[Software Development]

UNIX: a short history

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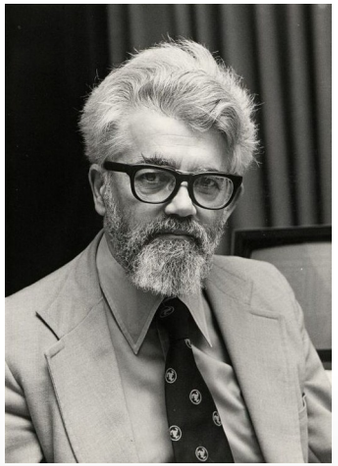
Early 60s - The Computers Stone Age

- 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 a time
  - Programs had to be prepared offline on *punch cards*



*John McCarthy

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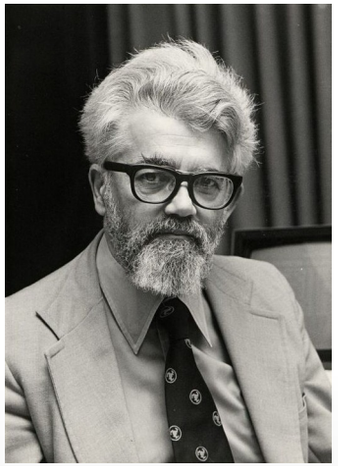
  - Programs had to be prepared offline on *punch cards*
- In the early 60s, scientists started working on the idea of supporting many users in parallel (timesharing)
  - While any single user was inefficient, a large group of users together were not
  - But running multiple programs at the same time, required completely re-designed OSs....



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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 **MUL**tiplexed **I**nformation and **C**omputing **S**ervice (MULTICS)
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- A few of Bell's employees (*Ken Thompson, Dennis Ritchie, Douglas McIlroy,* and *Joe 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`

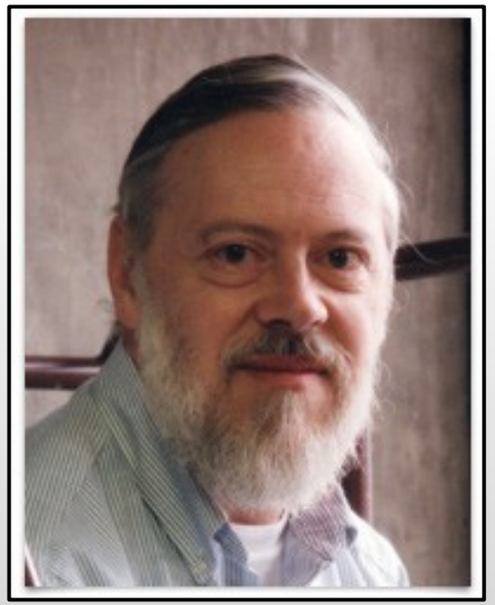
> "I allocated a week each to the operating system, the shell, the editor, and the assembler to reproduce itself..."
>
> -- Ken Thompson (summer of '69)

A New Language for a New System

- Thompson developed a compiler for a new high-level language he called B (a 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 lever 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, which included two important requirements:

  1. Bell Systems patents should have been licensed to competitors on request
  2. 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
  - However, to avoid a fight with the government, AT&T declared that they had no intention in pursing software as a business...
  - ..and start selling licenses of Unix “as is” with No support & No Bug fixes

USENIX

- The lack of technical support forced the users (in particular 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 exists today 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) put together the first UNIX Berkeley Software Distribution (BSD)

- Joy also added a Pascal compiler, the C Shell, and a new editor called **`VI`**
  - `vi` became the de-facto standard text editor in Unix environments
  - `vi` was later added to the *UNIX Specification*, so every conforming system must have it

The rise of the Network

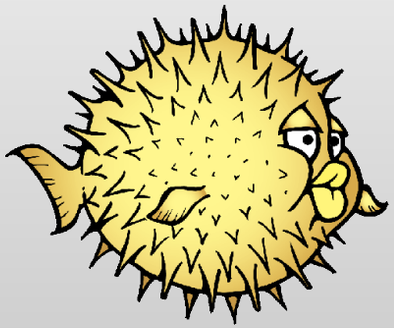
- DARPA gave Berkeley a major contract to enhance Unix so that it would be suitable for its new network
  - Joy had been instructed to plug Bolt, Beranek and Newman (BBN) TCP/IP stack into Berkeley Unix
  - He refused because, in his opinion, BBN's stack wasn't good enough. So he decided to write his 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

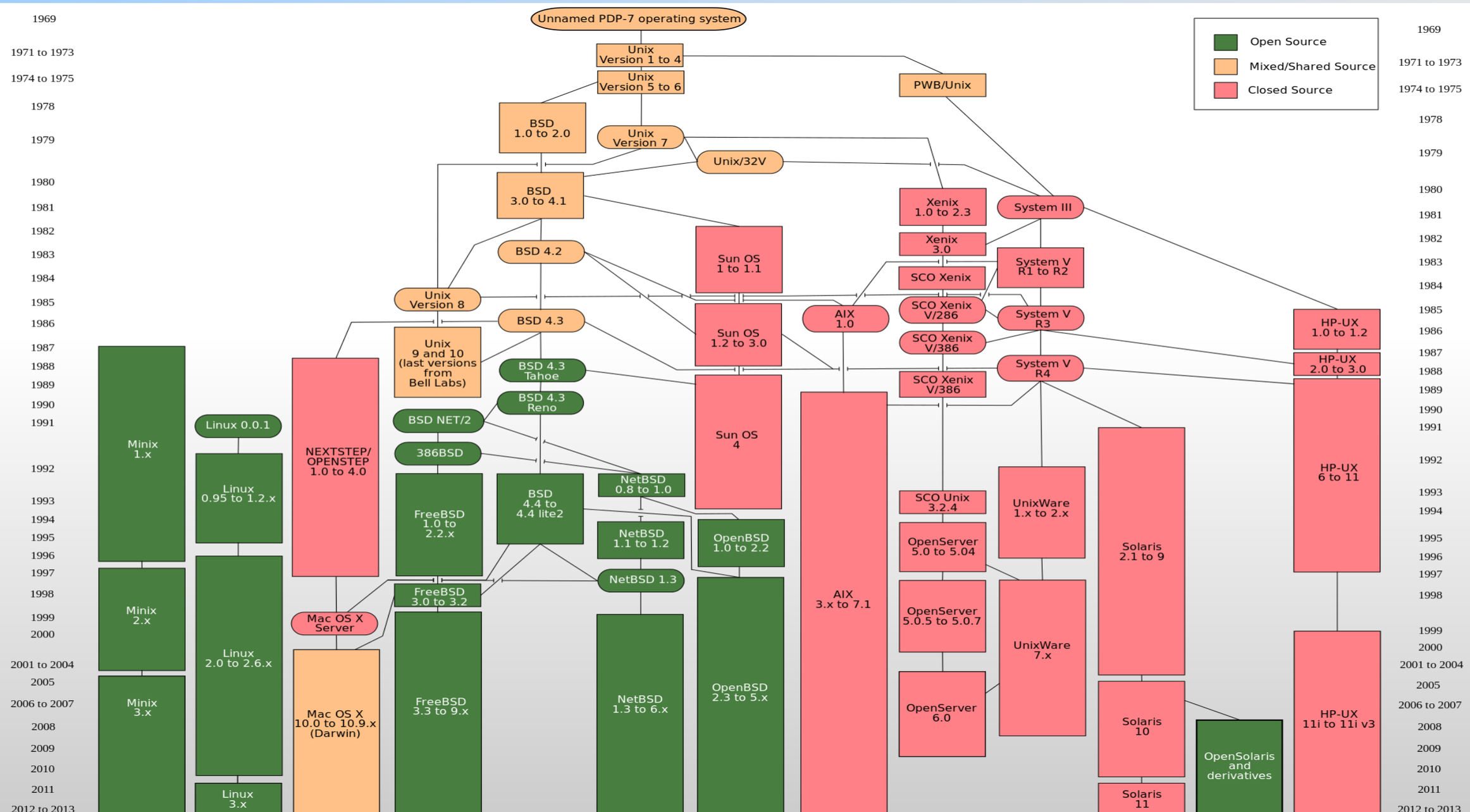
- BSD is also the base of some commercial OSs
  (such as Mac OS X)



Commercial Success

- Soon, 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



Phase 3: 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 1985 to raise founds to help the GNU Project
  - In 1989, 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 he wishes
     (access to the source code is a precondition for this)
  3. The freedom to redistribute copies to help other users
  4. The freedom to improve the program, and release the improvements (and modified versions in general) to the public, so that the whole community can benefit (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 1991, 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 put 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,...)
  - Some are maintained by a distributed community (Debian, Gentoo..)