



**Revisiting the State-Based CRT class**

A state-based CRDT is an algebraic structure: a set of values and operations that set

• Different algebraic structures have different laws

• A set of  $n$  associative binary operations is a semigroup

- A **semigroup** + a **neutral element**, such that  $\forall x: \text{merge}(e, x) = x$ , is a **monoid**

Answering that is also not a simple matter

**And, that is also a beautiful thing**



- So a state-based CRDT is a commutative and idempotent monoid, or bounded semilattice

# Revisiting the StateBasedCRDT class

- A state-based CRDT is an *algebraic structure*: a set + lawful operations on that set
- Different algebraic structures have different laws
  - A set + an associative binary operation is a **semigroup**
  - A semigroup + a neutral element, such that  $\forall x : \text{merge}(e, x) = e$ , is a **monoid**
  - A semigroup that is also commutative and idempotent is a **semilattice**
  - A monoid, that is also commutative and idempotent is a **bounded semilattice**
- So a state-based CRDT is a commutative and idempotent monoid, or bounded semilattice

A set + an associative binary operation is a **semigroup**

```
class Semigroup a where  
  append :: a → a → a
```