Exercises
List Comprehensions

* Exercise 1

Using list comprehension define the list of cubes of the values between (and including) 1 and 10.

```
cubes = [(1,1),(2,4),(3,9),(4,16),(5,25),(6,36),
           (7,49),(8,64),(9,81),(10,100)]
```

* Exercise 2

Using list comprehension define the following list (note that the second element in the 2-tuple is always 1.

```
myConstFunc = [(1,1),(2,1),(3,1),(4,1),(5,1)]
```

** Exercise 3

Write down the values as defined in the following lists l1, l2, l3. Check your answers.

```
f1 :: [(Int, Int)]
f1 = [(x, y) | x <-[1..3], y<- [4..5]]

f2 :: [(Int, Int)]
f2 = [(x, y) | y<- [4..5], x <-[1..3]]

f3 :: [(Int, Int)]
f3 = [(y, x) | x <-[1..3], y<- [4..5]]
```

** Exercise 4

Given the following definition of

```
isEven :: Integer -> Bool
isEven n = (n `mod` 2 == 0)
```

Write down the values as defined in the following list: Check your answer.

```
[2*n | n <- [2,4,7], isEven n, n>3]
```

** Exercise 5

Give a definition of a function

```
doubleAll :: [Integer] -> [Integer]
```

which doubles all the elements of a list of integers.

** Exercise 6

Give a definition of a function

```
capitalize :: String -> String
```

which converts all small letters in a String into capitals.
Hint:You can use the following function (having imported Data.Char):

```
import Data.Char
toupper :: Char -> Char
```

** Exercise 7

Using a list comprehension, give an expression that calculates the sum of

$$\sum_{i=1}^{i=100} i^2$$

** Exercise 8

Using a list comprehension,write a function sigma'

```
sigma' :: Int-> Int
```

that takes an integer n and calculates

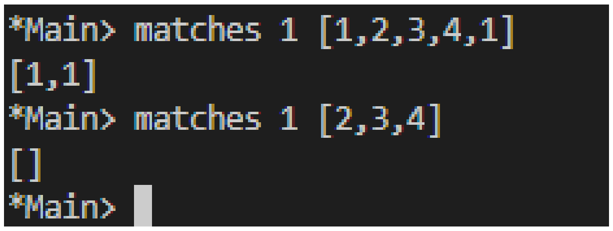
$$\sum_{i=1}^{i=n} i^2$$

**** Exercise 9

Define the function

```
matches :: Integer -> [Integer] -> [Integer]
```

which picks out all occurences of an integer in a list. For instance:



```
*Main> matches 1 [1,2,3,4,1]
[1,1]
*Main> matches 1 [2,3,4]
[]
*Main>
```

Using matches or otherwise, define a function

```
elem':: Integer -> [Integer] -> Bool  --elem is already defined in Prelude
```

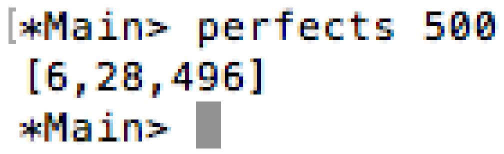
which is True is the Integer is an element of the list, and False otherwise.

**** Exercise 10

A positive integer is perfect if it equals the sum of all of its factors, excluding the number itself. Using a list comprehension and the function **factors**, define a function

```
perfects :: Int -> [Int]
```

that returns the list of all perfect numbers up to a given limit. For example:



```
*Main> perfects 500
[6,28,496]
*Main>
```