

Hello World in Haskell

Input and Output

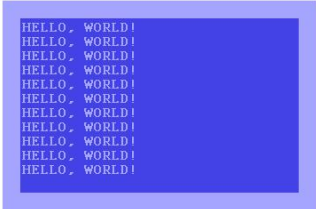
Principles of Programming Languages

Colorado School of Mines

<https://lambda.mines.edu>

Purely Functional Languages

Up until this point, our usage of Haskell has been in a world without side effects, where we need not worry about functions changing the state of the world...



```
HELLO, WORLD!  
HELLO, WORLD!  
HELLO, WORLD!  
HELLO, WORLD!  
HELLO, WORLD!  
HELLO, WORLD!  
HELLO, WORLD!  
HELLO, WORLD!  
HELLO, WORLD!  
HELLO, WORLD!
```

Input and output is dangerous... we're changing the state of the output device (or file) we are connected to, or the file we are reading might contain state information.

Haskell has a clever system of separating parts of our program which are pure and the parts which are impure...

IO Tagged Types

Haskell only allows IO from types that are "tagged" with IO. We can tag a type with IO by writing IO with a space in front of it:

```
-- This function is built into Haskell  
getChar :: IO Char  
-- definition not shown...
```

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```

When we perform an IO action but return no useful data, we tag the unit type `()`, empty parentheses) with IO:

```
-- This function is built into Haskell  
putChar :: Char -> IO ()  
-- definition not shown...
```

The main Function

To run your program, Haskell expects that you write a function called `main` that performs IO actions. Let's use the really simple function `putStrLn` which writes a line of text to the screen to see how this works:

```
-- Not my first Haskell program!  
main :: IO ()  
main = putStrLn "Hello, World!"
```

Sequencing Actions

Using the `do` syntax, you can run a series of IO actions in order:

```
main = do
  putStrLn "Hello, World!"
  putStrLn "This program runs functions in order!"
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Note

`do` is really just a fancy syntax for chaining together the `>>=` ("bind") operator, but usage of that operator is really just silly; I don't expect you to know or use it.

`print` is equivalent to `putStrLn . show`, in other words, it converts any object with a string representation to a string, then prints the result. For example:

```
factorial' :: Int -> Int
factorial' 0 = 1
factorial' n = n * factorial' (n - 1)

main = do
  print $ factorial' 5
  print $ factorial' 10
```


The <- Operator

Similar to `let` and `where`, `<-` lets you give a variable a value, but is allowed for IO tagged results: the result may not always be the same value.

```
main = do
  putStrLn "Please type your name!"
  name <- getLine
  putStrLn $ "Nice to meet you, " ++ name ++ "!"
```

Once the `do` block ends, the value of `name` is lost.

Making Strings Useful Things

Data which has the Read type class (for example, integers) can be created from strings using the read function.

```
main = do
  putStrLn "What number would you like factorialized?"
  num <- getLine
  print $ factorial $ read num
```

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  print $ factorial $ read num
```

Why did we not have to specify the type? Haskell is clever, figured out that num must be what factorial takes, an Int. If we wanted to explicitly specify this:

```
main = do
  putStrLn "What number would you like factorialized?"
  num <- getLine
  print $ factorial $ (read num) :: Int
```

The return function

The return function helps us make fake IO actions, for example, if we wanted to use `<-` to give values to variables:

```
main = do
  a <- return "CSCI-400"
  b <- return "Rocks!"
  putStrLn $ a ++ " " ++ b
```

Note that you could just use `let` or `where` in this case, but you'll see good use for `return` soon...

Note that the `return` function **does not return from a function call**.

Impure map: Introducing mapM

mapM takes an IO action, and applies the IO action to a sequence of elements:

```
GHCi> mapM print (filter odd [1..10])  
1  
3  
5  
7  
9  
[(),(),(),(),()]
```

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5
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9
[(),(),(),(),()]
```

Haskell also has mapM_, which discards the result of the mapping if you don't care about it.

forM could be defined as:

```
forM = flip mapM
```

In other words, it's equivalent to mapM but takes it's arguments backwards. This leads to some cool use:

```
weekdays = ["Sun", "Mon", "Tue", "Wed", "Thu", "Fri"]
```

```
main = do
  shirts <- forM weekdays (\ w -> do
    putStrLn $ "What do you wear on " ++ w ++ "?"
    shirt <- getLine
    return shirt)
  mapM_ print shirts
```

forever takes an IO action and repeats that IO action forever.

```
main = forever $ do  
    printStrLn "Are we there yet?"
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```

Food For Thought

How might we write forever?

Activity: Interacting with a Function

Take any pure function you've written for this course, and using `forever`, repeatedly prompt for input, and print the result of the function.

Share computers as necessary.

Conditionals in IO

Note that our usage of `if` and `else` has not changed, we just need to be careful about returning the correct type for IO, and remembering that every `if` must be paired with an `else`:

```
main = do
  putStrLn "Do you wear different shirts by weekday?"
  response <- getLine
  if response == "YES"
    then do
      shirts <- promptShirts
      mapM print shirts
    else return ()
```