Innovation for Entrepreneur

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Examples of Innovation

888147 - Innovation for Entrepreneur

Introduction

- identify sources of innovation
- identify examples of innovation in Thailand
- identify what we can learn from these examples

Brainstorm

- students create groups (e.g. 4 students)
- students sit in their groups
- each group must identify 3 examples of innovation
- research the examples
  A. why are these examples of innovation?
  B. what innovation was shown?
  C. what can we learn from these examples?

explore different sources, such as news articles, business directories, and local business communities.

Time Allocation

• introduction	20 minutes
• group research	30 minutes
• presentations	30 minutes
• summary	10 minutes

Examples

- Changes & innovation from 1954 to 2018
- But has anything changed since 2018?

Change

- What has changed since 2018?
- Food delivery e.g. Grab
- Anything else?
  - Thailand / Chiang Mai / Other?

Change

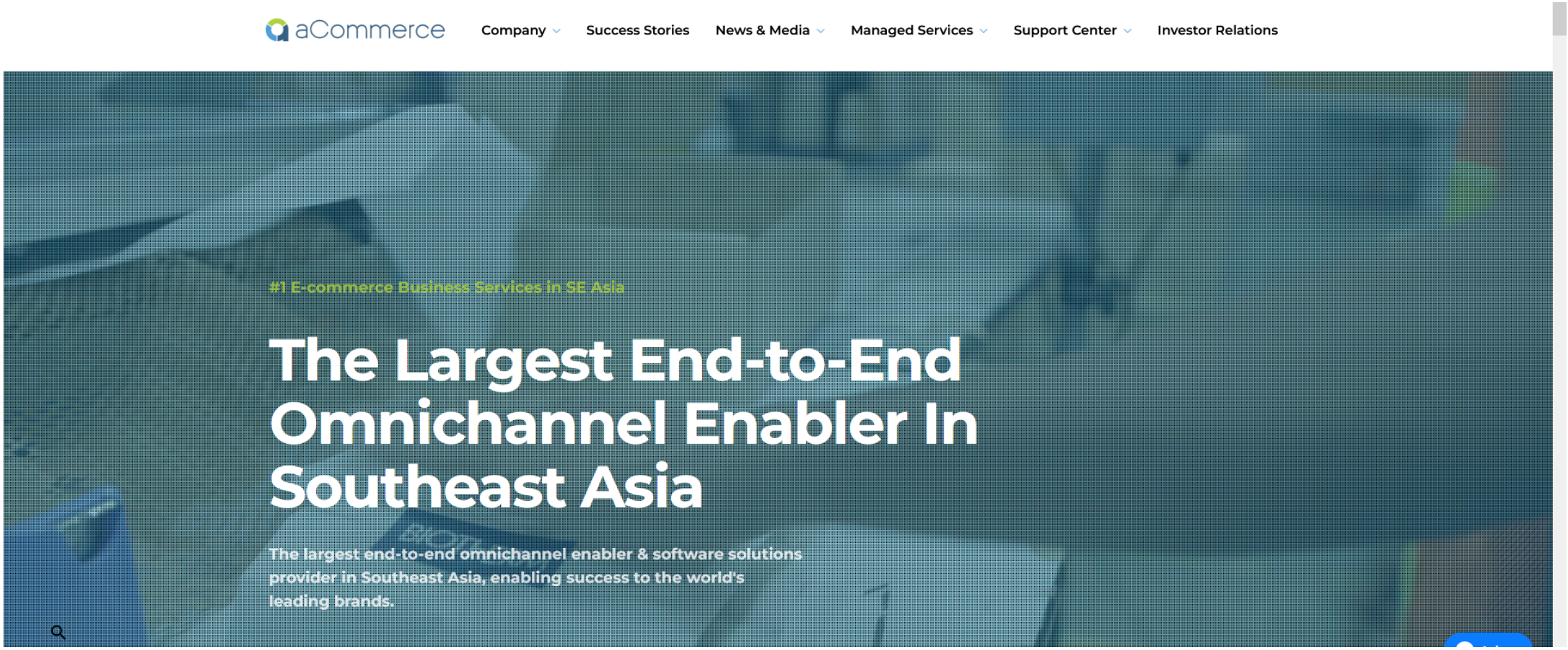
- Does innovation exist in Thailand?
  - where?
  - who?
  - how?

Examples in Thailand

- Grab is a ride-hailing platform that started in Malaysia but expanded rapidly throughout Southeast Asia, including Thailand.
- It revolutionized the way people book and travel in taxis and private cars, providing a convenient and efficient transportation solution.
- formerly GrabTaxi/GrabCar

aCommerce

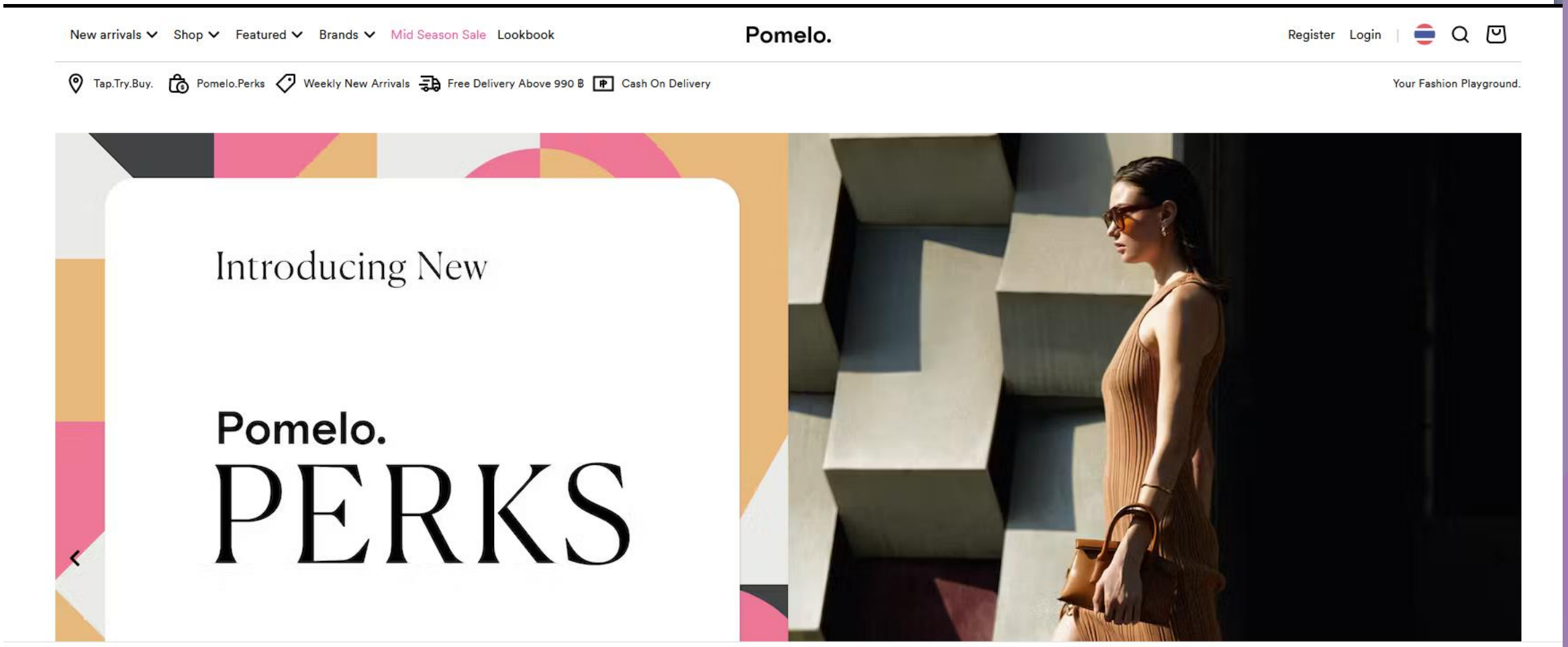
- aCommerce is a startup that offers end-to-end e-commerce solutions, including warehousing, fulfillment, and digital marketing services.
- It has played a significant role in supporting the growth of e-commerce in Thailand by providing tailored solutions for businesses to establish their online presence.



https://www.acommerce.asia/

Pomelo

- Pomelo is a fast-fashion e-commerce platform that has gained popularity for its trendy clothing and accessories.
- It has successfully combined fashion with technology, offering a seamless online shopping experience to customers and positioning itself as a leading fashion brand in the region.



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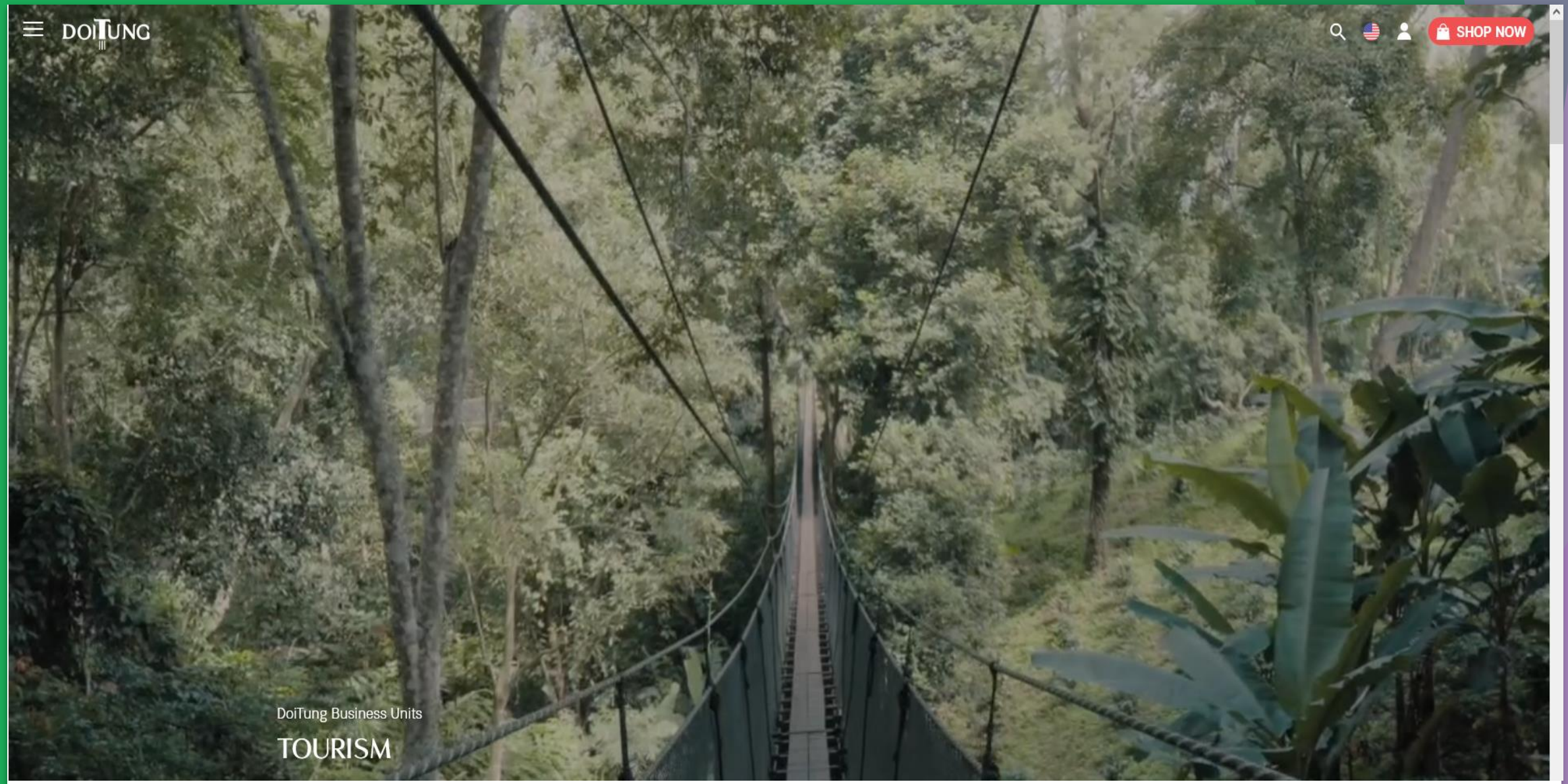

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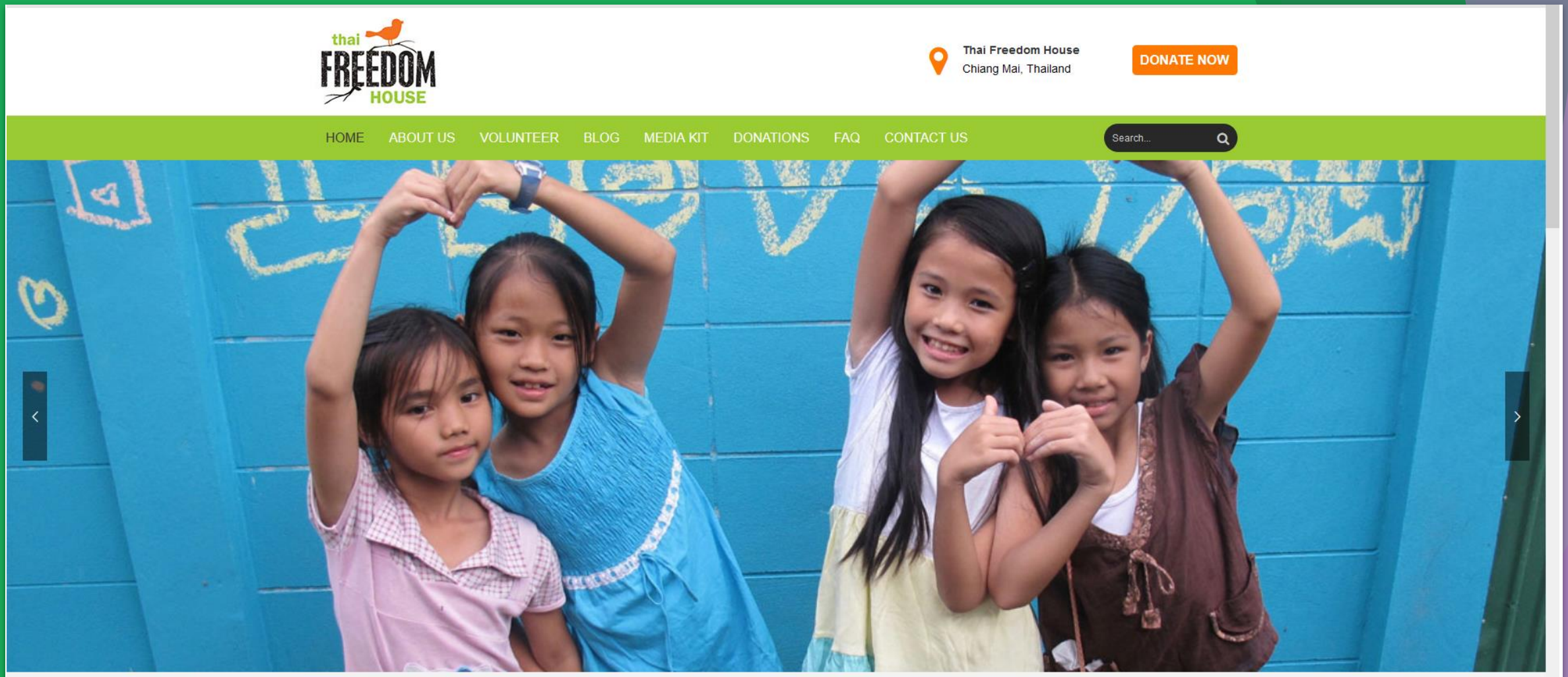

http://thaifreedomhouse.org/

https://superbee.me/

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https://daoethicalgifts.com/en/home

Omise:

- Omise is a fintech startup that provides payment gateway solutions for businesses. With its innovative technology and user-friendly interface, Omise has facilitated secure online transactions and helped businesses in Thailand embrace digital payments.

Wongnai:

- Wongnai is a popular restaurant review and food delivery platform in Thailand. It enables users to discover and review restaurants, order food for delivery, and make reservations. Wongnai has revolutionized the way people explore and experience the local food scene.

Skootar:

- Skootar is a startup that offers on-demand delivery and logistics services. It connects businesses and individuals with reliable couriers for quick and efficient deliveries. Skootar has played a crucial role in supporting the growth of e-commerce and facilitating last-mile delivery solutions.

Ookbee:

- Ookbee is a digital content platform that provides e-books, magazines, and comics to readers. It has transformed the way people consume content by offering a vast digital library accessible through mobile devices.

Eko Communications:

- Eko Communications is a communication and collaboration platform that helps businesses streamline internal communication and improve productivity. Its innovative features, such as secure messaging, audio messaging, and task management, have gained popularity among businesses in Thailand.

ChomCHOB:

- ChomCHOB is a social enterprise startup that promotes sustainable agriculture and connects farmers directly with consumers. It has created an online marketplace where consumers can purchase fresh and organic produce while supporting local farmers.

SkootJobs:

- SkootJobs is a startup that focuses on connecting job seekers with part-time or gig economy opportunities. It has provided a platform for individuals to find flexible work arrangements, contributing to the growth of the gig economy in Thailand.

Examples by Year

1954: Microwave Oven

In 1945 Raytheon's Percy Spencer stands in front of a magnetron (the power tube of radar) and feels a candy bar start to melt in his pocket: He is intrigued. When he places popcorn kernels in front of the magnetron, the kernels explode all over the lab. Ten years later Spencer patents a "radar range" that cooks with high-frequency radio waves; that same year, the Tappan Stove Co. introduces the first home microwave model.

1955: Polio Vaccine

The year Jonas Salk finds a way to prevent polio, there are 28,985 global cases; by 2017, the number drops to 22.

1956: Hard Drive

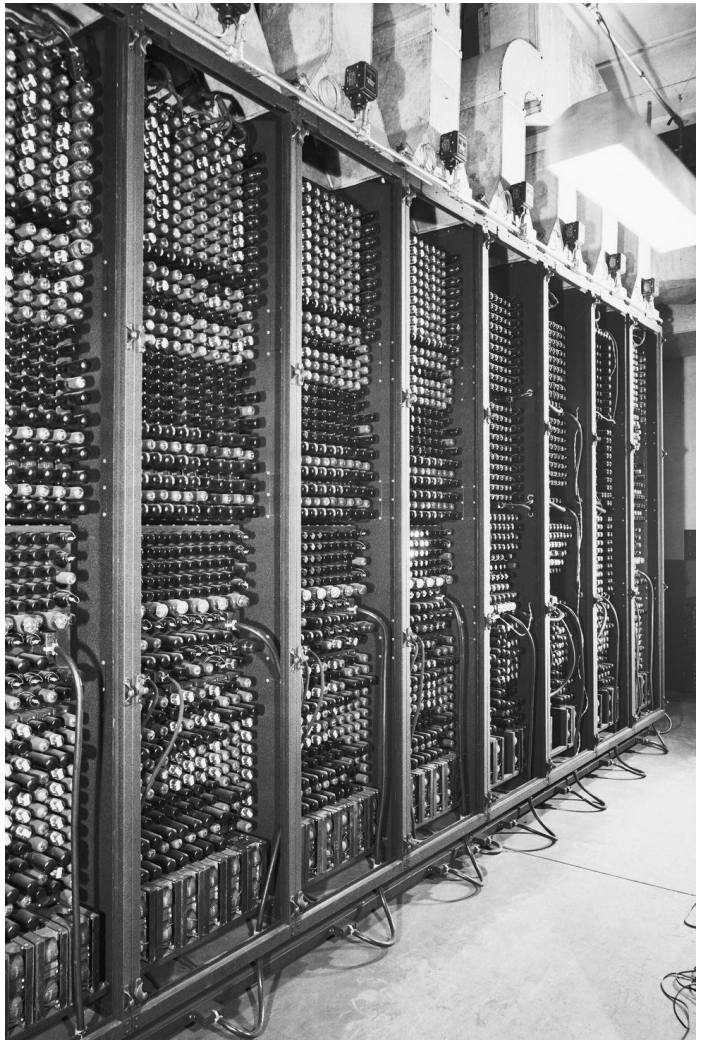
IBM releases the first computer hard disk drive, the 2,000-pound-plus, refrigerator-size IBM 305 RAMAC, which introduces magnetic disk storage. Up until then, files were either kept on spools of magnetic tape or on good old-fashioned paper, with no way to jump right to the record you wanted to pull up. With the RAMAC, a mechanical arm would retrieve data by storing data at a particular magnetic orientation. This technology goes on to be used (at a smaller size) in laptops and computer servers everywhere.

1957: Birth Control Pill

Enovid, a drug the FDA approves for menstrual disorders, comes with a warning: The mixture of synthetic progesterone and estrogen also prevents ovulation. Two years later, more than half a million American women are taking Enovid—and not all of them have cramps. In 1960 the FDA approves Enovid for use as the first oral contraceptive.

1958: Jet Airliner

The Boeing 707-120 debuts as the world's first successful commercial jet airliner, ushering in the era of accessible mass air travel. The four-engine plane carries 181 passengers and cruises at 600 mph for up to 5,280 miles on a full tank. The first commercial jet flight takes off from New York and lands in Paris; domestic service soon connects New York and Los Angeles.



1959: Integrated Circuit

The first general-purpose computer, the nearly 30-ton ENIAC (1947), contains 18,000 vacuum tubes, 70,000 resistors and 10,000 capacitors. In 1959, the integrated circuit puts those innards on one tiny chip.

1960: Pacemaker

In 1956, Wilson Greatbatch grabs the wrong resistor and connects it to a device he is building to record heartbeats. When the circuit emits a pulse, he realizes the device can be used to control the beat; in 1960 the first Pacemaker is successfully implanted in a human.

1961: Cordless Tools

Black and Decker releases its first cordless drill, but designers can't coax more than 20 watts from its NiCd batteries. Instead, they strive for efficiency, modifying gear ratios and using better materials. The revolutionary result puts new power in the hands of DIYers and—thanks to a NASA contract—the gloves of astronauts.

1962: Communications Satellite

Telstar is launched as the first "active" communications satellite—active as in amplifying and retransmitting incoming signals, rather than passively bouncing them back to Earth. Telstar makes real a 1945 concept by science-fiction author Arthur C. Clarke, who envisioned a global communications network based on geosynchronous satellites. Two weeks after Telstar's debut, President Kennedy holds a press conference in Washington, D.C., that is broadcast live across the Atlantic.

1963: Sketchpad program

Ivan Sutherland—The Father of Computer Graphics—revolutionized 3D computer modeling and simulation when he created the Sketchpad program. As the earliest iteration of a computer-aided design (CAD) program, Sketchpad pioneered the use of geometric constraints (fixing the length of a line or an angle between two segments). It was also one of the first programs to use a graphical user interface, as opposed to a text-based one—if you're reading this on a computer without knowing a single line of code, you can thank Sutherland and Sketchpad.

1964: Unmanned Aerial Vehicles

Widespread use of remotely piloted aircraft begins during the Vietnam War with deployment of 1000 AQM-34 Ryan Firebees. The first model of these 29-foot-long planes was developed in just 90 days in 1962. AQM-34s go on to fly more than 34,000 surveillance missions. Their success leads to the eventual development of the UAVs widely used today.

1965: KEVLAR

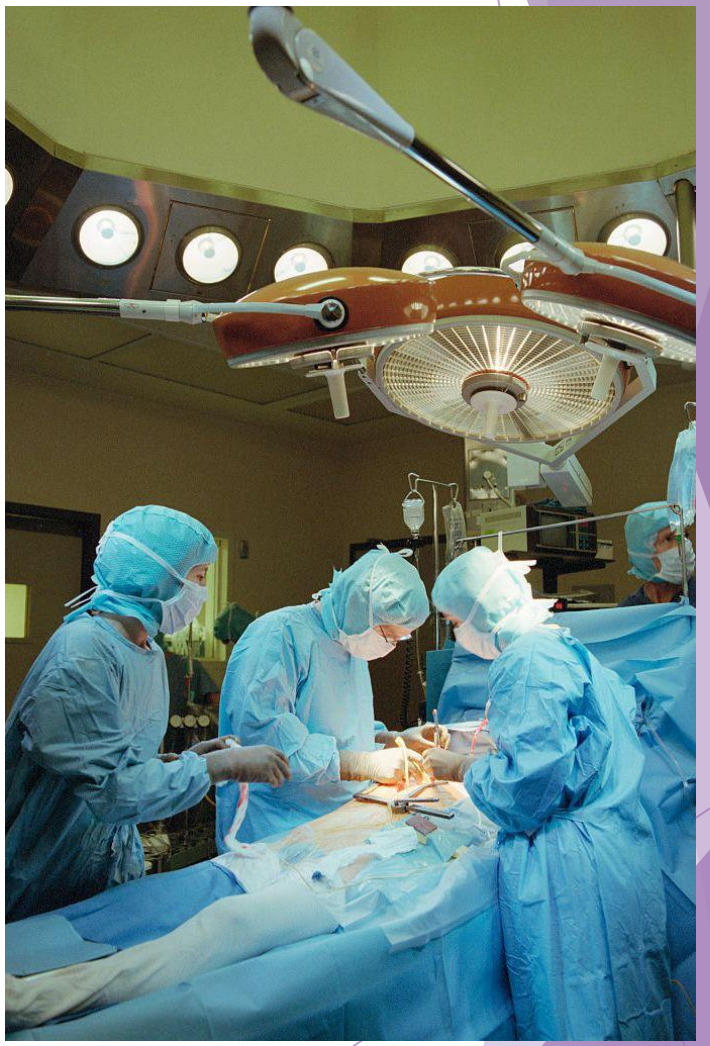
Thanks to DuPont's Stephanie Kwolek and Herbert Blades, who in 1965 invent a high-strength polymer called KEVLAR, the body armor of over 3,000 police officers has protected them from fatal attacks.

1966: High-Yield Rice

The International Rice Research Institute in the Philippines releases a semi-dwarf, high-yield Indica variety that, in conjunction with high-yield wheat, ushers in the Green Revolution. Indica rice thrives in tropical regions of Asia and South America, raising worldwide production more than 20 percent by 1970.

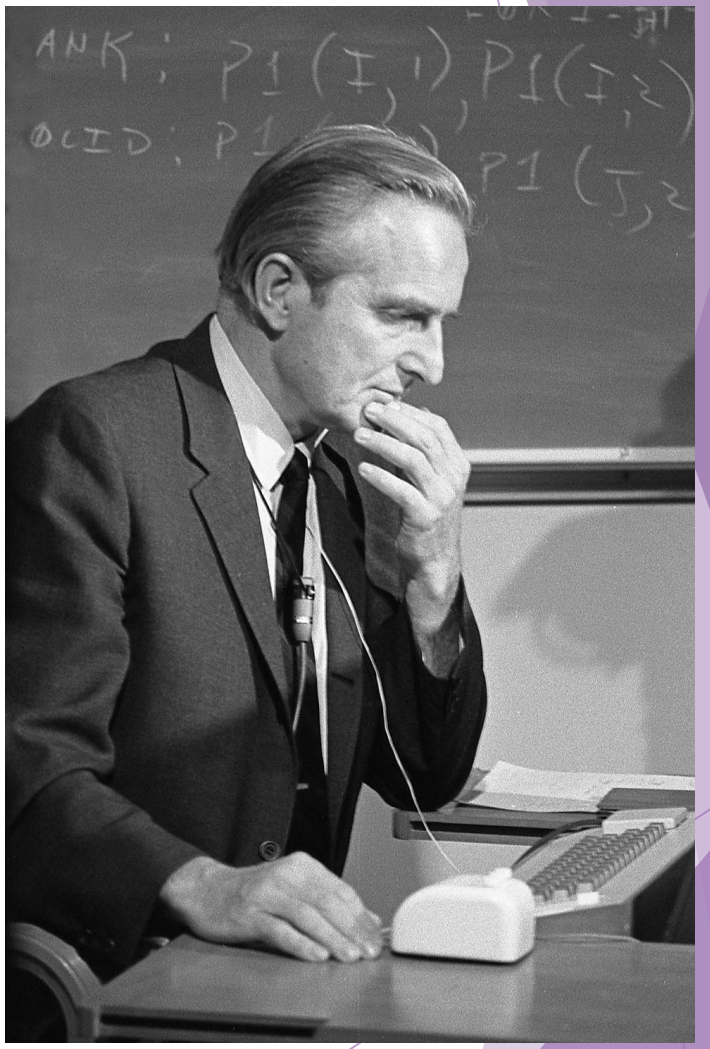
1967: Coronary Bypass Surgery

Rene Favaloro performs the first coronary bypass surgery in 1967, taking a length of vein from a leg and grafting it onto the coronary artery. This allows blood to flow around the blocked section. Thanks in part to these advances, the number of deaths from heart disease declines in the U.S. by almost 50 percent.



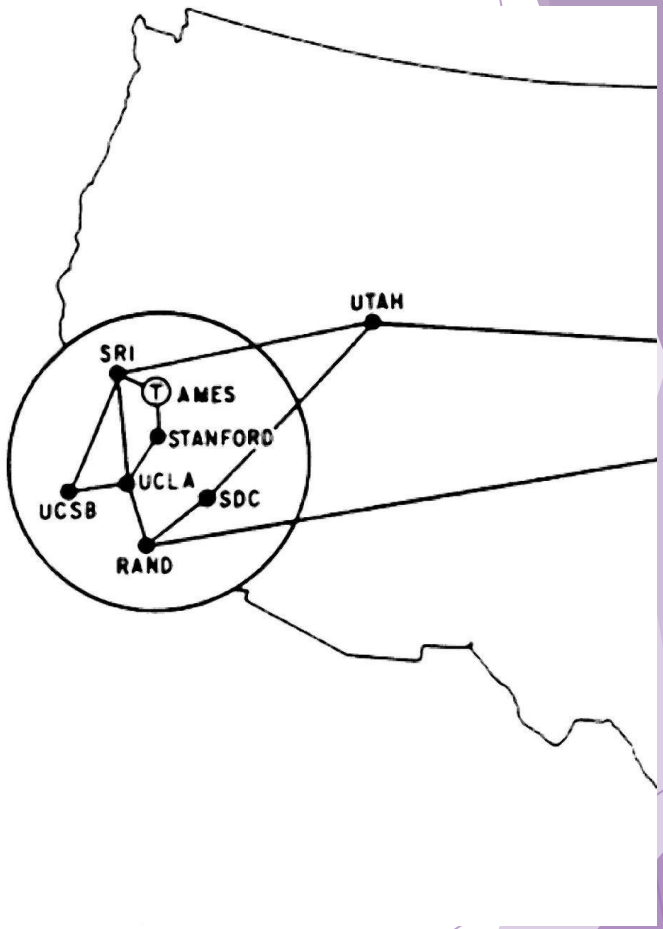
1968: Integrated Computer Systems

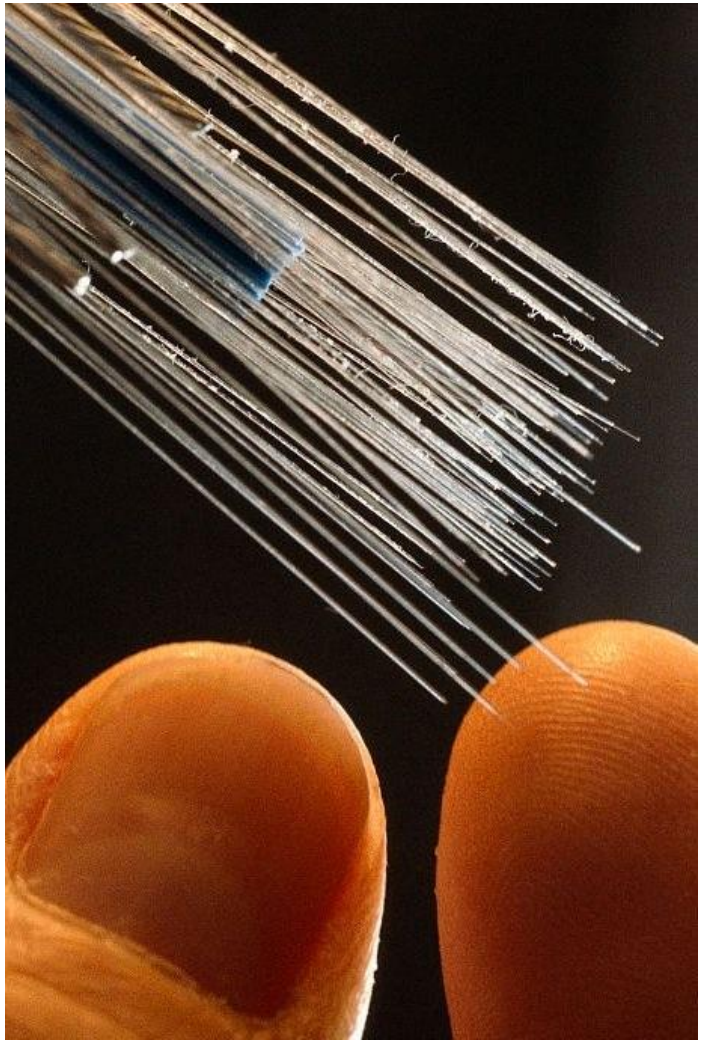
In a landmark December 1968 demonstration, later known as The Mother of all Demos, engineer Douglas Engelbart illustrates the use of lots of recent technologies in conjunction with each other, including: on-screen windows, hypertext, graphics, file linking, revision control, video conferencing, the computer mouse, and word processing. Both Mac and Windows user interfaces will borrow heavily from the example set here.



1969: Arpanet

Before the entire world is networked, there is the Arpanet—four computers linked in 1969. It introduces the concept of "packet switching," which simultaneously delivers messages as short units and reassembles them at their destination.





1970: Fiber Optics

The term "fiber optic" is coined in 1956, but it isn't until 1970 that scientists at Corning produce a fiber of ultrapure glass that transmits light well enough to be used for telecommunications.

1971: Waffle-Sole Running Shoes

Bill Bowerman, the track coach at the University of Oregon, sacrifices breakfast for peak performance when he pours rubber into his waffle iron, forming lightweight soles for his athletes' running shoes. Three years later, Bowerman's company, Nike, introduces the Waffle Trainer, which is an instant hit.

1972: Electronic Ignition

Chrysler paves the way for the era of electronic—rather than mechanical—advances in automobiles with the electronic ignition. It leads to electronic control of ignition timing and fuel metering, harbingers of more sophisticated systems to come. Today, these include electronic-control-transmission shift points, antilock brakes, traction-control systems, steering, and airbag deployment.

1973: MRI

Everyone agrees that magnetic resonance imaging (MRI) is a brilliant invention—but no one agrees on who invented it. The physical effect that MRIs rely on—nuclear magnetic resonance—earns various scientists Nobel Prizes for physics in 1944 and 1952. Many believe that Raymond Damadian establishes the machine's medical merit in 1973, when he first uses magnetic resonance to discern healthy tissue from cancer. Yet, in 2003, the Nobel Prize for medicine goes to Peter Lauterbur and Peter Mansfield for their "seminal discoveries." The topic of who is the worthiest candidate remains hotly debated.

1974: Barcode

A [10-pack of Wrigley's Juicy Fruit chewing gum] is the first product to integrate the usage of barcode technology when it's scanned at a grocery store in Ohio; the codes become the industry standard for storing pricing information at grocery stores and expand rapidly for both consumer-facing and internal tracking applications.

1975: Global warming

Not invented, but introduced to the lexicon in its modern sense of man-made climate change. The journal *Science* publishes a paper by geoscientist Wallace Broecker, "Are We on the Brink of a Pronounced Global Warming?" the first time that the phrase is used in a scientific paper.

Broecker predicted that CO2 would drive global temperatures unprecedentedly high early on in the 21st century, and and speculated about negative consequences for agriculture and sea level. By 2018, a group of international climate scientists are anticipating a 2.7°F temperature change by 2040, accompanied by food shortages, ever more disastrous wildfires, and a mass die-off of coral reefs.

1976: Supercomputer

The Cray-1, the first commercially developed supercomputer, is installed in the Los Alamos National Laboratory. It's the first supercomputer to successfully implement vector processors, a system that allows a single operation to quickly be performed on a large set of data, which is reflected in its speed of 160 MFLOPS—or 160 million floating-point operations per second. The Summit supercomputer, which goes online at the Oak Ridge National Laboratory in 2018, will be capable of 143.5 petaflops.

1977: Personal Computer

The Apple II, Commodore Pet and Radio Shack's TRS-80 are introduced in 1977—four years before IBM, soon to become synonymous with the term "PC," unveils its personal computer.

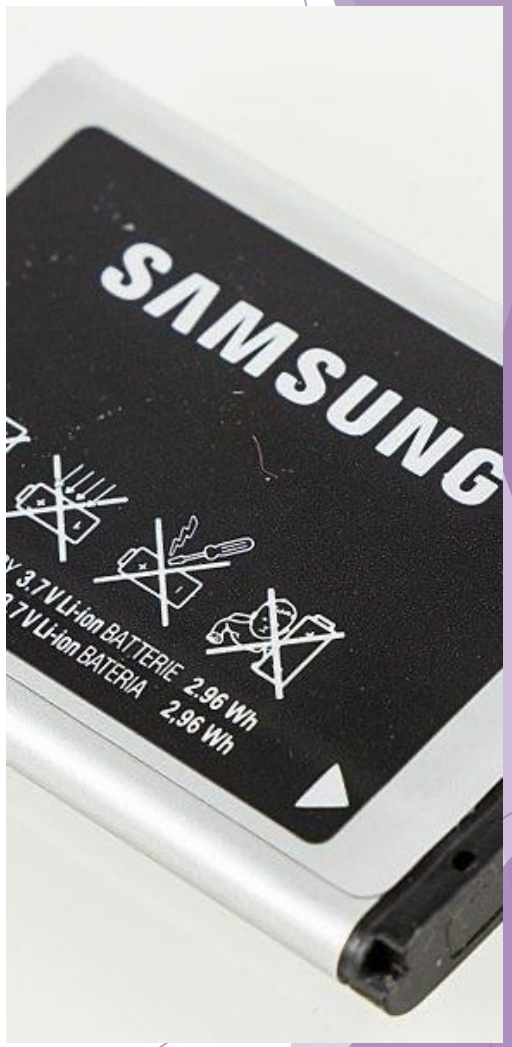
1978: GPS
The first satellite in the modern Navstar Global Positioning System (GPS) is launched. (The GPS's precursor, TRANSIT, was developed in the early 1960s to guide nuclear subs.) It is not until the year 2000, though, that President Clinton grants nonmilitary users access to an unscrambled GPS signal. Now, cheap, handheld GPS units can determine a person's location to within 3 yards.

1979: Sony Walkman

"This is the product that will satisfy those young people who want to listen to music all day." —*Akio Morita, Sony Chairman, February 1979*

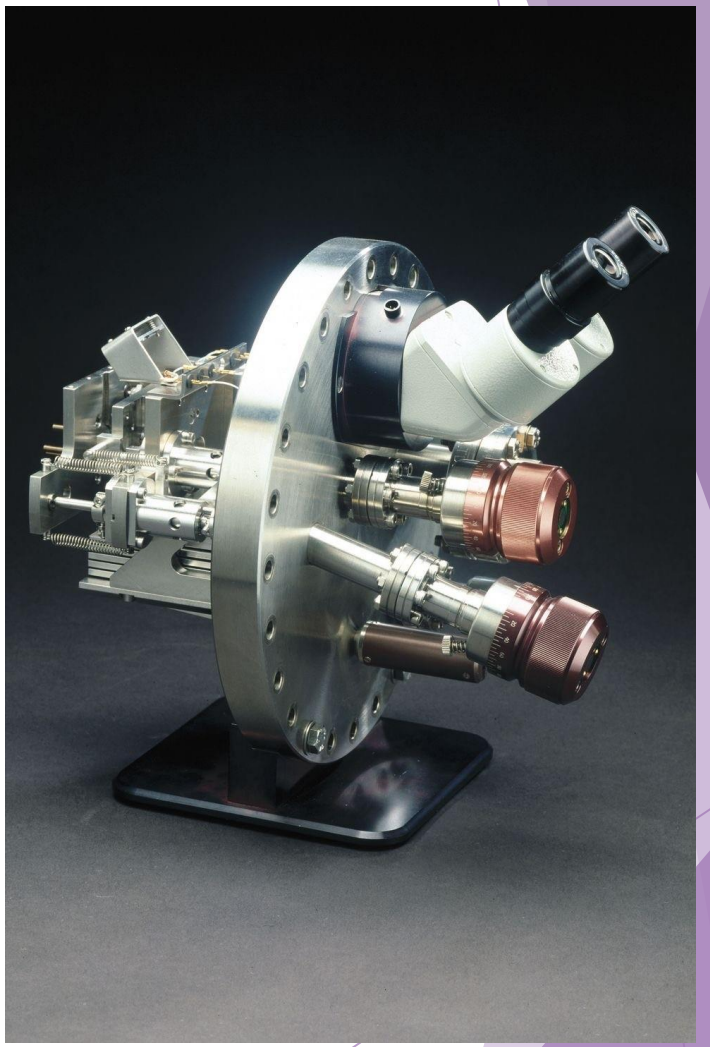
1980: Cobalt-oxide Cathode

John Bannister Goodenough invents the cobalt-oxide cathode, a crucial component of lithium-ion batteries—the rechargeable and portable batteries that are now in every smartphone, laptop, and electric vehicle. In 2017, the 94-year-old Goodenough, apparently deciding that his last invention wasn't good enough announces that he's come up with a [new glass-based battery] with even better storage capability.



1981: Scanning Tunneling Microscope

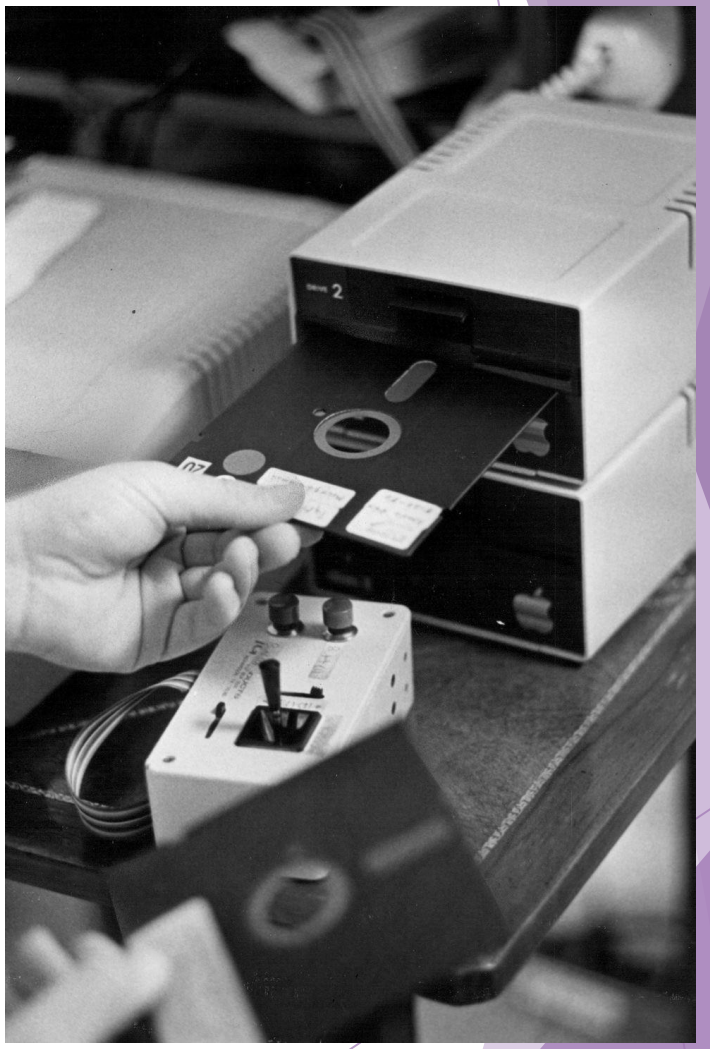
By moving the needle of the scanning tunneling microscope (STM) across a surface and monitoring the electric current that flows through it, scientists can map a surface to the level of single atoms. The STM is so precise that it not only looks at atoms—it also can manipulate them into structures. The microscope's development earns IBM researchers Gerd Binnig and Heinrich Rohrer a Nobel Prize and helps launch the emerging era of nanotechnology.



1982: Computer Virus

Fifteen-year-old Rich Skrenta creates an application called Elk Cloner as a prank—and ends up creating the first virus to spread outside its home network. Elk Cloner spreads via floppy disk and attaches to the Apple OS II operating system. When users boot from the disk, Elk Cloner transfers the computer's memory; any additional disks inserted without rebooting are also infected. On every fiftieth boot, the computer displays text written by Skrenta:

Elk Cloner: The program with a personality / It will get on all your disks / It will infiltrate your chips / Yes it's Cloner! / It will stick to you like glue / It will modify ram too / Send in the Cloner!



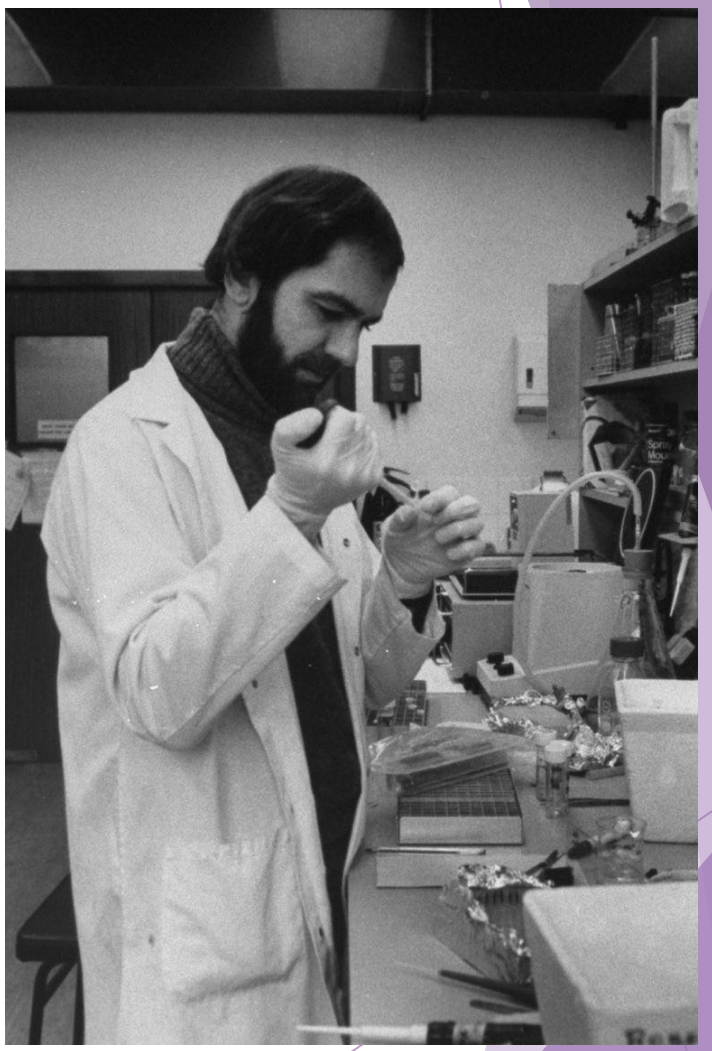
1983: Microsoft Word

Multi-Tool Word, the precursor to the Microsoft Word text-editing program, makes its debut as free copies are bundled with the November issue of *PC World*.Unlike most contemporary rivals, Word is designed to be used with a mouse, and features the ability to undo typing and to display bold, italic, and underlined text.

Microsoft steadily revises the program, which becomes a major success in 1990 when it's bundled with the Windows 3.0 operating system.

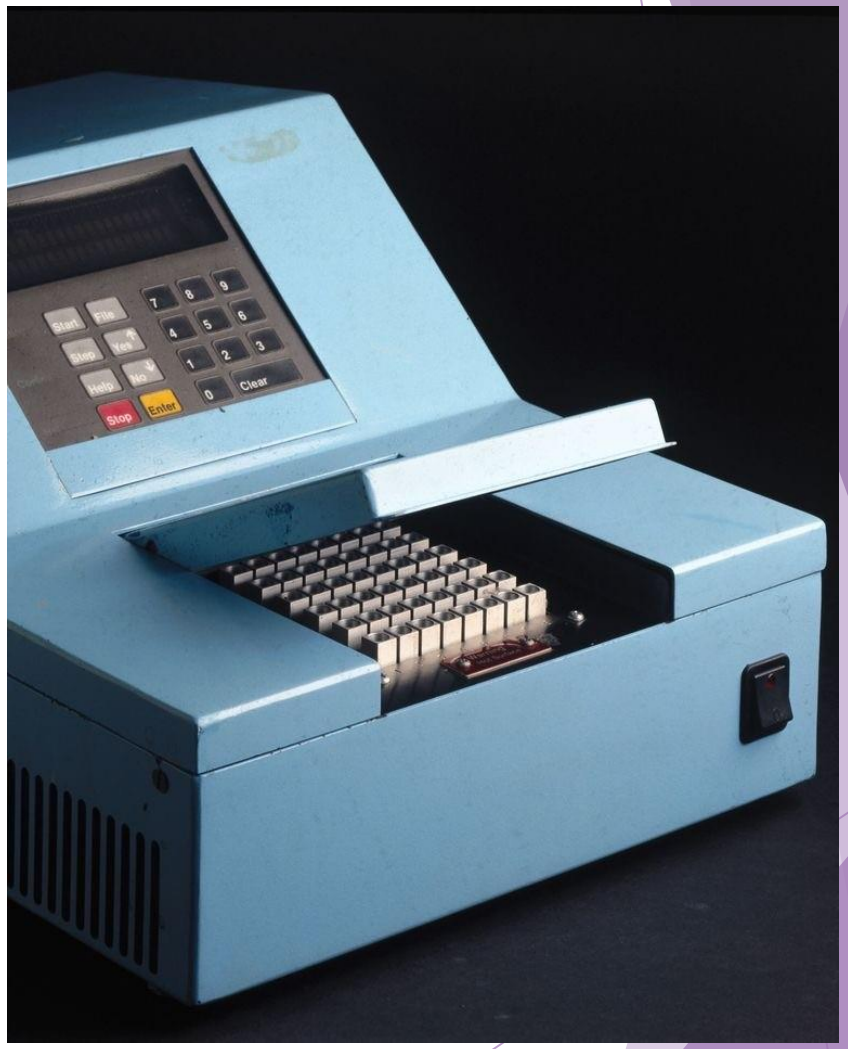
1984: DNA Fingerprinting

Molecular biologist Alec Jeffreys devises a way to make the analysis of more than 3 billion units in the human DNA sequence much more manageable by comparing only the parts of the sequence that show the greatest variation among people. His method quickly finds its way into the courts, where it is used to exonerate people wrongly accused of crimes and to finger the true culprits.



1985: Polymerase Chain Reaction

Biochemist Kary Mullis invents a technique that exploits enzymes in order to make millions of copies of a tiny scrap of DNA quickly and cheaply. No matter how small or dried-out a bloodstain is, forensic scientists can now gather enough genetic material to do DNA fingerprinting. With PCR, doctors also can search for trace amounts of HIV genetic code to diagnose infection much sooner than by conventional methods.



1986: Electronic Mailing List

Éric Thomas develops LISTSERV, the first automated mailing list management application. Before 1986, people had to be manually added or removed from a mailing list. By the 2010s, email newsletters are ubiquitous.

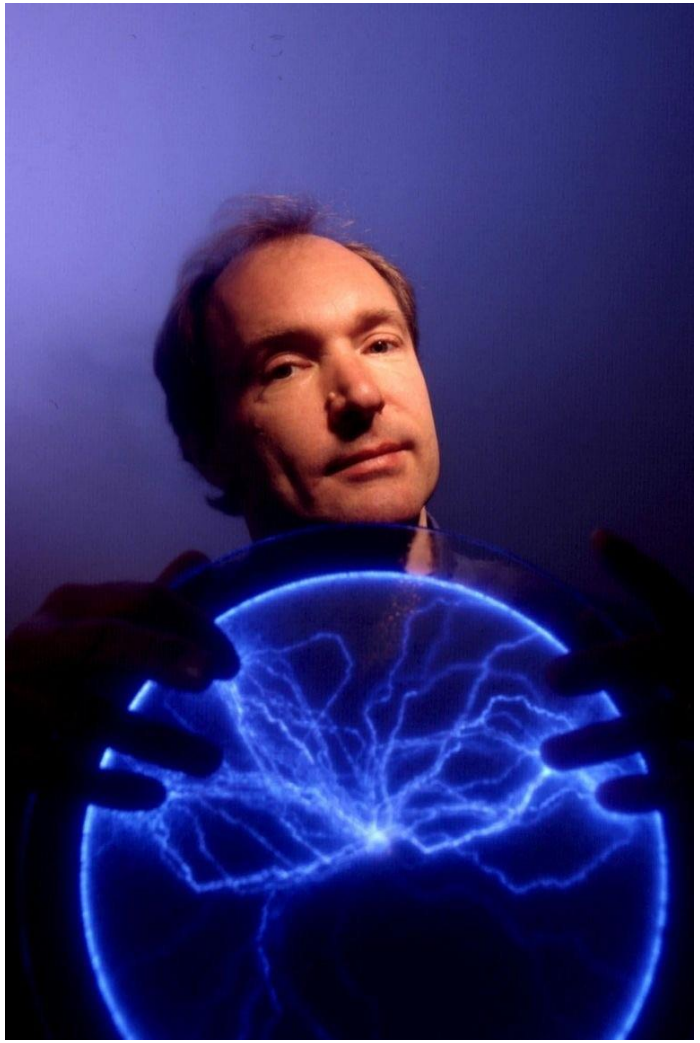
1987: Prozac

Prozac becomes the first in a new class of FDA-approved antidepressants called "selective serotonin re-uptake inhibitors," which block the reabsorption of the mood-elevating neurotransmitter serotonin, thereby prolonging its effects. Though at times controversial, Prozac helps patients cope with clinical depression, reshaping our understanding of how personality and emotion can be chemically controlled. Within five years, 4.5 million Americans are taking Prozac—making it the most widely accepted psychiatric drug ever.

1988: Internet Virus

Grad student Robert Morris illustrates the vulnerabilities in remotely connected computers with the release of his virus, known as the Morris worm, on November 2. As opposed to Rich Skrenta's Elk Cloner, the worm doesn't require any sort of hardware for transfer.

While Morris says it's just an exercise to gauge the size of the Internet, computers that are infected multiple times slow down considerably; within the first 15 hours, 2,000 computers are infected, many of them unsalvageable. Morris becomes the first person to be tried and convicted under the Computer Fraud and Abuse Act of 1984.



1989: World Wide Web

In 1989, Sir Tim Berners-Lee creates "hypertext markup language" (HTML) to make Web pages and the "Uniform Resource Locator" (URL) to identify where information is stored. These breakthroughs form the foundation of the World Wide Web.

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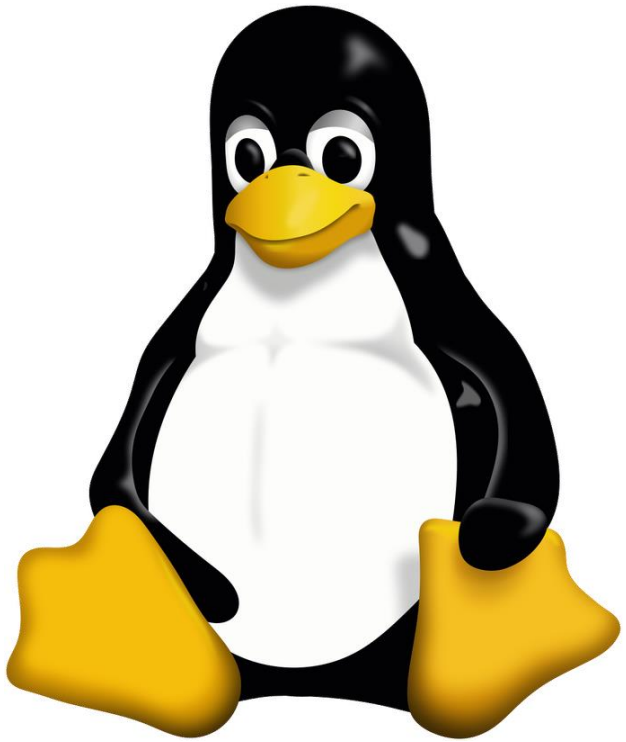
Apple Computer, Inc.
PCA107000073-629

1990: Photoshop

Today there are thousands of apps that make our digital lives easier, but none are quite as useful as Photoshop. First developed in 1987, the mega-popular photo-editing software wouldn't release its first commercial version until 1990. There's a reason this app remains ubiquitous on all our devices—it's just that good.



1991: Linux

In an early web world dominated by Microsoft and Apple, Linux was a new and powerful idea. Originally released on September 17, 1991, by Linus Torvalds, the operating system—including the Linux kernel—became one of the most important example of open source software. Now with a variety of different distributions, Linux provides a digital escape from the tech firms that increasingly run our lives.

1992: IBM Simon

On November 23, 1992, IBM debuted a weird little prototype at a COMDEX in Las Vegas, Nevada. Although it wouldn't be sold in the U.S. until 1994, the IBM Simon proved a commercial failure. But really, the idea was just way ahead of its time as many people consider the Simon to be the world's first smartphone.

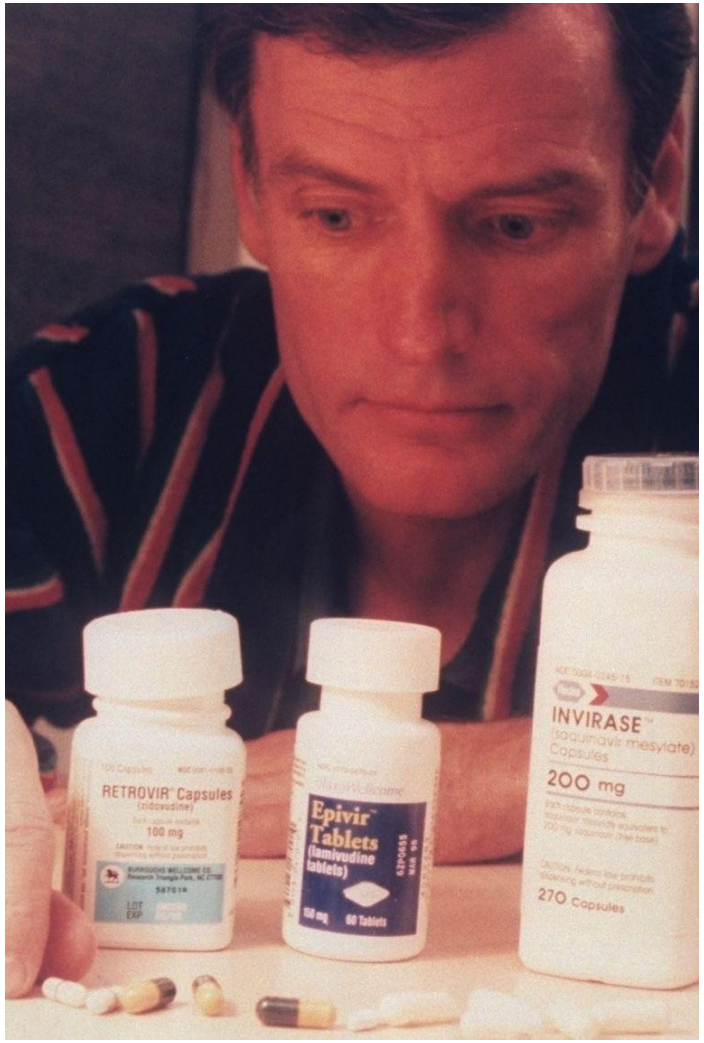
1993: Fuel Cell Vehicle

The fuel cell goes back more than 150 years, and the first fuel cell vehicle—a 20-hp tractor—is built in 1959. But it isn't until 1993 that a Canadian company, Ballard Power Systems, demonstrates the first zero-emissions fuel cell bus. Since then, progress toward an economically viable fuel cell car has remained slow but steady.

1994: RQ-1 Predator Drone

The idea for the RQ-1 Predator drone came in the 1980s, but its first flight test wouldn't be until 1994 in the Mojave desert. Since then, the drone has become increasingly integrated in the U.S. military and forever altering how humans fight wars. In 2002, the drone received its "MQ" designation, standing for "multi-role," to denote its armed capabilities beyond just passive reconnaissance.

This is one of the first instances of machines fighting wars in place of humans. Critics say the Predator drone causes innocent death and collateral damage through faulty intelligence and proponents say drones are much more accurate compared to conventional artillery weapons that have an average miss distance of 800 feet. But off the battlefield, the Predator drone also provided an impressive example of what other kinds of unmanned aerial bots can do, with some experts saying it was responsible for kickstarting our current fascination with drones, whether for delivering packages or as a new favorite pastime. In many ways,



1995: HIV Protease Inhibitors

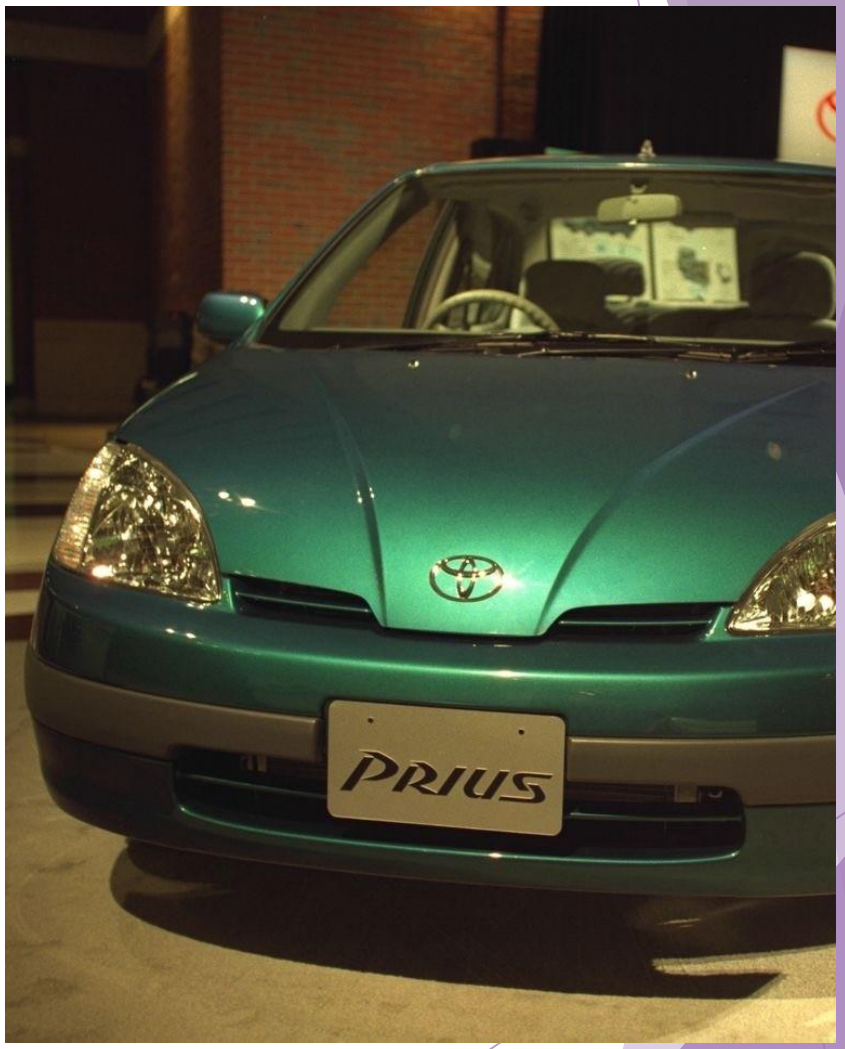
The outlook for people infected by HIV also dramatically changes. The FDA approves Invirase, the first of a class of drugs called HIV protease inhibitors in 1995. By blocking the function of enzymes used in the virus's replication, the inhibitors can reduce HIV to undetectable levels for sustained periods in up to 90 percent of patients.

1996: DVD

Although the DVD only lives on today through its ancestor Blu-Ray (a technology being slowly consumed by online streaming), the DVD was a massive step forward as the medium of choice in home entertainment and data storage due to its high capacity compared to other formats. The first DVD players went on sale in Japan on November 1, 1996.

1997: Hybrid Car

Ferdinand Porsche wins his class at the 1902 Exelberg Hill-Climb in Austria in a front-wheel-drive hybrid-electric car. But it is almost a century later, in 1997, that Toyota surprises its rivals by unveiling the hybrid Prius to Japanese consumers. It takes nearly three years for the Prius to reach North America.

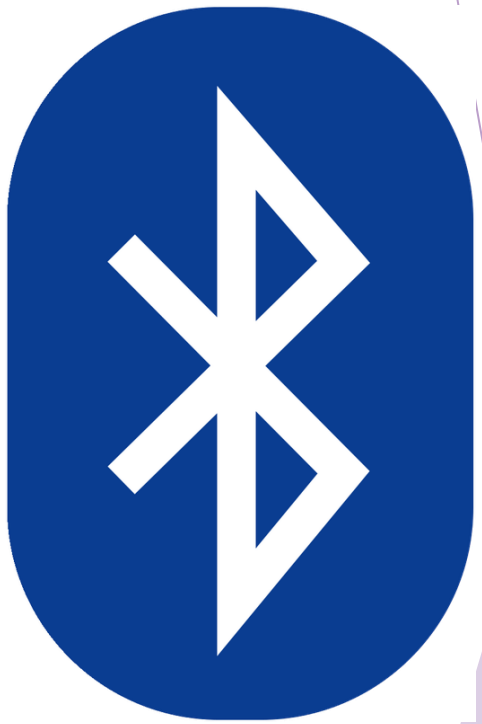


1998: International Space Station

On November 20, 1998, the Functional Cargo Block, aka Zarya, launched into space as the first piece of what would eventually become the International Space Station. Home of countless experiments and a shining example of international cooperation, the ISS is testament to what humanity can achieve when we work together.

1999: Bluetooth Version 1.0

Named after 10th-century Denmark king Harald "Bluetooth" Gormsson (seriously), Bluetooth can now be found packed inside almost every conceivable gadget we own and will be a major player in the unfolding future of the smartphone. Bluetooth's first version was released on July 26, 1999, and while it would take a decade (or two) to iron out the kinks, it helped us imagine a future free of needless wires.



2000: PlayStation 2

In the grand scheme of things, video games aren't *necessarily* important inventions—but they're fun. While many consoles could have made this list, Sony's PlayStation 2 harnessed an era of emerging tech to create a console that would solidify the company as a gaming behemoth, a title it retains to this day.

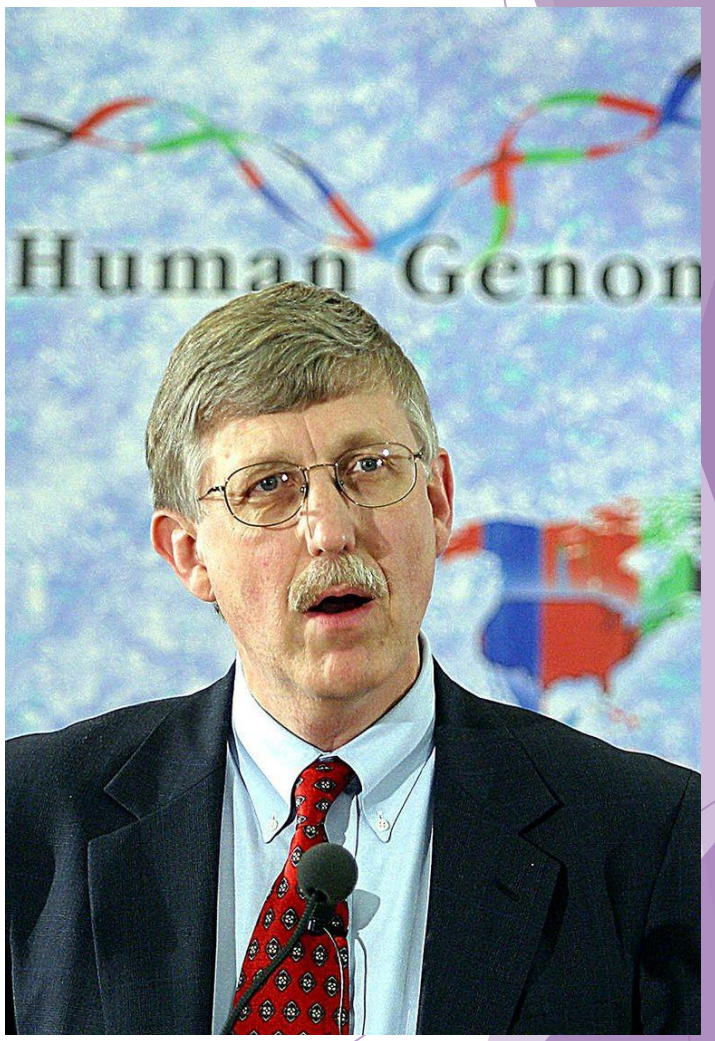
2001: Wikipedia

In hindsight, putting the encyclopedia online is a no-brainer. But *keeping* that digital encyclopedia ad-free for almost two decades—that's incredible. Wikipedia's user-generated model can sometimes get it in trouble, but overall it's a program that's become the cornerstone to finding answers online, and with any luck, it will keep doing so for decades to come.

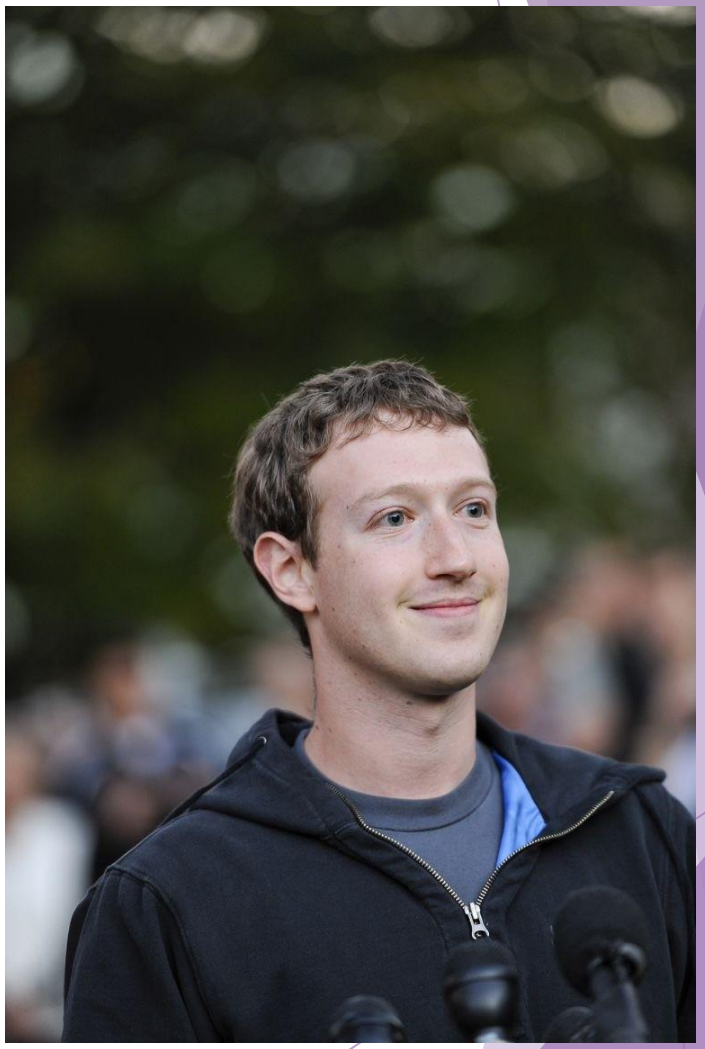
2002: IEEE 802.16

The geniuses at the Institute of Electrical and Electronics Engineers publish a wireless metropolitan area network standard that functions like Wi-Fi on steroids. An 802.16 antenna can transmit Internet access up to a 30-mile radius at speeds comparable to DSL and cable broadband. When it all shakes out, 802.16 could end up launching developing nations into the digital age by eliminating the need for wired telecommunications infrastructure.

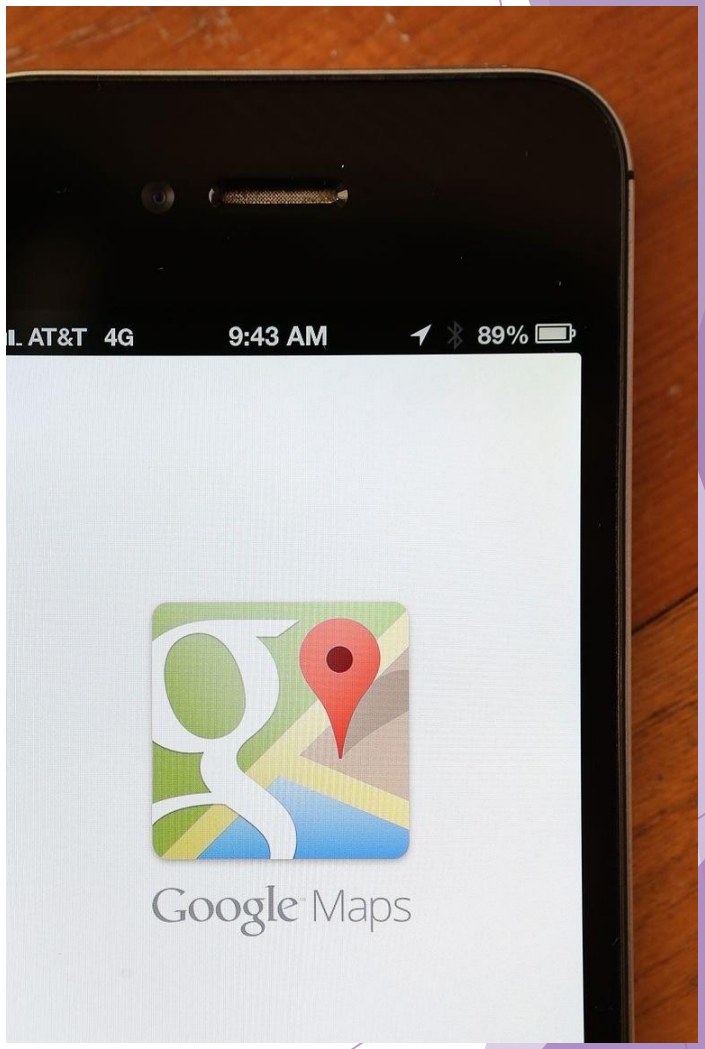
2003: The Human Genome Project
Officially completed on April 14, 2003, The Human Genome Project formed a foundation of understanding for creating further advances in future medicine and a better comprehension of where we come from. The fact that it's available to everyone online just makes it even more incredible.



2004: Facebook
Future Harvard dropout Mark Zuckerberg launches “thefacebook.com,” a social network site originally restricted to his fellow classmates, in February 2004. By its 10-year anniversary, Facebook averages 1.23 billion monthly users—17 percent of the entire global population. And in 2018, Zuckerberg is called to testify in front of the U.S. Congress about how hacked personal data from the site and targeted Facebook ads were leveraged to interfere in the 2016 presidential election.



2005: Google Maps
Combining a dynamic, searchable online map with the capacity to generate turn-by-turn driving instructions, Google Maps deals a definitive blow to stopping and asking for directions. Two years later, Google adds Street View, sending cars, trekkers, and bots around the world in an effort to let users see 360-degree street-level views of houses, roads, and landmarks. An app version of Google Maps is also included on the first iPhone—reportedly commissioned by Tim Cookmere weeks before launch when he realized the Apple prototype wouldn't cut it.

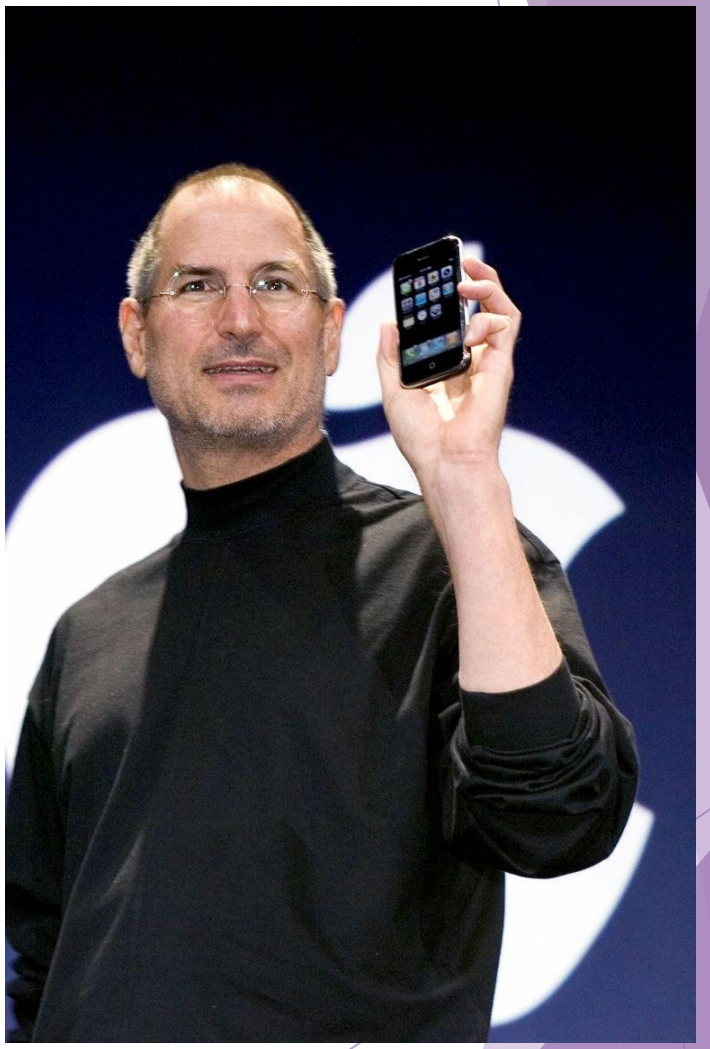


2006: Wii

Released by Nintendo in November 2006, the Wii's signature introduction is the Wii Remote, which uses optical sensors and gesture recognition to mirror a player's real-world movements within the scope of a game, from tennis to Mario Kart. It's both more immersive and more physically demanding than previous generations of video games, no matter what your parents say, and an important step toward synthesizing real-world and virtual activity.

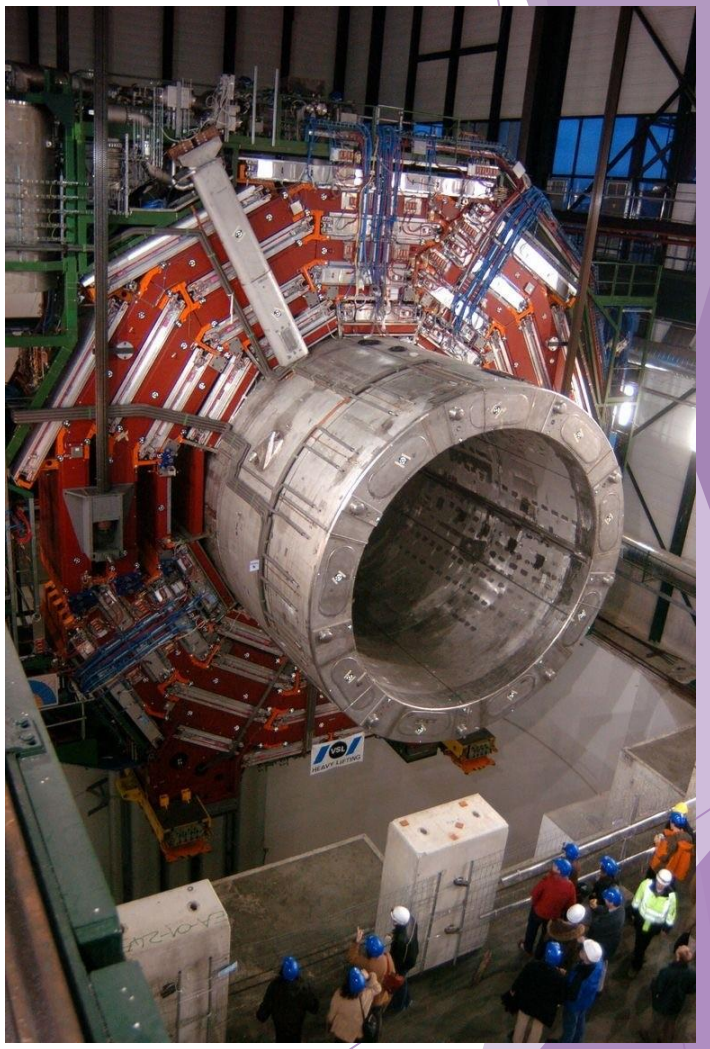
2007: iPhone

Steve Jobs introduces Apple's first smartphone with a prank-call order of 4,000 lattes from a nearby Starbucks. The iPhone is also the first U.S. smartphone without a physical keypad, and goes on to become the best-selling gadget ever, with more than 1.2 billion sold to date, and drives the development of app-based companies like Uber, Venmo, Tinder, Snapchat—and Postmates, which will indeed deliver Starbucks.



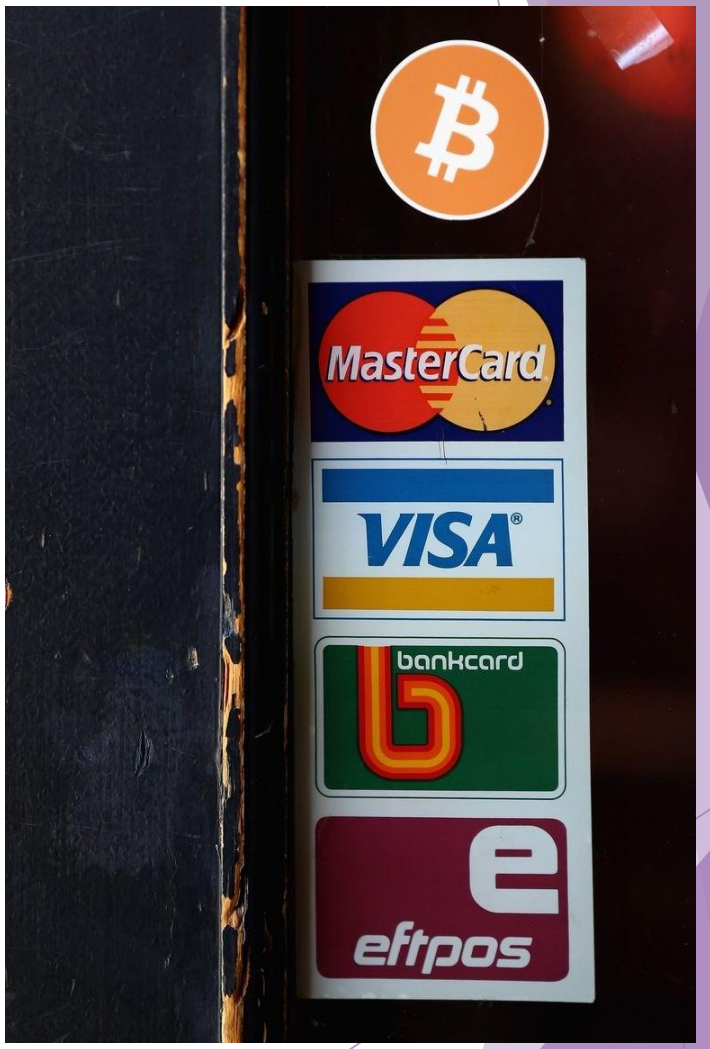
2008: Large Hadron Collider

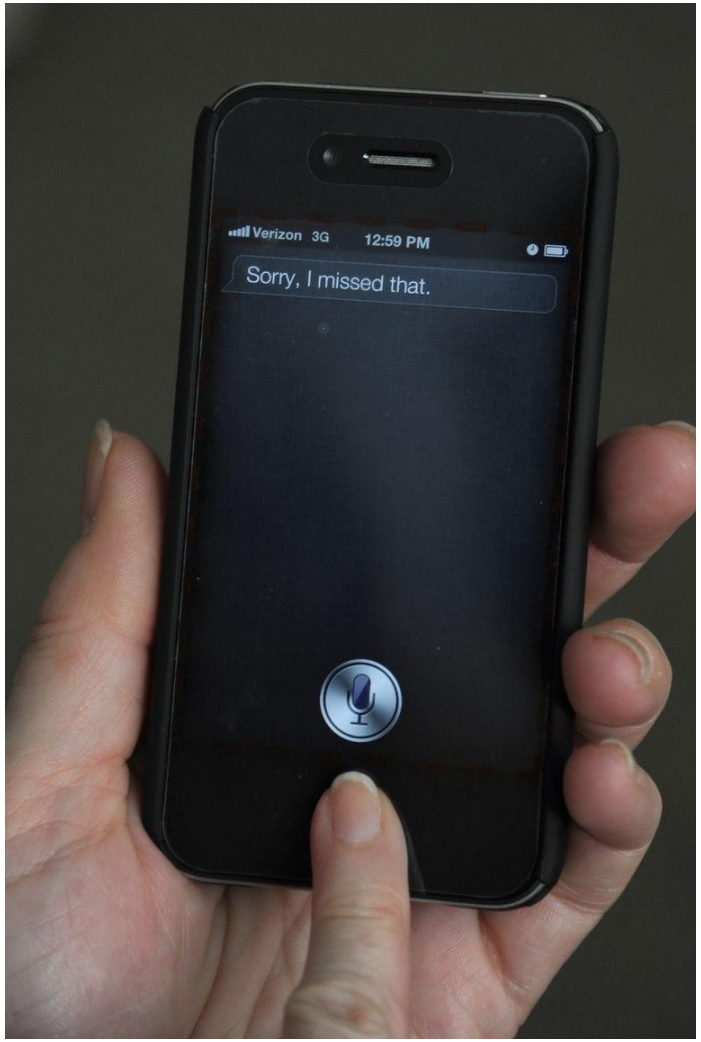
Ten years in the making at the European Organization for Energy Research (CERN), the LHC opens in 2008 as the world's largest and most powerful particle accelerator, capable of propelling energy beams at close to the speed of light. In 2012, tests at the LHC will reveal evidence of the Higgs boson, a subatomic particle believed to be instrumental in creating mass—and therefore one of the building blocks of the universe. Peter Higgs, the particle's namesake (and who disapproves of its being nicknamed "The God Particle"), wins the 2013 Nobel Prize in Physics for this advancement in scientific understanding of the properties of matter.



2009: Bitcoin

The pseudonymous Satoshi Nakamoto launches the first popular cryptocurrency, an anonymized peer-to-peer encrypted form of cash. Bitcoin uses blockchain computing to decentralize and verify payments, and is nearly tamper- (and explanation-) proof. To avoid inflation, the total number of Bitcoin is capped at 21 million. The amount of the currency in circulation increases as more are “mined," a computing process that uses enormous amounts of power. The value of the currency peaks in December 2017, with one Bitcoin worth over $19,000 USD.



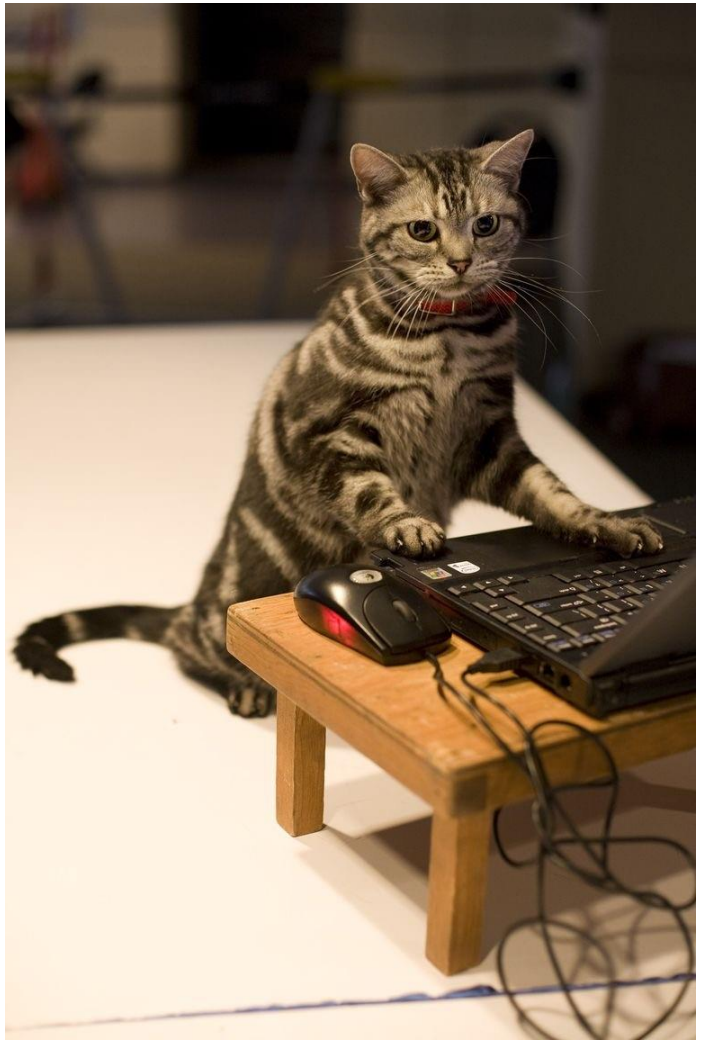


2010: Siri

Apple's digital assistant is released as an app for iOS; users can ask for information and directions, and prompt other phone functions, just by speaking to their iPhone. Although Siri 1.0 is buggy and has difficulty understanding some voices and accents, it's officially integrated into the iPhone 4S in October 2011, and has since been updated to include more languages, better speech-recognition software, and a British-accent option. Siri presages the swift introduction of more voice-activated virtual assistants, like Amazon's Alexa and Microsoft's Cortana (both 2014).

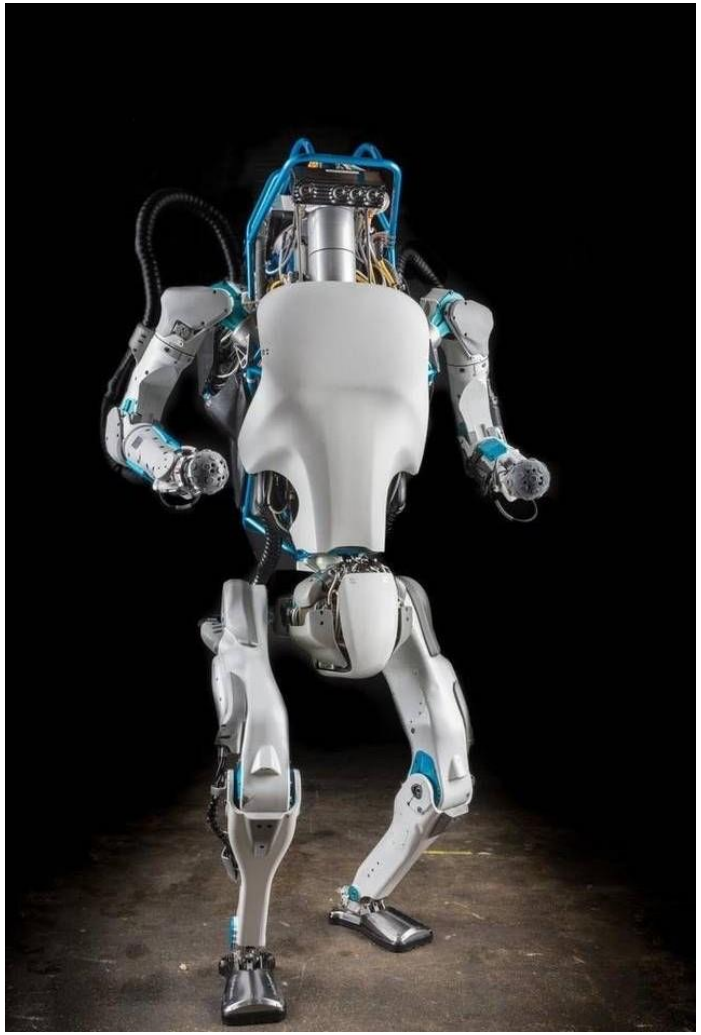
2011: Curiosity Rover

The *Curiosity* launches from Cape Canaveral in November 2011, landing on Mars the following August—an event made iconic by the meme-worthy haircut of flight director (and later, Popular Mechanics contributor) Bobak Ferdowsi. The rover's goal is to investigate environmental conditions on Mars and determine whether it will be suitable for microbial (and thus, perhaps, human) life. It is the most advanced rover to ever land on Mars, and can collect detailed imagery and environmental samples to analyze and send back to Earth.



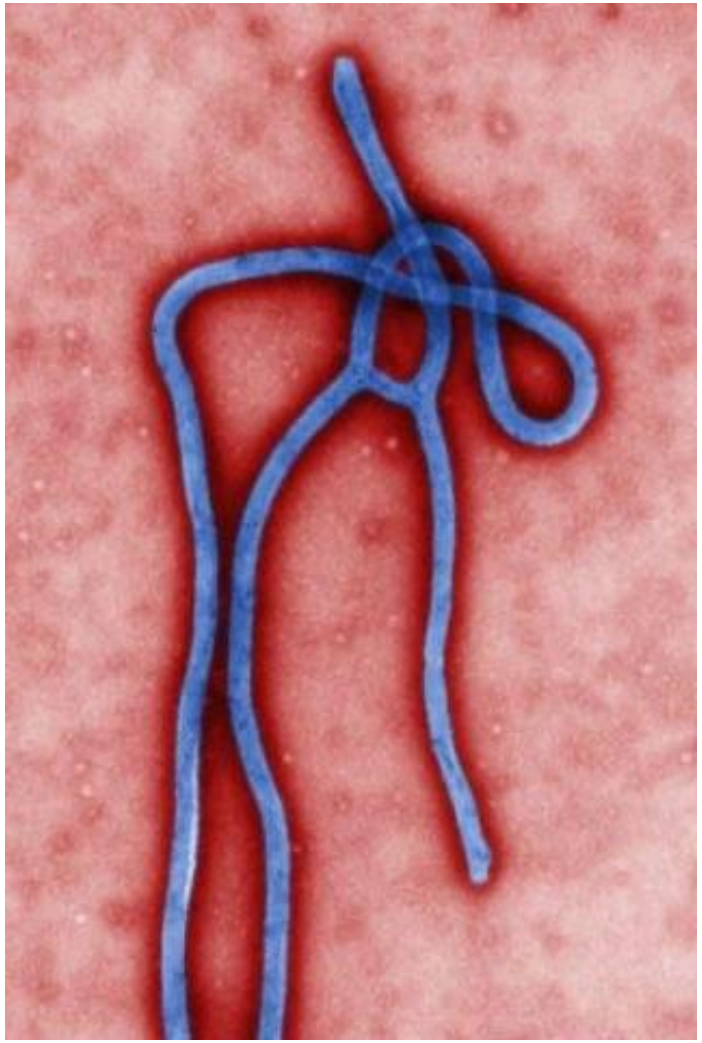
2012: Google's Machine Learning Project

The *New York Times* reports that, as part of Google's deep learning research, a cluster of 16,000 computers has taught itself how to recognize a cat. These advances arguably push the tech industry into a more serious pursuit of artificial intelligence and machine learning projects—including self-driving car technology, facial recognition software (Face ID and automatic tagging on Facebook), and technology that will help voice assistants like Alexa get smarter over time.



2013: Atlas

The robotic revolution still hasn't arrived, but if it does, it's hard to image Atlas won't be leading the pack. Built in 2013 by Boston Dynamics, the robot still has the capacity to amaze as it learns more and more tricks.



2014: Hemopurifier

In 2014, the world came to grips with the seriousness of the West African ebola virus epidemic. It's a story of incredible bravery on behalf of many who battled the disease, but one little device arrived at just the right time to help out the cause—the hemopurifier. With *Time* listing the device as one of the best inventions of 2014, the magazine says the device works by using a "specially designed cartridge that attaches to a dialysis machine," essentially sucking the ebola virus from blood. The device also works to combat hepatitis and cancer.

2015: Reusable Rockets

Both Blue Origin's New Shepherd and SpaceX's Falcon 9 rockets make successful upright landings after launch. Multiuse rockets could dramatically reduce the still-hefty cost of space travel, which SpaceX's partnership with NASA had already lowered. The Falcon 9 launch is touted by SpaceX founder Elon Musk as a step toward his ultimate goal of colonizing Mars—which we might need to do sooner than expected.

2016: Oculus Rift

Two years on from its $2 billion acquisition by Facebook in 2014, the first headset from Palmer Luckey's virtual-reality company is released. High-resolution screens on the inside of the goggles project stereoscopic images to mimic normal sight and convince the user's brain that they're seeing something real, even if that something is an enormous killer robot. While the headset is primarily intended as a gaming add-on, it's subsequently adapted for uses as disparate as medical education and driver training. Facebook, however, cancels production of the second-generation Rift in late 2018.

2017: Tesla Model 3

Elon Musk's EV company makes its biggest move toward the mainstream by commencing production on the Model 3, an all-electric car with a 310-mile range and an anticipated everyman price of $35,000. Despite production delays and a subsequent run on preorders, by Q3 of 2018, the Model 3 is the best-selling car in the U.S. by revenue.

2018: Metal 3D Printing

3D-printing metal parts has the potential to revolutionize the manufacturing business by speeding up production and making customization (or upholding years-old warranties) more cost-effective; parts can be lighter, stronger, and shaped in ways that traditional fabrication can't accommodate. In September, HP opens preorders for its industrial-scale Metal Jet printers, which are slated to become available in late 2020; early customers include Volkswagen and Primo Medical Group.

Thank you!

any questions?