CS 4530
Fundamentals of Software Engineering

Module 16: Open Source Principles

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Learning Goals

By the end of this lesson, you should be able to…

- Understand terminology and explain open source culture and principles
- Opine on philosophical/political debate between open source and proprietary principles
- Reason about tradeoffs of different open source licenses and business model

Background: laws and open source

Copyright protects creative, intellectual and artistic works — including software

Alternative: *public domain* (nobody may claim exclusive property rights)

Trademark protects the name and logo of a product

OSS is generally copyrighted, with copyright retained by contributors or assigned to entity that maintains it

Copyright holder can grant a *license for use*, placing restrictions on how it can be used (perhaps for a fee)

Early open source: UNIX to BSD

- Hardware was not yet standardized, computer vendors focused on hardware, building new operating systems for each platform
- Much software development focused in academic labs, and AT&T's Bell Labs
- Unix created at Bell Labs using the new, portable language "C", licenses initially released with source code
- 1978: UC Berkeley begins distributing their own derived version of Unix (BSD)
- AT&T is prohibited from entering *new* telecommunications businesses (can't make OS a product)

IBM 704 at NASA Langley in 1957 (Public domain)

The BSD License is *Permissive*

Authors of BSD created a license for the OS that:

1. Required those using it to credit the university
2. Limited liability for (mis)-use

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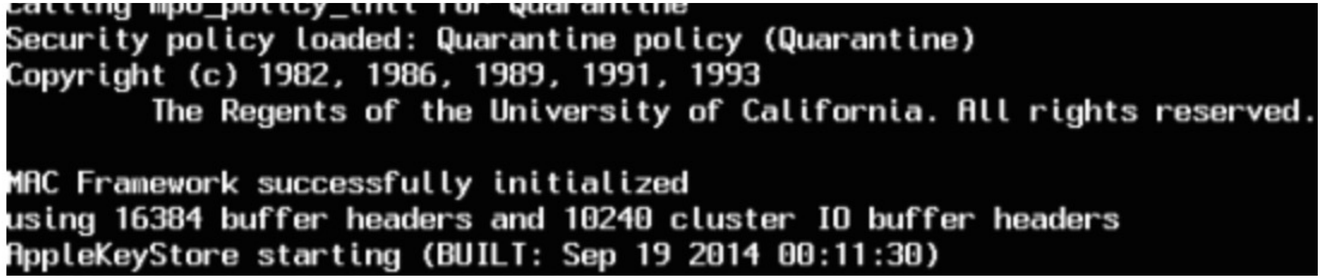


BSD Copyright in OS X boot sequence

UNIX to GNU's Not Unix

Timeline

- 1978: UC Berkeley begins distributing their own derived version of Unix (BSD)
- 1983: AT&T broken up by DOJ, UNIX licensing changed: no more source releases
- Competing commercial vendors all package and sell their derivations of UNIX (AT&T, HP, Sun, IBM, SGI)
- Also 1983: "Starting this Thanksgiving I am going to write a complete Unix-compatible software system called GNU (Gnu's Not Unix), and give it away free to everyone who can use it"

GNU logo (a gnu wildebeest)

Free software as a Philosophy

"Free as in Speech, not as in beer"

Richard Stallman's Free Software Foundation — free as in liberties

- Freedom 0: *run code as you wish, for any purpose*
- Freedom 1: *study how code works, and change it as you wish*
- Freedom 2: *redistributed copies (of original) so you can help others*
- Freedom 3: *distribute copies of your modified version to others*

Richard M Stallman (Licensed under GFDL)

Free software as a Philosophy

"Free as in Speech, not as in beer"

FSF: software licensed under GNU Public License (GPL), considering questions like:

- Required to redistribute modifications (under same license)? *Yes, "copyleft"*
- Can you combine it with more restrictive licenses? *No, not even with BSD!*

Alternative (more like BSD):

"Do whatever you want with this software, but don't blame me if it doesn't work" *freeware*

Copyleft v. permissive

Can I *combine* OSS with my product, releasing my product under a different license (perhaps not even OS)?

Permissive licenses encourage adoption by permitting this practice

Copyleft “protects the commons” by having all linked code under same license, *transitively requiring more sharing*

Philosophy: *do we force participation, or try to grow/incentivize it in other ways?*

GNU/Linux (1991-Today)

Stallman set out to build an operating system in 1983, ended up building utilities needed by an operating system (compiler, etc)

Linux is built around and with the GNU utilities, licensed under GPL

Rise of the internet, demand for internet servers drives demand for cheap/free OS

Companies adopted and support Linux for enterprise customers

IBM committed over $1B; Red Hat and others

IBM TV Commercial: “Prodigy”

https://www.youtube.com/watch?v=x7ozaFbqg00

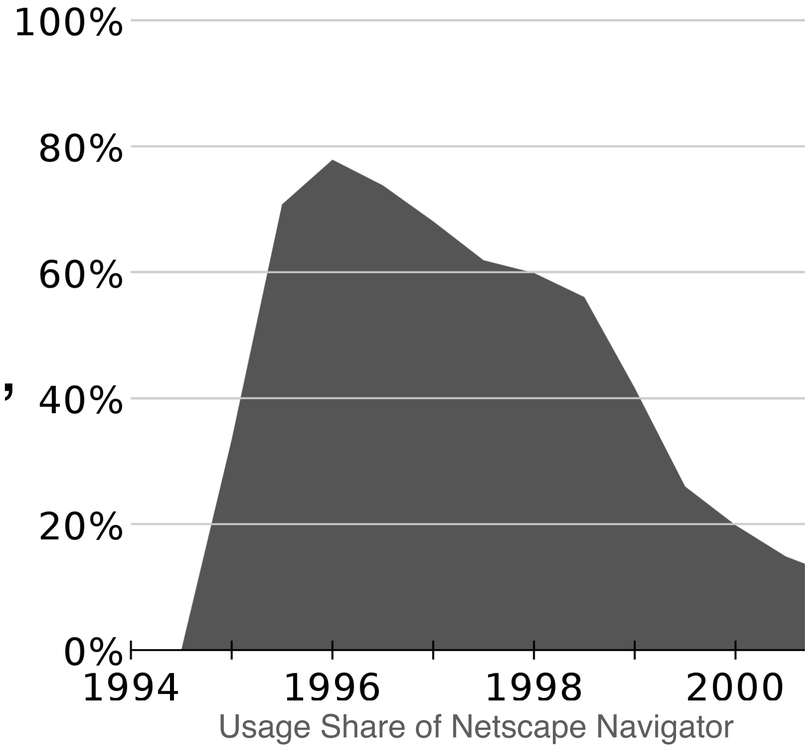
Netscape’s open source gambit

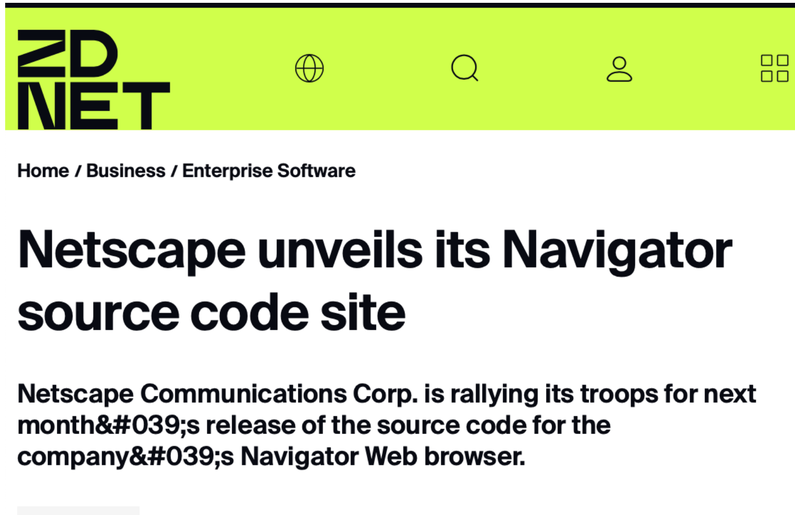
Netscape was dominant web browser early 90’s

Business model: free for home and education use, companies pay

Microsoft entered browser market with Internet Explorer, bundled with Windows95, soon overtakes Netscape in usage (free with Windows)

January 1998: Netscape first company to open source code for proprietary product (Mozilla)





Netscape creates a new license and model

Until Netscape, much of OSS was the FSF and its GPL

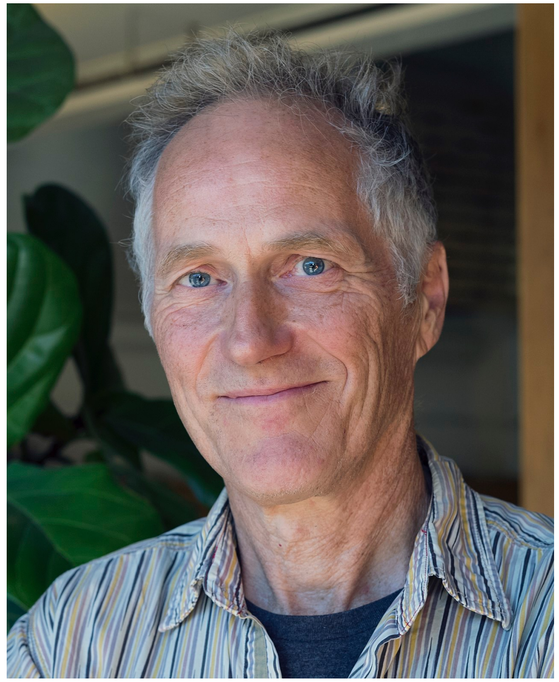
Open Source coined in 1998 by the Open Source Initiative to capture Netscape's aim for an open development process

New licenses follow, e.g. MIT, Apache, etc. *just like BSD, but without the advertising part*

Publisher Tim O'Reilly organizes a Freeware Summit later in 1998, soon rebranded as Open Source Summit

Open Source is a development methodology; free software is a social movement
— Richard Stallman

Open source initiative logo



Tim O'Reilly
Photo via Christopher Michel/Flickr, CC BY 2.0

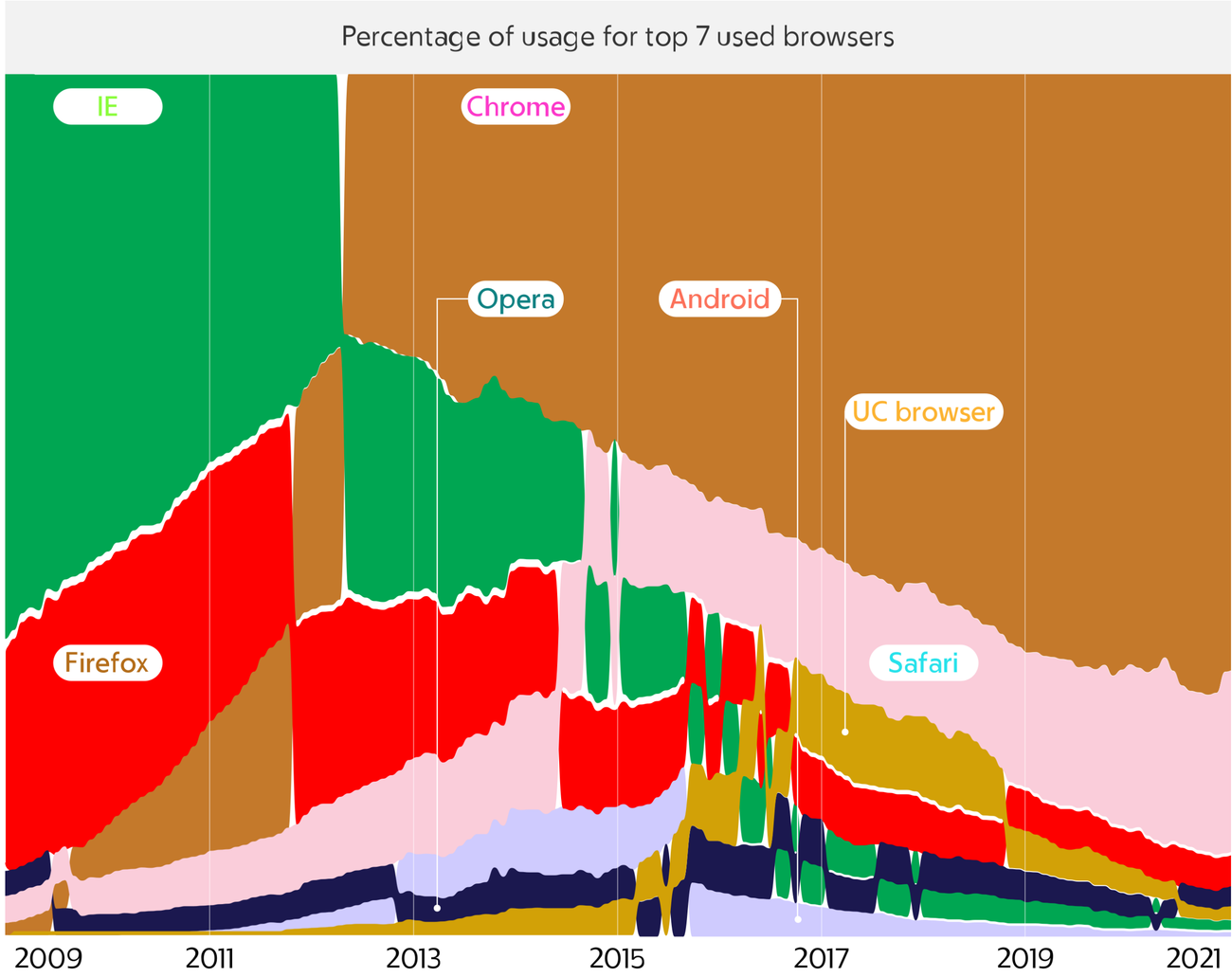
Firefox lost battle, Open Source wins war

Firefox lost to Chrome and Safari, but OSS won

- Chrome's core = Chromium OSS
- Safari's core = Webkit OSS
- Microsoft's Edge core = Chromium

How do browsers differentiate?

Why is there more than one?



[By Datavizzer, CC BY-SA 4.0]

OSS Provides Community Infrastructure

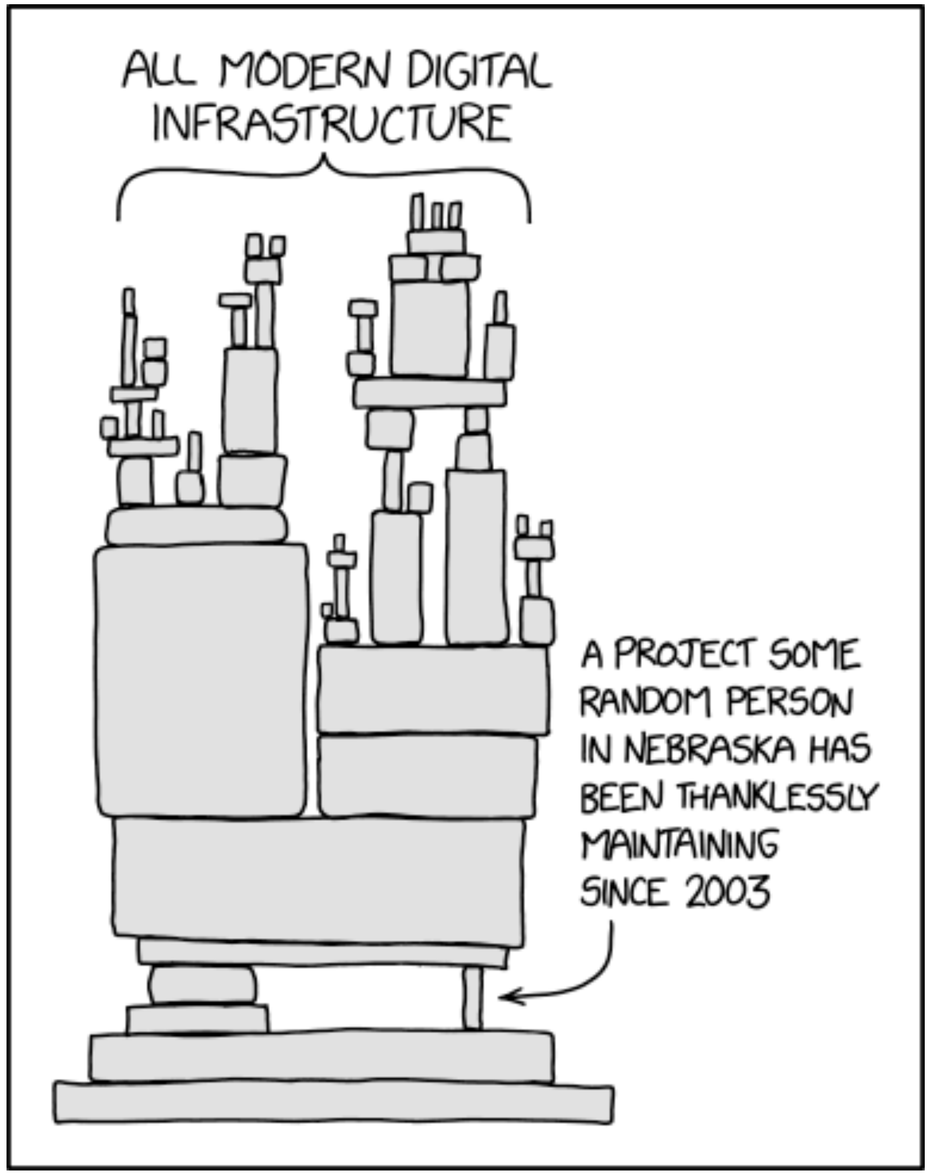
Operating Systems *are a utility for the common good*: everybody needs them, nobody wants to bear the cost

Eric S Raymond's 1997 essay compares software development methodologies as a "cathedral" or "bazaar"

Much OSS today follows "bazaar" model:

- Users treated as co-developers
- Release software early for feedback
- Modularize + reuse components
- Democratic organization

GitHub is the Modern Bazaar



XKCD “Dependency”

Adopting OSS has risks

Are licenses compatible? A significant concern for licenses with copyleft:

Adopting libraries with copyleft clause generally means what you distribute linked against that library must also have same copyleft clause (and be open source)

- Including permissive-licensed software in copyleft-licensed software is generally compatible (copyleft takes precedence)
- Are you certain that the software truly is released under the license that is stated? Did all contributors agree to that license?

OSS Risks: GitHub Copilot and Codex

Codex is a large language model trained on code in public repositories on GitHub

Copilot suggests lines of code as you program, based on the Codex model

Copilot will output entire snippets of code from public GitHub repositories

What is the ownership and license compatibility of the resulting code?

SIGN IN / UP The Register®

GitHub's Copilot flies into its first open source copyright lawsuit

It won't be the last

Steven J. Vaughan-Nichols Fri 11 Nov 2022 // 10:30 UTC

Log in

OPINION GitHub Copilot, Microsoft's AI-driven, pair-programming service, is already wildly popular. Microsoft broke out GitHub's revenue and subscription numbers in its latest quarterly report for the first time.

GitHub now has an annual recurring revenue of $1 billion, up from a reported $200 to $300 million when it was acquired. It now boasts 90 million active users on the platform, up from last November's 73 million. Much of its recent revenue and subscriber jump can be ascribed to Copilot. Too bad the party may soon be over.

https://www.theregister.com/2022/11/11/githubs_copilot_opinion/

Successful OSS have strong communities

OS projects thrive when *community* surrounding them contributes to push the project forward

Communities form around collective ownership (even if it's only perceived)

Contributors bring more than code: also documentation, support, and outreach

Community/ownership models:

- Corporate owner, community outreach/involvement (MySQL, MongoDB)
- Foundation owner, corporate sponsors (GNU, Linux)

Open Source Governance

Some OSS projects are managed by for-profit firms

- **Examples**: Chromium (Google), Moby (Docker), Ubuntu (Canonical), TensorFlow (Google), PyTorch (Meta), Java (Oracle)
- Contributors may be a mix of employees and community volunteers
- Corporations often fund platforms (websites, test servers, deployments, repository hosting, etc.)
- Corporations usually control long-term vision and feature roadmap

Many OSS projects are managed by non-profit foundations or ad-hoc communities

- **Examples:** Apache Hadoop/Spark/Hbase/Kafka/Tomcat (ASF), Firefox (Mozilla), Python (PSF), NumPy (community)
- Foundations fund project infrastructure via charitable donations
- Long-term vision often developed via a collaborative process (e.g., Apache) or by benevolent dictators (e.g., Python, Linux)

Business models can support both governance models

Contributing to open source projects

Mature OSS projects often have strict contribution guidelines

- Look for CONTRIBUTING.md or similar

Common requirements:

- Coding style (recall: linters) and passing static checks
- Inclusion of test cases with new code
- Minimum number of code reviews from core devs
- Standards for documentation
- Contributing licensing agreements
  - Without this, you own the copyright and IP for even small bug fixes and that can cause them legal headaches in the future

When communities move on: Forks

The only rights an OSS creator can realistically retain are trademarks on name

Code will be *forked*

Example:

- 1999: Sun buys StarOffice, GPL'ed as OpenOffice to fight MS Office
- 2010: Oracle buys Sun, fires internal developers, frustrating community
- 2011: Community fork it as LibreOffice, OpenOffice dies (Oracle gifts it to Apache)

Is Open Source a business model?

February 3, 1976

An Open Letter to Hobbyists

To me, the most critical thing in the hobby market right now is the lack of good software courses, books and software itself. Without good software and an owner who understands programming, a hobby computer is wasted. Will quality software be written for the hobby market?

Almost a year ago, Paul Allen and myself, expecting the hobby market to expand, hired Monte Davidoff and developed Altair BASIC. Though the initial work took only two months, the three of us have spent most of the last year documenting, improving and adding features to BASIC. Now we have 4K, 8K, EXTENDED, ROM and DISK BASIC. The value of the computer time we have used exceeds $40,000.

The feedback we have gotten from the hundreds of people who say they are using BASIC has all been positive. Two surprising things are apparent, however. 1) Most of these "users" never bought BASIC (less than 10% of all Altair owners have bought BASIC), and 2) The amount of royalties we have received from sales to hobbyists makes the time spent of Altair BASIC worth less than $2 an hour.

Why is this? As the majority of hobbyists must be aware, most of you steal your software. Hardware must be paid for, but software is something to share. Who cares if the people who worked on it get paid?

Is this fair? One thing you don't do by stealing software is get back at MITS for some problem you may have had. MITS doesn't make money selling software. The royalty paid to us, the manual, the tape and the overhead make it a break-even operation. One thing you do do is prevent good software from being written. Who can afford to do professional work for nothing? What hobbyist can put 3-man years into programming, finding all bugs, documenting his product and distribute for free? The fact is, no one besides us has invested a lot of money in hobby software. We have written 6800 BASIC, and are writing 8080 APL and 6800 APL, but there is very little incentive to make this software available to hobbyists. Most directly, the thing you do is theft.

What about the guys who re-sell Altair BASIC, aren't they making money on hobby software? Yes, but those who have been reported to us may lose in the end. They are the ones who give hobbyists a bad name, and should be kicked out of any club meeting they show up at.

I would appreciate letters from any one who wants to pay up, or has a suggestion or comment. Just write me at 1180 Alvarado SE, #114, Albuquerque, New Mexico, 87108. Nothing would please me more than being able to hire ten programmers and deluge the hobby market with good software.

Bill Gates

Bill Gates
General Partner, Micro-Soft

The Register

MS' Ballmer: Linux is communism

After a short silence, Motormouth is back, folks...

Graham Lea — Mon 31 Jul 2000 // 10:10 UTC

MS ANALYSTS Steve Ballmer was the only person to raise the issue of Linux when he wrapped up Microsoft's annual financial analysts meeting in Seattle, although he put Sun and Oracle ahead in terms of being stronger competitors. They of course are 'civilised' competitors - but the Linux crowd, in the world of Prez Steve, are communists.

Redmond top man Satya Nadella: 'Microsoft LOVES Linux'

Open-source 'love' fairly runneth over at cloud event

The New York Times

Microsoft Buys GitHub for $7.5 Billion, Moving to Grow in Coding's New Era

Give this article

A GitHub billboard being installed in San Francisco in 2014. Microsoft said on Monda that it would acquire the company for $7.5 billion. David Paul Morris/Bloomberg

“Open Source as a Utility” is a common model

The largest, most successful open source projects implement utility infrastructure:

- Operating systems, web servers, logging libraries, programming languages
- Business model: build and sell products and services using those utilities, contribute improvements back to the ecosystem
  - Linux, Kubernetes, React, etc.
- Many companies provide specialized *distributions* of these open source infrastructure and specialized tools to improve them; support upstream project

Monetize OSS with “open core, closed plugins”

Model: core component of product is open source; plugins for a fee

Example: Apache Kafka, a distributed message broker (glue in event-based system)

- Product is open source, maintained by Apache foundation, supported by a company
- Confluent provides plugins to connect Kafka to different systems out-of-the-box

[Screenshot: “Apache Kafka vs Confluent”]

Monetize OSS with dual licenses (?)

Model: Offer a free copyleft license to encourage adoption, prevent competitors from improving it without sharing improvements.

Offer custom, more permissive licenses to third parties willing to pay for that (needed to bundle MySQL with a proprietary system)

Only possible when there is a single copyright owner, who can unilaterally change license

Risk of losing control of the copyleft portion: nothing to stop the community from forking it (MySQL – MariaDB)

Monetize OSS by selling it as a SaaS (?)

Model: Creators of OSS provide a cloud hosted, “fully managed” installation as a service

Risk: What is your competitive advantage over cloud utility providers?

- Amazon improves your GPL code without sharing because it is not distributing it (operates it as a service)

Example: MongoDB Atlas (document-oriented database)

- MongoDB created a new copyleft license for providers operating MongoDB as a service
- Amazon forked GPL’ed MongoDB

Amazon DocumentDB

mongoDB

Monetize OSS by offering title insurance

- SQLite is an extremely popular database library, *in the public domain* (copyright is waived)
- License text:

The author disclaims copyright to this source code. In place of a legal notice, here is a blessing:

> May you do good and not evil.
>
> May you find forgiveness for yourself and forgive others.
>
> May you share freely, never taking more than you give.

- To have *legal proof* that the code is in the public domain (traceable links from code to waivers of copyright), you pay money

Other philosophies are expressed in some licenses

Learning Goals

You should be able to…

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