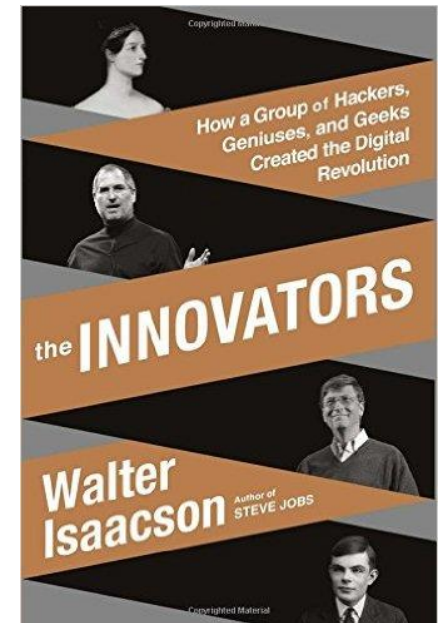# Tech Talks: Tech for Seniors

The Innovators

by Walter Isaacson

2014

Center for Learning in Retirement - Fall 2017

Glen Maxson

seniortechadvisor.com

Introduction

Walter Isaacson (born May 20, 1952)[2] is an American writer and journalist. He is the President and CEO of the Aspen Institute, a nonpartisan educational and policy studies organization based in Washington, D.C. He has been the chairman and CEO of Cable News Network (CNN) and the Managing Editor of *Time*. He has written biographies of Steve Jobs, Benjamin Franklin, Albert Einstein, and Henry Kissinger.

Video **8min**

Walter Isaacson, a versatile and workmanlike author, has never sounded as excited by his material as he does in "The Innovators." It may be that he has the same basic qualifications as many of the people he writes about here: "My father and uncles were electrical engineers, and like many of the characters in this book, I grew up with a basement workshop that had circuit boards to be soldered, radios to be opened, tubes to be tested, and boxes of transistors and resistors to be sorted and deployed."

Mr. Isaacson, who is 62, sounds as if he required no hindsight to know what thrilling times he grew up in. With the strain of romanticism that unites so many of the scientists that this book celebrates, he equates the postwar era with Wordsworth's description of those who witnessed the start of the French Revolution: "Bliss was it in that dawn to be alive."

Walter Isaacson: "The Innovators", Talks at Google
The Innovators: How a Group of Inventors Hackers Geniuses and Geeks Created the Digital Revolution, UCTV (10:29 - 44:35)
Walter Isaacson on the Innovative Genius, 92Y Plus
Walter Isaacson talks about Steve Jobs, The Aspen Institute
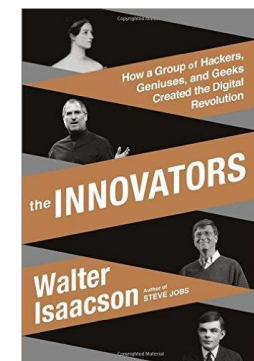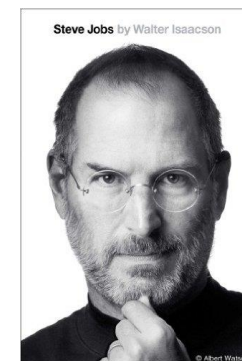
Summary

- The computer and the Internet are among the most important inventions of our era, but few people know who created them.

- Most innovations of the digital age were done collaboratively.

- There were a lot of fascinating people involved, some ingenious and a few were even geniuses.

- This is a story of pioneers, hackers, inventors, and entrepreneurs – who they were, how their minds worked, and what made them so creative.

- It's also a narrative of how they collaborated and why their ability to work as teams made them even *more* creative.

Overview

- Ada
- Computer - Babbage, Turing, Shannon, Aiken, Zuse, Atanasoff, Mauchly, Eckert
  - So, who invented the computer?
- Programming - Hopper, Von Neumann
  - Can machines think?
- Transistor - Shockley, Noyce, Moore
- Microchip - Kilby, Rock
- Games - Russell, Bushnell
- Internet - Bush, Licklider, Taylor, Roberts, Baran, Davies, Kleinrock
  - So, who invented the Internet? Cerf, Kahn, Berners-Lee, Al Gore?
- PC - Brand, Engelbart, Kay, Roberts
- Software - 'Bill', 'Steve', Bricklin, Stallman, Torvalds
- Online - 'Al'
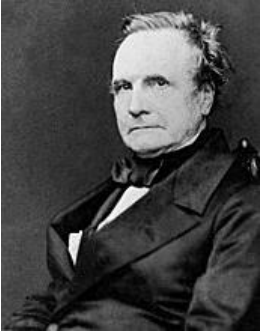- Web - Berners-Lee, Andreessen, Hall, Williams, Cunningham, Wales, Page, Brin
- Ada Forever…

Question 1 (1843 – 1945)

- Who invented the computer?
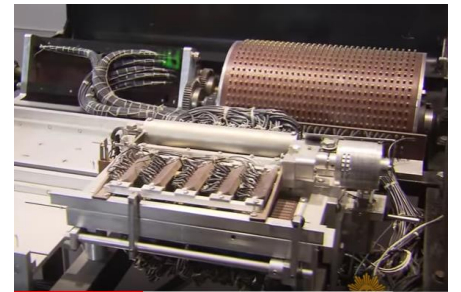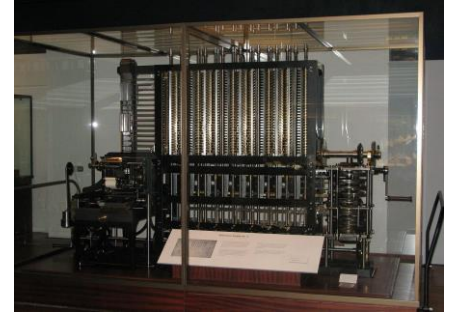
Our contestants

1837

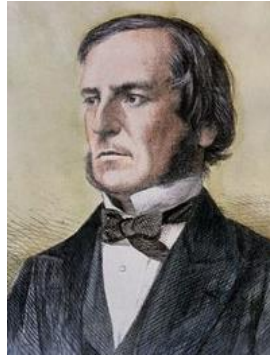Charles Babbage credited with inventing the first [mechanical computer](#)

1843

Ada, Countess of Lovelace, publishes "Notes" on Babbage's Analytical Engine.

1847

George Boole creates a system using algebra for logical reasoning.

1890

The census is tabulated with Herman Hollerith's punch-card machines.

1931

Vannevar Bush devises the Differential Analyzer, an analog electromechanical computer.

Our contestants (continued)

1935

Tommy Flowers pioneers use of vacuum tubes as on-off switches in circuits.

1937

Alan Turing publishes "On Computable Numbers," describing a universal computer.

[Link](#)

1937

Claude Shannon describes how circuits of switches can perform tasks of Boolean algebra.

1937

Bell Labs' George Stibitz proposes a calculator using an electric circuit.

1937

John Vincent Atanasoff puts together concepts for an electronic computer during a long December night's drive.

Our contestants (continued)

1938 — William Hewlett and David Packard form company in Palo Alto garage.

1939 — Atanasoff finishes model of electronic computer with mechanical storage drums.

Turing arrives at Bletchley Park to work on breaking German codes.

1941 — Konrad Zuse completes Z3, a fully functional electromechanical programmable digital computer.

1941 — John Mauchly visits Atanasoff in Iowa, sees computer demonstrated.

1942 — Atanasoff completes partly working computer with three hundred vacuum tubes, leaves for Navy.

Our contestants (continued)

1943

Colossus, a vacuum-tube computer to break German codes, is completed at Bletchley Park.

1944

Harvard Mark 1 goes into operation, build to Howard Aiken's specifications.

1944

John von Neumann goes to Penn to work on ENIAC.

1945

John Mauchly and J. Presper Eckert designed the first general-purpose electronic digital computer (ENIAC)

A Computer. What is it?

- Analog – works by analogy – ex. slide rule – not programmable
- Digital – electromechanical -> electronic circuits - programmable
- Binary – base-2, better for logical operations using on-off switches
- Electronic – vacuum tubes, relays, transistors, microchips -> speed
- General Purpose – handles many tasks and symbol manipulations
- Turing Completeness – computationally universal if it can be used to simulate any Turing Machine
- Computer Program – instructions that perform a specific task when executed by a computer

A Computer. Who invented it?

- Ada (Countess of Lovelace) – English mathematician and writer, worked with Babbage on the Analytical Engine, regarded as the 1st to recognize the full potential of a computing machine and the 1st computer programmer - 1843

- Charles Babbage – mathematician, philosopher, inventor and engineer, he originated the concept of a digital programmable computer. Even though his Difference Engine wasn't completed in his life time, a finished machine built in 1991 proved it would have worked. Functioning digital computers became operational 100 years later – Babbage's work (1822-1849), functional computers (1944-1946)

A Computer. Who invented it?

- Vannevar Bush – American engineer and inventor, known for his work on analog computers and for founding Raytheon

- Alan Turing – influential in the development of 'theoretical computer science', formalizing concepts of the Turing Machine, which is considered a model of a general purpose computer - 1936

- John Atanasoff – invented the 1st electronic digital computer (1937), a claim that was challenged and resolved in 1973 via the Honeywell v. Sperry Rand lawsuit

A Computer. Who invented it?

- Konrad Zuse – German civil engineer, inventor, computer pioneer, created in the 1st program-controlled Turing Complete Z3 which became operational in 1941, the 1st high-level programming language, Plankalkül (means 'formal system for planning'), and started the 1st computer business (Germany, 1941)

- John Mauchly & J. Presper Eckert – John (lived in Ambler, died in Abington), an American physicist, along with Presper, designed the ENIAC, the 1st general-purpose electronic digital computer (1945). They started the 1st computer company (US, 1945), and pioneered stored programs, subroutines, and programming languages. Presper, an American electrical engineer and computer pioneer, invented 'mercury line delay memory'. In 1950, when the Eckert-Mauchly Computer Corporation ran into financial problems, they were acquired by Remington Rand Corporation.

A Computer. Who invented it?

- Howard Aiken – an American physicist and computing pioneer, was the conceptual designer behind IBM's Harvard Mark 1 computer. One of the first programs to run on the Mark I was initiated on 29 March 1944 by John von Neumann, who worked on the Manhattan project at the time

- John von Neumann – Hungarian-American mathematician, physicist, and computer scientist. He modified the ENIAC by making it programmable and then wrote programs for it to do H-bomb calculations. Von Neumann is credited with developing the equilibrium strategy of mutual assured destruction (MAD). His last work, *The Computer and the Brain* discusses how the brain can be viewed as a computing machine. He also worked on the philosophy of artificial intelligence with Alan Turing

And winner is!

- Who invented the computer?
  - Mauchly and Eckert?
  - Atanasoff?
  - Turing?
 - Zuse?
  - ?

- And the answer is:
  - p. 84

Defining characteristics of some early digital computers of the 1940s (In the history of computing hardware)

| Name	First operational	Numeral system	Computing mechanism	Programming	Turing complete
Zuse Z3 (Germany)	May 1941	Binary floating point	Electro-mechanical	Program-controlled by punched 35 mm film stock (but no conditional branch)	In theory (1998)
Atanasoff–Berry Computer (US)	1942	Binary	Electronic	Not programmable—single purpose	No
Colossus Mark 1 (UK)	February 1944	Binary	Electronic	Program-controlled by patch cables and switches	No
Harvard Mark I – IBM ASCC (US)	May 1944	Decimal	Electro-mechanical	Program-controlled by 24-channel punched paper tape (but no conditional branch)	Debatable
Colossus Mark 2 (UK)	June 1944	Binary	Electronic	Program-controlled by patch cables and switches	In theory (2011)
Zuse Z4 (Germany)	March 1945	Binary floating point	Electro-mechanical	Program-controlled by punched 35 mm film stock	Yes
ENIAC (US)	July 1946	Decimal	Electronic	Program-controlled by patch cables and switches	Yes

Question 2 (1945 – 1952)

- Who invented programming?
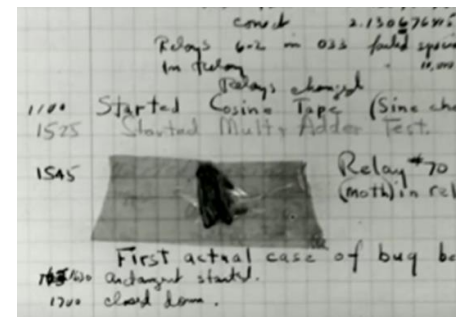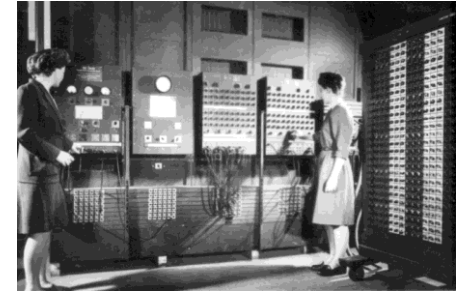
Our contestants

1945 — Von Neumann writes "First Draft of a Report on the EDVAC" describing a stored-program computer.
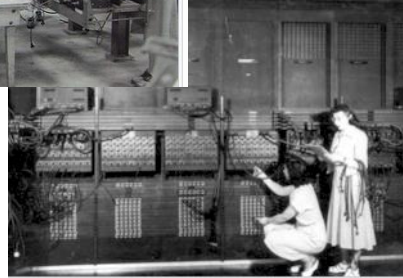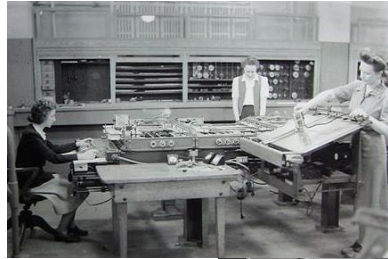
Six women programmers of ENIAC are sent to Aberdeen for training.

First ENIAC programmers

Kay McNulty
Betty Jennings
Betty Snyder
Marlyn Meltzer
Ruth Lichterman
Frances Bilas

1945 — Vannevar Bush publishes "As We May Think," describing personal computer.

Bush publishes "Science, the Endless Frontier," proposing government funding of academic and industrial research.

1950 — Turing publishes article describing a test for artificial intelligence.

1952 — Grace Hopper develops first computer compiler.

Von Neumann completes modern computer at the Institute for Advanced Study.

Programs. What are they?

- A *real* computer needs to be able to perform ANY logical operation

- [Ada](#) is often regarded as the 1st computer programmer, but it was several women involved during WW II that pioneered programming, starting with [Grace Hopper](#).

- Grace, working with [Howard Aiken](#) at Harvard (on the [Mark 1](#)), and later with John Mauchly and Presper Eckert (on the [UNIVAC](#)). She popularized the idea of 'machine-independent programming languages' leading to the development of [COBOL](#).

Dr. Grace Hopper told a reporter, programming was "just like planning a dinner. You have to plan ahead and schedule everything so that it's ready when you need it…. Women are 'naturals' at computer programming."

Programmers. Who were they?

ENIAC – the "Giant Brain"

- Men built computers.

- Women programed them.

  1946 – ENIAC at Penn - the '6 women of ENIAC'

Marlyn Meltzer

Ruth Lichterman

Betty Jennings

Kay McNulty

Betty Snyder

Frances Bilas

ENIAC contained 20,000 vacuum tubes, 7200 crystal diodes, 1500 relays, 70,000 resistors, 10,000 capacitors and approximately 5,000,000 hand-soldered joints. It weighed more than 30 short tons (27 t), was roughly 2.4 m × 0.9 m × 30 m (8 × 3 × 100 feet) in size, occupied 167 m^2 (1,800 ft^2) and consumed 150 kW of electricity. Several tubes burned out almost every day, leaving ENIAC nonfunctional about half the time.

And winner is!

- Who invented proramming?
  - Ada (Countess of Lovelace)?
  - Hopper"?
  - The 6 women of ENIAC?
  - ?

- And the answer is:
  - p. 117

'Thinking Machines'. The Birth of AI…

- Vannevar Bush – American engineer and inventor, writes 'As We may Think' in 1945

- Alan Turing – an English computer scientist, mathematician, logician, cryptanalyst, philosopher, and theoretical biologist writes 'Computing Machinery and Intelligence' in 1950 on the topic of artificial intelligence

- Turing test – also known as the 'Imitation Game' – a test of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human
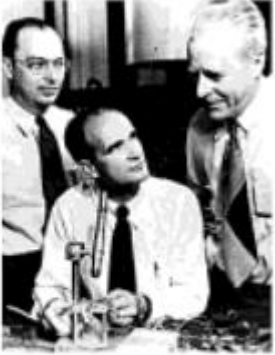
Question 3 (1947 – 1956)

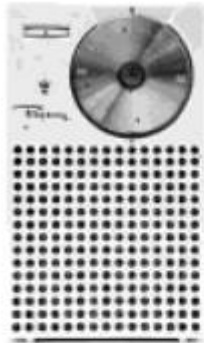- What is a 'transistor', and who invented it?

Our contestants

1947
Transistor invented at Bell Labs.

John Bardeen
Walter Brattain
William Shockley

1954
Texas Instruments introduces silicon transistor and helps launch Regency radio.

1956
Shockley Semiconductor founded.

First artificial intelligence conference.

The Transistor. What is it?

- A **transistor** is a semiconductor device used to amplify or switch electronic signals and electrical power. Today, transistors are packaged individually, but most are embedded in integrated circuits.
  - A **semiconductor** has an electrical conductivity value falling between that of a conductor, such as copper, and an insulator, such as glass
  - An **integrated circuit** (also referred to as an **IC**, a **chip**, or a **microchip**) is a set of electronic circuits on one small flat piece (or "chip") of semiconductor material, normally silicon.
- Shockley melt-down
  - Shockley, angered by not being included on the patent applications, secretly continued his own work to build a different sort of transistor
  - Bardeen began pursuing a theory for superconductivity and left Bell Labs in 1951
  - Brattain refused to work with Shockley further and was assigned to another group
  - Shockley could generally be summed up as domineering and increasingly paranoid
  - In 1956 Shockley started Shockley Semiconductor Laboratory, then in late 1957 eight of Shockley's researchers known as the "traitorous eight", resigned after Shockley decided not to continue research into silicon-based semiconductors…

The Transistor. What is it?

- William Shockley – theorized a solid-state replacement for the vacuum tube (an essential component of digital computers) – manager of the Bell Labs team that invented the transistor, incl. Bardeen and Brattain

- John Bardeen – quantum theorist, tasked to explain why early experiments failed, then focus on new 'surface state' experiments

- Walter Brattain – the 'lazy physicist', deft experimentalist, working side-by-side with Bardeen

- December 16, 1947 – Bell Labs – a strip of gold foil, a chip of semiconducting material, and a bent paper clip – a working transistor had been invented by Bardeen and Brattain

- When Bardeen gets home, he tells his wife "We discovered something important today." – *perhaps the understatement of the century…*

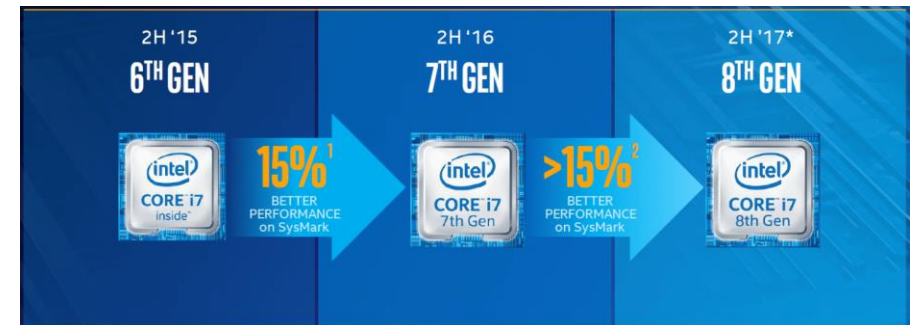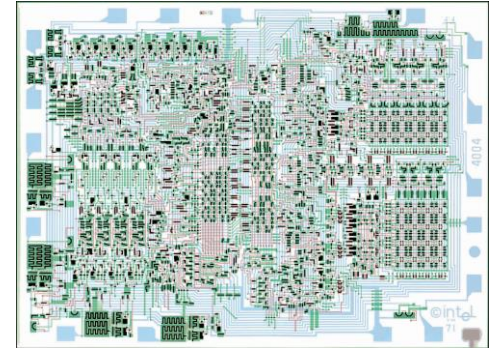# And winner is!

- Who invented the transistor?
  - Shockley?
  - Bardeen?
  - Brattain?
  - Mataré and Welker (1st functional "European" transistor, Paris – 1948)?
  - ?

- And the answer is: Not Shockley… p.164

Question 4 (1957 – 1959)

- What is a 'microchip', and who invented it?
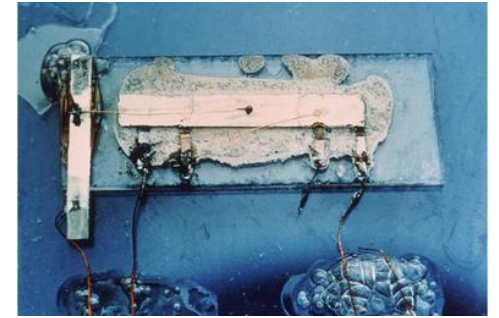
Our contestants

1957 — Russia launches *Sputnik*.

1958 — Advanced Research Projects Agency (ARPA) announced.

Jack Kilby demonstrates integrated circuit, or microchip.

1959 — Noyce and Fairchild colleagues independently invent microchip.

Arthur Rock

Intel founders
Gordon Moore, Robert Noyce, Andy Grove

A Microchip. What is it?

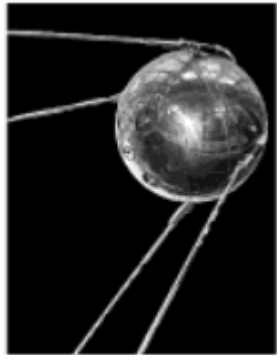- The 'tyranny of numbers': as the number of components in a circuit increased, the number of connections increased way faster

- The solution: an 'integrated circuit' or 'microchip'

- An **integrated circuit** (also referred to as an **IC**, a **chip**, or a **microchip**) is a set of electronic circuits on one small flat piece (or "chip") of semiconductor material, normally silicon (video1, video2)

- Concurrent invention: Texas Instruments and Fairchild Semiconductor

A Microchip. The Inventors

- Texas Instruments – Jack Kilby, September 1958 demonstrates the integrated circuit – "A new era in electronics had begun."

- Fairchild Semiconductor (established by the 'Traitorous Eight') funded by Sherman Fairchild on Arthur Rock's recommendation

Jean Hoerni, physicist, proposes building up an oxide layer on the surface of the transistor (dubbed 'the planar process'), then engrave tiny windows in the oxide layer to diffuse impurities at precise spots to create desired semiconductor properties

Gordon Moore, C. Sheldon Roberts, Eugene Kleiner, Robert Noyce, Victor Grinich, Julius Blank, Jean Hoerni and Jay Last. (1960)

A Microchip. The Inventors

- Robert Noyce calls John Ralls, Fairchild's patent lawyer. John asks "What else can we do with these ideas…"

- Robert Noyce and Gordon Moore pondered John's question and in January 1959 wrote "It would be desirable to make multiple devices on a single piece of silicon."

- Kilby tried to overcome the 'tyranny of numbers' problem. Noyce was motivated by neat tricks that could come from Hoerni's planar process

- Thus began the patent wars of the '60s – so who invented the IC?

What did the beaver tell the rabbit at the base of the Hoover Dam?
"No, I didn't build it myself, but it's based on an idea of mine."

And winner is!
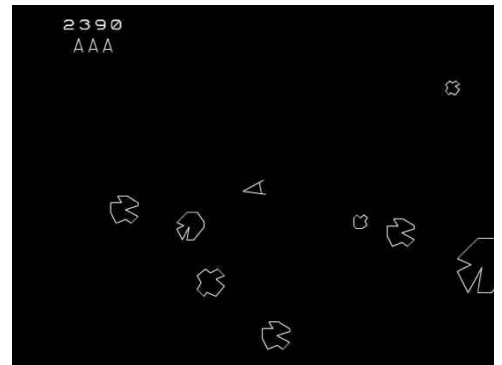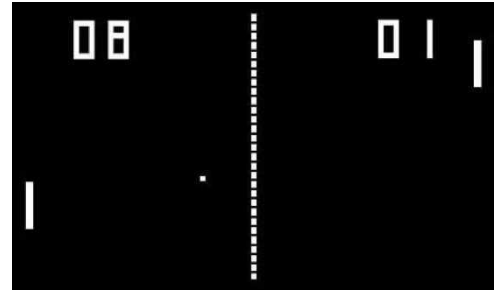
- Who invented the microchip?
  - Kilby?
  - Noyce and Moore?
  - ?

- And the answer is: p. 180

Question 5 (1961 – 1972)

• Who invented the video game?

Our contestants

1961 President Kennedy proposes sending man to the moon.

1962 MIT hackers create *Spacewar* game.

Steve Russell
Dan Edwards
Peter Samson

1972

Ted Dabney
Nolan Bushnell
Fred Marincic
Al Alcorn

& Pong

Video Games. What are they?

- With the evolution of microchips, it was just a matter of time before computers went from number crunching to having fun

- Steve Russell - American computer scientist, creator of *Spacewar!,* with members of the Tech Model Railroad Club at MIT, mentor of Bill Gates and Paul Allen on the DEC PDP-10, at Lakeside School (Seattle)

- Nolan Bushnell – established Atari, Inc. and Chuck E. Cheese, known as 'one of the founding fathers of the video game industry'

- Ted Dabney - co-founder of Syzygy (p.210) then Atari with Nolan Bushnell. *Computer Space w*as their first product at Syzygy.

- Al Alcorn - used Ted Dabney's video circuit created for Computer Space to create *Pong*

And winner is!

- Who invented the first video game?
    - Russell?
    - Bushnell?
    - Dabney?
    - Alcorn?
    - ?

- And the answer is: p. 215

Question 6 (1945 – 1969)

- Who invented the 'internet and why?
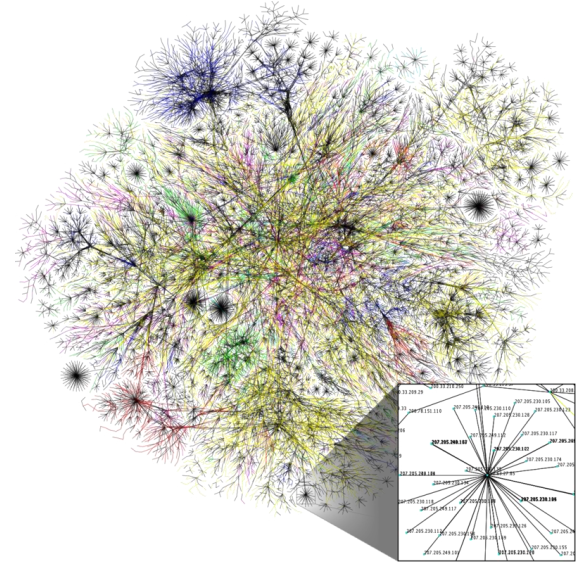
Our contestants

1945 Bush publishes "Science, the Endless Frontier," proposing government funding of academic and industrial research.
Link

1960 J. C. R. Licklider publishes "Man-Computer Symbiosis."
Link

Paul Baran at RAND devises packet switching.
Link

1962 Licklider becomes founding director of ARPA's Information Processing Techniques Office.

Doug Engelbart publishes "Augmenting Human Intellect."
Link

1963 Licklider proposes an "Intergalactic Computer Network."
Link

1966 Bob Taylor convinces ARPA chief Charles Herzfeld to fund ARPANET.

1967 ARPANET design discussions in Ann Arbor and Gatlinburg.

1968 Larry Roberts sends out request for bids to build the ARPANET's IMPs.

1969 First nodes of ARPANET installed.

The Internet. What is it?

- The Internet was built in partnership among the military, universities, and private corporations – the military-industrial-academic complex

- It is a global system of interconnected computer networks that use the Internet protocol suite (TCP/IP) to link devices worldwide. It is a *network of networks*

How did we get here?

- July 1945 – Vannevar Bush, with experience and influence in all 3 camps, at Roosevelt's behest, wrote 'Science, the Endless Frontier"

"basic science... is absolutely essential to national security"

SCIENCE - THE ENDLESS FRONTIER

"New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life."--
FRANKLIN D. ROOSEVELT November 17, 1944.

The Internet. How did we get here?

- 1960 - J. C. R. Licklider, America psychologist and computer scientist, known as 'computing's Johnny Appleseed', wrote 'Man-Computer Symbiosis', then 'Intergalactic Computer Network' in 1963

  "Consider the situation in which several different centers are netted together…"

- 1966 - Bob Taylor (American Internet pioneer) and Larry Roberts (American scientist) – worked together, but didn't get along very well.

  Roberts says Taylor is bitter because he didn't get enough credit: "I don't know what to give him credit for other than hiring me. That's the only important thing Bob did."

- But together Bob and Larry created ARPANET, which was the predecessor to the modern Internet

Packet Switching

- Packet switching is an efficient method of 'store and forward switching' where messages are broken into bite-size packets, and are given address headers describing where they should go.

- Paul Baran – every node has equal power to switch and route data

- Donald Davies – coined the term 'packet'

- Leonard Kleinrock – 1988 (Toward A National Research Network)

And winner is!

- Who invented the internet?
  - Bush?
  - Licklider?
  - Taylor and Roberts?
  - Baran, Davies, and Kleinrock?
  - What about Al Gore?
  - ?

- And the answer is: p. 260

Question 7 (1945 – 1980)

- Who put the word 'personal' in <u>personal</u> computer ?

Our contestants

1945 — Vannevar Bush publishes "As We May Think," describing personal computer.

([Document])

1963 — Engelbart and Bill English invent the mouse.

1964 — Ken Kesey and the Merry Pranksters take bus trip across America.

1966 — Stewart Brand hosts Trips Festival with Ken Kesey.

1968 — Engelbart stages the Mother of All Demos with Brand's help.

1973 — Alan Kay helps to create the Alto at Xerox PARC.

Ethernet developed by Bob Metcalfe at Xerox PARC.

Our contestants (continued)

1973

Community Memory shared terminal set up at Leopold's Records, Berkeley.

1974 Intel 8080 comes out.

1975

Popular Electronics

HOW TO "READ" FM TUNER SPECIFICATIONS

PROJECT BREAKTHROUGH!
World's First Minicomputer Kit to Rival Commercial Models...
"ALTAIR 8800" SAVE OVER $1000

Altair personal computer from MITS appears.

Ed Roberts

1975

Paul Allen and Bill Gates write BASIC for Altair, form Microsoft.

1975

First meeting of Homebrew Computer Club.

APPLE COMPUTER

Steve Jobs and Steve Wozniak launch the Apple I.

1977

The Apple II is released.

1979 Jobs visits Xerox PARC.

1980

IBM commissions Microsoft to develop an operating system for PC.

A 'Personal' Computer. What is it?

- Personal computer - a mass-market consumer electronic device starting the microcomputer revolution of the 1980s with the launch of the IBM Personal Computer in 1981

- The Atlantic Monthly, 1945 – Vannevar Buch states in his article 'As We May Think'

"Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and to coin one at random, memex will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory."

Who Put 'Personal' in Personal Computer?

- 1963 – Doug Engelbart and Bill English invent the 'mouse'

- 1966 – Stewart Brand assists Doug Engelbart with the 'Mother of All Demos' - 90-minute demo of fundamental elements of a modern PC (**MAD videos**)

- 1973 – Alan Kay (Xerox PARC) - pioneer on object-oriented programming and windowing graphical user interface design – developed the Xerox Alto (1st computer with graphical user interface) p.102

- 1975 – Ed Roberts (MITS) develops the Altair 8800 'personal computer' running the Intel 8080 CPU

- 1975 – Paul Allen and Bill Gates write Basic for the Altair 8800. Paul went to work for MITS and Bill took a leave of absence from Harvard to work with Allen in Albuquerque. They named their partnership 'Micro-Soft'

Who Put 'Personal' in Personal Computer?

- 1976 – Steve Jobs and Steve Wozniak co-found Apple to sell the Apple 1 personal computer

- 1979 – Steve visits Xerox PARC p. 362

- 1981 – IBM commissions Microsoft to develop their PC operating system (MS-DOS)

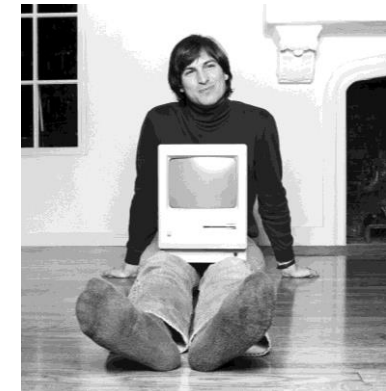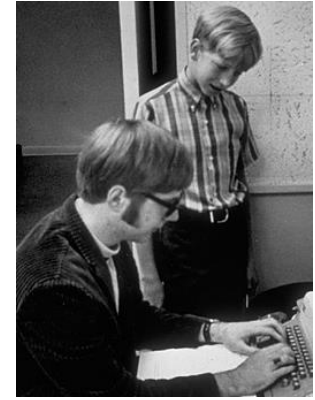**1981 Nightline video (start – 5:07)**

And winner is!

- Who invented the personal computer?
  - Bush?
  - Engelbart?
  - Kay?
  - Roberts?
  - Allen and Gates?
  - Jobs and Wozniak?
  - ?

- And the answer is: p.308

Question 8 (1975 – 1991)

- Where did 'software' come from?

Our contestants

1975 — Paul Allen and Bill Gates write BASIC for Altair, form Microsoft.

1979 — Dan Bricklin Creates VisiCalc

1983 — Microsoft announces Windows.

1983 — Richard Stallman begins developing GNU, a free operating system.

1984 — Apple introduces Macintosh.

1991 — Linus Torvalds releases first version of Linux kernel.

Software. What is it?

- Computer software, or simply software, is a part of a computer system that consists of data or computer instructions, in contrast to the physical hardware - software is usually written in high-level programming languages

- Software examples include application software, system software, and malicious software or malware

Where did Software come from?

- Ada wrote the first piece of software (an algorithm) in the 19th century for Babbage's Analytical Engine

- Alan Turing wrote his theory about software in 1935 (*Computable numbers with an application to the Entscheidungsproblem*)

- Programs stored in memory of digital computers became possible after 1948 – very limited

- The advent of 'personal computer' software made the hardware 'useful', starting with the BASIC interpreter written by Gates and Allen for the Altair 8800, allowing users to create their own programs – this effort launched the PC software industry!

Where did Software come from?

- 1979 - Dan Bricklin - "The Father of the Spreadsheet" – co-invented VisiCalc with Bob Frankston, available on Tandy TRS-80… for $100 – awarded a patent for VisiCalc in 1981 (programs now eligible)

- 1983 - Bill Gates announces Windows p. 366 (**1986 video**)

- 1983 - Richard Stallman – software should be free, launched the GNU Project, promoted copyleft and founded the Free Software Foundation

- 1984 - Steve Jobs – introduces the Mac* (**video**)

- 1991 - Linus Torvalds - creator, and (initially) principal developer of the Linux kernel – foundational to Linux, Android, and Chrome OS

And winner is!

- Who invented software?
  - Bricklin?
  - Gates?
  - Stallman?
  - Jobs?
  - Torvalds?
  - ?

- And the answer is: p.381

Question 9 (1971 – 1993)

- Where did the idea of 'online' (computing) come from?

Online (Computing). What is it?

- The Internet and PC, both born in the '70s, grew up apart from one another

- It didn't help that AT&T's monopoly over the nation's phone system made it illegal to connect anything 'not made by them' directly to a phone line hence the introduction of the acoustic coupler in 1963, approaching break-neck speeds with the AT&T 1200-baud modem in 1977, and the Hayes smart-modem in 1985 (following AT&T breakup in 1984)

- Acoustic-coupled modems facilitated the creation of dial-up bulletin board systems and online services in the late 70s

Our contestants

1971
Ray Tomlinson invents email.

1973
Vint Cerf and Bob Kahn complete TCP/IP protocols for the Internet.

1978
First Internet Bulletin Board System.

1979
Usenet newsgroups invented.

1985
THE WELL
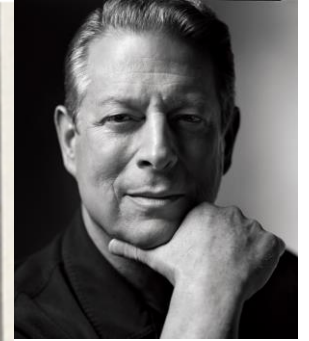
Stewart Brand and Larry Brilliant launch The WELL.

CVC launches Q-Link, which becomes AOL.

1993
Steve Case's AOL offers direct access to the Internet.

1993
Al Gore – National Information Infrastructure Act of 1993

Who invented 'on-line'?

- 1971 - Ray Tomlinson - implemented the first email program on ARPANET
- 1973 – Vint Cerf and Bob Kahn – co-invented TCP/IP, providing end-to-end communication specifying how data is packetized, addressed, transmitted, routed, and received
- 1985 – Stewart Brand and Larry Brilliant established The WELL*
- 1985 – Jim Kimsey and Steve Case – co-found AOL (**video :20 – 6:43**)
- 1993 – Al Gore – until 1992, it was illegal to connect a commercial service to the Internet. Gore led the effort to push through the 'National Information Infrastructure Act of 1993' that made the Internet available to the public and moved it into the commercial sphere

*Whole Earth 'Lectronic Link

And winner is!

- Who invented 'online' computing?
  - Tomlinson?
  - Cerf and Kahn?
  - Brand and Brilliant?
  - Kimsey and Case?
  - Gore?
  - ?

- And the answer is: p.403

Question 10 (1991 – 2001)

- Who invented the
  World Wide Web (WWW)?

Key Layers of the Internet

milestones

Layer	Milestone
CONTENT	1987-HyperCard — Bill Atkinson
SEARCH ENGINE*	1998-Google — Brin & Page
BROWSERS	1993-Mosaic — Marc Andreessen
WORLD WIDE WEB	1990-http:// — Tim Berners-Lee
INTERNET	1975-TCP/IP — Cerf & Kahn
NETWORKS	1973-Ethernet — Robert Metcalfe
COMPUTERS	1976-Apple — Jobs & Wozniak

The WWW. What is it?

- Modems and Online Services made connection to the Internet possible, but for most accessing anything useful was an ordeal

- The World Wide Web (Tim Berners-Lee – 1991 "WorldWideWeb: Proposal for a Hypertext Project" –

- **World Wide Web** ("**WWW**" or simply the "**Web**") is a global information medium which users can read and write via computers connected to the Internet. The Web is a service that operates over the Internet, just as e-mail does.

Who's responsible?

1991 — Tim Berners-Lee announces World Wide Web.
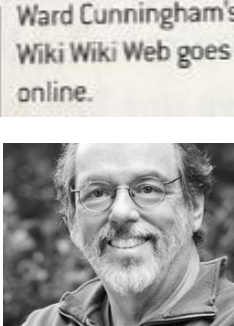
1993 — Marc Andreessen announces Mosaic browser.

1994 — Justin Hall launches Web log and directory.

HotWired and Time Inc.'s Pathfinder become first major magazine publishers on Web.

1995 — Ward Cunningham's Wiki Wiki Web goes online.

1998 — Larry Page and Sergey Brin launch Google.

1999 — Ev Williams launches Blogger.

2001 — Jimmy Wales, with Larry Sanger, launches Wikipedia.

WWW Inventors

- 1991 – Berners-Lee - received the 2016 Turing Award "for inventing the World Wide Web, the first web browser, and the fundamental protocols and algorithms allowing the Web to scale"

- 1993 – Marc Andreessen - co-author of Mosaic, the first widely used Web browser; co-founder of Netscape

- 1994 – Justin Hall – Web logs become blogs

- 1995 – Ward Cunningham - created WikiWikiWeb, the first internet wiki - users collaboratively modify content from a web browser

- 1998 – Larry Page and Sergey Brin launch Google

- 1999 – Ev Williams launches Blogger (acquired by Google in 2003)

- 2001 – Jimmy Wales and Larry Sanger launch Wikipedia (from Nupedia)

And winner is!

- Who invented the World Wide Web?
  - Tim Berners-Lee?
  - Andreessen?
  - Hall?
  - Cunningham?
  - Page and Brin?
  - Williams?
 - Wales and Sanger?
  - ?

- And the answer is: p. 464

Question 11 (2001 – current)

- What is the next great technology 'idea'?
- Where will it come from?

Today's innovators

- [Jeff Bezos](). Founder and CEO of Amazon.com, Bezos revolutionized e-commerce. (1994)

- [Elon Musk](). Co-founder of Paypal, founder of Tesla, and SpaceX.

- [Richard Branson](). British founder of Virgin Group.

- [Ray Kurzweil](). Futurist, inventor, researcher, and author, Director of Engineering at Google working in the field of AI.

- [Martine Rothblatt](). Founder of United Therapeutics, and Sirius Satellite Radio. Pioneering innovations in space science, satellites, and the human genome project.

- [Larry Ellison](). Co-founder of Oracle, and long-time pioneer and innovator in the software industry.

- [Michael Dell](). Founder of Dell Computers, changed the PC industry with his innovative business methods.

- [Mark Zuckerberg](). Co-founder of Facebook, responsible for the most successful social networking website on the internet.
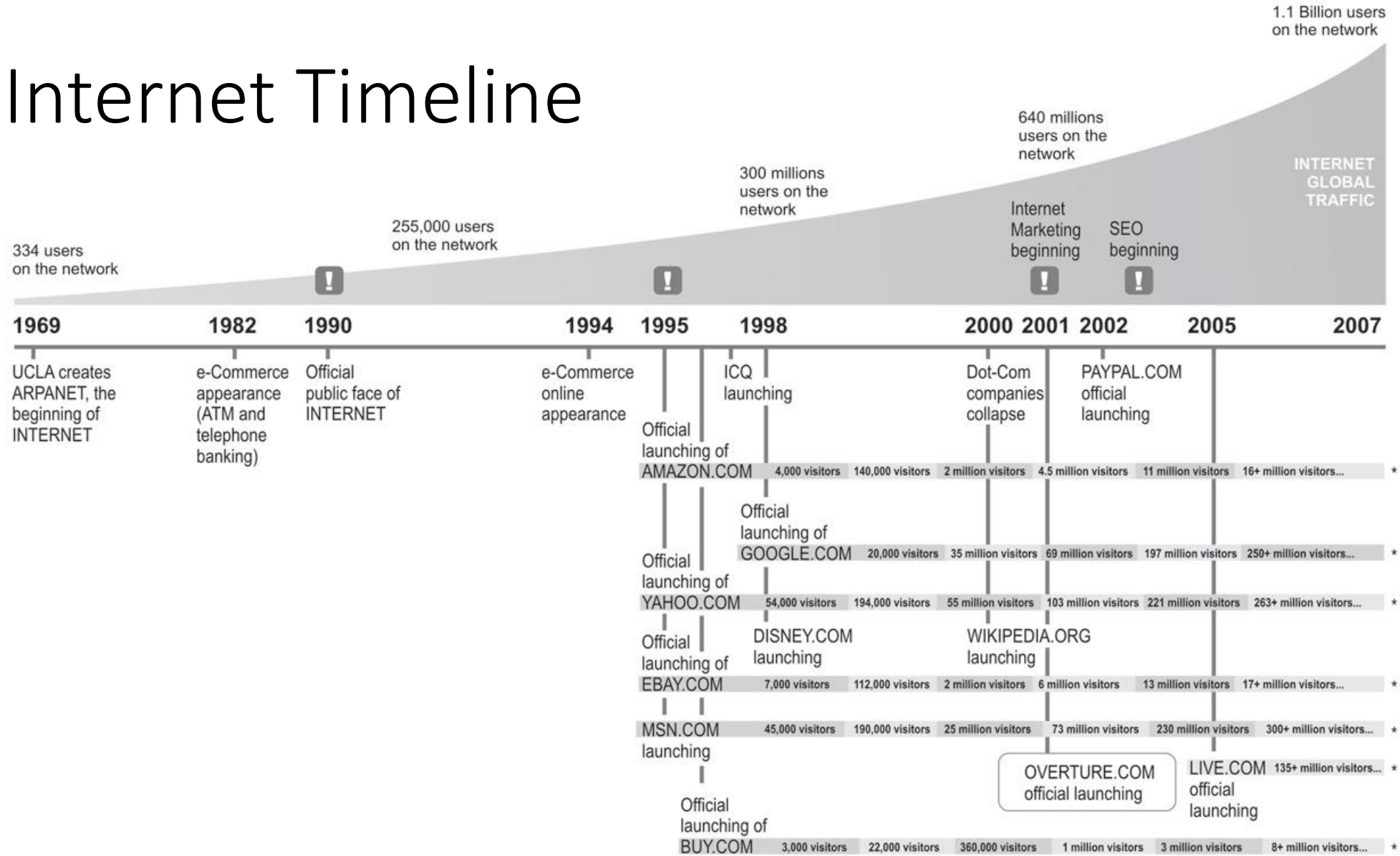
[And many more](1)...
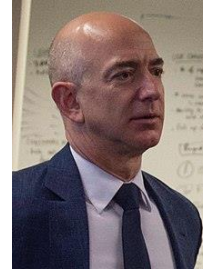
[Steve]()

[Sergey & Larry]()

Up & Coming Gen Y Innovators

- Mark Zuckerberg. The billionaire co-founder and CEO of Facebook is responsible for the most successful social networking website on the internet, born while he was studying at Harvard.

- Dustin Moskovitz. A former co-founder of Facebook with Mark Zuckerberg, Moskovitz left Facebook to found Asana, the web-based productivity software.

- Blake Ross. The pioneering founder of the Mozilla Firefox project, the successful open-source browser, Ross also worked at Facebook as head of product.

- Matt Brimer. Brimer is the co-founder of General Assembly, a global education company that provides entrepreneurs with opportunities and education in technology, design, and business.

- Jay Kimmelman. Kimmelman is the co-founder of Bridge International, a nonprofit designed to bring low-cost high quality education to those living on less than $2 a day.

- Ben Rattray. Founder and CEO of change.org, the online petition site focused on social change. Rattray has been named one of Fortune's 40 under 40 rising young business leaders.

- Leila Janah. Janah is the founder and CEO of Samasource, a nonprofit organization whose mission is to connect poor women and youth to the digital economy and "harness the untapped potential of the world's poor."

- Daniel Epstein. Co-founder of Unreasonable Institute, a "boot camp" for social entrepreneurs from around the world, Epstein offers successful applicants the opportunity to connect with mentors and potential investors and access the resources to make their dreams a reality.

- Pete Cashmore. Founder and CEO of Mashable, Cashmore is responsible for one of the most influential blogs and one of the world's largest websites.

- Elliott Bisnow. Bisnow is the founder and CEO of Summit Series, an innovative conference series for entrepreneurs based in Utah.

- Jack Andraka was only born in 1997, but by the age of 15 he has already changed the world with his innovation. Andraka has developed a new way to detect pancreatic, ovarian, and lung cancer during early stages when there is a much higher likelihood of a cure. His inexpensive method, which could save countless lives, won the 2012 Gordon E. Moore Award, the grand prize of the Intel International Science and Engineering Fair.

- Eesha Khare is another impressive young innovator, who at the age of 18 created a tiny device that could charge a mobile phone in 20-30 seconds—a revolutionary technology she calls a "super-capacitor." She won the 2013 Intel Foundation Young Scientist Award for her invention, and plans to use the prize money to pay for her tuition at Harvard and continue her work as an inventor.

Timelines (1843 – 2011)

Internet Timeline

PC Timeline

Web Timeline

Video Game Timeline

VIDEO GAME timeline

As the world of video games continue to evolve, we take a look back at popular consoles and video games that helped make Nintendo, Sony, and Microsoft the giants they are today.

1967
German-born television engineer Ralph Baer and his coworkers design the first video-game console that works on a standard television and dub it "Brown Box." They develop a chase game, allowing players to control two squares chasing each other on the screen. A modified toy gun is made and able to distinguish spots of light on the screen. 12 Other games are made

1972
The world's first home video game console, the Magnavox Odyssey, sold 330,000 units in it's lifetime

1972
One of the earliest arcade video games, PONG, is a simple tennis game that became the first commercially successful video game

1974
Gran Trak 10, the first racing arcade game, is released. It is the first arcade game to use ROM.

1974
Maze Wars is released. Considered to be the earliest first person shooter.

1976
Atari releases Break-out. The prototype was designed by Apple cofounders Steve Jobs and Steve Wozniak. Blackberry's current variant is called Brick Breaker

1977
Nintendo releases Color TV Game 6, packing 6 variations of "Light Tennis" (pong)

1977
Atari opens the first Pizza Time Theatre (later Chuck E. Cheese's), a video arcade pizzeria

1977
Atari releases the Video Game Computer System (Atari 2600 or VCS). It is the most successful video game console of its time

1979
Notable Releases:
Asteroids
Lunar Lander
Monaco GP
Flight Simulator

1980
Mattel releases the Intellivision video console; releasing a total of 125 games during it's lifetime

2nd Generation

1978
Notable Releases:
Space Invaders
Space Wars
Bee Gee

1980
Notable Releases:
Pac-Man
Missile Command
Defender
Centipede

1981
Notable Releases:
Galaga
Donkey Kong
Frogger

1982
Notable Releases:
Q-Bert
Tron
Megamania
Dig Dug
Pole Position
Joust

1983
Sega Releases the SG-1000 to the Japanese market. Finding only minor success

1983
Nintendo releases the Family Computer console in Japan and is later released in the United State as the Nintendo Entertainment System; 62 million units sold

3rd Generation

1984
Notable Releases:
Dragon Buster
Tetris
Balloon Fight
Gauntlet
1942
Paperboy

1985
Nintendo releases the NES in the US. Super Mario Bros. is released and sells 10 million copies before year's end; eventually being the top selling video game until 2008 with 40 million copies sold

1986
Notable Releases:
The Legend of Zelda
Out Run
Bubble Bobble
Dragon Quest
Metroid

1986
Sega releases the Sega Master System as a competitor to the NES

1987
Notable Releases:
Megaman
Street Fighter
Metal Gear
Final Lap
Castlevania
Contra
Final Fantasy
Phantasy Star
Maniac Mansion

1989
Bundled with Tetris, Nintendo releases the Game Boy and is an instant success; selling 118 million world wide

Also Released:
Power Glove
Turbografx-16
Prince of Persia

4th Generation

1988
The Sega Mega Drive (Sega Genesis in the US) is released. Sega's most successful console sold 29 million units

1990
Nintendo releases the Super Famicon (SNES); the best selling console of the 16-bit era sold 49 million units

Notable Releases:
Altered Beast
Super Mario Bros. 3
Power Pad

Other Releases:
Neo Geo
Game Genie
TurboExpress
Bonk's Adventure
Super Mario World
F-Zero

1991
Notable Releases:
Road Rash
Street Fighter II
Tecmo Super Bowl
Sonic the Hedgehog
Sega CD

1992
Notable Releases:
Mortal Kombat
Virtua Racing
Kirby's Dream Land
Mario Kart
Air Combat
Philips CD-i

5th Generation

1993
Notable Releases:
Ridge Racer
Star Fox
Virtua Fighter
Atari Jaguar
3DO

1994
Notable Releases:
Killer Instinct
Virtua Fighter
Earthworm Jim

Other Releases:
Resident Evil
Crash Bandicoot
Sega Super GT

1994
Sony releases the PlayStation Console and is heavily influences the end of the cartridge; 125 million units sold

Other releases:
Sega Saturn
Neo Geo CD
Sega 32X

1995
Notable Releases:
Chrono Trigger
Time Crisis

1996
Nintendo releases the N64. The last significant cartridge based home console was released in colors, it sold 33 million units sold

1997
Notable Releases:
Goldeneye 007
Final Fantasy 7
Oddworld
Grand Theft Auto
Gran Turismo

1998
Nintendo releases the Gameboy Color

Other Releases:
Rainbow Six
Metal Gear Solid
Xenogears

1999
Sega releases the Dreamcast. Considered to be ahead of its time and the pioneer of online gaming, the Dreamcast sold 10.6 million units

6th Generation

2000
Sony releases the PS2, 138 million units sold and is the best selling console to date

Other Releases:
Perfect Dark
Chrono Cross
Skies of Arcadia

2001
With their first venture into the video game console market, Microsoft releases the XBOX; 24 million units sold

2001
Nintendo releases the Gameboy Advance. With several different variants and colors, 81 million are sold

Other Releases:
Paper Mario
Devil May Cry
Halo

2001
Nintendo releases the Gamecube. Nintendo's first console to use optical discs; 21 million units sold

2002
Notable Releases:
SOCOM
Animal Crossing
Kingdom Hearts
Vice City
Splinter Cell
Medal of Honor

2004
Sony releases the first handheld console to use an optical disc, the Playstation Portable

2004
Nintendo releases the Nintendo DS sporting a touchscreen and stylus

Other Releases:
Fable
Halo 2

7th Generation

2005
Microsoft releases its second console, the XBOX 360

Other Releases:
Gran Turismo 4
Guitar Hero

2006
The Sony Playstation 3 and the Nintendo Wii are released just 8 days apart from each other; both enter the 3 way console war

2009
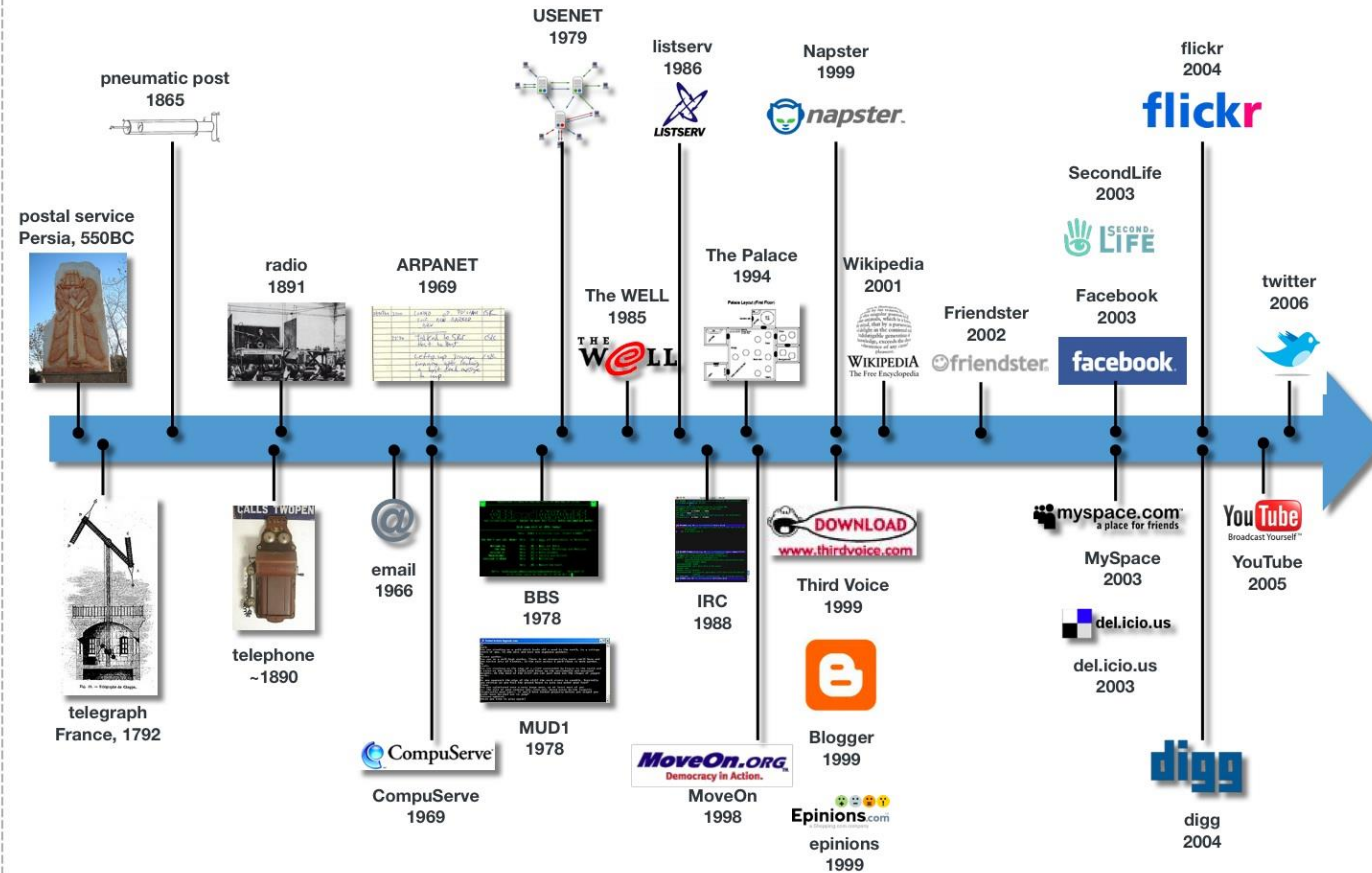Nintendo releases the Nintendo DSi and Sony releases the PSP Go.

Social Media Timeline

A (somewhat incomplete) Timeline of Social Media
not to scale

Programming Language Timeline

Mother Tongues

Tracing the roots of computer languages through the ages

Just like half of the world's spoken tongues, most of the 2,300-plus computer programming languages are either endangered or extinct. As powerhouses C/C++, Visual Basic, Cobol, Java and other modern source codes dominate our systems, hundreds of older languages are running out of life.

An ad hoc collection of engineers-electronic lexicographers, if you will-aim to save, or at least document the lingo of classic software. They're combing the globe's 9 million developers in search of coders still fluent in these nearly forgotten lingua frangas. Among the most endangered are Ada, APL, B (the predecessor of C), Lsp, Oberon, Smalltalk, and Simula.

Code-raker Grady Booch, Rational Software's chief scientist, is working with the Computer History Musuem in Silicon Valley to record and, in some cases, maintain languages by writing new compilers so our ever-changing hardware can grok the code. Why bother? "They tell us about the state of software practice, the minds of their inventors, and the technical, social, and economic forces that shaped history at the time," Booch explains. "They'll provide the raw material for software archaeologists, historians, and developers to learn what worked, what was brilliant, and what was an utter failure." Here's a peek at the strongest branches of programming's family tree. For a nearly exhaustive rundown, check out the Language List at *HTTP://www.informatik.uni-freiburg.de/Java/misc/lang_list.html.* - Michael Mendeno

Key

1954	Year Introduced
Active: thousands of users
Protected: taught at universities; compilers available
Endangered: usage dropping off
Extinct: no known active users or up-to-date compilers
Lineage continues
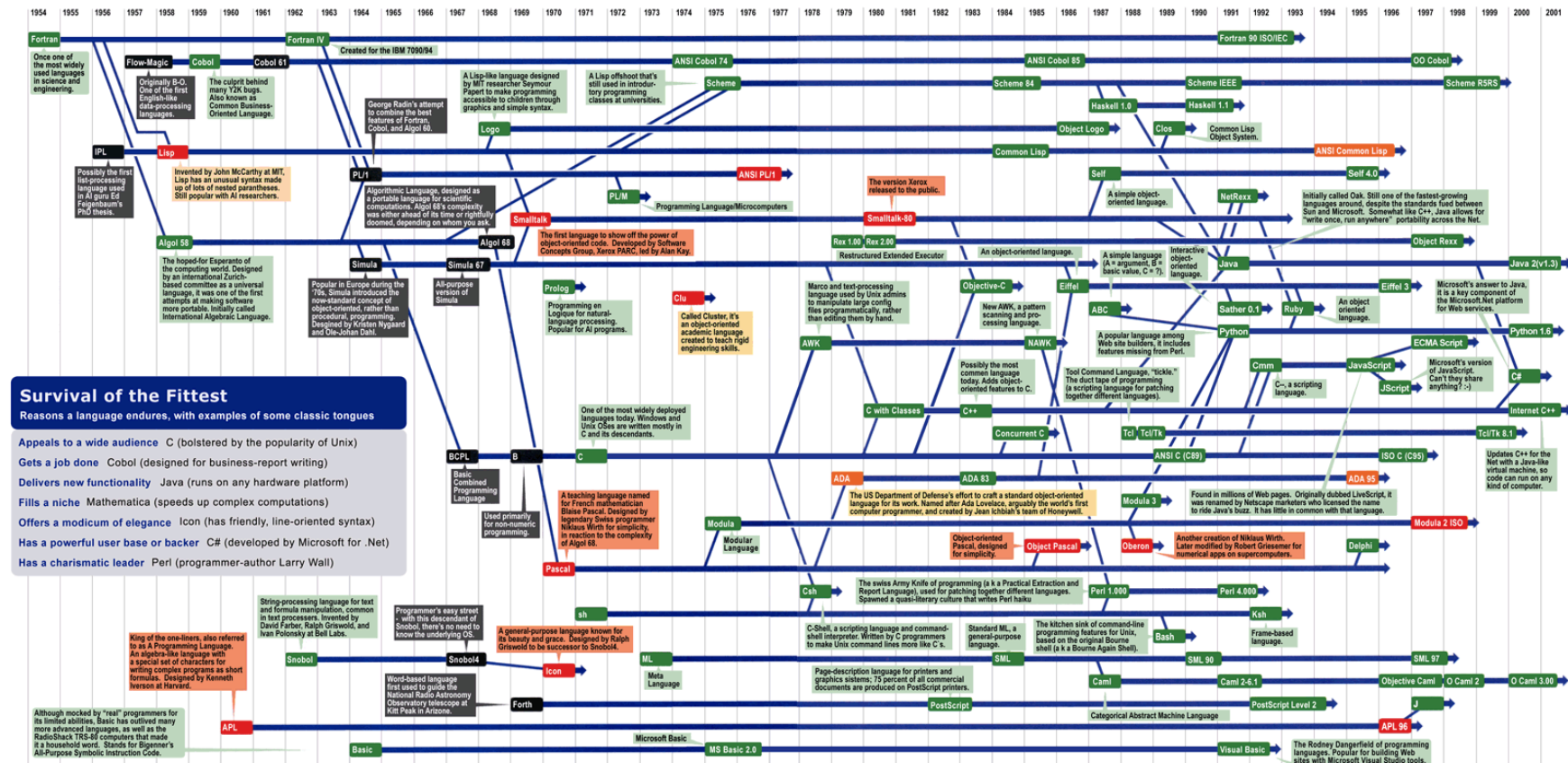
Survival of the Fittest

Reasons a language endures, with examples of some classic tongues

Appeals to a wide audience   C (bolstered by the popularity of Unix)
Gets a job done   Cobol (designed for business-report writing)
Delivers new functionality   Java (runs on any hardware platform)
Fills a niche   Mathematica (speeds up complex computations)
Offers a modicum of elegance   Icon (has friendly, line-oriented syntax)
Has a powerful user base or backer   C# (developed by Microsoft for .Net)
Has a charismatic leader   Perl (programmer-author Larry Wall)

Sources: Paul Boutin; Brent Hailpern, associate director of computer science at IBM Research; The Retrocomputing Museum; Todd Proebsting, senior researcher at Microsoft; Gio Wiederhold, computer scientist, Stanford University