PROGRAMMING IN HASKELL

Chapter 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

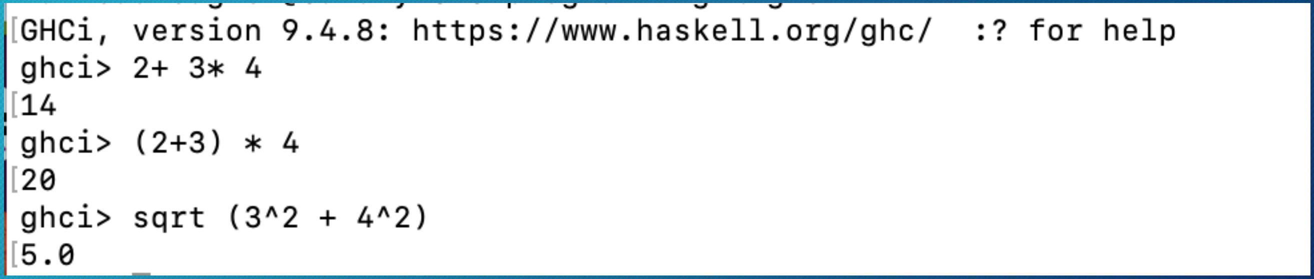
How to start

```
$ 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

```
> 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

- 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

- Select the nth element of a list:

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

- Select the first n elements of a list:

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

- Remove the first n elements from a list:

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

The Standard Prelude

- Calculate the length of a list:

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

- Calculate the sum of a list of numbers:

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

- Calculate the product of a list of numbers:

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

The Standard Prelude

- 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 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

Mathematics	Haskell
`f(x)`	`f x`
`f(x,y)`	`f x y`
`f(g(x))`	`f (g x)`
`f(x,g(y))`	`f x (g y)`
`f(x)g(y)`	`f x * g y`

Haskell Scripts

- 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

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

- 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
```

Comments in Haskell

- 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

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

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

The Layout Rule

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
```

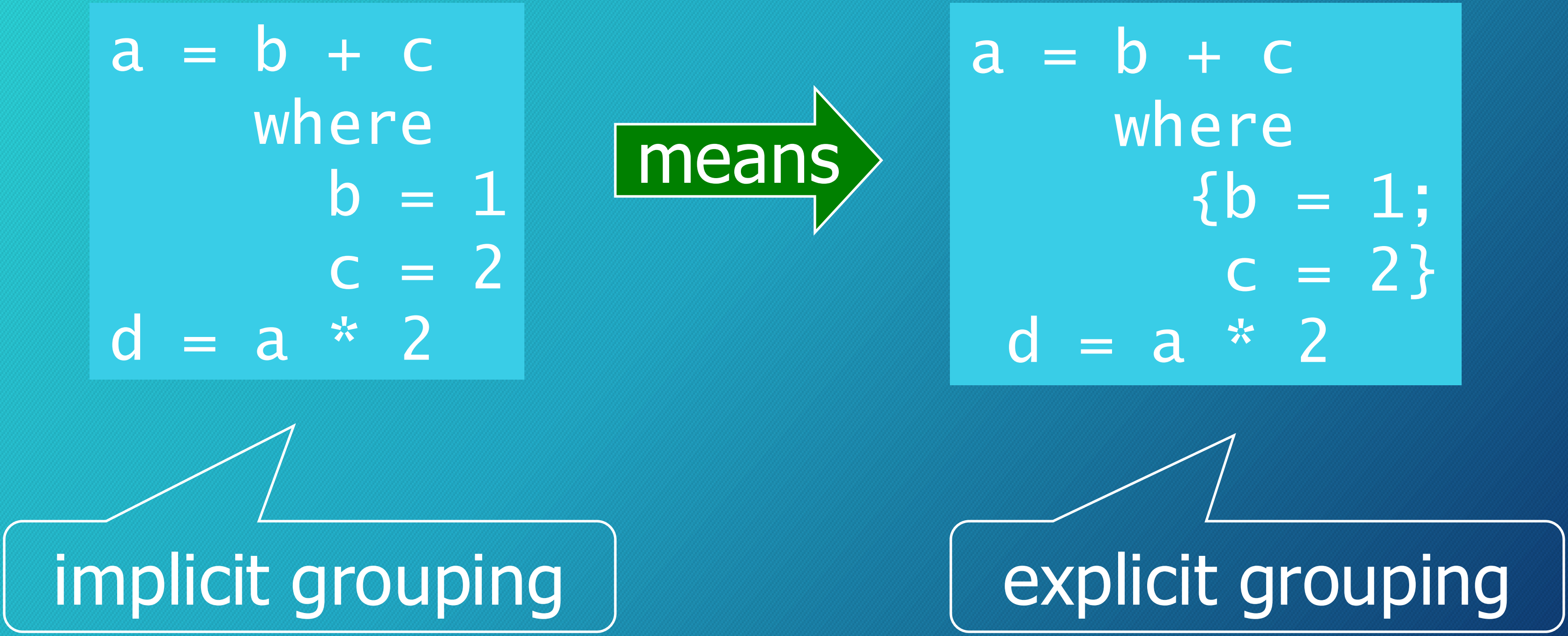
✗

```
 a = 10

b = 20

 c = 30
```

✗

The Layout Rule

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
```

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

Tip: Align code neatly to avoid syntax errors.

Recap

- **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.