



# Reproducibility & performance: Why choose?

Ludovic Courtès

**FOSDEM**, 5 February 2023

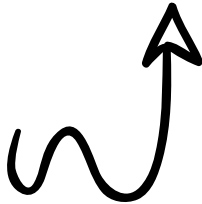
*Inria*



Software Heritage



The Re**Science** Journal



## Reproducible environments: 2 files, 2 commands

1. `guix describe -f channels > channels.scm`
2. `guix time-machine -C channels.scm -- \`  
`shell -m manifest.scm`

A photograph of a server room aisle. A woman in a light-colored sweater is crouching on the metal grating floor, looking at a server rack. In the background, two other people are standing and talking. The room is filled with rows of server racks, and the lighting is a warm, yellowish-green. The text "Two obsessions: MPI and AVX." is overlaid in white on the center of the image.

**Two obsessions: MPI and AVX.**

Some fairly common (but questionable) assumptions made by package managers (conda, pip, apt, etc.)

- **1:1 relationship between source code and binary (per platform)**
  - Good for reproducibility (e.g., Debian)
  - Bad for performance optimization
- **Binaries should be as portable as possible**
  - What most distributions do
  - Again, bad for performance
- **Toolchain is the same across the ecosystem**
  - One compiler, one set of runtime libraries
  - Or, no compiler (for interpreted languages)

Todd Gamblin (Spack)

**The jungle  
of vector extensions.**

**SSE2 (ca. 2003)**

**SSE3**

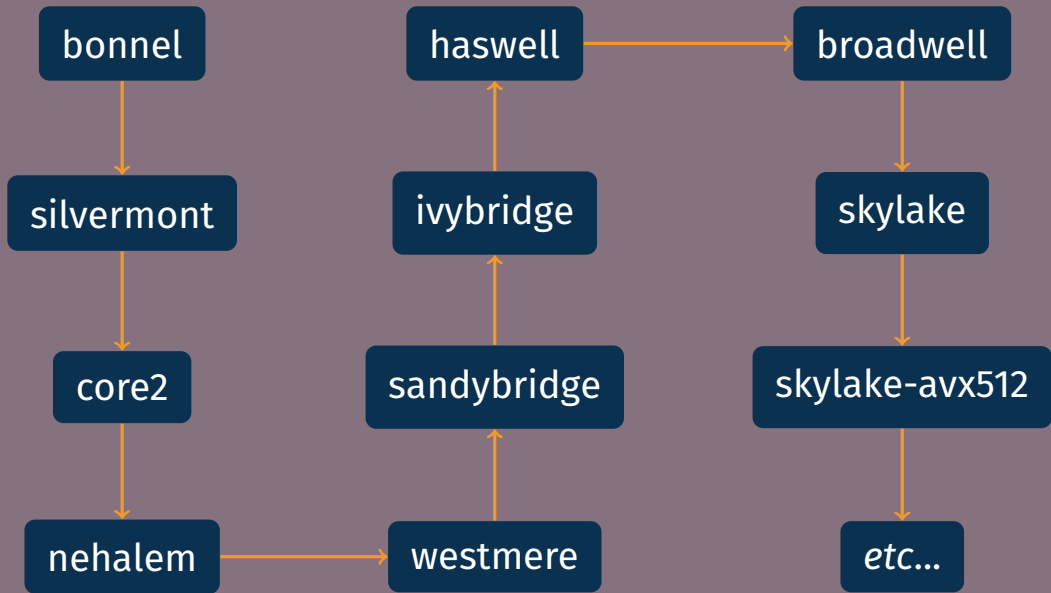
**SSSE3**

**x86\_64**

**AVX-512 (2013)**

**AVX2**

**AVX**





## code

Eigen (x86\_64 baseline)

Eigen -march=westmere

Eigen -march=sandybridge

Eigen -march=skylake

OpenBLAS

## GEMM 240x240x240

11 Gflops/s

12 Gflops/s

20 Gflops/s

**36** Gflops/s

16 Gflops/s



x3

```
guix shell eigen-benchmarks -- benchBlasGemm 240 240 240, Intel CORE i7
```

A white, multi-pointed starburst shape is centered on a solid orange background. The starburst has eight points, with the top and bottom points being the longest and most prominent. The text "Function multi-versioning!" is written in a bold, black, sans-serif font across the center of the white starburst.

**Function multi-versioning!**

GNU libc

Libgcrypt

Nettle

OpenBLAS

BLIS

FFTW

GMP

Julia

Rust

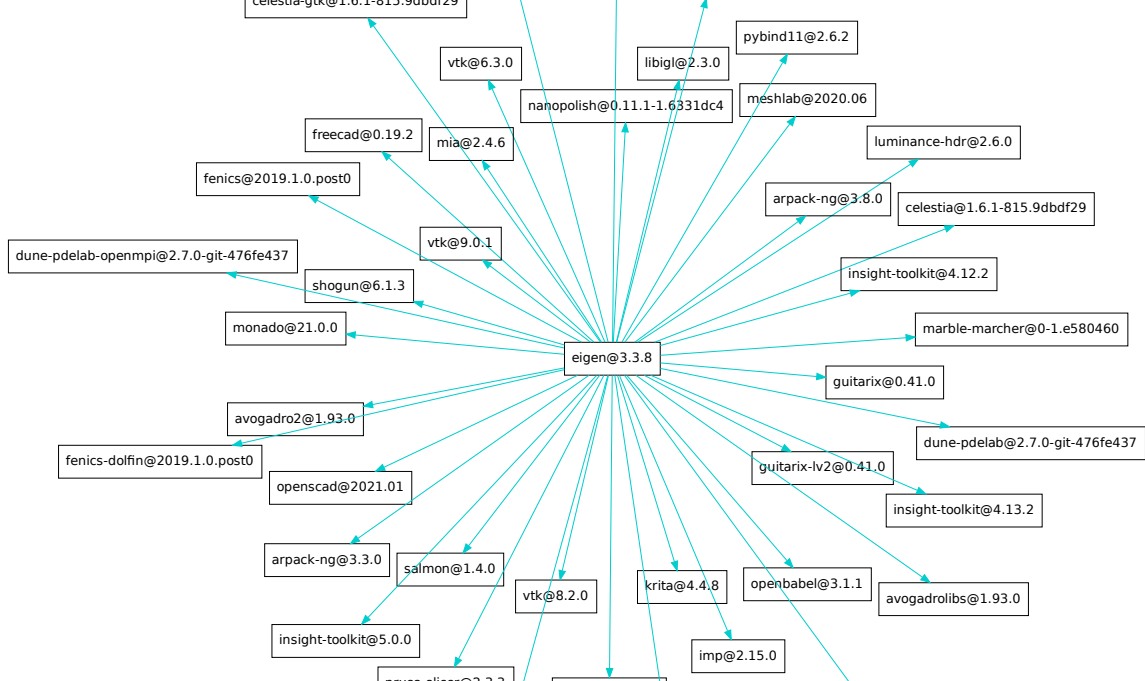
```
void my_func (double *array)
    __attribute__((target_clones ("arch=skylake", "default")))
```

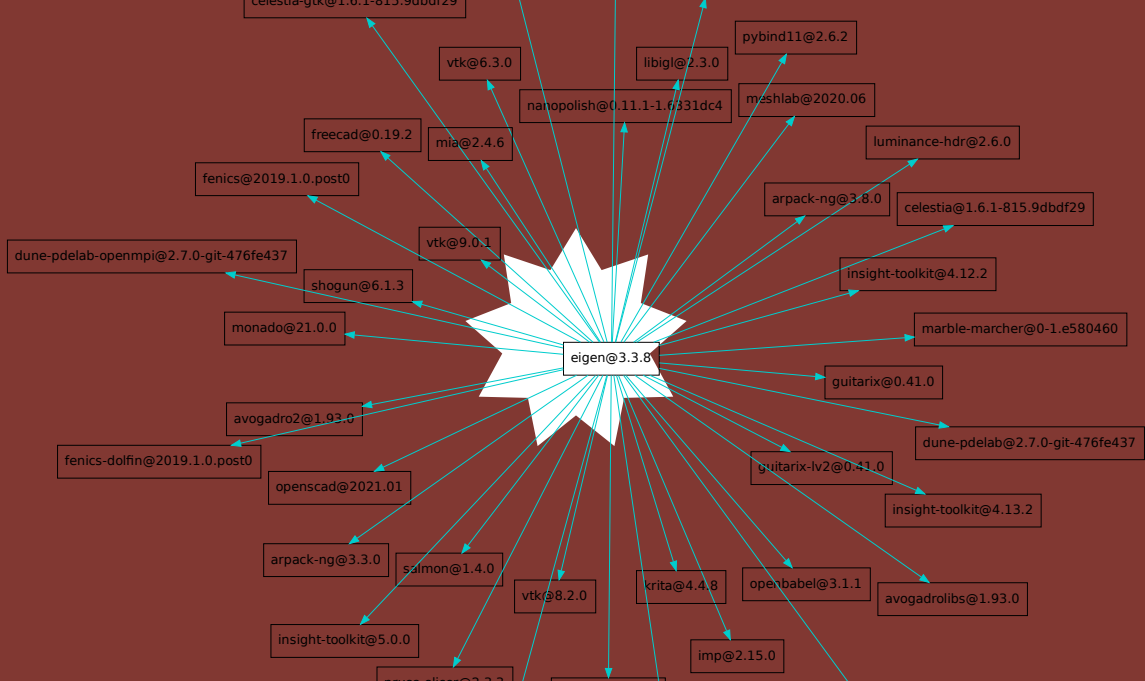
```
void my_func (double *array)
{
    ...
}
```

```
void my_func (double *array)
  __attribute__((target_clones ("arch=skylake", "default")))
```

```
void my_func (double *array)
{
  ...
}
```

<https://hpc.guix.info/blog/2018/01/pre-built-binaries-vs-performance/>





```
#ifdef
```

```
  __AVX512F__
```

```
...
```

```
#elif defined
```

```
  __AVX__
```

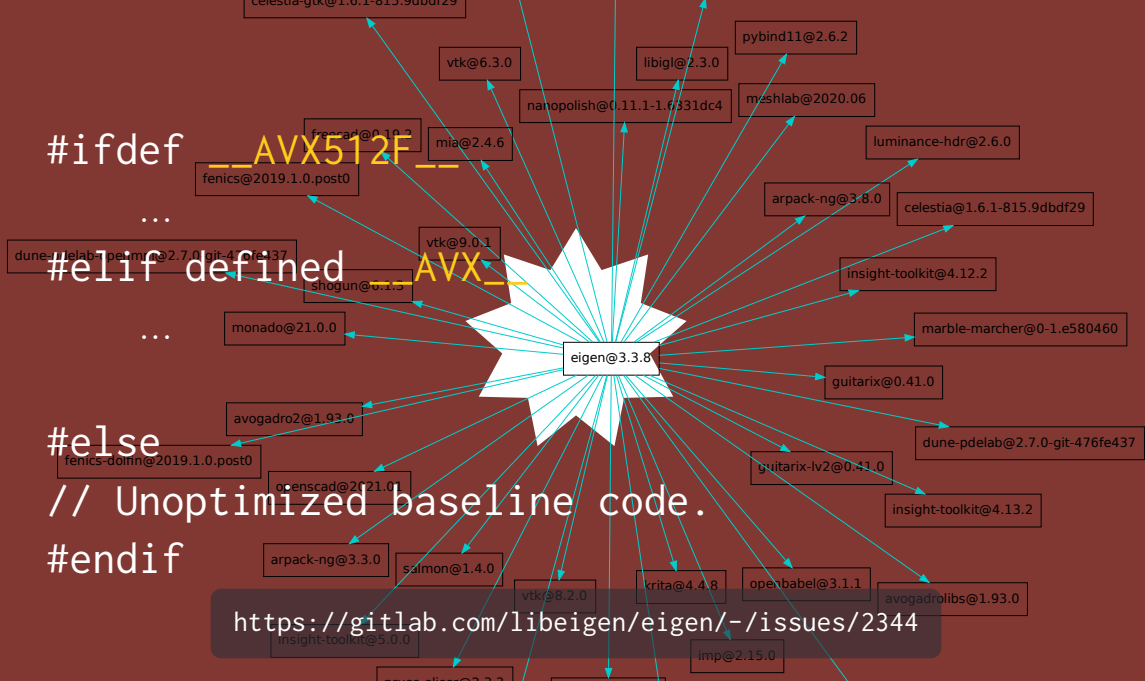
```
...
```

```
#else
```

```
// Unoptimized baseline code.
```

```
#endif
```

<https://gitlab.com/libeigen/eigen/-/issues/2344>





A large, solid orange starburst shape with eight points, centered on the page. The text "Package multi-versioning!" is written across the center of the starburst in a bold, black, sans-serif font.

**Package multi-versioning!**

```
$ guix shell eigen-benchmarks -- \
    benchBlasGemm 240 240 240
240 x 240 x 240
cblas: 0.20367 (16.289 GFlops/s)
eigen : 0.285149 (11.635 GFlops/s)
```

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```

```
$ guix shell --tune eigen-benchmarks -- \
guix shell: tuning for CPU micro-architecture skylake
240 x 240 x 240
cblas: 0.203131 (16.333 GFlops/s)
eigen : 0.0929638 (35.688 GFlops/s)
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**In Guix  
since 2022!**

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<https://hpc.guix.info/blog/2022/01/tuning-packages-for-a-cpu-micro-architecture/>

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**No world rebuilds!**

MPI, OPA, UCX, SSE, AVX, NEON...

MPI, OPA, UCX, SSE, AVX, NEON...

**Portability, performance,  
*and* reproducibility.**





<https://hpc.guix.info>

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