

1 Problem

If p is the perimeter of a right angle triangle with integral length sides, (a, b, c) , there are exactly three solutions for $p = 120$.

$$\{20, 48, 52\}, \{24, 45, 51\}, \{30, 40, 50\}$$

For which value of $p < 1000$, is the number of solutions maximised?

2 Solution

```
import Data.List
import qualified Data.Map as Map
import Data.Maybe
import System.Environment
import qualified Data.Set as Set

isRightTriangle :: (Integral a) => a -> a -> a -> Bool
isRightTriangle a b c = c'  $\uparrow$  2  $\equiv$  a'  $\uparrow$  2 + b'  $\uparrow$  2
  where [a', b', c'] = sort [a, b, c]

isRight :: (Integral a) => Triangle a -> Bool
isRight t = c  $\uparrow$  2  $\equiv$  a  $\uparrow$  2 + b  $\uparrow$  2
  where [a, b, c] = sort [aa t, bb t, cc t]

data (Integral a) => Triangle a = Triangle
  { aa :: a
  , bb :: a
  , cc :: a
  } deriving (Show, Read, Ord, Eq)

triWithPerim :: (Integral a) => a -> [Triangle a]
triWithPerim p =
  let cs = [(p `div` 3) .. (p `div` 2)]
      ts = concat $ map (\c -> map (\b -> Triangle (minimum $ sort [b, c, p - b - c]) ((sort [b, c, p - b - c]) !! 2)) $ filter (\b -> isRight (Triangle b c (p - b - c))) [1..c-1]) cs
  in Set.toList $ Set.fromList $ filter isRight ts

main = do
  let tris = map (\ts -> (length ts, (aa o head) ts + (bb o head) ts + (cc o head) ts)) $ filter (\lz -> z  $\neq$  []) $ map (\p -> (triWithPerim p)) [1..1000]
      maxVal = maximumBy (\a b -> compare (fst a) (fst b)) tris
  putStrLn $ "The largest number of solutions (" ++ (show o fst) maxVal ++ ")"
    ++ " is reached when p=" ++ (show o snd) maxVal ++ "."
```

3 Result

```
runhaskell problem39.1.hs
```