Intro to Haskell

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Colorado School of Mines

May 2, 2013

Install

- Linux:
  - Debian/Ubuntu:

    `apt-get install haskell-platform`
  - Fedora/CentOS/Redhat:

    `yum install haskell-platform`
  - or use justhub
  - Arch: Install from the AUR

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  - Go to: `http://www.haskell.org/platform/windows.html` download, install

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- Mac:
  - Option 1: Go to `http://www.haskell.org/platform/mac.html` download, install. Requires command line devel tools from XCode
  - Option 2: MacPorts, its in there somewhere
  - Option 3: HomeBrew, again its in there somewhere

Why the Haskell Platform

- Why not just ghc?

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- Why not just ghc?
- What does the Haskell Platform provide?
- Can I get away with just ghc?

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- Strong and Static Typing that can also be Inferred
- First Class Functions
- Lazy Evaluation
- Tons and Tons of syntactic sugar
- Haskell is Compiled, but it has an interpreter also (GHCi)

GHC

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- If it actually compiles your code, your code 99% of the time will not crash, and will do exactly what you wanted
- It is really, really good at what it does, Haskell is a High Performance language, often programs compete with C++, Java, or C in terms of speed.

Getting Started in GHCI

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  - `:main <args>`
  - `:h[elp]`

First File

In your editor of choice create a new file, call it example.hs
A lot of the examples are inspired by Learn You a Haskell for Great Good

First File

Functions basics

- Name has to start with lowercase letter
- Convention says to use camelCase, but underscores are fine too

Create a function

```
1  twice x = 2 * x
```

First File

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Add a type signature

```
1  twice :: Integer -> Integer
2  twice x = 2 * x
3
4  --Just to show a common idiom
5  twice' :: Integer -> Integer
6  twice' x = x + x
```

First File

Using functions

- Function application looks a lot like the definition

```
1 twiceTwo :: Integer -> Integer -> Integer
2 twiceTwo x y = twice x + twice y
```

Control Structures

if..then..else

- All if statements must have both a then clause *AND* an else clause

```haskell
-- The 'even' function in Prelude does just this
-- Lets through a Type Class in here as well
isEven :: Integral a => a -> Bool
isEven x = if x `mod` 2 == 0
           then True
           else False
```

Control Structures

case *expr* of . . .

```
1  isEven :: Integral a => a -> Bool
2  isEven x = case x `mod` 2 of
3      0 -> True
4      1 -> False
```

Control Structures

Loops

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- You have to use some form of a map
- Or a List Comprehension
- . . . or use recursion

Lists

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```
1 aList :: [Integer]
2 aList = [1,2,3,4]
```

Ranges and Construction

The range operator

```
1  -- .. is inclusive on both ends
2  >>= [1..4]
3  [1,2,3,4]
4  >>= [1..]
5  [1,2,3,...]
6  >>= [0,2..]
7  [0,2,4,...]
8  -- If you want to go backwards
9  >>= [9,8..0]
10 [9,8,7,6,5,4,3,2,1,0]
```

Ranges and Construction

List construction

```
1  -- : pronounced cons => prepends an item
2  >>= 'a' : ['b', 'c']
3  "abc"
4
5  -- ++ concatenate
6  >>= "hello" ++ " " ++ "world"
7  "hello world"
```

List Groups

```
1  -- head : tail
2  >>= head [10..20]
3  10
4  >>= tail [1..5]
5  [2,3,4,5]
6
7  -- init ++ [last]
8  >>= init [1..5]
9  [1,2,3,4]
10 >>= last [1..5]
11 5
```

List Info

```
1  -- null :: [a] -> Bool
2  >>= null []
3  True
4  >>= null ['a'..'f']
5  False
6
7  -- length :: [a] -> Int
8  >>= length []
9  0
10 >>= length ['0..'z']
11 75
```

More Functions

```
1  >>= reverse [1..4]
2  [4,3,2,1]
3
4  >>= take 5 [10,20..]
5  [10,20,30,40,50]
6
7  >>= drop 3 [2..9]
8  [5,6,7,8,9]
```

More Functions

```
1  >>= maximum [7,2,3,10,5,9]
2  10
3
4  >>= minimum [7,2,3,10,5,9]
5  2
6
7  >>= sum [7,2,3,10,5,9]
8  36
9
10 >>= product [7,2,3,10,5,9]
11 18900
```

Check and Access

```
1  >>= 'a' `elem` "hello world"
2  False
3
4  >>= elem 'w' "hello world"
5  True
6
7  >>= "hello world" !! 4
8  'o'
9
10 >>= head $ tail $ tail $ tail $ tail "hello world"
11 'o'
```

Map

Applies a function to each element in a list and returns the new list

```
1 map :: (a -> b) -> [a] -> [b]
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```python
#A little python code
for i in lst:
    newval = func(i)
    newlst.append(newval)

#Or use python's map
newlst = map(func, lst)

#Or a list comp
newlst = [func(i) for i in lst]
```

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```haskell
map :: (a -> b) -> [a] -> [b]
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```haskell
-- Multiplies each item in a list by 2
timesTwo lst = map (\x -> 2 * x) lst
```

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```haskell
-- Lets Clean up our function def a little
-- First lets get rid of the lambda

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timesTwo = map (* 2)
```

```haskell
-- How about a list comp
timesTwo xs = [ 2 * x | x <- xs ]
```

Filter

Checks each item against some condition. True ⇒ keep, False ⇒ Discard

```
1 filter :: (a -> Bool) -> [a] -> [a]
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```python
#More python
for i in lst:
    if func(i):
        newlst.append(i)

#Or python's filter
newlst = filter(func, lst)

#Or a list comp
newlst = [i for i in lst if func(i)]
```

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```haskell
-- Looks a lot like map
evens xs = filter even xs
```

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```

```haskell
-- Cleaned up a bit
evens = filter even
```

```haskell
-- As a list comp
evens xs = [ x | x <- xs, even x ]
```

Folds

Applies a function to each item of a list and an accumulator, returns the accumulator

```
1 foldl :: (a -> b -> a) -> a -> [b] -> a
2 foldr :: (a -> b -> b) -> b -> [a] -> b
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```python
#Python once more
for i in lst:
    accum = func(accum, i)

#Clear as mud right?
#Python also has a fold it is called reduce
from functools import reduce
reduce(func, lst)
```

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```
1 foldl :: (a -> b -> a) -> a -> [b] -> a
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```

```
1 -- Lets make a difference function
2 -- Continually subtracts each number
3 diffl x:xs = foldl (-) x xs
4 -- Or foldr
5 diffr xs = foldr (-) (last xs) (init xs)
```

Folds

Applies a function to each item of a list and an accumulator, returns the accumulator

```
1  foldl :: (a -> b -> a) -> a -> [b] -> a
2  foldr :: (a -> b -> b) -> b -> [a] -> b
```

```
1  -- These don't behave the same
2  >>= diffl [1..10]
3  -53
4
5  >>= diffr [1..10]
6  -5
```

Creating your first executable

```haskell
main = do
  putStr "What is your name? "
  user <- getLine
  putStr "Hi "
  putStrLn user
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```

To Run:

```
runhaskell <yourfile>
```

Or:

```
ghc <yourfile> -o <exename>; ./<exename>
```

Creating your first executable

```
1  -- Alternate way if you prefer
2  --   braces and semicolons
3  main = do {
4    putStr "What is your name? ";
5      user <- getLine;
6        putStr "Hi ";
7          putStrLn user;
8  }
9  -- The excess indetation is to show
10 --   that with this notation haskell
11 --   ignores whitespace
```

Creating your first executable

```
1  -- Alternate way using Monad operators
2  -- Note: This is technically one line
3  --   you are allowed to play with whitespace some
4  main = putStr "What is your name? " >>
5         getLine >>=
6         putStrLn . (++) "Hi "
```

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- Many More

Questions and Resources

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Questions?