Nixology

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Problem

Solution

Functions:

```
{ inputs = { ... }; }
```

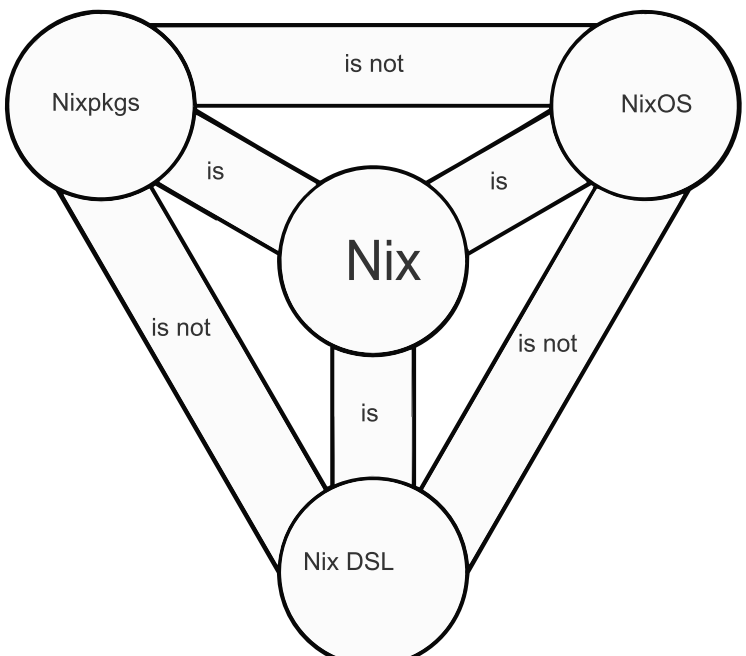
- Dependencies are inputs
- Usually tarballs or git repos
- Pinned and hashed

```
{ outputs = inputs: { ... }; }
```

- Outputs are functions of inputs
- Can be anything
- Lazily evaluated

Trinity

- Nix - the package manager
- Nix - the DSL
- Nixpkgs - the package collection
- NixOS - the operating system



Language Basics

Integers:

```
> x = 1 + 1
> x
2
```

Floats:

```
> y = 1.0 + 1.0
> y
2.0
```

Strings:

```
> z = "world"
> "hello ${z}"
"hello world"
```

Attribute sets:

```
> s = { a = { b = 1; }; }
> s.a.b
1
```

Language Basics

Lists:

```
> [ 1 "2" (_: 3) ]
[ 1 "2" <thunk> ]
```

Recursive attrsets:

```
> rec { x = 1; y = x; }
{ x = 1; y = 1; }
```

Bindings:

```
> let x = 1; in x + 1
2
```

Inherits:

```
> let x = 1; y = x; in
    { inherit x y; }
{ x = 1; y = 1; }
```

Language Basics

Functions 1:

```
> f = x: x + 1
> f 2
3
> g = g': x: g' x + 1
> g f 2
4
```

Functions 2:

```
> h = { x ? 1 }: x + 1
> h
<function>
> h { }
2
> h { x = 2; }
3
```

Derivation

A *derivation*

- is plan / blueprint
- it's used for producing
  - `lib`: library outputs
  - `bin`: binary outputs
  - `dev`: header files, etc.
  - `man`: man page entries
  - ...

```
derivation ::
  { system    : String
  , name      : String
  , builder   : Path | Drv
  , ? args    : [String]
  , ? outputs : [String]
  } -> Drv
```

Derivation

Example:

```
derivation ::                    derivation {
  { system    : String             system = "aarch64-darwin";
  , name      : String             name = "hi";
  , builder   : Path | Drv         builder = "/bin/sh";
  , ? args    : [String]           args = ["-c" "echo hi >$out"];
  , ? outputs : [String]           outputs = ["out"];
  } -> Drv                       }
```

Derivation

Special variables:

```
derivation {
  system = "aarch64-darwin";
  name = "hi";
  builder = "/bin/sh";
  args = ["-c" "echo hi >$out"];
  outputs = ["out"];     ^^^^
}              ^^^
```

- `$src`: build source
- `$out`: build output (default)
- custom outputs

Nix Store

```
/nix/store/l2h1lyz50rz6z2c8jbni9daxjs39wmn3-hi
|---------|--------------------------------|-|
store      hash                             name
prefix
```

- Store prefix can be either local or remote (binary cache)
- Hash either derived from input (default) or output (CA derivation)
- The hash ensures two realised derivations with the same name have different paths if the inputs differ at all

Packaging

The process of: Nix expressions ⇒ derivation(s)

- `builtins.derivation`
- `stdenv.mkDerivation` (from `nixpkgs`)
- `pkgs.buildGoApplication` (from `nixpkgs`)
- …

Packaging[1]

```nix
{
  inputs = { ... };

  outputs = { self, nixpkgs, flake-utils }:
    flake-utils.lib.eachDefaultSystem (system:
    let
      pkgs = nixpkgs.legacyPackages.${system};
    in
    {
      packages.default = pkgs.writeShellApplication {
        name = "moo";
        runtimeInputs = [ pkgs.cowsay ];
        text = "cowsay moo";
      };
    });
}
```

```
 _____
< moo >
 -----
        \   ^__^
         \  (oo)\_______
            (__)\       )\/\
                ||----w |
                ||     ||
```

[1]Example 1

Development[2]

Shell:

- `nix develop`
- `direnv`

```
devShells.default = pkgs.mkShell {
  packages = with pkgs; [
    cargo
    rustc
    rustfmt
  ];
};
```

Formatter:

- `nix fmt`
- a single package, or ↓

```
formatter = pkgs.writeShellScriptBin "formatter" ''
  set -eoux pipefail
  shopt -s globstar
  ${pkgs.nixpkgs-fmt}/bin/nixpkgs-fmt .
  ${pkgs.rustfmt}/bin/rustfmt **/*.rs
'';
```

[2]Example 2

Pinning

w/ builtin versions:

```
nix-repl> pkgs.coq_8_
pkgs.coq_8_10  pkgs.coq_8_12
pkgs.coq_8_14  pkgs.coq_8_16
pkgs.coq_8_18  pkgs.coq_8_5
pkgs.coq_8_7   pkgs.coq_8_9
...
```

w/ `nix shell`:

```
nix shell nixpkgs/<hash>#{pkg1,...}
```

or DIY!

w/ flakes:

```
inputs = {
  nixpkgsForA.url = "github:nixos/nixpkgs/<branch or hash>";
  nixpkgsForB.url = "github:nixos/nixpkgs/<branch or hash>";
  ...
};

outputs = { self, ... }: {
  ...
  pkgsA.<some pkg>;
  pkgsB.<some pkg>;
  ...
};
```

Build System[3]

Example: `eJS`

- Combine multiple build tools (`ant`, `make`, …)
- Build multiple targets (binary target, jar, …)
- Wrap programs
- …

[3] Example 3

System Configuration[4]

i.e. NixOS

```
outputs = { nixpkgs, ... }: {
  nixosConfigurations.test = nixpkgs.lib.nixosSystem {
    modules = [ /* a list of modules goes here */ ];
};};
```

System Closure:

```
nix build .#nixosConfigurations.test.config.system.build.toplevel
```

Rebuild:

```
nixos-rebuild <switch|boot|...> --flake .#test
```

[4]Ugawa lab infra

Resources

- Installer: https://github.com/determinatesystems/nix-installer
- REPL is your friend: `nix repl`
- Intro: https://zero-to-nix.com
- Mannual: https://nixos.org/manual/nix/unstable/
- Forum: https://discourse.nixos.org
- Options: https://mynixos.com
- Source code search:
  - https://github.com/features/code-search
  - https://sourcegraph.com