Apache Spark

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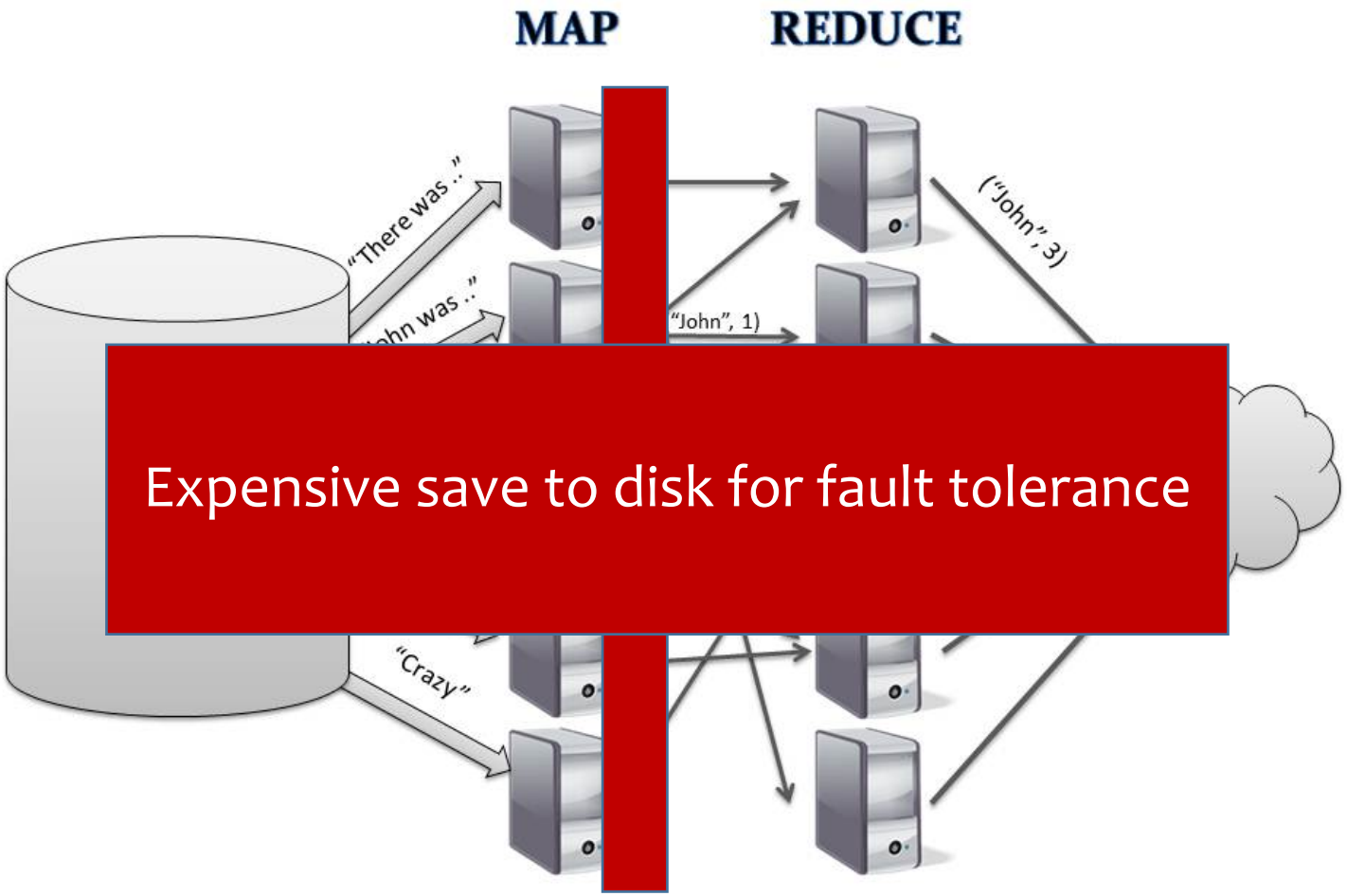
CS425, UIUC

Why Spark?

- Another system for big data analytics

- Isn’t MapReduce good enough?
  - Simplifies batch processing on large commodity clusters

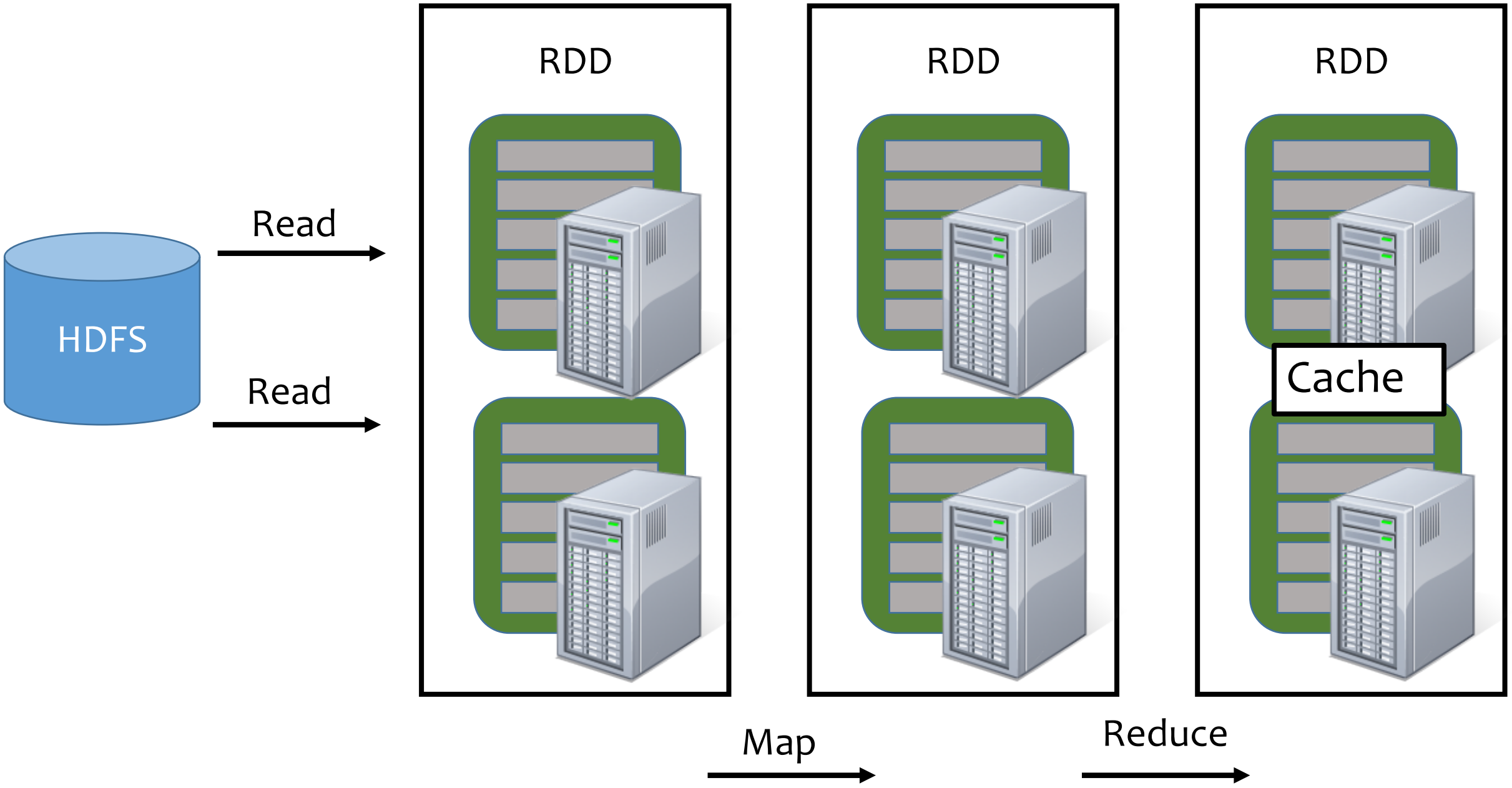

MAP
REDUCE
"There was .."
"John was .."
"Crazy"
"John", 1)
("John", 3)
Expensive save to disk for fault tolerance

Why Spark?

- MapReduce can be expensive for some applications e.g.,
  - Iterative
  - Interactive
- Lacks efficient data sharing
- Specialized frameworks did evolve for different programming models
  - Bulk Synchronous Processing (Pregel)
  - Iterative MapReduce (Haloop) ….

Solution: Resilient Distributed Datasets (RDDs)

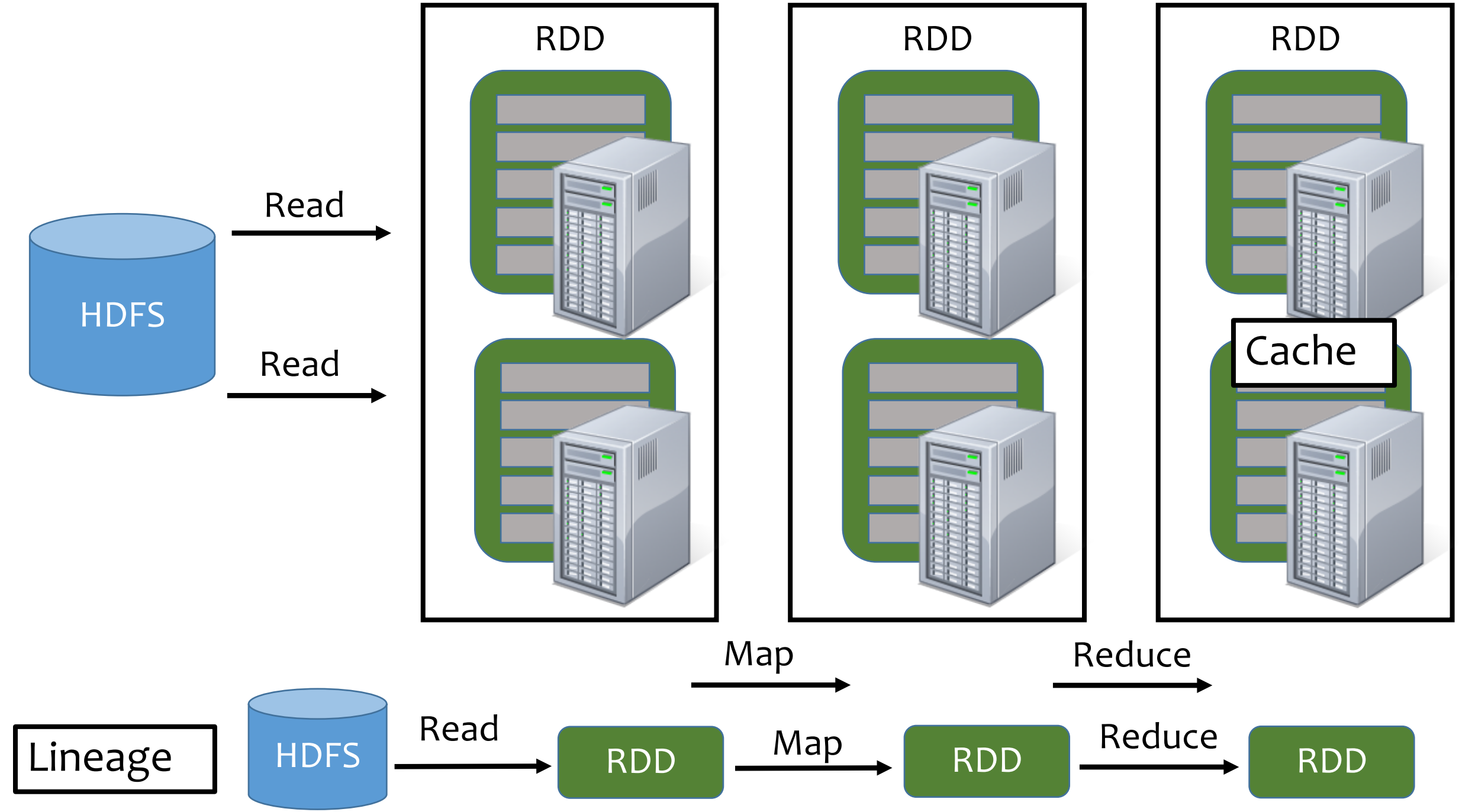
- RDDs
  - Immutable, partitioned collection of records
  - Built through coarse grained transformations (map, join …)
  - Can be cached for efficient reuse

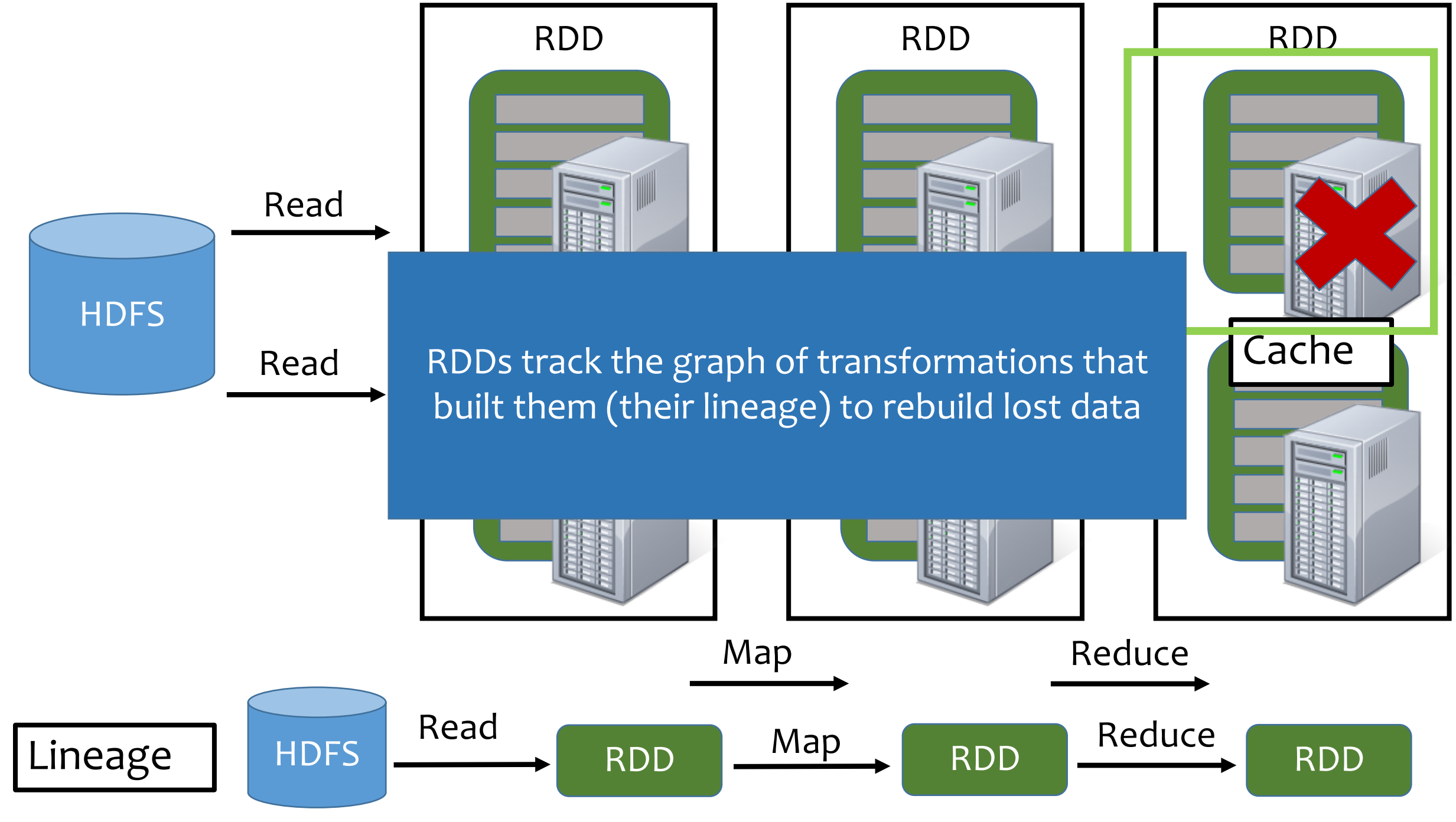

HDFS
Read
Read
RDD
RDD
RDD
Cache
Map
Reduce

Solution: Resilient Distributed Datasets (RDDs)

- RDDs
  - Immutable, partitioned collection of records
  - Built through coarse grained, ordered transformations (map, join …)

- Fault Recovery?
  - Lineage!
    - Log the coarse grained operation applied to a partitioned dataset
    - Simply recompute the lost partition if failure occurs!
    - No cost if no failure


RDD
RDD
RDD
Cache
HDFS
Read
Read
Map
Reduce
Lineage
HDFS
Read
RDD
Map
RDD
Reduce
RDD

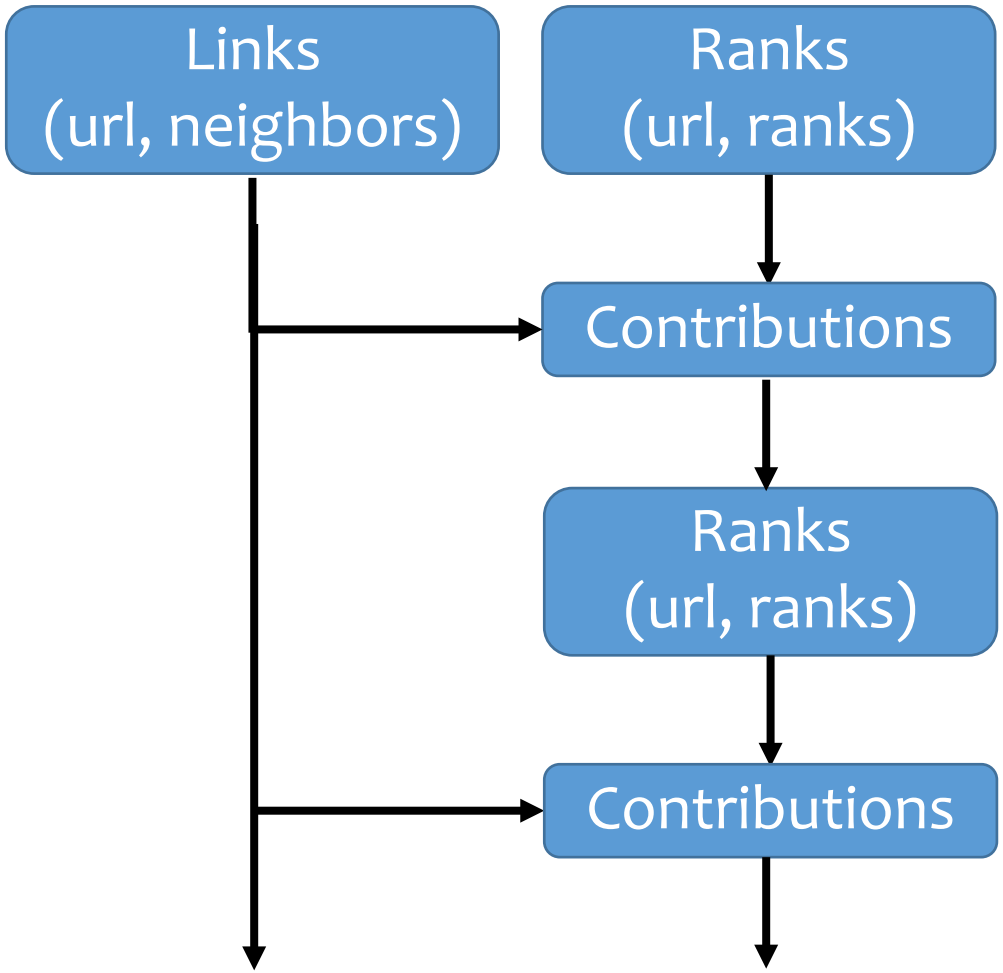

RDD
RDD
RDD
Read
HDFS
Read
RDDs track the graph of transformations that built them (their lineage) to rebuild lost data
Cache
Map
Reduce
Lineage
HDFS
Read
RDD
Map
RDD
Reduce
RDD

What can you do with Spark?

- RDD operations
  - Transformations e.g., filter, join, map, group-by …
  - Actions e.g., count, print …
- Control
  - Partitioning
  - Persistence

Partitioning

- PageRank

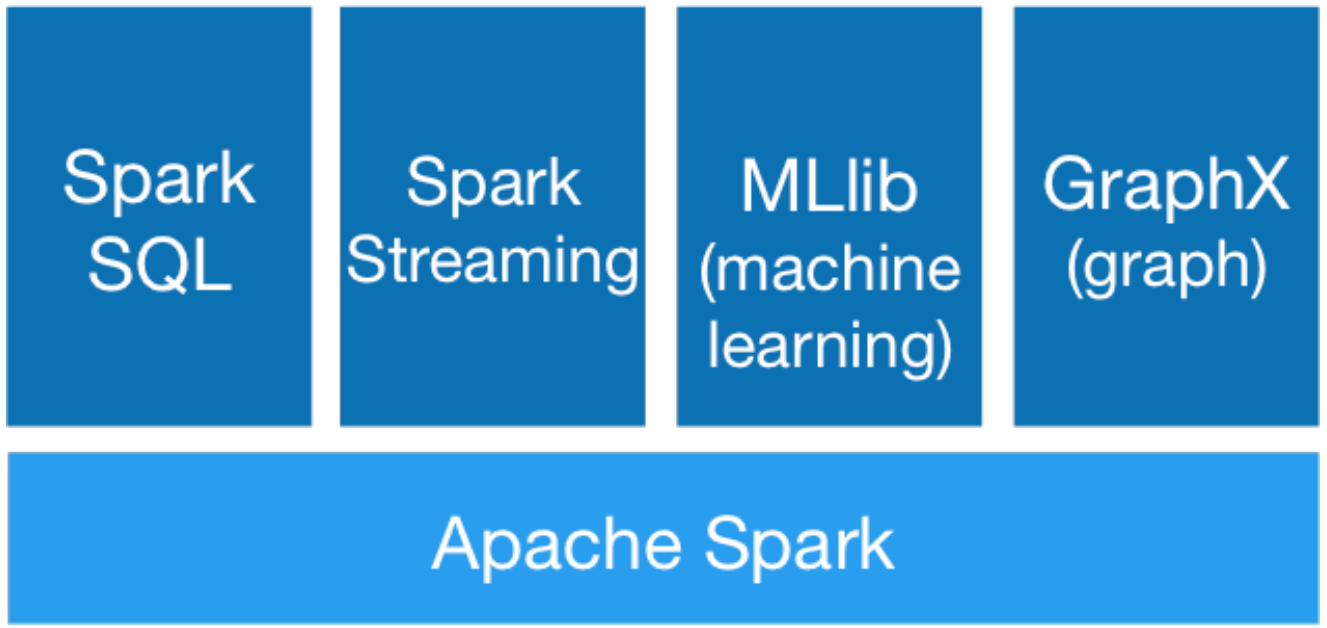


Joins take place repeatedly

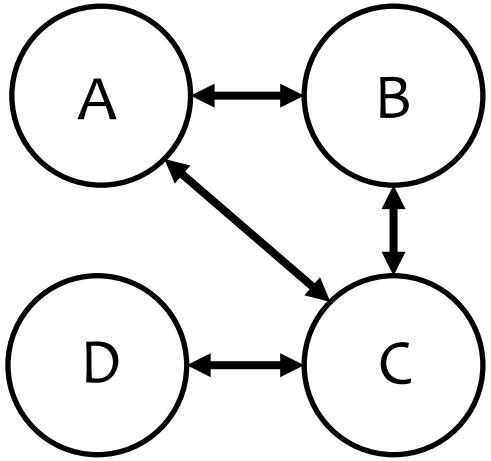
Good partitioning reduces shuffles

Generality

- RDDs allow unification of different programming models
  - Stream Processing
  - Graph Processing
  - Machine Learning …..

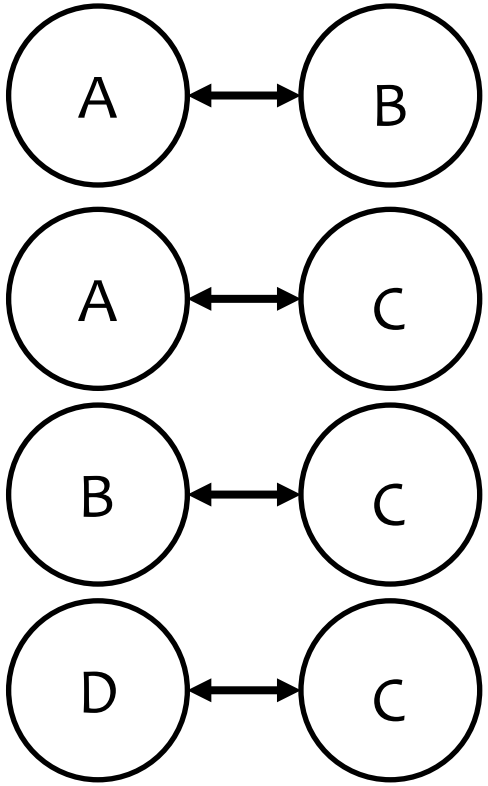


Gather-Apply-Scatter on GraphX



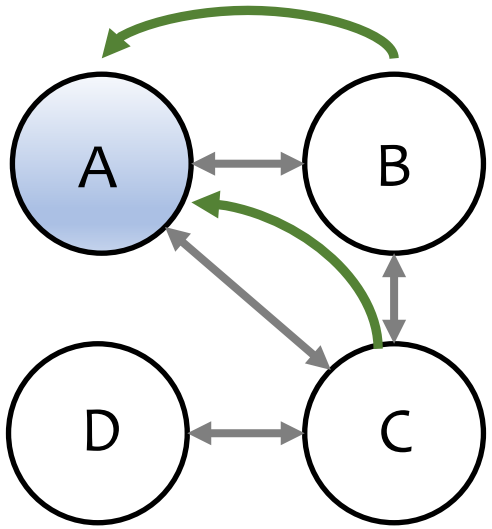
Vertices	Neighbors
A	B
A	C
B	C
D	C

Graph Represented In a Table

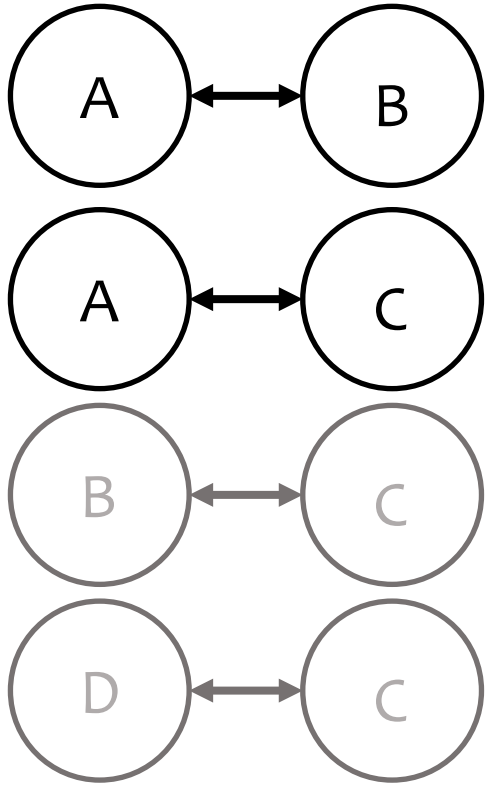


Triplets

Gather-Apply-Scatter on GraphX

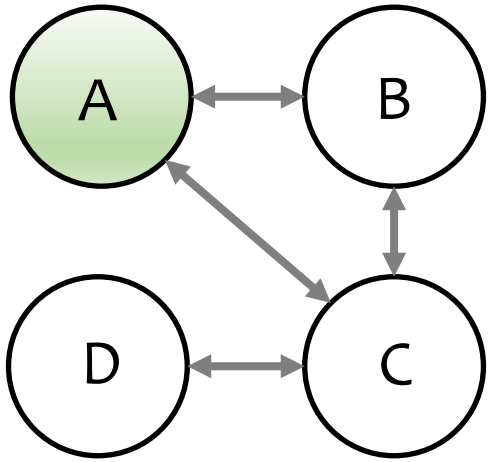


Gather at A

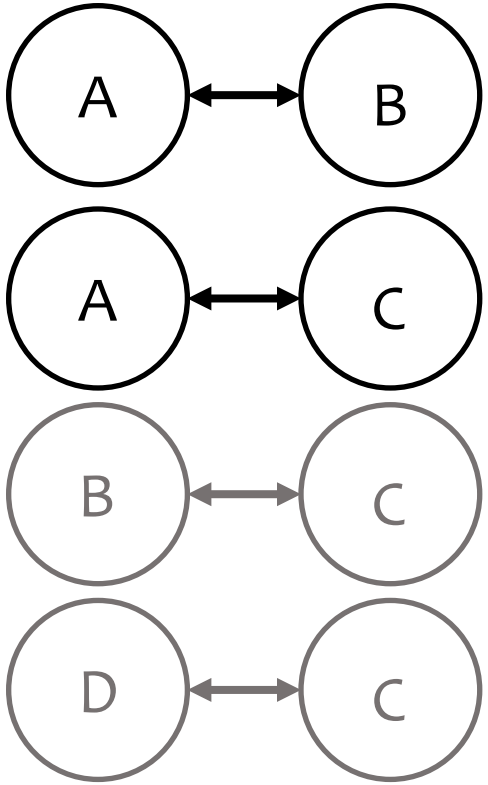


Group-By A

Gather-Apply-Scatter on GraphX

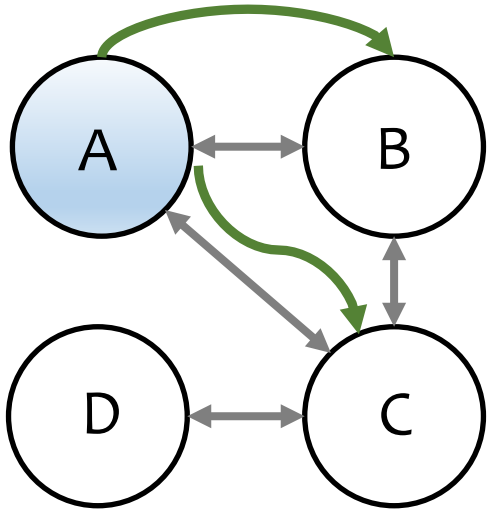


Apply

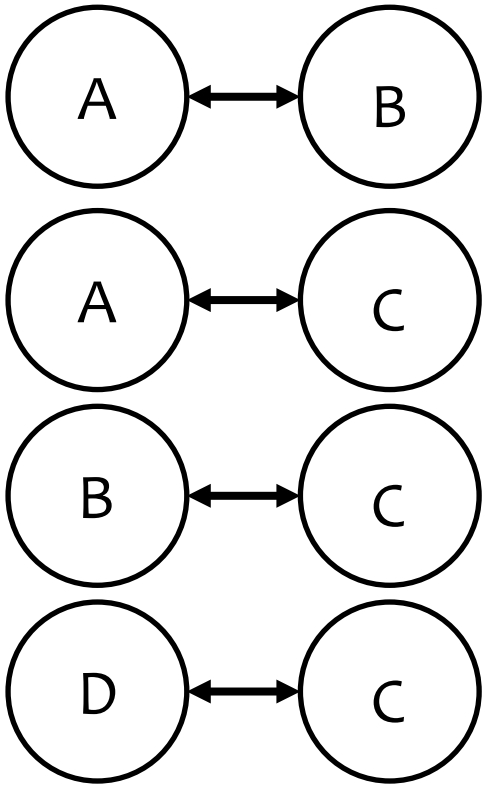


Map

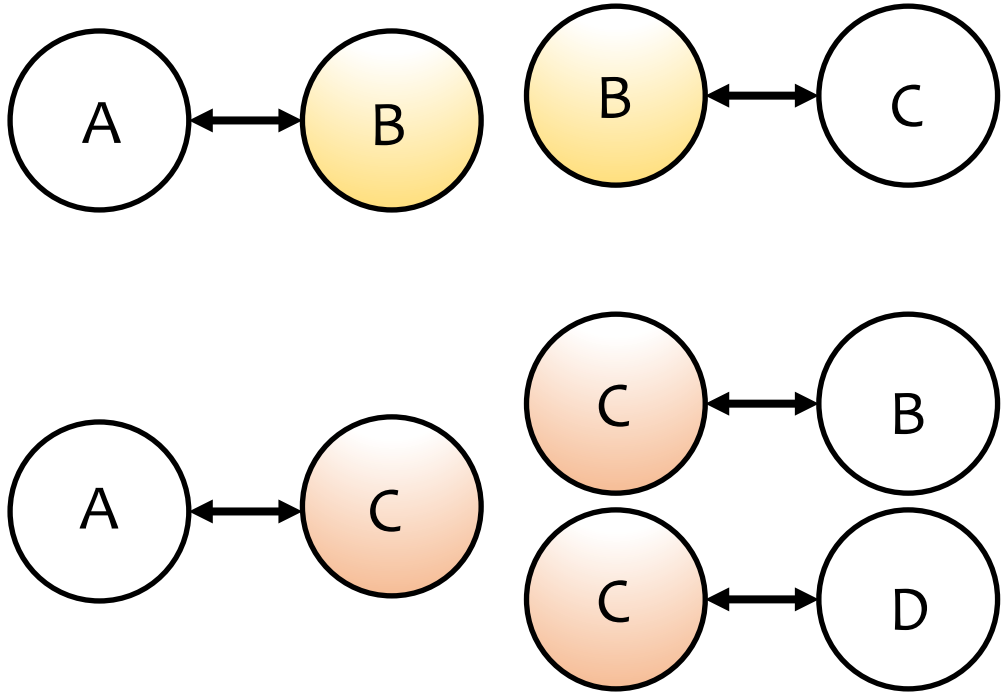
Gather-Apply-Scatter on GraphX



Scatter



Triplets



Join

Summary

- RDDs provide a simple and efficient programming model
- Generalized to a broad set of applications
- Leverages coarse-grained nature of parallel algorithms for failure recovery