

PROGRAMMING IN HASKELL⁰



Topic 2 - First Steps

Based on “Programming in Haskell” by Graham Hutton

Introduction to GHC (Glasgow Haskell Compiler)

- **What is GHC?**
 - The leading implementation of Haskell, comprising a compiler and interpreter.
 - Interactive interpreter (*GHCi*) suitable for teaching, prototyping, and testing.
- **Availability:**
 - Freely available at www.haskell.org



Starting with GHCi

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How to start

```
$ ghci
```

```
GHCi, version X: http://www.haskell.org/ghc/  ?: for help
```

```
ghci>
```

GHCi prompt (*ghci>*) indicates the interpreter is ready for expressions

Starting with GHCi

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```
> 2 + 3 * 4      -- 14  
  
> (2 + 3) * 4   -- 20  
  
> sqrt (3^2 + 4^2) -- 5.0
```

```
[GHCi, version 9.4.8: https://www.haskell.org/ghc/  :? for help  
ghci> 2+ 3* 4  
[14  
ghci> (2+3) * 4  
[20  
ghci> sqrt (3^2 + 4^2)  
[5.0
```

The Standard Prelude

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- **Library Overview:**

- Haskell includes many built-in functions for lists and numbers.

- **Examples:**

- Select the first element:

```
>head [1,2,3,4,5]  
> 1
```

- Remove the first element:

```
> tail [1,2,3,4,5]  
[2,3,4,5]
```

- Sum of a list::

```
> sum [1,2,3,4,5]  
15
```

The Standard Prelude

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- Select the nth element of a list:
- Select the first n elements of a list:
- Remove the first n elements from a list:

```
> [1,2,3,4,5] !! 2  
3
```

```
> take 3 [1,2,3,4,5]  
[1,2,3]
```

```
> drop 3 [1,2,3,4,5]  
[4,5]
```

The Standard Prelude

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- Calculate the length of a list:
- Calculate the sum of a list of numbers:
- Calculate the product of a list of numbers:

```
> length [1,2,3,4,5]  
5
```

```
> sum [1,2,3,4,5]  
15
```

```
> product [1,2,3,4,5]  
120
```

The Standard Prelude

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- Append two lists:

```
> [1,2,3] ++ [4,5]  
[1,2,3,4,5]
```

- Reverse a list:

```
> reverse [1,2,3,4,5]  
[5,4,3,2,1]
```

Function Application in Haskell

- Syntax
 - Function application uses spaces instead of parentheses:

Java:

$f(a, b) + c \cdot d$



Haskell:

$f\ a\ b + c * d$

Apply the function f to a and b , and add the result to the product of c and d .

Function Application in Haskell

Moreover, function application is assumed to have higher priority than all other operators.

f a + b



Means $(f a) + b$, rather than $f (a + b)$.

Examples

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Mathematics

$f(x)$

$f(x, y)$

$f(g(x))$

$f(x, g(y))$

$f(x)g(y)$

Haskell

`f x`

`f x y`

`f (g x)`

`f x (g y)`

`f x * g y`

Haskell Scripts

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- What is a script?
 - Text files containing Haskell code, typically with a .hs extension.
- Example Script:

```
double x = x + x
quadruple x = double (double x)
```
- Save the file as test.hs and load it into GHCi

```
$ ghci test.hs
> quadruple 10 -- 40
```

Defining Functions

- Examples:
 - factorial
 - factorial n = product [1..n]
 - average
 - average ns = sum ns `div` length ns
- Use backticks for infix notation: sum ns `div` length ns`
- x `f` y is just syntactic sugar for f x y.

Useful GHCi Commands

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Command	Description
:load <file>	Load a Haskell script
:reload	Reload the current script
:type <expr>	Show the type of an expression
:quit	Exit GHCi

Tip : use :q in GHCi for a list of all commands

Naming Requirements

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- Function and argument names must begin with a lower-case letter. For example:

myFun

fun1

arg_2

x'

- By convention, list arguments usually have an s suffix on their name. For example:

xs

ns

nss

- Strive to write clear, self-explanatory code (see <https://wiki.haskell.org/Commenting>)

```
swap :: (a,b) -> (b,a)
```

- Avoid redundant comments

Comments in Haskell - Syntax

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```
-- A one-line comment looks like this
```

```
{- A multiline  
comment can continue for many lines  
-}
```

The Layout Rule

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In a sequence of definitions, each definition must begin in precisely the same column:

```
a = 10  
b = 20  
c = 30
```

```
a = 10  
b = 20  
c = 30
```

```
a = 10  
b = 20  
c = 30
```



The Layout Rule

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The layout rule avoids the need for explicit syntax to indicate the grouping of definitions.

```
a = b + c  
where  
    b = 1  
    c = 2  
d = a * 2
```

means →

```
a = b + c  
where  
{b = 1;  
 c = 2}  
d = a * 2
```

implicit grouping

explicit grouping

Tip: Align code neatly to avoid syntax errors.

- **Key Takeaways:**

- GHCi is an interactive and powerful environment for Haskell.
- Use the Prelude for built-in functions and utilities.
- Write clean, concise scripts and test them in GHCi.



Any Questions ?