Why teaching functional programming to undergraduates at CUNY is important

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Monoid Definition

Definition (Monoid definition)

A data type, category or set is a monoid if it has a binary operation $\bullet$ which is associative and has an identity.

- $\forall a, b, c \in S, (a \bullet b) \bullet c = a \bullet (b \bullet c)$
- $e \bullet a = a \bullet e = a$

```
:set +m
:{
class Monoid m where
    mempty :: m
    mappend :: m -> m -> m
    mconcat :: [m] -> m
    mconcat = foldr mappend mempty
:}
```

Monoid functions defined

Defining the monoid functions

- 'mempty' is just the identity function
- mappend is the binary function
  - it doesn't just append
- mconcat reduces a list of monoid values and reduces them to one by applying mappend

Monoid Laws

Theorem (The Monoid Laws are just the definition in Haskell)

- $mappend\ mempty\ x = x$
- $mappend\ x\ mempty = x$
- $mappend\ (mappend\ x\ y)\ z = mappend\ x\ (mappend\ y\ z)$

Monoid examples

Example (List is a monoid)

- [] with (++) is a monoid
  - id = ""
- Natural numbers with (*) is a monoid
  - id = 1
- Natural numbers with (+) is a monoid
  - id = 0