Principles of Programming Languages

Introduction to Glasgow Haskell Compiler

Glasgow Haskell Compiler

- GHC is the leading implementation of Haskell, and comprises a compiler and interpreter;
- The interactive nature of the interpreter makes it well suited for teaching and prototyping;
- GHC is freely available from: www.haskell.org/platform

Starting GHCi

- The interpreter can be started from the terminal command prompt $ by simply typing ghci:

```
$ ghci

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

Prelude>
```

- The GHCi prompt > means that the interpreter is now ready to evaluate an expression.

Example

It can be used as a desktop calculator to evaluate simple numeric expressions:

```
> 2+3*4
14

> (2+3)*4
20

> sqrt (3^2 + 4^2)
5.0
```

The Standard Prelude

- Haskell comes with a large number of standard library functions.
- In addition to the familiar numeric functions such as + and *, the library also provides many useful functions on lists.
- Example: *Select the first element of a list*

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

The Standard Prelude

- Remove the first element from a list:

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

- 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]
```

The Standard Prelude

- Calculate the product of a list of numbers:

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

- Append two lists:

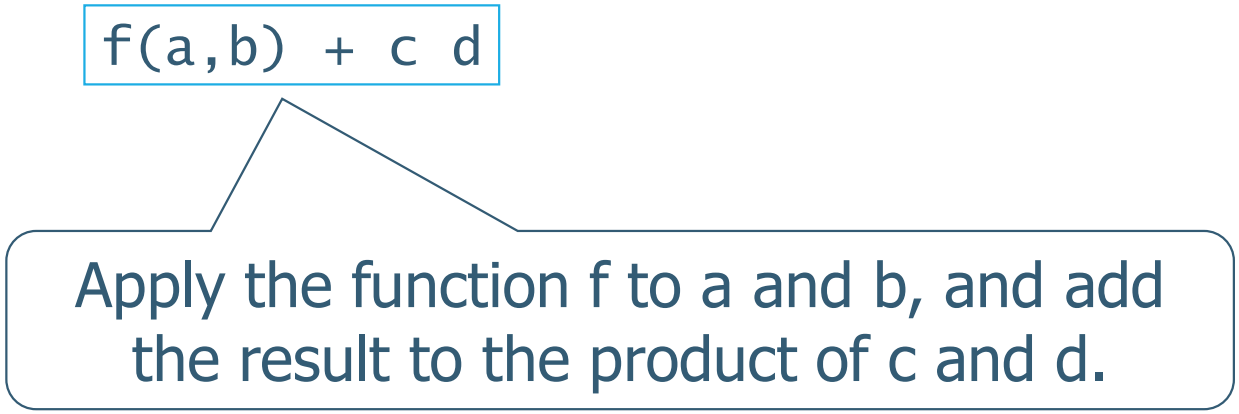
```
> [1,2,3] ++ [4,5]
[1,2,3,4,5]
```

- Reverse a list:

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

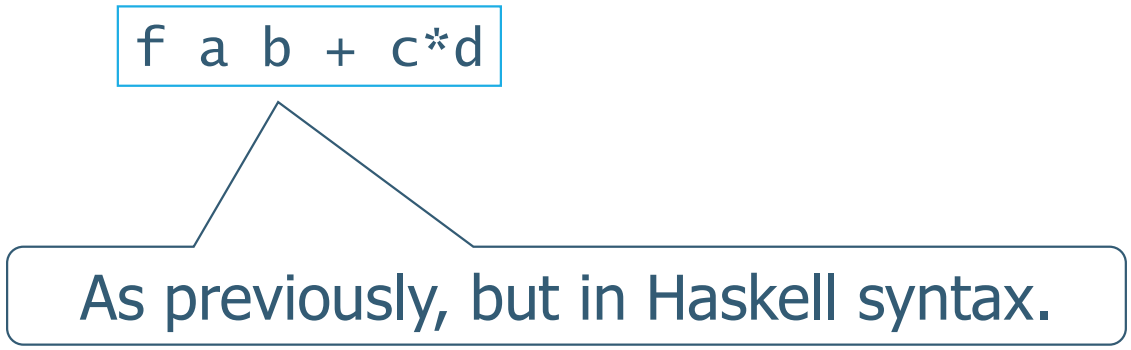
Function Application

- In mathematics, function application is denoted using parentheses, and multiplication is often denoted using juxtaposition or space.



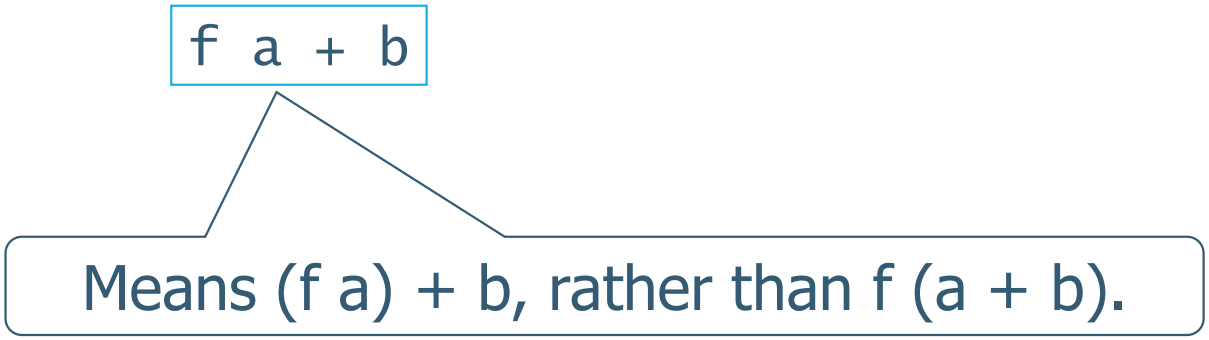
Function Application

- In Haskell, function application is denoted using space, and multiplication is denoted using *.



Function Application

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



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

- As well as the functions in the standard library, you can also define your own functions;
- New functions are defined within a script, a text file comprising a sequence of definitions;
- By convention, Haskell scripts usually have a .hs suffix on their filename. This is not mandatory but is useful for identification purposes.

First Script

- When developing a Haskell script, it is useful to keep two windows open, one running an editor for the script, and the other running GHCi.
- Start an editor, type in the following two function definitions, and save the script as **test.hs**:

```
double x     = x + x

quadruple x = double (double x)
```

- Leaving the editor open, in another window start up GHCi with the new script:

```
$ ghci test.hs
```

- Now both the standard library and the file test.hs are loaded, and functions from both can be used:

```
> quadruple 10
40

> take (double 2) [1,2,3,4,5,6]
[1,2,3,4]
```

- Leaving GHCi open, return to the editor, add the following two definitions, and resave:

```
factorial n = product [1..n]

average ns = sum ns `div` length ns
```

Note:-

- div is enclosed in back quotes, not forward;
- x `f` y is just syntactic sugar for f x y.

- GHCi does not automatically detect that the script has been changed, so a reload command must be executed before the new definitions can be used:

```
> :reload
Reading file "test.hs"

> factorial 10
3628800

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

Useful GHCi Commands

Command	Meaning
:load *name*	load script *name*
:reload	reload current script
:set editor *name*	set editor to *name*
:edit *name*	edit script *name*
:edit	edit current script
:type *expr*	show type of *expr*
:?	show all commands
:quit	quit GHCi

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
```

The Layout Rule

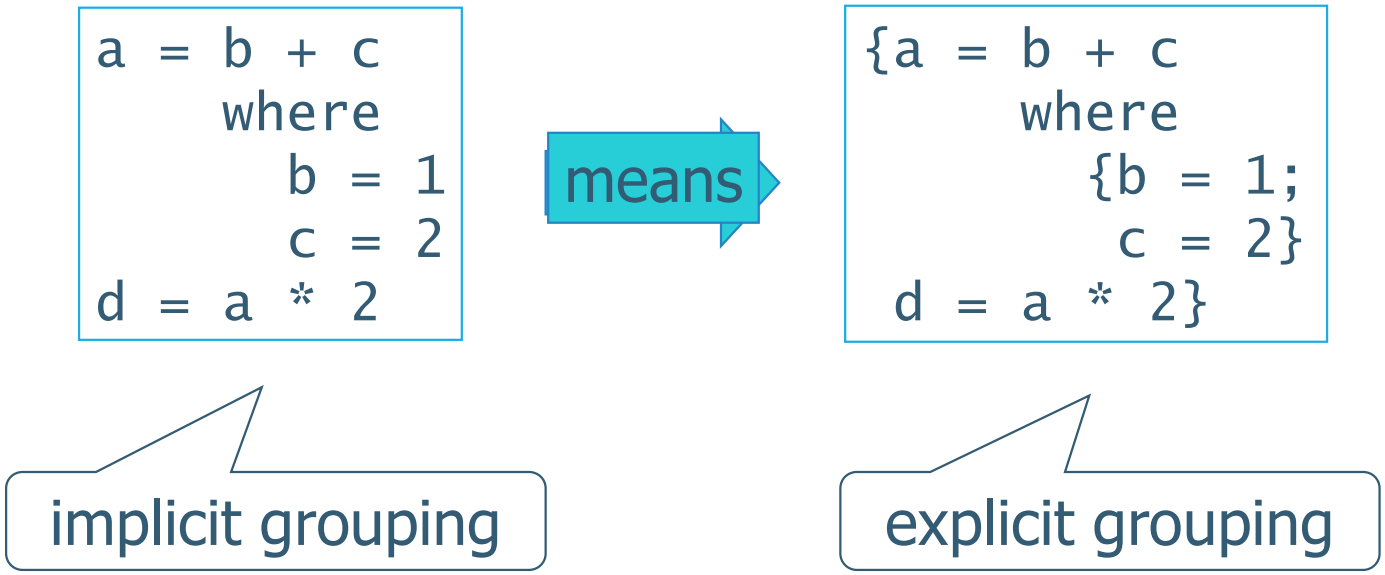
- In a sequence of definitions, each definition must begin in precisely the same column:

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

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

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

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



NEXT – Types in Haskell