module Lists where

-- we're redefining many functions in the standard Prelude, so we
-- suppress importing them here
import Prelude hiding (length, sum, product, reverse, minimum)

-- Compute the length of a list
length :: [a] -> Integer
length [] = 0
length (_:xs) = 1 + length xs

-- Compute the sum of a list of Integers
sum :: [Integer] -> Integer
sum [] = 0
sum (x:xs) = x + sum xs

-- Compute the product of a list of Integers
product :: [Integer] -> Integer
product [] = 1
product (x:xs) = x * product xs

-- Increment all Integers in a list by a value
incBy :: [Integer] -> Integer -> [Integer]
incBy [] _ = []
incBy (x:xs) n = x + n : incBy xs n

-- Update the nth Integer in a list with a new value, if the list is
-- long enough. (Does nothing otherwise.)
updateByIndex :: Integer -> Integer -> [Integer] -> [Integer]
updateByIndex _ _ [] = []
updateByIndex 0 y (x:xs) = y : xs
updateByIndex n y (x:xs) = x : updateByIndex (n-1) y xs

-- Append two lists
append :: [a] -> [a] -> [a]
append [] ys = ys
append (x:xs) ys = x : append xs ys

-- Add an element to the end of a list.
snoc :: [a] -> a -> [a]
snoc [] y = [y]
snoc (x:xs) y = x : snoc xs y

-- Reverse the elements in a list
reverse :: [a] -> [a]
reverse [] = []
reverse (x:xs) = snoc (reverse xs) x

-- This runs in O(n^2) time where n is the length of the list; why?

-- Reverse the elements in a list in linear time
fastReverse :: [a] -> [a]
fastReverse xs = go [] xs
  where
go acc [] = acc
    go acc (x:xs) = go (x:acc) xs

-- Compute both the quotient and modulus of two numbers
divMod :: Integer -> Integer -> (Integer, Integer)
divMod n d = (n \div' d, n \mod' d)

-- Split a list into evens and odds
evensOdds :: [Integer] -> ([Integer], [Integer])
evensOdds [] = ([], [])
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73:  evensOdds (x:xs)
74:   | even x    = (x:evens, odds)
75:   | otherwise = (evens, x:odds)
76:   where -- a "where" scopes over multiple guarded equations
77:     (evens, odds) = evensOdds xs
78:
79: -- Divide one number by another, returning Nothing if the divisor is 0
80:  safeDiv :: Integer -> Integer -> Maybe Integer
81:   -- "Maybe" offers the possibility of failure, called Nothing
82:   -- success is called Just
83:     safeDiv _ 0 = Nothing
84:     safeDiv n d = Just (n 'div' d)
85:
86: -- Retrieve the first element of a list, if one exists
87:  safeHead :: [a] -> Maybe a
88:     safeHead []    = Nothing
89:     safeHead (x:_) = Just x
90:
91: -- Retrieve the tail of a list, if it exists
92:  safeTail :: [a] -> Maybe [a]
93:     safeTail []    = Nothing
94:     safeTail (_:xs) = Just xs
95:
96: -- Compute the minimum of a list, if it exists
97:  minimum :: Ord a => [a] -> Maybe a
98:   -- The "Ord a =>" constraint says that the type a is ordered.
99:     minimum []     = Nothing
100:    minimum (x:xs) = Just (go x xs)
101:   where
102:     go x [] = x
103:     go x (y:ys)
104:       | x < y     = go x ys
105:       | otherwise = go y ys
106:
107: -- Tests whether or not the argument equals itself.
108:  isReflexive :: Eq a => a -> Bool
109:     isReflexive x = x == x