a stripe talk

# Aggregator: MapReduce in the type system

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# Data at Stripe

- Units: cards, users, customers, transactions
- Product usage analytics for business / product development, machine learning for fraud prevention, and much more
- Today: Use Aggregator on this data to predict fraud

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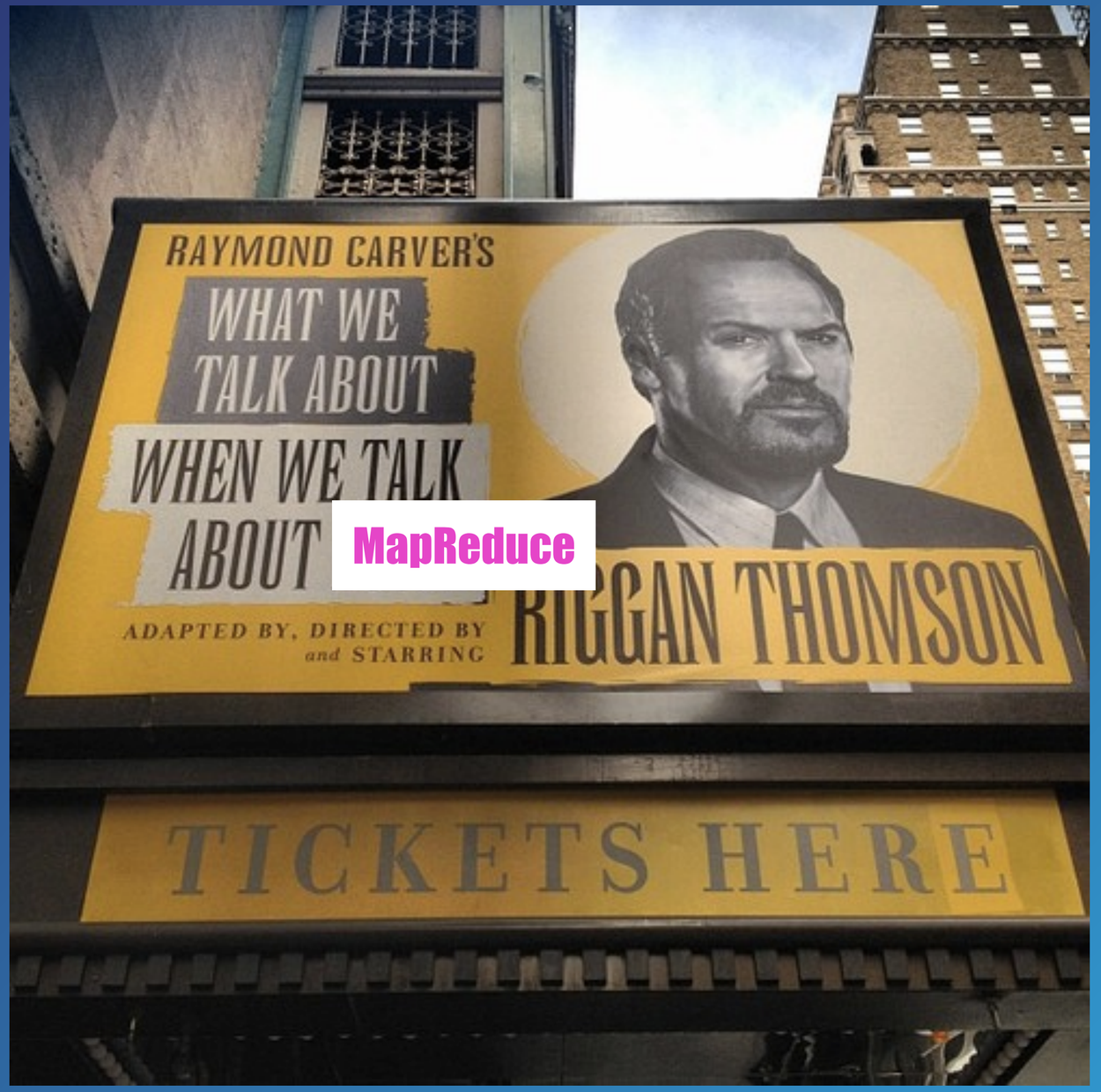
RAYMOND CARVER'S
WHAT WE TALK ABOUT
WHEN WE TALK ABOUT
MapReduce
ADAPTED BY, DIRECTED BY and STARRING
RIGGAN THOMSON
TICKETS HERE

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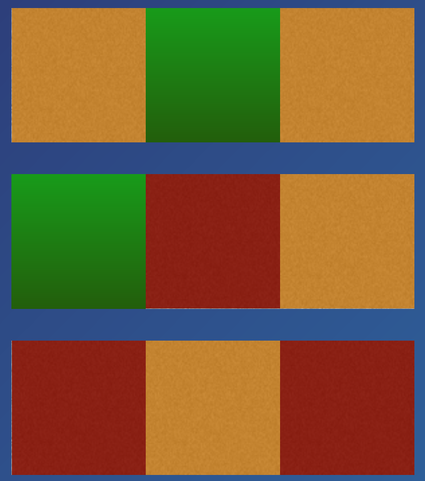
# Raw Data



# Properties

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# Further Reduction


Max = 4
Mean = 3
Std = 0.82

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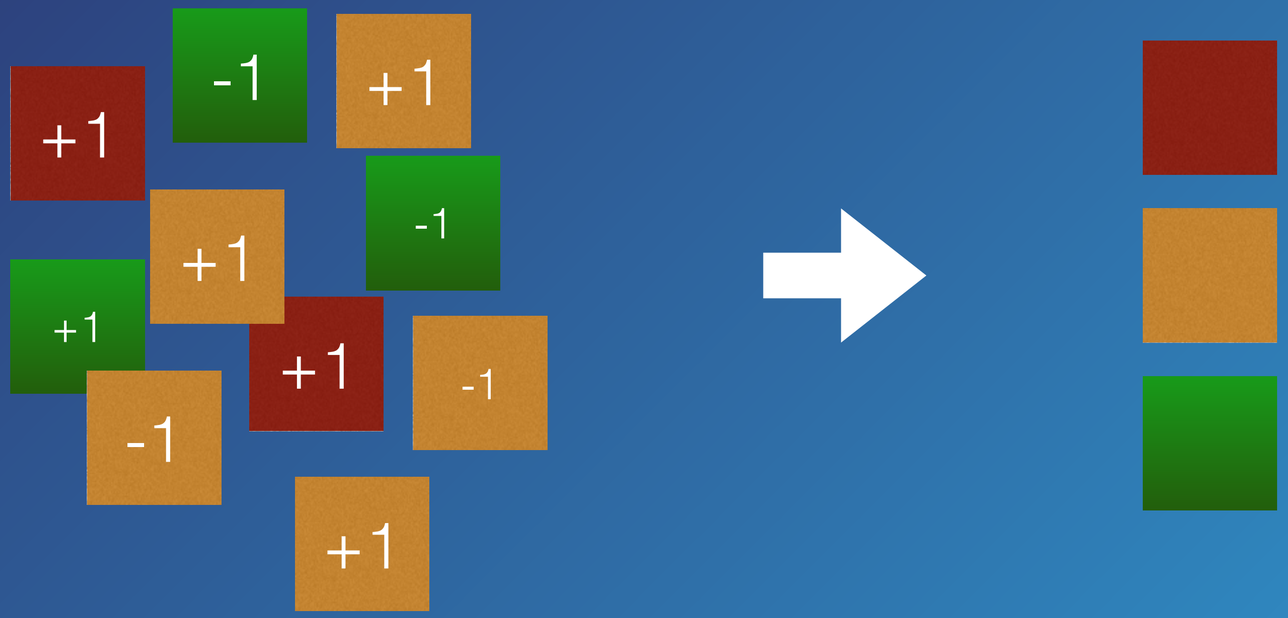
# Example: Comment Ranking



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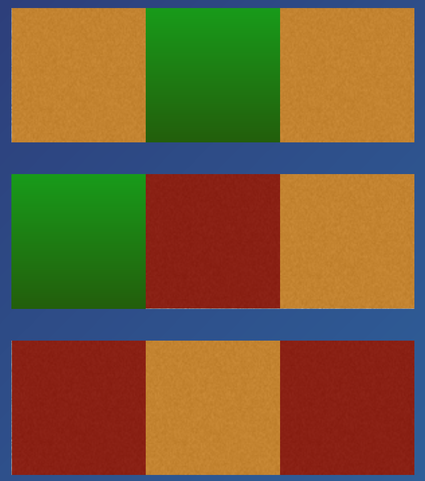
# Raw Data



# Properties

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# Example: How many charges per merchant?

```
1  SELECT merchant, COUNT(*)
2  FROM charges
3  GROUP BY 1
```

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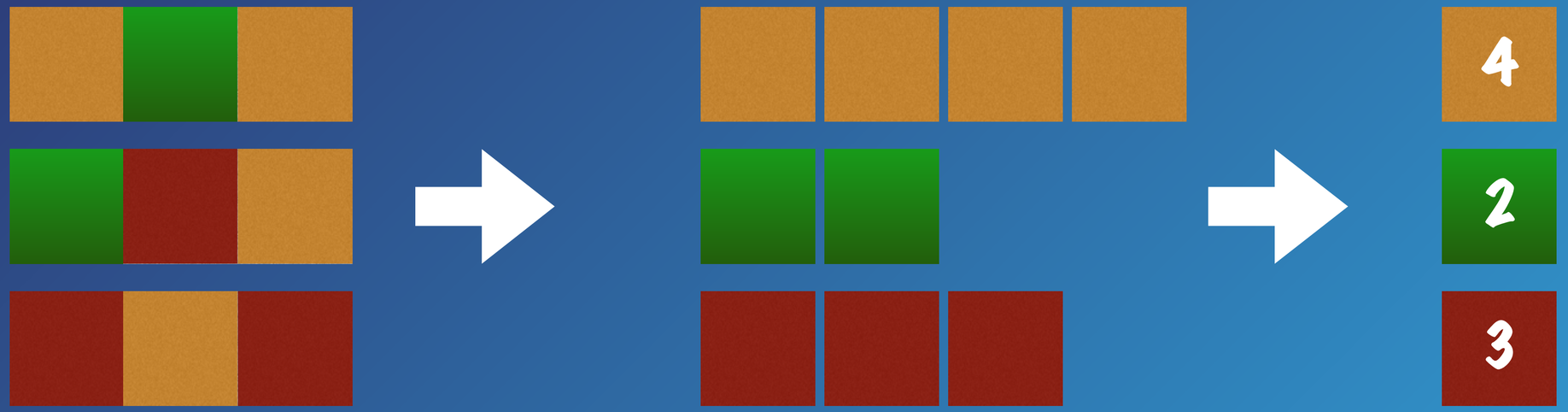

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```
map(K1,V1) => (K2,V2)
reduce(K2,Seq[V2]) => (K3,V3)
```

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# Example: How many charges per merchant?

```
1  def map(charge):
2      yield (charge['merchant'], 1)
3
4  def reduce(key, values):
5      yield (key, sum(values))
```

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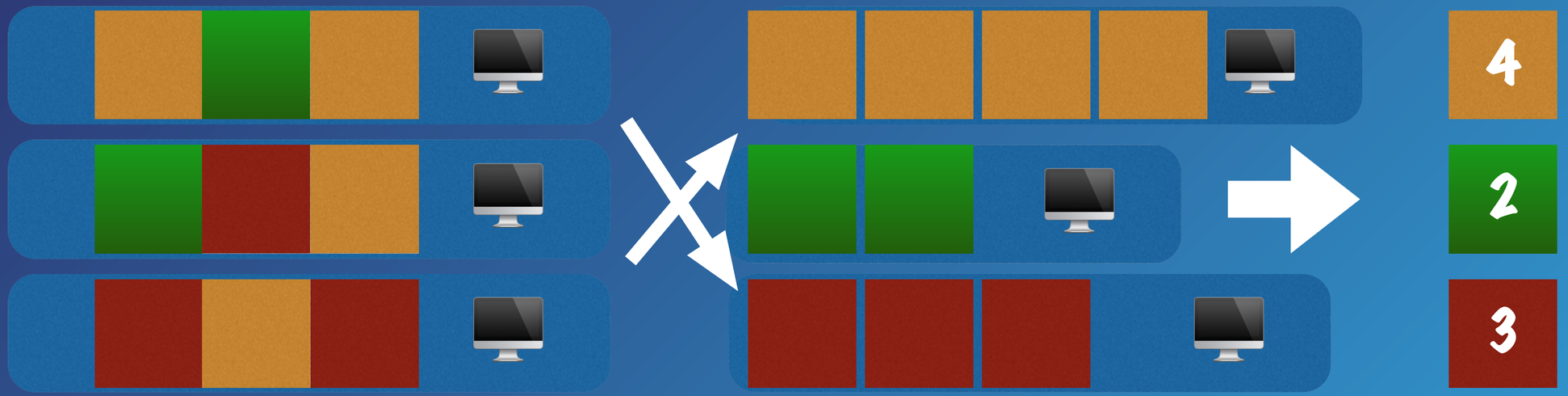
# Why MapReduce?



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# Breaking the decomposition boundary

(Orange, 1)

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# The "real" components

- Group data points by entities of interest (keys)
- Reduce a sequence of data points to a quantity of interest

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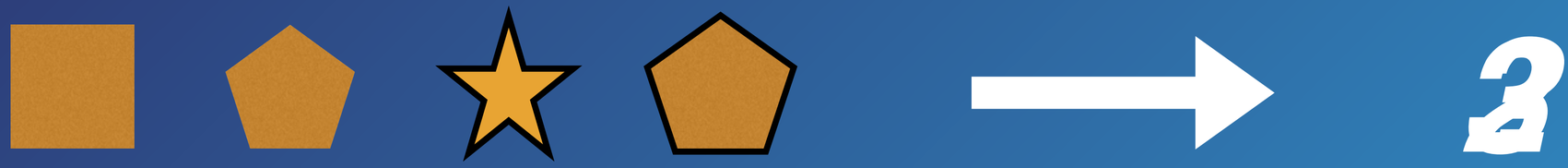

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# Example: How many cards per merchant?

```
1  SELECT merchant, COUNT(DISTINCT(card))
2  FROM charges
3  GROUP BY 1
```

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# Example: How many cards per merchant?

```
1  def map(_, charge):
2      yield (charge['merchant'], charge['card'])
3
4  def reduce(key, values):
5      yield (key, len(set(values)))
```

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# Aggregator

- Scala trait in Algebird: "Abstract Algebra for Scala"
- Use types to guide composition and reuse
- Agnostic to execution platform

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# Example: How many cards per merchant?

```
Seq[Charge] => Int
```

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# Computation type

```
Seq[Charge] => Set[Card] => Int
```

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```
val chars = List('S', 'C', 'A', 'L', 'A')

chars.map(_ => 1).reduce(_ + _) // => 5

chars.map(Set(_)).reduce(_ ++ _).size // => 4
```

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# Aggregator Components

```
Aggregator[A,B,C]

  prepare: A => B
reduce: (B, B) => B
  present: B => C
```

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# Example: How many cards per merchant?

```
1 class MerchantCardCount extends Aggregator[Charge, Set[Card], Long] {
2     def prepare(a: Charge) = Set(a.card)
3
4     def reduce(b1: Set[Card], b2: Set[Card]) = b1 + b2
5
6     def present(b: Set[Card]) = b.size
7 }
```

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# The Next Level

- Composition, reuse, and the "standard library"
- Aggregator execution patterns
- Aggregator and fraud at Stripe

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# Leveraging the standard library

```
Aggregator.uniqueCount[Card]
```

```
[Card, Set[Card], Int]
```

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# composePrepare

```
Aggregator.uniqueCount[Card]
    .composePrepare(a: Charge => a.card)
```

```
[Charge, Set[Card], Int]
```

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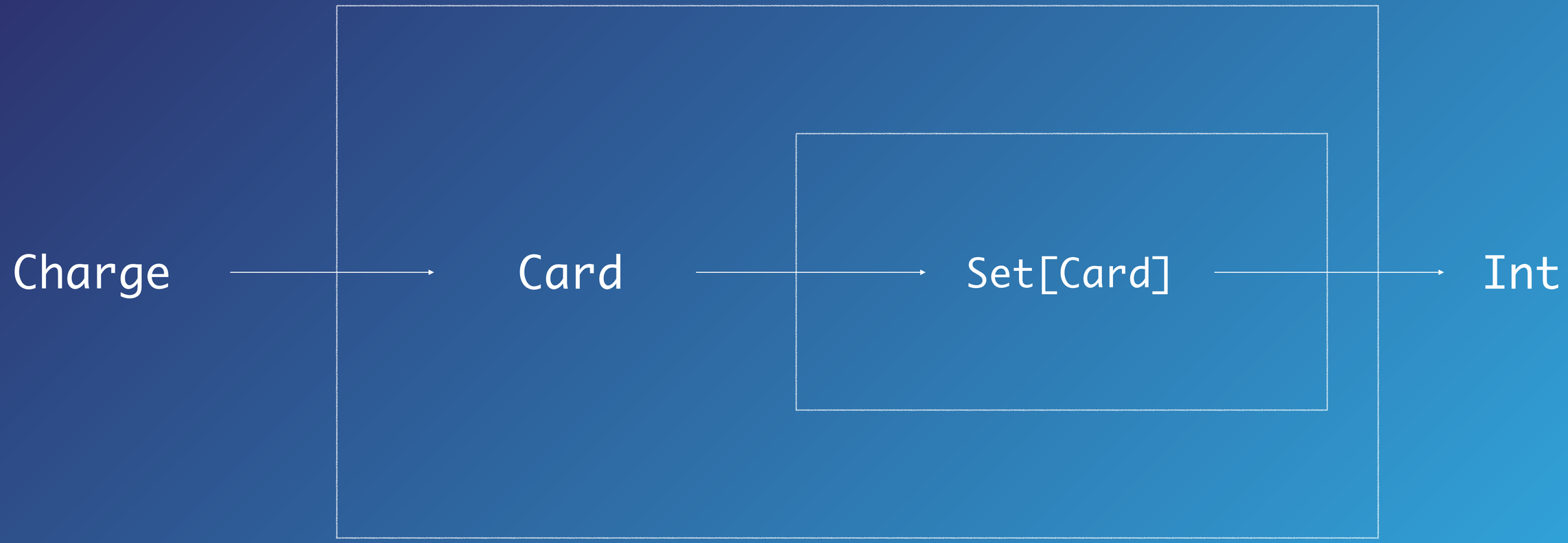

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# *Really* leveraging the standard library

```
SetSizeAggregator[Card](10) // bits for hll
    .composePrepare(a: Charge => a.card)
```

```
[Charge, HLL[Card] , Int]
```

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Approx Set Size -> HyperLogLog

Approx Item Count -> CountMinSketch

Approx Quantiles -> QTree

Heavy Hitters, Decayed Value, etc..

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# Aggregator Execution

```
apply(inputs: TraversableOnce[A]): C
```

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# MapReduce with Aggregator

```
def map(v: V) = (key(v), V)

def reduce(k: K, vs: Seq[V]) = agg(vs)
```

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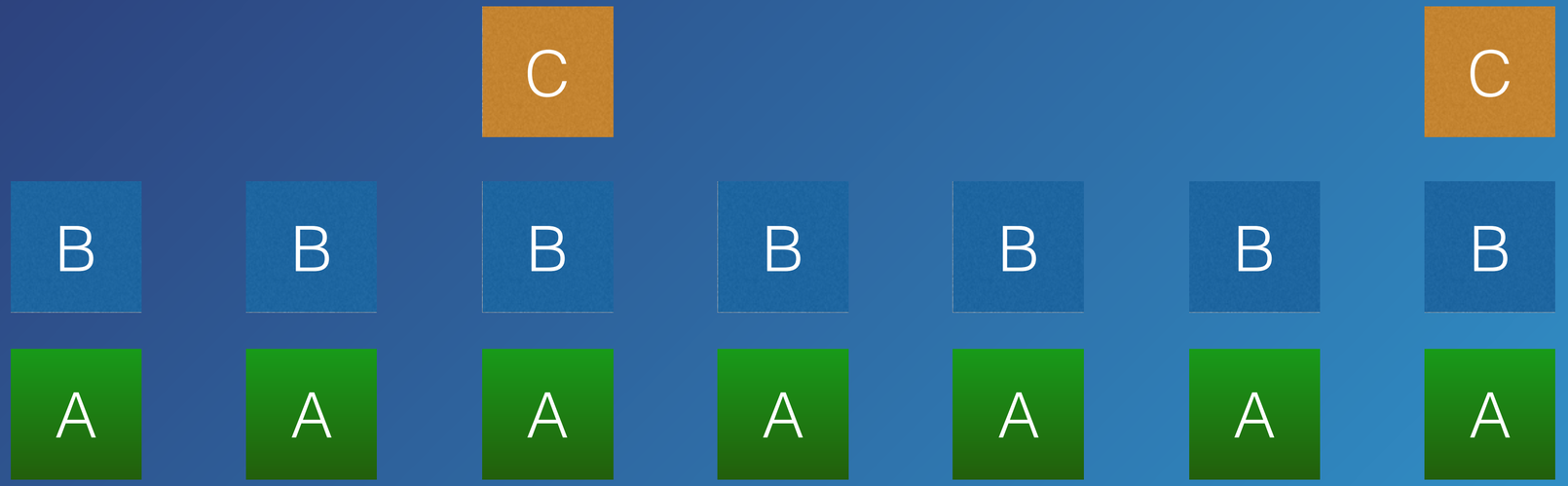
# More execution



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# Fraud Prevention at Stripe

- Merchants as bad actors
- Detect via activity on Stripe (charges)

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# Predictive Model

When evaluating a merchant, compute score like:

```
sum(weight1*feature1 + weight2*feature2 + ...)
```

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Static Features: Location, Time of Day...

Dynamic Features: Mean Charge Amount, Number of Cards

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# Feature: Number of international cards

```
def internationalCard(c: Charge): Option[Card] = ???

SetSizeAggregator[Card](10) // our normal SetSize
    .sumBefore() // make it work with Option
    .composePrepare(a: Charge => a.internationalCard)
```

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# Composing Aggregators

```
val intlRatio: Aggregator[A, (B1, B2), (C1, C2)] =
    from2(intlCards, totalCards)
```

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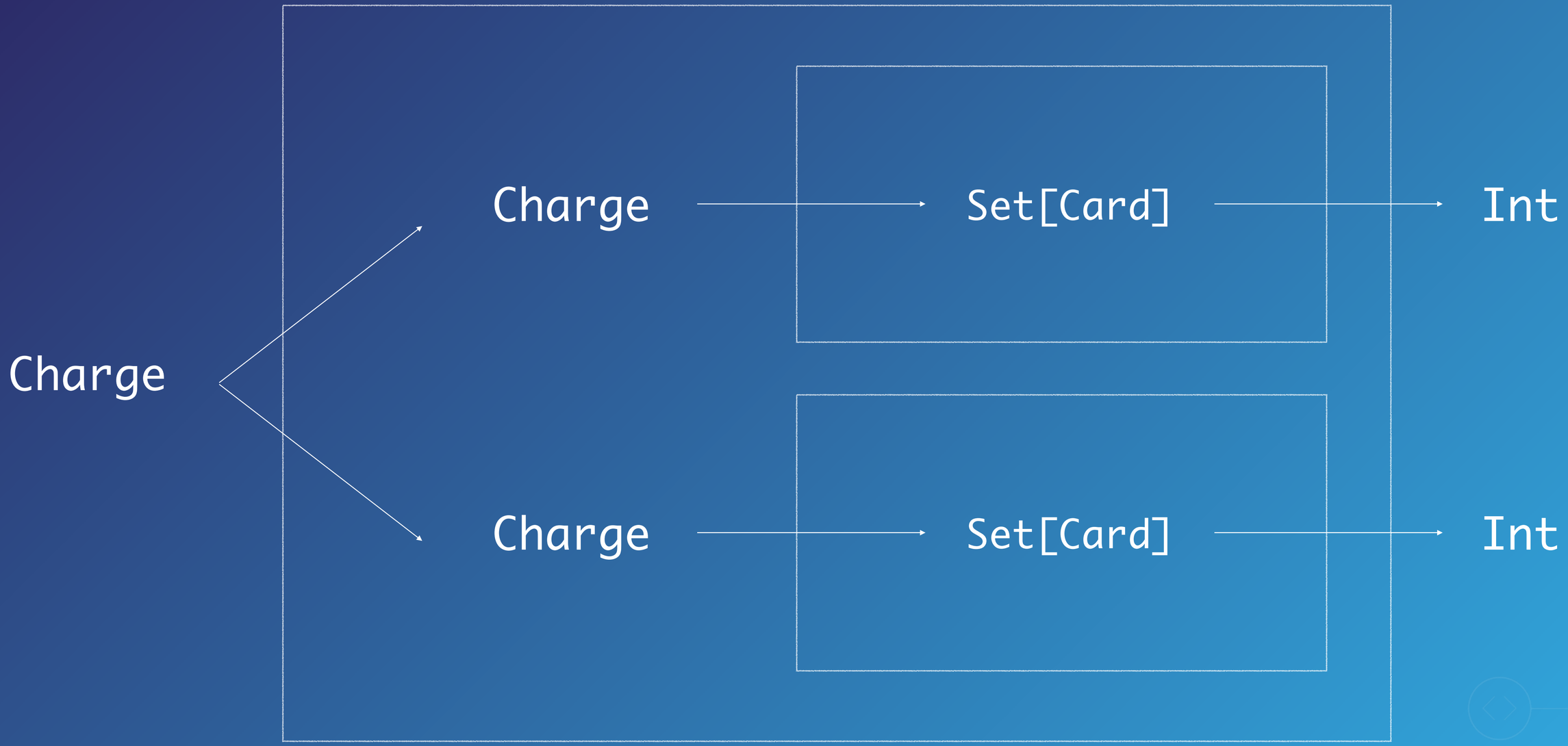

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# andThenPresent

```
val intlRatio: Aggregator[A, (B1, B2), Double] =
    from2(intlCards, totalCards)
    .andThenPresent(case (intl,total) => intl / total)
```

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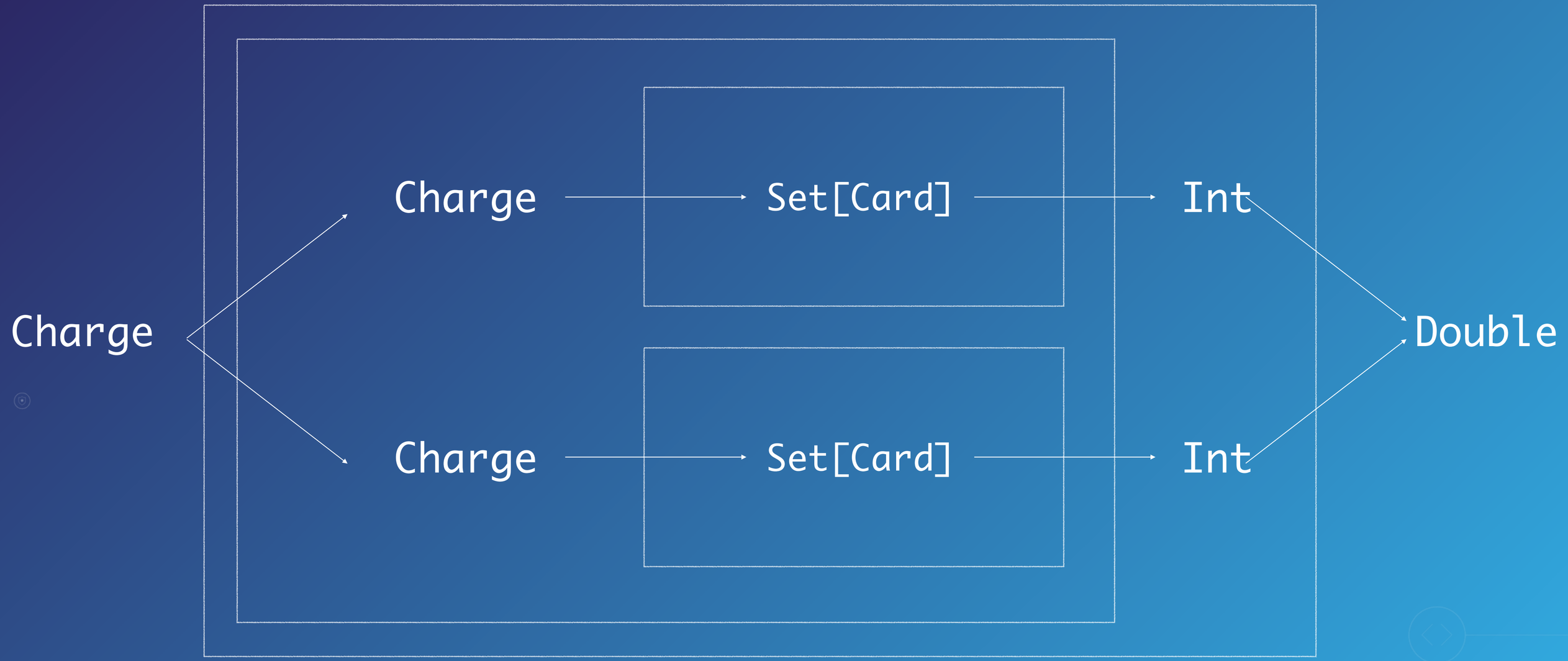

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# More features, no problem

```
val features = from2(intlRatio, prepaidRatio)
    .andThenPresent(toJson(_))
```

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# Fraudsters Don't Run on Cron

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# Beyond Hadoop

- Summingbird: run MapReduce-like code on Storm or Hadoop
- Combine results from two platforms at read-time
- Run complex calculations with Algebird + Aggregator

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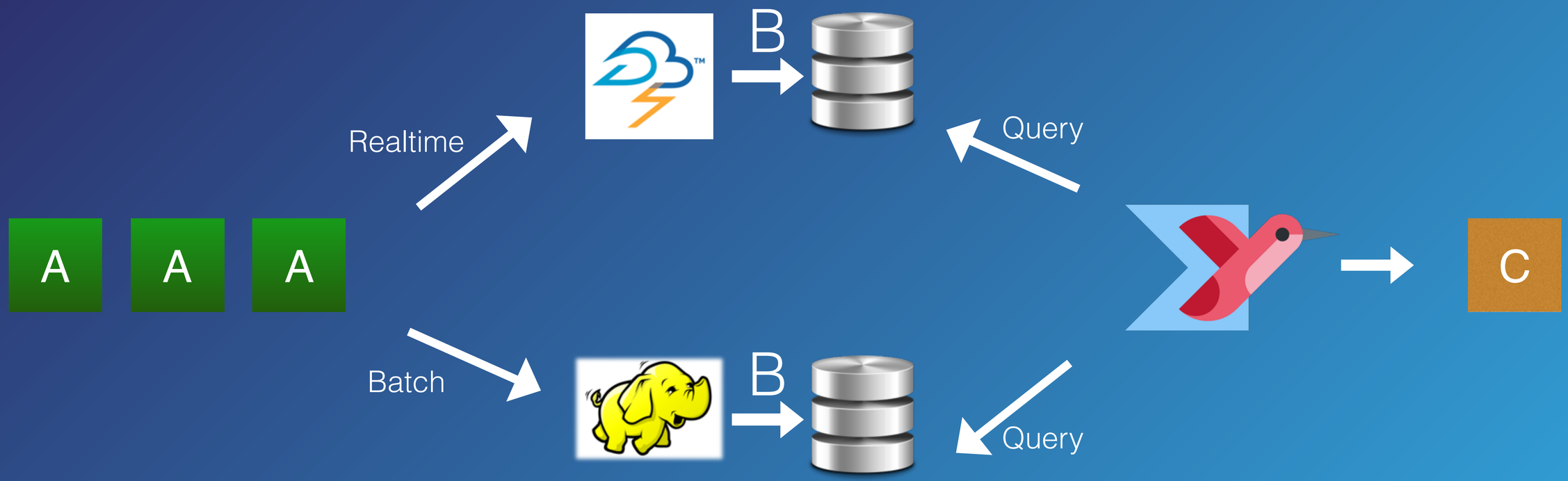

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# Recap

- Reduction (and MapReduce) at heart of data analysis
- Aggregator defines reduction in the type system
- (De)composability encourages reuse
- Execution-agnosticism encourages flexibile deployments

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# Thanks.

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