

Introduction to Free and Open Source Software

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TheAlternative

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What does «Free» mean?

100 % unrelated to price:

- ▶ German: «frei»
- ▶ French: «libre»
- ▶ Italian: «libero»
- ▶ Romansh: «liber»

What does «Open Source» mean?

```
# include <iostream>

using namespace std;

int main () {
    const int N = 10; // larger N for slower learners
    for(int i = 0; i < N; i++) {
        cout << "FOSS is also great for non-programmers!" << endl;
    }
    return 0;
}
```

```
000007e0 06 60 8f e0 05 50 8f e0 05 60 46 e0 01 80 a0 e1 |.'...P...'F.....|
000007f0 02 90 a0 e1 5a ff ff eb 46 61 b0 e1 f0 87 bd 08 |....Z...Fa.....|
00000800 00 40 a0 e3 01 40 84 e2 04 30 95 e4 09 20 a0 e1 |.@...@...0... ..|
00000810 08 10 a0 e1 07 00 a0 e1 33 ff 2f e1 04 00 56 e1 |.....3./...V.|
00000820 f7 ff ff 1a f0 87 bd e8 14 07 01 00 08 07 01 00 |.....|
00000830 1e ff 2f e1 08 40 2d e9 08 80 bd e8 01 00 02 00 |../..@-.....|
00000840 00 00 00 00 46 4f 53 53 20 69 73 20 61 6c 73 6f |....FOSS is also|
00000850 20 67 72 65 61 74 20 66 6f 72 20 6e 6f 6e 2d 70 | great for non-p|
00000860 72 6f 67 72 61 6d 6d 65 72 73 21 00 40 9b 01 81 |rogrammers!.@...|
00000870 b0 b0 80 84 00 00 00 00 78 fd ff 7f 01 00 00 00 |.....x.....|
00000880 60 fe ff 7f e8 ff ff 7f c8 fe ff 7f 01 00 00 00 |'.....|
00000890 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
```

Source code obfuscation

Make sourcecode almost unreadable

- ▶ Variable naming: `max_iterations` vs `tsaoheuoou`
- ▶ Instruction flow obfuscation
- ▶ Security by obscurity

Early Computing

~1950-1960: Public Domain Software, academic «hacking» culture



Bendix G-15 photo by Gah4 - CC BY-SA 4.0 via Commons

Birth of the Proprietary Software Industry

~1970-1980

- ▶ Increasingly easy to withhold control (e.g. binary-only distribution)
- ▶ United States vs. IBM (1969, dropped 1982): «Bundled Software is anticompetitive»
- ▶ Computer Software Copyright Act (1980): «Software is patentable»

Confronting the Software Industry



- ▶ Promotes 4 universal freedoms: study, distribute, create, and modify computer software.
- ▶ Promotes moral obligation to use free software.
- ▶ «Ethical» (dogmatic?)

Working with the Software Industry

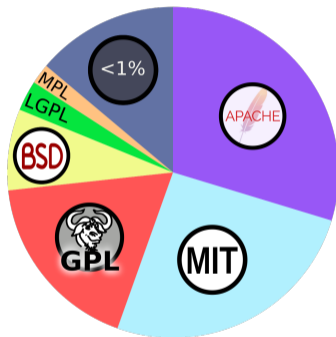


- ▶ Promotes open-source principles.
- ▶ «Rebranded» the free software movement.
- ▶ Google, Facebook, etc. produce open-source software.

Sticking it together

FOSS

Overview



CC BY-SA 4.0

Copyleft



- ▶ All derivatives must forever stay free
- ▶ May restrict interaction with non-free programs (e.g. library linking)
- ▶ «Viral Licensing»

Permissive

- ▶ «BSD-Style» licenses
- ▶ Minimal restrictions
- ▶ Warranty Disclaimers

Apache License

- ▶ Permissive
- ▶ Authors must be stated
- ▶ No warranty

MIT License

- ▶ Permissive
- ▶ Use however one wants
- ▶ Include license in substantial parts of software
- ▶ No warranty

GNU General Public License – based on the FSF's «four freedoms»

- ▶ The freedom to run the program as you wish, for any purpose
- ▶ The freedom to study how the program works, and change it so it does your computing as you wish
- ▶ The freedom to redistribute copies so you can help your neighbor
- ▶ The freedom to distribute copies of your modified versions to others

BSD License – very permissive 3 clauses

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Creative Commons – Beyond Software



- ▶ BY: author must be credited
- ▶ SA: same terms
- ▶ NC: non-commercial
- ▶ ND: no derivatives

CC0: public domain dedication

Performance

Linus' Law: «Given enough eyeballs, all bugs are shallow.»¹

You:

- ▶ experience less crashes.
- ▶ increase performance (especially for older hardware).
- ▶ get better support – if ever it still fails.

¹Take this with a grain of salt

Education

You can:

- ▶ better manifest your intelligence and creativity.
- ▶ learn valuable, transferrable skills.
- ▶ get better software habits
 - ▶ Open Formats (e.g. .odt or .svg)
 - ▶ L^AT_EX
 - ▶ git
 - ▶ CLI

Why Open Formats?

Adobe Illustrator (.ai)

- ▶ binary with no definition on how it works
- ▶ hard or impossible to implement
- ▶ makes competing software intentionally incompatible
- ▶ might be patented

Inkscape (.svg)

- ▶ plain text²
- ▶ open format specification
- ▶ can be implemented by anyone

²no format can ever be more open than plain text

Empowerment

You:

- ▶ free yourself from vendor lock-in.
- ▶ get control over any service running on your system.
- ▶ innovate faster, never having to ask for permission.
- ▶ have more freedom, even than on the open market.

Vendor Lock-In: Example

«The Windows API is so broad, so deep, and so functional that most independent software vendors would be crazy not to use it. And it is so deeply embedded in the source code of many Windows apps that there is a huge switching cost to using a different operating system instead... It is this switching cost that has given the customers the patience to stick with Windows through all our mistakes, our buggy drivers, our high TCO (total cost of ownership), our lack of a sexy vision at times, and many other difficulties [...] Customers constantly evaluate other desktop platforms, [but] it would be so much work to move over that they hope we just improve Windows rather than force them to move. In short, without this exclusive franchise called the Windows API, we would have been dead a long time ago.»

– Aaron Contorer, Head of C++ development at Microsoft

Vendor Lock-In: Example 2



Security

You:

- ▶ benefit from more privacy.
- ▶ use software which is more transparent (as for government – i.e. trustworthy).
- ▶ have access to better encryption.

Sustainability

«the quality of being able to continue over a period of time»

The Software:

- ▶ depends on no single entity for its continuity.
- ▶ can be improved by all and degraded by none.
- ▶ is reproducible and transparent (as for science – i.e. comprehensible).

Sustainability: Example

Fundamental in scientific research:

- ▶ Transparency
- ▶ Reproducibility

Microsoft Excel

- ▶ not transparent: not possible to check if the functions do what they should do
- ▶ not reproducible: The blackbox makes it difficult to get the same conditions

Python

- ▶ transparent: The source code has all information about any function
- ▶ reproducible: The same source code leads to the same results

Software as a Service



- ▶ Also known as SaaS or «the cloud»
- ▶ May be (based on) FOSS
- ▶ Usage paradigm is unfree, closed, and unsustainable

Regulation - from without

E.g. via laws and regulations:

- ▶ «Privacy» threatens admissible information sources.
- ▶ «Copyright» threatens admissible information matter.
 - ▶ Embrace, Extend, Extinguish as a business model.
- ▶ «Consumer Protection» threatens admissible information destinations.

Embrace, Extend, Extinguish: Example

- ▶ **Embrace:** Google joining the browser market with Chrome/Chromium
- ▶ **Extend:** Add proprietary features that are not standard-compliant. Google apps use these features, leading to compatibility problems on other browsers.
- ▶ **Extinguish:**
 - ▶ Developers don't test their applications on other browsers
 - ▶ Applications break
 - ▶ Other browsers lose market share due to «being bad»

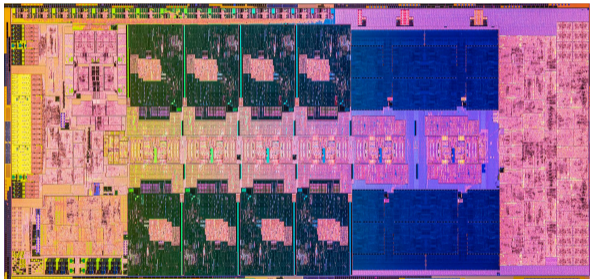
Regulation from within

E.g. *via* political «Codes of Conduct», which can:

- ▶ make participation contingent on ideology (less free).
- ▶ encourage exclusion from the community (less open).
- ▶ reduce resource pooling (less sustainable).

Hardware

- ▶ Software runs on Hardware
- ▶ Hardware almost always closed



«CPU Die» Intel Raptor Lake

<https://www.custompc.com/wp-content/sites/custompc/2023/05/Intel-Raptor-Lake-Die.jpg>

Why do we need OS AI

- ▶ Open Source has many advantages for collaborative work
- ▶ Artificial Intelligence (NN) is widely used
- ▶ "Normal OSI Licenses not suitable for NN
 - ▶ Training Data
 - ▶ NN Architecture
 - ▶ Parameters

«AI» definiton

An AI system is a machine-based system that, for explicit or implicit objectives, **infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions** that can influence physical or virtual environments. Different AI systems vary in their levels of autonomy and adaptiveness after deployment.

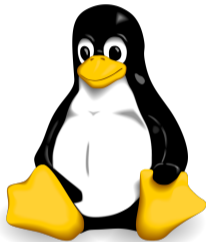
License Goals

- ▶ Use the system for any purpose and without having to ask for permission.
- ▶ Study how the system works and inspect its components.
- ▶ Modify the system for any purpose, including to change its output.
- ▶ Share the system for others to use with or without modifications, for any purpose.

What we need

- ▶ Data information: Data used to train the system, training methodologies, obtaining data, labeling
- ▶ Code: source code of model, pre- and post processing, training&testing, libraries, and model architecture
- ▶ Weights: weights, (hyper)parameters, intermediate steps, final result

Linux Kernel



«Tux» by Larry Ewing, Simon Budig, Anja Gerwinski Licensed under Attribution via Commons

As of 2010, only 2 % of the Linux Kernel (3.034×10^7 LOC in 2021) was written by Linus Torvalds.

The GNU/Linux Operating System

Developed by the FSF:

- ▶ GNU Compiler Collection (gcc)
- ▶ GNOME
- ▶ GIMP, GNU Octave, GnuCash, etc.

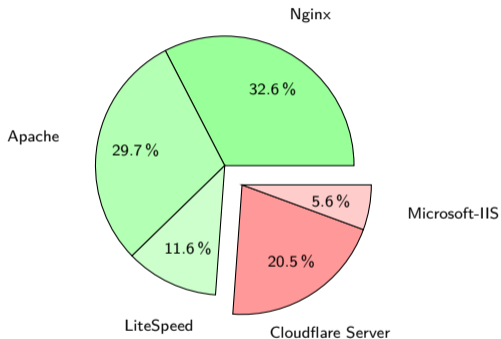


«Gnu-and-penguin-color» by FSF – CC BY-SA 3.0 via Commons

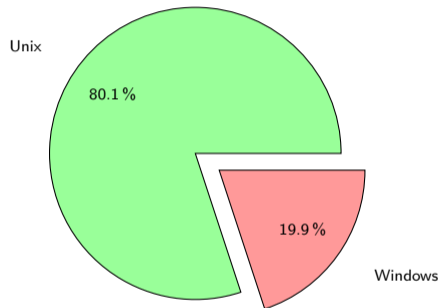
SO much more

- ▶ **Desktop:** Chromium, Firefox, LibreOffice, OnlyOffice, L^AT_EX, etc.
- ▶ **Multimedia:** mpv, VLC, Audacity, Kdenlive, etc.
- ▶ **Scientific:** NumPy, matplotlib, JabRef, R, GNU Octave, Jupyter etc.
- ▶ **Server/Cloud:** Openstack, WordPress, NextCloud, Mastodon, GitLab, etc.
- ▶ **Graphics:** RawTherapee, GIMP, Inkscape, Blender, Darktable, Krita, etc.
- ▶ **Programming:** VSCodium, Spyder, git, gcc, python, etc.
- ▶ etc.

The Internet



Web Server Market Share 2022-09-27 via w3techs



Website OS Market Share 2022-09-27 via w3techs

Public Institutions

- ▶ Governments (benefits: strategic, economic)
- ▶ ETH
 - ▶ Linux Cluster running CentOS (Euler)
 - ▶ Fedora/Windows dual boot on public computers
- ▶ UZH
 - ▶ OpenStack-based cluster (ScienceCloud)

Businesses



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Businesses



redhat®

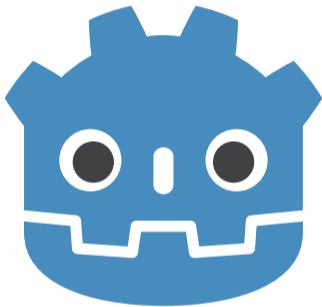
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- ▶ Founded 1993, subsidiary of IBM since 2019
- ▶ 2015–2018 stock price $\beta_{\text{RHT}} = 1.16$ (e.g. $\beta_{\text{MSFT}} = 1.22$)
- ▶ Very diverse open source products, e.g. OpenStack, RHEL, CloudForms

Business Models based on FOSS

- ▶ Paid Build: Threema
- ▶ Paid Support: RedHat, SUSE
- ▶ Paid Hosting (SaaS): Vercel, WordPress, GitLab, Nextcloud
- ▶ Paid Products: tailwindcss, Mantine
- ▶ Paid Development: Ubique, Alexander Schoch
- ▶ Dual License: Elasticsearch, MongoDB, Qt

Developers



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via Godot Website



“Made with Unity Logo” by Unity Technologies
- Proprietary License via Brandfolder

The Fediverse

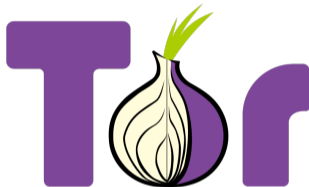


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The Persecuted



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Free and Open by design, not by convention.

► Whistleblowers

► Marginalized Gvmnts.

► (Alleged) Criminals

The Persecuted: Example



WhatsApp



Signal

The Busy and Creative

- ▶ Students
- ▶ Scientists
- ▶ Engineers
- ▶ Analysts
- ▶ Artists

*Get the opportunity to learn **the right way**, keep the freedom to do it **your way**.*

Most of all: You

- ▶ The sooner the better
- ▶ Less time-intensive than 1 ETCS
- ▶ You have already started!

What now?

- ▶ Q&A round
in a few seconds
- ▶ Come to the next LinuxDays events:
<https://thealternative.ch/>. "Introduction to Linux" on Tuesday next week!
- ▶ Join the next Stammtisch:
Thursday @ SPH
- ▶ Office Hours: Tuesdays, 10:30-13:30, CAB E 14

These Slides

- ▶ Links on <https://thealternative.ch>
- ▶ Latest Slides:
https://gitlab.ethz.ch/thealternative/courses/-/blob/master/FS24_FOSS/main.pdf
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