Learn Nix the Fun Way

Why I love Nix, and you should too

Farid Zakaria · farid.m.zakaria@gmail.com

fzakaria.github.io/learn-nix-the-fun-way

github.com/fzakaria/learn-nix-the-fun-way · 02108e5
/nix/store/3x9v5nfy2x31cx9c5n5hnjlds9r48si7-source

Hello 👋

My name is Farid Zakaria, and I'm a software engineer at Meta, with a PhD from UC Santa Cruz.

- Long-time Nix user (circa 2018)
- Introduced Nix at many companies, including Confluent & Google, and an active member of their internal communities
- Written a lot of Nix software and projects, such as nixmultiverse.com, omnibin.dev, trynix.dev and omniflake.com, to name a few
- Daily drive NixOS on my wonderful frame.work laptop

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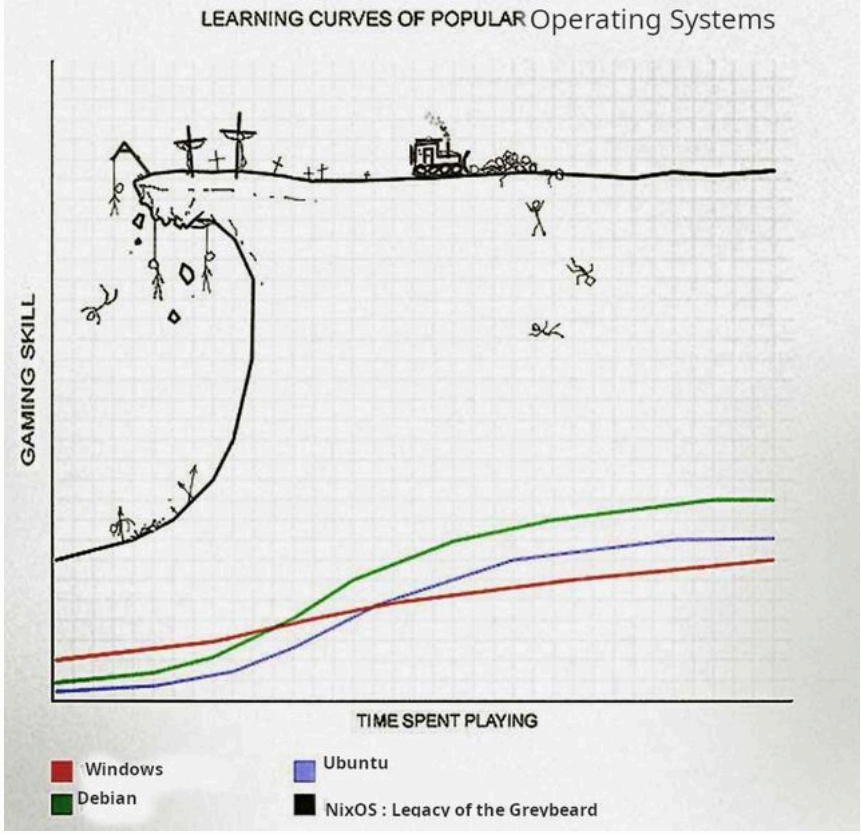
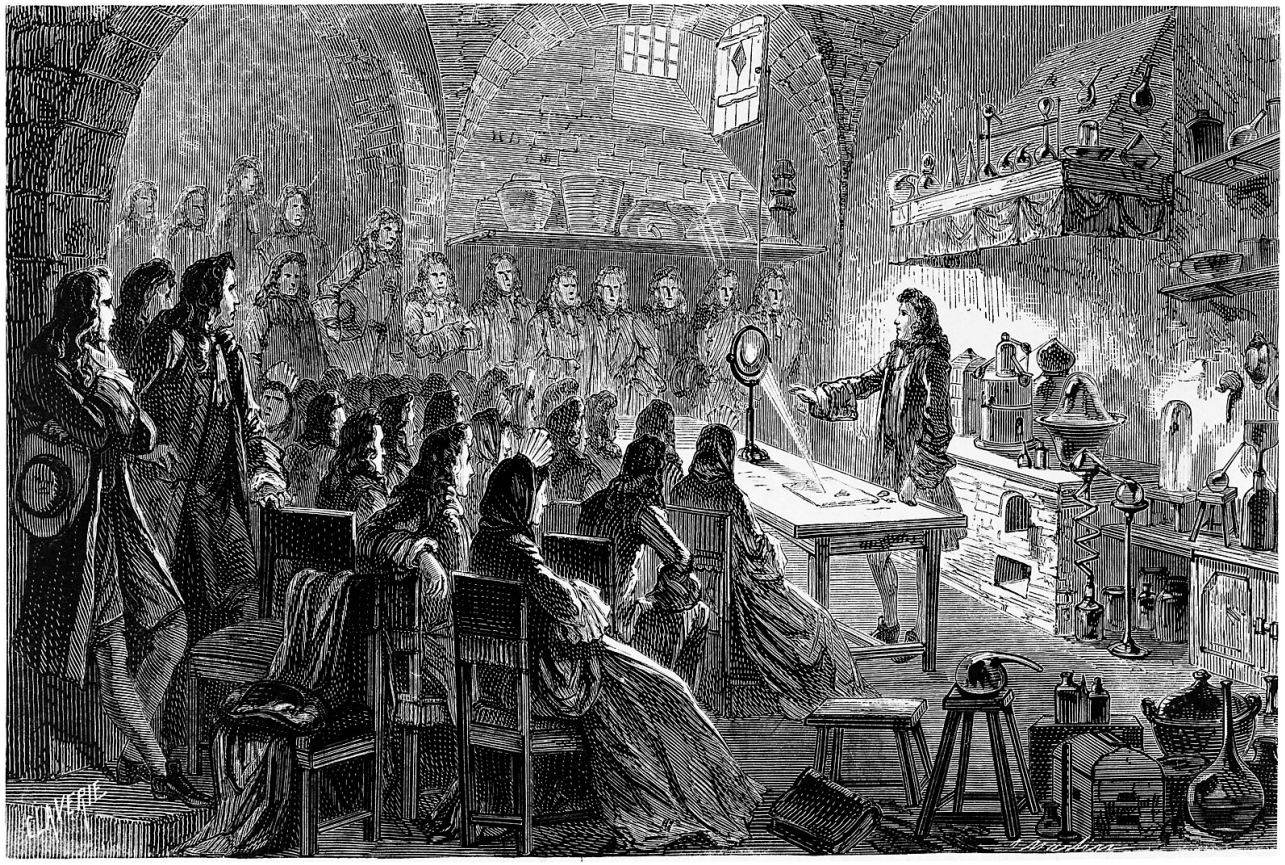
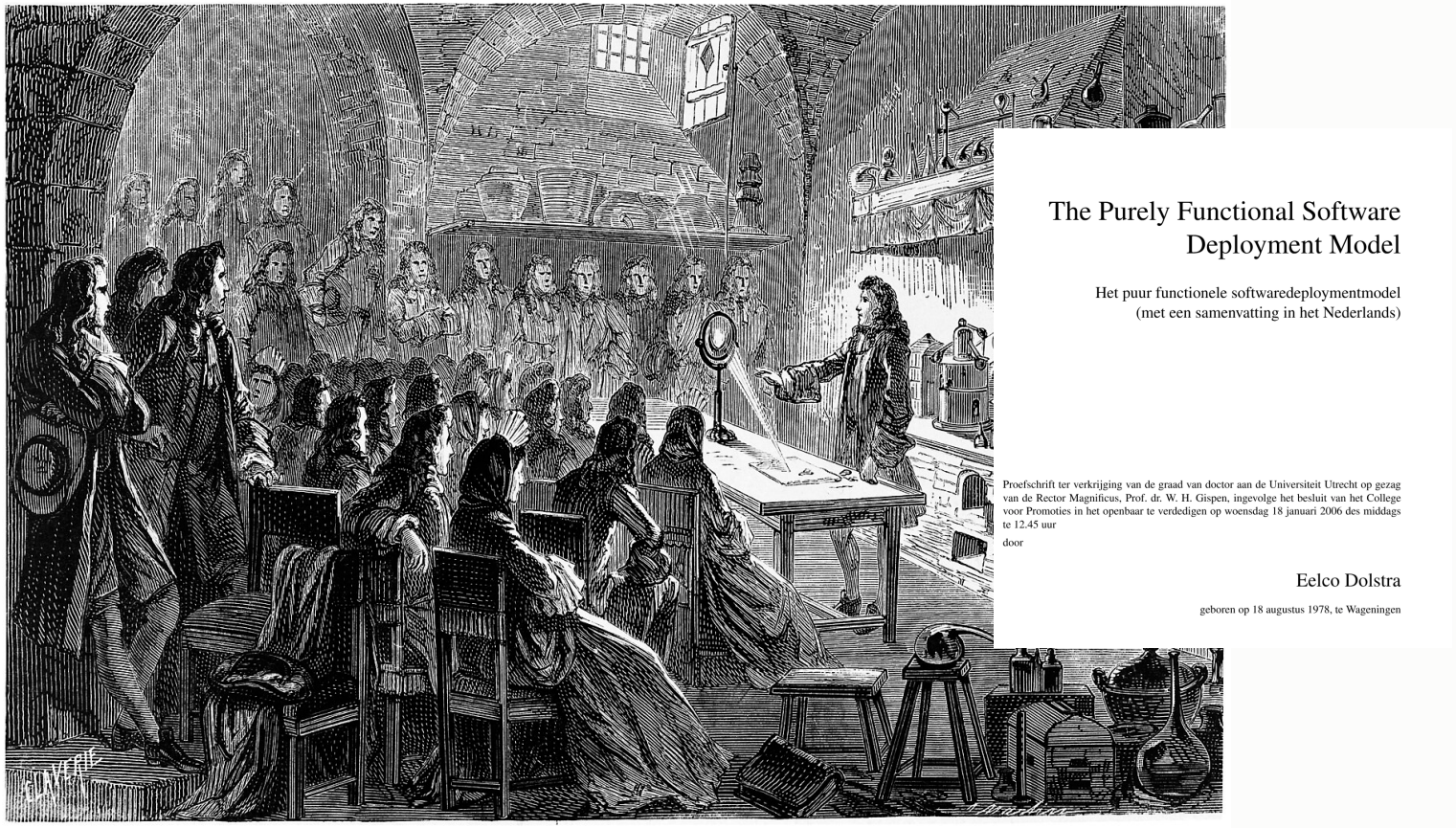
Disclaimer


LEARNING CURVES OF POPULAR Operating Systems
GAMING SKILL
TIME SPENT PLAYING
Windows
Debian
Ubuntu
NixOS : Legacy of the Greybeard

Why I love Nix, and you should too! 💖





The Purely Functional Software Deployment Model

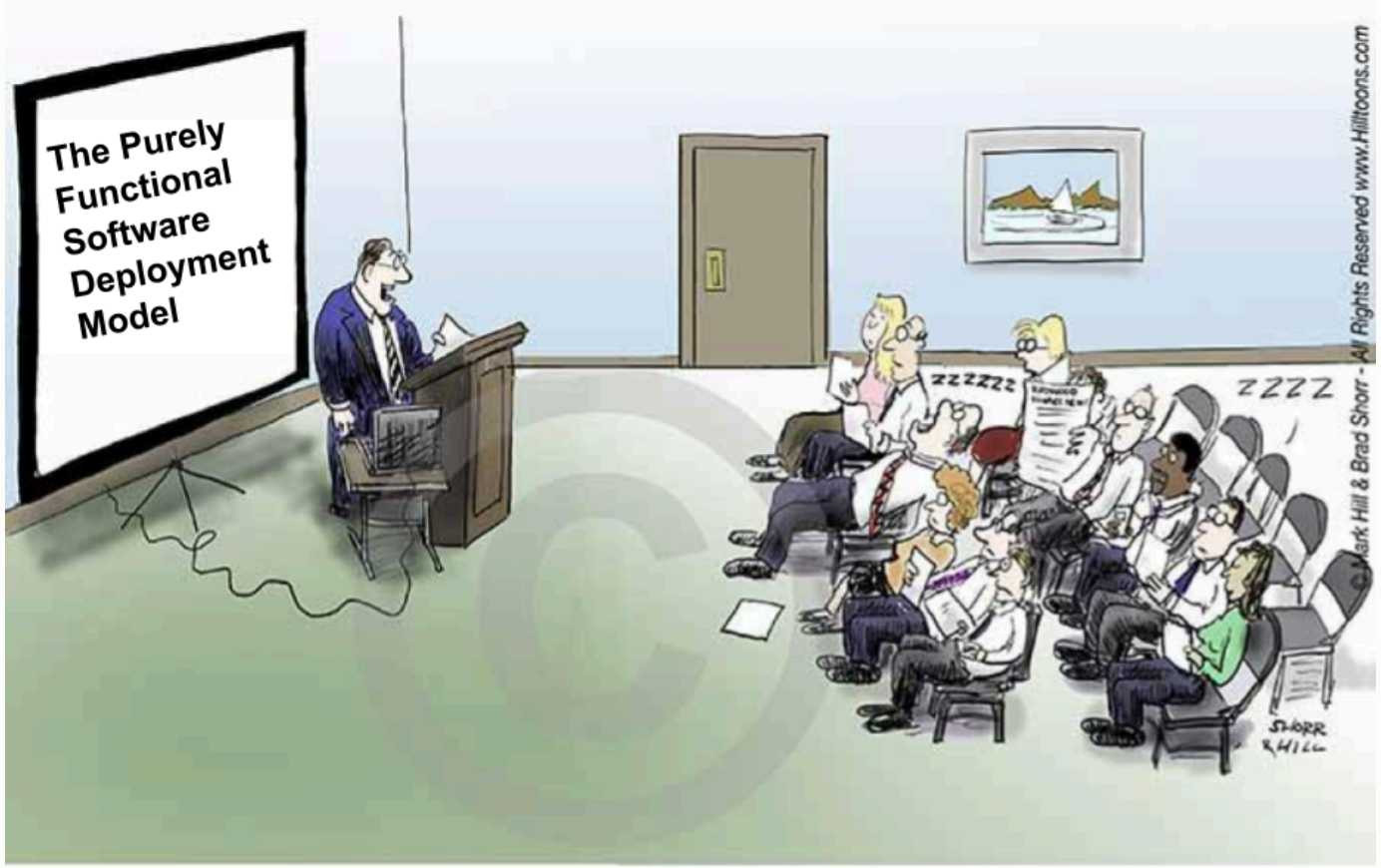
Het puur functionele softwaredeploymentmodel
(met een samenvatting in het Nederlands)

Proefschrift ter verkrijging van de graad van doctor aan de Universiteit Utrecht op gezag van de Rector Magnificus, Prof. dr. W. H. Gispen, ingevolge het besluit van het College voor Promoties in het openbaar te verdedigen op woensdag 18 januari 2006 des middags te 12.45 uur

door

Eelco Dolstra

geboren op 18 augustus 1978, te Wageningen


The Purely Functional Software Deployment Model
ZZZZZZ
ZZZZ
© Mark Hill & Brad Shorr - All Rights Reserved www.Hilltoons.com
SHORR
HILL

The Purely Functional Software Deployment Model
www.Hilltoons.com
A PESSIMISTIC HASH WHICH CONSTITUTES THE TRANSITIVE CLOSURE OF ALL DEPENDENCIES
RESULTING IN A HERMETIC SEAL LEVERAGING LINUX PATTERNS SUCH AS RUNPATH

Let’s do it different this time.

Let’s do it different this time.

Let’s learn Nix the fun way.

What is my IP?

```
#! /usr/bin/env bash
> curl -s http://httpbin.org/get | \
    jq --raw-output .origin
```

What is my IP?

```
#! /usr/bin/env bash
> curl -s http://httpbin.org/get | \
    jq --raw-output .origin

73.231.52.39
```

The same script, in Nix

```
{
  system ? builtins.currentSystem,
  pkgs ?
    let
      # NixOS 24.11
      rev = "5ef6c425980847c78a80d759abc476e941a9bf42";
      url = "https://github.com/NixOS/nixpkgs/archive/${rev}.tar.gz";
    in
      import (fetchTarball url) {inherit system;},
}:
derivation {
  name = "what-is-my-ip";
  builder = "/bin/sh";
  args = [
    "-c"
    ''
      ${pkgs.coreutils}/bin/mkdir -p $out/bin
      echo '#!/bin/sh' > $out/bin/what-is-my-ip
      echo '${pkgs.curl}/bin/curl -s http://httpbin.org/get | \
      ${pkgs.jq}/bin/jq --raw-output .origin' \
            >> $out/bin/what-is-my-ip
      ${pkgs.coreutils}/bin/chmod +x $out/bin/what-is-my-ip
    ''
  ];
  system = builtins.currentSystem;
  outputs = ["out"];
}
```

The same script, in Nix

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{
  system ? builtins.currentSystem,
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    let
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```

The same script, in idiomatic Nix

```nix
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  system ? builtins.currentSystem,
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    let
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      url = "https://github.com/NixOS/nixpkgs/archive/${rev}.tar.gz";
    in
      import (fetchTarball url) {inherit system;},
}:
pkgs.writeShellScriptBin "what-is-my-ip" ''
  ${pkgs.curl}/bin/curl -s http://httpbin.org/get | \
    ${pkgs.jq}/bin/jq --raw-output .origin
''
```

The same script, in idiomatic Nix

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  system ? builtins.currentSystem,
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  ${pkgs.curl}/bin/curl -s http://httpbin.org/get | \
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''
```

Let’s build it

```
> nix build -f what-is-my-ip.nix --print-out-paths
```

Let’s build it

```
> nix build -f what-is-my-ip.nix --print-out-paths

/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip
```

Let’s build it

```
> nix build -f what-is-my-ip.nix --print-out-paths

/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip

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73.231.52.39
```

What did we build?

```
> cat /nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip/bin/what-is-my-ip
```

What did we build?

```
> cat /nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip/bin/what-is-my-ip

#!/nix/store/gwgqdl0242ymlikq9s9s62gkp5cvyal3-bash-5.2p37/bin/bash
/nix/store/7p8814g62bybwa8blmaqr9piv3vjwan5-curl-8.11.1-bin/bin/curl -s http://httpbin.org/get | \
/nix/store/jhw7aklgrc23125ysg1mc72y8zq0lndw-jq-1.7.1-bin/bin/jq --raw-output .origin
```

What is `/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip`?

What is `/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip`?

Why do we care about `y2g0ijqqiyi9vxr9xgmvvgblxqflqzav`?

What is `/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip`?

Why do we care about `y2g0ijqqiyi9vxr9xgmvvgblxqflqzav`?

```
> nix derivation show /nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip
```

Hashed into `y2g0ijqqiyi9vxr9xgmvvgblxqflqzav`


```
{
  "/nix/store/rw89fpljini3yx09v83ds4hyl4945lmk-what-is-my-ip.drv": {
    "args": [
      "-e",
      "/nix/store/v6x3cs394jgqfbi0a42pam708flxaphh-default-builder.sh"
    ],
    "builder": "/nix/store/gwgqdl0242ymlikq9s9s62gkp5cvyal3-bash-5.2p37/bin/bash",
    "env": {
      "buildCommand": "<build command>",
      "builder": "/nix/store/gwgqdl0242ymlikq9s9s62gkp5cvyal3-bash-5.2p37/bin/bash",
      "name": "what-is-my-ip",
      "out": "/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip",
      "stdenv": "/nix/store/cf464y41p2x3lh1qvbg6678lc3f8zbd6-stdenv-linux",
      "system": "x86_64-linux",
      "text": "<contents of script removed for brevity>"
    },
    "inputDrvs": {
      "/nix/store/7k0msqyp2dm021sdj0qjgpkzff8xhqzr-bash-5.2p37.drv": {},
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    },
    "system": "x86_64-linux"
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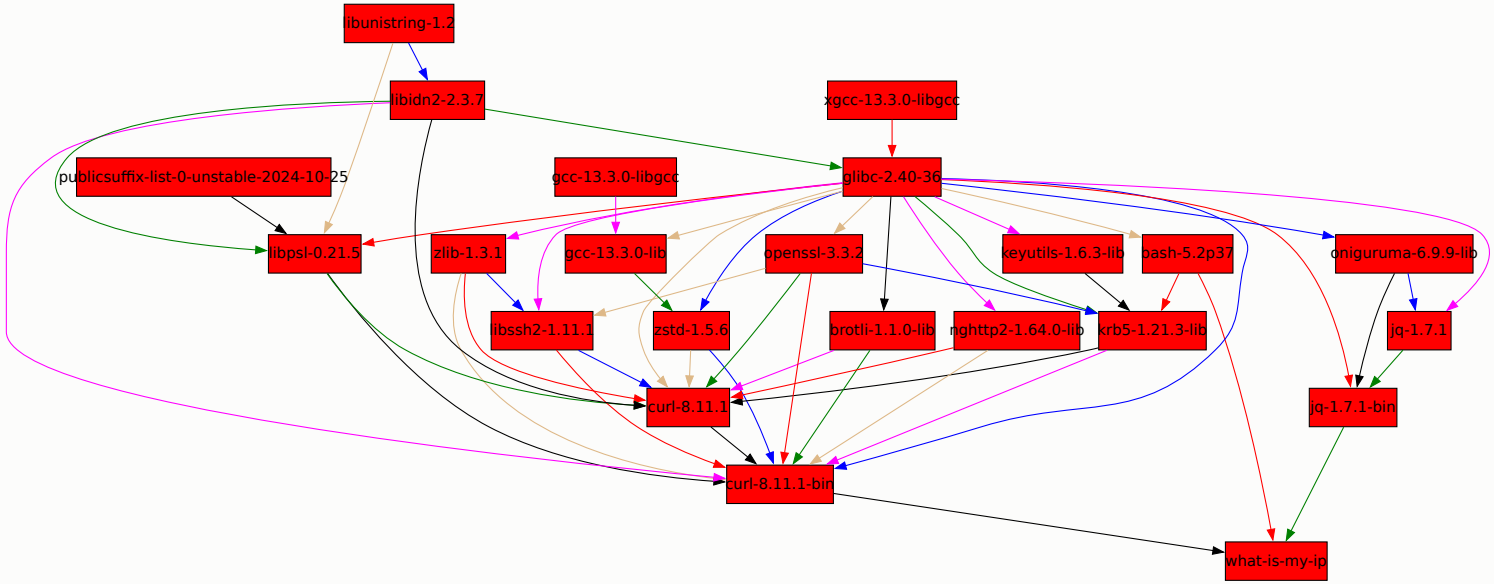
```

Extremely strong guarantees

Seeing `y2g0ijqqiyi9vxr9xgmvvgblxqflqzav` means we have *extremely* strong guarantees of the software graph down to the commit and build instructions.

Once you know your full software graph, everything is a permutation on that




```
> nix-store --query --graph /nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip
```

Permutation #1: a developer shell

```nix
let
  rev = "5ef6c425980847c78a80d759abc476e941a9bf42";
  url = "https://github.com/NixOS/nixpkgs/archive/${rev}.tar.gz";
  pkgs = import (fetchTarball url) {};
  what-is-my-ip = import ./what-is-my-ip.nix {inherit pkgs;};
in
  pkgs.mkShell {
    packages = [what-is-my-ip];

    shellHook = ''
      echo "Hello, Nix!"
    '';
  }
```

Permutation #1: a developer shell

```nix
let
  rev = "5ef6c425980847c78a80d759abc476e941a9bf42";
  url = "https://github.com/NixOS/nixpkgs/archive/${rev}.tar.gz";
  pkgs = import (fetchTarball url) {};
  what-is-my-ip = import ./what-is-my-ip.nix {inherit pkgs;};
in
  pkgs.mkShell {
    packages = [what-is-my-ip];

    shellHook = ''
      echo "Hello, Nix!"
    '';
  }
```

Permutation #1: a developer shell

```nix
let
  rev = "5ef6c425980847c78a80d759abc476e941a9bf42";
  url = "https://github.com/NixOS/nixpkgs/archive/${rev}.tar.gz";
  pkgs = import (fetchTarball url) {};
  what-is-my-ip = import ./what-is-my-ip.nix {inherit pkgs;};
in
  pkgs.mkShell {
    packages = [what-is-my-ip];

    shellHook = ''
      echo "Hello, Nix!"
    '';
  }
```

Permutation #1: a developer shell

```
> nix-shell what-is-my-ip-shell.nix
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #1: a developer shell

```
> nix-shell what-is-my-ip-shell.nix

Hello, Nix!
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #1: a developer shell

```
> nix-shell what-is-my-ip-shell.nix

Hello, Nix!


[nix-shell]
> which what-is-my-ip
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #1: a developer shell

```
> nix-shell what-is-my-ip-shell.nix

Hello, Nix!

[nix-shell]
> which what-is-my-ip

/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip/bin/what-is-my-ip
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #1: a developer shell

```
> nix-shell what-is-my-ip-shell.nix

Hello, Nix!

[nix-shell]
> which what-is-my-ip

/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip/bin/what-is-my-ip

[nix-shell]
> /nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip/bin/what-is-my-ip
73.231.52.39
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Reproducible developer environments ✔️

We actually know everything about our code now.

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We can now do binary or source deployments 🚀🛠️📦
since we know the full dependency closure of our tool(s).

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We can now do binary or source deployments 🚀🛠️📦 since we know the full dependency closure of our tool(s).

We simply copy the necessary `/nix/store` paths to another machine ~~with Nix installed.~~

Profit 🤑

Permutation #2: a deployment

```
> nix copy --to ssh://dennard.soe.ucsc.edu \
  $(nix build -f what-is-my-ip.nix --print-out-paths)
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #2: a deployment

```
> nix copy --to ssh://dennard.soe.ucsc.edu \
  $(nix build -f what-is-my-ip.nix --print-out-paths)


> ssh dennard.soe.ucsc.edu
Last login: Mon Mar  3 05:02:57 2025 from 73.231.52.39
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #2: a deployment

```
> nix copy --to ssh://dennard.soe.ucsc.edu \
  $(nix build -f what-is-my-ip.nix --print-out-paths)


> ssh dennard.soe.ucsc.edu
Last login: Mon Mar  3 05:02:57 2025 from 73.231.52.39


[dennard]
> /nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip/bin/what-is-my-ip
128.114.53.24
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Binary (or source) deployments ✔️

That’s awesome! Unfortunately, our company uses Docker / Kubernetes 😔

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No problem! Again, once we know the graph of our software everything is just a permutation.

```
let
  rev = "5ef6c425980847c78a80d759abc476e941a9bf42";
  url = "https://github.com/NixOS/nixpkgs/archive/${rev}.tar.gz";
  pkgs = import (fetchTarball url) {};
  what-is-my-ip = import ./what-is-my-ip.nix {inherit pkgs;};
in
  pkgs.dockerTools.buildImage {
    name = "what-is-my-ip-docker";
    config = {
      Cmd = ["${what-is-my-ip}/bin/what-is-my-ip"];
    };
  }
```

That’s awesome! Unfortunately, our company uses Docker / Kubernetes 😔

No problem! Again, once we know the graph of our software everything is just a permutation.

```
let
  rev = "5ef6c425980847c78a80d759abc476e941a9bf42";
  url = "https://github.com/NixOS/nixpkgs/archive/${rev}.tar.gz";
  pkgs = import (fetchTarball url) {};
  what-is-my-ip = import ./what-is-my-ip.nix {inherit pkgs;};
in
  pkgs.dockerTools.buildImage {
    name = "what-is-my-ip-docker";
    config = {
      Cmd = ["${what-is-my-ip}/bin/what-is-my-ip"];
    };
  }
```

Permutation #3: a container

```
> nix build -f what-is-my-ip-docker.nix --print-out-paths
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #3: a container

```
> nix build -f what-is-my-ip-docker.nix --print-out-paths

/nix/store/vwlbi7m9123cm6kjy1skh4fskh02c5zc-docker-image-what-is-my-ip-docker.tar.gz
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #3: a container

```
> nix build -f what-is-my-ip-docker.nix --print-out-paths

/nix/store/vwlbi7m9123cm6kjy1skh4fskh02c5zc-docker-image-what-is-my-ip-docker.tar.gz

> docker load /nix/store/vwlbi7m9123cm6kjy1skh4fskh02c5zc-docker-image-what-is-my-ip-docker.tar.gz
Loaded image: what-is-my-ip-docker:vwlbi7m9123cm6kjy1skh4fskh02c5zc
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #3: a container

```
> nix build -f what-is-my-ip-docker.nix --print-out-paths

/nix/store/vwlbi7m9123cm6kjy1skh4fskh02c5zc-docker-image-what-is-my-ip-docker.tar.gz

> docker load /nix/store/vwlbi7m9123cm6kjy1skh4fskh02c5zc-docker-image-what-is-my-ip-docker.tar.gz
Loaded image: what-is-my-ip-docker:vwlbi7m9123cm6kjy1skh4fskh02c5zc

> docker run -it what-is-my-ip-docker:vwlbi7m9123cm6kjy1skh4fskh02c5zc
73.231.52.39
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #3: a container

```
> nix build -f what-is-my-ip-docker.nix --print-out-paths

/nix/store/vwlbi7m9123cm6kjy1skh4fskh02c5zc-docker-image-what-is-my-ip-docker.tar.gz

> docker load /nix/store/vwlbi7m9123cm6kjy1skh4fskh02c5zc-docker-image-what-is-my-ip-docker.tar.gz
Loaded image: what-is-my-ip-docker:vwlbi7m9123cm6kjy1skh4fskh02c5zc

> docker run -it what-is-my-ip-docker:vwlbi7m9123cm6kjy1skh4fskh02c5zc
73.231.52.39

> docker inspect what-is-my-ip-docker:vwlbi7m9123cm6kjy1skh4fskh02c5zc --format "{{.Config.Cmd}}"
[/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip/bin/what-is-my-ip]
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Cool! 😎

Nix + Docker integrate perfectly. The image produced has only the files exactly necessary to run the tool provided, effectively distroless.

You can do the same thing for any deployment format!

- OCI images
- tarballs
- self-extracting ZIP
- rpm
- deb
- Flatpak / AppImage

A Linux distribution is simply a collection of packages.

Permutation #4: an operating system

```nix
let
  rev = "5ef6c425980847c78a80d759abc476e941a9bf42";
  url = "https://github.com/NixOS/nixpkgs/archive/${rev}.tar.gz";
  nixpkgs = fetchTarball url;
  pkgs = import nixpkgs {};
  what-is-my-ip = import ./what-is-my-ip.nix {inherit pkgs;};
  nixos = import "${nixpkgs}/nixos" {
    configuration = {
      users.users.alice = {
        isNormalUser = true;
        # enable sudo
        extraGroups = ["wheel"];
        packages = [
          what-is-my-ip
        ];
        initialPassword = "swordfish";
      };

      system.stateVersion = "24.05";
    };
  };
in
  nixos.vm
```

Permutation #4: an operating system

```nix
let
  rev = "5ef6c425980847c78a80d759abc476e941a9bf42";
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  what-is-my-ip = import ./what-is-my-ip.nix {inherit pkgs;};
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  pkgs = import nixpkgs {};
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  url = "https://github.com/NixOS/nixpkgs/archive/${rev}.tar.gz";
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  pkgs = import nixpkgs {};
  what-is-my-ip = import ./what-is-my-ip.nix {inherit pkgs;};
  nixos = import "${nixpkgs}/nixos" {
    configuration = {
      users.users.alice = {
        isNormalUser = true;
        # enable sudo
        extraGroups = ["wheel"];
        packages = [
          what-is-my-ip
        ];
        initialPassword = "swordfish";
      };

      system.stateVersion = "24.05";
    };
  };
in
  nixos.vm
```

Permutation #4: an operating system

```
> nix build -f what-is-my-ip-vm.nix --print-out-paths
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #4: an operating system

```
> nix build -f what-is-my-ip-vm.nix --print-out-paths

/nix/store/k6vqp2hn0gh7r5dmc61f5knqgnqn53wz-nixos-vm
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #4: an operating system

```
> nix build -f what-is-my-ip-vm.nix --print-out-paths

/nix/store/k6vqp2hn0gh7r5dmc61f5knqgnqn53wz-nixos-vm

> QEMU_KERNEL_PARAMS=console=ttyS0 \
    /nix/store/k6vqp2hn0gh7r5dmc61f5knqgnqn53wz-nixos-vm/bin/run-nixos-vm -nographic; reset
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #4: an operating system

```
> nix build -f what-is-my-ip-vm.nix --print-out-paths

/nix/store/k6vqp2hn0gh7r5dmc61f5knqgnqn53wz-nixos-vm

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    /nix/store/k6vqp2hn0gh7r5dmc61f5knqgnqn53wz-nixos-vm/bin/run-nixos-vm -nographic; reset

... long boot sequence ...

<<< Welcome to NixOS 24.11pre-git (x86_64) - ttyS0 >>>

nixos login: alice
Password:
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

Permutation #4: an operating system

```
> nix build -f what-is-my-ip-vm.nix --print-out-paths

/nix/store/k6vqp2hn0gh7r5dmc61f5knqgnqn53wz-nixos-vm

> QEMU_KERNEL_PARAMS=console=ttyS0 \
    /nix/store/k6vqp2hn0gh7r5dmc61f5knqgnqn53wz-nixos-vm/bin/run-nixos-vm -nographic; reset

... long boot sequence ...

<<< Welcome to NixOS 24.11pre-git (x86_64) - ttyS0 >>>

nixos login: alice
Password:

[alice@nixos:~]$ which what-is-my-ip
/etc/profiles/per-user/alice/bin/what-is-my-ip

[alice@nixos:~]$ realpath $(which what-is-my-ip)
/nix/store/y2g0ijqqiyi9vxr9xgmvvgblxqflqzav-what-is-my-ip/bin/what-is-my-ip

[alice@nixos:~]$ what-is-my-ip
73.231.52.39
```

Remember y2g0ijqqiyi9vxr9xgmvvgblxqflqzav

So… what is Nix?

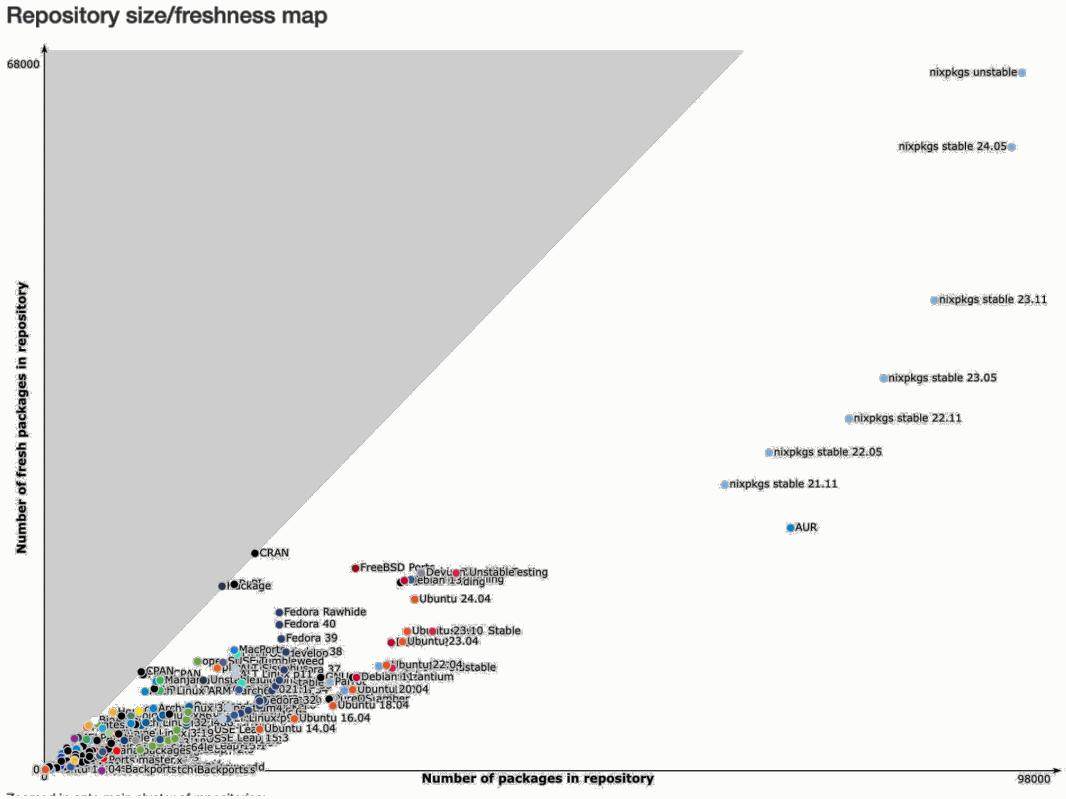
A language, and a command-line tool

```nix
# hello-world.nix
derivation {
  name = "hello-world";
  # POSIX requires this file to be present
  # so we can depend on it but not on /bin/bash
  builder = "/bin/sh";
  args = [ "-c" "echo 'hello world' > $out" ];
  system = builtins.currentSystem;
}
```

```nix
# hello-world-writeText.nix
let pkgs = import <nixpkgs> {};
in
pkgs.writeText "hello-world" "hello world"
```

```
> nix build --file hello-world.nix --json | jq -r '.[].outputs.out'
/nix/store/dg2rpsw16yfiw3h2ma14j5qh7a6m08kk-hello-world

> cat /nix/store/dg2rpsw16yfiw3h2ma14j5qh7a6m08kk-hello-world
hello world
```

A package collection: nixpkgs



github.com/NixOS/nixpkgs

Repository size vs. freshness, from repology.org

One recipe, many permutations

```
> nix run nixpkgs#hello
Hello, world!
```

One recipe, many permutations

```
> nix run nixpkgs#hello
Hello, world!

> nix build nixpkgs#hello --no-link --print-out-paths
/nix/store/m1r53pnnm6hnjwyjmxska24y8amvlpjp-hello-2.12.1
```

One recipe, many permutations

```
> nix run nixpkgs#hello
Hello, world!

> nix build nixpkgs#hello --no-link --print-out-paths
/nix/store/m1r53pnnm6hnjwyjmxska24y8amvlpjp-hello-2.12.1

> nix build nixpkgs#pkgsStatic.hello --no-link --print-out-paths
/nix/store/d3scd1vhylfvjgjwgp2ydbhdlss7zpcr-hello-static-x86_64-unknown-linux-musl-2.12.1
```

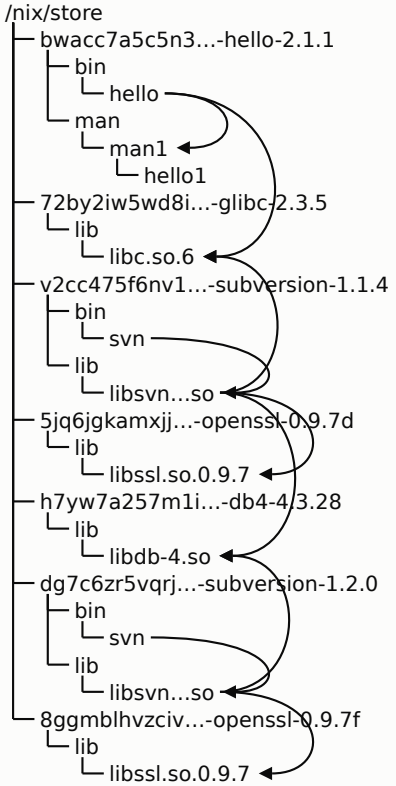
One recipe, many permutations

```
> nix run nixpkgs#hello
Hello, world!

> nix build nixpkgs#hello --no-link --print-out-paths
/nix/store/m1r53pnnm6hnjwyjmxska24y8amvlpjp-hello-2.12.1

> nix build nixpkgs#pkgsStatic.hello --no-link --print-out-paths
/nix/store/d3scd1vhylfvjgjwgp2ydbhdlss7zpcr-hello-static-x86_64-unknown-linux-musl-2.12.1

> nix build nixpkgs#pkgsCross.riscv64.hello --no-link --print-out-paths
/nix/store/p2fhzrphxmd8if2mf7b28biawj7walf1-hello-riscv64-unknown-linux-gnu-2.12.1
> /nix/store/p2fhzrphxmd8if2mf7b28biawj7walf1-hello-riscv64-unknown-linux-gnu-2.12.1/bin/hello
bash: .../bin/hello: cannot execute binary file
```

One recipe, many permutations

```
> nix run nixpkgs#hello
Hello, world!

> nix build nixpkgs#hello --no-link --print-out-paths
/nix/store/m1r53pnnm6hnjwyjmxska24y8amvlpjp-hello-2.12.1

> nix build nixpkgs#pkgsStatic.hello --no-link --print-out-paths
/nix/store/d3scd1vhylfvjgjwgp2ydbhdlss7zpcr-hello-static-x86_64-unknown-linux-musl-2.12.1

> nix build nixpkgs#pkgsCross.riscv64.hello --no-link --print-out-paths
/nix/store/p2fhzrphxmd8if2mf7b28biawj7walf1-hello-riscv64-unknown-linux-gnu-2.12.1
> /nix/store/p2fhzrphxmd8if2mf7b28biawj7walf1-hello-riscv64-unknown-linux-gnu-2.12.1/bin/hello
bash: .../bin/hello: cannot execute binary file

> nix build nixpkgs#pkgsCross.mingwW64.hello --no-link --print-out-paths
/nix/store/b78fyx3z62pdww8a3nk8vfa3cb2api6h-hello-x86_64-w64-mingw32-2.12.1
> wine64 /nix/store/b78fyx3z62pdww8a3nk8vfa3cb2api6h-hello-x86_64-w64-mingw32-2.12.1/bin/hello.exe
Hello, world!
```

A store



Source: Eelco Dolstra, *The Purely Functional Software Deployment Model* (2006), redrawn

An operating system

```
eudoxia@sextant:~$ neofetch

                          eudoxia@sextant
                          ------
                          OS: NixOS 22.11.3681.2b1bba76a13 (Raccoon) x86_64
                          Host: LENOVO 20Y5002MAU
                          Kernel: 5.15.106
                          Uptime: 2 hours, 7 mins
                          Packages: 934 (nix-system), 1431 (nix-user)
                          Shell: bash 5.1.16
                          Resolution: 2560x1600
                          DE: none+spectrum
                          WM: spectrum
                          Theme: Adwaita [GTK3]
                          Icons: Adwaita [GTK3]
                          Terminal: urxvt
                          Terminal Font: terminus
                          CPU: 11th Gen Intel i7-11800H (16) @ 4.600GHz
                          GPU: NVIDIA GeForce RTX 3050 Ti Mobile
                          GPU: Intel TigerLake-H GT1 [UHD Graphics]
                          Memory: 3218MiB / 15727MiB
```

Nix Language

Nix Operating System

Nix Package Manager

Modeling software as a directed acyclic graph.

Nix Ecosystem

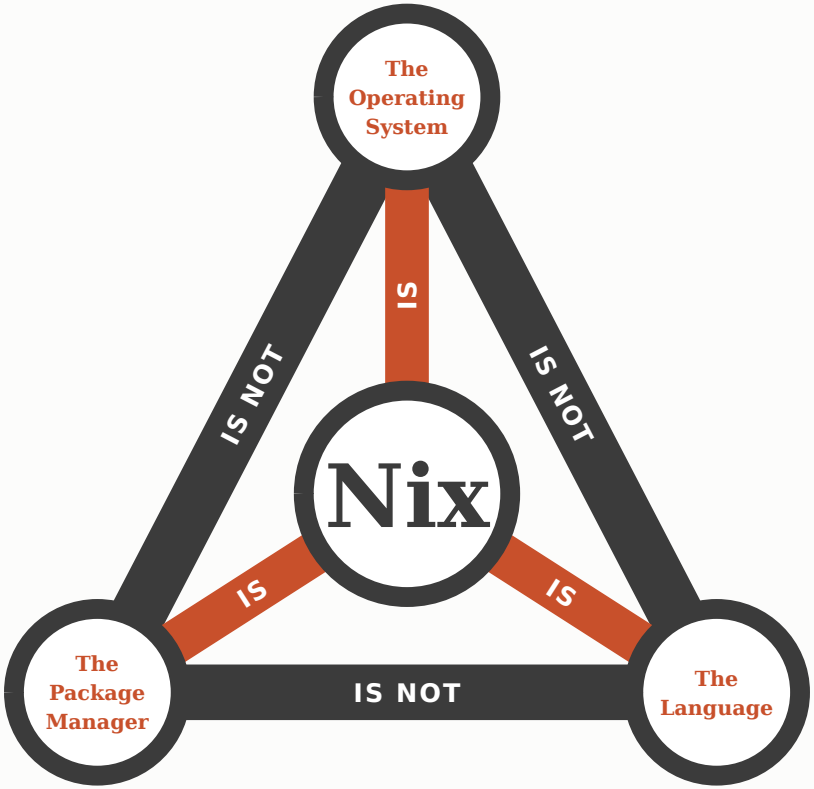
Nix Build System

Nix Stores

Nix Command Line Tools

Developer Environments

The declarative trinity



Source: Understand NixOS, redrawn

Under the hood

How does any of this actually work?

A story about Ruby

```
> ls /usr/bin/ruby*
/usr/bin/ruby  /usr/bin/ruby3.0  /usr/bin/ruby3.1
```

A story about Ruby

```
> ls /usr/bin/ruby*
/usr/bin/ruby  /usr/bin/ruby3.0  /usr/bin/ruby3.1


> /usr/bin/ruby3.1 --version
ruby 3.1.2p20 (2022-04-12 revision 4491bb740a) [x86_64-linux-gnu]
```

Building Ruby

1. Install the prerequisite dependencies for building the CRuby interpreter:
   - C compiler

   For RubyGems, you will also need:
   - `OpenSSL` 1.1.x or 3.0.x / LibreSSL
   - libyaml 0.1.7 or later
   - zlib

   If you want to build from the git repository, you will also need:
   - autoconf - 2.67 or later
   - gperf - 3.1 or later
     - Usually unneeded; only if you edit some source files using gperf
   - ruby - 2.5 or later
     - We can upgrade this version to system ruby version of the latest Ubuntu LTS.
2. Install optional, recommended dependencies:
   - libffi (to build fiddle)
   - gmp (if you wish to accelerate Bignum operations)
   - libexecinfo (FreeBSD)
   - rustc - 1.58.0 or later, if you wish to build YJIT.

From Ruby's building_ruby.md

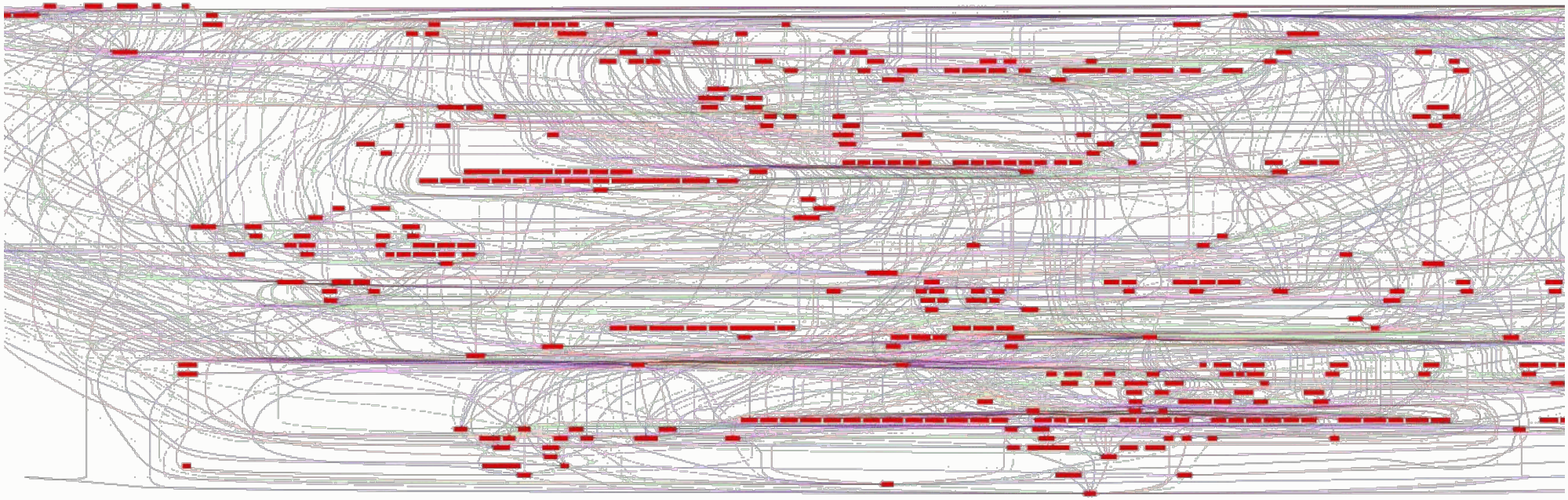
What does it actually load?

```
> libtree /usr/bin/ruby3.1 -p
/usr/bin/ruby3.1
├── /lib/x86_64-linux-gnu/libruby-3.1.so.3.1
│   ├── /lib/x86_64-linux-gnu/libz.so.1
│   ├── /lib/x86_64-linux-gnu/libcrypt.so.1
│   └── /lib/x86_64-linux-gnu/libgmp.so.10
├── /lib/x86_64-linux-gnu/libcrypt.so.1
├── /lib/x86_64-linux-gnu/libgmp.so.10
└── /lib/x86_64-linux-gnu/libz.so.1
```

…and everything it loads, loads

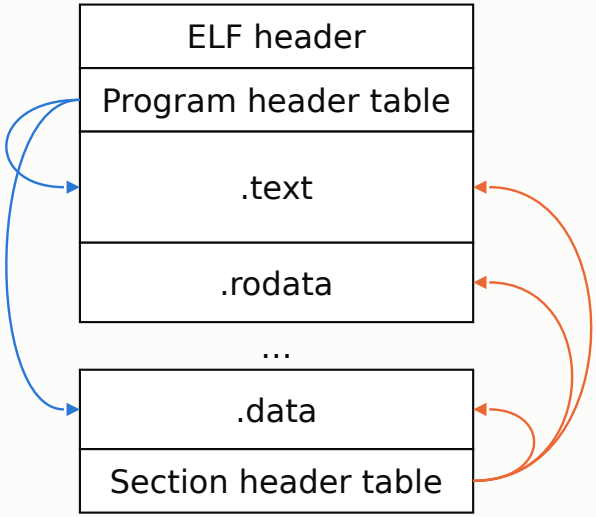
```
> libtree /usr/bin/ruby3.1 -vvv
/usr/bin/ruby3.1
├── libruby-3.1.so.3.1 [ld.so.conf]
│   ├── libz.so.1 [ld.so.conf]
│   │   └── libc.so.6 [ld.so.conf]
│   │       └── ld-linux-x86-64.so.2 [ld.so.conf]
│   ├── ld-linux-x86-64.so.2 [ld.so.conf]
│   ├── libc.so.6 [ld.so.conf]
│   │   └── ld-linux-x86-64.so.2 [ld.so.conf]
│   ├── libm.so.6 [ld.so.conf]
│   │   ├── libc.so.6 [ld.so.conf]
│   │   │   └── ld-linux-x86-64.so.2 [ld.so.conf]
│   │   └── ld-linux-x86-64.so.2 [ld.so.conf]
│   ├── libcrypt.so.1 [ld.so.conf]
│   │   └── libc.so.6 [ld.so.conf]
│   │       └── ld-linux-x86-64.so.2 [ld.so.conf]
│   └── libgmp.so.10 [ld.so.conf]
│       └── libc.so.6 [ld.so.conf]
│           └── ld-linux-x86-64.so.2 [ld.so.conf]
│
├── libc.so.6 [ld.so.conf]
│   └── ld-linux-x86-64.so.2 [ld.so.conf]
├── libm.so.6 [ld.so.conf]
│   ├── libc.so.6 [ld.so.conf]
│   │   └── ld-linux-x86-64.so.2 [ld.so.conf]
│   └── ld-linux-x86-64.so.2 [ld.so.conf]
├── libcrypt.so.1 [ld.so.conf]
│   └── libc.so.6 [ld.so.conf]
│       └── ld-linux-x86-64.so.2 [ld.so.conf]
├── libgmp.so.10 [ld.so.conf]
│   └── libc.so.6 [ld.so.conf]
│       └── ld-linux-x86-64.so.2 [ld.so.conf]
└── libz.so.1 [ld.so.conf]
    └── libc.so.6 [ld.so.conf]
        └── ld-linux-x86-64.so.2 [ld.so.conf]
```

Ruby, as Nix sees it



```
> nix-store --query --include-outputs --graph \
$(nix-store --query --deriver $(nix eval nixpkgs#ruby.outPath --raw))
```

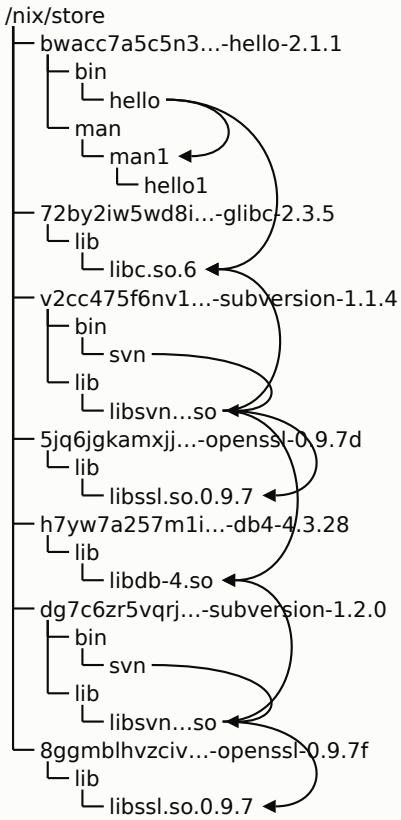
Quick primer: what’s a binary?




```
$ readelf -a $(which ruby) | grep NEEDED
 0x0000000000000001 (NEEDED)   Shared library: [libruby-2.7.so.2.7]
 0x0000000000000001 (NEEDED)   Shared library: [libc.so.6]
$ readelf -a libruby-2.7.so.2.7 | grep NEEDED
 0x0000000000000001 (NEEDED)   Shared library: [libpthread.so.0]
 0x0000000000000001 (NEEDED)   Shared library: [librt.so.1]
 0x0000000000000001 (NEEDED)   Shared library: [libgmp.so.10]
 0x0000000000000001 (NEEDED)   Shared library: [libdl.so.2]
 0x0000000000000001 (NEEDED)   Shared library: [libcrypt.so.1]
 0x0000000000000001 (NEEDED)   Shared library: [libm.so.6]
 0x0000000000000001 (NEEDED)   Shared library: [libc.so.6]
 0x0000000000000001 (NEEDED)   Shared library: [ld-linux-x86-64.so.2]
```

Source: Surueña, CC BY-SA 3.0, redrawn

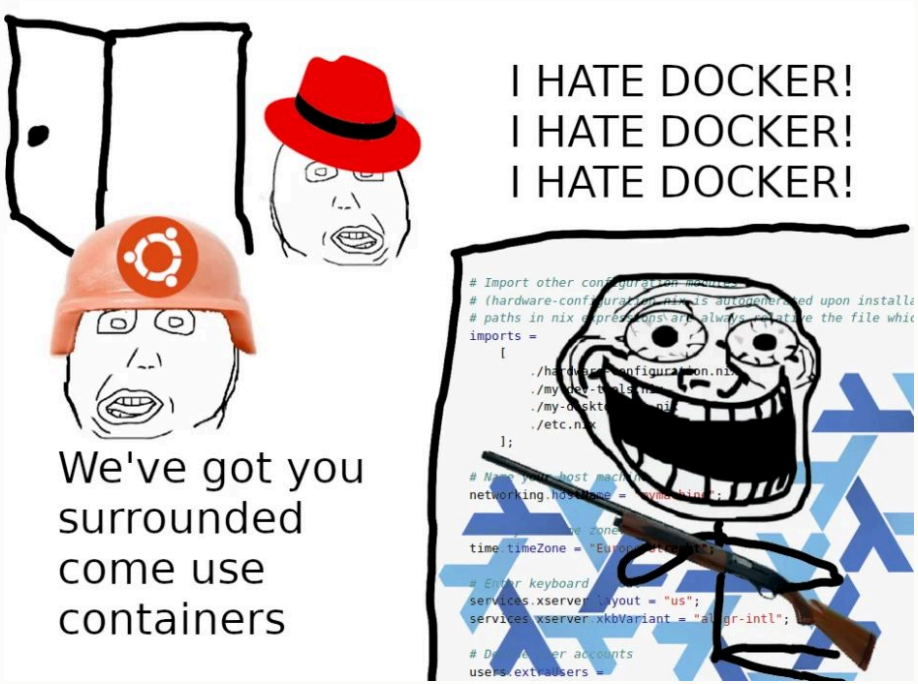
An alternative to the FHS model




```
$ patchelf --print-rpath ruby | tr ':' '\n'
/nix/store/yyhykbfxj6jfc62x4f9a2awfbch605fd-ruby-2.6.6/lib
/nix/store/6hhqb94ilrdmh0cx5bhdqb92m6bqkvdj-zlib-1.2.11/lib
/nix/store/90illc73xfs933d06daq6d41njs8yh66-glibc-2.32-37/
```

Source: Eelco Dolstra, *The Purely Functional Software Deployment Model* (2006), redrawn

When you discover NixOS



https://www.reddit.com/r/NixOS/comments/p132mz/when_you_discover_nixos/

Fin.

Thank you!

fzakaria.github.io/learn-nix-the-fun-way

fzakaria.com/2024/07/05/learn-nix-the-fun-way.html