Units of Composition
recipes, overlays, and packages

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Introduction

- What is this called?
- Why it matters?
- What problems we encounter?
- Proposals
- Examples
- References

Disclaimer: Intermediate Nix experience helpful

What is this called?

{ stdenv , fetchurl }:

stdenv.mkDerivation (finalAttrs: {
    pname = "hello";
    version = "2.12.1";

    src = fetchurl {
        url = "mirror://gnu/hello/hello-${finalAttrs.version}.tar.gz";
        sha256 = "sha256-jZkUKv2SV28wsM18tCqNxoCZmLxdYH2Idh9RLibH2yA=";
    }
});

... Often called a “package”, but that’s not quite right?

The main idea of this talk is to explain how we work with this, and to suggest we give it a name.

Docker has a name for the image, and names for containers, not the recipe. It might produce a package. It is missing
Package: take 1

Create a package.nix file in the package directory, containing a Nix expression — a piece of code that describes how to build the package. In this case, it should be a function that is called with the package dependencies as arguments, and returns a build of the package in the Nix store.

Nixpkgs pkgs/README.md

Package: take 2

Nix doesn’t really have a notion of “package”. The term is only mentioned in a few places in the code, … Nixpkgs on the other hand is all about packages, but it does not define precisely what a package is.

Nix Issue #6507

roberth proposed a definition of package

Package: take 3

I think we need to expose all the functions we callPackage on their own.

As a middle ground, also expose the function to be fixed (“all packages”) but no fixed point “yet”

Nixpkgs Issue #172008

The value of a name

• They allow us to communicate.
• They allow us to teach.
• They allow us to precisely define abstractions.

why we should care

• This thing is used throughout Nixpkgs
• Beginners encounter this.
• We build further abstractions over it.
• Nix should understandable.
There is a long history of the importance of having a name. Knowing a name gives you power over it.

problems

- “I created a package. How can I build it?”
- “I got a package to build, how can I add it to Nixpkgs?”
- “My other packages can’t see my own package.”
- “My NixOS/home-manager can’t see my package.”
- “What is an overlay?”
- Overlays, fixed points, callPackage: oh my!
- “What is a flake? How do I add my package?”

callPackage

- A function which will call your definition with the correct arguments from a scope⁴ and provide a few usability benefits such as overrides.

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⁴https://github.com/NixOS/nixpkgs/blob/master/lib/customisation.nix#L308
• Used throughout Nixpkgs to avoid tedious and error-prone threading of
dependencies from their declaration to where they are used.
• good reference at: https://summer.nixos.org/blog/callpackage-a-tool-for-the-lazy/

poorly named

callPackage: overview

let
callPackageWith = scope: f: extra:
  let argsFrom = builtins.intersectAttrs (builtins.functionArgs f);
  f (argsFrom scope // extra);

    callPackage = callPackageWith ({
      a = 1;
      b = 2;
    } // packages);

    packages = {
      c = callPackage ({a}: a + 2) {};
      d = callPackage ({a,c}: a + c) {};
    };
  in
    packages

define the helper

    # define a function with three arguments
    callPackageWith = scope: f: extra:
      let argsFrom =
        # extract those arguments from the scope
        builtins.intersectAttrs
          # extract the required arguments of the function
          (builtins.functionArgs f);

        # call the original function with the extracted args
        f (argsFrom scope // extra);

define callPackage

    callPackageWith = scope: f: extra: ...;

    # "capture" a scope that remaining callers have access to
    callPackage = callPackageWith (
# a simple scope (or Nixpkgs)
{
    a = 1;
    b = 2;
}

... # The most mind-boggling thing.
# Expand the scope with the packages we are about to define.
# Requires lazy language.
// packages);

callPackage captures a closure and extends it

using callPackage
{
    callPackageWith = scope: f: extra: ...;
    callPackage = f: extra: ... // packages);

    packages = {
        c = callPackage functionC {};
        d = callPackage functionD {};
    };
}

This looks reasonable. Next, one would want to make this set of extensions available and re-usable, we’ve given this concept a name: “overlays”.

using overlays

callPackageWith = scope: f: extra: ...;
callPackage = f: extra: ...;
packages = {...};

overlay = final: prev: {
    c = final.callPackage functionC {};
    d = final.callPackage functionD {};
};

What is final? prev? Does anyone understand this?
overlays

- overlays are very powerful
- error prone: infinite recursion, nested sets, ...
- most users don’t need that full expressivity
- most common to add a package or two to the scope
- difficult to extract the original re-usable function

Overlays are the correct way compose packages, but are hard to use.

Package sets

```nix
packageWith = scope: f: extra: ...;
package = f: extra: ...;

packages =
  # Provide the base packages and the new ones.
let pkgs = {...};
in
  # Include hooks to be able to further add more.
  pkgs // { inherit callPackage extend pkgs; };
```

Package set features

- We have several in Nixpkgs, but not standardized
  - pkgs (top-level)
  - pythonPackages + python3Packages
  - haskellPackages
  - perlPackages
- ...
- Includes the machinery needed to use.
- Relatively unknown how they work.
- Difficult to nest: try overriding in pythonPackages

NAT Proposal: standardize + document package sets
scopes

Not a full treatment of the topic, but worth being aware of. Creating a scope allows one to add a bunch of packages to a set, compose everything, then later extract only the ones you added.

callPackageWith = scope: f: extra: {...};

makeScope = callPackageWith: f:
  let self = f self // {
      callPackageWith = scope: callPackageWith (self // scope);
      packages = f;
  };
  in self;

nixpkgs internals

Proposals

Things we can discuss and do today.

name this thing

{ stdenv , fetchurl }:

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  });
})

Proposal: Names

- package: related, but misses key concepts
- package function: correct, but awkward
- derivation: not until resolved
- proto-derivation: correct, but awkward
- blueprint: sterile
- recipe: instructions which allow variations
Any name is better than no name?

recipe

- instructions
- allows for variations
- cookbooks
stdf

recipes = {
    my-app-a = import ./pkgs/my-app-a/;
    my-app-b = {runCommand}: runCommand "b" {} "touch $out";
    my-app-c = {hello}: hello.overrideAttrs (_: {name = "c"});
    my-data = {}: "some data, some data";
};

• no “system”, friendly to cross-compiling
• obvious translation from a “cookbook” into overlays
• “recipes” as an official top-level flake output.
• nixpkgs expose them prior to being callPackage’d.
• no lockfiles needed
• frameworks: FUP, flake-parts, devenv, flox, etc.
no lockfile bloat

recipes.packages = {
  my-app-a = import ./pkgs/my-app-a/;
  my-app-b = {runCommand}: runCommand "b" {"touch $out"};
  my-app-c = {hello}: hello.overrideAttrs (_: {name = "c"};);
  my-data = {}: "some data, some data";
};

These are pure functions with no references to a system or a nixpkgs. So they can be accessed without needing to bring in transitive inputs.

additional thoughts

{stdenv, fetchurl}: # User question: "what am I allowed to put here?"

stdenv.mkDerivation {
  pname = "bbbb";
  version = "1.0";
  src = ...
}

Hard question to answer if someone has used overlays, overrides, added new packages, or are in a nested package set. We can expose this scope directly!

$ nix search .#context gcc
$ nix search .#scope.myPackages gcc

What is next?

• no underlying technical changes required
• a social convention is enough to start
• thoughts?
• RFC?
• add support in libraries and frameworks
• developer experience needs to expand

“using”

using baseNixpkgs {

  hello-go = ./pkgs/hello-go;
  hello-perl = ./pkgs/hello-perl;

  python3Packages = {
    hello-python-library = ./pkgs/python3Packages/hello-python-library;
  };
  hello-python = ./pkgs/hello-python;
# Escape-hatch into full nixpkgs overrides

```nix
hello-python-override =
callPackage: (callPackage ./pkgs/hello-python {})
    .overrideAttrs (_: {name="hello-python-override"});
```

Demo?

No time, but this approach exists in various forms.

This talk about trying to explain and then change how we think about such topics.

References

Nixpkgs pkgs/README.md Nix Issue #6507 Nixpkgs Issue #172008 customisation https://summer.nixos.org/blog/callpackage-a-tool-for-the-lazy/ nixpkgs internals