

# Haskell Intro

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 **Haskell**

# Haskell - Let's get our hands dirty

- ▶ Introduction on basic features
- ▶ Practice
- ▶ Some mind-bending exercises to get up-to-speed

## Install the env

Install haskell platform, including everything you need!

<https://www.haskell.org/platform/>

Then create a file named `code.hs` with content:

```
module Main where
```

```
main = putStrLn "Hello World!"
```

Run `stack runhaskell code.hs`. You're good to go!

# REPL

Use stack ghci to run the REPL in the directory where your code is:

```
Prelude> :load code -- Loads your module
[1 of 1] Compiling Session1      ( code.hs, interpreted )
Ok, modules loaded: Session1.
```

```
*Main> main -- Calls function `main` from loaded module
Hello World
```

```
*Main> :type [1, 2] -- Displays type of an expression
[1, 2] :: Num t => [t]
```

```
*Main> :info [1, 2]
data [] a = [] | a : [a]      -- Defined in 'GHC.Types'
instance Eq a => Eq [a]      -- Defined in 'GHC.Classes'
...
```

Use :type and :info on main!

# Types

Type annotations are of the form `:: Type`. Examples of types:

```
42 :: Int
```

```
42.0 :: Float
```

```
[1, 2] :: [Int]
```

```
"Hello" :: [Char] -- : '(
```

```
length :: [a] -> Int
```

Use `:type` in `ghci` to query the type of more complex expressions.

Like: `(^)`, `main`, `map`, `(:)`

# Functions

Functions are declared with an (optional) type signature:

```
zip :: [a] -> [b] -> [(a, b)]
```

And one or more body with *pattern matching*:

```
zip [] _ = []  
zip _ [] = []  
zip (x1:xs1) (x2:xs2) = (x1, x2) : zip xs1 xs2  
--      ^           ^           ^           ^           ^  
--      arg 1      arg2      tuple cons recursive call
```

Or just:

```
zip list1 list2 = ...  
-- Deal with different patterns in the body  
-- of the function directly (we will see how later)
```

# Types



# Lists

List is the most ubiquitous data structure in Haskell. It's implemented as a *linked list* of elements with *same type* :: [a].

```
*Main> :info []
data [] a = [] | a : [a] -- Defined in 'GHC.Types'
--      ^      ^      ^      ^
--      /      /      /      constructor 2 (cons)
--      /      /      constructor 1 (empty list)
--      /      type parameter
--      type name
```

List is either empty or one element with the rest of the list.

```
*Main> []
*Main> [1]
*Main> [1, 2]
*Main> 1 : [2]
*Main> 1 : 2 : []
*Main> [1..2] -- Syntactic sugar for range
```

# Pattern matching

In Haskell you can pattern-match on data types

## Let's play!

Add the following lines in your file to create a module and hide the standard functions:

```
module Session1 where

import Prelude hiding (
    length,
    map,
    sum,
    product,
    filter,
    reverse
)
```

## Functions on list

You have to deal with at least two cases:

- ▶ The list is empty
- ▶ The list has at least one element

```
listFunction :: [a] -> ?
```

```
listFunction [] = -- Empty case
```

```
listFunction (x:xs) = -- Other cases
```

You can also match “one element” or “two elements”:

```
listFunction [a] = -- One element
```

```
listFunction [a, b] = -- two elements
```

```
listFunction [a, 42] = -- second element must be `42`
```

## Length

Implement the length function:

```
length :: [a] -> Int
```

```
-- Example:
```

```
-- length [1, 2, 3, 4, 5] == 5
```

## Map

Implement the function `map` with following type:

```
map :: (a -> b) -> [a] -> [b]
```

```
-- Example:
```

```
-- map (1+) [1, 2, 3, 4] == [2, 3, 4, 5]
```

## Sum/Product/Fold

Implement a `sum` function which takes a list of numbers and return the sum of all of them:

```
sum :: Num a => [a] -> a
```

Implement the `product` function which does the multiplication of all the elements of a list:

```
product :: Num a => [a] -> a
```

Can you identify a pattern here? This is `fold`. Implement the `fold` function:

```
fold :: (b -> a -> b) -> b -> [a] -> b
```

Is there another possible implementation?

# Filter

Implement the `filter` function with following signature:

```
filter' :: (a -> Bool) -> [a] -> [a]
```

```
-- Example:
```

```
-- filters' even [1, 2, 3, 4, 5, 6, 7] == [2, 4, 6]
```



# Reverse

Implement the reverse function with the following signature:

```
reverse :: [a] -> [a]
```

```
-- Example:
```

```
-- reverse [1, 2, 3] == [3, 2, 1]
```

# Concat

Implement the `concat` function with the following signature:

```
concat :: [a] -> [a] -> [a]
```

```
-- Examples:
```

```
-- concat [1, 2, 3] [4, 5] == [1, 2, 3, 4, 5]
```

```
-- concat [] [4, 5] == [4, 5]
```

```
-- concat [1, 2, 3] [] == [1, 2, 3,]
```