Rewriting a Shallow DSL using a GHC compiler Extension

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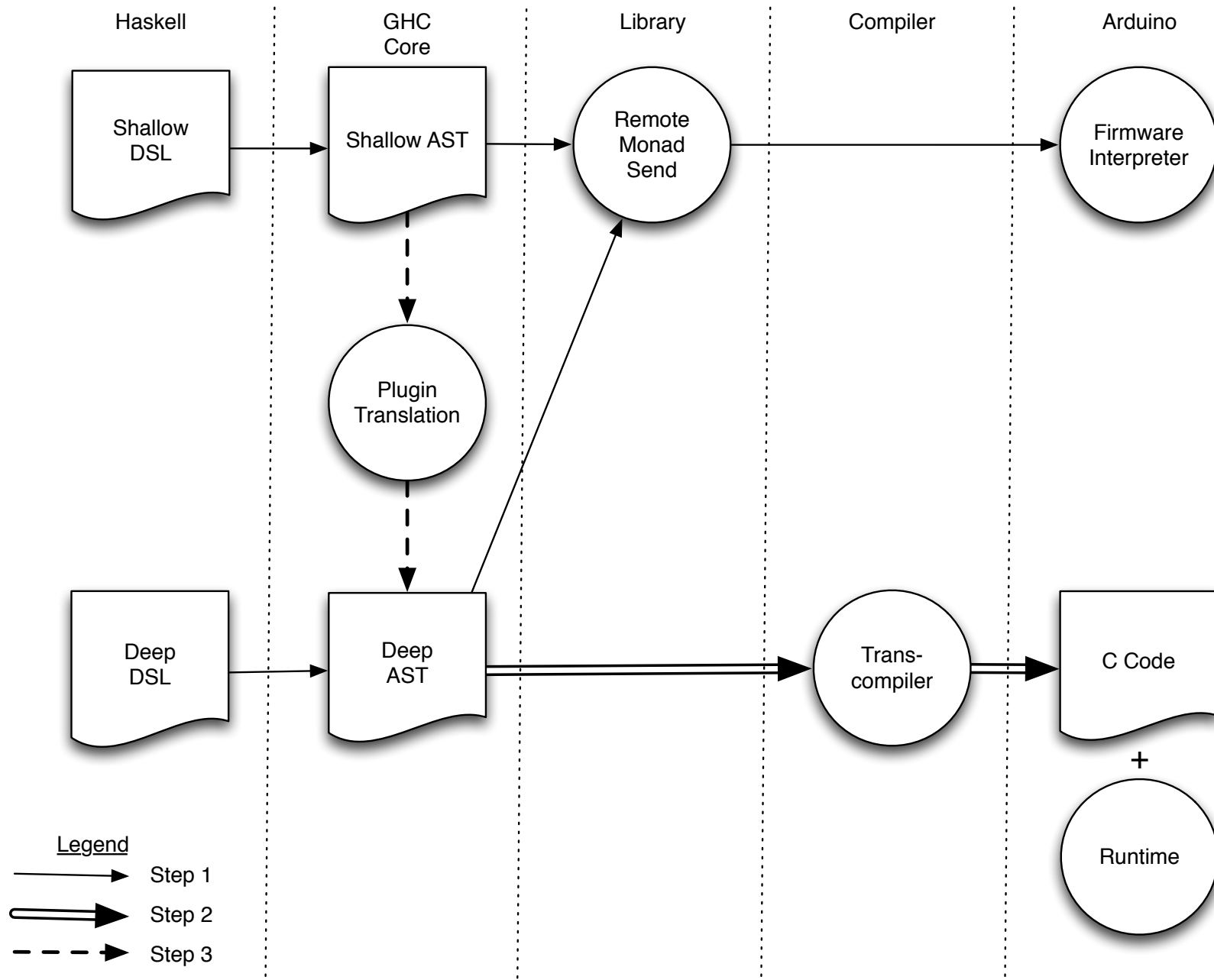mark.grebe@ittc.ku.edu   david.young@ittc.ku.edu   andrew.gill@x.team

The University of Kansas

Haskino Evolution

Haskell · GHC Core · Library · Compiler · Arduino

Shallow DSL → Shallow AST → Remote Monad Send → Firmware Interpreter

Shallow AST ⇢ Plugin Translation ⇢ Deep AST

Deep DSL → Deep AST → Trans-compiler → C Code + Runtime

Deep AST → Remote Monad Send

Legend
→ Step 1
⇒ Step 2
⇢ Step 3

Shallow/Deep Translation

- Using worker-wrapper based transformations the shallow DSL can be changed to the deep DSL.

- We automate this using a GHC plugin to do transformations in Core to Core passes.

```
loop (
  digitalRead button1 >>=
    (\a -> digitalRead button2 >>=
      (\b -> digitalWrite led (a || b))) >>
        delayMillis 100)
```

```
loopE (
  digitalReadE (rep button1 ) >>=
    (\a' -> digitalReadE (rep button2 ) >>=
        (\b' -> digitalWriteE (rep led )
                          ( a' ||* b'))) >>
        delayMillisE (rep 100))
```

Shallow/Deep + Recursion Translation

```
analogKey :: Arduino Word8
  analogKey = do
    v <- analogRead button2
    case v of
       | v < 30   -> return KeyRight
       | v < 150 -> return KeyUp
       | v < 350 -> return KeyDown
       | v < 535 -> return KeyLeft
       | v < 760 -> return KeySelect
       _               -> analogKey ()
```

```
analogKeyE :: Arduino (Expr Word8)
  analogKeyE = analogKeyE' (lit ())

analogKeyE' :: Expr () -> Arduino (Expr Word8)
analogKeyE' t = iterateE t analogKeyE'I

analogKeyE'I :: Expr () ->
              Arduino (ExprEither () Word8)
  analogKeyE'I _ = do
    v <- analogReadE button2
    ifThenElseEither (v <* 30)
      (return (ExprRight (lit KeyRight)))
      (ifThenElseEither (v <* 150)
        (return (ExprRight (lit KeyUp)))
        (ifThenElseEither (v <* 350)
          (return (ExprRight (lit KeyDown)))
          (ifThenElseEither (v <* 535)
            (return (ExprRight (lit KeyLeft)))
            (ifThenElseEither (v <* 760)
              (return (ExprRight (lit KeySelect)))
              (return (ExprLeft (lit ()))))))))
```

To be presented at GPCE 2017
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Compiler Extension

github.com/ku-fpg/haskino