How To Make Package Managers ~~Cry~~ **Scream**

Kenneth Hoste

FOSDEM 2026 Main Track | https://fosdem.org

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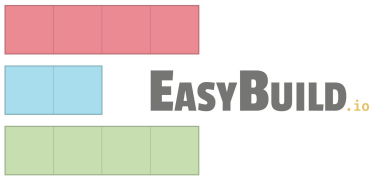
Yes, that font is Comic Sans.
No, that's not by accident...

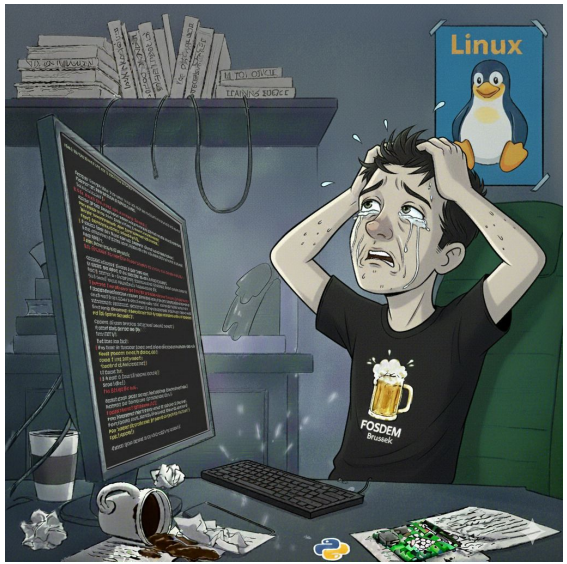
whoami

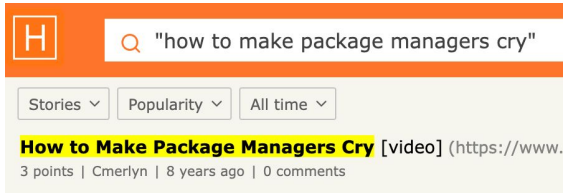
- Supercomputer sysadmin @ Ghent University (Belgium) since 2010
- Open source software enthusiast for ~20 years (yes, I'm old)
- I also like family, (loud) gigs, beer (but I'm picky), stickers, dad jokes, ...
- FOSDEM attendee since 2012, (co-)organising HPC devroom since 2014
- Lead developer of EasyBuild, core contributor to EESSI, ...



1000_2 years ago, at FOSDEM 2018

- ~25 min talk in Package Management devroom:
  "How to Make Package Managers Cry"
- Devroom got a bit crowded during my talk 😅
- Some people liked it!
- It even reached HackerNews (well, kind of)
  - RandomCSGeek also posted it in
    "Ask HN: What is your favourite tech talk?" thread
    (April 2018) ❤️





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

https://archive.fosdem.org/2018/schedule/event/how_to_make_package_managers_cry

Today at FOSDEM 2026: the sequel !

- Initially submitted to Package Management devroom
- Got promoted to FOSDEM Main Track \o/
- More of the same, but also kinda different…
- We live in a (very) different world compared to 2018

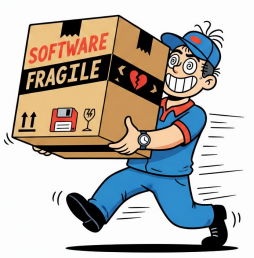
I expect some heckling throughout the talk.

<u>Make it happen.</u> Do your part! 🍺

This talk is a little biased (again)

- My main experience is with installing **scientific** software on **supercomputers**
- Supercomputers ❤️ **Linux** (Windows, macOS or BSD: a lot less so…)
- We often need to **build software from source code** (it's fun, really!)
- **Software developed by scientists** can be particularly… interesting
- I generally focus on central installations on **multi-tenant systems**
- A lot of what I'll cover should also translate well to other communities…

Package managers are people too



- In this talk, package managers are the **people** who *package* software, so it can be installed/used easily (by themselves or others)
- If you "install" software for others, I consider you a package manager (ymmv)
- "First line responders": they're **exposed early** on to new software releases
- **Package managers don't give up easily**, they like solving puzzles…
- They have seen a lot, but there are **more of us**, and we're a **creative** bunch!

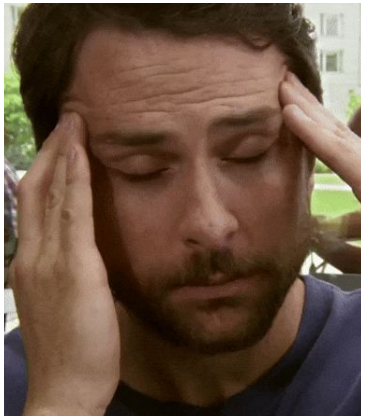
Who is this talk for?

- You like working with **computers**, coding, making them dance as you want them to
- You like showing your work to the world as **open source software**
- **You don't like dealing with people** who are using your software, or trying to use it….
  - They try to install your software in weird environments
  - They ask annoying questions, and expect you to have the answers
  - They report problems and "bugs" that you probably don't care much about
  - They even request additional changes, improvements, features, ...

Why do we want to make package managers ~~cry~~ scream?!?

- **Package managers make it easier** for people to install & use your software
- **We don't want that**, since it eventually only results in **more work** for us
- We want package managers to **give up** on packaging your software
- If that doesn't work, we at least want to **frustrate** them, **slow them down**, …
- This talk includes a bunch of **techniques & tricks** you can use
- **Any package managers in the room?**
  - If you're sitting next to a package manager, **distract them**!

Goals



Spoiler: Topics we'll be covering in this talk

- LLMs
- Naming is hard
- Terminology
- Code structure
- Documentation
- Hosting
- Self "packaging"
- Dependencies (surprise!)
- 🏆 Prizes (huh?!)
- Hidden tricks
- Build tools (and then some)
- Testing
- Programming languages
- Compilers
- Versioning

And some examples along the way…

WARNING

May contain traces of SARCASM

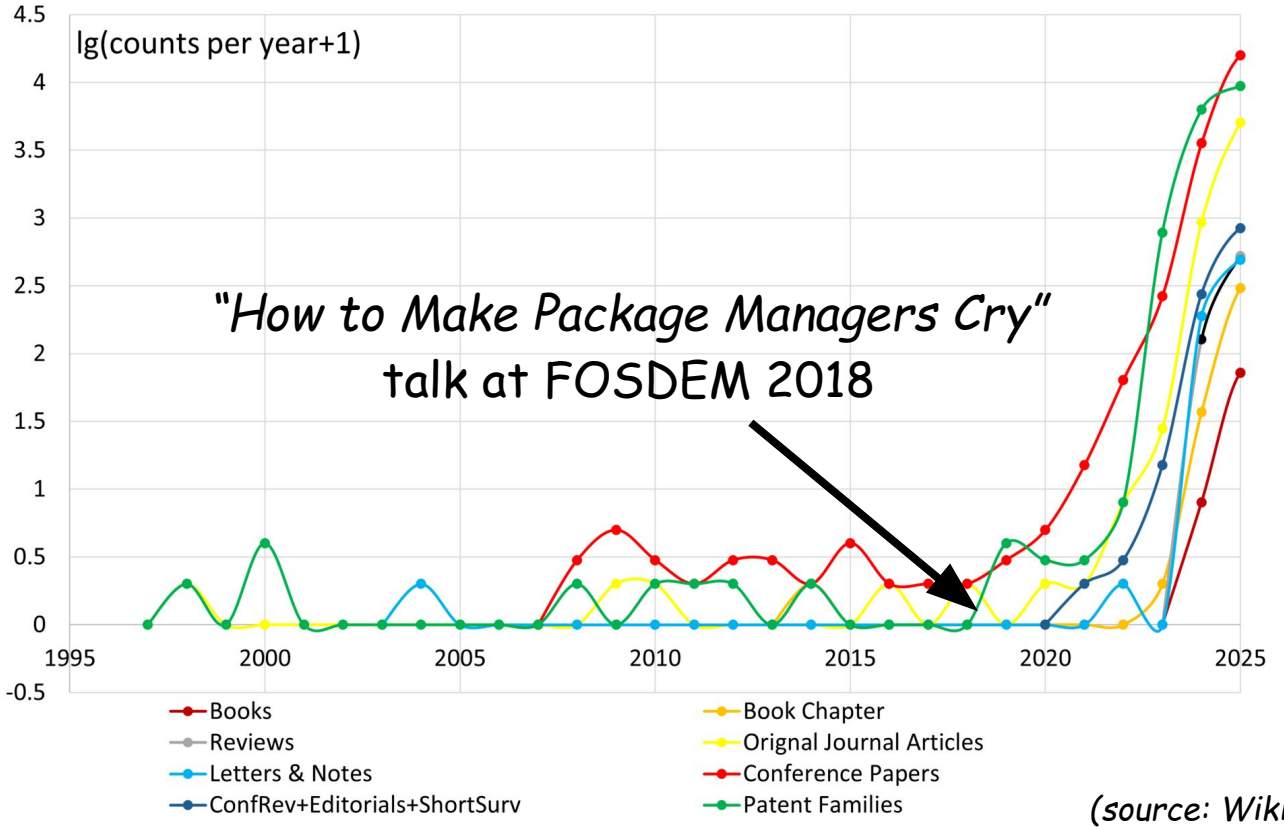
This talk is meant to be an eye-opener regarding

bad practices in software installation procedures.

Please do NOT interpret the given 'advice' as genuine.

I do NOT want to insult particular people or projects.

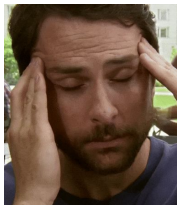
What caused explosion of publications on LLMs starting 2018?



(source: Wikipedia)

LLMs can help us make package managers ~~cry~~ scream

- Let's get this out of the way, shall we…
- **No need to learn** a lot about the tools & techniques you will hear in this talk \o/
- If somebody complains, blame it on **hallucinations** of the LLM you used
- Tell package managers that they should **let LLMs install** the software instead
- Proposal for `install.md` standard to tell LLMs how to install your software
  https://www.mintlify.com/blog/install-md-standard-for-llm-executable-installation
  - **Please don't use this**, may lead to better docs for package managers!



Choose the name of your project wisely

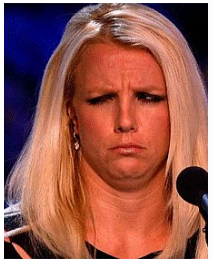
- Make sure it's **hard to search** for
- Aim for **maximum confusion** with other things/projects (animals! mythology!)
- Your project name should **imply something that's totally false**
- Use **"funny" characters**: special ASCII characters, Unicode (trademark sign!), ...
- Come up with ways to trigger frequent **typos**
- Be as **inconsistent** as you can, do what you can to encourage others to do the same

Some examples of naming done well

- **Rust** is a well-known programming language, but also a color, a popular game, a chemical process, a movie, … 😵
- Single-letter names like **C** and **R** are hard to use in search engines 👍
- **EasyBuild** has over 250 configuration options (wasn't this supposed to be easy?!)
- "Ask in the **Spack** Slack for help to install Spark in a stack using a spec."
- Python packages on PyPI being forced to use _ instead of - in filenames
- **Open|SpeedShop** (a pipe!), **LaTeX** (max. camel-case), **Ωmega** (❤️ Unicode), …

Particular example of well-chosen project name: PRRTE

- PRRTE is a key dependency of Open MPI (for distributed computing workloads)
- Short for "PMIx Reference Runtime Environment"
- PMIx is a standard, short for "Process Management Interface - Exascale"
- Both are kind of hard to pronounce (prrrrr-tee? pretty? pee-em-ai-ex? pim-ex?) 👍
- Inconsistent naming across docs, GitHub, API, configuration, commands, …



The project is formally referred to in documentation by "PRRTE", and the GitHub repository is `prrte`.

Note

We have found that most users do not like typing the two consecutive `r` letters in the name. Hence, all of the internal API symbols, environment variables, MCA frameworks, and CLI executables all use the abbreviated `prte` (one `r`, not two) for convenience.

https://docs.prrte.org

Names you should consider for your next project

- **Phoenix** (or derivatives like Feniks, Fenix, …) - "rise from the ashes"
- **Hydra** - the "multiple heads" can mean many things (parallelism, …)
- Anything else from Greek/Roman **mythology**: Thor, Helix, Titan, Orion, Zeus, …
- Some play on **snakes**, to join the club: Python, Conda, Mamba, Cobra, Viper, …
- **Open<something>** - especially if some aspect of the project is not open at all
- **Alpha<something>** - interesting if you want to win a Nobel Prize

Terminology

- **Don't use standard terminology** for things, invent your own (like "crates" in Rust)
- Use tools that have their own **custom terminology**
- **Overload commonly used terminology** even more by also using it;
  "modules" is a particularly good one: Linux kernel modules, Fortran modules, CMake modules, Python modules, Ansible modules, environment modules, … 🫠
- Try to **distort well established terminology** by giving your own spin to it:
  "In my project, interface actually means something slightly different…"

Code structure & where stuff is located

- It's up to you how you structure your project, it's your project!
- It **does not need to make sense** to others (only to you, sort of)
- **Distribute your source code** across lots of different (deep) subdirectories
- Configuration & build tools look in standard places, so **hide your stuff** well
- You don't need to install binaries into `<prefix>/bin`, and **nobody can make you**
- Likewise for libraries in `lib(64)`, header files in `include`, etc.

Documentation

- You need to have some docs, you can't get away with not having any at all
- That doesn't it mean it can't be helpful to make package managers ~~cry~~ scream…
- Your documentation can be:
  - Minimal
  - Incomplete
  - Out of date
  - Confusing
  - Long and boring
  - Scattered across many different places
  - Barely searchable
  - Only a research paper, nothing more
  - Only available in an annoying format (like PDF)
  - Only (comments in) the source code

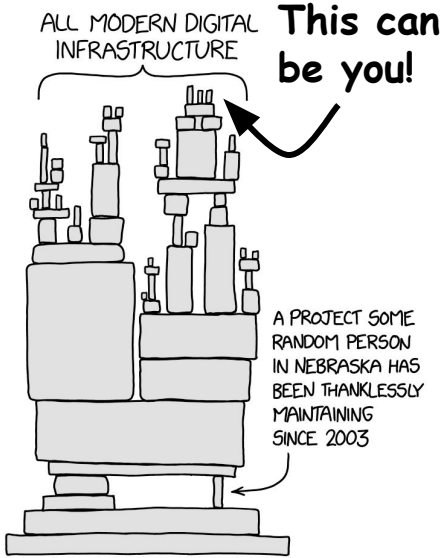
Hosting (code, website, releases)

- **Host your project "somewhere else"**, not on the usual platforms
  - Force package managers to have an account everywhere, just to ask questions
  - Make them learn the slightly different (and constantly changing) interface
  - Self-hosted GitLab is an interesting option (especially in a walled garden)
- **Don't use Git**, there are many several alternatives (check out CVS!)
- **Be inconsistent, scatter releases**: tag versions (some as release), mirror with infrequent sync, only upload some releases to PyPI, have an outdated website, …
- Include **source tarballs** or zip files in a ~~**Git**~~ **repository** (yes, it *is* allowed)
- **Split your project** across (many) different repositories (cfr. AMD ROCm™)

“Packaging” things yourself

- Take matters into your own hands, beat package managers at their own game
- Only provide instructions to do system-wide installation on Ubuntu (for example)
  - Some people *will* think that Ubuntu a hard requirement for your software…
  - Multiple cases of *“I tried to run* `sudo apt install example`*, but it didn’t work”* from researchers using a supercomputer running a RHEL-based distro…
- Only provide a **Docker file** as installation instructions
- Release your software **only as a Jupyter notebook** (no other source files!)
  Hat tip: *"I don't like notebooks"* talk: https://youtu.be/7jiPeIFXb6U?si
- Consider creating your very **own package manager** (cfr. AMD’s TheRock™)

Dependencies



https://xkcd.com/2347

- More dependencies is better. Always.
- **Choose them well**, aim for maximum likelihood of trouble
- Look for **obscure** dependencies in particular
- Adopt newly **emerging libraries** ASAP
- You don't need to actually use all those dependencies in your code, **be reasonable**
  - Just make your configuration tool require them, error out if they're missing
  - Add `include` statements in your code, but don't use any of the provided functions
  - If somebody complains, just state that you're "future-looking"

Can you win prizes with making package managers ~~cry~~ scream?

- **Yes, you can!**
- AlphaFold (https://github.com/google-deepmind/alphafold)
- Tool to predict how proteins fold based on its sequence by Google DeepMind

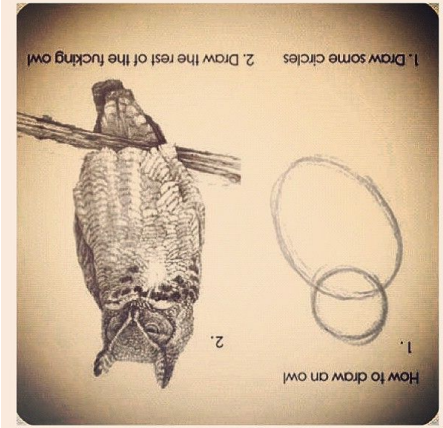
Installation and running your first prediction

You will need a machine running Linux, AlphaFold does not support other operating systems. Full installation requires up to 3 TB of disk space to keep genetic databases (SSD storage is recommended) and a modern NVIDIA GPU (GPUs with more memory can predict larger protein structures).

Please follow these steps:

1. Install Docker.
   - Install NVIDIA Container Toolkit for GPU support.
   - Setup running Docker as a non-root user.
2. Clone this repository and `cd` into it.

```
git clone https://github.com/deepmind/alphafold.git
cd ./alphafold
```



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- **Yes, you can!**
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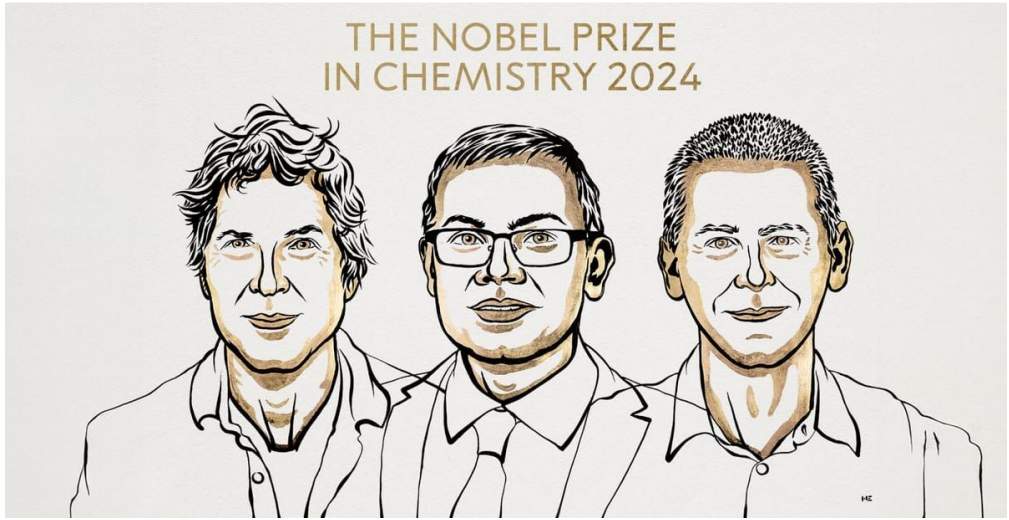
- 🏆 Prize?



Hidden tricks

- You may need to take some measures to **keep yourself sane**…
- Implement **undocumented** knobs and features to make things easier for you
- Put stuff behind **environment variables** that nobody knows about
  - Make sure they are hard to find
  - Do not use project name as prefix
  - Use magic required values!
  - Example code in Python:

```
# BAD example
skip_flaky_tests = os.getenv('EXAMPLE_SKIP_FLAKY_TESTS')
if not skip_flaky_tests:
    run_tests()
```

```
# good example!
PROJ_PREF = 'EX'
key_parts = ['sk' + 'ip', 'fla' + 'ky', 'te' + 'sts']
env_var_name = PROJ_PREF + '_' + '_'.join(key_parts).upper()
s = os.getenv(env_var_name)
if s != 'YeS_Sk1p_em':
    run_tests()
```

Build tools

- Choose your build tools wisely… **Aim for maximum damage**

- **CMake** is always a good choice, it confuses and annoys *everyone*

  - For inspiration:
    - https://xallt.github.io/posts/cmake-is-a-pain-in-the-ass
    - https://twdev.blog/2021/08/cmake

  - From https://news.ycombinator.com/item?id=34589687:

> ▲ girvo on Jan 31, 2023 | parent | prev | next [–]
>
> I would give up my firstborn to never have to deal with CMake again.

Build tools (part deux)

- You should **combine multiple** build tools, there's no reason to stick to just one
  - Call `cmake` , `make`, … from `setup.py` (sure you can)
  - Use a script named `configure.py`, implement it in Perl 😈
- Have **all of these** in your repository for your Python project:
  `setup.py`, `setup.cfg`, `requirements.txt`, `pyproject.toml`, `environment.yml`
- Guess what: build tools have **dependencies** too! \o/
- It doesn't stop with choosing one (or more), it's also about **how you use** them
- Think outside the box: use CMake as a *runtime* dependency in your software!
- If CMake is not enough for you, use **Bazel** instead (guaranteed success)

Build tools (yes, there's more)

- Do not read the docs of the tools you're using, or only use the outdated stuff

- Do not use well established tools according to best practices
  - Look up classic CMake vs modern CMake, use the former (well duh!)
  - Do still require that the *very latest* CMake version is used!
  - With a bit of luck, someone will hit some unexpected "regression" in CMake…
  - Pro tip: get alerts for new CMake releases via https://newreleases.io

- Beast mode: deliberately use hard to spot "typos" in filenames and commands
  - Example: `./nnake -f CMakeLitst.txt > pyproject.toml`
  - Some day a package manager *will* fall for it and waste their weekend!

Testing

- Package managers like to be able to **test** the installation of your software
- They often **lack domain knowledge** for doing so well, **use that to your benefit**
- Aim for a test suite that **takes forever** to run
- **Flaky tests are your friend** (you know which ones to ignore)
- Don't pass on requiring **extra dependencies** to run your tests!
  - Package managers really hate having to do even more work just to run your tests

Particular example of test suites done well: PyTorch

- PyTorch has a massive test suite...
- **More than 250,000 tests**, takes **~36h** to run on a single (recent, beefy) system
- Significant changes to the structure of the test suite every PyTorch release \o/
- Example test suite result for PyTorch 2.7.1 (as produced by EasyBuild):

```
WARNING: 52 test failures, 0 test errors (out of 261883):
    distributed/_composable/fsdp/test_fully_shard_state_dict (1 failed, 1 passed, 4 skipped, 0 errors)
    distributed/test_store (1 failed, 32 passed, 0 skipped, 0 errors)
    dynamo/test_compiler_bisector (1 failed, 6 passed, 0 skipped, 0 errors)
    higher_order_ops/test_invoke_quant (1 failed, 13 passed, 0 skipped, 0 errors)
    higher_order_ops/test_invoke_subgraph (1 failed, 19 passed, 1 skipped, 0 errors)
    inductor/test_aot_inductor (2 failed, 313 passed, 102 skipped, 0 errors)
    ...
```

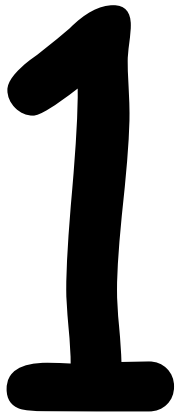
52 failing tests out of 261k => 99.98% of tests passing, is that good enough? 🤔

- A package manager person would be very tempted to try and reach 100%...

Live poll

- I will count to 3, and then you all SCREAM what you think is the correct answer
- Here comes the question…
- **No screaming yet!** Wait for the countdown!
- **Which programming language is most likely to make package managers scream?**
- *Think about it first, no screaming yet!*
- Are you ready for the countdown?

Live poll: programming language to make 'em SCREAM?



Live poll: programming language to make 'em SCREAM?

Live poll: programming language to make 'em SCREAM?

3

Live poll: programming language to make 'em SCREAM?

SCREAM

(some programming language, not just something random)







THE programming language to make 'em SCREAM

- Pfft, where do we begin…
- C++ standard library is a gem
- Error messages produced by C++ compilers are… waaaauw
- Templates in C++
- Metaprogramming, what a concept (*run* the code at compile time!)
- Both Linus Torvalds and the FBI recommend you shouldn't use C++. **So use it!**
- Bonus points for the name…
- Don't take my word for it, see *"The worst programming language of all time"* https://www.youtube.com/watch?v=7fGB-hjc2Gc (rant of 2 hours 9 min!)

  Random quote: *"If you like C++, then you don't know it well enough"*

Other programming languages you should consider using

- **Python**: the installation tools! setuptools! Conda! Python 4 on the horizon?!
- **Rust**: different enough to make your head spin, lots of custom terminology
- **FORTRAN**: since 1956, still in use (scientific software), #12 in TIOBE Index
- **C#**: just in case C++ isn't enough…
- **JavaScript**: the inconsistencies! Npm!
- **Go weird**: OCaml, Haskell, Prolog (WTF?!), Erlang, F#, Lisp, Bash, Scheme, Ada, ...
- There's a new programming language born every day, adopt them early on!

Compilers

- A.k.a. how to make C++ even worse than it already is...
- They're huge, complex, and impossible to avoid for any serious work
- **Screenfilling cryptic error messages** with C++ (it's worth repeating, admit it)
- Defaults change frequently (cfr. https://gcc.gnu.org/gcc-15/porting_to.html)
- **Compilers have dependencies too!** They even depend on each other!!!
- **Embrace the diversity**, explore alternatives, don't stick to GCC
- Try to make sure that **GCC can not be used** for some reason,
  and force package managers to use another set of compilers…

TensorFlow

- Implemented in C++ \o/
- Only generic pre-built binaries available on PyPI (don't look up WheelNext!)
- Still uses Bazel as configuration & build tool \o/
- Clang compiler is now preferred over GCC
- Magic environment variables everywhere, but nowhere to be found in docs
  - They all start with `$TF_` (not `$TENSORFLOW_`)

Versioning

- Don't waste the opportunity to confuse people through **software versions**
- **Suggest** that you're using **semantic versioning**, but violate it (cfr. Python, Lua, ...)
- Start with calendar versioning (20260131), release 1.0, then switch to zerover (0.x)
  - Let package managers figure out what the latest release is…
- HDF5
  - Stable releases have **even** minor number (1.8, 1.10)
  - Development "releases" (?!) have an **odd** minor number (like 1.9, 1.11)
  - No more since HDF5 2.0, since they adopted semantic versioning (but, **why?!**)
  - https://support.hdfgroup.org/documentation/hdf5/latest/_r_e_l_v_e_r_s_i_o_n.html
- Encourage **forks**, especially without changing the name (see OpenFOAM!)

Things we did not get to cover (in detail)

- Python installation tools. Oh boy… (pro tip: stay away from `uv` !)
- Containers: build your own messy world, and get others to use it willingly somehow
- Downloading stuff during building/testing (yes `cargo`, I'm looking at you…)
- Misleading error messages, errors that are really just warnings (or vice versa), error messages that go out of there way to hide the actual problem (`pip`!), etc.
- Recent and upcoming CPU families (for scientific computing): Arm, RISC-V
  It's about to get a whole lot worse very soon! \o/
- **What else?! Come talk to me, I'll be here all FOSDEM, let's have a 🍺 !**

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No, that's not by accident...