Functional programming, Seminar No. 1

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General words on Haskell

- The language is named after Haskell Curry, an American logician
- The first implementation: 1990
- The language standard: Haskell2010
- Default compiler: Glasgow Haskell compiler
- Haskell is a strongly-typed, polymorphic, and purely functional programming language

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- Vox populi:

Chris Burnor
@chrisburnor

Is Haskell the Rick and Morty of programming languages? 🤔 twitter.com/thejameskyle/s...

The Haskell Platform installation

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Choose any way you prefer. All these ways are equivalent to each other.

I'm a Mac user, but I believe that you'll manage to install the Haskell Platform on NixOs/Windows/Linux/etc quite quickly.

GHC

- GHC is a default Haskell compiler as we told above
- GHC is an open-source project. Don't hesitate to contribute!
- GHC is mostly implemented on Haskell
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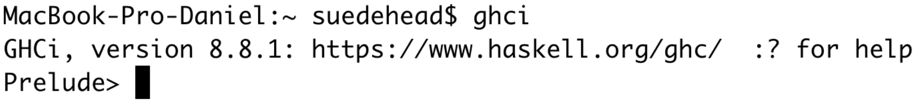
- GHC is an open-source project. Don't hesitate to contribute!
- GHC is mostly implemented on Haskell
- GHC is developed under the GHC Steering committee control
- Very roughly, compiling pipeline is arranged as follows:
  parsing ⇒ compile-time (type-checking mostly) ⇒ runtime (program execution)

GHCi

- GHCi is a Haskell interpreter based on GHC
- One may run GHCi with a quite simple command `ghci` on a shell
- You play with GHCi as a calculator, the ordinary arithmetical operators are written in a usual way
- Take a look at the GHCi chapter in the GHC User's Guide to be familiar with GHCi closely



```
MacBook-Pro-Daniel:~ suedehead$ ghci
GHCi, version 8.8.1: https://www.haskell.org/ghc/  :? for help
Prelude> █
```

Cabal

- Cabal is a system of library and dependency management
- A `.cabal` file describes the version of a package and its dependencies
- Cabal is also a packaging tool
- Keep in mind that Cabal is known as a reason of so-called dependency hell

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That's how this dependency hell might look like:

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- Stack allows one to
  - install packages and version of GHC (and their concrete versions) you need
  - build, execute, and test projects
  - reproduce builds
  - create an isolated location

Snapshots

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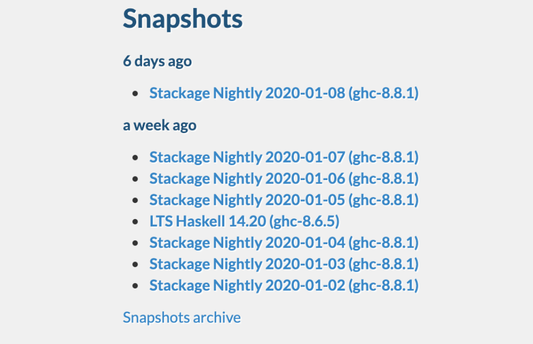
- Snapshot is a curated package set used by Stack
- Stackage is a stable repository that stores snapshots
- Resolver is a reference to a required snapshot
- Let us take a look at the screenshot from Stackage:



Snapshots

6 days ago

- Stackage Nightly 2020-01-08 (ghc-8.8.1)

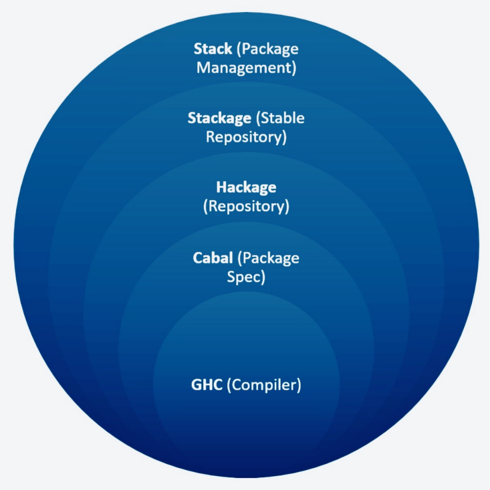
a week ago

- Stackage Nightly 2020-01-07 (ghc-8.8.1)
- Stackage Nightly 2020-01-06 (ghc-8.8.1)
- Stackage Nightly 2020-01-05 (ghc-8.8.1)
- LTS Haskell 14.20 (ghc-8.6.5)
- Stackage Nightly 2020-01-04 (ghc-8.8.1)
- Stackage Nightly 2020-01-03 (ghc-8.8.1)
- Stackage Nightly 2020-01-02 (ghc-8.8.1)

Snapshots archive

Ecosystem encapsulation

The Haskell ecosystem encapsulation might be described as the following sequence:



Creating a Haskell project via Stack

- Figure out how to call your project and run the script `stack new <projectname>`
- You will see the following story after the command `tree .` in the project directory:

Creating a Haskell project via Stack

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```
MacBook-Pro-Daniel:myFirstProject suedehead$ tree .
.
├── ChangeLog.md
├── LICENSE
├── README.md
├── Setup.hs
├── app
│   └── Main.hs
├── myFirstProject.cabal
├── package.yaml
├── src
│   └── Lib.hs
├── stack.yaml
└── test
    └── Spec.hs

3 directories, 10 files
```

stack.yaml

Let us discuss dependencies files in a Haskell project. First of all, we observe the stack.yaml file:

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```
resolver: lts-14.19

# User packages to be built.
# Various formats can be used as shown in the example below.
#
# packages:
# - some-directory
# - https://example.com/foo/bar/baz-0.0.2.tar.gz
#   subdirs:
#   - auto-update
#   - wai
packages:
- .

# extra-deps:
# - acme-missiles-0.3
# - git: https://github.com/commercialhaskell/stack.git
#   commit: e7b331f14bcffb8367cd58fbfc8b40ec7642100a
#
# extra-deps: []
```

Cabal file

As we told above, the `.cabal` file describe the relevant version of a project and its dependencies:

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```
cabal-version: 1.12
name:           myFirstProject
version:        0.1.0.0
description:    Please see the README on GitHub at <https://github.com/githubuser/myFirstProject#readme>
homepage:       https://github.com/githubuser/myFirstProject#readme
bug-reports:    https://github.com/githubuser/myFirstProject/issues
author:         Author name here
maintainer:     example@example.com
copyright:      2020 Author name here
license:        BSD3
license-file:   LICENSE
build-type:     Simple
extra-source-files:
    README.md
    ChangeLog.md

source-repository head
  type: git
  location: https://github.com/githubuser/myFirstProject

library
```

package.yaml

The package.yaml generates automatically from the stack.yaml and .cabal files:

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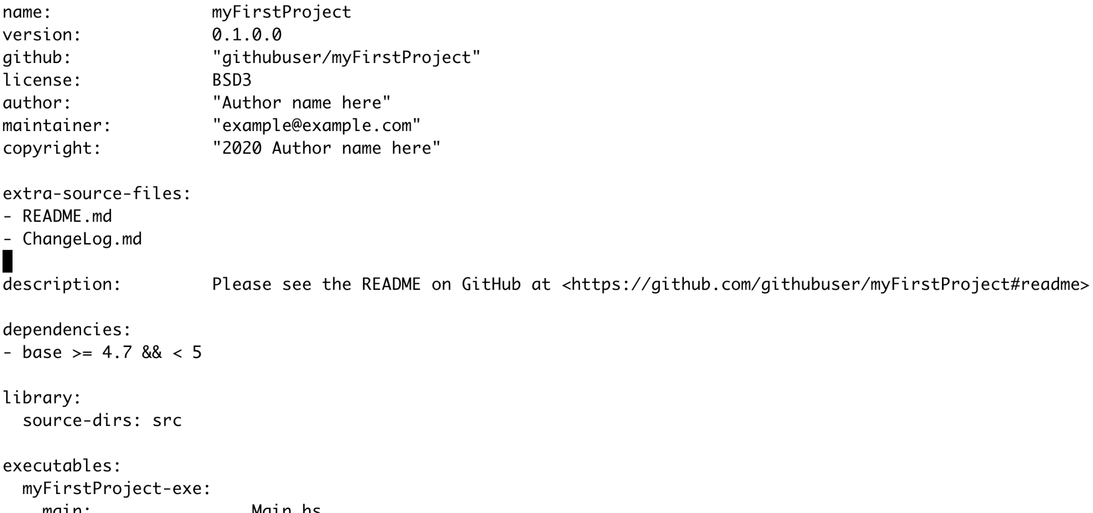

```
name:                myFirstProject
version:             0.1.0.0
github:              "githubuser/myFirstProject"
license:             BSD3
author:              "Author name here"
maintainer:          "example@example.com"
copyright:           "2020 Author name here"

extra-source-files:
- README.md
- ChangeLog.md

description:         Please see the README on GitHub at <https://github.com/githubuser/myFirstProject#readme>

dependencies:
- base >= 4.7 && < 5

library:
  source-dirs: src

executables:
  myFirstProject-exe:
    main:                Main.hs
```

Building and running a project

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- `stack run`
- `stack exec`
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The roles of these commands follow from their quite self-explanatory names.

Hackage

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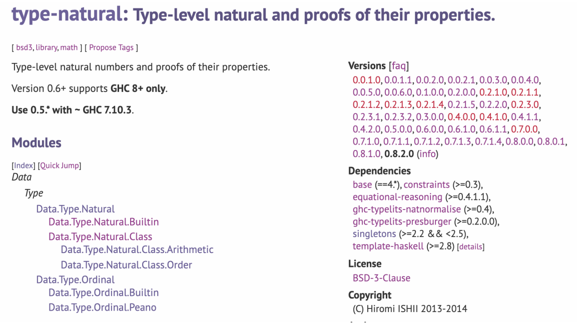

type-natural: Type-level natural and proofs of their properties.

[bsd3, library, math] [Propose Tags]

Type-level natural numbers and proofs of their properties.

Version 0.6+ supports **GHC 8+ only**.

Use 0.5.* with ~ GHC 7.10.3.

Modules

[Index] [Quick Jump]

Data
- *Type*
  - Data.Type.Natural
    - Data.Type.Natural.Builtin
    - Data.Type.Natural.Class
      - Data.Type.Natural.Class.Arithmetic
      - Data.Type.Natural.Class.Order
  - Data.Type.Ordinal
    - Data.Type.Ordinal.Builtin
    - Data.Type.Ordinal.Peano

Versions [faq]
0.0.1.0, 0.0.1.1, 0.0.2.0, 0.0.2.1, 0.0.3.0, 0.0.4.0, 0.0.5.0, 0.0.6.0, 0.1.0.0, 0.2.0.0, 0.2.1.0, 0.2.1.1, 0.2.1.2, 0.2.1.3, 0.2.1.4, 0.2.1.5, 0.2.2.0, 0.2.3.0, 0.2.3.1, 0.2.3.2, 0.3.0.0, 0.4.0.0, 0.4.1.0, 0.4.1.1, 0.4.2.0, 0.5.0.0, 0.6.0.0, 0.6.1.0, 0.6.1.1, 0.7.0.0, 0.7.1.0, 0.7.1.1, 0.7.1.2, 0.7.1.3, 0.7.1.4, 0.8.0.0, 0.8.0.1, 0.8.1.0, **0.8.2.0** (info)

Dependencies
base (==4.*), constraints (>=0.3), equational-reasoning (>=0.4.1.1), ghc-typelits-natnormalise (>=0.4), ghc-typelits-presburger (>=0.2.0.0), singletons (>=2.2 && <2.5), template-haskell (>=2.8) [details]

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Hoogle

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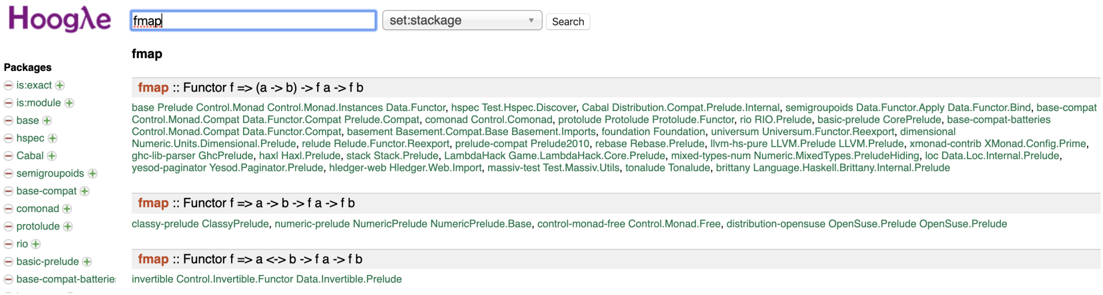

fmap | set:stackage ▾ | Search

fmap

Packages

- ⊖ is:exact ⊕
- ⊖ is:module ⊕
- ⊖ base ⊕
- ⊖ hspec ⊕
- ⊖ Cabal ⊕
- ⊖ semigroupoids ⊕
- ⊖ base-compat ⊕
- ⊖ comonad ⊕
- ⊖ protolude ⊕
- ⊖ rio ⊕
- ⊖ basic-prelude ⊕
- ⊖ base-compat-batterie

fmap :: Functor f => (a -> b) -> f a -> f b

base Prelude Control.Monad Control.Monad.Instances Data.Functor, hspec Test.Hspec.Discover, Cabal Distribution.Compat.Prelude.Internal, semigroupoids Data.Functor.Apply Data.Functor.Bind, base-compat Control.Monad.Compat Data.Functor.Compat Prelude.Compat, comonad Control.Comonad, protolude Protolude Protolude.Functor, rio RIO.Prelude, basic-prelude CorePrelude, base-compat-batteries Control.Monad.Compat Data.Functor.Compat, basement Basement.Compat.Base Basement.Imports, foundation Foundation, universum Universum.Functor.Reexport, dimensional Numeric.Units.Dimensional.Prelude, relude Relude.Functor.Reexport, prelude-compat Prelude2010, rebase Rebase.Prelude, llvm-hs-pure LLVM.Prelude LLVM.Prelude, xmonad-contrib XMonad.Config.Prime, ghc-lib-parser GhcPrelude, haxl Haxl.Prelude, stack Stack.Prelude, LambdaHack Game.LambdaHack.Core.Prelude, mixed-types-num Numeric.MixedTypes.PreludeHiding, loc Data.Loc.Internal.Prelude, yesod-paginator Yesod.Paginator.Prelude, hledger-web Hledger.Web.Import, massiv-test Test.Massiv.Utils, tonalude Tonalude, brittany Language.Haskell.Brittany.Internal.Prelude

fmap :: Functor f => a -> b -> f a -> f b

classy-prelude ClassyPrelude, numeric-prelude NumericPrelude NumericPrelude.Base, control-monad-free Control.Monad.Free, distribution-opensuse OpenSuse.Prelude OpenSuse.Prelude

fmap :: Functor f => a <-> b -> f a -> f b

invertible Control.Invertible.Functor Data.Invertible.Prelude

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We observed today such topics as

1. General aspects of GHC and GHCi
2. The Haskell Platform installation
3. Dependency management via Stack and Cabal

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On the next seminar, we will discuss:

1. The basic Haskell syntax
2. The underlying aspects of the Haskell type system
3. Functions and lambdas
4. Immutability and Laziness