

[Software Development]

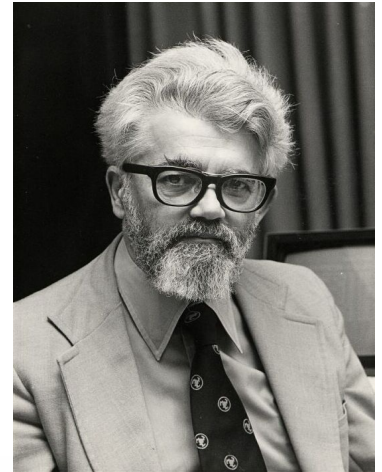
UNIX: a short history

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Early 60s - The Stone Age

- OSs were written for a particular machine and they operated in **batch mode**:
 - Computers were completely dedicated to run a *single program* for a *single user* at the time
 - Programs had to be prepared offline on *punch cards*
- In the early 60s, scientists start working on the idea of supporting many users at the same time (**timesharing**)
 - While any single user was inefficient, a large group of users together were not
 - But running multiple programs at the same time, required completely re-designed OSs....



*John McCarthy



Before Multics there was chaos.. and afterwards, too

- In 1965 a group of scientists from Bell Labs and GE joined an effort underway at MIT to develop a dependable timesharing operating system
 - The project was called **MULT**iplexed **I**nformation and **C**omputing **S**ervice (MULTICS)
 - The joint effort was not successful and Bell Labs withdrew from the project in 1969

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 - The project was called **MULT**iplexed **I**nformation and **C**omputing **S**ervice (MULTICS)
 - The joint effort was not successful and Bell Labs withdrew from the project in 1969
- A few of Bell's employees (*Ken Thompson, Dennis Ritchie, Douglas McIlroy, and J. F. Ossanna*) didn't give up and decided to try again
 - Frustrated by the size and complexity of Multics they decided to try with something simpler

UNIX, the best Screwdriver ever built

- Thompson wrote the first version of the yet-unnamed operating system in assembly language for a DEC PDP-7 minicomputer
 - The name (written Unics at the beginning) was coined by Brian Kernighan as a pun on Multics



"I allocated a week each to the operating system, the shell, the editor, and the assembler to reproduce itself..."

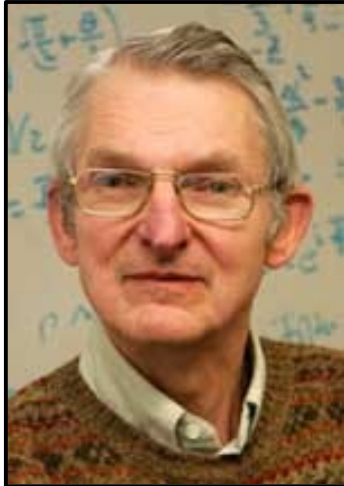
-- Ken Thompson
(summer of '69)

A new language for a new system

- Thompson developed a compiler for a new high-level language he called B (stripped-down version of the BCPL language)
- In 1972 Dennis Ritchie created a new language called C
 - Inherited B's concise syntax
 - Added a powerful mix of high-level functionality and the low level features required to program an operating system
 - “The Unix installations has grown to 10 with more expected”
- In 1973 most of the UNIX kernel was rewritten in C
 - Easier to understand and modify
 - Easier to port to new platforms



From a System to a Philosophy



"We should have some ways of coupling programs like garden hose -- screw in another segment when it becomes necessary to massage data in another way"

-- Doug McIlroy

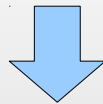
- The **pipe** fostered a distinctive approach to software design:
 - Solve a problem by interconnecting simpler tools, rather than by creating large monolithic application programs
 - Not just programs but **tools**: software programs that would be in a "tool box", available when the user needs them
- When Thompson implemented the pipes, he also put something else into UNIX – a **philosophy**

AT&T

- In 1951 the United States Department of Justice announced that it was pursuing an antitrust action against AT&T, which controlled most of the nation's telephone network
- In 1956 AT&T and the Government reached a consensus, including two important requirements:
 - Bell Systems patents should have been licensed to competitors on request
 - AT&T would stay out of *"any business other than the furnishing of common carrier communications services."*

UNIX Early Days

- In October 1973 Thompson presented Unix to the 4th ACM Symposium on Operating Systems Principles
- Suddenly, a large number of universities and research departments started asking AT&T for a copy of Unix
 - To avoid a fight with the government, AT&T declared that they had no intention in pursuing software as a business...
 - ..and start selling licenses of Unix “as is”:



No support
No Bug fixes

USENIX

- The lack of technical support forced the users (in particular the universities) to share programs and information and to improve themselves the OS
- In 1974, a meeting of Unix users was organized in New York
 - The “Unix Users Group” became an organization, that still existing and it is now called **USENIX**

Phase 2: UNIX in the Universities

- In 1976-77, Thompson took a six-month sabbatical from Bell Labs to teach as a visiting professor at the University of California-Berkeley
- When Thompson returned to Bell Labs, students and professors at Berkeley continued to enhance UNIX
 - In 1977 **Bill Joy** (a grad student at the time) puts together the first UNIX Berkeley Software Distribution (**BSD**)
- Joy also added a Pascal compiler, the C Shell, and a new text editor called **VI**
 - vi became the de facto standard Unix editor
 - vi was later added to the *UNIX Specification*, so every conforming system must have it

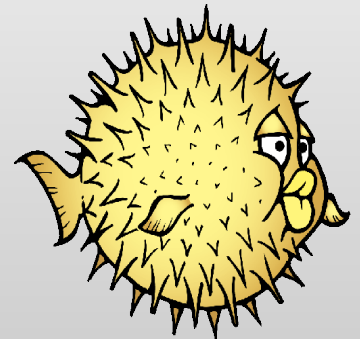
The rise of the Network

- DARPA gave Berkeley a major contract to enhance Unix so that it would be suitable for its new network
 - Joy had been instructed to plug Bolt, Beranek and Newman (BBN) TCP/IP stack into Berkeley Unix
 - He refused because, in his opinion, BBN's stack wasn't good enough. So he wrote his own high-performance TCP/IP stack
- BSD worked so well that DARPA chose it to be the preferred operating system for its Arpanet research nodes
 - * In 1982, Joy co-founded Sun Microsystems where he created NFS and helped designing the SPARC microprocessor and the JAVA language



BSD Today

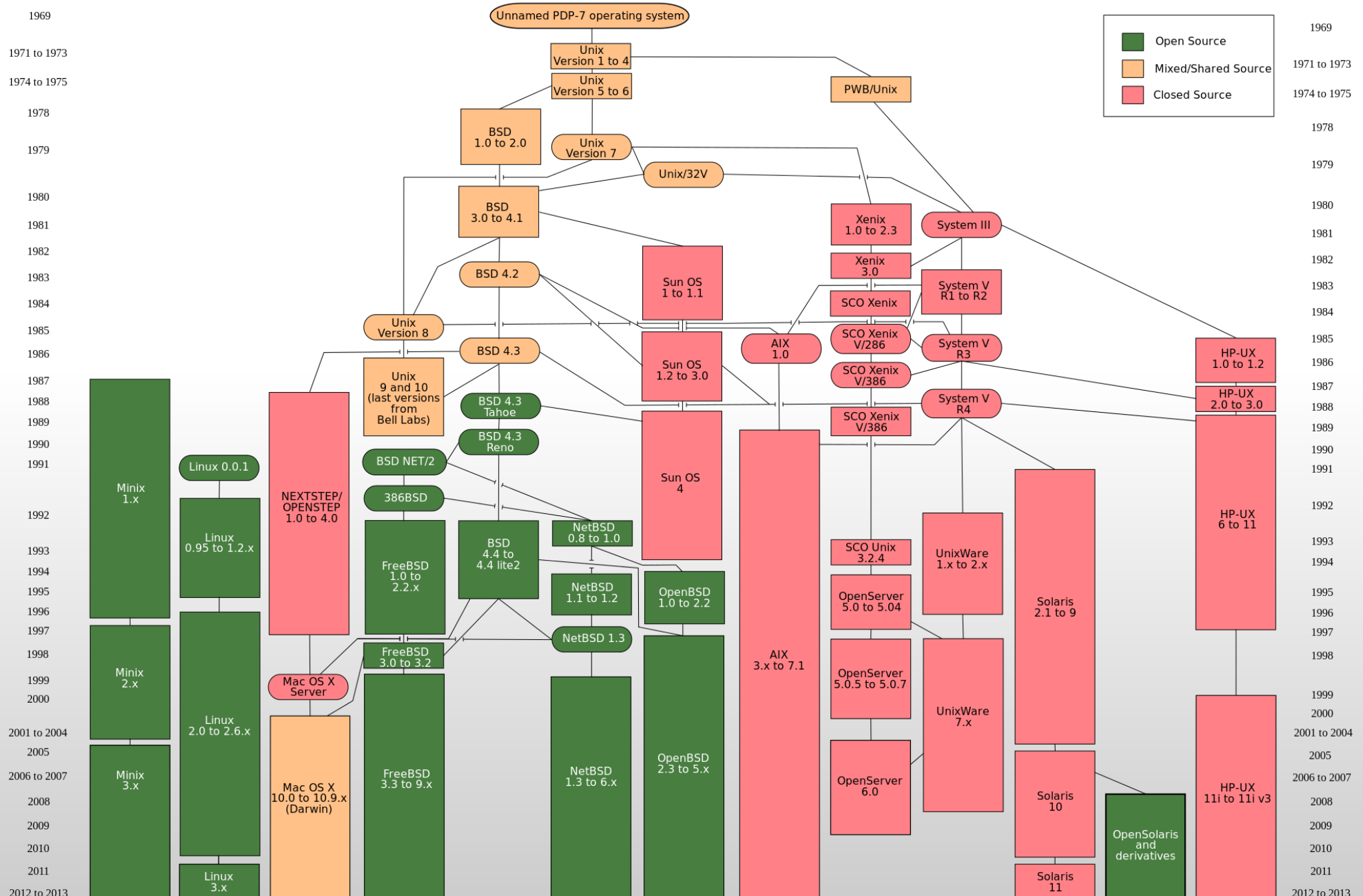
- Three BSD distributions were created (in '93 and '95) to maintain and enhance BSD
 - [FreeBSD](#), focused on personal computers
Contains the more cutting edge feature, and has the larger user base
 - [NetBSD](#), focused on portability
Supports as many platforms as possible
 - [OpenBSD](#), focused on improving the security of BSD
- All of them can be freely downloaded from the Internet
- BSD is also the base of some commercial OSs (such as Mac OS X)



Commercial Success

- Each company proposed its own Unix flavor:
 - AIX (IBM)
 - Solaris, SunOS (SUN)
 - Ultrix (DEC)
 - Hp-UX (HP)
 - IRIX (Silicon Graphics)
 - XENIX (Microsoft → SCO)
 - MacOSX (Apple)
 - Tru64 (Compaq)
- Portable Operating System Interface for Unix (**POSIX**)
 - Set of IEEE standards to define the application programming interface (API), shell and utilities interfaces for software compatible with variants of the Unix operating system

The Family Picture



A Guy with a Dream

- In September 1983, [Richard Stallman](#) launched a project to create a free Unix-like operating system called [GNU](#) (recursive acronym for “GNU's Not Unix”)
 - The Free Software Foundation (FSF) was founded in '85 to raise funds to help the GNU Project
 - In '89, the FSF published a new license called The GNU General Public License (GPL)
- Stallman also contributed with many tools
 - The [Emacs](#) text editor
 - The GNU Compiler Collection ([GCC](#))
 - The GNU Debugger ([GDB](#))



Free as In Freedom

- The program's users must have four essential freedoms:
 1. The freedom to **run the program**, for any purpose
 2. The freedom to **study** how the program works, and **change** it to make it do what you wish
(access to the source code is a precondition for this)
 3. The freedom to **redistribute** copies so you can help your neighbor
 4. The freedom to **improve** the program, and **release** your improvements (and modified versions in general) to the public, so that the whole community benefits
(access to the source code is a precondition for this)
- A program is Free Software if users have all of these freedoms
 - The FSF website lists all the licenses that are free software compatible

A System looking for a Kernel

- By 1990, the GNU system had almost all the pieces except the most important one: the OS kernel
 - BSD was in the middle of a lawsuit against AT&T over intellectual property related to UNIX
 - In 1987, a professor named Andrew Tanenbaum wrote from scratch a UNIX-like operating system for the IBM PC. He called it **MINIX**
 - The source code was available but its modification and redistribution were restricted (no free software)
 - In '91, a Finnish student by name Linus Torvalds released a freely modifiable UNIX-like kernel
- The combination GNU/Linux is what is now simply called **Linux**

The Age of the Penguin

- In 1993 Patrick Volkerding puts together the first Linux distribution (Slackware).
- In 1994 the Linux kernel ver. 1.0 is released
- Today there are over 300 Linux distributions in active development
 - Each distribution consists of a large collection of applications
 - Some are maintained by companies (Fedora, Ubuntu, Mandriva..)
 - Some are maintained by a distributed community (Debian, Gentoo..)



