Haskell offers two primary ways of working with code via GHCi:

i) typing directly into GHCi or REPL

ii) writing source files and loading them into the GHCi.

↓

Using the REPL (Read, evaluate, print, loop)

↓

originated with LISP, but are now common to modern programming langs. including Haskell.

→ The normal method of working with REPL and loading source files in REPL and playing with them and also unloading them. (:module)

→ Understanding expressions: everything in Haskell is an expression or declaration. expressions may be values, combination of values, and or func applied to values.

↓

Expressions evaluate to a result. In the case of a literal value, the evaluation is trivial as it only evaluates to itself. In the case of an arithmetic eq., the evaluation process is the process of evaluating / computing the operator and its arguments.

↓

That is, all of Haskell's expression work to evaluate

a result in a predictable, transparent manner.

↓

Expressions are the building blocks. Programs → big expressions made of smaller expressions.

↓

Declarations are top level bindings which allows us to name expressions. These names can be used to refer to them multiple times without copying

→ As mentioned before expressions are the most basic unit of a Haskell program, and functions are a special type of expression.

↓

functions in Haskell are related to functions in mathematics, meaning they map inputs to outputs.

↓

As in lambda calculus, all functions in Haskell take one argument and return one result.

↓

The way to think of this is that, in Haskell, when it seems we are passing multiple arguments to a function, we are actually applying a series of nested fns, each to one argument. This is called currying.

↓

functions can appear in expressions that form the bodies

of other functions to be used as arguments to functions, just as any other value can be.

↓

Function definition: name of the fn, followed by parameters of the fn., separated only by white space. Then an equal sign, which expresses equality of terms. finally there is an expression that is the body of the function and can be evaluated to return a value.

→ lowercase letter init

← corresponding to the head of the lambda.

↓ CamelCase convention

↓ even for variables

↓

Haskell uses a nonstrict evaluation strategy which defers evaluation of terms until they're forced by other terms referring to them.

Note: canonical ≅ normal form

↓

Haskell doesn't evaluate everything to canonical or normal form by default. Instead, it only evaluates to a weak head normal form (WHNF) by default. This means that not everything will get reduced to its irreducible form immediately.

i.e. $(\lambda f \rightarrow (1, 2+f))\ 2 \Rightarrow (1, 2+2)$

↓

not evaluated to 4 until the last moment.

These are prefix functions. There are functions that operate in an infix manner as well, like the arithmetic operators.

↓

Prefix functions can be used as infix functions, with a small change in syntax. Using backticks.

↓

infix functions can be used in prefix fashion by using them in brackets.

↓

If the fn. name is alphanumeric, it is a prefix fn. by default, and if the fn. name is a symbol, then they are infix by default.

→ Associativity and precedence : info can be used to get information about a given fn.

: info (+) ⇒ infixl 6 +

6 → precedence (on a scale of 0 - 9)

↓

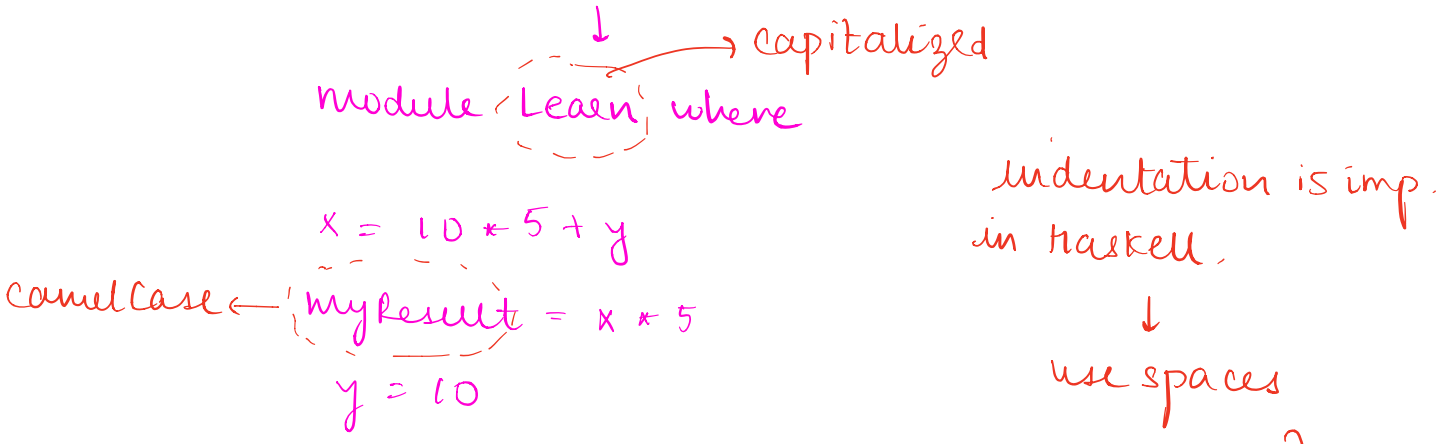
infix operator, left associative

↓

higher precedence is applied first

→ Order of declaration matters in REPL, but doesn't matter in source files.

→ Declaring files in source files. First we declare the name of our module, so it can be imported by name in a project.



Indentation is imp. in Haskell.
↓
use spaces
↓
a common point of error in Haskell.

→ Whitespace is significant in Haskell in general.

→ Make certain when we break up lines of code that the second line begins at least one space from the beginning of that line.

→ Another cause of error is to not start a declaration at a start of the line

→ '--' used to comment out lines in source code.

Operator	Name	Purpose/application
+	plus	addition
-	minus	subtraction
*	asterisk	multiplication
/	slash	fractional division
div	divide	integral division, round down
mod	modulo	like 'rem', but after modular division
quot	quotient	integral division, round towards zero
rem	remainder	remainder after division

•) Usually want to use 'div' for integral division, due to the way div and quot round.

•) 'rem' and 'mod' have different use cases.

→ laws for quotients and remainders : in Haskell, if one or both arguments are negative, the results of mod will have the same sign as the divisor, while the result of the rem will have the same sign as the dividend :

⇒ −5 'mod' 2

1

⇒ 5 'mod' (−2)

−1

⇒ (−5) 'rem' 2

−1

mod → divisor

rem → dividend.

⇒ Negative numbers : due to interaction of parantheses, currying and infix syntax, negative numbers get special treatment

↓

(parantheses around them)

got to do more with precedence order, than anything else.

→ $ operator : does almost nothing. Defn. of ($) :

f $ a = f a

↓

infix operator with least precedence.

used for convenience for when we want to express something with less pair of

parantheses.

↓

`$' allows everything to the right to be executed first and can be used to delay fn. appln.

→ need to wrap infix operators with parantheses. Also (+1) is the adder fn. but with one argument applied, making it return the next argument it's applied to plus one. This is called sectioning and allows us to pass around partially applied fns.

↓

using section with a fn. where order matters, should be taken into careful consideration.

↓

subtraction is a special case. Since (-2) has already been used for negation.

→ let and where : used to introduce components of expressions.

↓

constrast is that let introduces an expression, so it can be used wherever you can have an expression, but where is a declaration and is bound to a surrounding syntactic construct.

(*) scope is the area of source code where a binding of a variable applies.

(*) As we build larger projects, we will use a project manager called stack.

```haskell
-- FunctionWithWhere.hs
module FunctionWithWhere where

printInc n = print plusTwo
  where plusTwo = n + 2
```

main expr

where expr

declared later

```haskell
-- FunctionWithLet.hs
module FunctionWithLet where

printInc2 n = let plusTwo = n + 2
              in print plusTwo
```

let-expr

main expr