

ELEC 424/553

Mobile & Embedded Systems

Lecture 2
How Did We Get Here?



Assignment 0 - Did anyone not partake in consumerism yet?



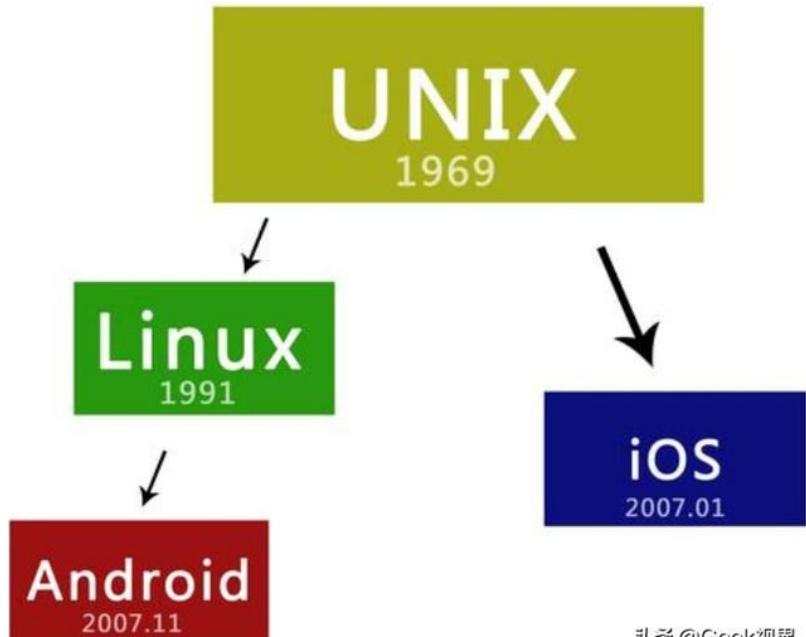
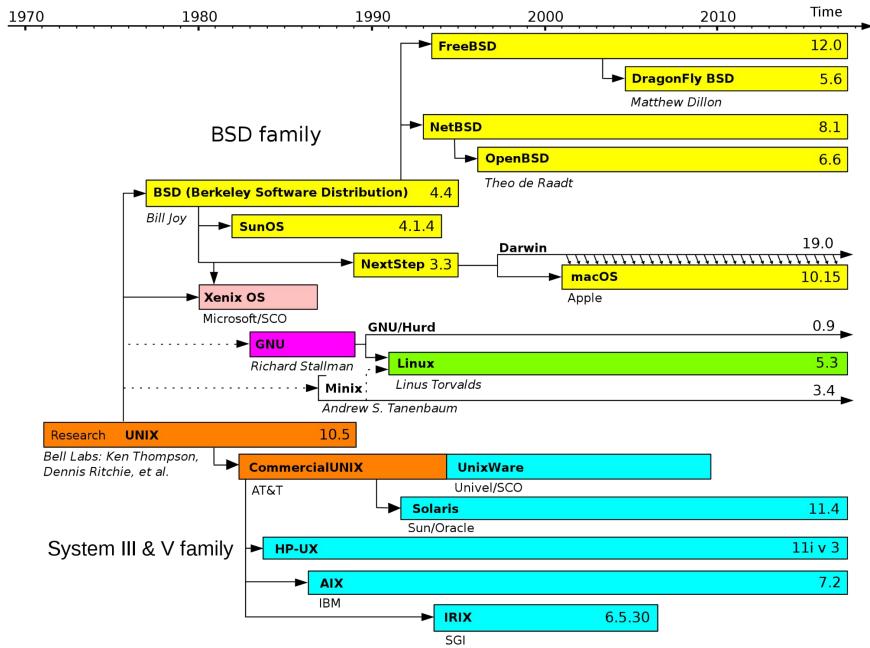
Soldering Session TBA

Will likely be farther in future,
don't immediately require RPi
Zero W for coursework

Questions

Post to Canvas (don't email
unless individual questions)

UNIX is the Common Ancestor of Many Modern Operating Systems



https://commons.wikimedia.org/wiki/File:Unix_timeline.en.svg

<http://p3.pstatp.com/large/tos-cn-i-0022/37eb9a84671944aa871b7a46642bad33>

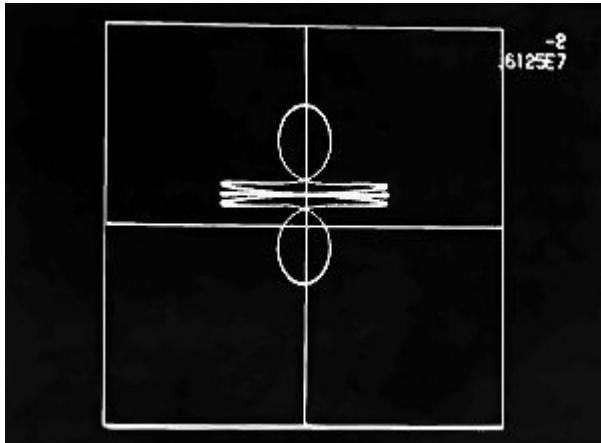
We Begin With (You Guessed It) Bell Labs

- Work began in 1969
- Hot off the heels Bell Labs leaving the OS project Multics (Bell Labs, MIT, & General Electric)
- Ken Thompson didn't have anything better to do
- Dennis Ritchie & others joined the effort



<https://www.bell-labs.com/institute/blog/invention-unix/>

Motivation for Unix: Space Travel Game



"This was the game that UNIX was created to run. **Literally, Ken Thompson invented UNIX to run this game.** Thus it is the first UNIX application and the first UNIX game."

<https://www.uvlist.net/game-164857-Space+Travel>

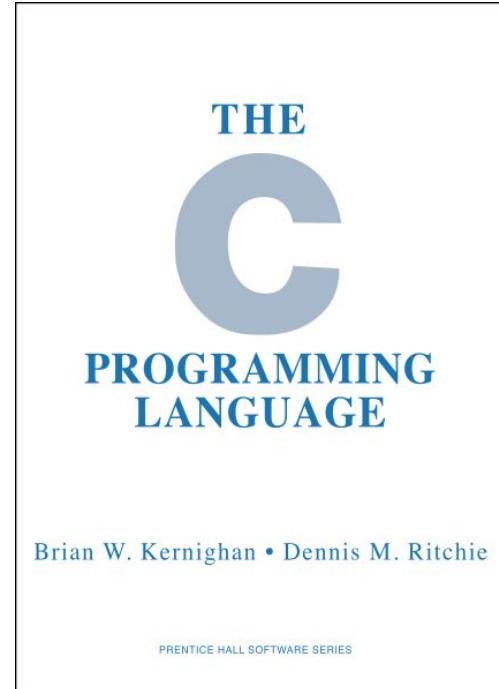
PDP-7 (Made by Digital Equipment Corporation (DEC))



<https://en.wikipedia.org/wiki/File:Pdp7-oslo-2005.jpeg>
[Author - en:User:Toresbe; Creative Commons ShareAlike 1.0 License]

Early Days of UNIX

- Goal: Streamline Multics
- Version 1 released in 1971
- C was realized for UNIX by Dennis Ritchie
- UNIX Version 4 was released in 1973
 - A rewrite based on C
 - UNIX widely popular at Bell Labs at this point
- *Note to Joe: Can show pdp7-unix demo*



The C Programming Language (1978)

<https://frontpagelinux.com/articles/guide-through-history-of-unix-linux-everything-you-need-to-know/>
<https://www.section.io/engineering-education/history-of-c-programming-language/>
<https://www.computerhope.com/history/unix.htm>

https://commons.wikimedia.org/wiki/File:The_C_Programming_Language,_First_Edition_Cover.svg

UNIX Breaks Out of Bell Labs

- 1974: Version 5 released
 - Academic institutions given access
- 1975: Version 6 released
 - First version with commercial availability
- 1976: Apple created
- 1977: 1BSD released - First Berkeley Software Distribution (BSD)
 - Not an independent OS
 - A supplement to Version 6 of UNIX
 - Assembled by Bill Joy (vi; co-founder of Sun Microsystems - 1982)



Wozniak & Jobs

<https://www.businessinsider.com/how-steve-jobs-met-steve-wozniak-2014-12>
Justin Sullivan/Getty



Bill Joy

<https://engineering.berkeley.edu/bill-joy-co-founder-of-sun-microsystems/>

<https://frontpagelinux.com/articles/guide-through-history-of-unix-linux-everything-you-need-to-know/>
<https://www.computerhope.com/history/unix.htm>
<https://www.oreilly.com/library/view/unix-filesystems-evolution/9780471456759/chap01-sec008.html>
<https://engineering.berkeley.edu/bill-joy-co-founder-of-sun-microsystems/>

IEEE Spectrum Feature:

THE STRANGE BIRTH AND LONG LIFE OF UNIX

The classic operating system turns 40, and its progeny abound

BY WARREN TOOMEY | 28 NOV 2011 | 12 MIN READ | 

'In 1956, AT&T had agreed to a U.S government consent decree that prevented the company from selling products not directly related to telephones and telecommunications'

IEEE Spectrum Feature:

The screenshot shows a dark-themed article page. At the top, there are two small tabs: 'FEATURE' and 'HISTORY OF TECHNOLOGY'. Below them is a large, bold title: 'THE STRANGE BIRTH AND LONG LIFE OF UNIX'. Underneath the title is a subtitle: 'The classic operating system turns 40, and its progeny abound'. At the bottom of the main content area, there is a thin horizontal line followed by the author information: 'BY WARREN TOOMEY | 28 NOV 2011 | 12 MIN READ |

'In 1956, AT&T had agreed to a U.S government consent decree that prevented the company from selling products not directly related to telephones and telecommunications, in return for its legal monopoly status in running the country's long-distance phone service. So Unix could not be sold as a product.'

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'In 1956, AT&T had agreed to a U.S government consent decree that prevented the company from selling products not directly related to telephones and telecommunications, in return for its legal monopoly status in running the country's long-distance phone service. So Unix could not be sold as a product. Instead, AT&T released the Unix source code under license to anyone who asked, charging only a nominal fee. The critical wrinkle here was that the consent decree prevented AT&T from supporting Unix. Indeed, for many years Bell Labs researchers proudly displayed their Unix policy at conferences with a slide that read, "No advertising, no support, no bug fixes, payment in advance."

1978: UNIX Ported for the First Time?

- At this point, UNIX was believed by a number of people to have the potential to rise to position of the universal OS
- C-based nature allowed for portability to other hardware
- “We have recently moved the UNIX system kernel, together with much of its software, from its original host machine (DEC PDP-11) to a very different machine (Interdata 8/32)”
 - *Bell System Technical Journal*, Vol. 57, No. 6, Part 2, July-August 1978, pp 2021-2048. Copyright © 1978 American Telephone and Telegraph Company. [Link to text](#)



<https://www.bell-labs.com/institute/blog/invention-unix/>

One Other Port Completed Around the Same Time

Technical Sessions Wednesday – Friday, June 17–19, 1998

Thursday, June 18 9:00am – 10:30am

Joint Session: Historical UNIX

Reflections on the '73 CACM Paper

Dennis Ritchie, *Lucent Technologies, Bell Laboratories*

Dennis Ritchie will "deconstruct" the original CACM paper—what have we learned, what we got right, what did we overlook. Computing has changed in the past 25 years and the ideas of distribution and networking were less central then than they are today. Clearly, modern systems have been impacted by UNIX and the ideas presented in the original paper. But how has UNIX been impacted by our changes in thinking?

20th Anniversary of the First Port of UNIX

Steve Johnson, *Transmeta*; Richard Miller, *Miller Research*; and Juris Reinfelds, *New Mexico State University*

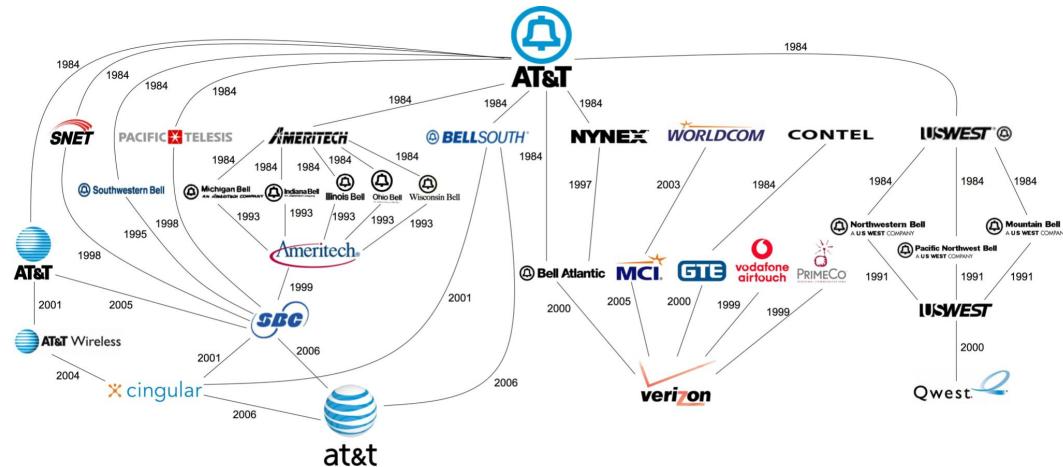
Nowadays, the portability of UNIX is taken for granted. The first ports of UNIX were audacious projects. Two teams independently succeeded with ports of UNIX at about the same time, only to find out about each other when the ports were finished. Both teams used different techniques for porting, and these talks will present the strategies used and how they hold up to current porting practice.

The UNIX code was so well designed that it could be picked up and ported without any consultations with the authors of the code. Reinfelds and his research team ported UNIX to Interdata 7/32 at the University of Wollongong in Australia, where Richard Miller proposed an innovative implementation of the port and proved its effectiveness by single handedly porting the kernel code and most applications. The Wollongong port later became the first computer vendor-supported UNIX.

Johnson and Ritchie were doing the port at Bell Labs on Interdata 8/32. Porting Unix required that C "get serious" about portability. Portability concerns led directly to such innovations as separate name spaces for structure members, sizeof, and indirectly to tools such as lint and social conventions such as the use of header files. This talk will also discuss places where we were less successful, notably alignment, byte order, and bit fields.

Early 1980s:

- Many commercial UNIX versions introduced
 - Onyx System's Microcomputer UNIX
 - Santa Cruz Operation (SCO)/Microsoft's Xenix
- AT&T was the biggest company in the world
 - Employed over 1 million people
- 1982: AT&T monopoly taken apart



1982: The Split of AT&T

VOL.CXXXI... No. 45,188

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NEW YORK, SATURDAY, JANUARY 9, 1982

30 cents beyond 50-mile zone from New York City.
Higher in air delivery cities.

25 CENTS

U.S. SETTLES PHONE SUIT, DROPS I.B.M. CASE; A.T.&T. TO SPLIT UP, TRANSFORMING INDUSTRY

**NEW LAYOFFS PUSH
U.S. JOBLESS RATE
TO 8.9% FROM 8.4%**

Impact in Heavy Industry Puts
Level for Adult Males at a
Post-World War II High

By SETH S. KING

Special to The New York Times

WASHINGTON, Jan. 8 — Layoffs of 460,000 workers in December pushed the nation's unemployment rate from 8.4 percent of the labor force to 8.9 percent, the second highest monthly level since the beginning of World War II. The number of unemployed Americans climbed to a nearly 9.5 million.

At the same time, the total number employed last month fell to 97,188,000, a

U.S. Drops Rule On Tax Penalty For Racial Bias

By STUART TAYLOR Jr.

Special to The New York Times

WASHINGTON, Jan. 8 — The Reagan Administration, reversing an 11-year-old Federal policy, announced today that it would no longer deny tax-exempt status to private schools, colleges and certain other nonprofit institutions that practice racial discrimination.

The decision on the interpretation of the tax laws will apparently entitle more than 100 schools and other organizations whose tax exemptions were revoked in the last decade to receive favorable tax treatment as charitable organizations. It is also expected to open the door to tax exemptions for many other private segregated schools that have never had them.

Justice and Treasury Department officials said that the reason for the policy



COURT HEARING SET

\$80 Billion Divestiture Is
Required — Rises in
Local Rates Seen

By ERNEST HOLSENDOLPH

Special to The New York Times

WASHINGTON, Jan. 8 — The American Telephone and Telegraph Company settled the Justice Department's antitrust lawsuit today by agreeing to give up the 22 Bell System companies that provide most of the nation's local telephone service.

On a landmark antitrust day, the Justice Department also dropped its marathon case against the International Business Machines Corporation, a suit

Excerpts from decree, page 36.

1980s Continued to be Disorienting

- 1983: UNIX System V released
 - Richard Stallman also started GNU Project
 - Started developing free programs functionally equivalent to UNIX programs
- The UNIX wars (late 80s to mid 90s)
 - What is UNIX? Many versions were floating around
- Efforts for peace were made
 - 1985: AT&T introduced the System V Interface Definition (SVID)
 - 1988: IEEE POSIX (Portable Operating System Interface)
 - AT&T worked with others to merge other UNIX versions into System V
 - The Open Software Foundation countered with OSF/1
 - All the while, more commercial distributions of UNIX appeared that expanded beyond AT&T's standard



Richard Stallman

From the cover of: *Free as in Freedom*, Sam Williams.
https://www.amazon.com/Free-Freedom-Richard-Stallmans-Software-dp-0596002874/ref=mt_other?_encoding=UTF8&me=&qid=1630343742

It's a Unix System



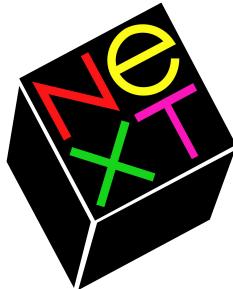
Jurassic Park
1993

IRIX is a version of
System V with
BSD extensions

*Note to Joe: Can
try to show fsv
(rather than fsn)
on my computer*

Steve Jobs Leaves Apple

- 1985: Steve Jobs resigns from Apple
- Jobs begins NeXT in 1985 as well
- Late 80s: NeXTSTEP, NeXT's OS, starts getting worked on
- NeXTSTEP was a mix of:
 - CMU's Mach microkernel
 - BSD



<http://www.financetwitter.com/2014/08/steve-jobs-resignation-letters-in-1985-and-2011-are-some-of-the-best-ever.html>

NeXTSTEP in Action (1992)



1987: MINIX Appears

- *UNIX-like* rather than *UNIX-based*
- Developer: Andrew Stuart Tanenbaum
- Focus: CS education
- Not meant to be an evolving community-developed project
- Started from a blank slate
- Microkernel, not monolithic kernel

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The Free Encyclopedia

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Contents
Current events
Random article
About Wikipedia
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Learn to edit
Community portal
Recent changes
Upload file

Tools
What links here
Related changes
Special pages
Permanent link
Page information
Cite this page
Wikidata item

The Tanenbaum–Torvalds debate was a written [debate](#) between [Andrew S. Tanenbaum](#) and [Linus Torvalds](#), regarding the Linux kernel and kernel architecture in general. Tanenbaum, the creator of Minix, began the debate in 1992 on the Usenet discussion group [comp.os.minix](#), arguing that microkernels are superior to monolithic kernels and therefore Linux was, even in 1992, [obsolete](#).^[1] The debate has sometimes been considered a [flame war](#).^[2]

Find sources: "Tanenbaum–Torvalds debate" – news · newspapers · books · scholar · JSTOR (July 2013) (Learn how and when to remove this template message)

 Andrew S. Tanenbaum

 Linus Torvalds

Contents [hide]

1 The debate

https://en.wikipedia.org/wiki/Tanenbaum–Torvalds_debate

Late 1980s The GNU Project was Chugging Along

- Founder: Richard Stallman
- Free Software Foundation
- Goal: Make a free *Unix-like* OS
- *Note to Joe: Show example of GNU program - nano*
 - *Students - you can try this too!*
- Mostly complete by the late 1980s apart from the **kernel**



Richard Stallman

From the cover of: *Free as in Freedom*, Sam Williams.
https://www.amazon.com/Free-Freedom-Richard-Stallmans-Software-dp-0596002874/ref=mt_other?_encoding=UTF8&me=&qid=1630343742



http://www.gnu.org/graphics/heckert_gnu.html

1991: A Graduate Student Changes the Trajectory of History

From: torvalds@klaava.Helsinki.FI (Linus Benedict Torvalds)

Newsgroups: comp.os.minix

Subject: What would you like to see most in minix?

Summary: small poll for my new operating system

Message-ID:

Date: 25 Aug 91 20:57:08 GMT

Organization: University of Helsinki

Hello everybody out there using minix -

I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready. I'd like any feedback on things people like/dislike in minix, as my OS resembles it somewhat (same physical layout of the file-system (due to practical reasons) among other things).

I've currently ported bash(1.08) and gcc(1.40), and things seem to work. This implies that I'll get something practical within a few months, and I'd like to know what features most people would want. Any suggestions are welcome, but I won't promise I'll implement them :-)

Linus (torvalds@kruuna.helsinki.fi)

PS. Yes - it's free of any minix code, and it has a multi-threaded fs. It is NOT portable (uses 386 task switching etc), and it probably never will support anything other than AT-harddisks, as that's all I have :-(.



Linus Torvalds: A Distinct Personality



“C++ is a horrible language. It's made more horrible by the fact that a lot of substandard programmers use it, to the point where it's much much easier to generate total and utter crap with it. Quite frankly, even if the choice of C were to do *nothing* but keep the C++ programmers out, that in itself would be a huge reason to use C.”

<http://harmful.cat-v.org/software/c%2B%2B/linus>

Early Versions of Linux

- 1991: Linux kernel 0.01 released
 - 10,239 lines of code
 - Contained GNU Project software
 - Bash
 - GNU C Compiler (eventually called GCC)
- 1992: Linux kernel 0.12 released
 - GNU General Public License (GPL) v2
 - Generally ensures that modifications to the source code will always be open



The Significance of the Release of BSD Net/2

- June 1991: BSD Net/2 released
 - Complete, Unix-like system
- Permissive license
 - Source code available
 - Free redistribution
- ‘**first “open source” operating system**’
- First functional Unix-like system that was free
 - Linux kernel released later
 - GNU OS had no kernel
- Ultimately was held up in a lawsuit between USL (Unix System Laboratories) and BSDi (Berkeley Software Design, Inc) started in 1992
 - Caused questions about the practicality of BSD
 - Gave Linux the chance it needed to get going

The BSD License Couldn't Compete

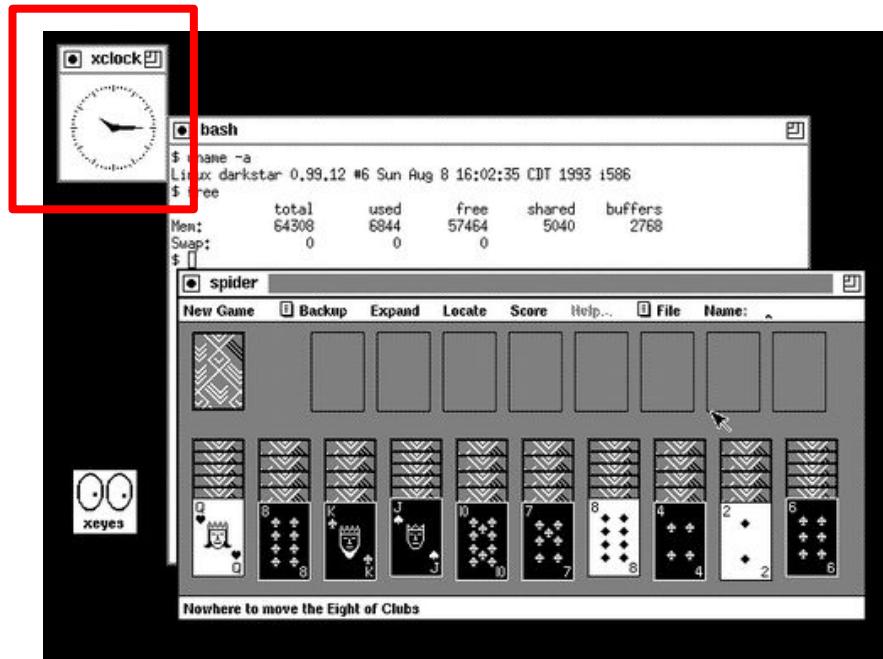
- Overly *permissive*
- Modified BSD code didn't have to be published
- NeXT/Apple could develop proprietary systems from BSD
- How do you compete with the world?

1992: A Big Year for Linux

- X Window System ported to Linux
 - First GUI on Linux
- Software and Systems Development Corporation (S.u.S.E.) born
 - Commercial Unix support
 - Linux distribution

Let's try xclock in the terminal

- You may have to install it
- May also have to install XQuartz on Mac



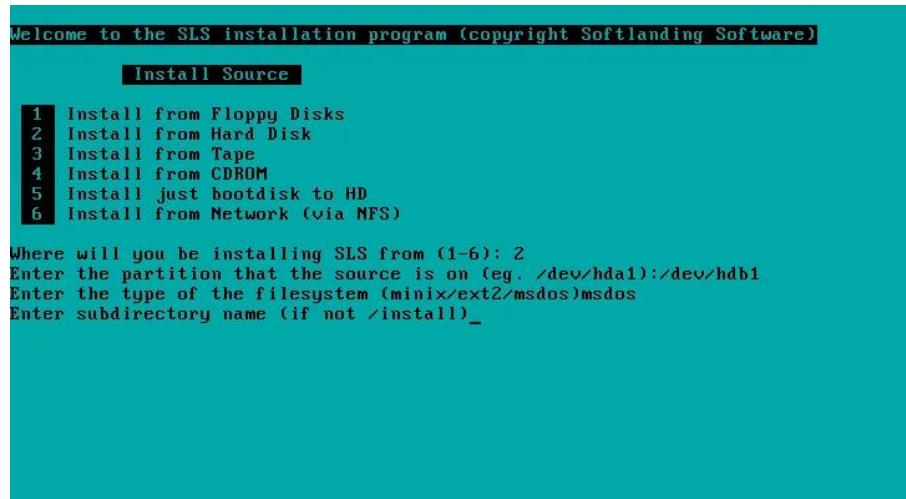
<https://doublslash.com/blog/2013/05/11/linux-user-base-is-below-1-and-it-is-changing/>

1992: Joe was Born



1992-1994: Distributions, Distributions, & More Distributions

- Softlanding Linux System (SLS)
- SLS spawned:
 - Slackware
 - S.u.S.E. developed off of this
 - Debian
- Red Hat
 - Acquired by IBM (2019)
- 1994: Linux kernel 1.0
 - 176,250 lines of code



<https://bdmpublications.com/brief-history-linux/>



<https://static.redhat.com/libs/redhat/brand-assets/2/corp/logo--200.png>

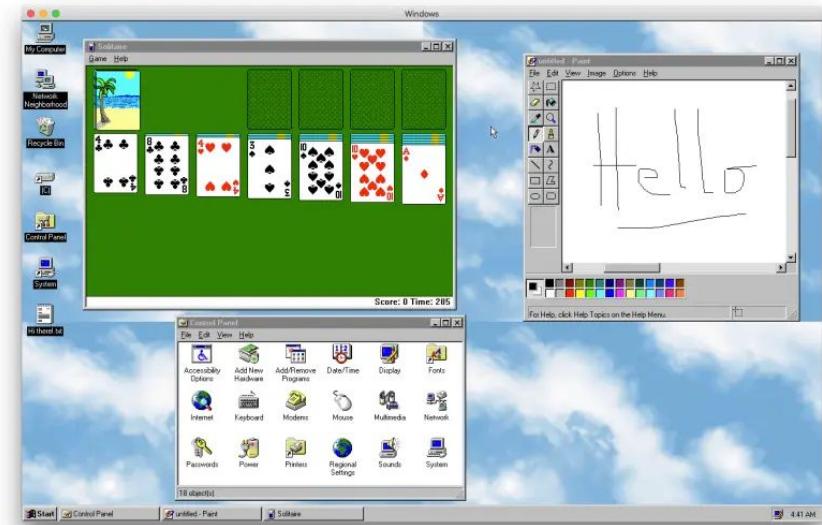
<https://frontpagelinux.com/articles/guide-through-history-of-unix-linux-everything-you-need-to-know/>

<https://www.linuxtrainingacademy.com/what-is-linux/>

<https://bdmpublications.com/brief-history-linux/>

Windows 95 - A Big Deal

- Windows 95 sold incredibly well
 - “57.4 percent of the desktop operating system market” in 1998
[[CNET article](#), number from International Data Corporation]
- First Windows to start up with a GUI automatically
 - Start menu
 - Taskbar
- Backwards compatibility
 - MS-DOS
 - Windows 3.x
- Crashes were not rare :)



<https://qz.com/1367939/windows-95-is-now-an-app-you-can-download-on-your-mac-or-pc/>

NYTimes Article on Windows 95



Stuart Goldenberg

“Where is the Shut Down option?
On the Start button, of course!”

The scaffolding isn't
all new, but most of
the time, it works.

By STEPHEN MANES

OPERATING systems are essentially programs meant to run other programs. Once upon a time they had self-effacing names like DOS and CP/M and p-system, silently intervened between computer programs and the hardware on which they ran and were utterly alien to anyone outside the computer world.

Times have changed. Now operating systems come with flashy handles like Warp and Windows, earn more notoriety than Kevin Costner movies and breed on-line brawls of religious ferocity. Although it will not be generally available until Aug. 24, the Microsoft Corporation's long-delayed Windows 95 has already become such a household name that it is mentioned facetiously in a radio commercial for Hawaiian Airlines.

Since it was first released in 1985, Windows has always tried to emulate the far more elegant Apple Macintosh, but until now it has always required a separate version of DOS, the creaky original operating system for the I.B.M. PC. Windows 95 benefits from an extremely Mac-

like cosmetic makeover and is much improved in other ways, but it is hardly an all-new program under the hood. With Windows 95, Microsoft's own diagnostics programs report that the operating system is MS-DOS 7.0, and the environment is Windows 4.0. In many ways this is an edifice built of baling wire, chewing gum and prayer, but you will probably end up living there.

Why? Because most of the time it works, and there is plenty of software to run on it. The Windows/DOS combination, while hardly a technical knockout, has proven serviceable for millions of users and thousands of software developers. This upgrade runs most current DOS and Windows programs (and new ones

meant for it alone), fixes many problems, adds scads of new features and sells for about \$80, which was once the cost of Windows without DOS.

Unless some horrible bug should turn up to stop the show, Windows is likely to become more pervasive than ever. But as a week's experience with the finished version shows, there will be some pain and suffering along the way.

If you already use Windows, the hardest part of installing Windows 95 may be backing up your hard disk beforehand. Install it over an old version, and Windows 95 will capture all (well, most) of the old settings. Ask it to safeguard your old system files (a very good idea), and Win-

dows 95 will tuck them away.

To anyone who has dealt with the arcane settings involved in configuring a personal computer other than an Apple Macintosh, the ability of Windows 95 to sniff out a system's resources is quietly dazzling. On my machine, built before the advent of so-called Plug and Play technology, Windows 95 managed to find and set up the video card, the sound card, the CD-ROM drive and everything else in the box. It even recognized my onboard modem.

I opened the box, swapped video cards and rebooted. In the past, software hassles would have come next, but Windows 95 calmly identified the new card and installed the proper

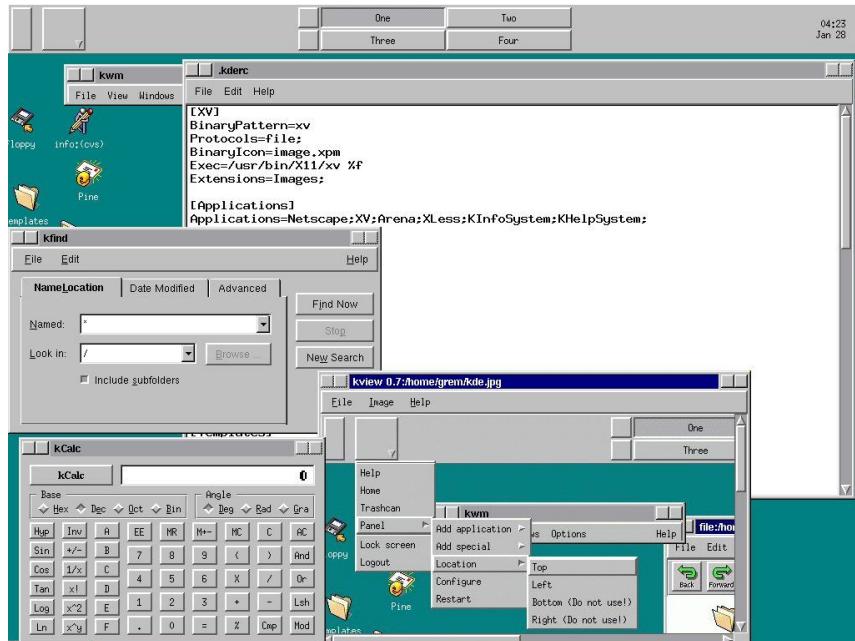
Continued on Page C5

“Note that the CD-ROM edition offers much that the 13-diskette version leaves out”

“That and a video from Weezer are operating-system firsts, unimagined in the days when operating systems were just called DOS.”

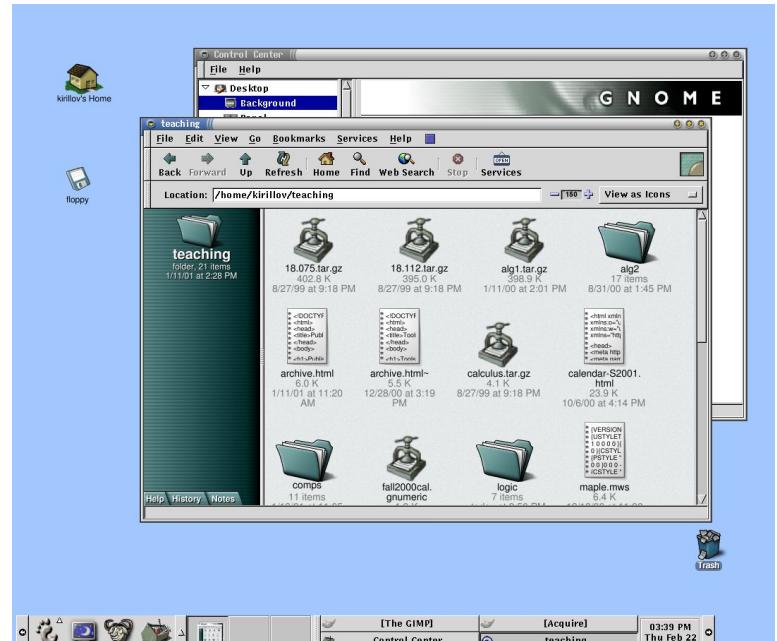
Linux Desktop Environments Appearing

KDE in 1997



<https://imgur.com/gallery/CPNOQ8Z>

Gnome



<http://www.fifi.org/doc/gnome-intro/html/introduction-to-gnome/C/firstglance.html#DESKTOP-FIG>

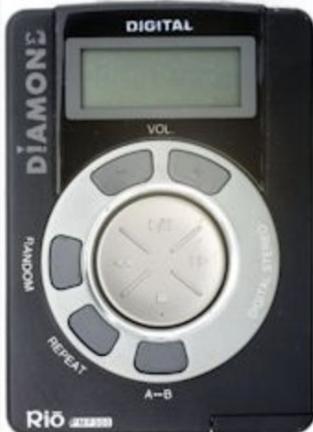
The Mobile Revolution

Diamond Rio PMP-300 - First Successful MP3 Player (9/1998)

- First commercially successful MP3 player
- Size of a deck of cards

Product Description:

- Internet Music in the Palm of Your Hand!
- First portable MP3 music player for under \$200 that stores up to 60 minutes of digital-quality sound.
- It's smaller than an audio cassette and has no moving parts, so it never skips.
- Powered by a single AA battery, Rio provides up to 12 hours of continuous music playback.



Product Specs:

- Palm size for easy portability
- Supports MP3 compression
- 32MB built-in flash memory
- Expandable playback time with removable flash cards
- Skip free - no moving parts
- MusicMatch Jukebox Limited Edition software for converting CD's to an MP3 format
- CD Music Sampler
 - Goodnoise: The premier source on the net for high-quality, downloadable music
 - MP3.com: Tons of songs from new artists
 - MP3 songs from MusicMatch and Audio Explosion, also included
- \$199.95, RIO 16MB Flash Memory Upgrade \$49.95

<-Screenshot of information at:

https://www.manifest-tech.com/ce_gallery/portable_gallery_players.htm#Early

2001: The iPod



Say hello to iPod.
1,000 songs in your pocket.



“Easy on the eyes”

The iPod has a large, high-quality liquid crystal display (LCD) for viewing up to six lines of text. And the LCD features a white light-emitting diode (LED) backlight for clear visibility in low-light situations — indoors or outdoors.”

- \$400
- 5GB hard drive
- 10-hour battery life
- 0.4 pounds
- 2.43" x 4.02" x 0.78"
- 160-by-128-pixel resolution
- “OS: Operating system for mobile devices based on Pixo OS 2.1.”
[<https://igotoffer.com/apple/ipod-1st-gen>]

Glorious Early Smartphones



**Samsung
BlackJack**

**BlackBerry
8800**

**Treo
700p**

2005: Is Apple Working on a Phone?



2007: The iPhone - Unix on Smartphones

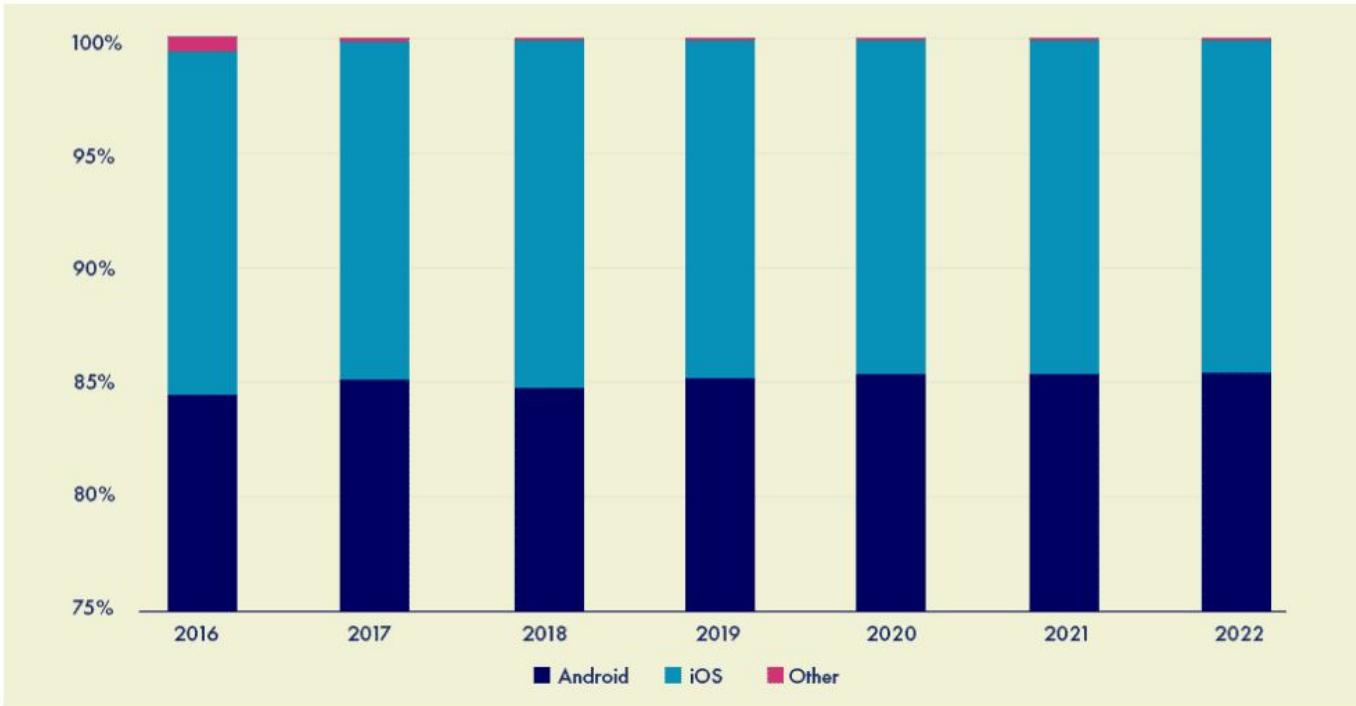


2008: Android 1.0 Released - Linux Arrives on Smartphones



Apple & Google Dominate Smartphones

Global Android & iPhone Market Share



Moment of Silence for Windows Phone

MICROSOFT \ MOBILE \ TECH \

Windows Phone was a glorious failure

Looking back on the bumpy road taken by Microsoft's most ambitious mobile OS

By Vlad Savov | @vladsavov | Oct 10, 2017, 9:41am EDT

f t SHARE

Photo by Vlad Savov / The Verge

This past weekend, Microsoft made official what was already known for years: the Windows Phone mobile operating system is dead. There'll be no further development, no miraculous [Windows 10 Mobile](#)

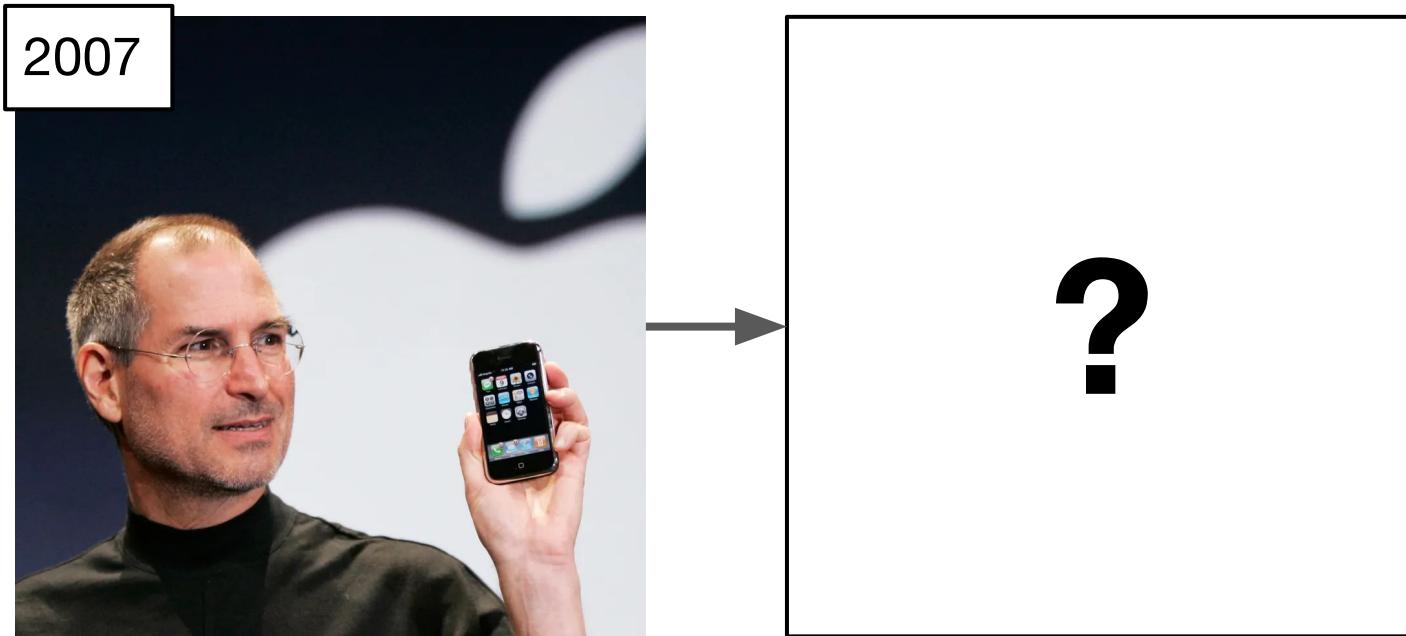
“Carriers at some point realized that handset manufacturers were terrible”



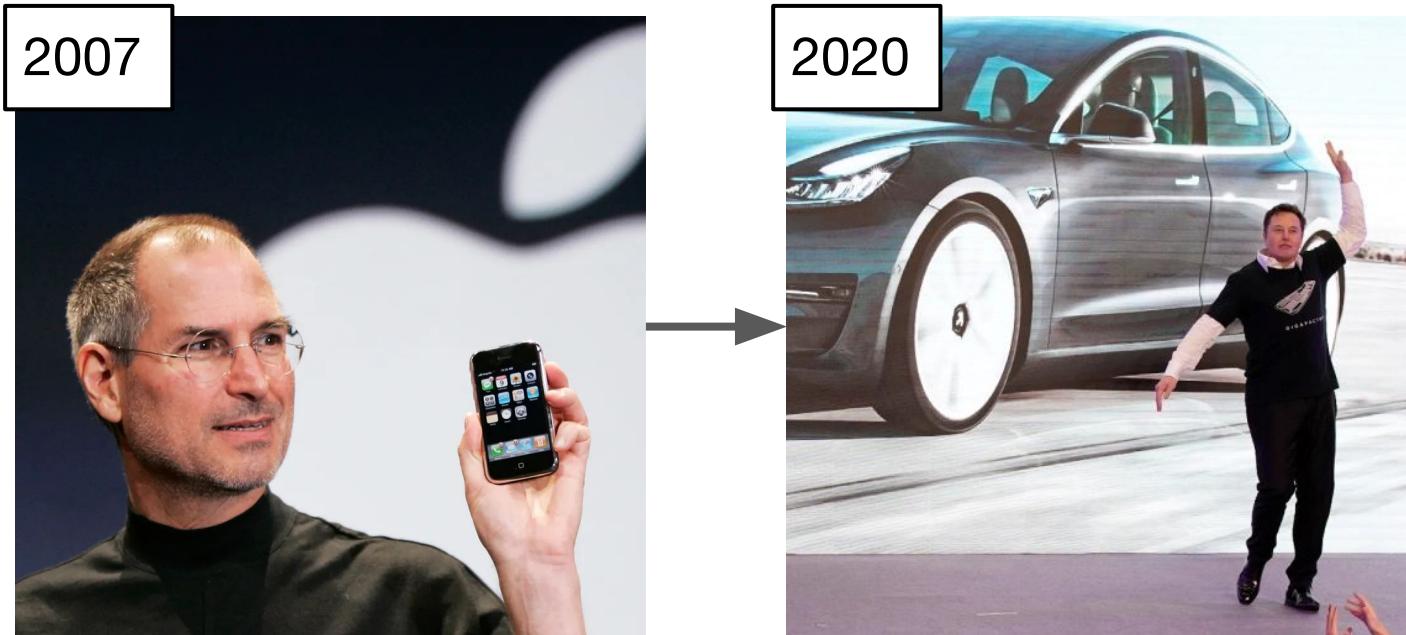
Dominant Players Couldn't Innovate on Software



Jumping Ahead 1.5 Decades: What's Next?



Jumping Ahead 1.5 Decades: What's Next?



<https://www.wired.com/story/iphone-history-dogfight/>

Image Credit: REUTERS/Aly Song
<https://venturebeat.com/2020/07/09/elon-musk-says-tesla-is-very-close-to-level-5-autonomous-driving/>

Similarities Between Self-Driving Cars & Smartphones?



Paul Graham @paulg

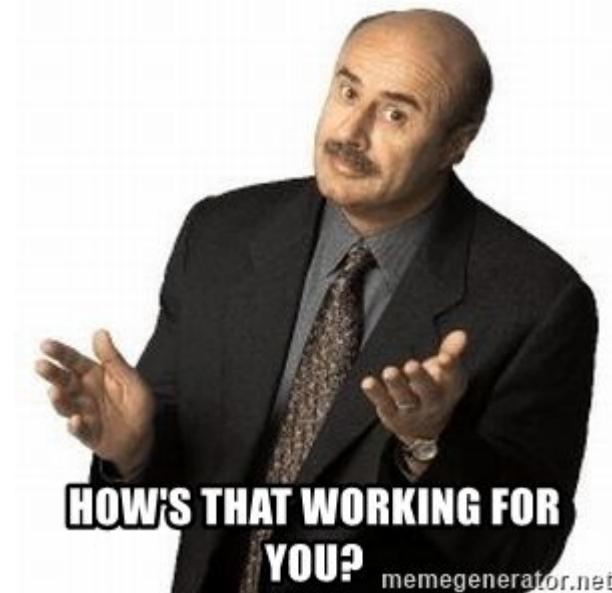
...

The Tesla Model S was like the iPhone in that all other manufacturers now have to copy it. The difference is many don't realize that yet.

1:08 AM · May 18, 2017 · Twitter Web Client

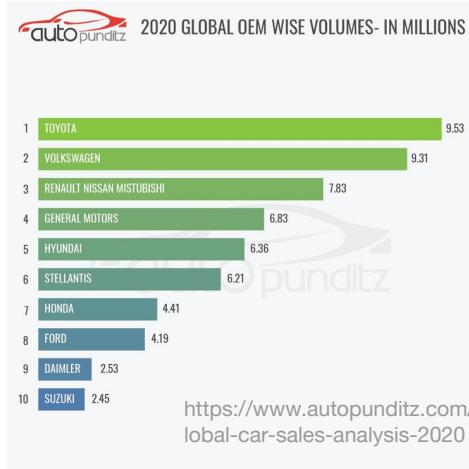
359 Retweets 37 Quote Tweets 828 Likes

<https://twitter.com/paulg/status/865086587574648833>



<https://memegenerator.net/instance/10859951/dr-phil-hows-t-hat-working-for-you>

The Situation is Not Looking Good



The New York Times

Toyota Led on Clean Cars. Now Critics Say It Works to Delay Them.

The auto giant bet on hydrogen power, but as the world moves toward electric the company is fighting climate regulations in an apparent effort to buy time.

<https://www.nytimes.com/2021/07/25/climate/toyota-electric-hydrogen.html>

Consumer Reports

Active Driving Assistance Systems: Test Results and Design Recommendations
Nov. 2020

Overall Ratings Results

SYSTEM NAME	SCORE	CAPAB. & PERF.	KEEPING DRIVER ENGAGED	EASE OF USE	CLEAR WHEN SAFE TO USE	UNRESPONSIVE DRIVER
Comma Two Open Pilot	78	8	9	8	6	8
Cadillac Super Cruise	69	8	7	3	8	9
Tesla Autopilot	57	9	3	7	2	6
Ford/Lincoln Co-Pilot 360	52	8	4	3	4	5
Audi Driver Assistance Plus	48	8	3	3	2	6
Mercedes-Benz Driver Assistance	46	6	4	4	2	5
Subaru Eyesight	46	7	4	3	4	5
Hyundai Smart Sense, Kia Drive Wise	46	5	4	5	4	4
BMW Active Driving Assistance Pro	44	7	3	3	2	6
Porsche Active Safe	41	4	3	6	2	5
Volvo Pilot Assist	41	6	3	3	2	5
Toyota/Lexus Safety Sense 2.0	40	5	4	2	4	5
Honda/Acura Sensing	40	6	4	2	4	4
Nissan/Infiniti ProPILOT Assist	40	5	3	3	4	7
Volkswagen Driver Assistance	39	4	3	6	2	5
Land Rover Driver Assist	38	4	3	6	2	4
Buick/Chevy Driver Confidence	36	3	3	5	2	6
Mazda i-ACTIVSENSE	27	3	2	5	2	1

<https://data.consumerreports.org/wp-content/uploads/2020/11/consumer-reports-active-driving-assistance-systems-november-16-2020.pdf>

The Situation Does Look Good for Us

It's a Linux-powered car world

It's not just Tesla with Linux under the hood. Audi, Mercedes-Benz, Hyundai, and Toyota, to name a few, all rely on Linux.



By Steven J. Vaughan-Nichols | January 4, 2019 – 16:17 GMT (08:17 PST) | Topic: [Hardware](#)



<https://www.zdnet.com/article/its-a-linux-powered-car-world/>

Themes to Think Over

- Free/open software vs. proprietary software
- Incumbent entities limited ability to innovate in software
- Market traction difficult if software not pre-installed
- It's a great time to be a Linux expert :)

Next Lecture:

What is Linux?

“UNIX is basically a simple operating system,
but you have to be a genius to understand the simplicity.”

- Dennis Ritchie