

How To Make Package Managers ~~Cry~~ Scream

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



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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](#), ...

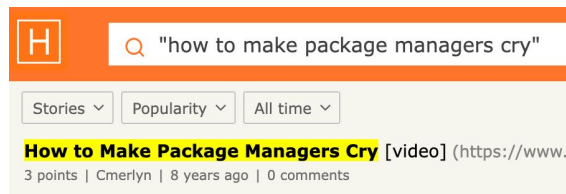


1000₂ years ago, at FOSDEM 2018

- ~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=NSemIYagjIU>

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.

Make it happen. 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!

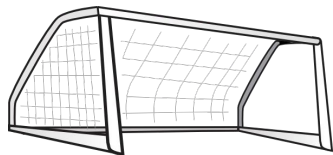
Who is this talk for?

- 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, ...

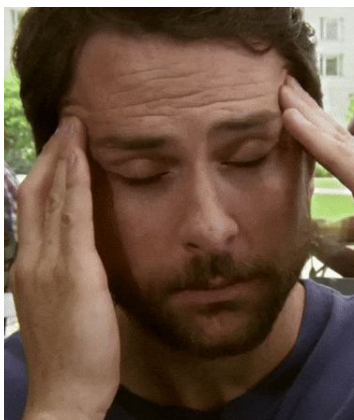
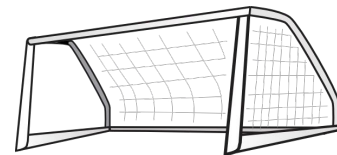
Why do we want to make package managers ~~cry~~ scream?!?

- **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

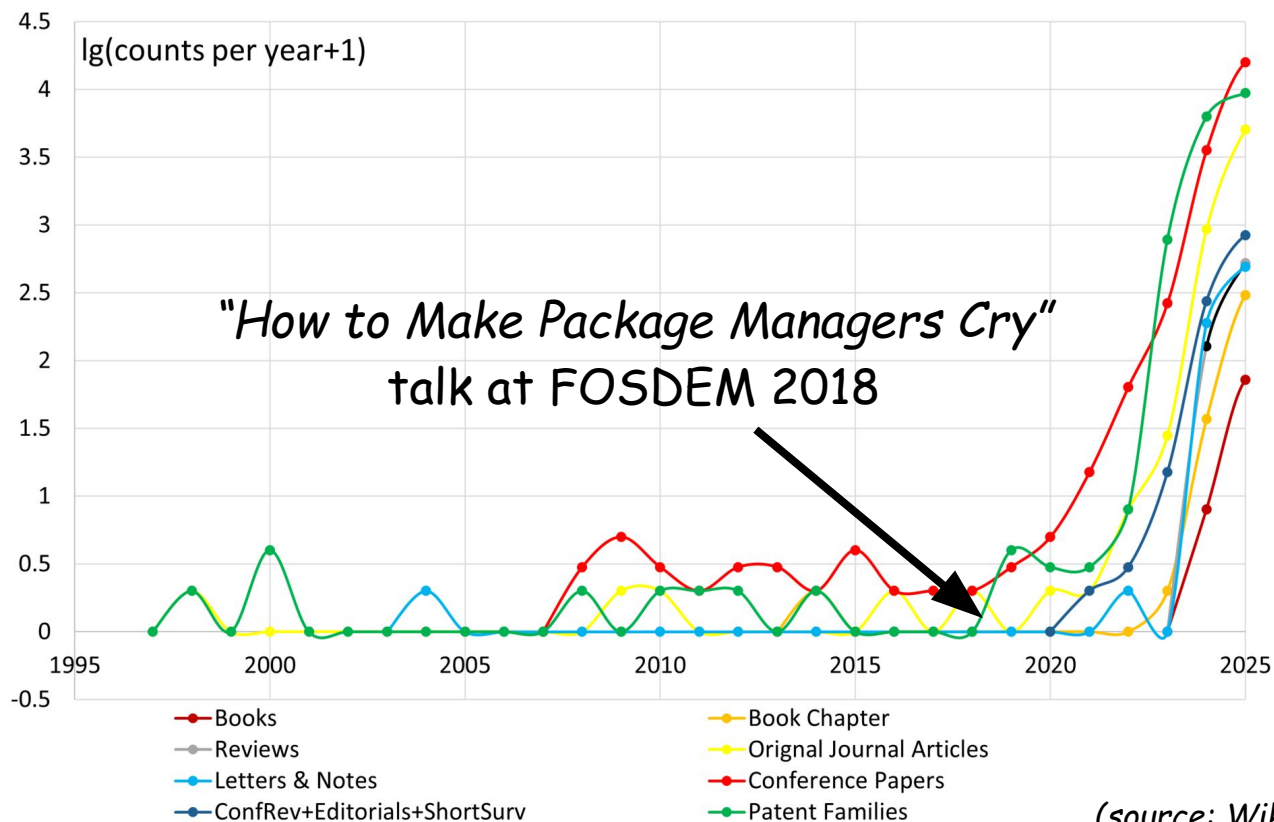
May contain traces of **SARCASM**

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.

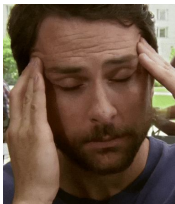
What caused explosion of publications on LLMs starting 2018?



(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 `prtte`.

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.prt.e.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 ~~enr~~ 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 ROCmTM)

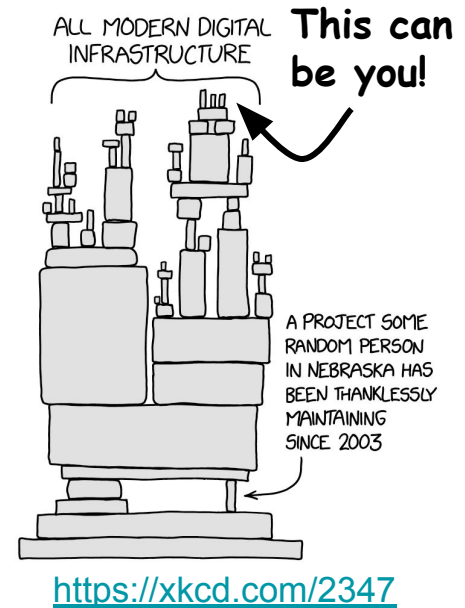
"Packaging" things yourself

- 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 TheRockTM)



Dependencies

- 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).

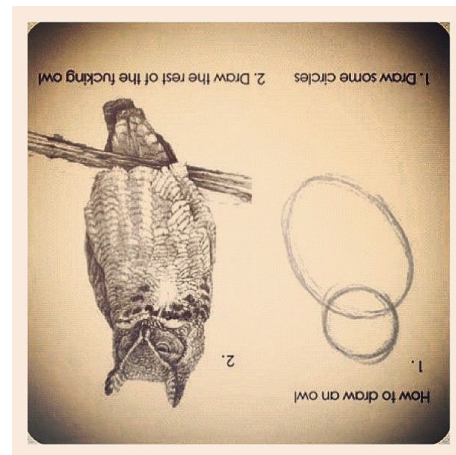
Please follow these steps:

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
```



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

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5. Build the Docker image:

```
docker build -f docker/Dockerfile -t alphafold .
```

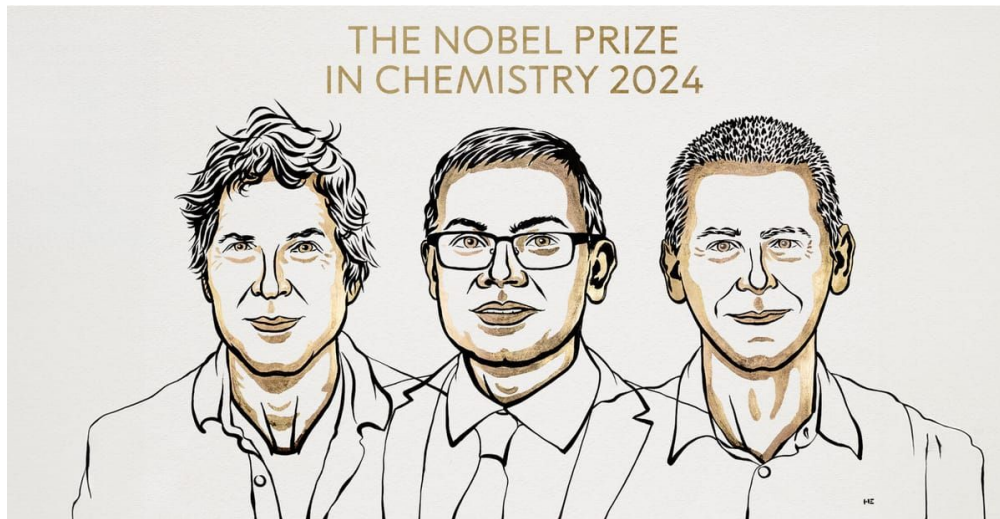
If you encounter the following error:

```
W: GPG error: https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1804/x86_64 I:  
E: The repository 'https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1804/x86_64' is not a valid source for the repository.
```

use the workaround described in [#463 \(comment\)](#).

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

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

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?

1

Live poll: programming language to make 'em SCREAM?

2

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...

- 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_`)

```
222 + cmd.append('//tensorflow/tools/pip_package:build_pip_package')
```

 **damianam** on 8 Dec 2017 Member
I am not sure what this does, but I going to guess that the double slash is a typo.

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/releversion.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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