Look Ma, No Signatures!

Separate Modular Development without Interfaces

Edward Z. Yang

Look Ma, No Signatures!

How to compile mutually recursive modules without hs-boot files

Edward Z. Yang

The problem...

#1409 new feature request

Opened 8 years ago
Last modified 5 weeks ago

Allow recursively dependent modules transparently (without .hs-boot or anything)

Reported by:	Isaac Dupree	Owned by:	
Priority:	normal	Milestone:	⊥
Component:	Compiler	Version:	6.10.2
Keywords:	backpack	Cc:	dterei, pho@cielonegro.org, alfonso.acosta@gmail.com, mnislaih@gmail.com, lazycat.manatee@gmail.com, alexander.dunlap@gmail.com, id@isaac.cedarswampstudios.org, lennart@augustsson.net, ben.franksen@online.de, nr@cs.tufts.edu, ndmitchell@gmail.com, asr, explicitcall@gmail.com, kolmodin@gentoo.org, lambda-belka@yandex.ru, analytic@gmail.com, tora@zonetora.co.uk, sveina@gmail.com, ganesh, illissius@gmail.com, hackage.haskell.org@liyang.hu,

The problem...

"Manually keeping hs-boot files... is a nuisance."

"It's not a little problem."

"I absolutely hate it if I have to write a [.hs-boot] file."

"I waste too much time [fixing] import cycle[s]."

The problem?

Changed 6 years ago by simonpj — comment:15

↳ Reply ✎ Edit – Delete

Clearly a lot of people are interested in this ticket, but I'm not clear why:

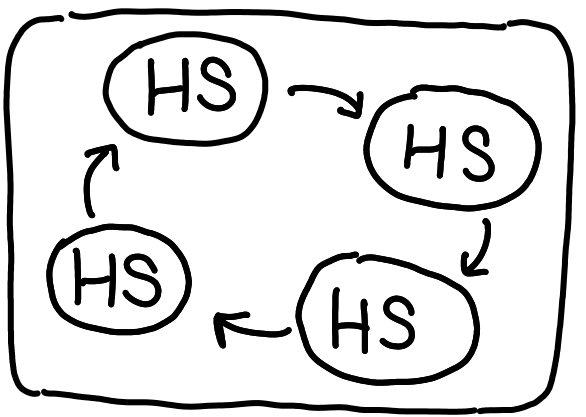
- Writing an `hs-boot` file is very like writing a module signature in ML; and that in turn is a bit like writing a type signature on a function. Why is that so bad?
- At the moment I am very un-clear about the *design* of a viable alternative. Lennart's recent suggestion comes closest; but does that meet the goals of others.

Once there is a clear motivation, and a clear design, it'll become easier to comment about how easy or difficult it is to implement.

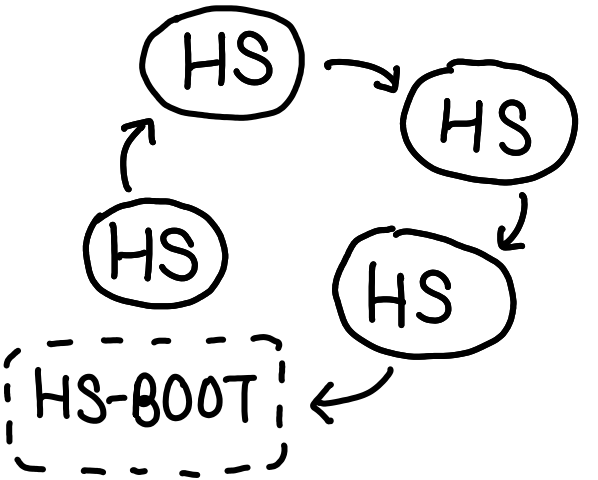
Simon

"The ML community considers it a major virtue that module signatures and implementations are sepacate."

Two design paths

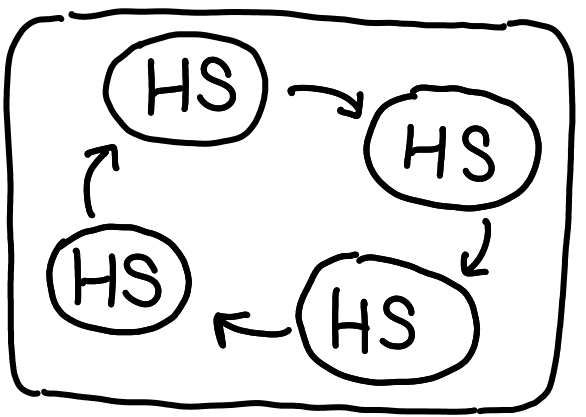


Compile SCC as one monolithic unit



Automatically infer hs-boot file

Two design paths



Compile SCC as one monolithic unit

✓ Best perfoming generated code

✗ No recompilation avoidance

✗ How does ghc -c work?

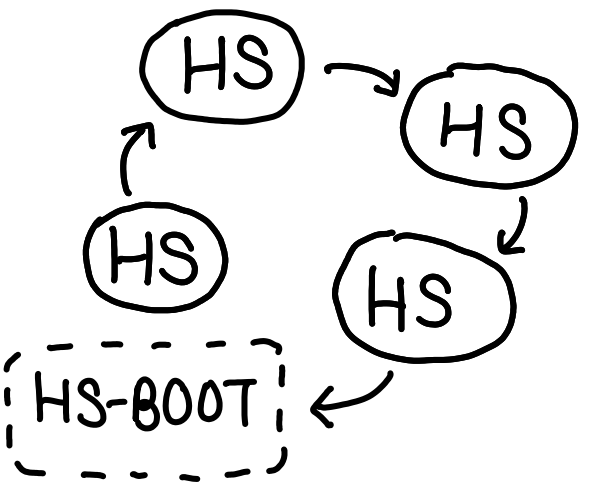
⚠ Unclear impact on GHC's architecture

Two design paths

✓ Recompilation avoidance and one-shot work

✗ Cannot inline across hs-boot

✗ How do you infer the hs-boot file?



Automatically infer hs-boot file

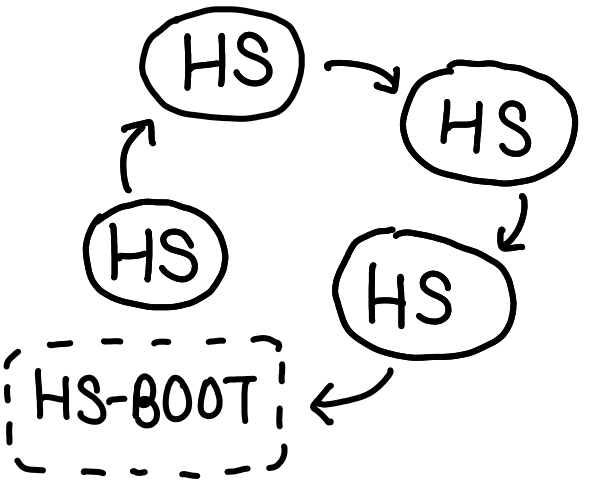
Two design paths

✓ Recompilation avoidance and one-shot work

✗ Cannot inline across hs-boot

✗ How do you infer the hs-boot file?

??



Automatically infer hs-boot file

Trouble:

```
module A where
    import B
    data A = MkA B
    fromB :: B → A
    fromB (MkB a) = a
```

```
module B where
    import A
    data B = MkB A
    fromA :: A → B
    fromA (MkA b) = b
```

assume explicit type signatures

Trouble:

```
module A where
    import B
    data A = MkA B
    fromB :: B → A
    fromB (MkB a) = a
```

Trouble:

```
module A where
    import B
    data A = MkA B
    fromB :: B → A
    fromB (MkB a) = a
```

```
--B.hs-boot
module B where

    data B = MkB A
```

Trouble:

```
module A where
    import B
    data A = MkA B
    fromB :: B → A
    fromB (MkB a) = a
```

```
--B.hs-boot
module B where

    data B = MkB A
```

hs-boot files may need to import hs-boot files

So how do we do it?

So how do we do it?

Stratification

```
module A where
    import B
    data A = MkA B
    fromB :: B → A
    fromB (MkB a) = a
```

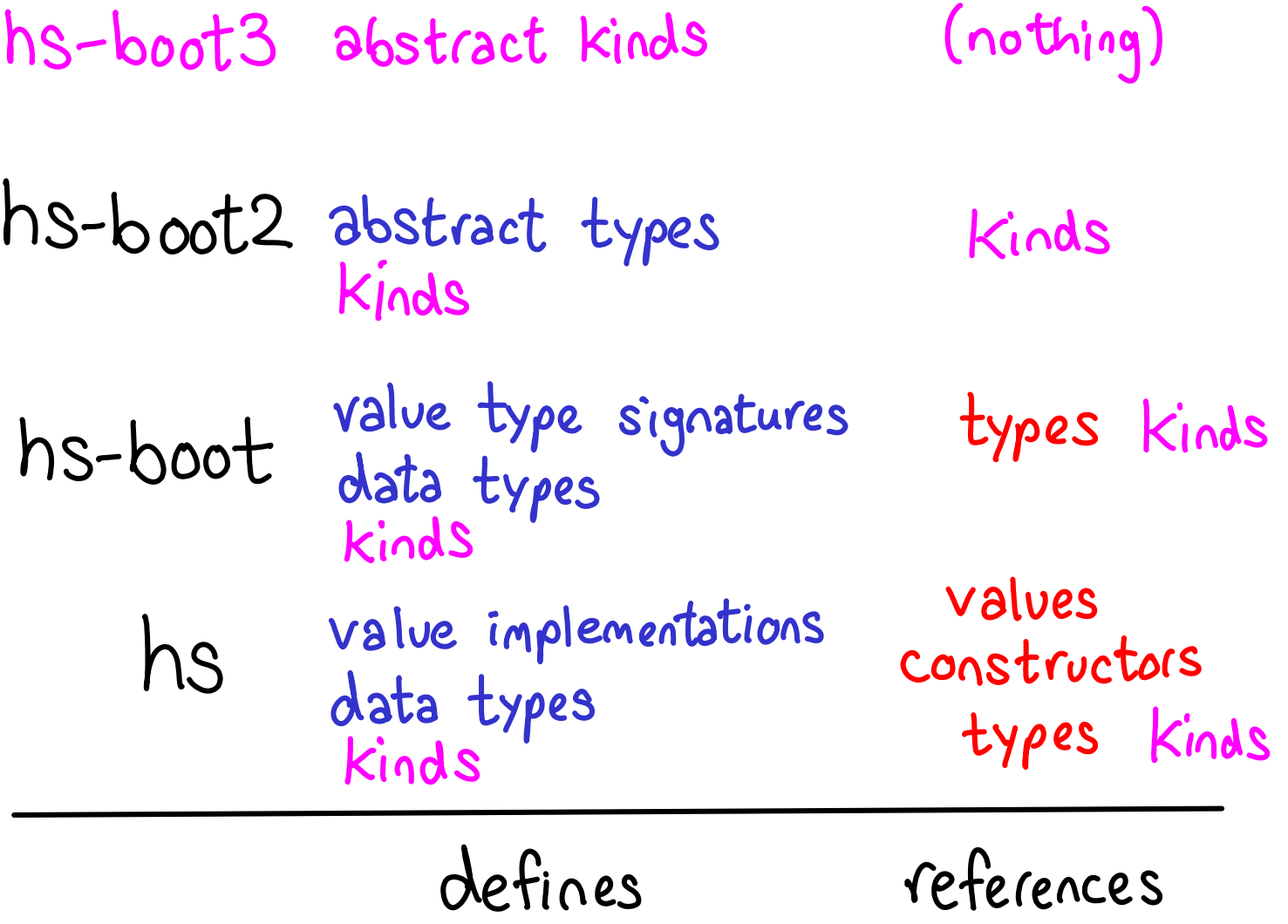
---

defines references

	defines	references
hs	value implementations data types	values constructors types

	defines	references
hs-boot	value type signatures data types	types
hs	value implementations data types	values constructors types

	defines	references
hs-boot2	abstract types	(nothing)
hs-boot	value type signatures data types	types
hs	value implementations data types	values constructors types


hs-boot3
abstract kinds
(nothing)
hs-boot2
abstract types
kinds
kinds
hs-boot
value type signatures
data types
kinds
types kinds
hs
value implementations
data types
kinds
values
constructors
types kinds
defines
references

hs-boot2

```
module A where
  data A
```

```
module B where
  data B
```

hs-boot

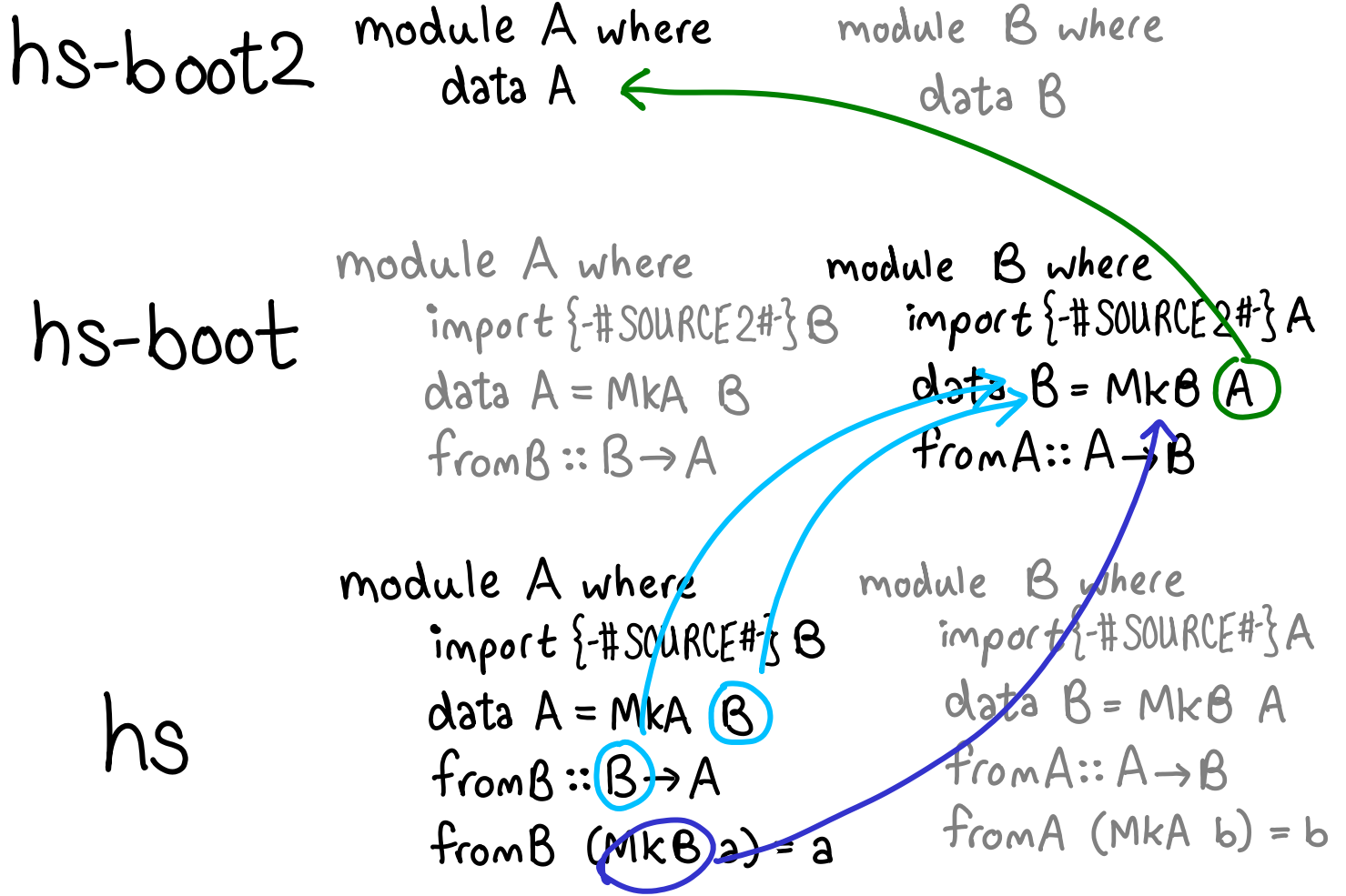
```
module A where
  import {-#SOURCE 2#-} B
  data A = MkA B
  fromB :: B → A
```

```
module B where
  import {-#SOURCE 2#-} A
  data B = MkB A
  fromA :: A → B
```

hs

```
module A where
  import {-#SOURCE#-} B
  data A = MkA B
  fromB :: B → A
  fromB (MkB a) = a
```

```
module B where
  import {-#SOURCE#-} A
  data B = MkB A
  fromA :: A → B
  fromA (MkA b) = b
```


hs-boot2
module A where
data A
module B where
data B
hs-boot
module A where
import {-#SOURCE2#-} B
data A = MkA B
fromB :: B → A
module B where
import {-#SOURCE2#-} A
data B = MkB A
fromA :: A → B
hs
module A where
import {-#SOURCE#-} B
data A = MkA B
fromB :: B → A
fromB (MkB a) = a
module B where
import {-#SOURCE#-} A
data B = MkB A
fromA :: A → B
fromA (MkA b) = b

The plan

1. Break import cycles with {-#SOURCE#-}
2. If an hs-boot file is absent: (in memory)
   - Generate an hs-boot file by erasing value implementations
   - Generate an hs-boot2 file for each module in the SCC with only abstract types

The plan

1. Break explicitly import cycles with {-# SOURCE #-}
2. If an hs-boot file is absent: (in memory)
   - Generate an hs-boot file by erasing value implementations
   - Generate an hs-boot2 file for each module in the SCC with only abstract types

imports in SCC are {-# SOURCE 2 #-}, others are normal

Implications for Backpack

Every implementation implicitly defines a signature

Implications for Backpack

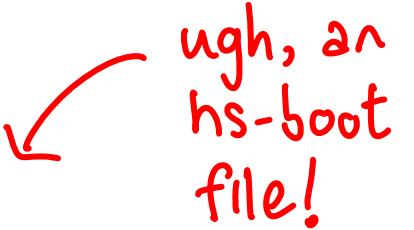
bakes in a specific implementation of A

```
unit myapp where
    include mylib (A)
    module App where
        import A
```

(Why yes, they are named units now. And the inline module syntax does work!)

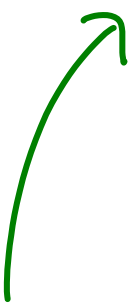
Implications for Backpack

```
unit myapp where
    signature A where
        foo :: Int -> Int
    module App where
        import A
```



Implications for Backpack

```
unit myapp where
    require mylib (A)
    module App where
        import A
```



infer the required interface

Implications for Backpack

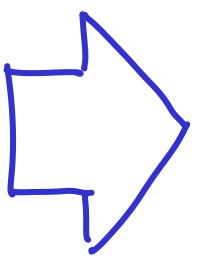
- If you don't use a value/type, it's not counted for your requirement

- hs-boot2 files don't influence type identity

Implications for Backpack

- Existing packages are Backpack packages

```
name: network
build-depends:
    base,
    bytestring,
    unix
```



```
unit network where
    require base
    require bytestring
    require unix
```

Warning: Merging types with kinds

```
data A
data B :: A → *
data C :: B a → *
data D :: C b → *
```

Warning: Merging types with kinds

```
data A                    -- hs-boot4
data B :: A -> *          -- hs-boot3
data C :: B a -> *        -- hs-boot2
data D :: C b -> *        -- hs-boot
```

Warning: Merging types with kinds

```
data A                    -- hs-boot4
data B :: A -> *          -- hs-boot3
data C :: B a -> *        -- hs-boot2
data D :: C b -> *        -- hs-boot
```

Possible fix: explicitly mark the "max level"

Look Ma, More Signatures!

	defines...	requires...
hs-boot2	abstract types	(nothing)
hs-boot	value type signatures data types	types
hs	value implementations data types	values constructors types

Thank you!