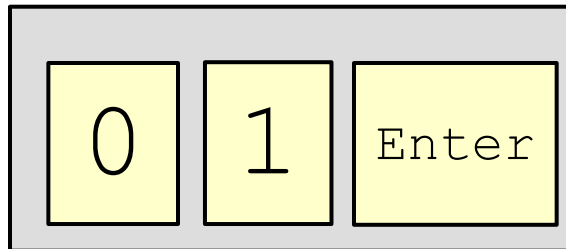


Image credit: Microsoft



The keyboard used by REAL programmers

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## Microsoft's Influence On Microcomputers

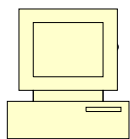
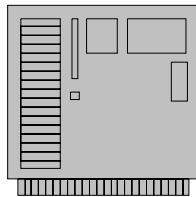


Image copyright unknown

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## 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.

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## 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

02/17/2007  06:34 PM  <DIR>  .
02/17/2007  06:34 PM  <DIR>  ..
11/04/2003  03:11 PM  <DIR>  .java
11/04/2003  03:11 PM  <DIR>  .javaws
01/20/2004  02:07 PM  <DIR>  .plugin141
01/20/2004  02:07 PM             710 .plugin141_02.trace
02/13/2003  11:16 PM             0 AdobeHes.log
02/07/2007  07:27 PM  2,592,068 cached-routers
02/08/2007  03:12 PM  12,216  cached-routers.new
02/24/2007  02:51 PM  <DIR>  cached-status
02/15/2003  04:01 PM  <DIR>  Contacts
02/25/2007  07:39 PM  <DIR>  Desktop
02/17/2007  05:36 PM  <DIR>  Favorites
02/13/2007  06:27 PM  <DIR>  gview32.ini
02/05/2007  11:17 AM  <DIR>  junk
02/13/2007  06:27 PM  <DIR>  My Documents
02/05/2007  11:17 AM  <DIR>  My pictures and videos
10/14/2003  12:06 AM  <DIR>  .log
10/10/2003  07:43 PM             24 presets.ini
02/12/2007  08:37 PM  <DIR>  RECENT
02/08/2007  02:24 PM  <DIR>  Start Menu
02/08/2007  02:24 PM             23 state
12/13/2003  07:03 AM  <DIR>  subtle_technologies.doc
12/13/2003  07:03 AM             4,131 t.
11/19/2003  01:38 PM  <DIR>  t.
02/23/2003  05:49 PM  <DIR>  VSWebCache
02/23/2003  05:49 PM  <DIR>  WINDOWS
02/12/2004  05:26 PM  <DIR>  zip utilities
02/19/2003  04:51 AM  502,744  on
02/19/2003  04:51 AM  306,446  e#
02/01/2003  04:11 PM  24,826  e#
12/27/2003  05:24 PM  4,131  U1
12/06/2003  07:30 AM             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

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## 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

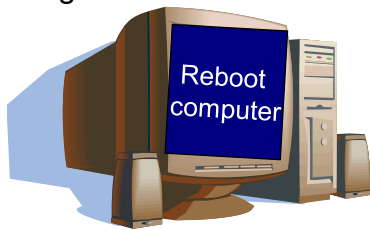


Image copyright unknown



Image Credit: Microsoft

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## 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

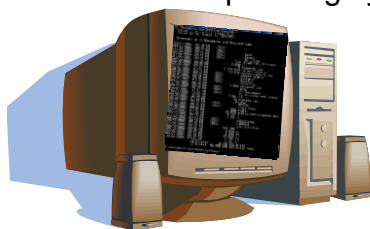


Image copyright unknown



Image Credit: Microsoft

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## The IBM PC (Personal Computer: 1981)



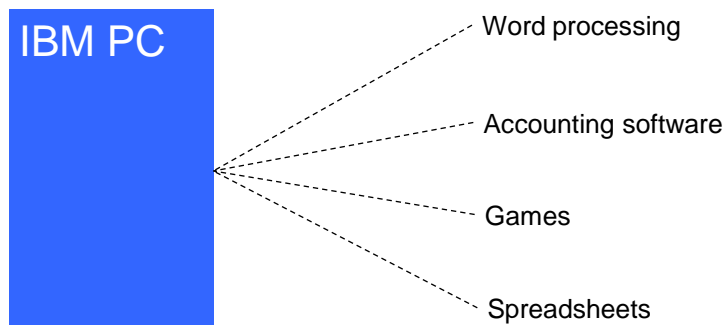
[www.computerhistory.org](http://www.computerhistory.org) (2012)

- 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.

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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.



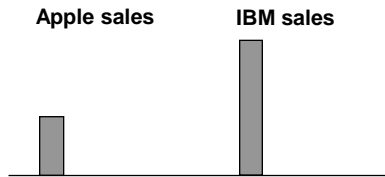
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## The IBM PC (Personal Computer: 1981): 3

- 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 the Apple in sales.



There were many other important microcomputer manufacturers (omitted for brevity)

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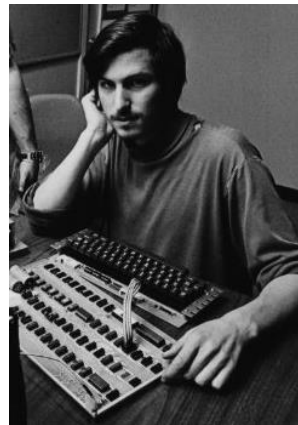
## The History Of Apple Computers: Steve And Steve

- 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](http://www.computerhistory.org) (2012)

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## The Apple I Computer (1976)



Extras

- It was far from the standard of a modern computer

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## 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 (2012)

Apple II:

[www.computerhistory.org](http://www.computerhistory.org)

Donkey Kong:

[www.donkeykong.gamepub.com](http://www.donkeykong.gamepub.com)

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## 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"*<sup>1</sup>

Images (2012)

Apple II:

[www.computerhistory.org](http://www.computerhistory.org)

Donkey Kong:

[www.donkeykong.gamepub.com](http://www.donkeykong.gamepub.com)

<sup>1</sup> "Just for Fun" (Chapters 2,3) by Torvalds and Diamond

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## 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](http://www.flickr.com/photos/mwichary) (2012)

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## The Apple Lisa (1983)



Image © Mark Richards from [www.computerhistory.org](http://www.computerhistory.org) (2012)

- 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)



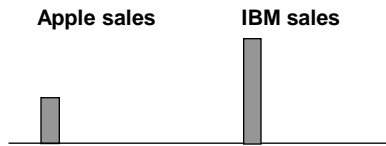
Image © Mark Richards from [www.computerhistory.org](http://www.computerhistory.org) (2012)

- 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

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## The Attack Of The Clones

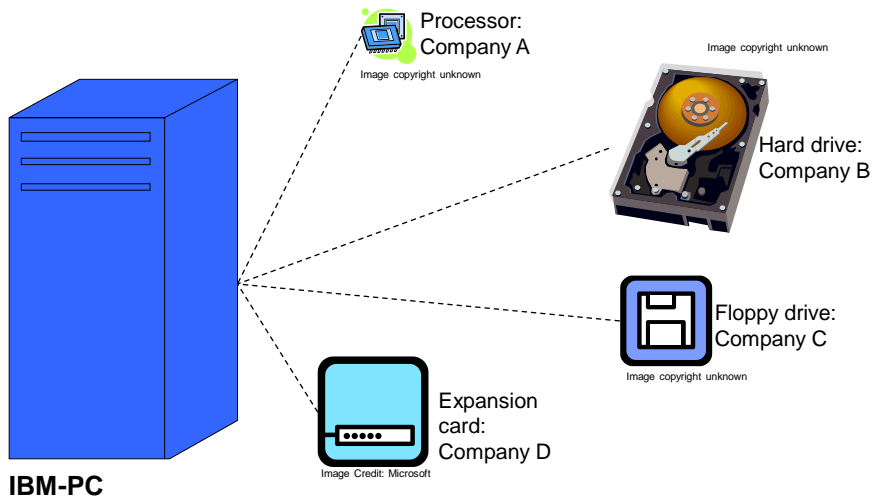
- Although it was a late entry into the microcomputer market IBM eventually dominated.



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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 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**

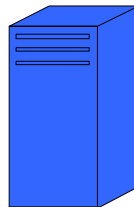
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### The Attack Of The Clones (4)

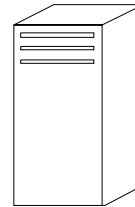
- This opened the flood gates for other computer manufacturers to produce their own clone computers.



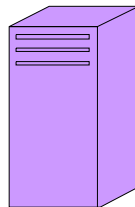
**Compaq clone**



**IBM-PC**



**Mom and pop shop clone**

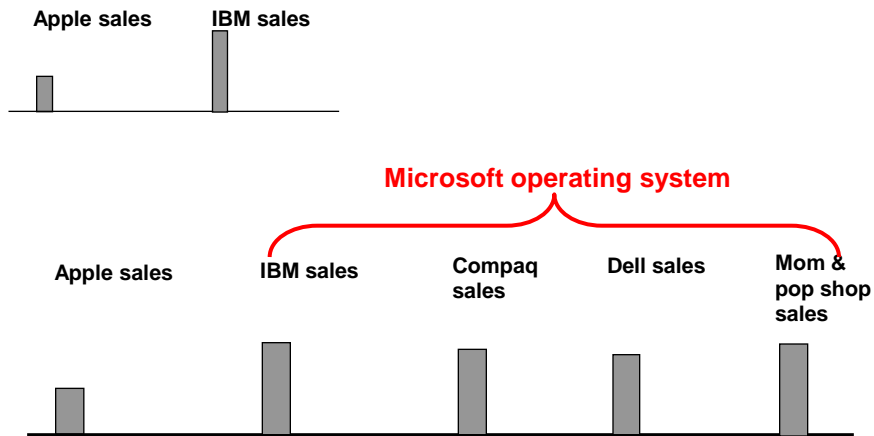


**Dell clone**

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## The Attack Of The Clones (5)

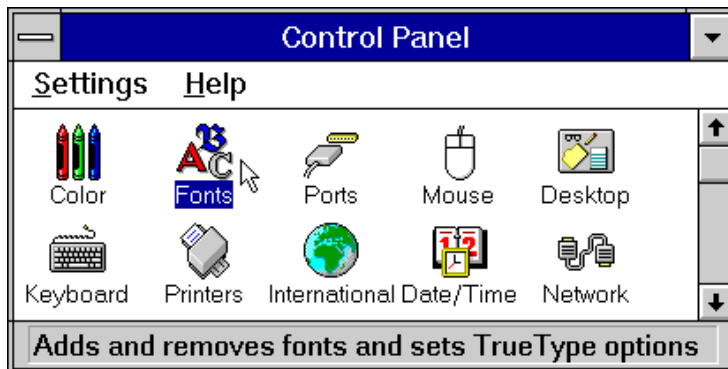
- The result was that IBM eventually lost control over the computer architecture that it was the first one to market.



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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 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](http://www.microsoft.com) (2012)

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## Origins Of The Internet

- What was happening in the 1950's



### **The Cold War**

Image Credit: Microsoft

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## 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).

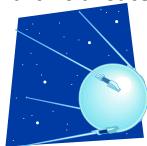


Image Credit: Microsoft

- 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 :(



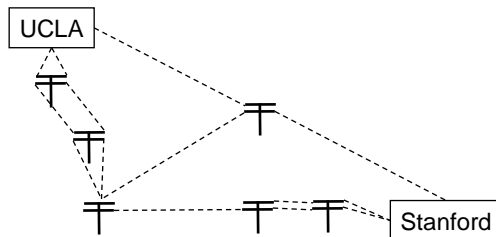
Image Credit: Alexander Chernov/ Virtual Space Museum/ NASA

## ARPA

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

## ARPANET

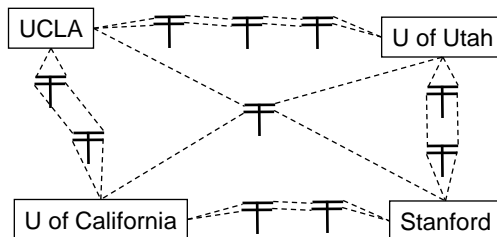
- The first computers were connected via ARPANET (Advanced Research Projects Agency Network).
- The initial ARPANET consisted of 2 host computers which were connected at the start of 1969 (birth of the early Internet!) from the following locations:
  - UCLA
  - Stanford
- A standard protocol was used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



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## The First Data Sent On The Internet<sup>1</sup>

- 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!

<sup>1</sup> "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.

Image Credit: Microsoft



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## The History Of The World Wide Web



From [www.computerhistory.org](http://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’<sup>1</sup> was written.
- 1993:
  - Mark Andreessen of NCSA (National Center for Super Computing Applications) launched Mosaic X the first popular web browser.

<sup>1</sup> <http://www.w3.org/People/Berners-Lee/WorldWideWeb.html>

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## The History Of The World Wide Web (2)



From [www.computerhistory.org](http://www.computerhistory.org) (2012)

- 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

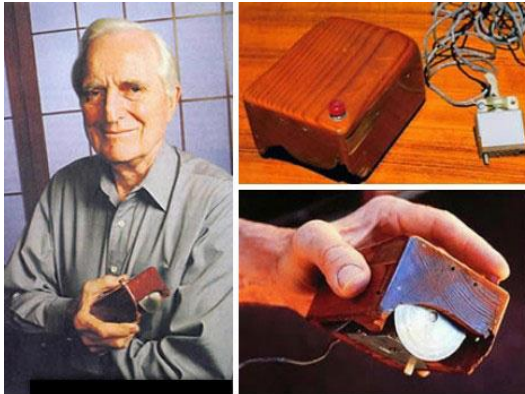
## The Mouse

- 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.”<sup>1</sup>
- Douglas Engelbart applied for funding.

<sup>1</sup> “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> (2012)

## **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