Introduction to the Nix Package Manager

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Introduction

Our use case

- Develop, test, distribute software (OAR, Melissa, Batsim...)
- Define and run controlled experiments

How Nix can help?

- Define/manage/customize packages and their dependencies
- Reproducible/deterministic packages
- Run code in controlled environments

Summary

1. Nix's main concepts
2. What we do with it
3. Conclusion and additional resources

Concept 1 — How to store the packages?

```
/usr
├── bin
│   └── myprogram
└── lib
    ├── libc.so
    └── libmylib.so
```

Usual (non Nix) approach: Merge them all

- Default environment all the time (or hacked manually by user)
  - `PATH` set to `/usr/bin` (or similar)
  - `LD_LIBRARY_PATH` set to `/usr/lib` (or similar)
  - `LIBRARY_PATH` set to `/usr/lib` (or similar)
- Huge limitation on package variation
  - Conflicts, as present implies accessible here
  - Files do not have well-defined needs

Concept 1 — Nix Store

Nix approach: Keep them separated

- Convenient package variation
  - Different package source → Different store path
  - Files have precise dependencies
    (`DT_RUNPATH` in ELFs, wrappers for `PYTHONPATH`...)
- Can *install* in default environment (tune `PATH`...)
- Isolated environments (enter shell with well-defined `PATH`...)

Concept 2 — Expressions, derivations, functions

Descriptive approach

- Define packages/environments in a DSL (also called Nix)
- Derivation = build action that populates the store
- Most of the time, package = function that returns a derivation
  - Inputs: dependencies, build systems, source, build script
  - Outputs: trees of files to write in the store

Convenient customization

- Can `override` a package to change its inputs
  - Sources for a apecific version of your soft
  - Add or change a dependency
- Can also `override` *phases* of the build script

Concept 3 — How to achieve reproducible builds?

Main ideas

- Package description
  - Default *phases* rarely need customization
  - Only customize what you need, do not write full build scripts
- Pure build environment (depends on arch, not system)
- Compilers told to use generic instruction sets by default
- Build in a sandbox/jail
  - No network access (*inputs* such as sources are fetched before)
  - No filesystem access (unless it is an *input*)
  - No ipc accesses (unless part of your build)
  - No time accesses: back to *epoch* we go

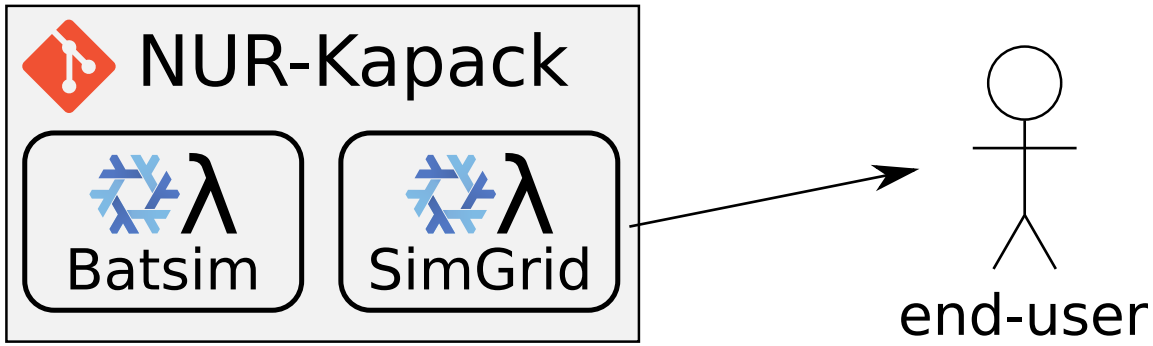
Key advantages

- Makes it really hard to change behavior depending on weather
- Do not miss dependencies anymore

What we do with Nix in a nutshell

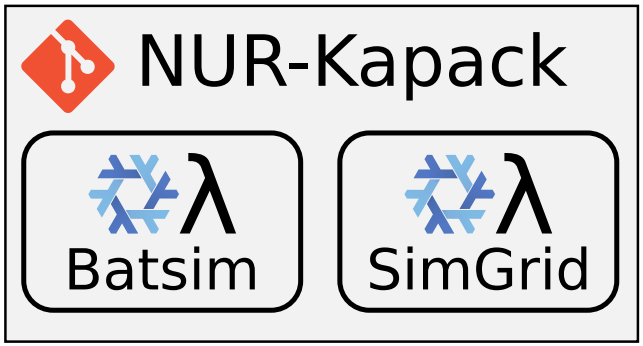
Write Nix expressions.

What we do with Nix in a nutshell

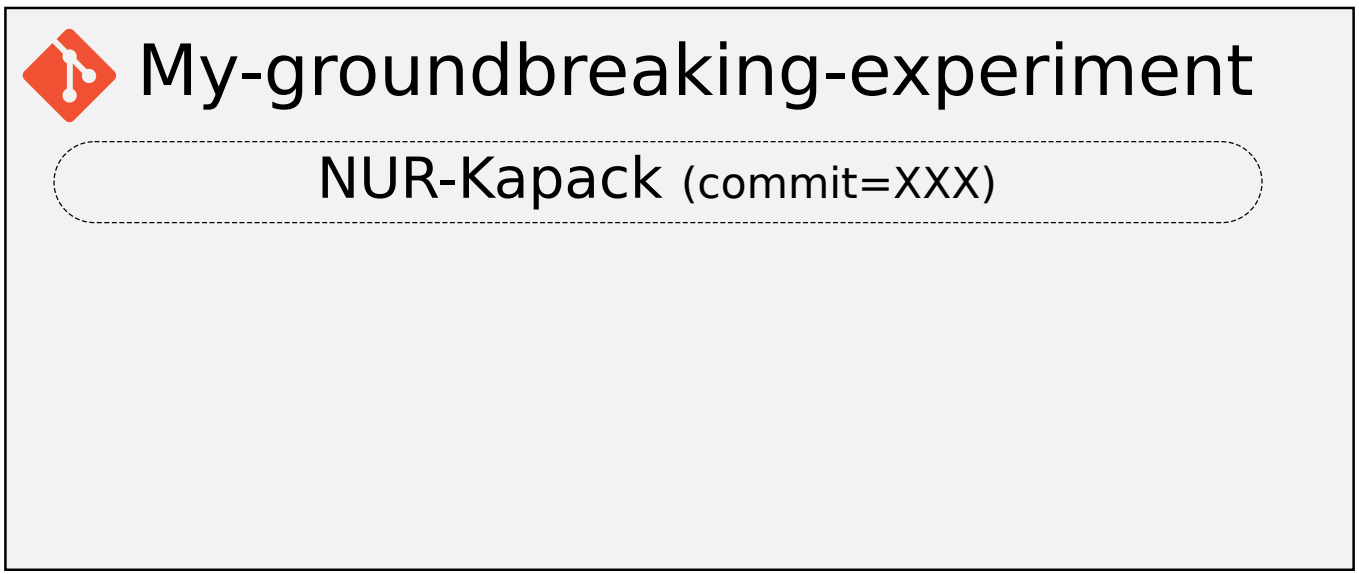


Put them in a Git repository.

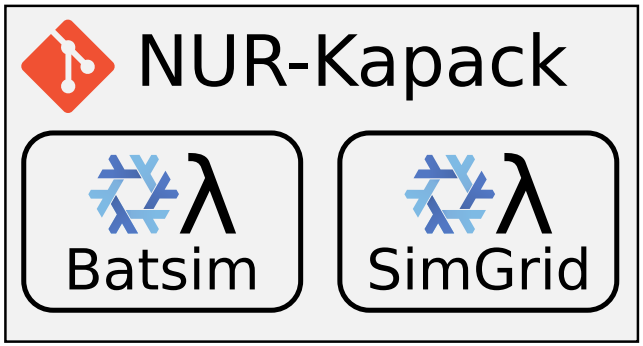
What we do with Nix in a nutshell



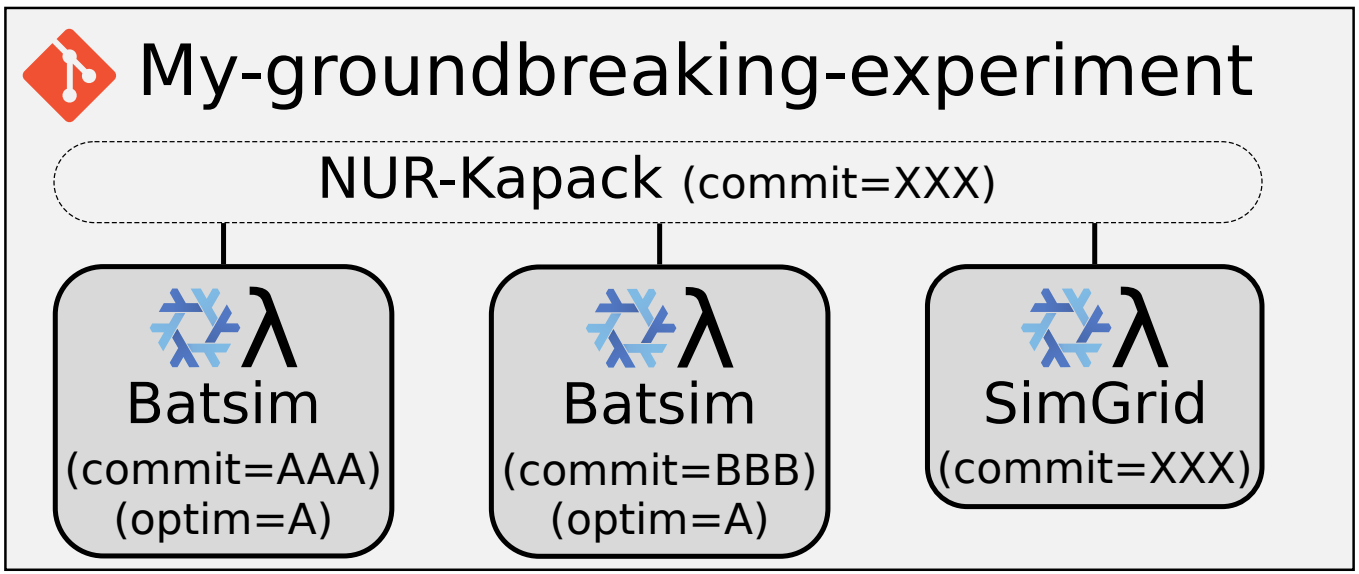
Use them for your experiment.



What we do with Nix in a nutshell



Customize them.



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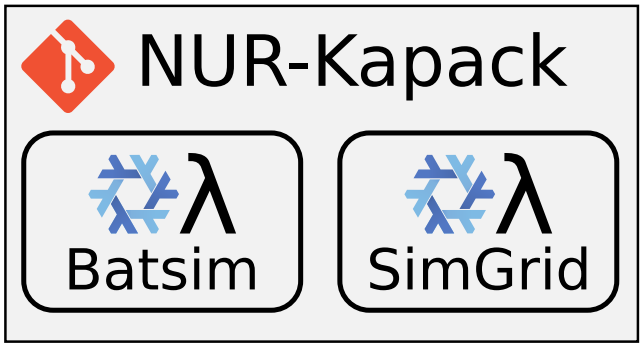
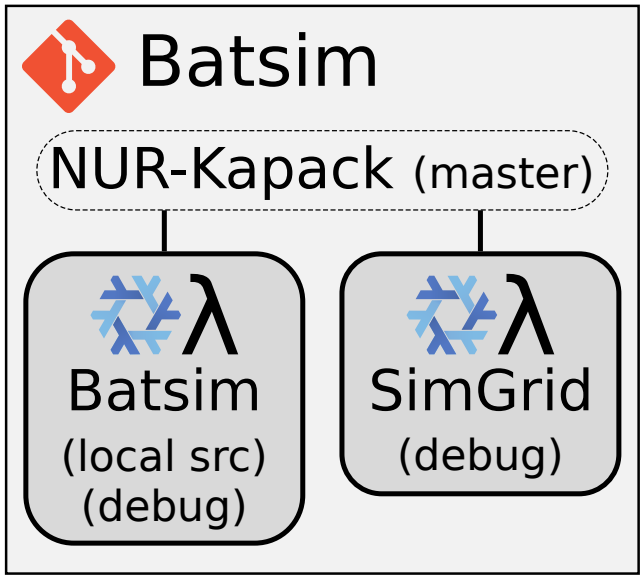
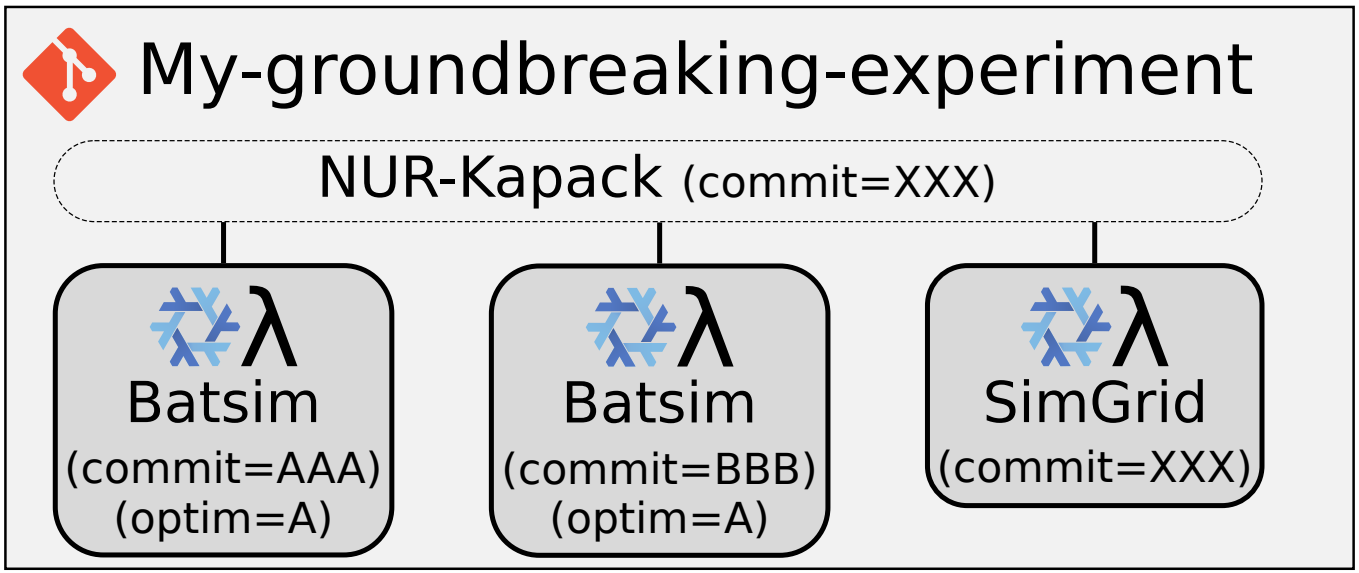




Use them for dev, including CI.



Take home message

Nix: Reproducible packages/environments

- Descriptive approach for packages/environments
- Multilanguage `virtualenv` → lightweight containers
- Steep learning curve, worth it for complex software or repro

Additional resources

- 1-hour introduction presentation (french) [1]
- Tutorial on Nix for reproducible experiments [2]
- Nix official website [3] — install, getting started...
- Nix pills [4] — how Nix works

1. `https://mpoquet.github.io/research.html#presentations-tutorials`
2. `https://nix-tutorial.gitlabpages.inria.fr/nix-tutorial`
3. `https://nixos.org`
4. `https://nixos.org/guides/nix-pills`