A Brief History of the Digital Revolution

by

Bob Walker

How much of our lives now involves or relates to the use of computer technology? In other words, how much of our lives is now digital? And how did this all happen?

We'll have a look in

"A Brief History of the Digital Revolution"

Back on Feb 11, 2015 I gave a presentation *"The History of Computing, Part One"*, which took us up to the beginning of the Personal Computer.

The intent at the time was that I'd give *"Part Two"* in the near future when we couldn't find a speaker.

The time has finally arrived, and a lot has happened since 2015!

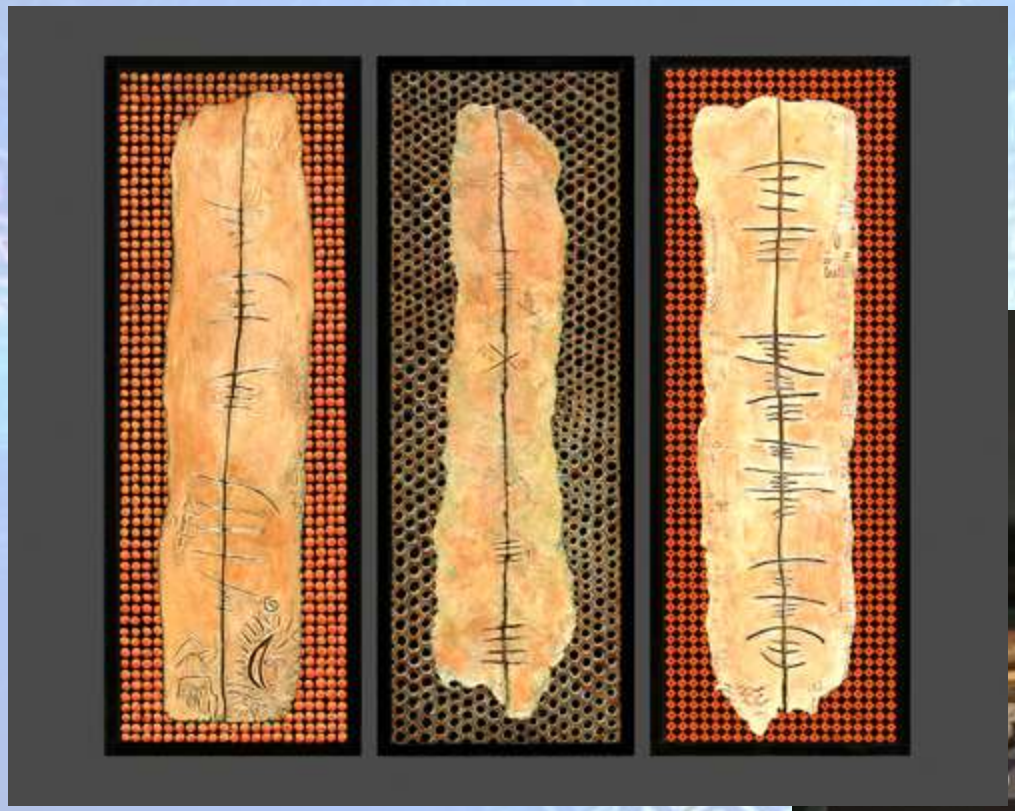
Let's do a quick review of:

What do an eighteenth century fabric maker, a nineteenth century countess and the twentieth century author of James Bond novels have in common? They are all figures in the

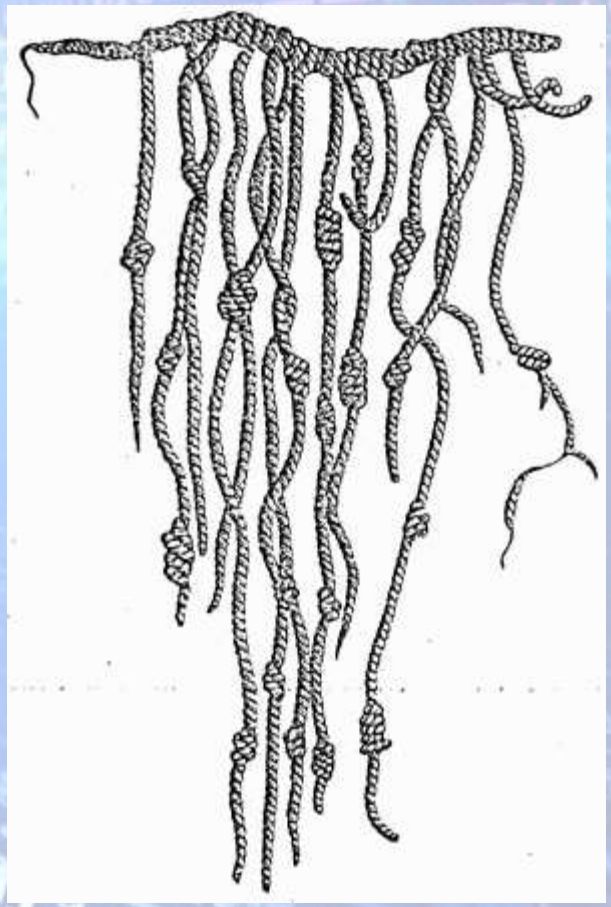
History of Computing Part One


The Beginning

Tally Sticks



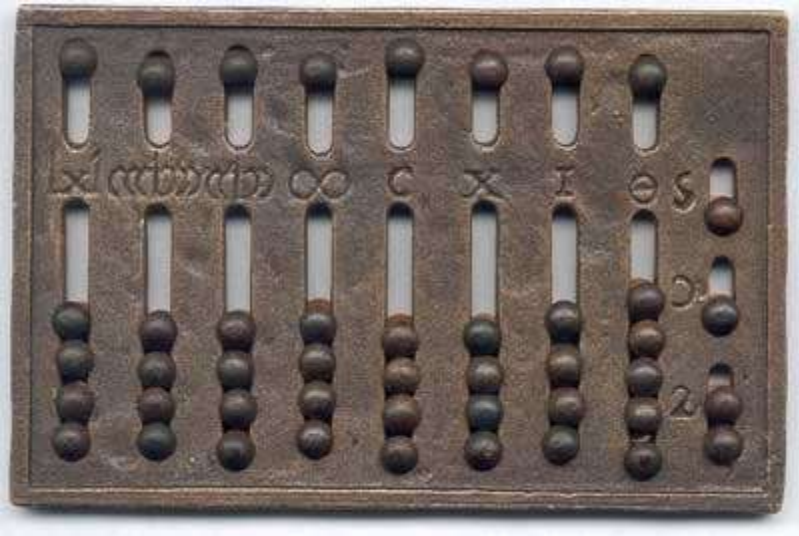
Quipu



Abacus

~2400BC - The first known calculator,

laid the foundations for positional notation (ones, tens, hundreds, etc.)

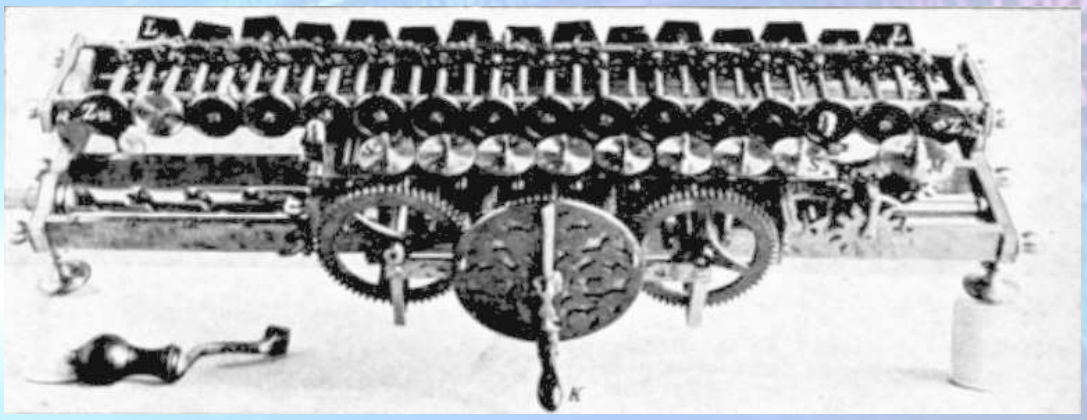


Developments in Mathematics

- c. 500 BC - First known use of zero
- c. 300 BC –Pingala first described the binary number system
- c. 100 BC - First known use of negative numbers

Mechanical Calculators

1670s - Gottfried Leibniz' "Stepped Reckoner" could multiply and divide, but wasn't reliable due to Leibniz' lack of engineering and mechanical skills.



1640s - Blaise Pascal's mechanical calculator could add and subtract.

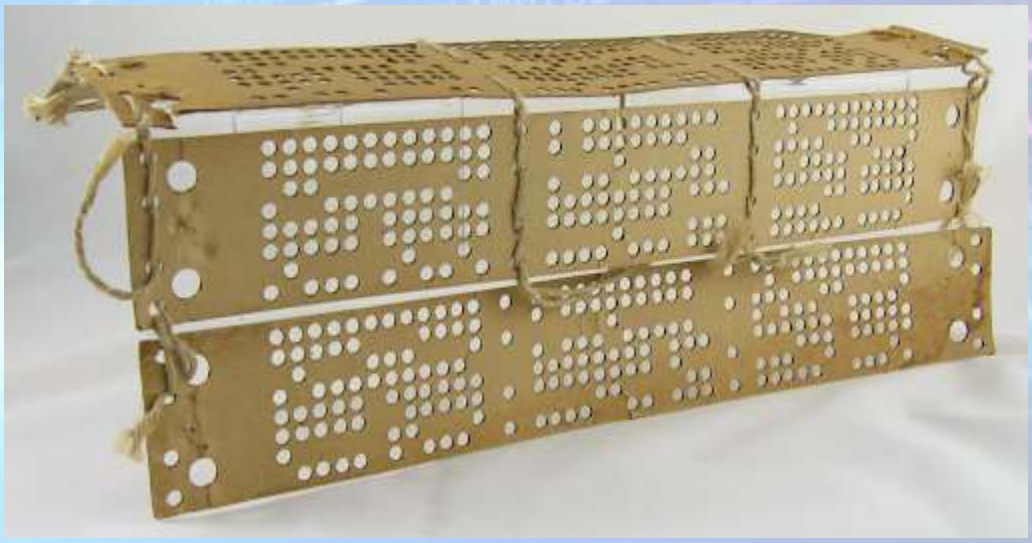
Jacquard Loom

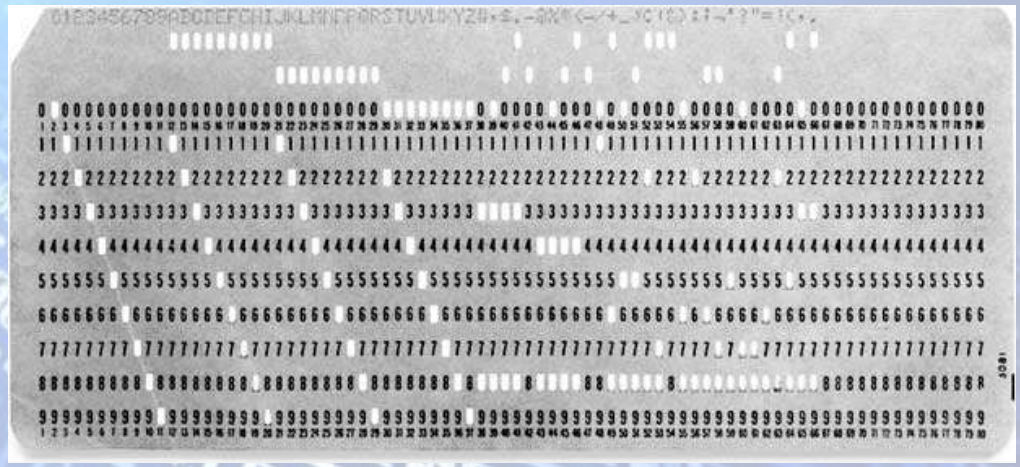
In the early 1800's Joseph-Marie Jacquard develops a mechanism to program weaving looms using punched cards.


Which brings us to Binary
0 1
OFF ON
01010111 01101001 01101011
01101001 01110000 01100101
01100100 01101001 01100001

Punched Cards

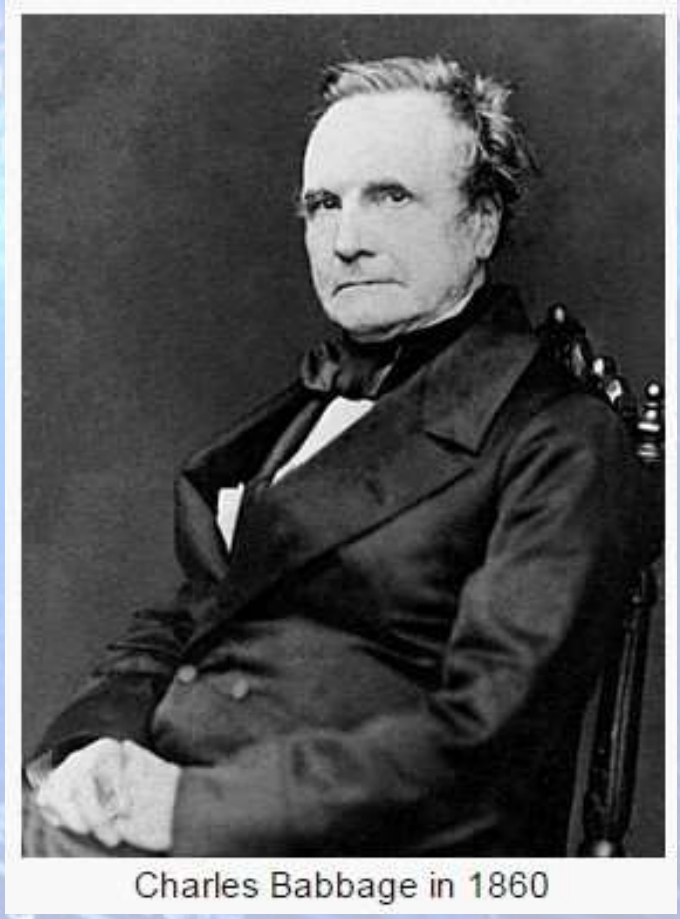
The holes and blanks in punched cards are essentially binary (on or off, 0 or 1) indicators





Charles Babbage

Charles Babbage (1791 – 1871) is best remembered for originating the concept of a programmable computer.



Charles Babbage in 1860

- **In 1834 Babbage conceived a general-purpose computer that could carry out a variety of different operations based on programming instructions given to it.**
- **It could perform one task, then be made to switch and perform another task.**
- **It could even tell itself to switch tasks, or alter its *"pattern of action,"* based on its own interim calculations.**

Babbage named this proposed machine the *'Analytical Engine'*. He was one hundred years ahead of his time.

In 1836, Babbage made a leap that would represent a milestone in the prehistory of computers:

"Suggested Jacquard's loom as a substitute for the drums."

Using punch cards rather than steel drums (i.e. music box type drums with pins) meant that an unlimited number of instructions could be input.

In addition, the sequence of tasks could be modified, thus making it easier to devise a general-purpose machine that was versatile and reprogrammable.

Few people, however, saw the beauty of Babbage's proposed new machine, and the British government had no inclination to fund it.

Babbage could generate little notice in either the popular press or scientific journals. But he did find one believer:

Ada Lovelace

Ada Lovelace

- **Augusta Ada King, Countess of Lovelace (1815 – 1852), born Augusta Ada Byron and now commonly known as Ada Lovelace, was the only legitimate child of the great poet Lord Byron.**
- **Byron separated from his wife a month after Ada was born and left England forever four months later.**

Ada King, Countess of Lovelace, 1840

- **Ada's mathematical talents led her to an ongoing working relationship and friendship with fellow British mathematician Charles Babbage, and in particular Babbage's work on the Analytical Engine.**
- **In 1842 she translated a report on Babbage's work. The report is the most important work describing the Analytical Engine. Babbage suggested she should add notes to the report.**
- **Ada Lovelace's now famous "Notes" were three times the length of the original report, and contained the first published computer program: Instructions on how to calculate the Bernoulli numbers.**

In her *"Notes"*, Ada explored four concepts that would have historical resonance later when the computer was finally born.

ONE

The first was the principle of a

GENERAL PURPOSE MACHINE

that could perform not only a preset task but instead could be programmed and re-programmed to do a limitless and changeable array of tasks.

"The Analytical Engine weaves algebraical patterns just as the Jacquard loom weaves flowers and leaves."

TWO

The all purpose machine did not need to be limited to math and numbers. She noted that a machine such as the Analytical Engine could store, manipulate, process, and act upon anything that could be expressed in symbols: words and logic and music and anything else we might use symbols to convey.

A computer operation, she noted, could alter the relationship not just between numbers but between any symbols that were logically related.

This makes the conceptual leap from machines that were mere calculators to ones that we now call computers.

THREE

She figured out in step-by-step detail the workings of what we now call a computer program or algorithm.

THREE (con't)

Ada helped to devise the concepts of:

- **Subroutines** (a sequence of instructions that performs a specific task, such as computing a cosine or calculating compound interest, and can be dropped into larger programs as needed)
- **Recursive Loops** (a sequence of instructions that repeats itself), and
- **Conditional Branching** (changing to a different path of instructions if certain conditions are met).

THREE (con't)

She created a table and diagram showing exactly how the algorithm would be fed into the computer, step by step, including two recursive loops.

It was a numbered list of coding instructions that included destination registers, operations, and commentary - something that would be familiar to any C + + programmer today.

It was mainly on the basis of this diagram that Ada has been accorded by her fans the accolade of *"the world's first computer programmer."*

FOUR

There was one other significant concept that she introduced in her "Notes," which harked back to the Frankenstein story produced by Mary Bysshe Shelley after a weekend with Ada's father Lord Byron.

It raised what is still the most fascinating metaphysical topic involving computers, that of artificial intelligence:

Can machines think?

FOUR (con't)

Can machines think?

Ada believed not. A machine such as Babbage's could perform operations as instructed, she asserted, but it could not come up with ideas or intentions of its own.

"The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform. It can follow analysis; but it has no power of anticipating any analytical relations or truths."

A century later this assertion would be dubbed

"Lady Lovelace's Objection"

by computer pioneer Alan Turing.

Ada Lovelace also developed a vision on the capability of computers to go beyond mere calculating or number-crunching, while others, including Babbage himself, focused only on those capabilities.

Her mind-set of *"poetical science"* led her to ask questions about the Analytical Engine examining how individuals and society relate to technology as a collaborative tool.

Ada Lovelace died at the age of 36 - the same age that her father had died at - from uterine cancer. She was buried, at her request, next to her famous father.

In 1979 the ADA Programming language was introduced by Jean Ichbiah and team at Honeywell for the US Department of Defense.

Herman Hollerith

Perfecting the use of punch cards for computers came about because Herman Hollerith, an employee of the U.S. Census Bureau, was appalled that it took close to eight years to manually tabulate the 1880 census. He resolved to automate the 1890 count.

Herman Hollerith

Using Hollerith's tabulators , the 1890 census was completed in one year rather than eight. It was the first major use of electrical circuits to process information.

Herman Hollerith

The company that Hollerith founded became in 1924, after a series of mergers and acquisitions, the International Business Machines Corporation, or IBM.

1937

New approaches , technologies, and theories began to emerge in 1937, exactly a hundred years after Babbage first published his paper on the Analytical Engine.

It would become an Annus Mirabilis (Year of Wonders) of the computer age.

The result would be the triumph of the '*Four Properties*' that would define modern computing

1937 and the ‘Four Properties’

- **DIGITAL (discrete vs continuous, digital instead of analog)**
- **BINARY (‘0’s and ‘1’s)**
- **ELECTRONIC (not mechanical)**
- **GENERAL PURPOSE**

War Mobilizes Science

World War II led to major computer development on both the Allied and German sides.

The Germans failed to utilize their computers in an effective way.

The British and Americans used theirs to win the war.

War Mobilizes Science

Practical applications for computers during WWII included artillery ballistics table calculation and most especially important, *ENEMY CODE BREAKING.*

For much more great information on this, see the presentation "Computers at War" that I gave on November 11 (Remembrance Day) 2020

Colossus

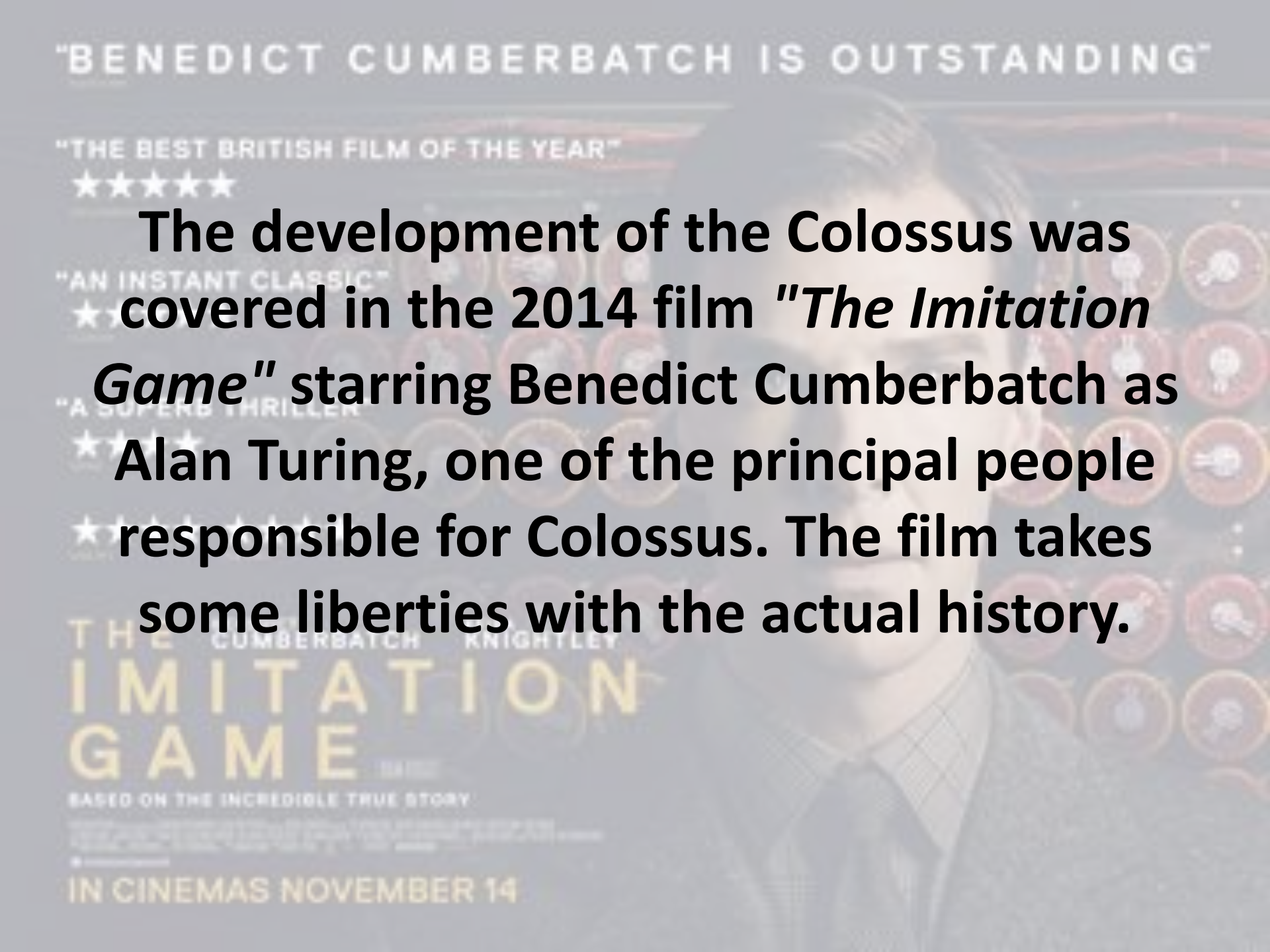
There were several major breakthroughs in computers and computing before, during and shortly after World War Two, but perhaps the biggest was the development of the Colossus computers by the British

Colossus

- Colossus was a set of computers developed in the years 1943-1945 to help in the cryptanalysis of the Enigma and Lorenz German ciphers.
- Colossus used vacuum tubes instead of electro-mechanical switches to perform its operations.
- Colossus is thus regarded as the world's first programmable, electronic, digital computer.

Colossus

- The prototype Colossus Mark 1 was working in December 1943 and was in use at Bletchley Park by early 1944. Several other Mark 1 and Mark 2's were built.
- Bletchley Park's use of these machines allowed the Allies to obtain a vast amount of high-level military intelligence from intercepted messages between the German High Command and their army commands and military units throughout occupied Europe.



The development of the Colossus was covered in the 2014 film *"The Imitation Game"* starring Benedict Cumberbatch as Alan Turing, one of the principal people responsible for Colossus. The film takes some liberties with the actual history.

Alan Turing

- **Alan Turing, OBE , FRS (1912 – 1954) was a British pioneering computer scientist, mathematician, logician, cryptanalyst, philosopher, mathematical biologist, and marathon and ultra distance runner.**
- **He was highly influential in the development of computer science, providing a formalization of the concepts of "algorithm" and "computation" with the Turing machine, which can be considered a model of a general purpose computer.**
- **Turing is widely considered to be the father of theoretical computer science and artificial intelligence (he disagreed with what he dubbed *"Lady Lovelace's Objection"* on Artificial Intelligence).**

The Turing Machine

A Turing Machine is a hypothetical device that manipulates symbols according to a table of rules. A Turing machine can be adapted to simulate the logic of any computer algorithm.

In essence, it can do anything that's computable.

Turing Complete

In computability theory, a system of data-manipulation rules (such as a computer's instruction set, a programming language, or a cellular automaton) is said to be Turing-complete or computationally universal if it can be used to simulate any Turing machine.

This means that this system is able to recognize or decide other data-manipulation rule sets.

Turing completeness is used as a way to express the power of such a data-manipulation rule set.

Virtually all programming languages today are Turing-complete.

The Turing Test

- **Turing addressed the problem of artificial intelligence, and proposed an experiment which became known as the ‘Turing Test’, an attempt to define a standard for a machine to be called ‘intelligent’.**
- **The idea was that a computer could be said to "think" if a human interrogator could not tell it apart, through conversation, from a human being.**
- **Turing suggested that rather than building a program to simulate the adult mind, it would be better rather to produce a simpler one to simulate a child's mind and then to subject it to a course of education.**

Alan Turing

- **Turing was prosecuted in 1952 for homosexual acts, when such behaviour was still criminalised in the UK.**
- **He accepted treatment with oestrogen injections (chemical castration) as an alternative to prison.**
- **Turing died in 1954, 16 days before his 42nd birthday, from cyanide poisoning. There is controversy as to whether it was an accident or suicide.**

The Post-War Era

- 1951 - J Lyons, a United Kingdom food company, famous for its tea, made history by running the first business application on an electronic computer, a payroll system.
- Most computers in the period after WW2 were used by corporations and government departments for data processing, with the rest being used for scientific research and by academia and the military.

IBM and the Seven Dwarves

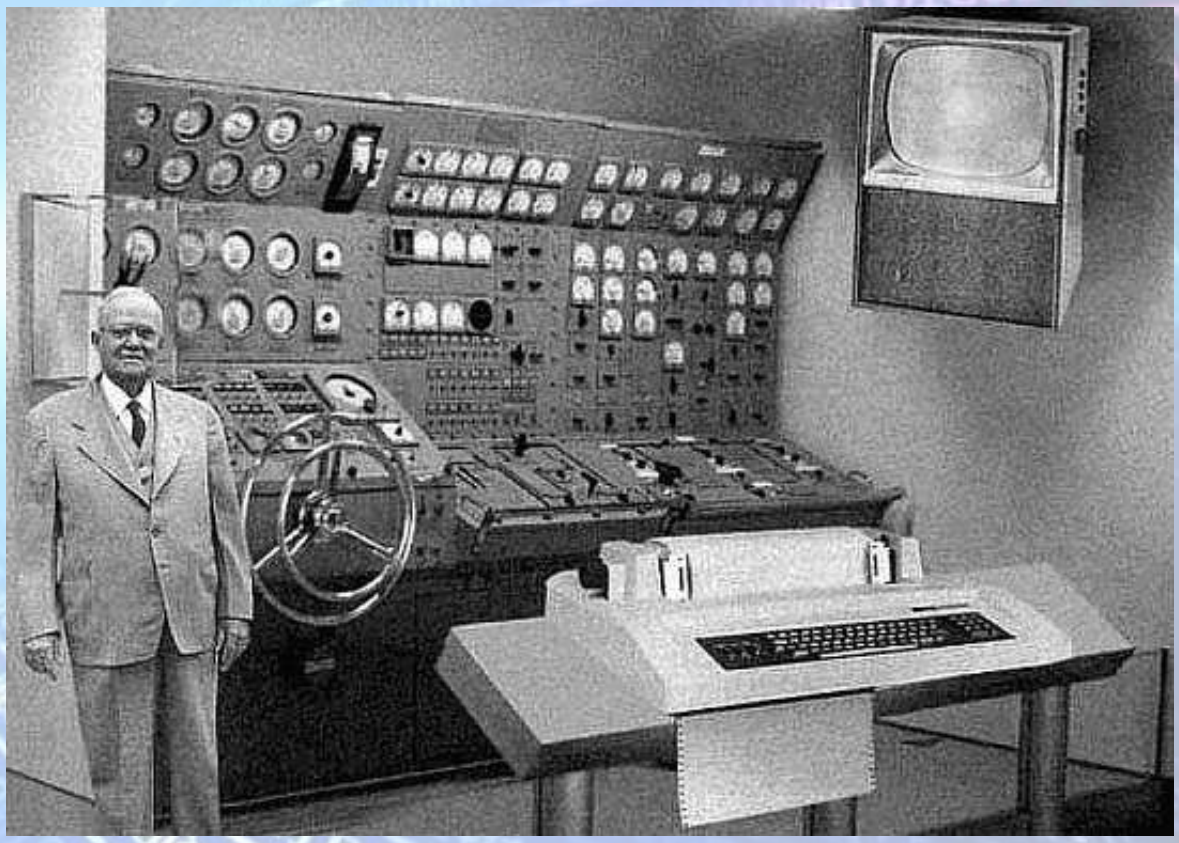
Through most of the 1960's IBM was one of the seven major United States computer companies with

- **Burroughs,**
- **Honeywell,**
- **NCR Corporation,**
- **Control Data Corporation (CDC),**
- **General Electric (GE),**
- **RCA and**
- **Sperry Rand (UNIVAC)**

IBM's share of the market at the time was so much larger than all of the others, that this group was often referred to as *"IBM and the Seven Dwarfs."*

The Home Computer of the Future?

In 1954 scientists from Rand Corp. created this model to illustrate how a 'Home Computer' might look 50 years in the future.



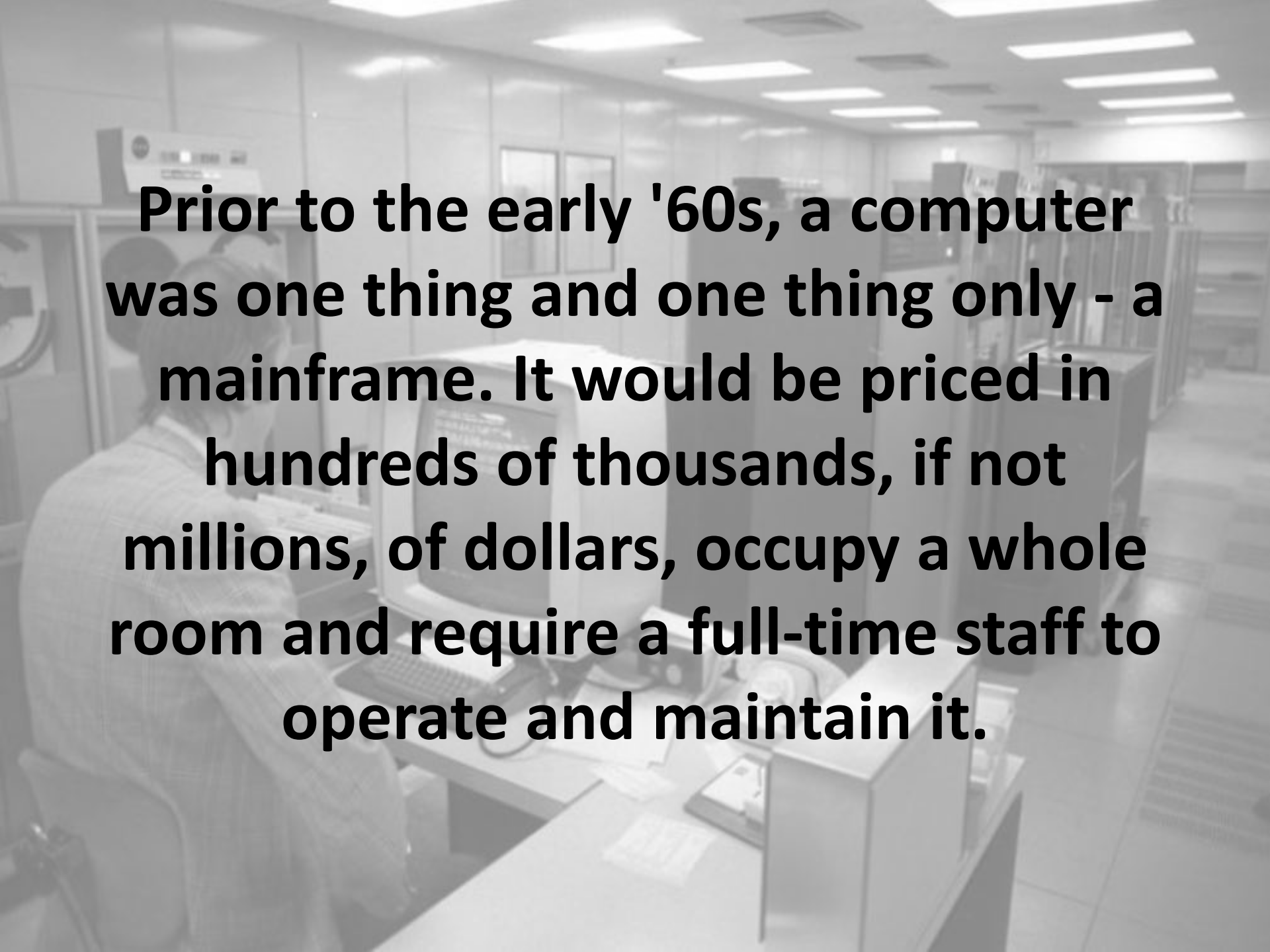
And that brings us to the end of

"The History of Computing, Part One"

and the start of the personal computer age and the beginnings of the Digital Revolution.

"Every new beginning comes from some other beginning's end"

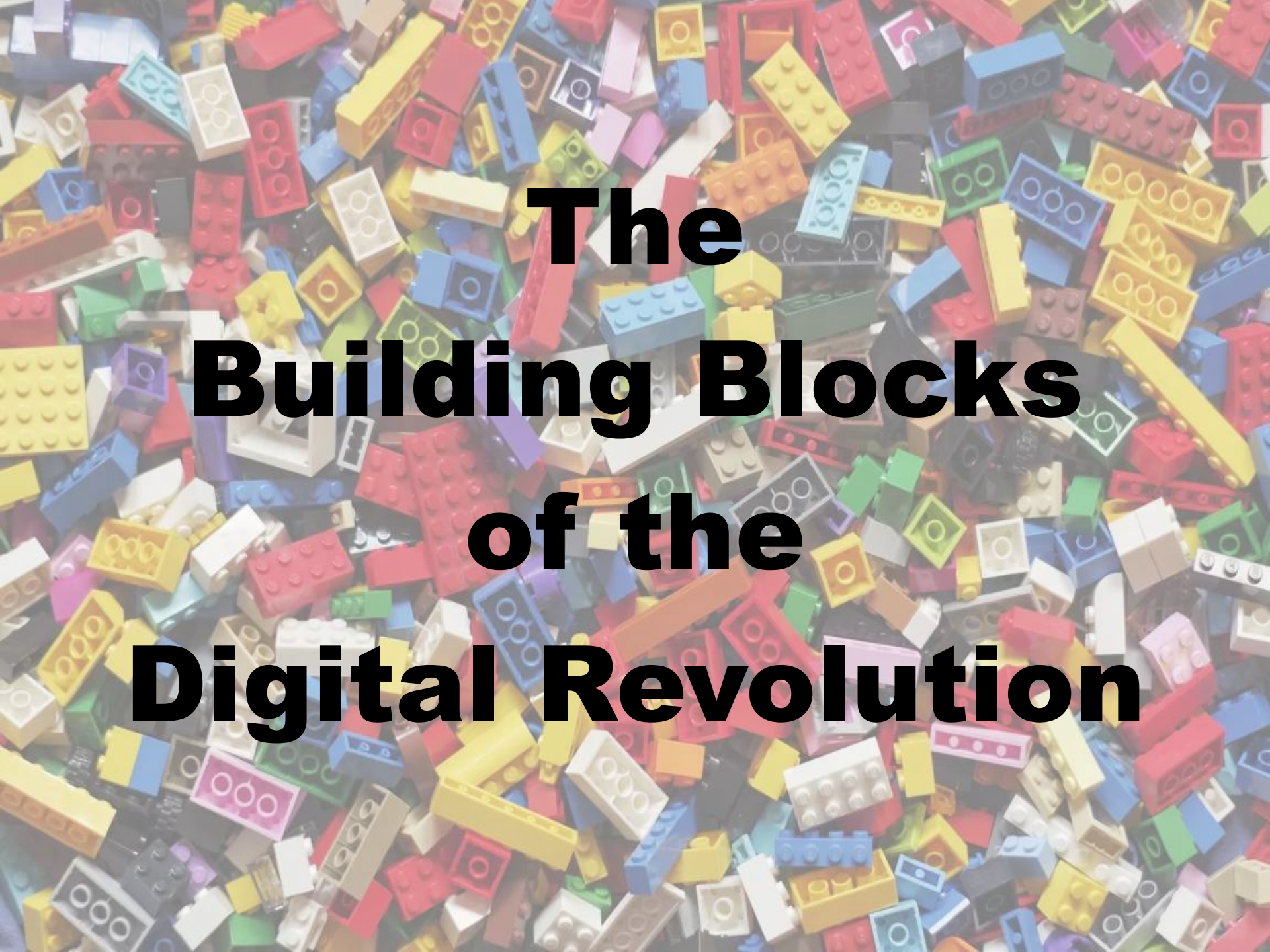
from the song 'Closing Time' by Semisonic and originally attributed to ancient Greek philosopher Seneca



Prior to the early '60s, a computer was one thing and one thing only - a mainframe. It would be priced in hundreds of thousands, if not millions, of dollars, occupy a whole room and require a full-time staff to operate and maintain it.

- In 1964 DEC launched the PDP- 8, which is generally considered the first commercially successful minicomputer.
- It was the size of a refrigerator, cost just $18,000 and over 50,000 were sold - more than any other computer before it.

For the first time, a computer could be owned by a single department, not a huge organisation, and it could be operated by people who weren't scientists.


The
Building Blocks
of the
Digital Revolution

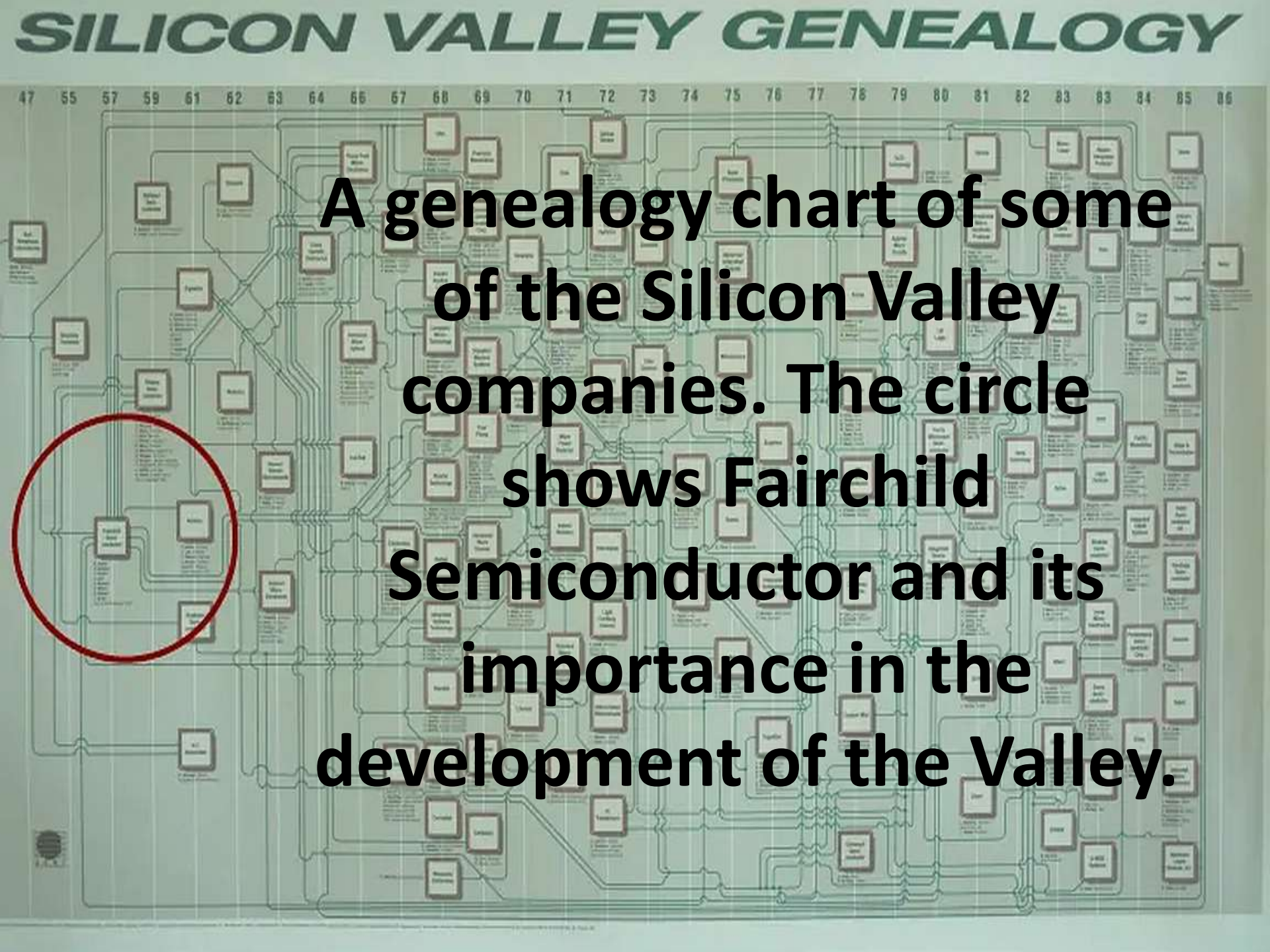
The Semiconductor Revolution

- **1947: The invention of the transistor at Bell Laboratories, USA, by William B. Shockley, John Bardeen and Walter Brattain. The three scientists were jointly awarded the 1956 Nobel Prize in Physics.**
- **1956 - In an attempt to commercialize a new transistor design, Shockley's founded Shockley Semiconductor Laboratory in 1956 in Mountain View, California. Although Shockley Semiconductor Laboratory closed in 1968, the site of the original building has a sign marking it as the *"Real Birthplace of Silicon Valley"*.**

The Semiconductor Revolution

- **1957 - A core group of Shockley employees, later known as the *"Traitorous Eight"*, became unhappy with his management of the company and left to found Fairchild Semiconductor.**
- **Many of the original Fairchild founders, otherwise known as the *"Fairchildren"*, left Fairchild in the 1960s to form companies that grew to prominence in the 1970s. Robert Noyce and Gordon Moore (Intel) were among the last of the original founders to leave.**
- **A Fairchild advertisement of the time showed a collage of the logos of Silicon Valley with the annotation *"We started it all"*. It was later, in 1971, that Don Hoefler popularized the name *"Silicon Valley USA"* in Electronic News.**

FAIRCHILD
SEMICONDUCTOR®


SILICON VALLEY GENEALOGY
47 55 57 59 61 62 63 64 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 83 84 85 86
A genealogy chart of some of the Silicon Valley companies. The circle shows Fairchild Semiconductor and its importance in the development of the Valley.

The Semiconductor Revolution

- **1958 - Jack Kilby and Robert Noyce while working at Texas Instruments unveil the integrated circuit, also known as the computer chip. Kilby was awarded the Nobel Prize in Physics in 2000 for his work.**
- **1968 - Intel is founded in Mountain View, California by Fairchild alumni Gordon Moore (known for *"Moore's Law"*) and Robert Noyce.**
- **1970 - Intel unveils the Intel 1103, the first Dynamic Access Memory (DRAM) chip.**
- **1971 - Intel releases the Intel 4004, the first single-chip microprocessor, and laid the foundations for the microcomputer revolution that began in the 1970s.**

Moore's Law

"The number of transistors on a microchip doubles every two years, though the cost is halved."

- Gordon Moore, co-founder of Fairchild Semiconductor and Intel (and former CEO of the latter)

Texas Instruments

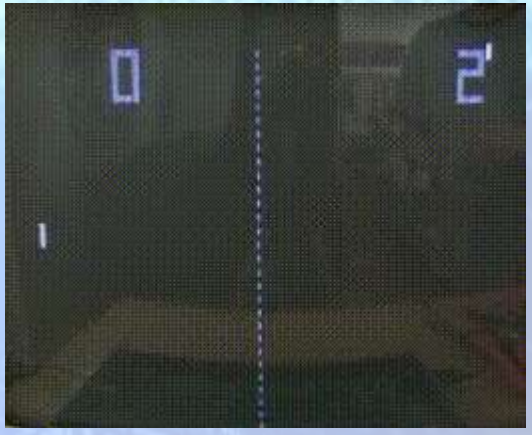
- Texas Instruments emerged in 1951 after a reorganization of Geophysical Service Incorporated, a company founded in 1930 that manufactured equipment for use in the seismic industry, as well as defense electronics.
- TI produced the world's first commercial silicon transistor in 1954, and the same year designed and manufactured the first transistor radio.

Texas Instruments

- Jack Kilby and Robert Noyce invented the integrated circuit in 1958 while working at TI's Central Research Labs.
- TI invented the hand-held calculator in 1967. They cost over $100 if you could get one.
- Within 5 years hand-held calculators were available for under $10.

GAMES

- 1962 – Hackers at MIT create the Spacewar computer game
- 1972 – Atari introduces the arcade version of Pong
- 1975 – Atari introduces a home version of Pong to be sold through Sears



Digital Cameras

- Work in the 1960's and early 1970's, primarily at Bell Labs, using mostly CMOS technology leads to the development of digital image sensors.

- The Cromemco Cyclops was an all-digital camera introduced in 1975. Its design was published as a hobbyist construction project in the February 1975 issue of Popular Electronics magazine. It used a 32×32 metal-oxide-semiconductor (MOS) image sensor,

Digital Cameras

- In 1975 Steven Sasson at Eastman Kodak invented and built a self-contained electronic camera that used a charge-coupled device (CCD) image sensor.
- In 1989, Fujifilm released the FUJIX DS-X, the first fully digital camera to be commercially released.
- The first mass-market camera phone was the J-SH04, a Sharp J-Phone model sold in Japan in November 2000. It could instantly transmit pictures via cell phone telecommunication.
- By the mid-2000s, most higher-end cell phones had an integrated digital camera. By the beginning of the 2010s, almost all smartphones had an integrated digital camera.

Digital Cameras

Digital cameras, both still and video, quickly replaced film cameras, whether they were stand-alone digital cameras or built-in to devices like cell phones, smartphones and tablets.

Doug Engelbart

Doug Engelbart is best known for his work on founding the field of human-computer interaction, which resulted in creation of the computer mouse, and the development of hypertext, networked computers, and the precursors to graphical user interfaces.

The first mouse prototype, 1964

Doug Engelbart

These were demonstrated at what has become known as *"The Mother of All Demos"* in 1968 for ACM/IEEE*. This live presentation essentially demonstrated almost all the fundamental elements of modern personal computing: windows, hypertext, graphics, efficient navigation and command input, video conferencing, the computer mouse, word processing, dynamic file linking, revision control, and a collaborative real-time editor.

*** - the Association for Computing Machinery / Institute of Electrical and Electronics Engineers**

Doug Engelbart

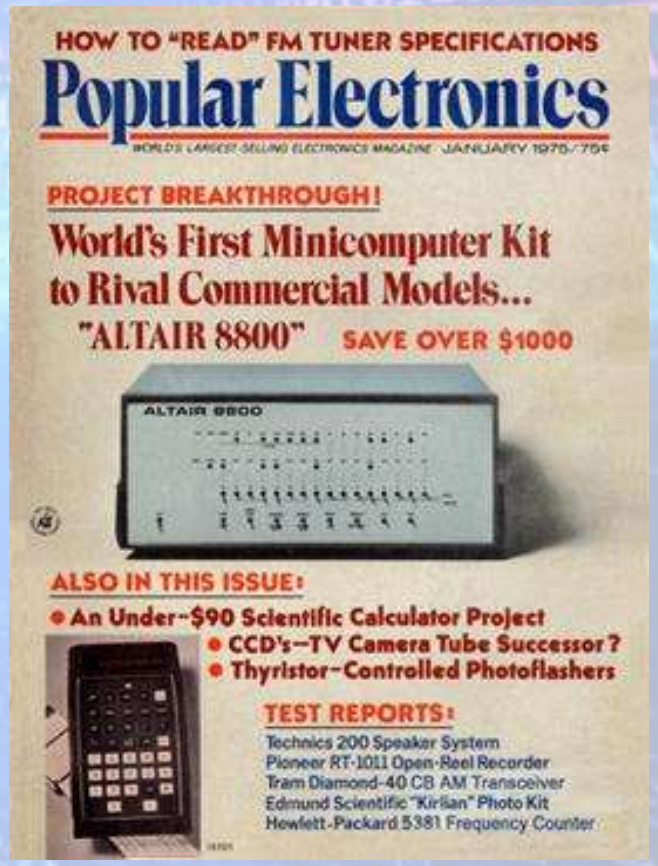
The underlying technologies developed by Doug Engelbart and his team at SRI* influenced both the Apple Macintosh and Microsoft Windows graphical user interface operating systems in the 1980s and 1990s.

In December 2000, United States President Bill Clinton awarded Engelbart the National Medal of Technology, the U.S.'s highest technology award. In December 2008, Engelbart was honored by SRI at the 40th anniversary of the "Mother of All Demos".

*** - SRI (Stanford Reasearch Institute) nonprofit scientific research institute headquartered in Menlo Park, California.**

The Altair 8800

The Altair 8800 microcomputer by MITS and based on the Intel 8080 CPU is featured on the cover of the January 1975 issue of Popular Electronics and was sold by mail order through advertisements there, in Radio-Electronics, and in other hobbyist magazines.



The MITS Altair is widely recognized as the spark that ignited the microcomputer revolution as the first commercially successful personal computer.

The Altair 8800

- The computer bus designed for the Altair was to become a de facto standard in the form of the S-100 bus, and was later used in the IBM PC.
- The first programming language for the machine was Microsoft's founding product, Altair BASIC.

The Homebrew Computer Club

- **The Homebrew Computer Club was an early computer hobbyist group in Menlo Park, California, which met from March 1975 to December 1986. The club played an influential role in the development of the microcomputer revolution and the rise of that aspect of the Silicon Valley information technology industrial complex.**
- **Several high-profile hackers and computer entrepreneurs emerged from its ranks, including Steve Jobs and Steve Wozniak, the founders of Apple Computer, and Adam Osborne (Osborne Computer).**
- **With its newsletter and monthly meetings promoting an open exchange of ideas, the club has been described as *"the crucible for an entire industry"* as it pertains to personal computing.**

OPCUG

- April 1982 – The Ottawa IBM PC Users Group is founded with 20 charter members
- September 1984 – The first issue of the OPCUG newsletter
- Nov 1987 – OPCUG hosts its first Swap Meet
- Oct 1988 – The Pub BBS opens for business. The AT Clone, 640K memory, 1.2MB floppy, Hercules card and monitor, 72MB hard drive, Digiboard with 4 channels serial interface and three 2400 modems cost about $10 000.

BBS’s

- A handful of microcomputer based BBS's (Bulletin Board Systems) started springing up in the late 1970's, but their popularity exploded as more and more personal computers came into use in the early to mid 1980’s.
- These were primarily dial-up based services, and once logged in, the user could perform functions such as uploading and downloading software and data, reading news and bulletins, and exchanging messages with other users through public message boards and sometimes via direct text chatting. In the early 1980s, message networks such as FidoNet were developed to provide services such as NetMail, which is similar to internet-based email.
- Many BBS's also offer online games in which users can compete with each other. BBS's with multiple phone lines often provided chat rooms, allowing users to interact with each other.
- InfoWorld estimated that there were 60,000 BBS's serving 17 million users in the United States alone in 1994. The introduction of inexpensive dial-up internet service and the Mosaic web browser offered ease of use and global access that BBS's did not provide, and led to a rapid crash in the market starting in 1994.

Bulletin board systems were in many ways a predecessor to today's social networks.

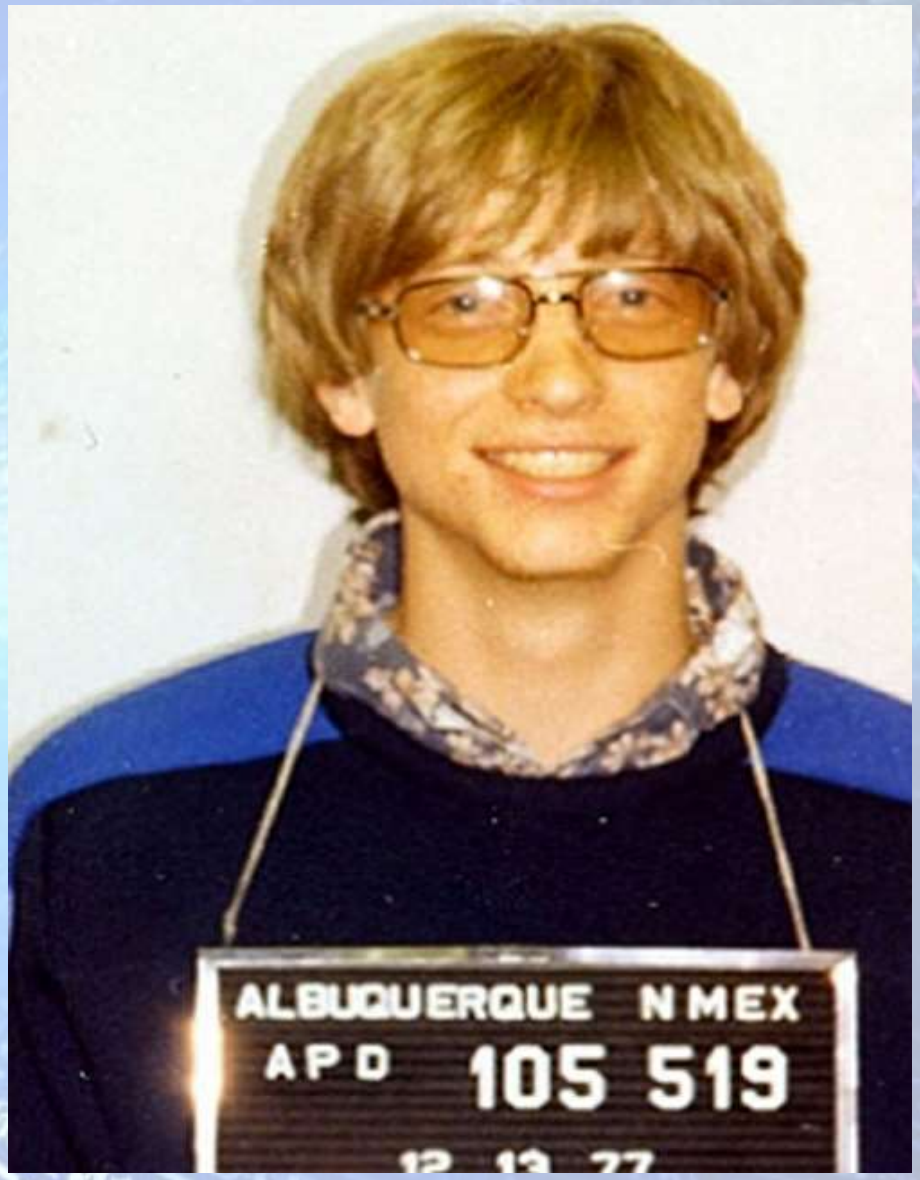
Computer Service Providers

- **Computer Service Providers such as CompuServe, Prodigy, America Online and The Source developed at about the same time as BBS's. Some started out as commercial service providers in the 1970's and started up consumer versions with the growth of personal computers in the 1980's.**
- **They offered chat systems, message forums covering a variety of topics, extensive software libraries for most computer platforms, a series of popular online games and other services.**
- **Early versions were dial-up, but unlike BBS's they survived the transition to the Internet in the late 1980's and early 1990's before losing much of their popularity in the late 1990's.**
- **In their advertising, The Source claimed:**

"It's not hardware. It's not software. But it can take your personal computer anywhere in the world."

The early world of Personal Computers was mostly hobbyists, who freely exchanged schematics, software and other information.

One important exception to this was Bill Gates, who saw the Personal Computer as the way to make his fortune.



Actual mugshot of Gates after an arrest for speeding in 1977

The Founding of Microsoft

When Paul Allen saw the January 1975 Popular Electronics cover with the Altair on it, he was both exhilarated and dismayed. Although thrilled that the era of the personal computer had arrived, he was afraid that he was going to miss the party. He showed to his good buddy Bill Gates, and declared:

"Hey, this thing is happening without us."

Gates realized that Allen was right. For the next eight weeks, the two of them embarked on a frenzy of code writing that would change the nature of the computer business. They wrote 'Altair BASIC', a version of the BASIC computer programming language, and formed Microsoft in 1975.

The Founding of Microsoft

What Gates and Allen set out to do on that December day in 1974 when they first saw the Popular Electronics cover was to create the software for personal computers.

More than that, they wanted to shift the balance in the emerging industry so that the hardware would become an interchangeable commodity, while those who created the operating system and application software would capture most of the profits.

"When Paul showed me that magazine, there was no such thing as a software industry," **Gates recalled.** ***"We had the insight that you could create one. And we did."***

Years later, reflecting on his innovations, he said,

"That was the most important idea that I ever had."

The Founding of Microsoft

Microsoft agreed to license the Altair BASIC software to MITS for ten years, to be bundled with each Altair, for $30 in royalty per copy. Gates was able to win two provisions that would be historically significant:

(1) He insisted that he and Allen would retain ownership of the software; MITS would merely have rights to license it.

(2) He also required that MITS use its 'best efforts' to sublicense the software to other computer makers, splitting the revenues with Gates and Allen.

It set a precedent for the deal Gates would make six years later with IBM.

"We were able to make sure our software worked on many types of machines,"* he said. *"That allowed us and not the hardware makers to define the market."

Mass-market, Ready-Assembled PC's

- The first successfully mass-marketed personal computer was the Commodore PET in January 1977. Three months later (April), the Apple II (usually referred to as the "Apple") was announced with the first units being shipped 10 June 1977, and the TRS-80 from Tandy Corporation / Tandy Radio Shack following in August 1977, which sold over 100,000 units during its lifetime.
- Together, these 3 machines were referred to as the "1977 trinity". Mass-market, ready-assembled computers had arrived, and allowed a wider range of people to use computers, focusing more on software applications and less on development of the processor hardware.

The Commodore PET, the Apple II, and the TRS-80 Model I.

Xerox PARC

Xerox PARC (Palo Alto Research Center) has been the inventor and incubator of many elements of modern computing:

- **Laser printers,**
- **Computer-generated bitmap graphics**
- **The Graphical user interface, featuring windows and icons, operated with a mouse**
- **The WYSIWYG text editor**
- **Liquid Crystal Displays (LCD's)**
- **Interpress, a resolution-independent graphical page-description language and the precursor to PostScript**
- **Ethernet as a local-area computer network**
- **Fully formed object-oriented programming in the Smalltalk programming language and integrated development environment.**
- **Model–view–controller software architecture**

Xerox PARC

After basically inventing the modern personal computer in the 1970's, Xerox has been heavily criticized (particularly by business historians) for failing to properly commercialize and profitably exploit PARC's innovations.

A number of PARC engineers left to join Apple Computer, where they were instrumental in the development of the Apple LISA and MacIntosh computers.

In 2002, Xerox spun off their Palo Alto Research Center into PARC (Palo Alto Research Center Incorporated), dedicated to developing and maturing advances in science and business concepts with the support of commercial partners and clients.

Microsoft, IBM and MS-DOS

During the 1970s IBM dominated the mainframe market with its 360 series. But it was beaten by DEC and Wang in the market for refrigerator-size minicomputers, and it looked like it might be left behind in personal computers as well.

"IBM bringing out a personal computer would be like teaching an elephant to tap dance“

With a one-year deadline, IBM knew they would have to license software from outside vendors rather than have it written in-house. So in July 1980, they placed a call to Bill Gates and reached an agreement to license all of Microsoft's software products, including MS BASIC.

Microsoft, IBM and MS-DOS

There was one essential piece of software, in addition to these programming languages, that IBM was missing. It needed an operating system, the software program that would serve as the foundation for all of the other programs.

An operating system handles the basic instructions that other software uses, including such chores as deciding where data should be stored, how memory and processing resources should be allocated, and how applications software interacts with the computer's hardware.

Microsoft, IBM and MS-DOS

Microsoft did not yet make an operating system. It was instead working with one called CP/M (for Control Program for Microcomputers) that was owned by Gary Kildall, a childhood friend of Gates.

When Gates sent IBM Kildall's way, Kildall flipped them off. Thus Kildall's little company had just blown its HUGE chance to become the dominant player in computer software.

Microsoft, IBM and MS-DOS

Fortunately, Paul Allen knew someone in Seattle who could help: Tim Paterson, who worked for a small firm called Seattle Computer Products. A few months earlier Paterson had become frustrated that Kildall's CP/M was not yet available for Intel's newest microprocessors, so he adapted it into an operating system that he dubbed QDOS, for 'Quick and Dirty Operating System'.

By then Gates had come to the realization that one operating system, most likely the one chosen by IBM, would end up being the standard operating system that most personal computers would use. He also figured out that whoever owned that operating system would be in the catbird seat. So instead of sending the IBM folks to see Paterson, Gates and his team went themselves.

Microsoft, IBM and MS-DOS

Microsoft bought Paterson's software outright, without telling him why. *"We ended up working out a deal to buy the operating system from him, for whatever usage we wanted, for fifty thousand dollars,"* Allen recalled.

For that pittance Microsoft acquired the software that, after they spruced it up, would allow it to dominate the software industry for more than three decades.

Microsoft's 1980 revenues were $7.5 million, compared to IBM's $30 billion, but Gates was gunning for an agreement that would allow Microsoft to keep ownership of an operating system that IBM would turn into a global standard.

Microsoft, IBM and MS-DOS

After a month of back-and-forth, a thirty-two-page deal was struck in early November 1980. Gates declared *"We didn't get paid that much. The total was something like $186,000."* At least initially. But it had the two provisions that Gates knew would alter the balance of power in the computer industry.

Microsoft, IBM and MS-DOS

The first was that IBM's license to use the operating system, which it would call PC-DOS, would be nonexclusive. Gates could license the same operating system to other personal computer makers under the name MS-DOS.

Second, Microsoft would keep control of the source code. This meant that IBM couldn't modify or evolve the software into something that became proprietary to its machines. Only Microsoft could make changes, and then it could license each new version to any company it wanted.

"We knew there were going to be clones of the IBM PC," **Gates said.** ***"We structured that original contract to allow them. It was a key point in our negotiations."***

Microsoft, IBM and MS-DOS

The deal was similar to the one Gates had made with MITS, when he retained the right to license BASIC to other computer makers as well.

That approach allowed Microsoft's BASIC and then, more important, its operating system to become an industry standard, one that Microsoft controlled.

The IBM PC

August 12, 1981 - The IBM Personal Computer is released, and forms the basis for the IBM PC compatible de facto standard.

IBM Personal Computer with keyboard and monitor

The machine was based on open architecture, and a substantial market of third-party peripherals, expansion cards and software grew up rapidly to support it.

The IBM PC

The PC had a substantial influence on the personal computer market. The specifications of the IBM PC became one of the most popular computer design standards in the world, and the only significant competition it faced from a non-compatible platform throughout the 1980s was from the Apple Macintosh product line.

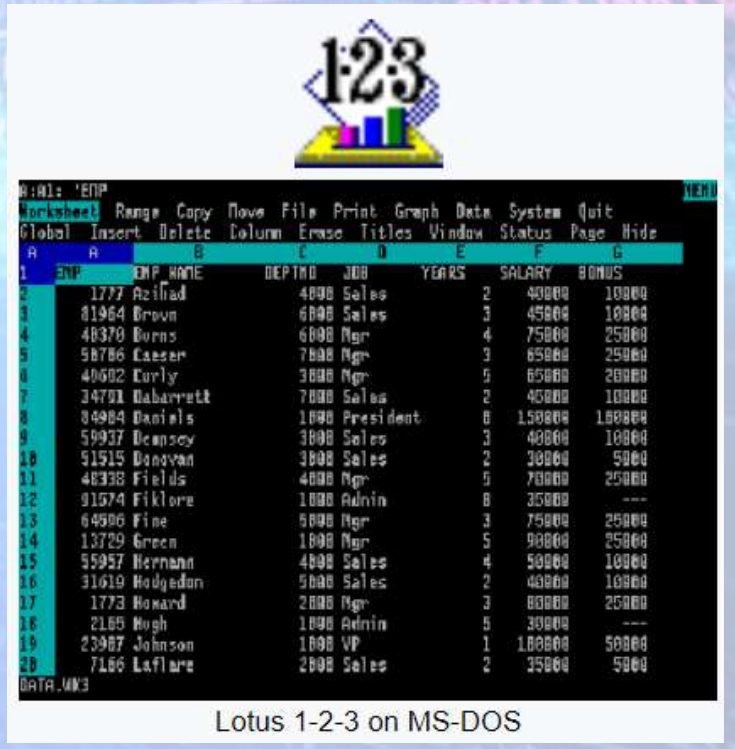
The majority of modern personal computers are distant descendants of the IBM PC.

In 2005 IBM sold off their PC business to Lenovo (the elephant stopped tap dancing)

Lotus 1-2-3

January 1983 - Lotus Software releases the Lotus 1-2-3 spreadsheet program.

It was the first killer application for the IBM PC, and was hugely popular in the 1980s. It significantly contributed to the success of IBM PC-compatibles.



Lotus 1-2-3 on MS-DOS

Windows Software Takes Over

Lotus 1-2-3 was the spreadsheet standard throughout the 1980s and into the 1990s, part of an unofficial set of three stand-alone office automation products that included dBase and WordPerfect, to build a complete business platform.

With the acceptance of Windows 3.0 starting in 1990, the market for desktop software grew even more. None of the three companies had seriously considered the graphical user interface (GUI) to supplement their DOS offerings, and so they responded slowly to Microsoft's own GUI-based products Excel and Word.

The Apple Macintosh

- January 24, 1984 - Apple releases the Apple Macintosh personal computer.
- It came with a keyboard and mouse, a graphical user interface (GUI) and included bundled MacPaint and MacWrite software. Other programs available included MacProject, MacTerminal and Microsoft Word.
- It had an initial selling price of US$2,495 (equivalent to $6,215 in 2020).

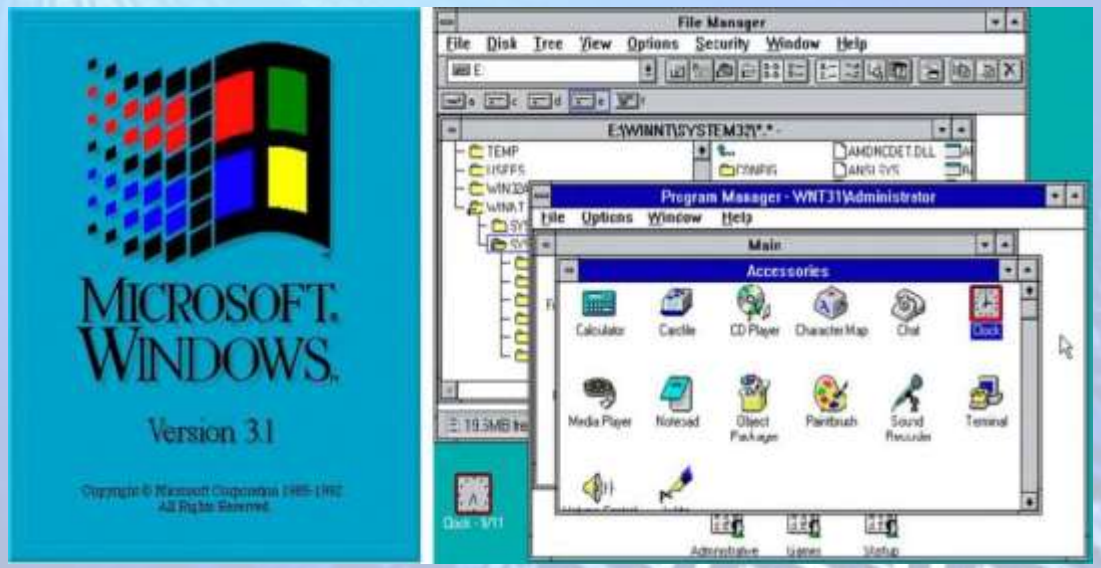
The Apple Macintosh

The Macintosh was introduced by the now-famous television commercial directed by Ridley Scott, "1984", which aired on CBS during the third quarter of Super Bowl XVIII on January 22, 1984.

Sales reached 70,000 units on May 3, 1984.

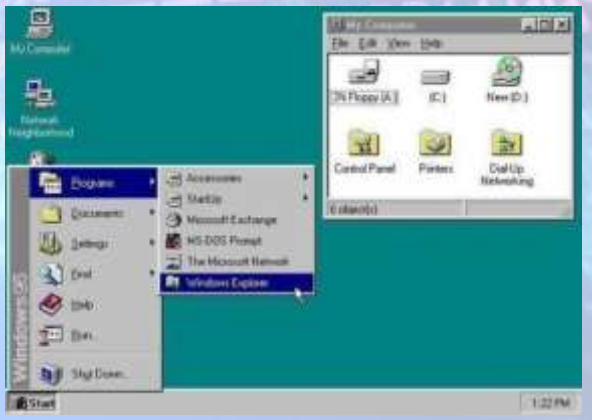
Microsoft Windows

- In 1990 Microsoft released Windows 3.0. This version corrected some of the issues with Windows 1.x and 2.x, and was the first version of Windows to gain any real market popularity.
- Windows 1.x, 2.x and 3.x were all graphical shells that ran on top of MS-DOS and used it for file system services.



Microsoft Windows

In 1995 Microsoft introduced Windows 95, the first version of Windows integrated with the operating system. Several other versions of Windows would be introduced over the years, culminating (so far) with Windows 10.

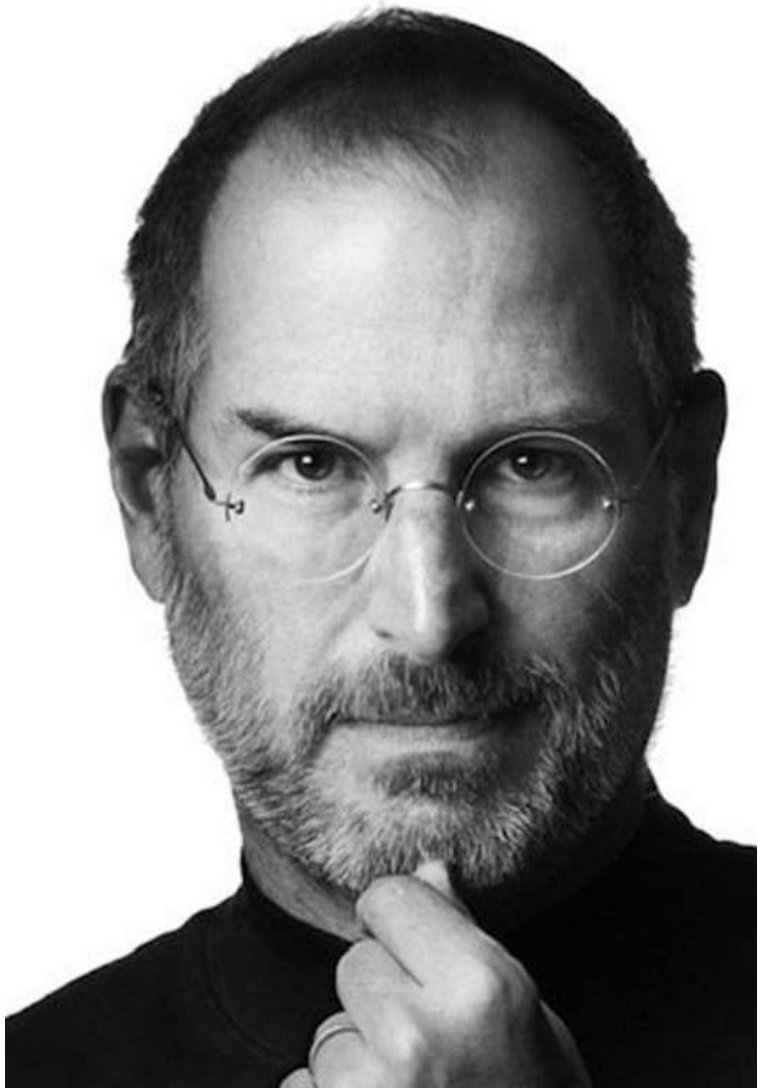


The original personal computer form factor of the desktop PC has evolved into several other forms including laptops and tablets, and the basic technology has been incorporated into many other devices like smartphones and car infotainment systems

Steve Jobs

Steve Jobs and Steve Wozniak co-founded Apple in 1976.

Apple introduced the Apple II in 1977, one of the first highly successful mass-produced microcomputers.



Steve Jobs

Jobs saw the commercial potential of the Xerox Alto in 1979, which was mouse-driven and had a graphical user interface (GUI). This led to the development of the unsuccessful Apple Lisa in 1983, followed by the breakthrough Macintosh in 1984, the first mass-produced computer with a GUI.

The Macintosh introduced the desktop publishing industry in 1985 with the addition of the Apple LaserWriter, the first laser printer to feature vector graphics.

Steve Jobs

Jobs was forced out of Apple in 1985 after a long power struggle with the company's board and its then-CEO John Sculley.

That same year, Jobs took a few of Apple members with him to found NeXT, a computer platform development company that specialized in computers for higher-education and business markets.

Jobs helped to develop the visual effects industry when he funded the computer graphics division of George Lucas's Lucasfilm in 1986. The new company was Pixar, which produced the first 3D computer animated feature film Toy Story (1995), and went on to become a major animation studio, producing over 20 films since then.

Steve Jobs

Jobs returned to Apple in 1997, following Apple's acquisition of NeXT. He was largely responsible for helping revive Apple, which had been on the verge of bankruptcy.

Also in 1997, Steve Jobs and Bill Gates struck a deal. Microsoft agreed to invest $150 million in Apple stock. The companies agreed to settle all outstanding litigation and cross-license patents, while making Microsoft Office available for the Macintosh, and making the Internet Explorer the default browser - but not the only one - on the Mac.

Microsoft's investment in Apple wasn't entirely altruistic. Microsoft was under investigation in the US and European Union for its monopolistic practices, and by rescuing its failing competitor it took the edge off these investigations.

Steve Jobs

Jobs worked closely with designer Jony Ive to develop a line of products that had larger cultural ramifications, beginning in 1997 with the *"Think different"* advertising campaign and leading to the iMac, iTunes, iTunes Store, Apple Store, iPod, iPhone, App Store, and the iPad.

Steve Jobs died of cancer in 2011. One of the last people to see him was Bill Gates.

The Digitization of Media

Books

Paper Books → Digital Text Files → Digital eBooks → Read Online

Photos

Paper Photos (Film Cameras) → Digital Files (Digital Cameras) (1989)

Audio

Analog Vinyl Records, Cassettes (Turntables, Cassette Players, Walkmen) → Digital CD's (1982) (CD Players) → Digital Files (MP3's, M4A's, etc.) (Music Players, iPods, Computers, Smartphones, etc.) → Streaming (Many Devices)

Video

Analog Movie Film → Analog Videotapes (VCR's) → Digital DVD's (1996), Blue-Rays (2006) (DVD & Blue-Ray Players) → Digital Files (M4A's, etc.) → Streaming

Software

Digital Diskettes → Digital CD's, DVD's → Digital Downloads → Use in the Cloud

The ARPANET

ARPA (the Advanced Research Projects Agency of the United States Department of Defense, and now known as DARPA) launches the ARPANET project in 1966 to serve as a backbone for interconnection of regional academic and military networks.

The ARPANET was the first wide-area packet-switched network with distributed control and one of the first networks to implement the TCP/IP protocol suite. Both technologies became the technical foundation of the Internet.

The first computers were connected in 1969. The network expanded rapidly and was declared operational in 1975 when control passed to the Defense Communications Agency.

The ARPANET and CSNET

Access to the ARPANET was expanded in 1981, when the National Science Foundation (NSF) funded the Computer Science Network (CSNET).

In the early 1980s, the NSF funded the establishment of national supercomputing centers at several universities, and provided network access and network interconnectivity through CSNET in 1986.

The ARPANET was formally decommissioned in 1990, after partnerships with the telecommunication and computer industries had assured private sector expansion and future commercialization of an expanded world-wide network, now known as the Internet.

The Internet

The Internet is the global system of interconnected computer networks that uses the Internet protocol suite (TCP/IP) to communicate between networks and devices.

It is a 'Network of Networks' that consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies.

The Internet carries a vast range of information resources and services, such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), electronic mail, telephony, and file sharing.

The Internet

Although the Internet was widely used by academia in the 1980s, commercialization since then has incorporated its services and technologies into virtually every aspect of modern life.

The Dot-Com Bubble

- The dot-com bubble, also known as the dot-com boom, the tech bubble, and the Internet bubble, was a stock market bubble caused by excessive speculation of Internet-related companies in the late 1990s, a period of massive growth in the use and adoption of the Internet.
- Between 1995 and its peak in March 2000, the Nasdaq Composite stock market index rose 400%, only to fall 78% from its peak by October 2002, giving up all its gains during the bubble.
- During the crash, many online shopping companies, such as Pets.com, Webvan, and Boo.com, as well as several communication companies, such as Worldcom, NorthPoint Communications, and Global Crossing, failed and shut down.
- Some companies, such as Cisco, whose stock declined by 86%, Amazon.com, and Qualcomm, lost a large portion of their market capitalization but survived.

The Influence of the Internet

- Most traditional communication media, including telephony, radio, television, paper mail and newspapers are reshaped, redefined, or even bypassed by the Internet, giving birth to new services such as email, Internet telephony, Internet television, online music, digital newspapers, and video streaming websites.
- Newspaper, book, and other print publishing are adapting to website technology, or are reshaped into blogging, web feeds and online news aggregators.
- The Internet has enabled and accelerated new forms of personal interactions through instant messaging, Internet forums, and social networking services.
- Online shopping has grown exponentially for major retailers, small businesses, and entrepreneurs, as it enables firms to extend their "brick and mortar" presence to serve a larger market or even sell goods and services entirely online.

WWW - The World Wide Web

- English scientist Tim Berners-Lee invented the World Wide Web in 1989. He wrote the first web browser in 1990 while employed at CERN* near Geneva, Switzerland. The browser was released outside CERN 1991.
- The World Wide Web (WWW), commonly known as the Web, is an information system where documents and other web resources are identified by Uniform Resource Locators (URLs, such as https://example.com/), which may be interlinked by hyperlinks, and are accessible over the Internet.
- The resources of the Web are transferred via the Hypertext Transfer Protocol (HTTP), and may be accessed by a web browser, and are published by a web server. Web resources may be any type of downloaded media, but web pages are hypertext documents formatted in Hypertext Markup Language (HTML).

* - CERN - The European Organization for Nuclear Research. operates the largest particle physics laboratory in the world.

WWW - The World Wide Web

The Web began to enter everyday use in 1993, when websites for general use started to become available.

The World Wide Web has been central to the development of the Information Age, and is the primary tool billions of people use to interact on the Internet.

Amazon.com

Jeff Bezos founded Amazon from his garage in Bellevue, Washington, in 1994. It started as an online marketplace for books but expanded to sell electronics, software, video games, apparel, furniture, food, toys, jewelry and many other things.

In 2015, Amazon surpassed Walmart as the most valuable retailer in the United States by market capitalization. In August 2017, Amazon acquired Whole Foods Market for US$13.4 billion, which substantially increased its footprint as a physical retailer. In 2018, its two-day delivery service, Amazon Prime, surpassed 100 million subscribers worldwide.

amazon

Amazon.com

Since its founding, Amazon.com, Inc. has also expanded into e-commerce, cloud computing, digital streaming, and artificial intelligence.

It is one of the Big Five companies in the U.S. information technology industry, along with Google, Apple, Microsoft, and Facebook. The company has been referred to as *"one of the most influential economic and cultural forces in the world"*, as well as the world's most valuable brand.

Amazon.com

Amazon is known for its disruption of well-established industries through technological innovation and mass scale.

It is the world's largest

- **online marketplace,**
- **AI assistant provider,**
- **live-streaming platform and**
- **cloud computing platform**

as measured by revenue and market capitalization.

- **Amazon is the largest Internet company by revenue in the world.**
- **It is the second-largest private employer in the United States and one of the world's most valuable companies.**
- **As of 2020, Amazon has the highest global brand valuation.**

Some of Amazon's Businesses

- Amazon distributes a variety of downloadable and streaming content through its Amazon Prime Video, Amazon Music, Twitch, and Audible subsidiaries.
- Amazon has publishing arm Amazon Publishing,
- Amazon has film and television studio Amazon Studios, and is currently in the process of purchasing Metro-Goldwyn-Mayer.
- Amazon has cloud computing subsidiary, Amazon Web Services.
- It produces consumer electronics including Kindle e-readers, Fire tablets, Fire TV, and Echo devices.
- Its acquisitions over the years include Ring, Twitch, Whole Foods Market, and IMDb.

Amazon.com

While separate from Amazon, Jeff Bezos, the founder and executive chairman of Amazon also founded Blue Origin, a privately funded aerospace manufacturer and spaceflight services company.

Today Blue Origin launched William Shatner, who played Captain Kirk in the Star Trek TV series and movies, on a sub-orbital flight, making him at 90 the oldest person to venture into space (the previous oldest person was original Mercury astronaut John Glenn, who in 1998 at the age of 77 flew to space as a payload specialist with NASA's space shuttle mission STS-95 aboard the shuttle Discovery).

Social Networking

The potential for computer networking to facilitate newly improved forms of computer-mediated social interaction was evident early on.

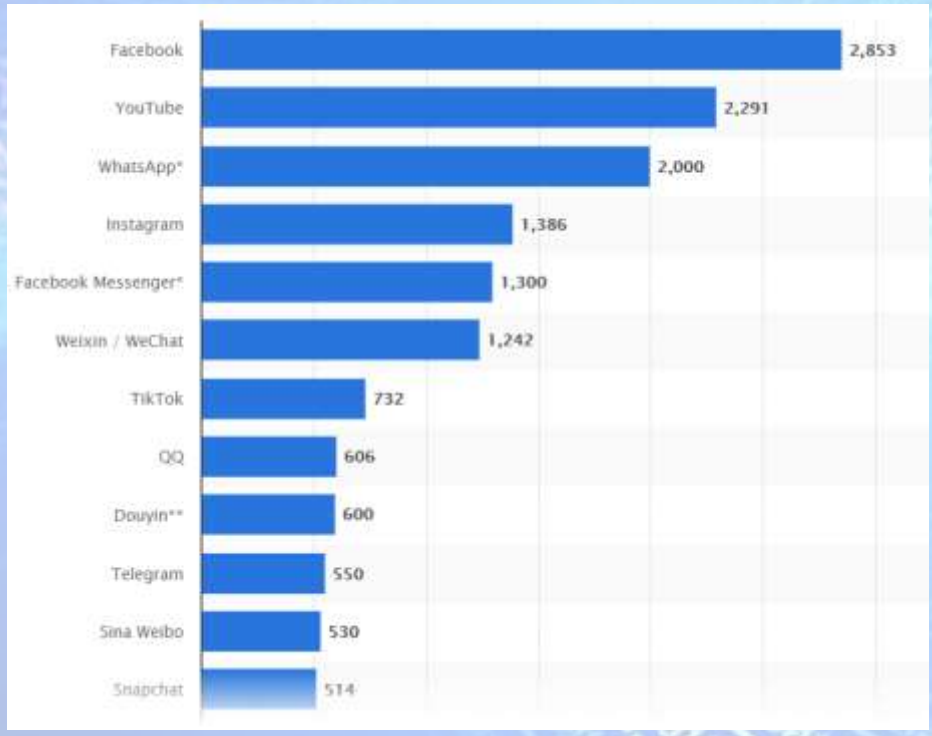
Efforts to support social networks via computer-mediated communication were made in many early online services, including Usenet, ARPANET, LISTSERV, and many bulletin board services (BBS).

Many prototypical features of social networking sites were also present in early online services such as America Online, Prodigy, CompuServe, ChatNet, and The WELL.

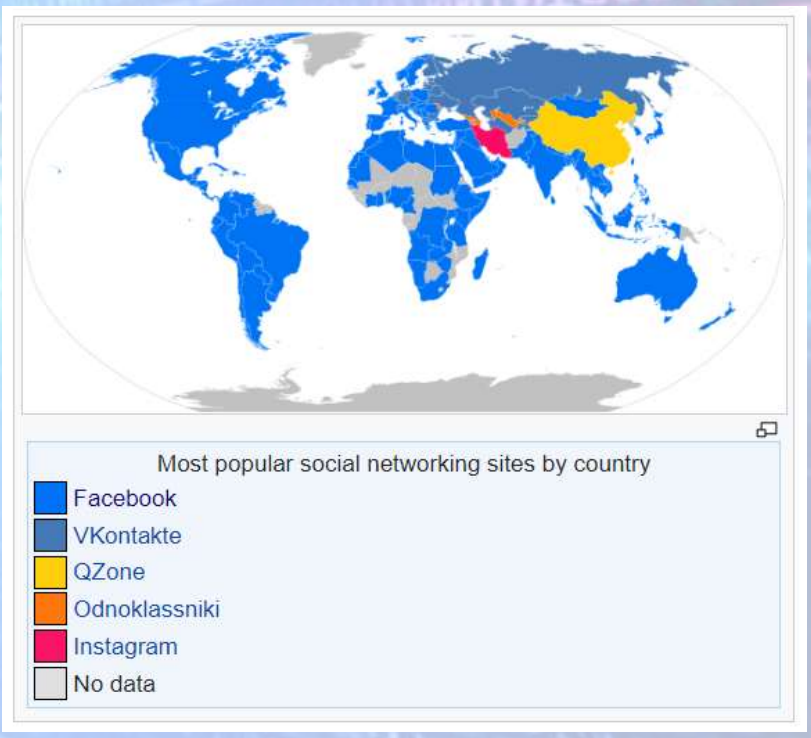
Social Networking

- In the late 1990s, user profiles became a central feature of social networking sites, allowing users to compile lists of 'friends' and search for other users with similar interests.
- New social networking methods were developed by the end of the 1990s, and many sites began to develop more advanced features for users to find and manage friends. Open Diary, a community for online diarists, invented both friends-only content and the reader comment, two features of social networks important to user interaction.
- Facebook, launched in 2004, became the largest social networking site in the world in early 2009. Facebook was first introduced as a Harvard social networking site, expanding to other universities and eventually to anyone.

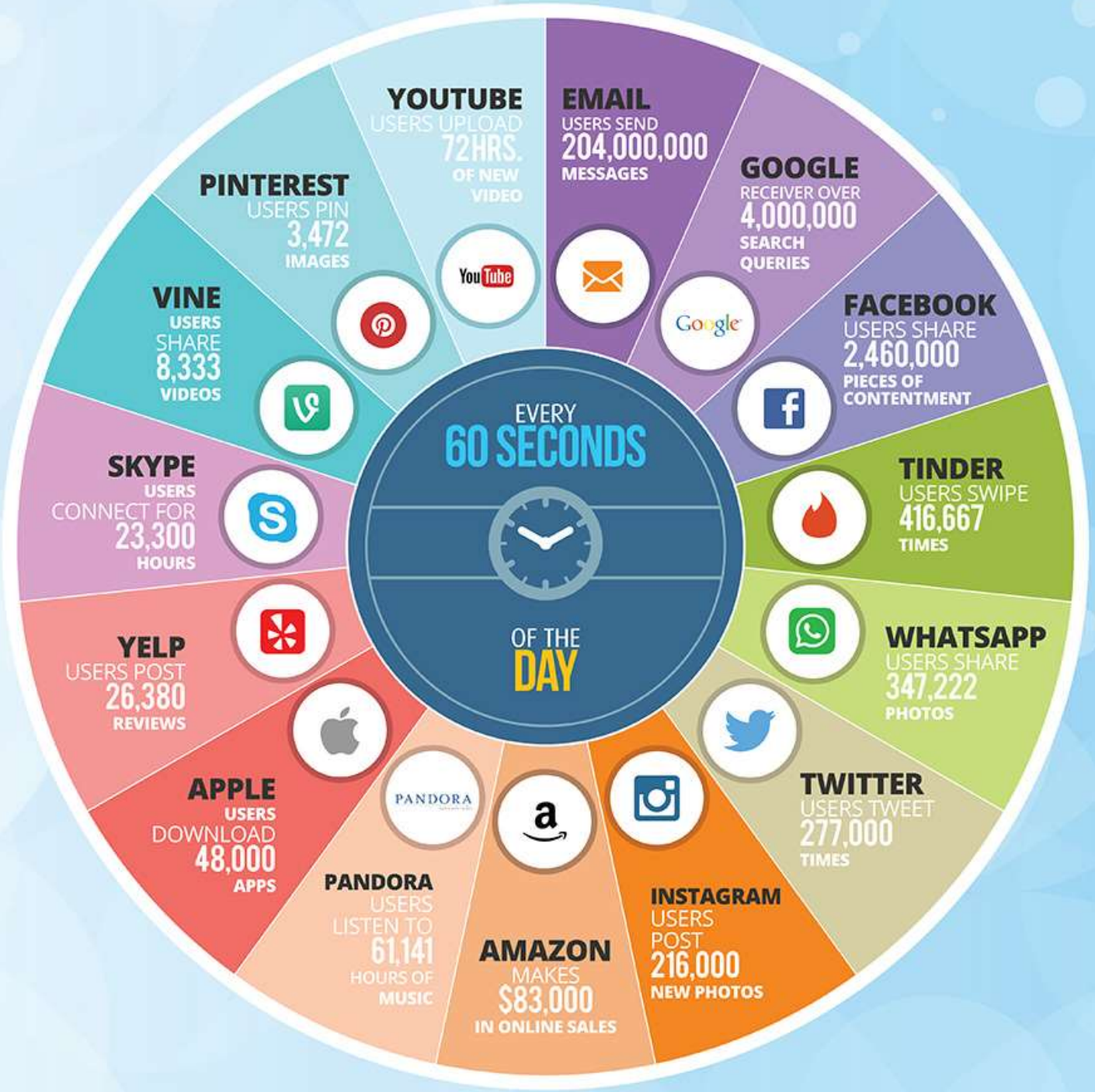
Social Networking



Most popular social networks worldwide as of July 2021, ranked by number of active users (https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/)



Most popular social networking sites by country (https://en.wikipedia.org/wiki/Social_networking_service)


EVERY
60 SECONDS
OF THE
DAY
YOUTUBE
USERS UPLOAD
72HRS.
OF NEW
VIDEO
EMAIL
USERS SEND
204,000,000
MESSAGES
GOOGLE
RECEIVER OVER
4,000,000
SEARCH
QUERIES
FACEBOOK
USERS SHARE
2,460,000
PIECES OF
CONTENTMENT
PINTEREST
USERS PIN
3,472
IMAGES
VINE
USERS
SHARE
8,333
VIDEOS
SKYPE
USERS
CONNECT FOR
23,300
HOURS
TINDER
USERS SWIPE
416,667
TIMES
YELP
USERS POST
26,380
REVIEWS
WHATSAPP
USERS SHARE
347,222
PHOTOS
APPLE
USERS
DOWNLOAD
48,000
APPS
TWITTER
USERS TWEET
277,000
TIMES
PANDORA
USERS
LISTEN TO
61,141
HOURS OF
MUSIC
INSTAGRAM
USERS
POST
216,000
NEW PHOTOS
AMAZON
MAKES
$83,000
IN ONLINE SALES

Cell Phones

At the beginning of World War II, Hollywood Actress Hedy Lamarr and composer George Antheil developed a radio guidance system using frequency-hopping spread spectrum technology for Allied torpedoes, intended to defeat the threat of jamming by the Axis powers.

The technology they developed became the basis for cell phone, WiFi and Bluetooth technology.

Cell Phones

- The development of metal-oxide-semiconductor (MOS) large-scale integration (LSI) technology, information theory and cellular networking led to the development of the first cell phones.
- The first handheld cellular mobile phone was demonstrated by John F. Mitchel and Martin Cooper of Motorola in 1973, using a handset weighing 2 kilograms.

Martin Cooper of Motorola, shown here in a 2007 reenactment, made the first publicized handheld mobile phone call on a prototype DynaTAC model on 3 April 1973.

Cell Phones

- Analog cellular networks (1G) start appearing in 1979, followed by digital cellular networks (2G) in 1991.
- 3G (144 kbit/sec) in 2001, 4G (100 mbits/sec) in 2006, 4G LTE (1 gbits/sec) in 2013, and 5G (10 gbits/sec) in 2019.
- In developing countries that didn't have a well-developed landline infrastructure, cell phones have experienced explosive growth.

Smartphones

- Smartphones combine mobile telephone and computing functions into one unit. As well as operating over cell phone networks, they can also connect over as Bluetooth and Wi-Fi, and can connect with the Internet over all three.
- They typically include multimedia functionality (including music, video, cameras, and gaming) and satellite navigation alongside core phone functions such as voice calls and text messaging.
- The early smartphones were usually feature phones (cell phones with extra features like cameras) combined with PDA's (Personal Digital Assistants), and were primarily aimed at the business and commercial market. One of the most popular of these were the Blackberry phones, which were hugely popular in the mid to late 2000's.

The iPhone

- The first smartphone to gain huge popularity with the public was the Apple iPhone. The first iPhone was released in the United States on June 29, 2007 at the price of $499 for the 4 GB model and $599 for the 8 GB model, both requiring a 2-year contract.
- The original iPhone was introduced by Steve Jobs on January 9, 2007 in a keynote address at the Macworld Conference & Expo. In his address, Jobs said, "Today, Apple is going to reinvent the phone". He introduced the iPhone as a combination of three devices: a "widescreen iPod with touch controls"; a "revolutionary mobile phone"; and a "breakthrough Internet communicator".
- Thousands of people were reported to have waited outside Apple and AT&T retail stores days before the device's launch; many stores reported stock shortages within an hour of availability. To avoid repeating the problems of the PlayStation 3 launch, which caused burglaries and even a shooting, off-duty police officers were hired to guard stores overnight.
- The device broke with prevailing mobile phone designs by eliminating most physical hardware buttons, and eschewing a stylus for its screen-based interface, instead featuring only a few physical buttons and a touch screen.

'The Internet of Things' (IoT)

- **The concept of a network of smart devices was discussed as early as 1982, with a modified Coca-Cola vending machine at Carnegie Mellon University becoming the first ARPANET-connected appliance, able to report its inventory and whether newly loaded drinks were cold or not.**
- **The concept of the 'Internet of Things' and the term itself, first appeared in a speech by Peter T. Lewis in 1985. According to Lewis, *"The Internet of Things, or IoT, is the integration of people, processes and technology with connectable devices and sensors to enable remote monitoring, status, manipulation and evaluation of trends of such devices."***
- **Defining the Internet of Things as *"simply the point in time when more 'things or objects' were connected to the Internet than people"*, Cisco Systems estimated that the IoT was 'born' between 2008 and 2009, with the things/people ratio growing from 0.08 in 2003 to 1.84 in 2010.**

'The Internet of Things' (IoT)

'The Internet of Things' (IoT) in the consumer market is most synonymous with products pertaining to the concept of the 'Smart Home', including devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers.

Computing in the Cloud

During the 1960s, time-sharing on mainframe and mini-computers became popular. Organizations and individual users didn't have to invest in and support expensive computer hardware and software infrastructures, and instead could 'pay as you go'. Computers could be accessed at terminals on the network, or through dial-up connections.

The Personal Computer Revolution put individual users in control of their own computer and its software, which proved to be both a blessing and a curse. This required a certain level of computer knowledge and expertise for individual users, and expensive support groups for organizations, especially when organizations began networking their PC’s.

Computing in the Cloud

- In the 1990s, telecommunications companies began offering virtual private network (VPN) services at a lower cost than dedicated networks. They began to use the cloud symbol to denote the demarcation point between what the provider was responsible for and what users were responsible for.
- With the growing popularity of the internet, in the 2000's companies began offering cloud-based software and other online computer services.
- By mid-2008, Gartner saw an opportunity for cloud computing *"to shape the relationship among consumers of IT services, those who use IT services and those who sell them"*.

Computing in the Cloud

The goal of cloud computing is to allow users to take benefit from diverse technologies, without the need for deep knowledge about or expertise with each one of them.

The cloud aims to cut costs and helps the users focus on their core business instead of being impeded by IT obstacles.

Computing in the Cloud

‘The Cloud’ IS the Internet.

More specifically, it's all of the things you can access remotely over the Internet. When something is in the cloud, it means it's on Internet servers instead of on your own computer.

Grumpy old man’s perspective:

“There is no cloud, it’s just someone else’s computer.”

Computing in the Cloud

Cloud computing is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user.

It allows the user to access their data (e.g., photos, music, books, documents, videos, etc.), cloud based software and internet based services (e.g. video and music streaming services, Amazon Alexa, Google Home) from anywhere with internet access using any one of a number of devices including computers, tablets and smartphones.

Computing in the Cloud

Using the cloud frees the user from:

- **Having to backup their data**
- **Having to buy expensive software and/or high-horsepower hardware for only occasional use**
- **Having to keep software, operating systems and hardware up-to-date and current**

The Four Phases of the Digital Revolution

In broad strokes, the phases of the Digital Revolution can be described as:

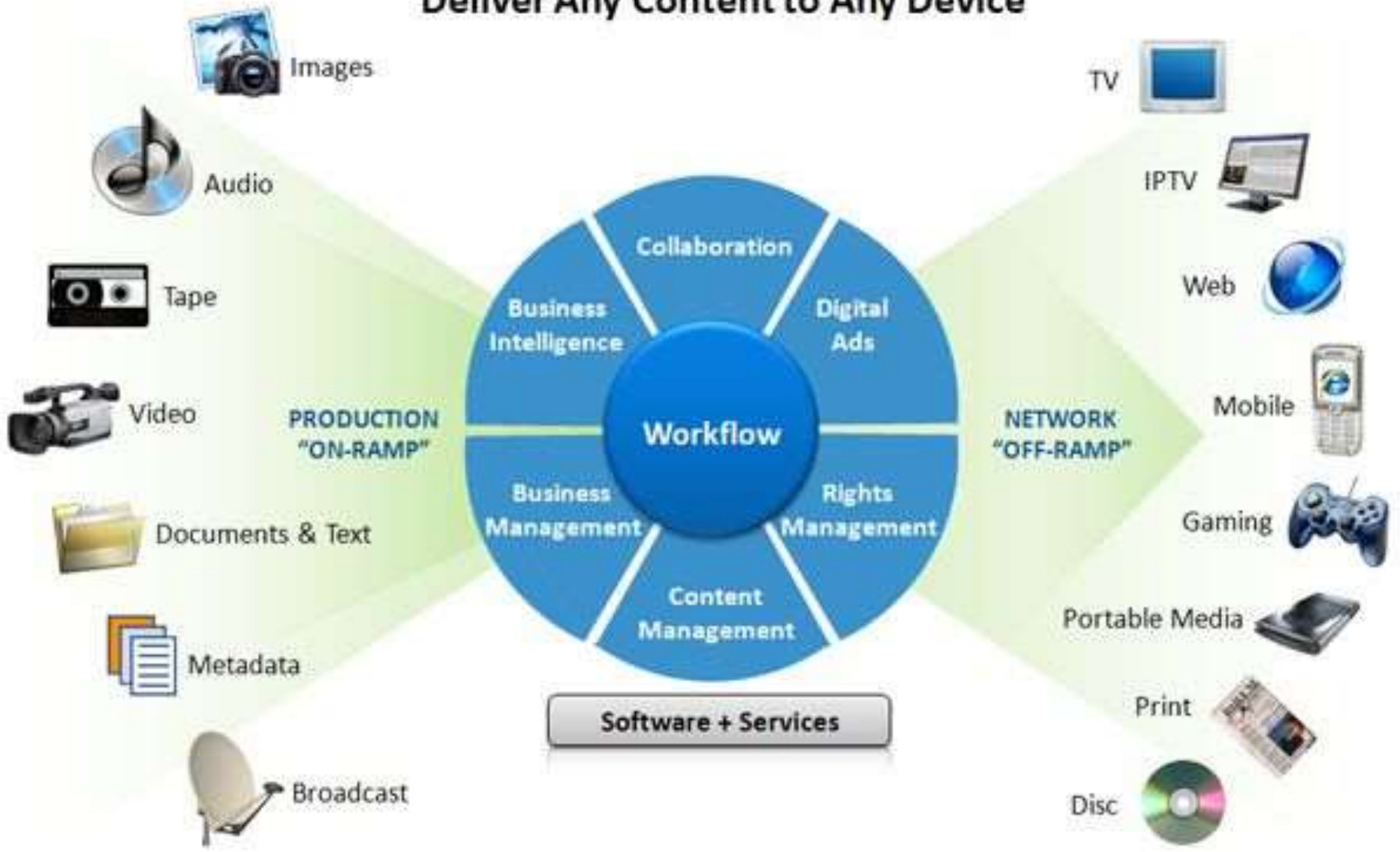
- **Data Processing (Phase 1) (covered in *"The History of Computing, Part One"*)**
- **Personal Computing (Phase 2)**
- **Network Computing (the Internet)(Phase 3)**
- **Cloud Computing (Phase 4)**

Convergence

One of the main principles of the Digital Revolution is Convergence:

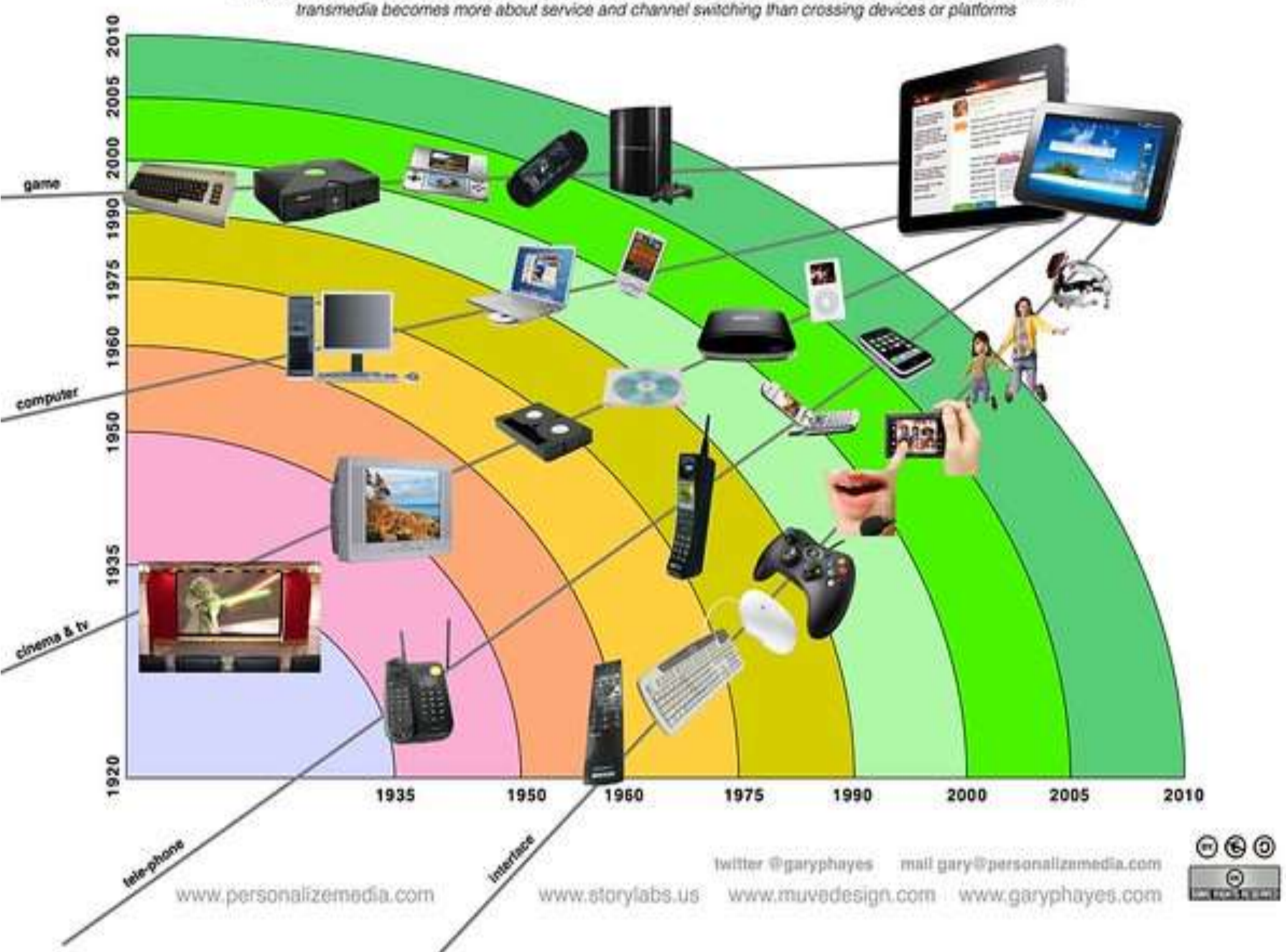
- **Deliver any content to any device**
- **Convergence of functionality from several discrete devices to only a few devices**

Deliver Any Content to Any Device



Platform Convergence and the Dawn of Trans-Media Channels © Gary Hayes 2010

An updated chart (and post/article) looking at the evolution of key platforms towards a convergent device on which transmedia becomes more about service and channel switching than crossing devices or platforms



twitter @garyphayes mail gary@personalizemedia.com

www.personalizemedia.com www.storylabs.us www.muvedesign.com www.garyphayes.com

The Digital Revolution

Every major technological revolution has had a profound impact on humankind's production patterns and lifestyles. The use of IT enables people to break their past reliance on conventional means of transportation and communication, and expands their scope of development and contacts.

Digital Revolution is for real – Let us be part of it!!!

Era & Timeline	Simple Trade Era (Before 1840)	Industrial Revolution (1840 – 1960)	Technological Revolution (1960-2010)	Digital Revolution (2010 Onwards)
				
Crux	Individual Production	Mass Production	Productivity Enhancement	Customer Experience
Brief	This era was limited by individual's production capability in farms and other means. Everyone exchanged what they produced in excess and purchased what they needed.	Mass Production initially helped meet the excess demand. Once mass production capacity increased, artificial demand was created through marketing to sell the products.	Technological advancement enabled the businesses to improve their processes by virtue of automating using software's.	**Serving Customers Real time** using the Digital technologies (Internet & Smartphone, especially) by understanding the customer problems better
Driven By	Need	Production & Artificial Need Creation	Better access to basic goods & Luxury products	Customer Experience – Better living
Examples	Agriculture Produces, Mud vessels, furniture	Textile, Cars production, Household Products	ERP's, Tally, CRM, Desktop based Printing, etc.,	Amazon, OLA, Rivigo, WatsApp, Digital Banking

Created by Karunamoorthi P

The Future of Digital Transformation

At the current rate of digital transformation, half of the S&P 500 companies will be replaced in the next decade.

Digital transformation has been on the agenda for years—but the next several years will be the tipping point by which DX efforts must be implemented or enterprises be left in the dust.

2019

of all technology spending will go toward digital transformation

Tech spending will exceed

$3 TRILLION globally

$1.5 TRILLION in the US

2020

of the Global 2000 will see most of their business depend on their ability to create digitally-transformed products, services, and experiences

of the Global 2000 will have allocated capital budget equal to at least 10% of revenue to DX

2021

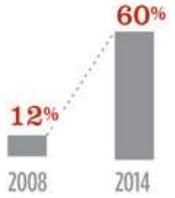
The prevalence of apps, payments, AI, bots, and other digital technology will embed digitization into our everyday lives

of all activities will involve one of the seven digital giants—Google, Apple, Facebook, Amazon, Baidu, Alibaba, and Tencent

Video
Social
Search
.com
Mobile
Email
Big Data
Cloud
Apps

CL 60% UD

OF SERVER WORKLOADS WILL BE VIRTUALIZED IN **2** YEARS



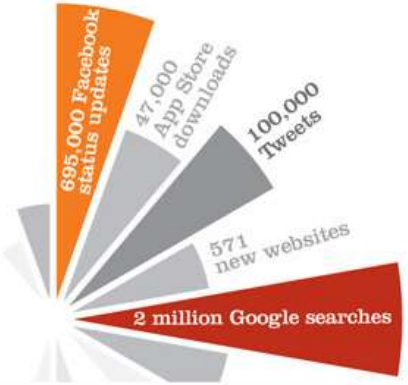
SOCIAL BUSINESS

★★★½☆

23% Fortune 500 companies with blogs

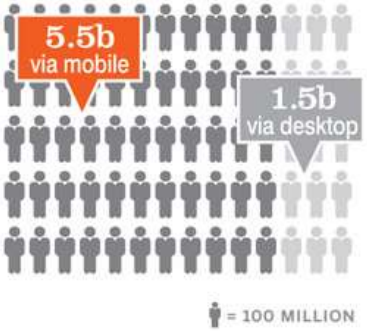
62% Fortune 500 companies active on Twitter

IN ONE MINUTE ...



MOBILITY

HOW THE WORLD GETS ONLINE



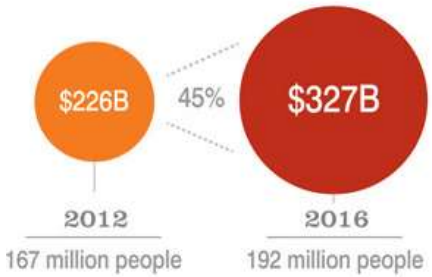
MOBILE STRATEGY

31%

OF COMPANIES REPORT THEY ARE **JUST STARTING** TO DEVELOP A MOBILE STRATEGY OR HAVE **NO MOBILE STRATEGY AT ALL.**

ONLINE RETAIL

U.S. OUTLOOK: GROWTH



BIG DATA

90%

OF THE WORLD'S DATA WAS CREATED IN THE LAST

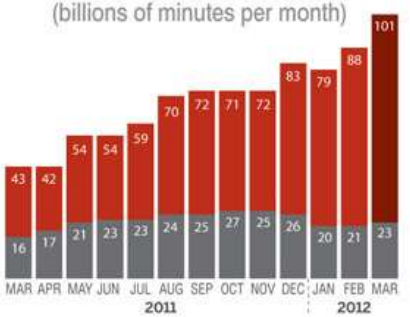
2

YEARS

APPS

WHERE MOBILE USERS SPEND TIME

(billions of minutes per month)



ACTIVE BLOGS	
2000	2010
12,000	141 MILLION

DAILY GOOGLE SEARCHES	
2000	2010
100 MILLION	2 BILLION

REALITY-TV SHOWS	
2000	2010
4	320

VIDEOGAME REVENUE	
2000	2010
$7.98 BILLION	$19.66 BILLION

'LAW & ORDER' EPISODES	
2000	2010
223	905

BOOKS PUBLISHED	
2000	2010
282,242	1,052,803

DAILY LETTERS MAILED	
2000	2010
207.88 BILLION	175.67 BILLION

DAILY E-MAILS	
2000	2010
12 BILLION	247 BILLION

TEXT MESSAGES	
2000	2010
400,000	4.5 BILLI

HARD-DRIVE STORAGE	
2000	2010
$10/GIGABYTE	6¢/GIGABYTE

CLOWNS	
2000	2010
1,200	2,700

TIME SPENT ONLINE	
2000	2010
2.7 HRS./WK.	18 HRS./WK.

DAILY NEWSPAPERS	
2000	2010
1,480	1,382

CD SALES REVENUE	
2000	2010
$943 MILLION	$427.9 MILLION

ITUNES DOWNLOADS	
2000	2010
0	10 BILLION

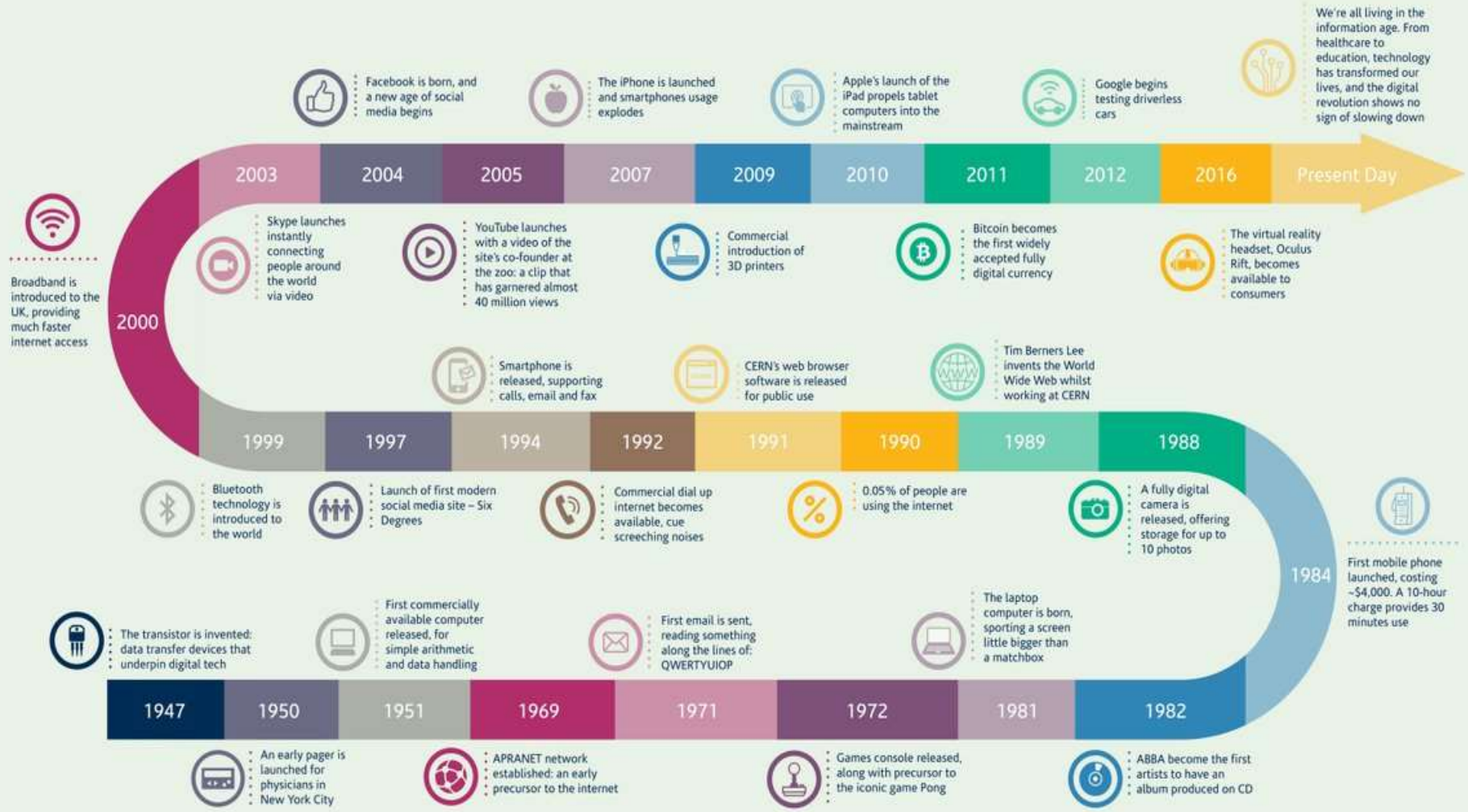
Available NOW: Semi-Autonomous Cars

Coming SOON: Self-Driving Cars*

*** - See my December 2017 presentation**

"Where Are Self-Flying Planes and Self-Driving Cars Taking Us?"

A BRIEF HISTORY OF THE DIGITAL REVOLUTION



Science & Technology Facilities Council

1940s

Claude Shannon, the father of modern digital communications and information theory, paves the way for digitization in his article *A Mathematical Theory of Communication*

1950s

The microchip and today's most widely-used semiconductor transistor are invented—meaning analog computing can now go digital

1960s

The first message is sent over ARPANET, the foundation of the internet as we know it

Gordon Moore theorizes that computing power doubles once about every year—Moore's Law goes on to guide innovations that increase the scope and reach of digitization

1970s

Home computers are introduced

Space Invaders ushers in the golden age of (digital) arcade video games

Data entry jobs crop up to help businesses convert their analog records into digital data

1980s

The World Wide Web is invented and computers achieve semi-ubiquity in developed nations

Automation begins to enter the workforce

1990s

The World Wide Web becomes publically accessible and is integral to international culture by the end of the decade

The 1990 World Cup is the first public, digital HDTV broadcast

The 2G network is introduced and digital cell phones are sold commercially

2000s

Over half of American households own a personal computer and the population of the internet tops 1 billion

The digital revolution spreads to the rest of the developing world

The Digital Revolution

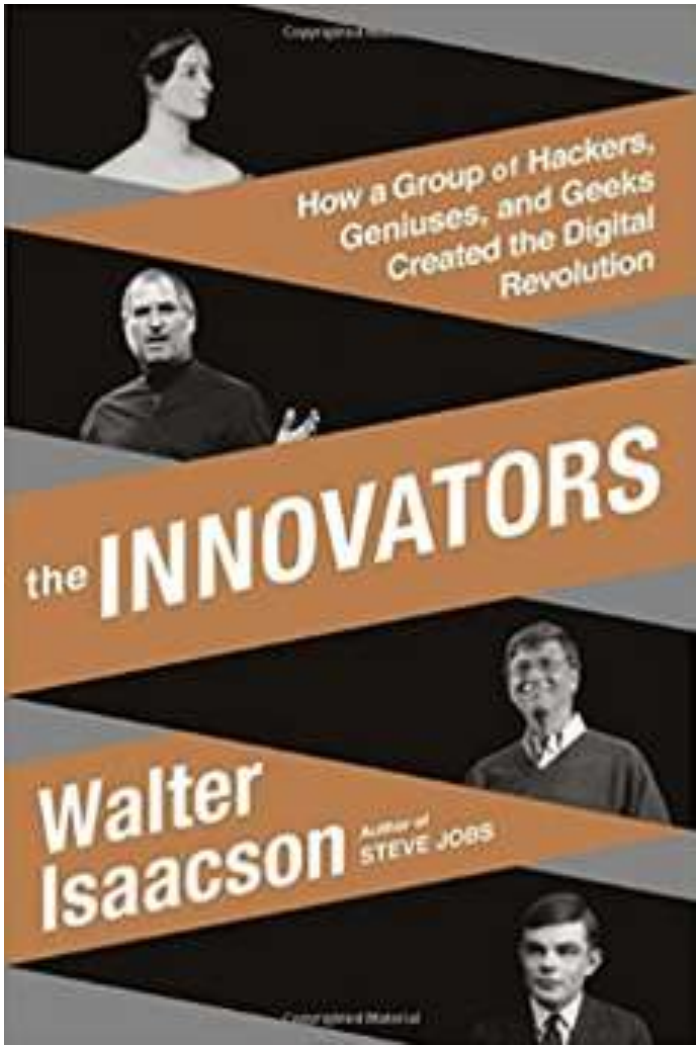
What was I doing during the Digital Revolution?

- Son of senior database manager, IBM (lots of time in mainframe rooms)
- Precision Sheet Metal Machinist, Electronic Design and Assembly (EDA)
- Supervisor (Systems Assembly), Consolidated Computer
- Quality Assurance Inspector, Consolidated Computer
- Production Planning and Control, Consolidated Computer
- Manager (In-Process and Final QA), Mitel
- Industrial Engineer, Mitel
- Designer/Builder, Photomatrix (Fiber Optics)
- Production Manager, Photomatrix (Fiber Optics)
- Materials Manager, Photomatrix (Fiber Optics)
- Marketing Services Manager, Photomatrix (Fiber Optics)
- Senior IT Project Manager, Health Canada/Public Health Agency of Canada

The Ottawa Connections

- Electronic Design and Assembly (EDA) (I worked there)
- Consolidated Computer Inc. (CCI) (I worked there)
- Mitel (I worked there)
- Photomatrix/FITEL Photomatrix (now merged into JDS Uniphase) (I worked there as the very first employee)

- MicroSystems International (MSI) (where Mitel founders Terry Mathews and Mike Cowpland met)
- Zarlink (originally Mitel Semiconductor)
- QNX (spun off from Research In Motion (RIM)/Blackberry)
- Corel (founded by Mike Cowpland after he left Mitel)
- Bynamics (founded by Mike Cowpland after he left Mitel, manufacturer of the Hyperion portable computer, one of which was once owned by OPCUG's own Chris Taylor)
- JDS Optics/JDS Uniphase (JDSU)
- Newbridge Networks (founded by Terry Mathews after he left Mitel and bought out by Alcatel)
- Northern Telecom/Nortel
- Digital Equipment Canada (DEC)
- Control Data Corp. (CDC)
- Eurocom (high performance laptops)
- And so very many others



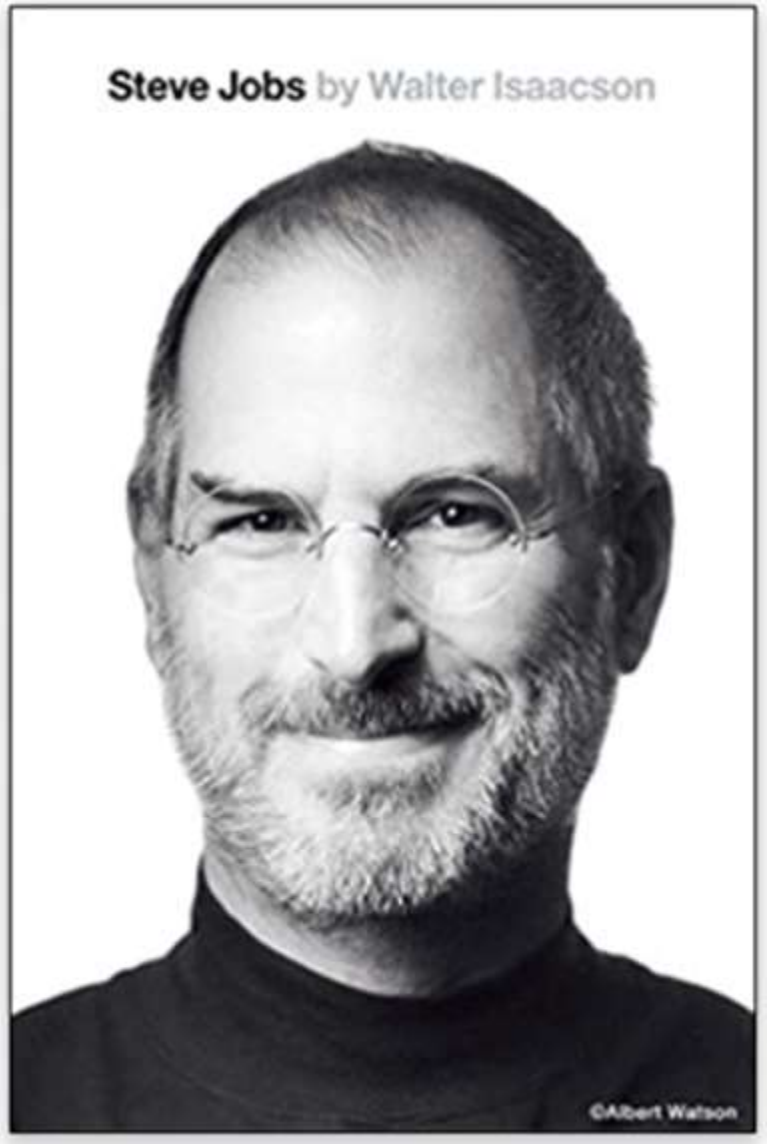
This presentation is partly based on the book

"The Innovators: How a Group of Hackers, Geniuses, and Geeks Created the Digital Revolution"

by

Walter Isaacson

(2015)



and the book

Steve Jobs

by

Walter Isaacson

(2015)

and the book

"The Four: The Hidden DNA of Amazon, Apple, Facebook, and Google"

by

Scott Galloway

(2017)

and the TV series and books

"Connections"

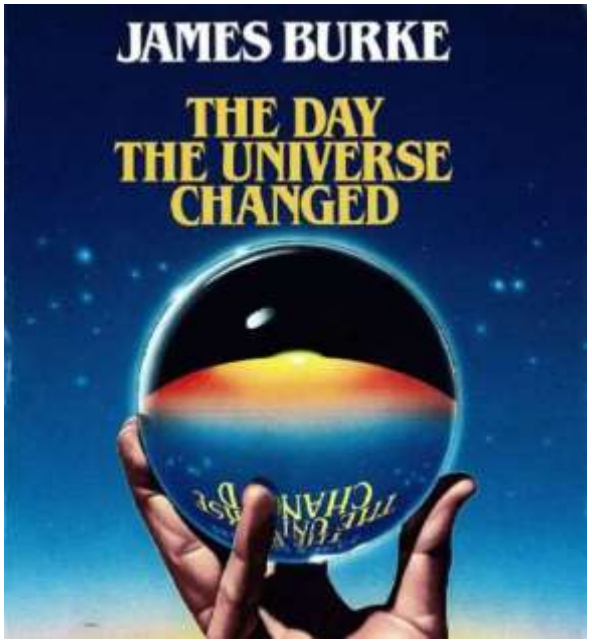
and

"The Day the Universe Changed"

by historian and futurist

James Burke

(many of the TV shows are available on YouTube)



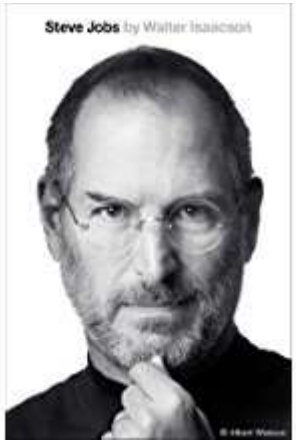
PBS

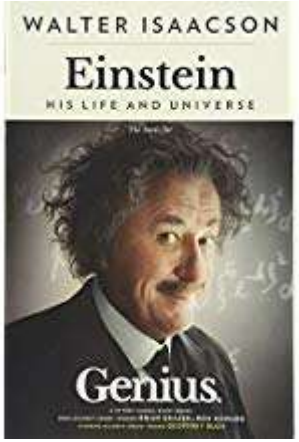
YouTube

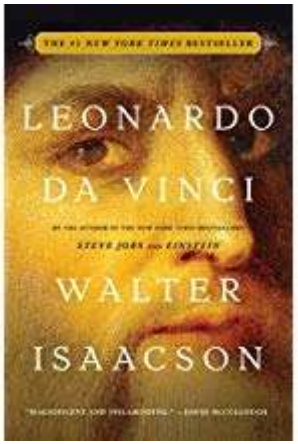
BBC

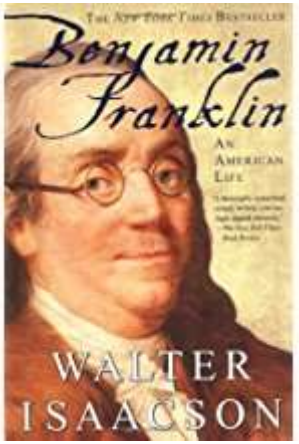
TLC
THE LEARNING CHANNEL

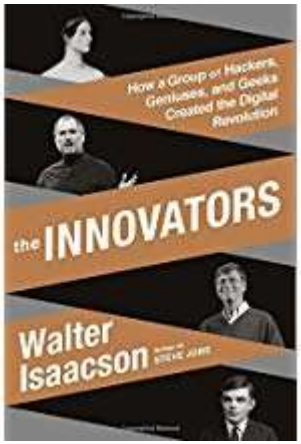
Books by Walter Isaacson

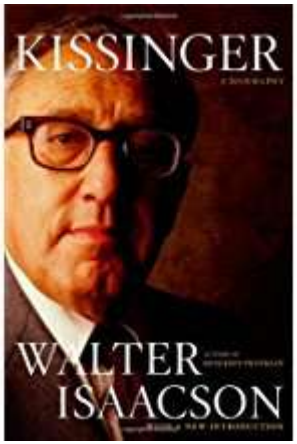


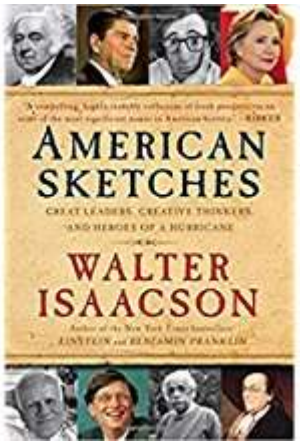


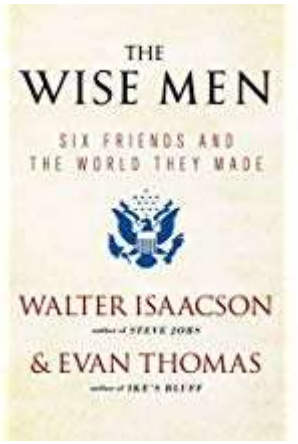












CAUTION

YOU HAVE REACHED THE

LAST PAGE

OF THE INTERNET

TURN OFF YOUR BROWSER AND GO BACK TO WORK
THERE'S NOTHING ELSE TO SEE HERE


THE END

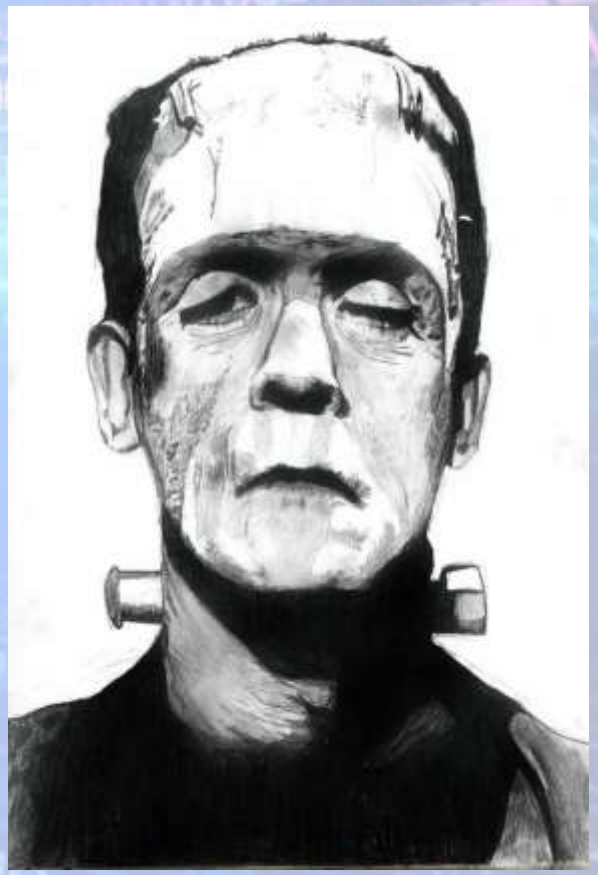
Outtakes

- ***"I think there is a world market for maybe five computers."*** **Thomas J Watson, President of IBM, 1943**
- ***"Computers in the future will weigh no more than 1.5 tons."*** **Popular Mechanics, 1949**
- ***"There is no reason for any individual to have a computer in his home."*** **Ken Olsen, co-founder of Digital Equipment Corporation, 1977**
- ***"I have travelled the length and breadth of this country and talked with the best people, and I can assure you that data processing is a fad that won't last out the year."*** **Editor in charge of business books at Prentice Hall, 1957**

TRIVIA

Lord Byron's Frankenstein Connection

In the summer of 1816 famous poet Lord Byron, father of Ada Lovelace, settled at the Villa Diodati by Lake Geneva, Switzerland, with physician John William Polidori, poet Percy Bysshe Shelley, and Shelley's future wife Mary Godwin (now known as Mary Bysshe Shelley).



Kept indoors by the "incessant rain", Byron proposed that they "each write a ghost story". Mary Bysshe Shelley produced what would become *'Frankenstein, or The Modern Prometheus'*, and Polidori produced *'The Vampyre'*, the progenitor of the romantic vampire genre.

TRIVIA

Lord Byron's Frankenstein Connection

Frankenstein was the story of a scientist who turned a man-made assemblage into a thinking human.

It was a cautionary tale about technology and science.

It also raised the question that would become associated with Lord Byron's daughter Ada Lovelace:

Can man-made machines ever truly think?