First Haskell Programming Assignment Solution

This assignment serves as our introduction to Haskell. It includes recursive functions, higher order functions, list comprehension, and more. We utilize a statistical formula as well as a morse code encoder and decoder

Task 1 – Mindfully Mimicking the Demo

```
GHCi, version 9.2.1: https://www.haskell.org/ghc/  :? for help
ghci> :set prompt ">>> "
>>> length [2,3,5,7]
4
>>> words "need more coffee"
["need","more","coffee"]
>>> unwords ["need","more","coffee"]
"need more coffee"
>>> reverse "need more coffee"
"eeffoc erom deen"
>>> reverse ["need","more","coffee"]
["coffee","more","need"]
>>> head ["need","more","coffee"]
"need"
>>> tail ["need","more","coffee"]
["more","coffee"]
>>> last ["need","more","coffee"]
"coffee"
>>> init ["need","more","coffee"]
["need","more"]
>>> take 7 "need more coffee"
"need mo"
>>> drop 7 "need more coffee"
"re coffee"
>>> ( \x -> length x > 5 ) "Friday"
True
>>> ( \x -> length x > 5 ) "uhoh"
False
>>> ( \x -> x /= ’ ’ ) ’Q’

<interactive>:15:14: error: lexical error at character ' '
>>> ( \x -> x /= ’ ’ ) 'Q'

<interactive>:16:14: error: lexical error at character ' '
>>> ( \x -> x /= ' ' ) 'Q'
True
>>> ( \x -> x /= ' ' ) ' '
False
>>> filter ( \x -> x /= ' ' ) "Is the Haskell fun yet?"
"IstheHaskellfunyet?"
>>>
```

Task 2 – Numeric Function Definitions

```
---task 2
squareArea x = x * x

circleArea x = pi * x * x

blueAreaOfCube x = ((square - circle) * 6)
    where square = squareArea x
          circle = circleArea (x/4)
paintedCube1 x = if x < 3 then 0 else c*c*6
    where c = x-2

paintedCube2 x = if x < 3 then 0 else c*12
    where c = x-2
```

```
>>> squareArea 10
100
>>> squareArea 12
144
>>> circleArea 10
314.1592653589793
>>> circleArea 12
452.3893421169302
>>> blueAreaOfCube 10
482.19027549038276
>>> blueAreaOfCube 12
694.3539967061512
>>> blueAreaOfCube 1
4.821902754903828
>>> map blueAreaOfCube [1..3]
[4.821902754903828,19.287611019615312,43.39712479413445]
>>> paintedCube1 1
0
>>> paintedCube1 2
0
>>> paintedCube1 3
6
>>> map paintedCube1 [1..10]
[0,0,6,24,54,96,150,216,294,384]
>>> paintedCube2 1
0
>>> paintedCube2 2
0
>>> paintedCube2 3
12
>>> map paintedCube2 [1..10]
[0,0,12,24,36,48,60,72,84,96]
>>>
```

Task 3 – Puzzlers

```
---task 3
reverseWords xs = c
    where c = concat (reverse (intersperse " " (words xs)))


averageWordLength sentence = fromIntegral nrChars / fromIntegral nrWords
    where nrChars = length(filter (/=' ') sentence)
          nrWords = length(words sentence)
```

```
>>> reverseWords "appa and baby yoda are the best"
"best the are yoda baby and appa"
>>> reverseWords "want me some coffee"
"coffee some me want"
>>> averageWordLength "appa and baby yoda are the best"
3.5714285714285716
>>> averageWordLength "want me some coffee"
4.0
>>>
```

Task 4 – Recursive List Processors

```
--task 4
list2set :: (Eq a) => [a] -> [a]
list2set (x:xs) = x : list2set(filter(/=x) xs)
list2set [] = []

isPalindrome xs = xs == (reverse xs)
```

```
>>> list2set [1,2,3,2,3,4,3,4,5]
[1,2,3,4,5]
>>> list2set "need more coffee"
"ned morcf"
>>> isPalindrome ["coffee","latte","coffee"]
True
>>> isPalindrome ["coffee","latte","espresso","coffee"]
False
>>> isPalindrome [1,2,5,7,11,13,11,7,5,3,2]
False
>>> isPalindrome [2,3,5,7,11,13,11,7,5,3,2]
True
```

Task 5 – List Comprehensions

```
--task 5
count x xs = length[n | n <- xs, n == x]

freqTable xs = [(i,j) | i <- list2set xs, j <- [count x xs | x <- [i]]]
```

```
>>> count 'e' "need more coffee"
5
>>> count 4 [1,2,3,2,3,4,3,4,5,4,5,6]
3
>>> freqTable "need more coffee"
[('n',1),('e',5),('d',1),(' ',2),('m',1),('o',2),('r',1),('c',1),('f',2)]
>>> freqTable [1,2,3,2,3,4,3,4,5,4,5,6]
[(1,1),(2,2),(3,3),(4,3),(5,2),(6,1)]
>>>
```

Task 6 – Higher Order Functions

```
--task 6
tgl x = foldl (+) 0 [1..x]

triangleSequence x = map tgl [1..x]

vowelCount s = length (filter (\x -> (x `elem` ['a','e','i','o','u'])) s)

lcsim f p xs = map f (filter p xs)
```

```
>>> tgl 5
15
>>> tgl 10
55
>>> triangleSequence 10
[1,3,6,10,15,21,28,36,45,55]
>>> triangleSequence 20
[1,3,6,10,15,21,28,36,45,55,66,78,91,105,120,136,153,171,190,210]
>>> vowelCount "cat"
1
>>> vowelcount "mouse"

<interactive>:166:1: error:
    * Variable not in scope: vowelcount :: String -> t
    * Perhaps you meant `vowelCount' (line 44)
>>> vowelCount "mouse"
3
>>> lcsim tgl odd [1..15]
[1,6,15,28,45,66,91,120]
>>> animals = ["elephant","lion","tiger","orangatan","jaguar"]
>>> lcsim length (\w -> elem ( head w ) "aeiou") animals
[8,9]
>>>
```

Task 7 – An Interesting Statistic: nPVI

```
a :: [Int]
a = [2,5,1,3]

b :: [Int]
b = [1,3,6,2,5]

c :: [Int]
c = [4,4,2,1,1,2,2,4,4]

u :: [Int]
u = [2,2,2,2,2,2,2,2,2,2]

x :: [Int]
x = [1,9,2,8,3,7,2,8,1,9]

pairwiseValues :: [Int] -> [(Int,Int)]
pairwiseValues [] = []
pairwiseValues xs = (zip (take 1 xs) (drop 1 xs)) ++ pairwiseValues (tail xs)

pairwiseDifferences xs = map (\(i,j) -> i - j) (pairwiseValues xs)
pairwiseSums xs = map (\(i,j) -> i + j) (pairwiseValues xs)

half :: Int -> Double
half number = ( fromIntegral number) / 2

pairwiseHalves :: [Int] -> [Double]
pairwiseHalves xs = map half xs

pairwiseHalfSums :: [Int] -> [Double]
pairwiseHalfSums xs = pairwiseHalves(pairwiseSums xs)

pairwiseTermPairs :: [Int] -> [(Int, Double)]
pairwiseTermPairs xs = zip(pairwiseDifferences xs)(pairwiseHalfSums xs)

term :: (Int,Double) -> Double
term ndPair = abs (fromIntegral (fst ndPair) / (snd ndPair))

pairwiseTerms :: [Int] -> [Double]
pairwiseTerms xs = map term (pairwiseTermPairs xs)

nPVI :: [Int] -> Double
nPVI xs = normalizer xs * sum (pairwiseTerms xs)
    where normalizer xs = 100 / fromIntegral ((length xs) - 1)
```

7b:

```
>>> pairwiseValues a
[(2,5),(5,1),(1,3)]
>>> pairwiseValues b
[(1,3),(3,6),(6,2),(2,5)]
>>> pairwiseValues c
[(4,4),(4,2),(2,1),(1,1),(1,2),(2,2),(2,4),(4,4)]
>>> pairwiseValues u
[(2,2),(2,2),(2,2),(2,2),(2,2),(2,2),(2,2),(2,2),(2,2)]
>>> pairwiseValues x
[(1,9),(9,2),(2,8),(8,3),(3,7),(7,2),(2,8),(8,1),(1,9)]
>>>
```

7c:

```
>>> pairwiseDifferences a
[-3,4,-2]
>>> pairwiseDifferences b
[-2,-3,4,-3]
>>> pairwiseDifferences c
[0,2,1,0,-1,0,-2,0]
>>> pairwiseDifferences u
[0,0,0,0,0,0,0,0,0]
>>> pairwiseDifferences x
[-8,7,-6,5,-4,5,-6,7,-8]
>>>
```

7d:

```
>>> pairwiseSums a
[7,6,4]
>>> pairwiseSums b
[4,9,8,7]
>>> pairwiseSums c
[8,6,3,2,3,4,6,8]
>>> pairwiseSums u
[4,4,4,4,4,4,4,4,4]
>>> pairwiseSums x
[10,11,10,11,10,9,10,9,10]
>>>
```

7e:

```
>>> pairwiseHalves [1..10]
[0.5,1.0,1.5,2.0,2.5,3.0,3.5,4.0,4.5,5.0]
>>> pairwiseHalves u
[1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0]
>>> pairwiseHalves x
[0.5,4.5,1.0,4.0,1.5,3.5,1.0,4.0,0.5,4.5]
>>>
```

7f:

```
>>> pairwiseHalfSums a
[3.5,3.0,2.0]
>>> pairwiseHalfSums b
[2.0,4.5,4.0,3.5]
>>> pairwiseHalfSums c
[4.0,3.0,1.5,1.0,1.5,2.0,3.0,4.0]
>>> pairwiseHalfSums u
[2.0,2.0,2.0,2.0,2.0,2.0,2.0,2.0,2.0]
>>> pairwiseHalfSums x
[5.0,5.5,5.0,5.5,5.0,4.5,5.0,4.5,5.0]
>>>
```

7g:

```
>>> pairwiseTermPairs a
[(-3,3.5),(4,3.0),(-2,2.0)]
>>> pairwiseTermPairs b
[(-2,2.0),(-3,4.5),(4,4.0),(-3,3.5)]
>>> pairwiseTermPairs c
[(0,4.0),(2,3.0),(1,1.5),(0,1.0),(-1,1.5),(0,2.0),(-2,3.0),(0,4.0)]
>>> pairwiseTermPairs u
[(0,2.0),(0,2.0),(0,2.0),(0,2.0),(0,2.0),(0,2.0),(0,2.0),(0,2.0),(0,2.0)]
>>> pairwiseTermPairs x
[(-8,5.0),(7,5.5),(-6,5.0),(5,5.5),(-4,5.0),(5,4.5),(-6,5.0),(7,4.5),(-8,5.0)]
>>>
```

7h:

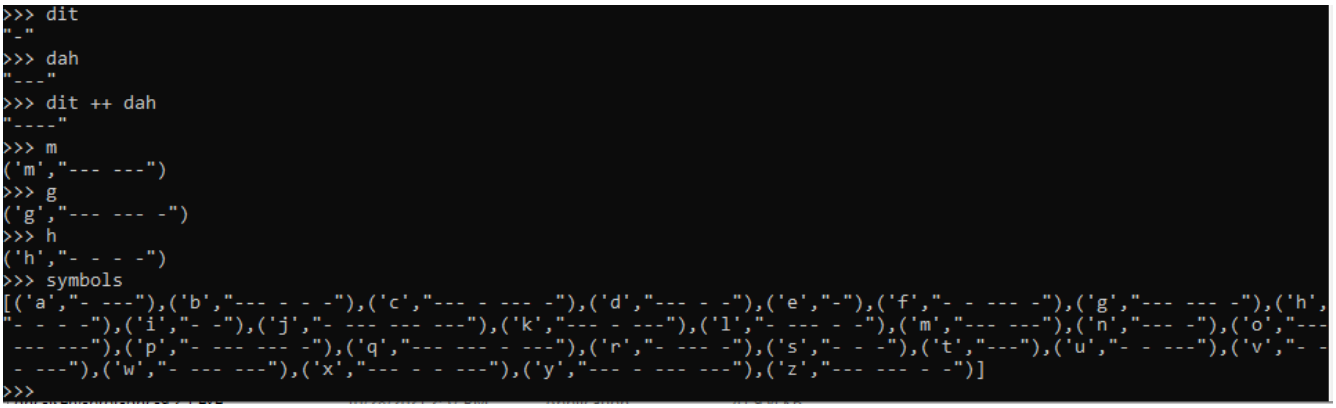
```
>>> pairwiseTerms a
[0.8571428571428571,1.3333333333333333,1.0]
>>> pairwiseTerms b
[1.0,0.6666666666666666,1.0,0.8571428571428571]
>>> pairwiseTerms c
[0.0,0.6666666666666666,0.6666666666666666,0.0,0.6666666666666666,0.0,0.6666666666666666,0.0]
>>> pairwiseTerms u
[0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0]
>>> pairwiseTerms x
[1.6,1.2727272727272727,1.2,0.9090909090909091,0.8,1.1111111111111112,1.2,1.5555555555555556,1.6]
>>>
```

7i:

```
>>> nPVI a
106.34920634920636
>>> nPVI b
88.09523809523809
>>> nPVI c
33.33333333333333
>>> nPVI u
0.0
>>> nPVI x
124.98316498316497
>>>
```

Task 8 – Historic Code: The Dit Dah Code

8a:

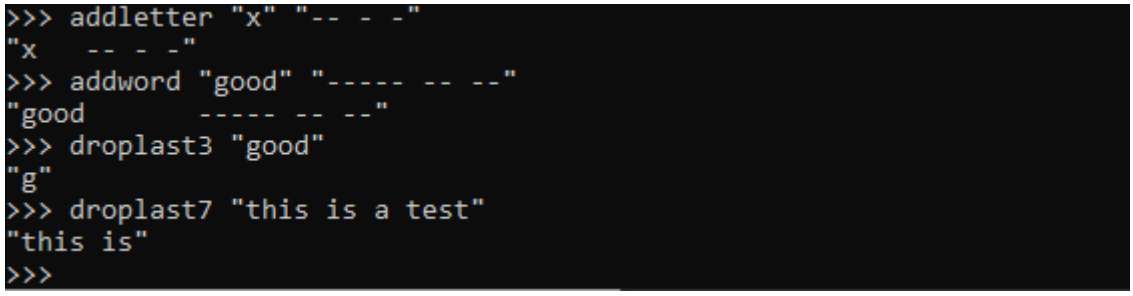


```
>>> dit
"-"
>>> dah
"---"
>>> dit ++ dah
"----"
>>> m
('m',"--- ---")
>>> g
('g',"--- --- -")
>>> h
('h',"- - - -")
>>> symbols
[('a',"- ---"),('b',"--- - - -"),('c',"--- - --- -"),('d',"--- - -"),('e',"-"),('f',"- - --- -"),('g',"--- --- -"),('h',
"- - - -"),('i',"- -"),('j',"- --- --- ---"),('k',"--- - ---"),('l',"- --- - -"),('m',"--- ---"),('n',"--- -"),('o',"---
 --- ---"),('p',"- --- --- -"),('q',"--- --- - ---"),('r',"- --- -"),('s',"- - -"),('t',"---"),('u',"- - ---"),('v',"- -
 - ---"),('w',"- --- ---"),('x',"--- - - ---"),('y',"--- - --- ---"),('z',"--- --- - -")]
>>>
```

8b:

```
>>> assoc 'x' symbols
('x',"--- - - ---")
>>> assoc 'y' symbols
('y',"--- - --- ---")
>>> find 'w'
"- --- ---"
>>> find 'z'
"--- --- - -"
>>>
```

8c:



```
>>> addletter "x" "-- - -"
"x   -- - -"
>>> addword "good" "----- -- --"
"good       ----- -- --"
>>> droplast3 "good"
"g"
>>> droplast7 "this is a test"
"this is"
>>>
```

8d:

```
>>> encodeletter 'm'
"--- ---"
>>> encodeletter 'x'
"--- - - ---"
>>> encodeletter 'y'
"--- - --- ---"
>>> encodeword "yay"
"--- - --- ---   - ---   --- - --- ---"
>>> encodeword "nay"
"--- -   - ---   --- - --- ---"
>>> encodeword "test"
"---   -   - - -   ---"
>>> encodemessage "need more coffee"
"--- -   -   -   --- - -       --- ---   --- --- ---   - --- -   -       --- - --- -   --- --- ---   - - --- -   - - ---
 -   -   -"
>>> encodemessage "secret message here"
"- - -   -   --- - --- -   - --- -   -   ---       --- ---   -   - - -   - - -   - ---   --- --- -   -       - - - -   -
   - --- -   -"
>>> encodemessage "impossible to crack"
"- -   --- ---   - --- --- -   --- --- ---   - - -   - - -   - -   --- - - -   - --- - -   -       ---   --- --- ---
   --- - --- -   - --- -   - ---   --- - --- -   --- - ---"
>>>
```