# Getting up, running, and contributing to GHC

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Galois, Inc.

GHC Contributors' Workshop
7 June, 2023

# About me

- Learned Haskell in 2013, now use it professionally
- First GHC contribution in 2015
- Expertise is in GHC’s frontend (`deriving`, Template Haskell, pattern matching, typechecking, etc.)

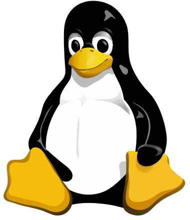
# Why contribute to GHC?

- You *can* make a difference
- Improve your understanding on the language and tools
- Your contributions help everyone (including yourself)
- It’s fun!

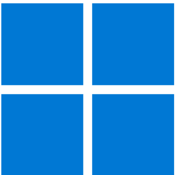
# Preparing to build GHC

**https://gitlab.haskell.org/ghc/ghc/-/wikis/building/preparation**

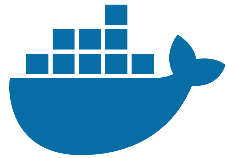
# Supported configurations


Linux

macOS


Windows

Nix


Docker

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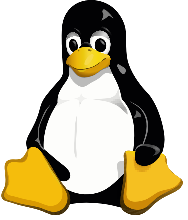

Linux

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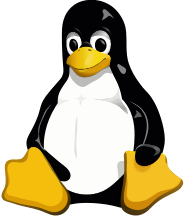

Linux

```
$ sudo apt-get install build-essential
    git autoconf python3 libgmp-dev
    libnuma-dev libncurses-dev

$ cabal v2-install alex happy

$ ghcup install ghc 9.4.5
```

# Cloning GHC

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```
$ git clone --recurse-submodules
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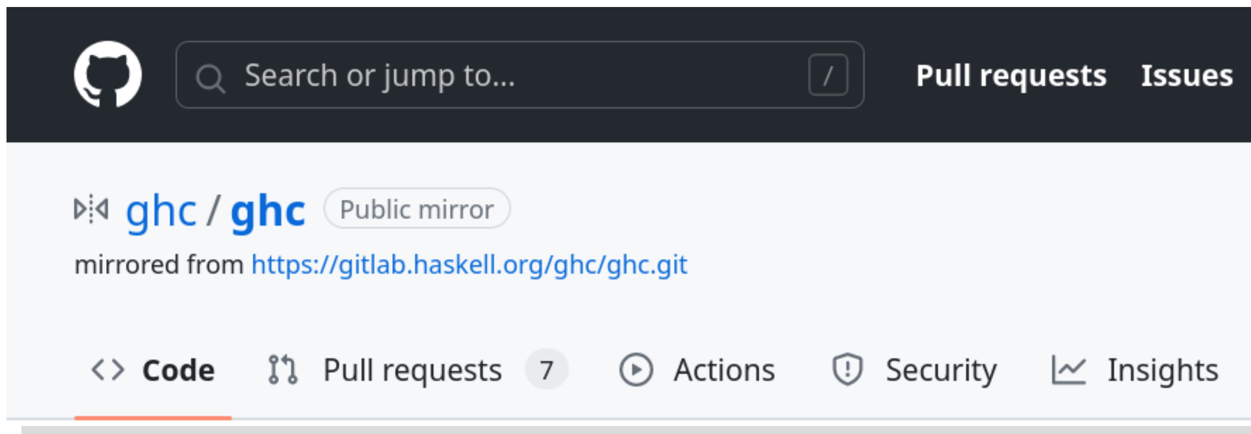

# Managing multiple GHC trees

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- Option 2: Use `git wtas` to manage multiple working trees within the same checkout:

```
$ git wtas ../ghc-my-new-feature
$ git submodule update --init
```

(`git wtas` is defined at `https://stackoverflow.com/a/31872051/388010`)

# Build system

# Hadrian

- Custom-made build system based on Shake library

- https://gitlab.haskell.org/ghc/ghc/blob/master/hadrian/README.md

# Hadrian: Your first build

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```
$ ./boot && ./configure      # run autoconf scripts, etc.
```

# Hadrian: Your first build

```
$ ./boot && ./configure --enable-tarballs-autodownload
  # Windows-only flag for downloading external dependencies
```

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```
$ ./boot && ./configure        # run autoconf scripts, etc.

$ hadrian/build -j             # build GHC with parallelism

# Go brew some coffee and wait :)

$ _build/stage1/bin/ghc --version
The Glorious Glasgow Haskell Compilation System, version
9.7.20230430
```

# Hadrian: Using GHCi

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```
$ _build/stage1/bin/ghci
```

```
$ ls _build/stage1/bin
ghc   ghc-pkg   haddock   hp2ps   hpc   hsc2hs   runghc
```

# Hadrian: Using GHCi

```
$ _build/stage1/bin/ghci
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```
$ ls _build/stage1/bin
ghc   ghc-pkg   haddock   hp2ps   hpc   hsc2hs   runghc

$ _build/stage1/bin/ghc --interactive
```

# Hadrian: Build stages

| Stage 0 | Stage 1 | Stage 2 | Stage 3 |
| --- | --- | --- | --- |
| | | | |

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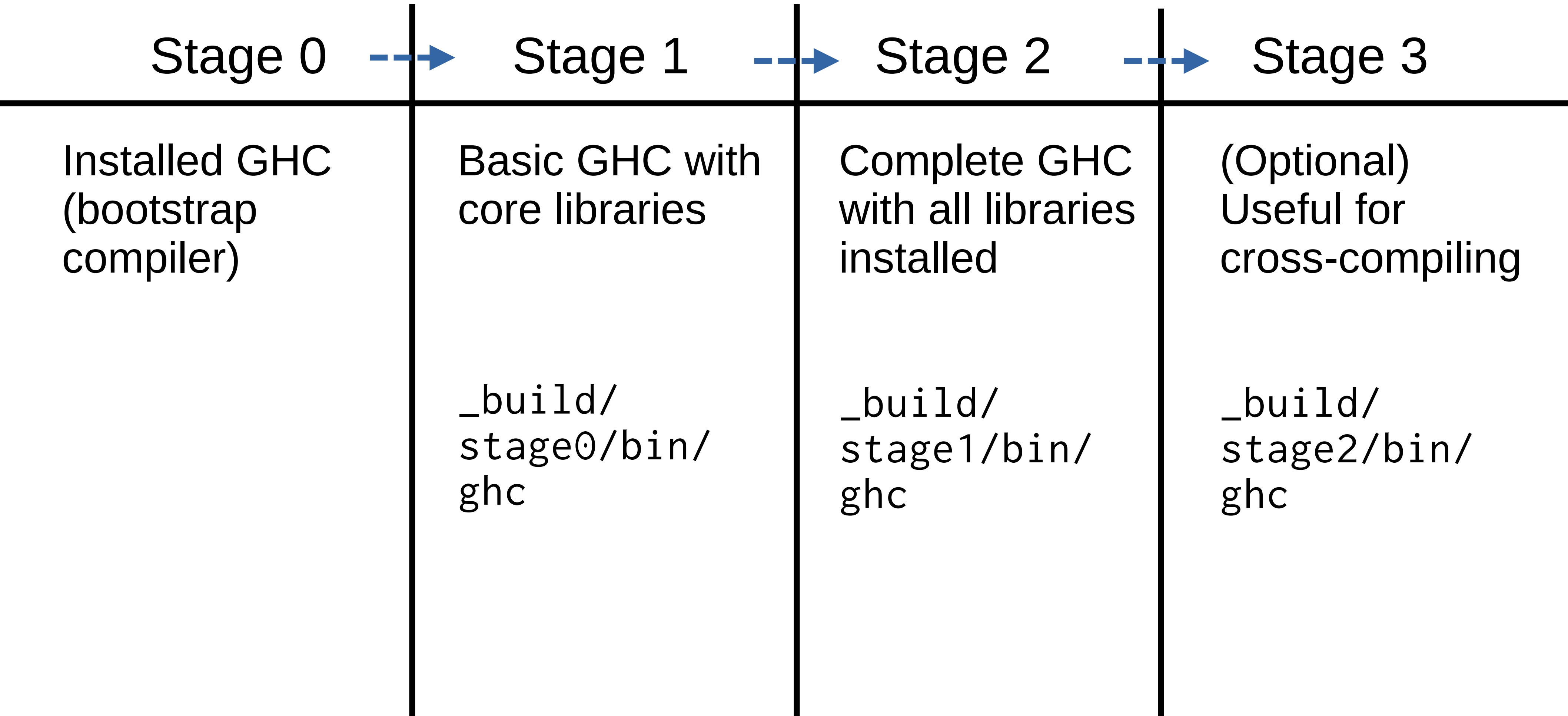

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**The “u” in “flavour” is mandatory!**

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```
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# Hadrian: User settings

- Specify flavour to use on every Hadrian invocation by copying the file:

  `hadrian/src/UserSettings.hs`

  To:

  `hadrian/UserSettings.hs`

# Hadrian: Save yourself some time

`--freeze1`: Once stage-1 GHC is built, do not rebuild it on subsequent invocation of Hadrian

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`hadrian/ghci`: Load GHC's source code into GHCi session

- Useful for fast development feedback
- Note that code is only typechecked, not compiled, so you cannot run GHC itself this way

# Hadrian: Running the test suite

```
$ hadrian/build test
```

# Hadrian: Running the test suite

```
$ hadrian/build test

$ hadrian/build test --only="test1 test2"
```

# Hadrian: Haskell Language Server (HLS)

- GHC’s source code generally Just Works™ with HLS
- Loading the GHC source code into HLS for the first time can take a while, so you can use this to “pre-build” it:

```
$ hadrian/build --build-root=.hie-bios --flavour=ghc-in-ghci
    --docs=none -j tool:ghc/Main.hs
```

# Code overview

```
$ tree ghc -L 1 -d
ghc
├── compiler
├── docs
├── ghc
├── hadrian
├── libraries
├── nofib
├── rts
├── testsuite
└── utils
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compiler: Where most of GHC’s source code lives

ghc: Where the `ghc` binary source code lives

hadrian: Build system

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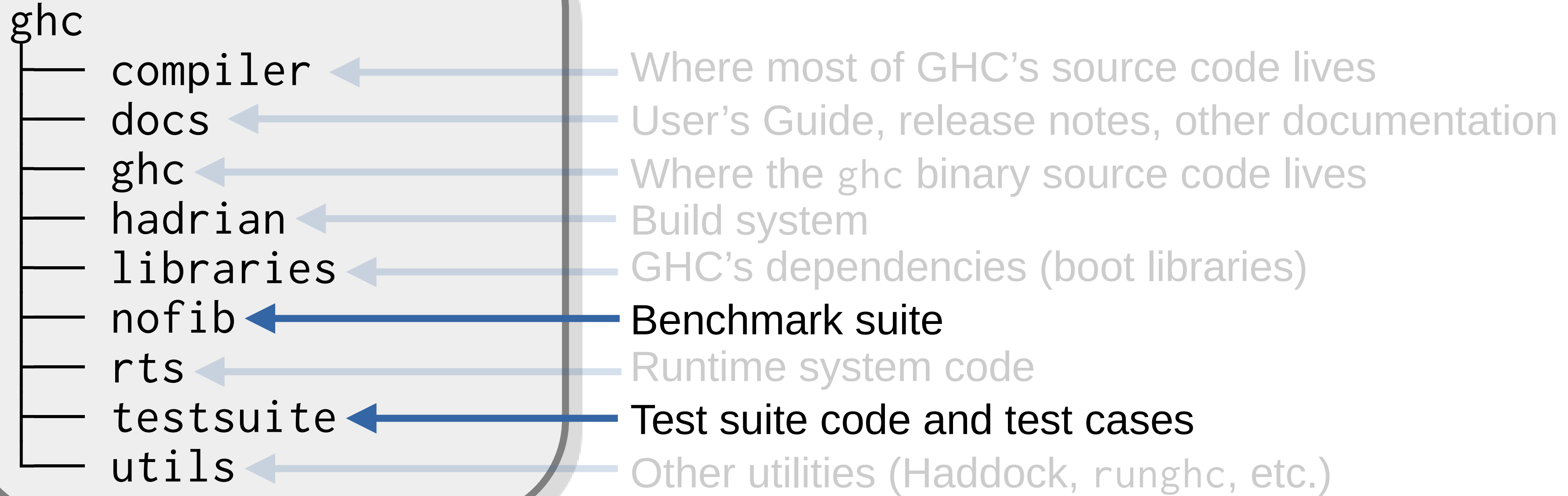
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Where most of GHC's source code lives
User's Guide, release notes, other documentation
Where the ghc binary source code lives
Build system
GHC's dependencies (boot libraries)
Benchmark suite
Runtime system code
Test suite code and test cases
Other utilities (Haddock, runghc, etc.)

# Code style

# Capitalization conventions

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```
tcLookupRecSelParent (RnRecUpdParent { rnRecUpdCons = cons })
  = case any_con of
      PatSynName ps ->
        RecSelPatSyn <$> tcLookupPatSyn ps
      DataConName dc ->
        RecSelData . dataConTyCon <$> tcLookupDataCon dc
  where
    any_con = head $ nonDetEltsUniqSet cons
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CamelCase

- Exported identifiers

snake_case

- Non-exported identifiers
- Local identifiers (i.e., with `let` or `where`)

# Whitespace vs. semicolons

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```
doptM flag = do
  logger <- getLogger
  return (logHasDumpFlag logger flag)
```

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```haskell
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```

```haskell
getEps = do
  { env <- getTopEnv
  ; liftIO $ hscEPS env
  }
```

# Documentation conventions

- Make sure to leave enough comments for others to understand the code you contribute
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pprTyThing :: ShowSub -> TyThing -> SDoc
-- We pretty-print 'TyThing' via 'IfaceDecl'
-- See Note [Pretty printing via Iface syntax]
```

```haskell
pprIfaceDecl :: ShowSub -> IfaceDecl -> SDoc
-- NB: pprIfaceDecl is also used for pretty-printing TyThings in GHCi
--     See Note [Pretty printing via Iface syntax] in GHC.Types.TyThing.Ppr
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```
{- Note [Pretty printing via Iface syntax]
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Our general plan for pretty-printing
  - Types
  - TyCons
  - Classes
  - Pattern synonyms
  ...etc...

is to convert them to Iface syntax, and pretty-print that. For example
  - pprType converts a Type to an IfaceType, and pretty prints that.
  - pprTyThing converts the TyThing to an IfaceDecl,
    and pretty prints that.
```

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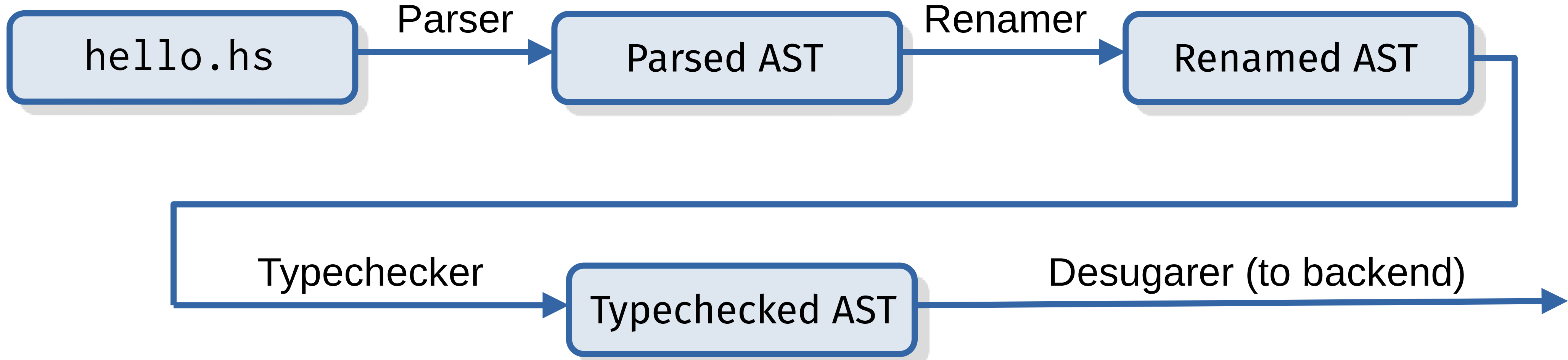
# Compiler pipeline

# Compiler pipeline (frontend)



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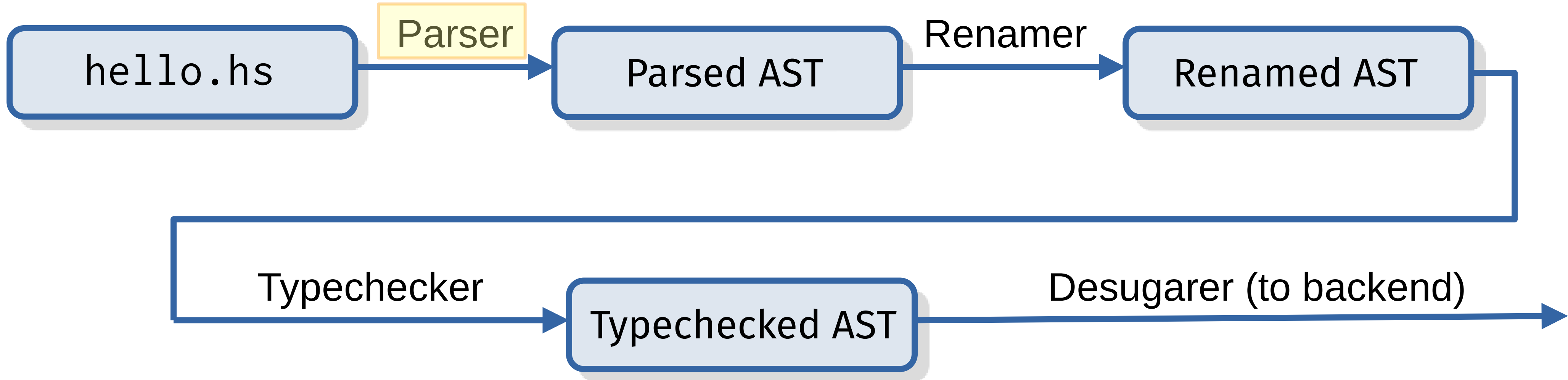

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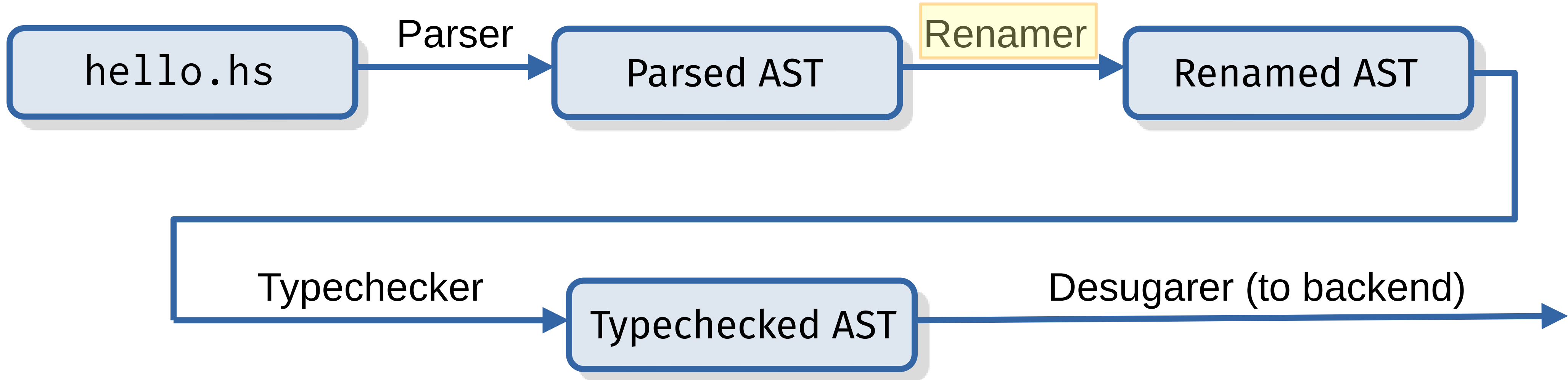

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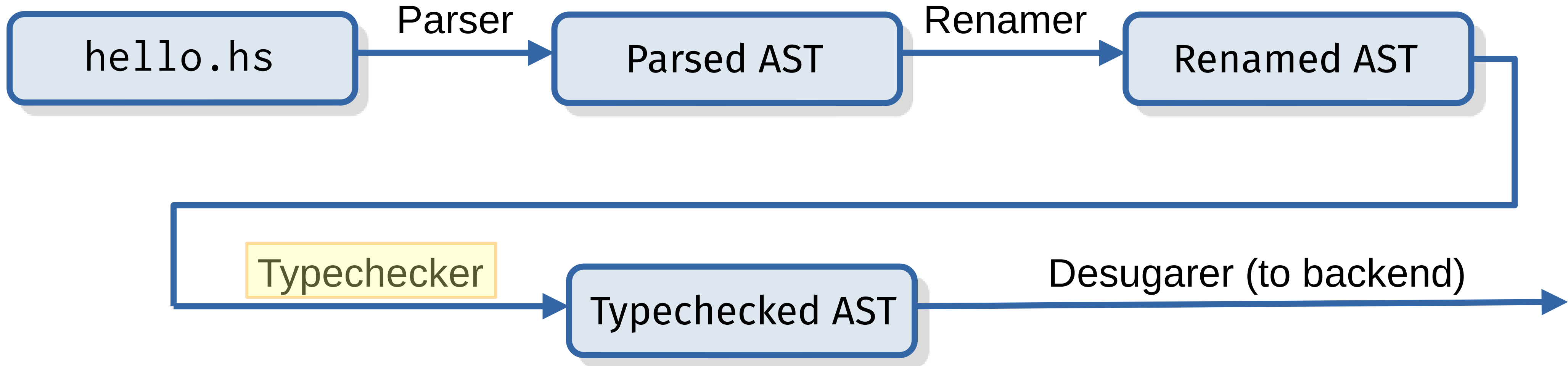

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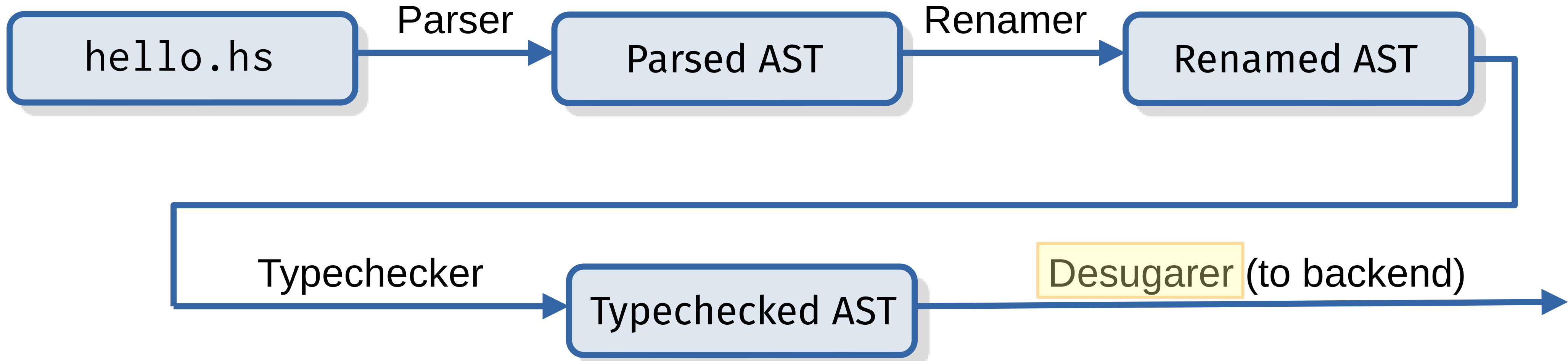

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```
data HsExpr p
  = HsVar (XVar p) (LIdP p)
  | HsApp (XApp p) (LHsExpr p) (LHsExpr p)
  | HsLam (XLam p)
          (MatchGroup p (LHsExpr p))
  | ...
```

```
data HsType p
  = HsTyVar (XTyVar p)
            PromotionFlag (LIdP p)
  | HsAppTy (XAppTy p)
            (LHsType p) (LHsType p)
  | ...
```

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  | ...
```

- The `X*` type families are explained in `Note [Trees That Grow]` in `compiler/Language/Haskell/Syntax/Extension.hs`

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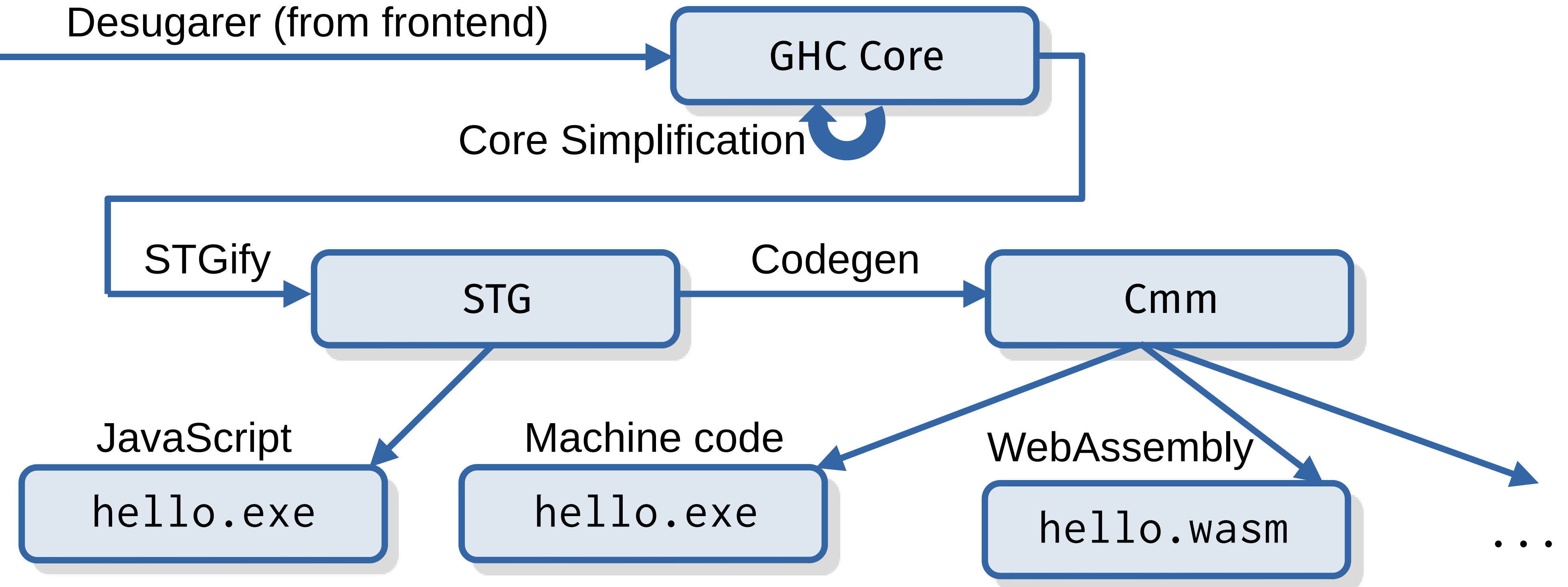

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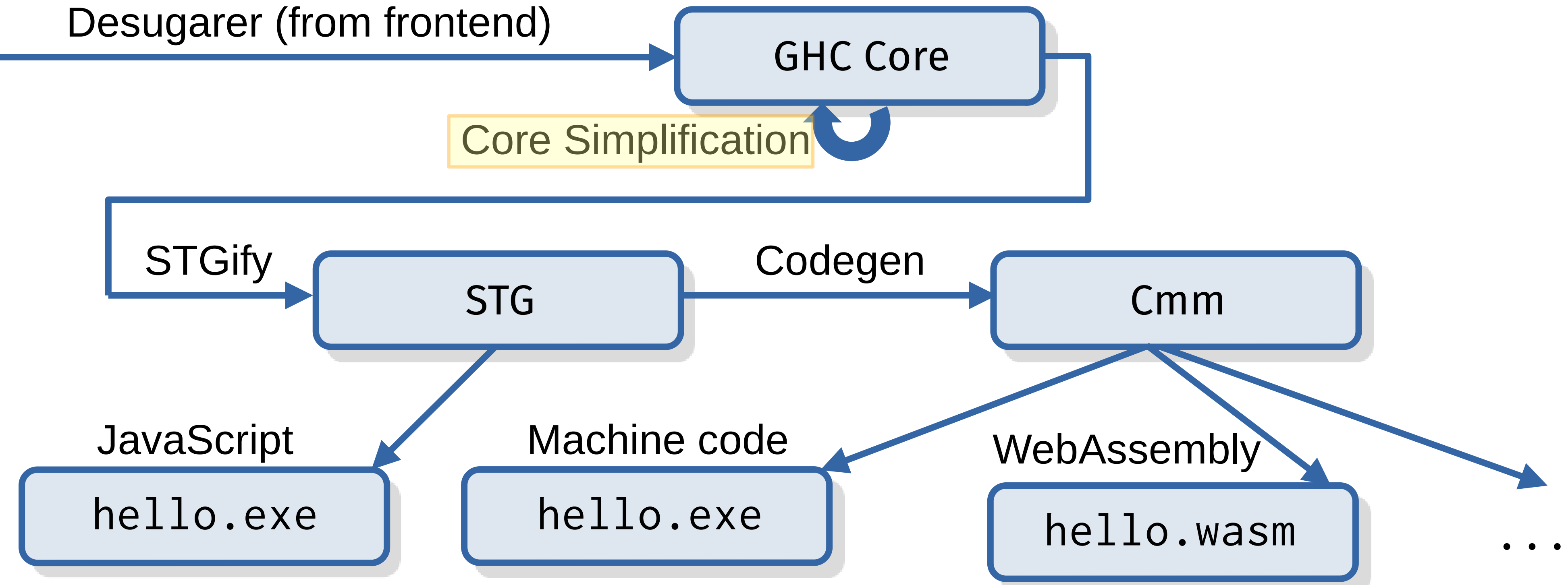

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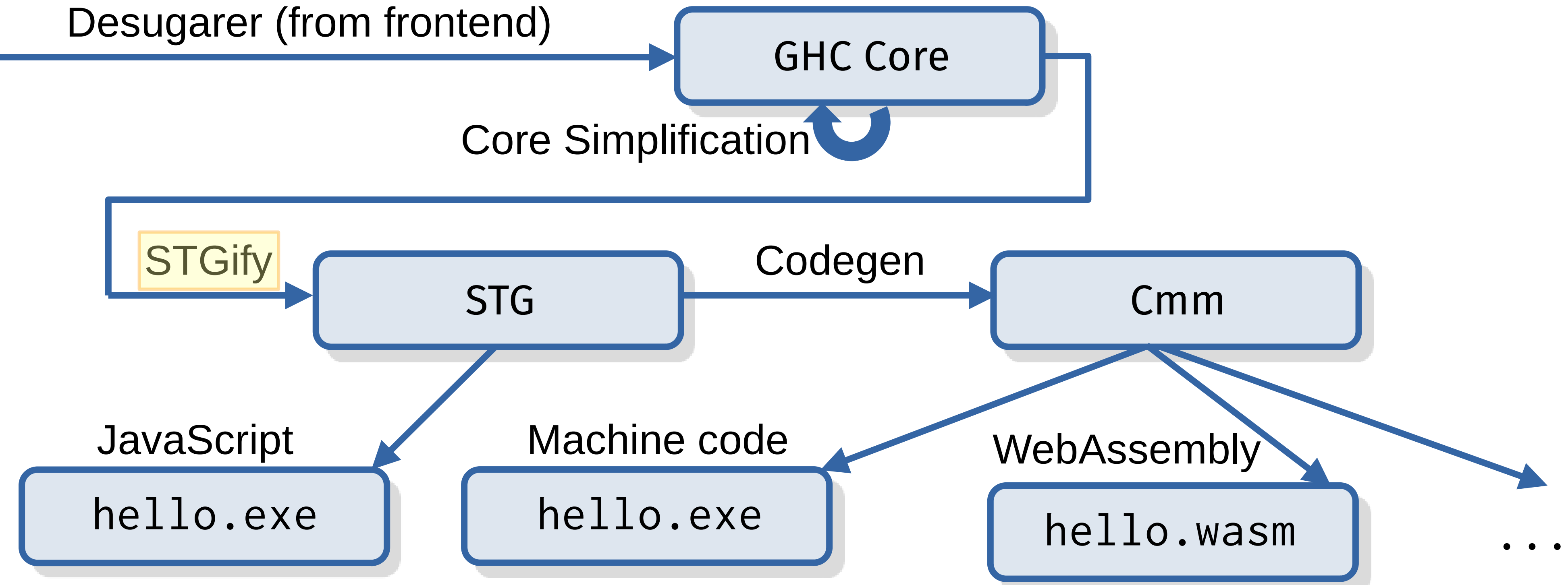

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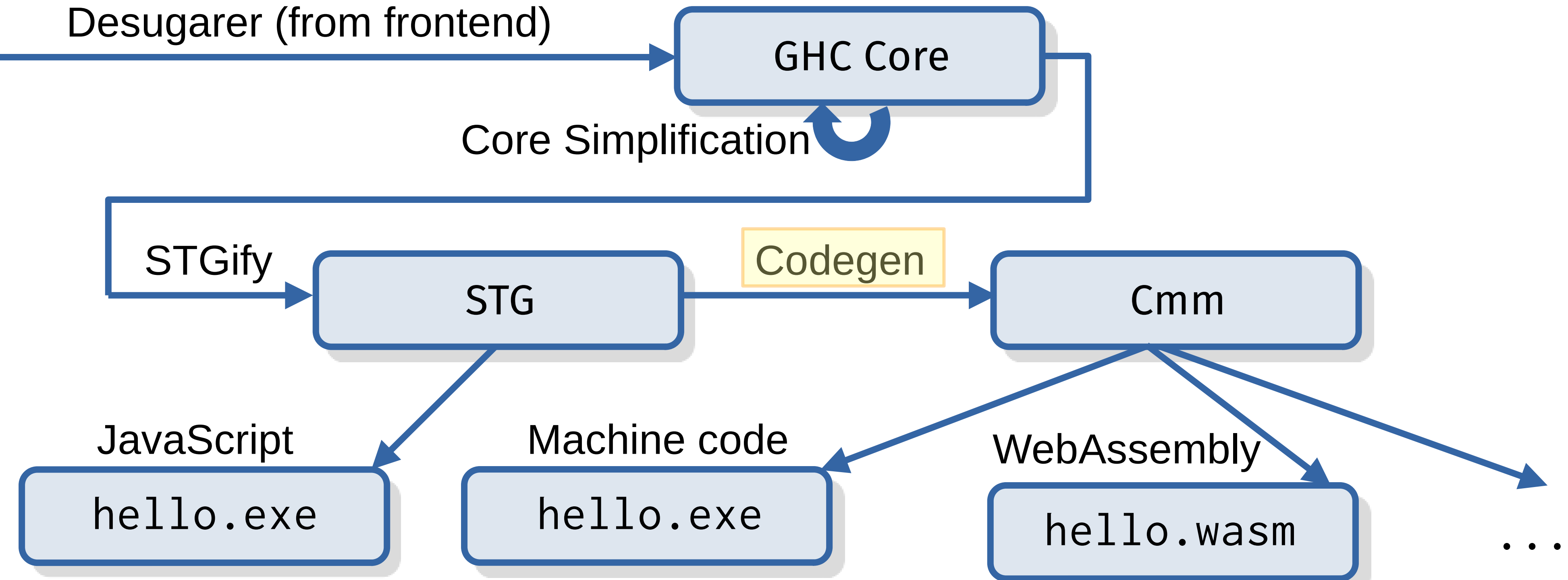

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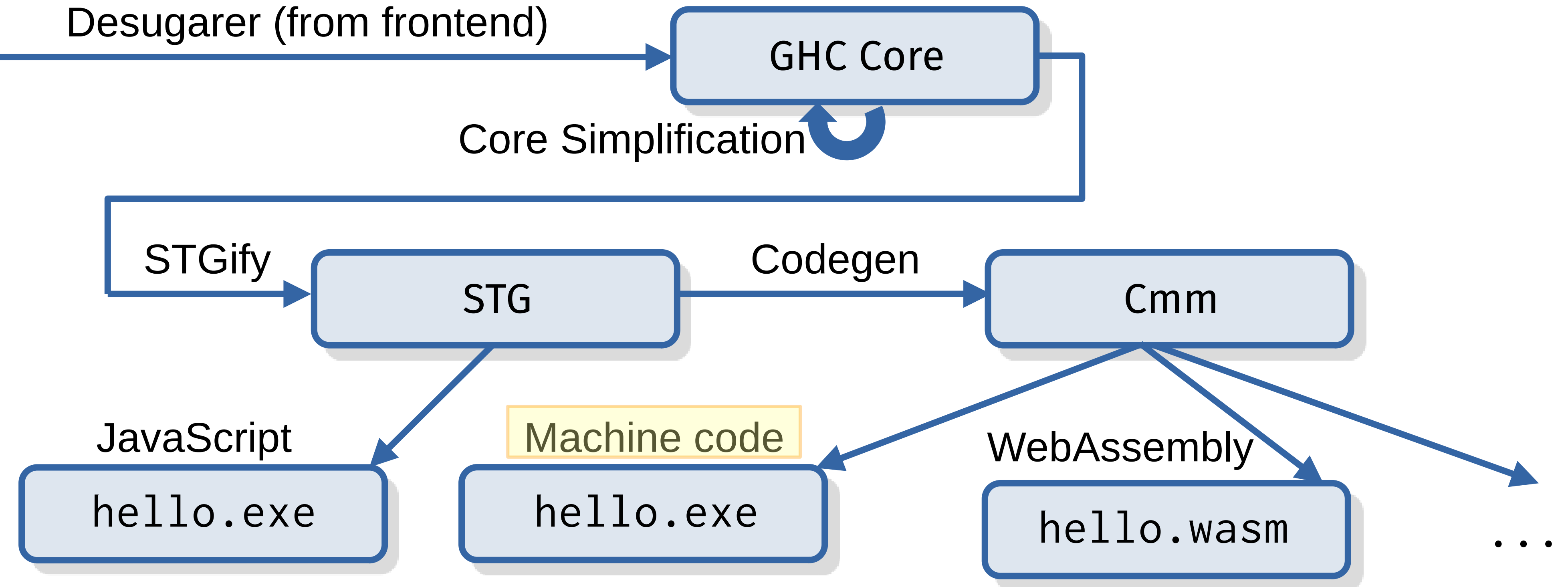

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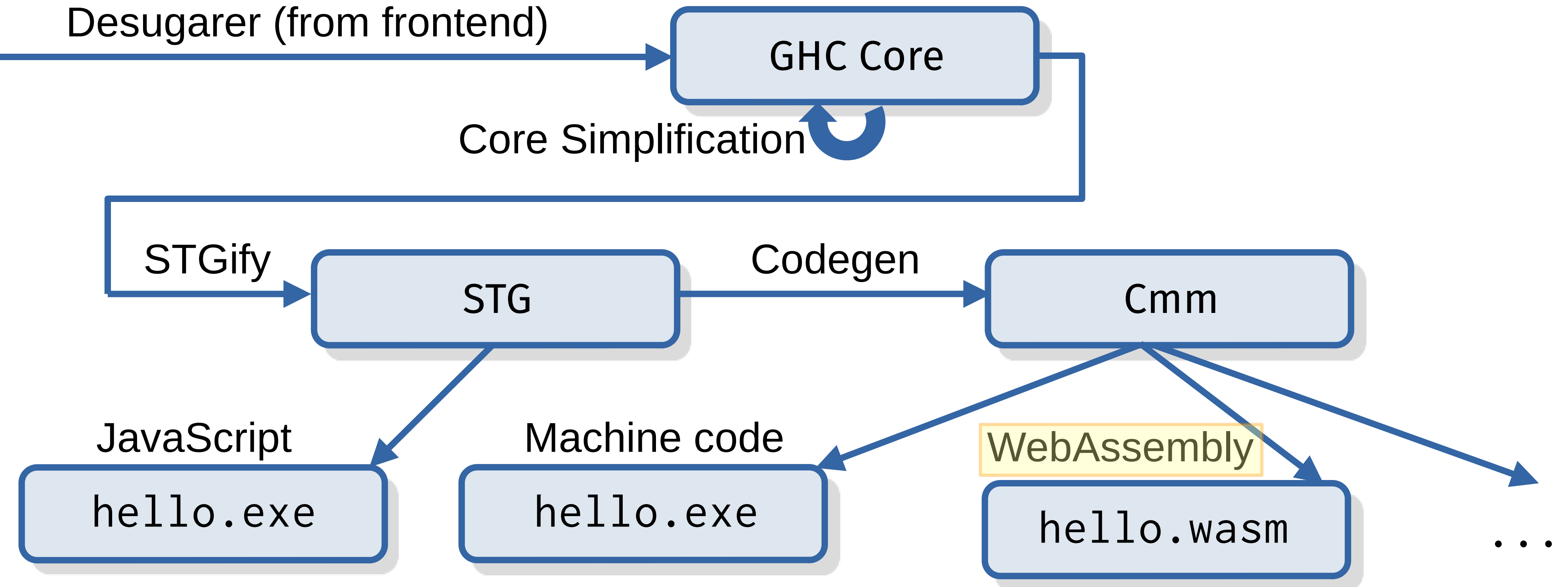

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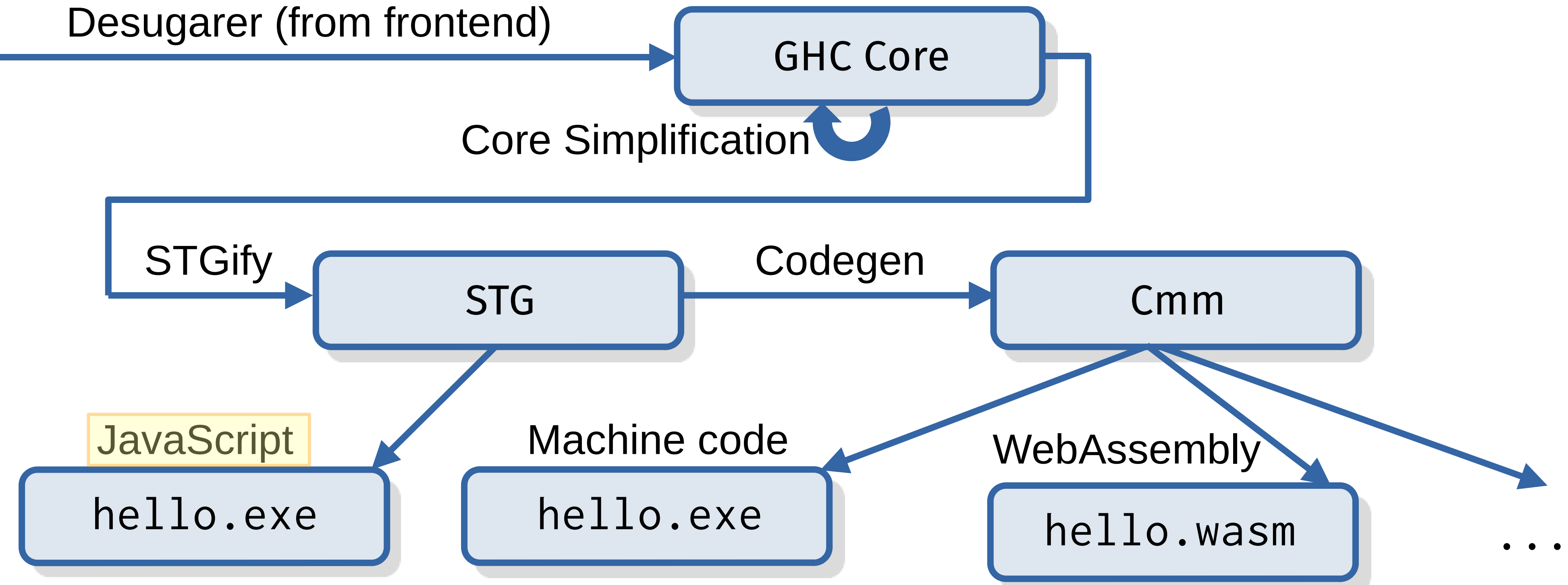

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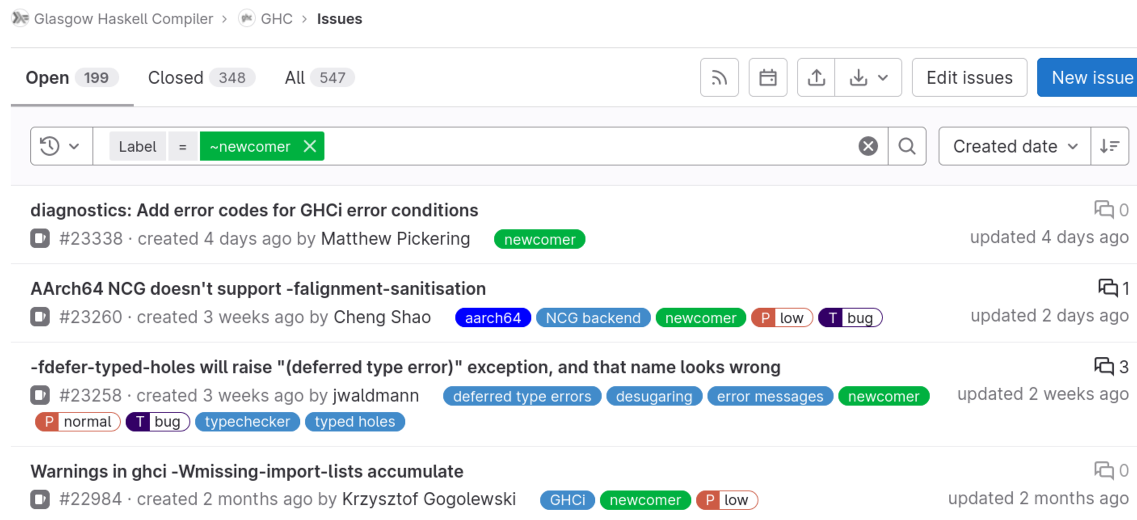
```
data Expr b
  = Var      Id                          -- x
  | Lit      Literal                     -- 27
  | App      (Expr b) (Arg b)            -- e1 e2
  | Lam      b (Expr b)                  -- \x. e
  | Let      (Bind b) (Expr b)           -- let { x = e1; ... } in e2
  | Case     (Expr b) b Type [Alt b] -- case e as x return ty of { ... }
  | Cast     (Expr b) CoercionR          -- e `cast` co
  | Tick     CoreTickish (Expr b)        -- tick<e>
  | Type     Type                        -- ty
  | Coercion Coercion                    -- co
```

# Writing your first patch

# How do I pick an issue to fix?

- Use GitLab's `~newcomer` label:




- Or, just ask one of us!

# The bug-fixing checklist

- Pick a bug, and announce you are working on it
- Add a failing test case
- Fix the bug
- Ensure that the test case now passes
- Refer to issue number in commit message
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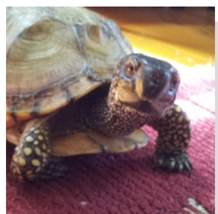
# Review process

Seek approval from at least one person from:

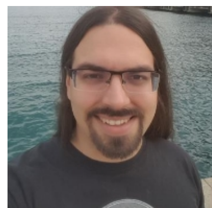
- Codeowners (see CODEOWNERS file)
- GHC maintainers



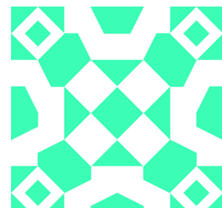
Ben
@bgamari

Matthew
@mpickering

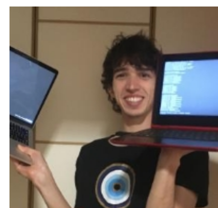
Sam
@sheaf



Andreas
@AndreasK



Zubin
@wz1000



Rodrigo
@alt-romes

# Demo time

https://gitlab.haskell.org/ghc/ghc/-/issues/22559

# Note that...

- There are other ways to contribute besides fixing bugs
  - Documentation fixes
  - Creating minimal examples

# Note that...

- There are other ways to contribute besides fixing bugs
  - Documentation fixes
  - Creating minimal examples

- If you are unsure of how to fix a bug, it can be helpful to ask for help first
  - **At the workshop**: Discord (or talk to one of us!)
  - **Any time**:
    - Ask a question on a GitLab issue
    - IRC: `#ghc` channel on Libera.Chat
    - Matrix: `https://matrix.to/#/#ghc:libera.chat` (bridges with IRC)
    - GHC devs mailing list: `http://www.haskell.org/mailman/listinfo/ghc-devs`

# Questions?