

FizzBuzz in Haskell

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Introducing Haskell

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4. Recursion

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3. Haskell is for academic ivory-towerists who do too much category theory for their own good
 - 3.1 Haskell is actually a very practical language for all sorts of tasks, and it has been battletested in industry for decades

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How would you solve FizzBuzz?

Lists in Haskell

```
data [a] = [] | a : [a]
-- data List a = Empty | Cons a (List a)
-- (:) x xs == x : xs
-- ([]) a == [a]
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```

1. Data declarations
2. Parametric data declarations
3. Special syntax for stuff

What does it look like?

```
firstFourPrimes :: [Int]
firstFourPrimes = 2:(3:(5:(7:[])))

everFlavoredBeanFlavors :: [String]
everFlavoredBeanFlavors =
    ["earwax", "vomit", "marmalade", "spinach"]
```

(put drawing of a linked list here)

A useful function

```
range :: Int -> Int -> [Int]
range n m
  | n == m      = m:[]
  | otherwise    = m:(range (n+1) m)
-- range n m == [n..m]
```

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1. Currying

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-- range n m == [n..m]
```

1. Currying
2. Guard Notation

Functors! (Scary? No!)

```
class Functor f where
  fmap :: (a -> b) -> f a -> f b

instance Functor ([]) where
  fmap g [] = []
  fmap g (x:xs) = (g x):(fmap g xs)
  -- fmap :: (a -> b) -> ([]) a -> ([]) b
  -- fmap :: (a -> b) -> [a] -> [b]
```

What does it look like?

(put drawing of a functor diagram here)

Luke, use the fmap!

```
-- String == [Char]

fizzbuzz1 :: Int -> String
fizzbuzz1 n
  | rem n 15 == 0 = "FizzBuzz"
  | rem n  5 == 0 = "Buzz"
  | rem n  3 == 0 = "Fizz"
  | otherwise    = show n

sol1 :: [String]
sol1 = fmap describeNumber [1..100]
```

Discuss first solution

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2. What did we not like?

Discuss first solution

1. What did we like?
 - 1.1 Types and Typeclasses!
 - 1.2 Recursion!
 - 1.3 Combinators that allowed us to not do recursion!
 - 1.4 Case syntax!
2. What did we not like?
 - 2.1 Not extensible enough! (What about Bazz??)

FizzBuzzBazz

```
fizzbuzzbazz1 :: Int -> String
fizzbuzzbazz1 n
  | rem n 105 == 0 = "FizzBuzzBazz"
  | rem n  35 == 0 = "BuzzBazz"
  | rem n  21 == 0 = "FizzBazz"
  | rem n  15 == 0 = "FizzBuzz"
  | rem n   7 == 0 = "Bazz"
  | rem n   5 == 0 = "Buzz"
  | rem n   3 == 0 = "Fizz"
  | otherwise      = show n
```

FizzBuzzBazz

```
fizzbuzzbazz1 :: Int -> String
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  | rem n   5 == 0 = "Buzz"
  | rem n   3 == 0 = "Fizz"
  | otherwise      = show n
```

This is terrible!

And now for something completely different

```
class Monoid m where
  mempty :: m
  mappend :: m -> m -> m
  -- (<>) == mappend
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```
a <> mempty == a == mempty <> a
```

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1. Identity

```
a < > mempty == a == mempty < > a
```

2. Associativity

And now for something completely different

```
class Monoid m where
  mempty :: m
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```

We require a couple laws

1. Identity

$$a \langle \rangle \text{mempty} == a == \text{mempty} \langle \rangle a$$

2. Associativity

$$(a \langle \rangle b) \langle \rangle c == a \langle \rangle (b \langle \rangle c)$$

You already know lots of monoids!

Take a couple minutes and think of monoids.

List Monoid

```
(++) :: [a] -> [a] -> [a]  
[] ++ ys = ys  
(x:xs) ++ ys = x:(xs ++ ys)
```

```
instance Monoid [a] where  
  mempty = []  
  mappend = (++)
```


Maybe Monoid

```
data Maybe a = Just a | Nothing

instance (Monoid a) => Monoid (Maybe a) where
    mempty = Nothing
    mappend Nothing Nothing = Nothing
    mappend (Just a) Nothing = Just a
    mappend Nothing (Just b) = Just b
    mappend (Just a) (Just b) = Just (a <> b)
```

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```

Note the "type constraint" in the instance for the Maybe monoid; we need this in order to deal with the last case.

Two useful functions

```
foldl :: (a -> b -> a) -> a -> [b] -> a
foldl f acc [] = acc
foldl f acc (x:xs) = foldl f (f acc x) xs
-- sum == foldl (+) 0
-- length == foldl (\n _ -> n + 1) 0
```

```
mconcat :: (Monoid m) -> [m] -> m
mconcat = foldl mappend mempty
-- mconcat ["tweedle", "dee"] == "tweedledee"
```

Working with Maybes

```
fromMaybe :: a -> Maybe a -> a
fromMaybe def Nothing = def
fromMaybe _ (Just y) = y

makeMaybe :: Bool -> a -> Maybe a
makeMaybe True x = Just x
makeMaybe False _ = Nothing
```

FizzBuzz revisited

```
zzer1 :: [(Int, String)] -> Int -> String
zzer1 zzConds n = fromMaybe (show n) zzs
  where
    zzs = mconcat (fmap maybeZz zzConds)
    maybeZz (k, zz) = makeMaybe (rem n k == 0) zz

sol2 :: [String]
sol2 = fmap (zzer1 fizzbuzz) [1..100]
  where fizzbuzz = [(3, "Fizz"), (5, "Buzz")]
```

Reflections on take 2

What do we like?

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Reflections on take 2

What do we like?

1. Much more extensible!
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What do we not like?

1. Division

Infinity and Beyond!

(Talk about infinite lists)

FizzBuzz: The Final Showdown

```
looper :: Int -> a -> [Maybe a]
looper n s = loop (n-1)
  where
    loop 0 = (Just s):(loop (n-1))
    loop k = Nothing:(loop k-1)

zzer2 :: [(Int, String)] -> [Maybe String]
zzer2 zzConds = foldl (zip (<>)) zzLists
  where zzLists = map (uncurry looper) zzConds

sol3 :: [String]
sol3 = zip fromMaybe (fmap show [1..100]) zzs
  where zzs = zzer2 [(3,"Fizz"), (5,"Buzz")]
```