Apache Spark
when things go wrong

Apache Spark - when things go wrong

```
val sc      = new SparkContext(conf)
sc.textFile("hdfs://journal/*")
    .groupBy(extractDate _)
    .map { case (date, events) => (date, events.size) }
    .filter {
        case (date, size) => LocalDate.parse(date) isAfter LocalDate.of(2015,3,1)
    }
    .take(300)
    .foreach(println)
```

```
1 2015-05-09T01:11 UserInitialized Brad Smith
1 2015-05-08T02:12 LoggedIn
1 2015-05-07T03:13 LoggedIn
```

*If above seems **odd**, this talk is rather **not** for you.*

Target for this talk

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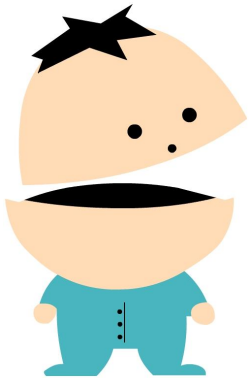

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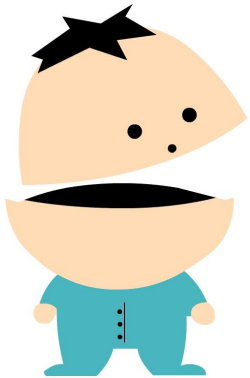

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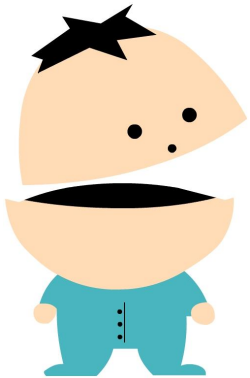

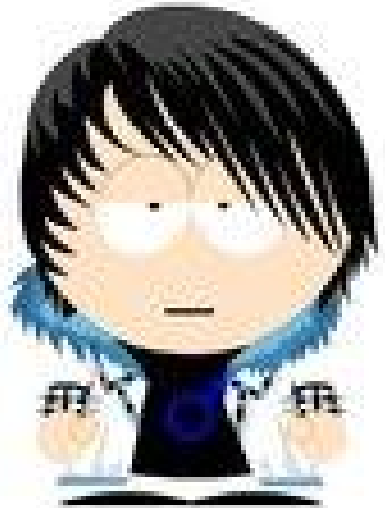

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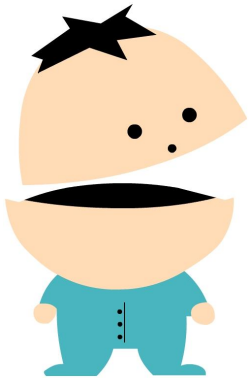

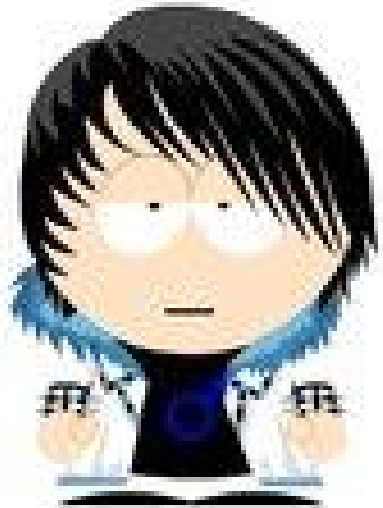

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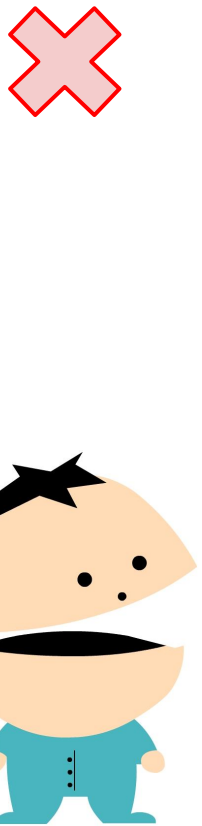

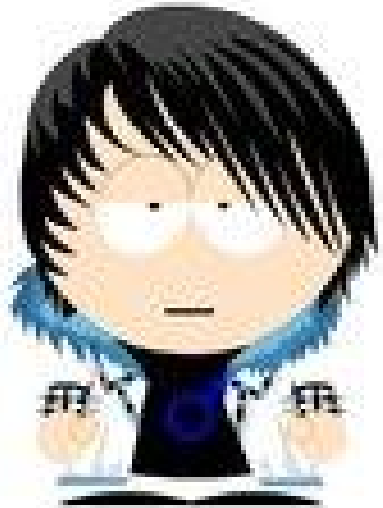

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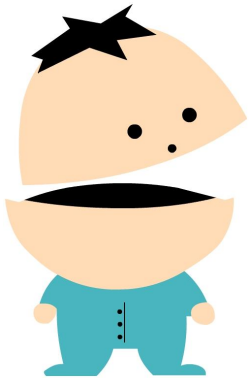

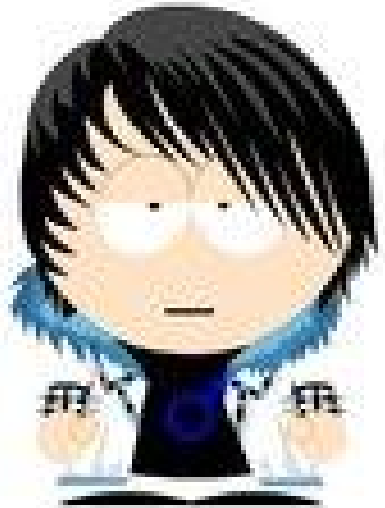

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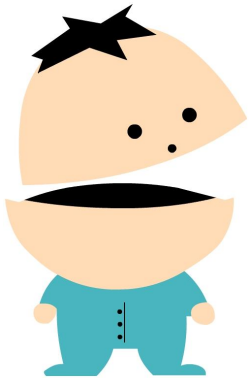

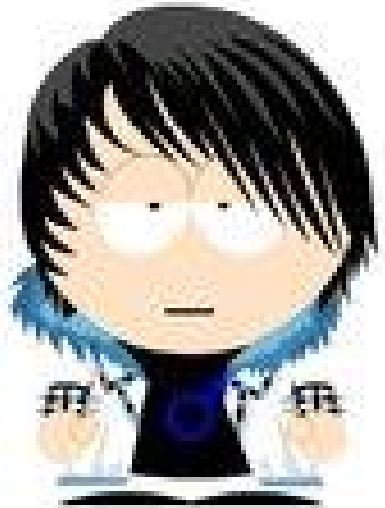

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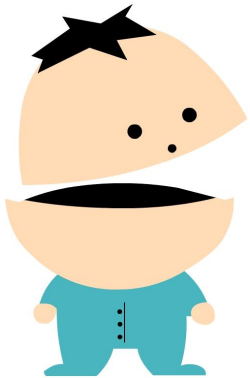

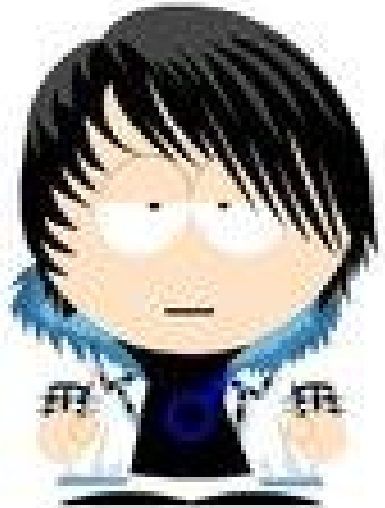

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1. Knowledge of how Apache Spark works internally

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1. Knowledge of how Apache Spark works internally
2. Courage to look at Spark's implementation (code)
3. Notion of how to write efficient Spark programs
4. Basic ability to monitor Spark when things are starting to act weird

Two words about examples used

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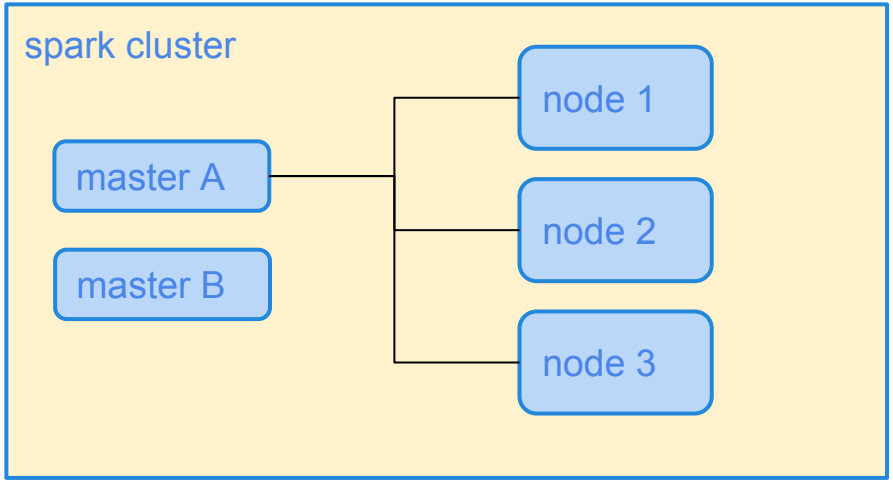

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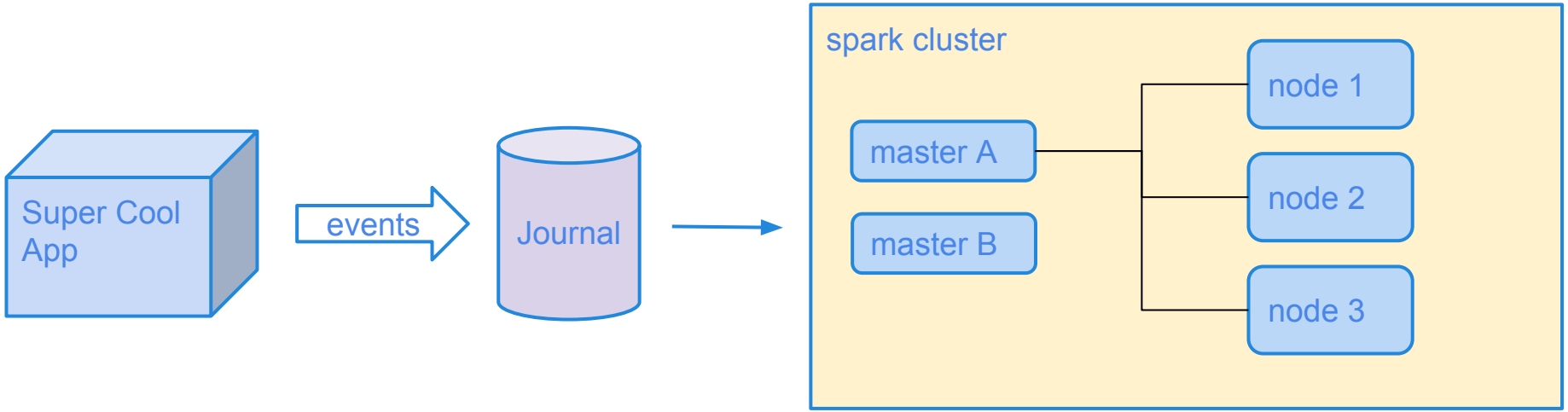

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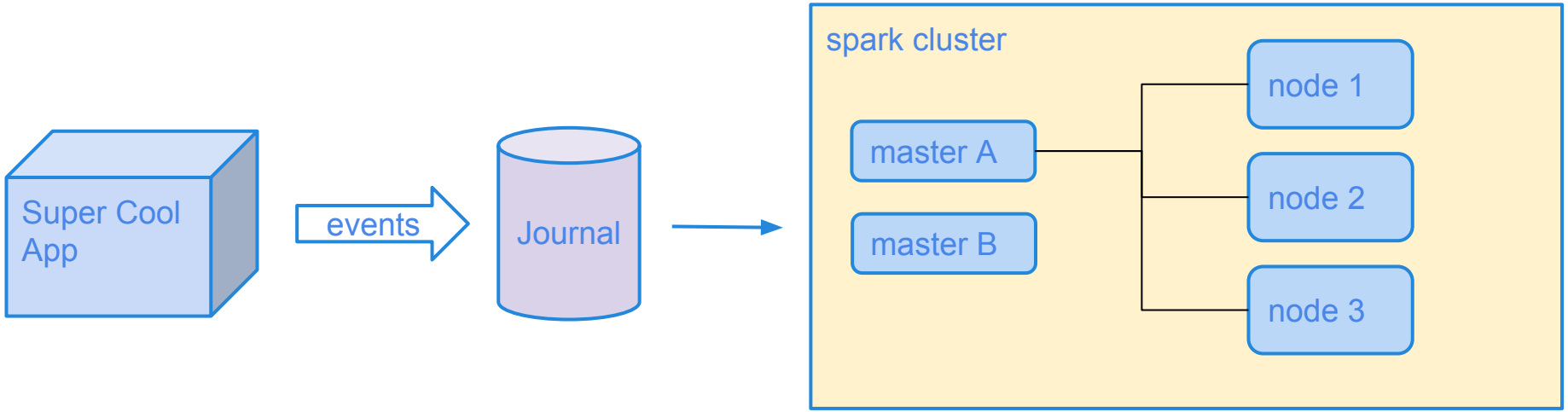

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What is a RDD?

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Resilient Distributed Dataset

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Resilient **Distributed Dataset**

What is a RDD?

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10   10/05/2015 10:14:01 UserInitialized Ania  Nowak
10   10/05/2015 10:14:55 FirstNameChanged Anna
12   10/05/2015 10:17:03 UserLoggedIn
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 …
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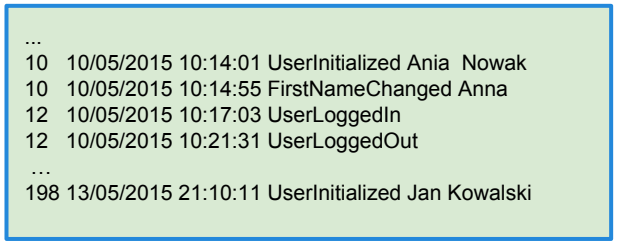
```

What is a RDD?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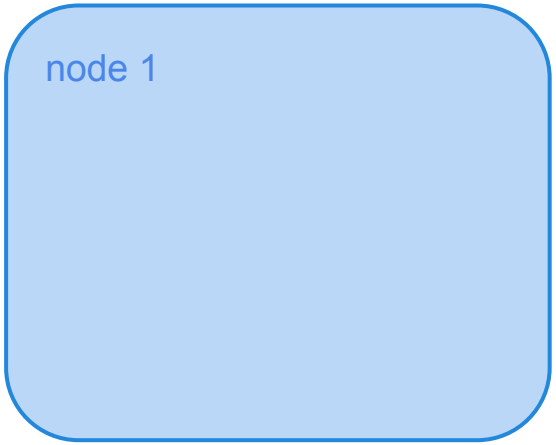
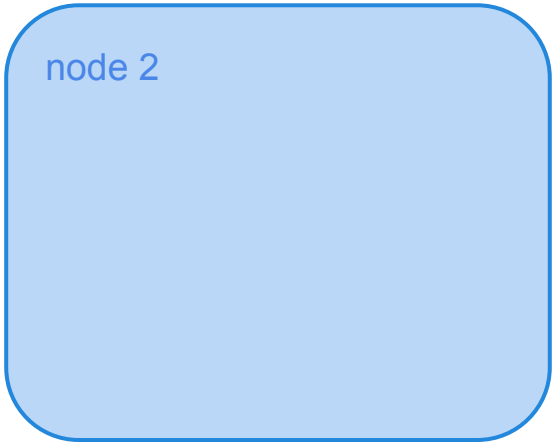
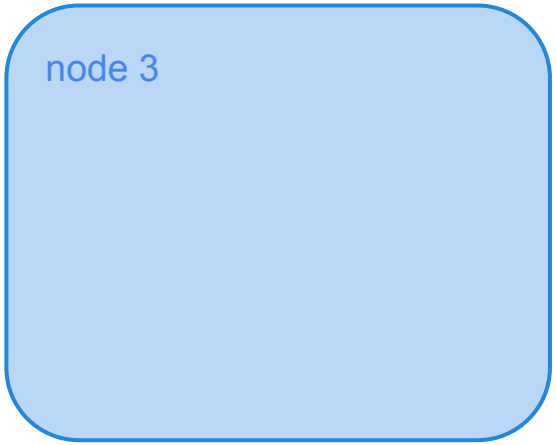
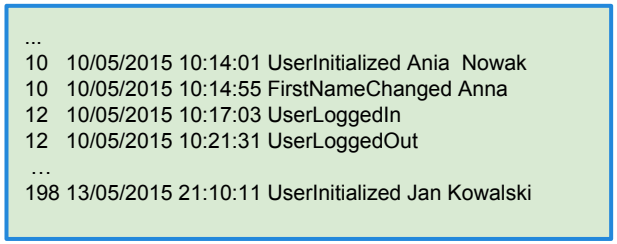

node 1


node 2


node 3

What is a RDD?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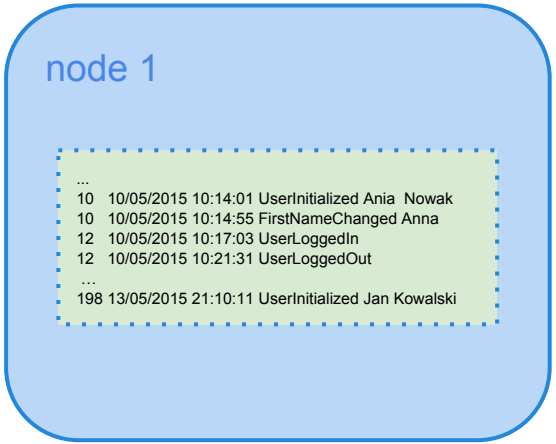
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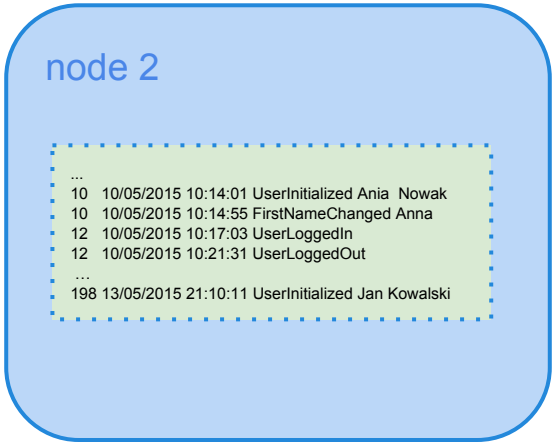
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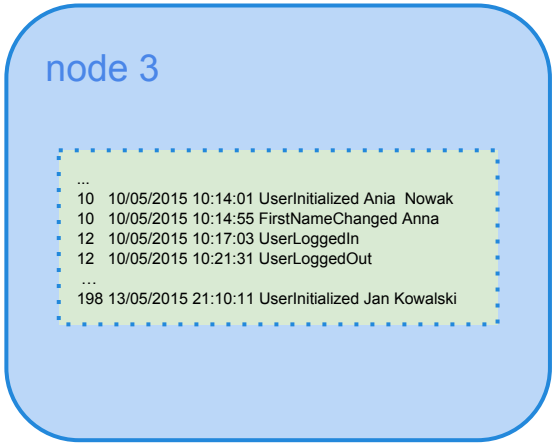
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What is a partition?

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A partition represents subset of data within your distributed collection.

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How this subset is defined depends on type of the RDD

example: HadoopRDD

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val journal = sc.textFile(“hdfs://journal/*”)
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How HadoopRDD is partitioned?

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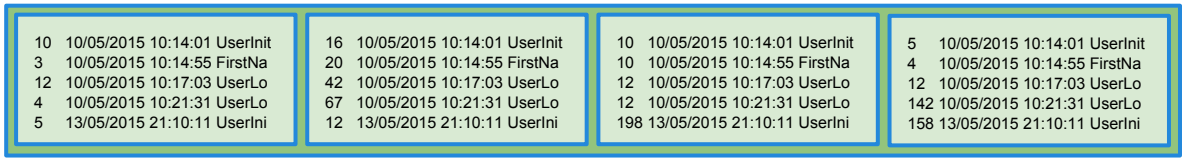
How HadoopRDD is partitioned?

In HadoopRDD partition is exactly the same as file chunks in HDFS

example: HadoopRDD



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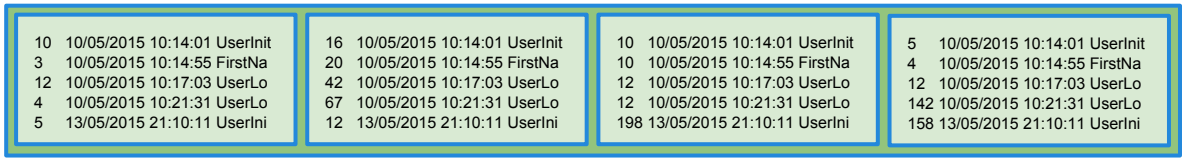

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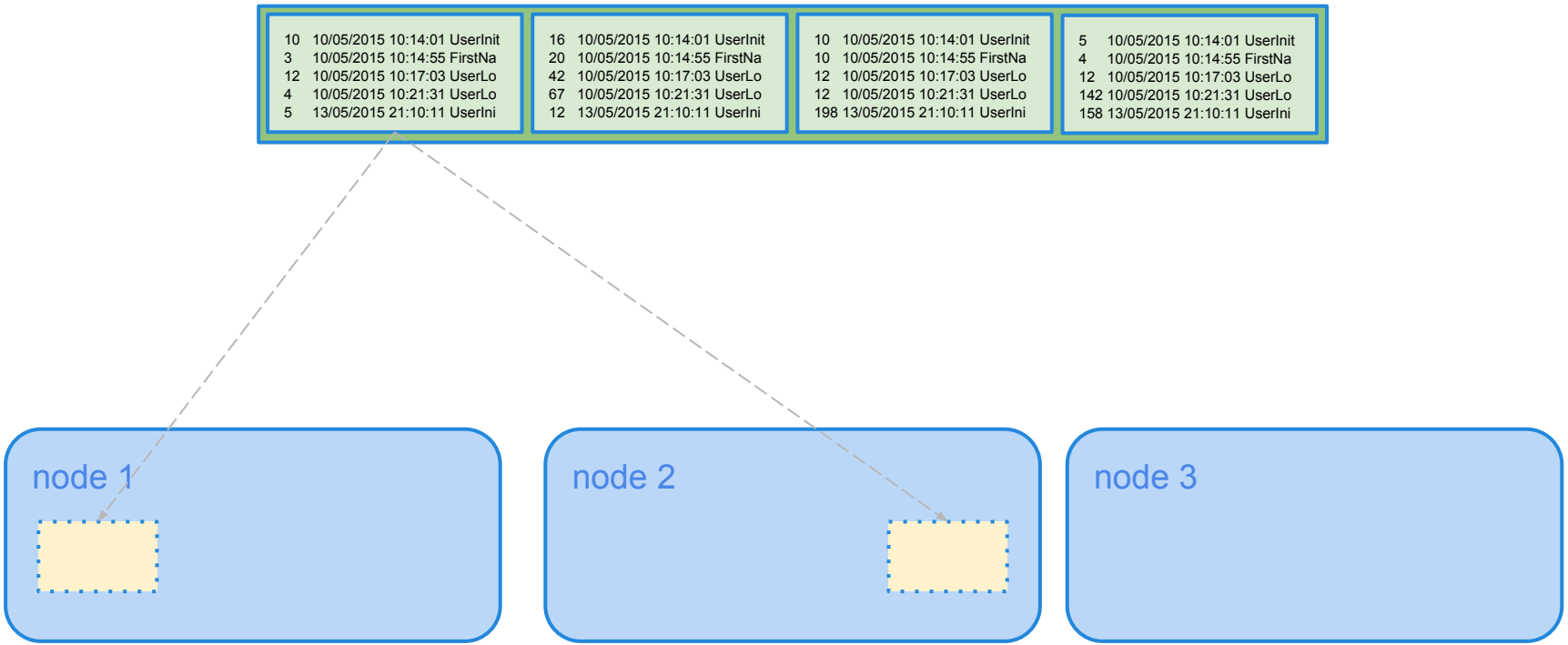

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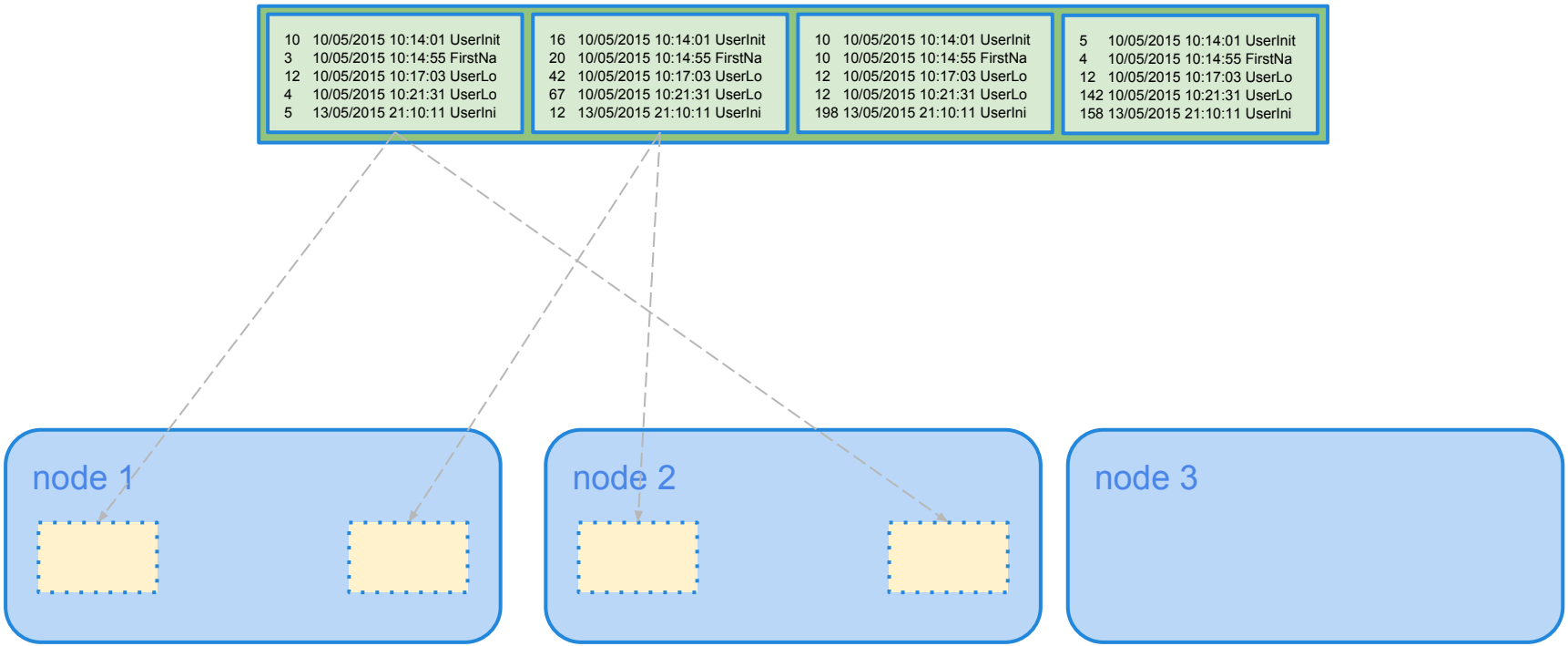

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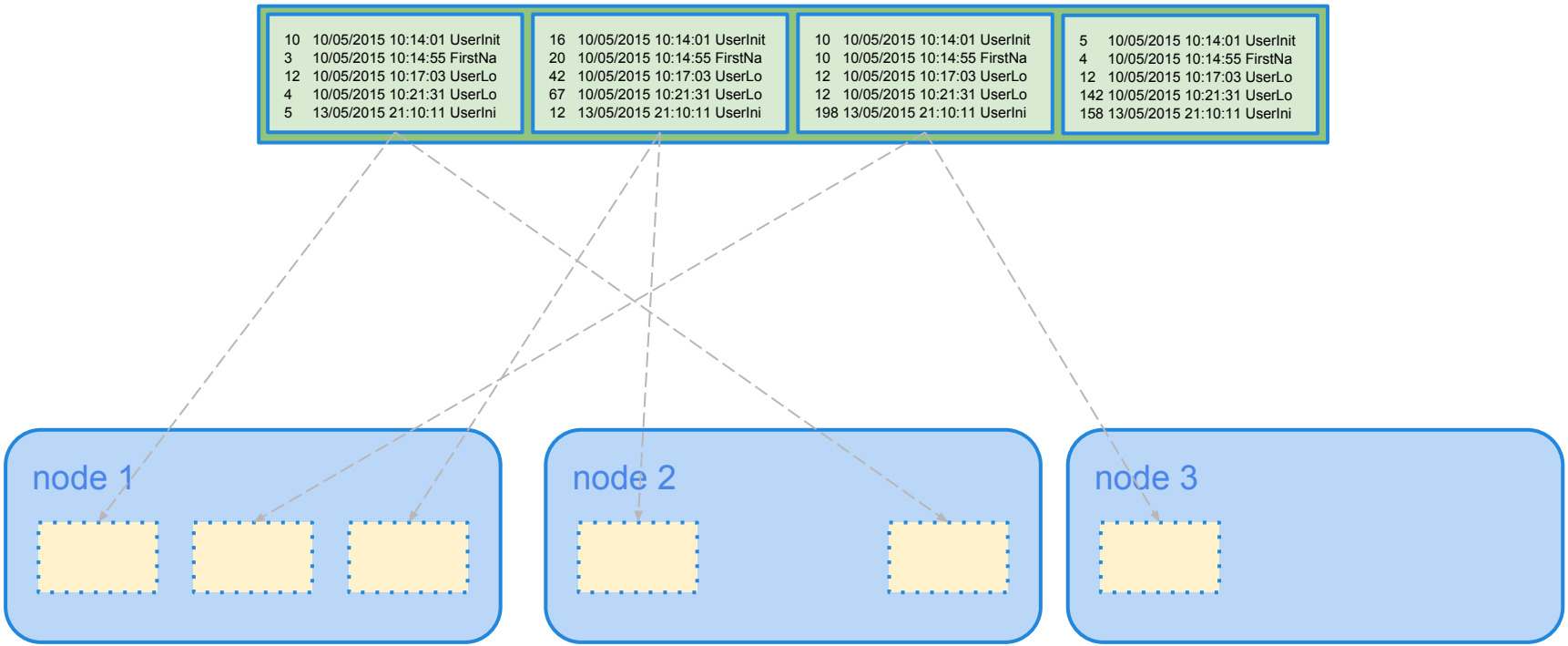

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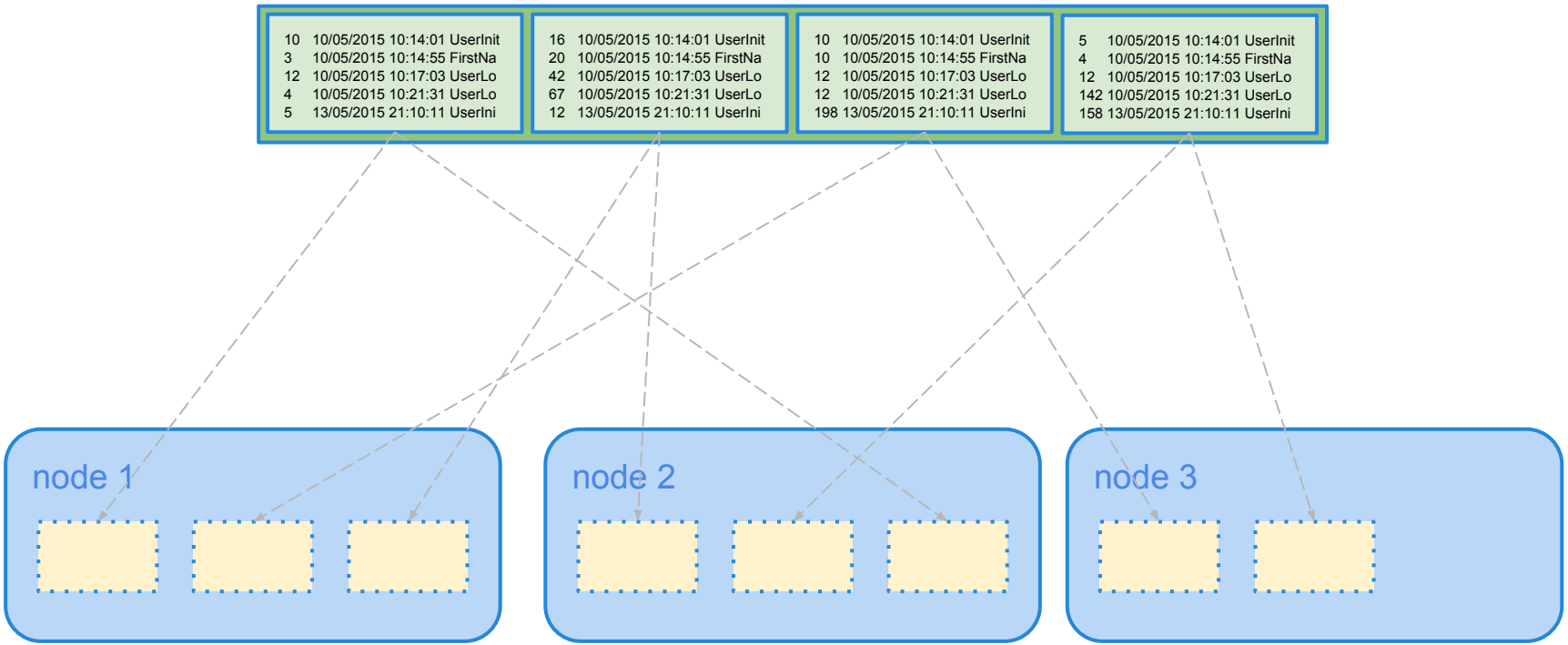

example: HadoopRDD

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class HadoopRDD[K, V](...) extends RDD[(K, V)](sc, Nil) with Logging {
...
override def getPartitions: Array[Partition] = {
        val jobConf = getJobConf()
        SparkHadoopUtil.get.addCredentials(jobConf)
        val inputFormat = getInputFormat(jobConf)
        if (inputFormat.isInstanceOf[Configurable]) {
                inputFormat.asInstanceOf[Configurable].setConf(jobConf)
        }
        val inputSplits = inputFormat.getSplits(jobConf, minPartitions)
        val array = new Array[Partition](inputSplits.size)
        for (i <- 0 until inputSplits.size) { array(i) = new HadoopPartition(id, i, inputSplits(i))  }
        array
}
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example: MapPartitionsRDD

```
val journal = sc.textFile(“hdfs://journal/*”)
val fromMarch = journal.filter {
     case (date, size) => LocalDate.parse(date) isAfter LocalDate.of(2015,3,1)
    }
```

example: MapPartitionsRDD

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val fromMarch = journal.filter {
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How MapPartitionsRDD is partitioned?

example: MapPartitionsRDD

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val fromMarch = journal.filter {
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    }
```

How MapPartitionsRDD is partitioned?

MapPartitionsRDD inherits partition information from its parent RDD

example: MapPartitionsRDD

```
class MapPartitionsRDD[U: ClassTag, T: ClassTag](...)  extends RDD[U](prev) {
...
  override def getPartitions: Array[Partition] = firstParent[T].partitions
```

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RDD parent

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sc.textFile()
    .groupBy()
    .map { }
    .filter {

    }
    .take()
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```

Directed acyclic graph

```
sc.textFile()    .groupBy()    .map { }    .filter { }    .take()    .foreach()
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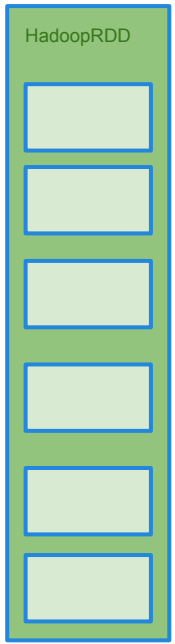

Directed acyclic graph

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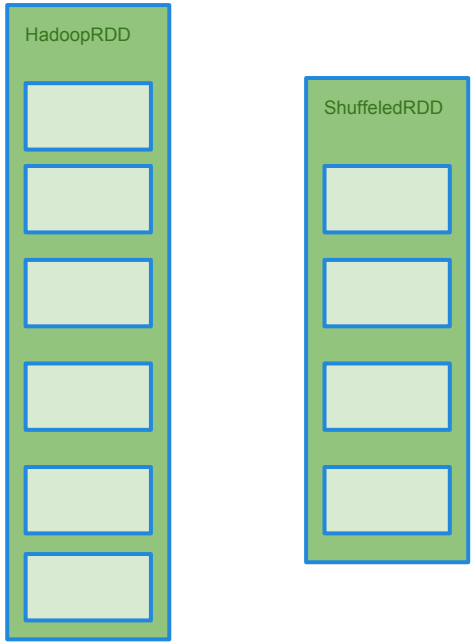

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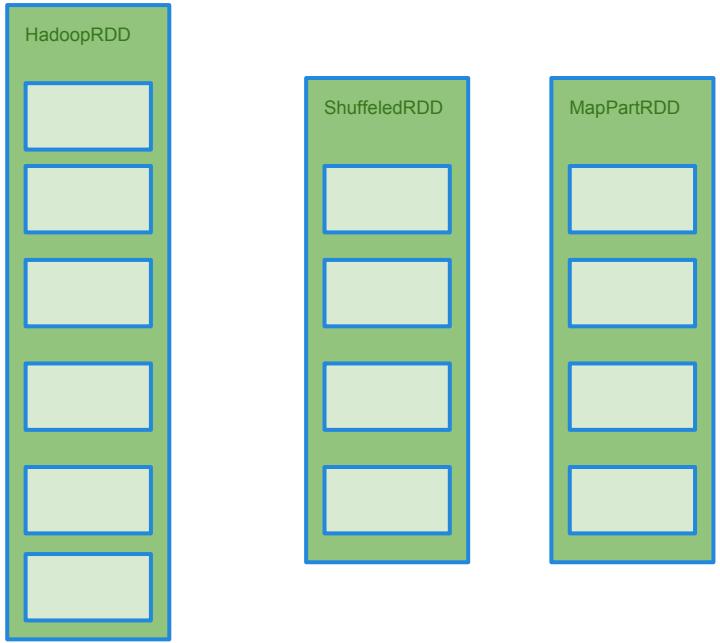

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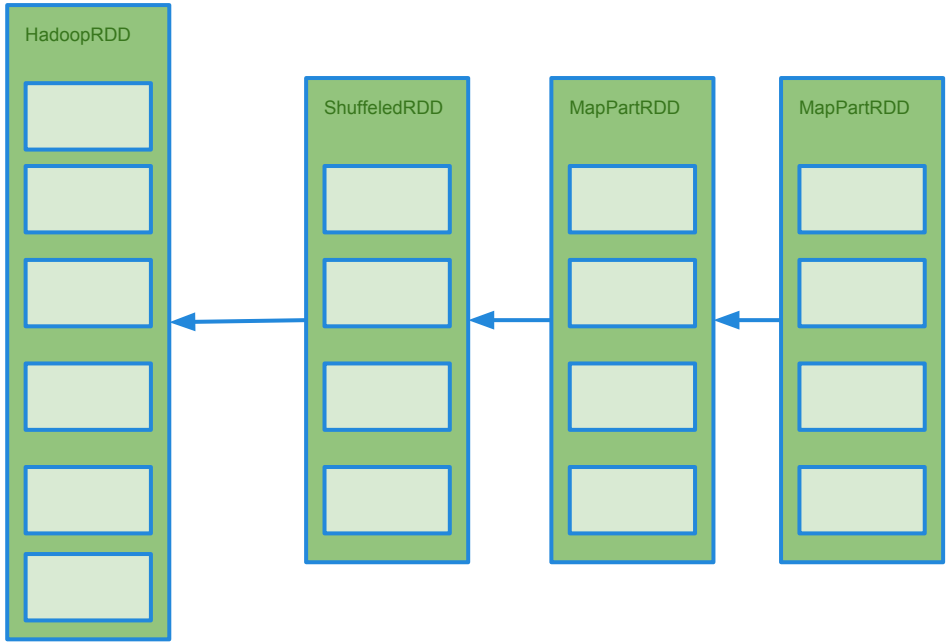

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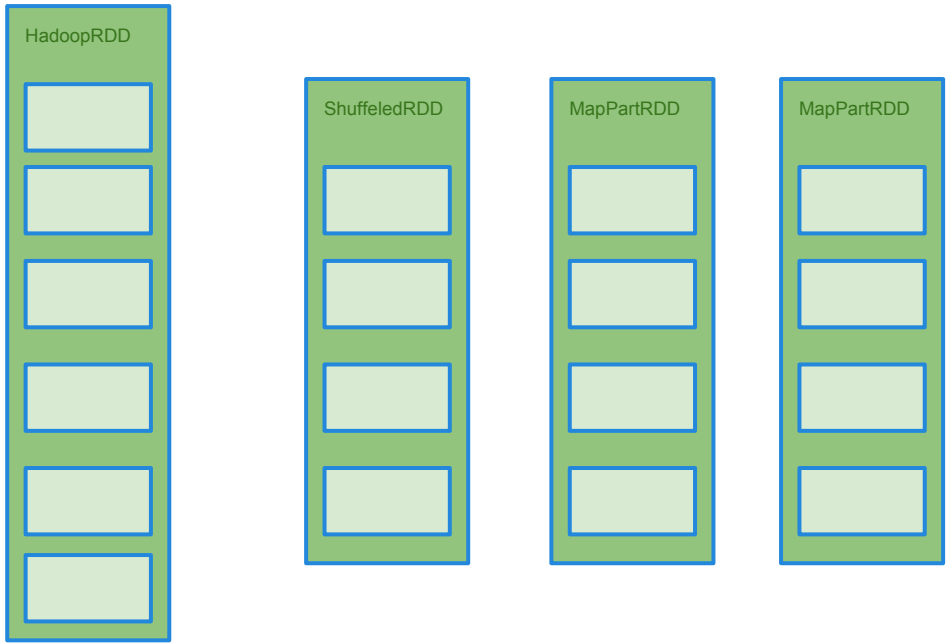

Two types of parent dependencies:

1. narrow dependency
2. wider dependency

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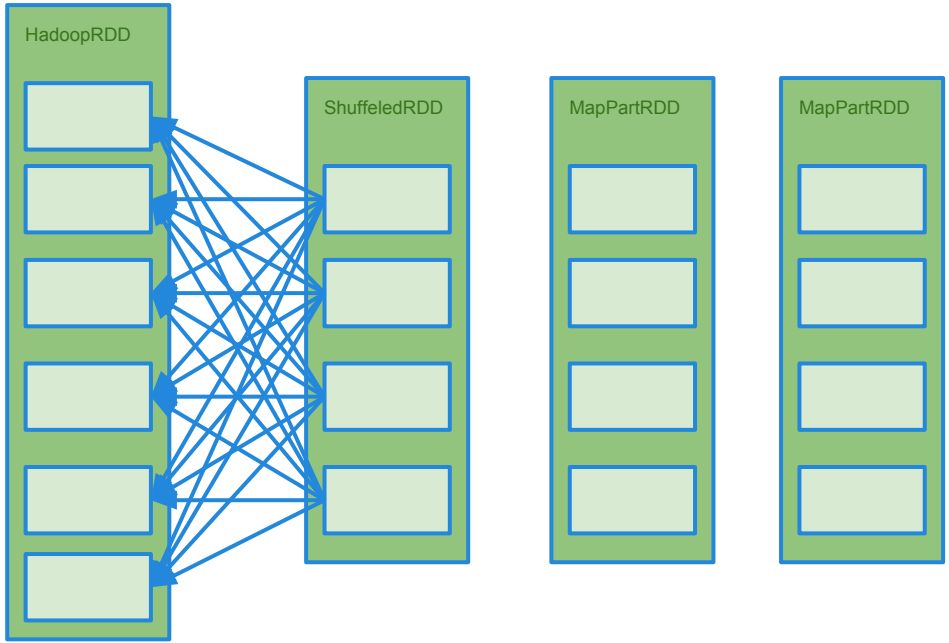

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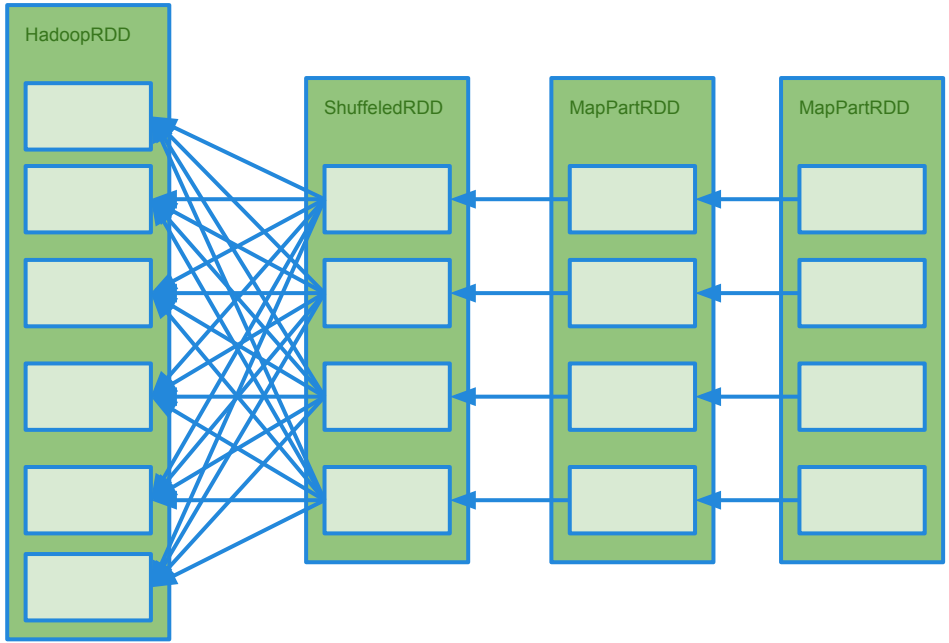

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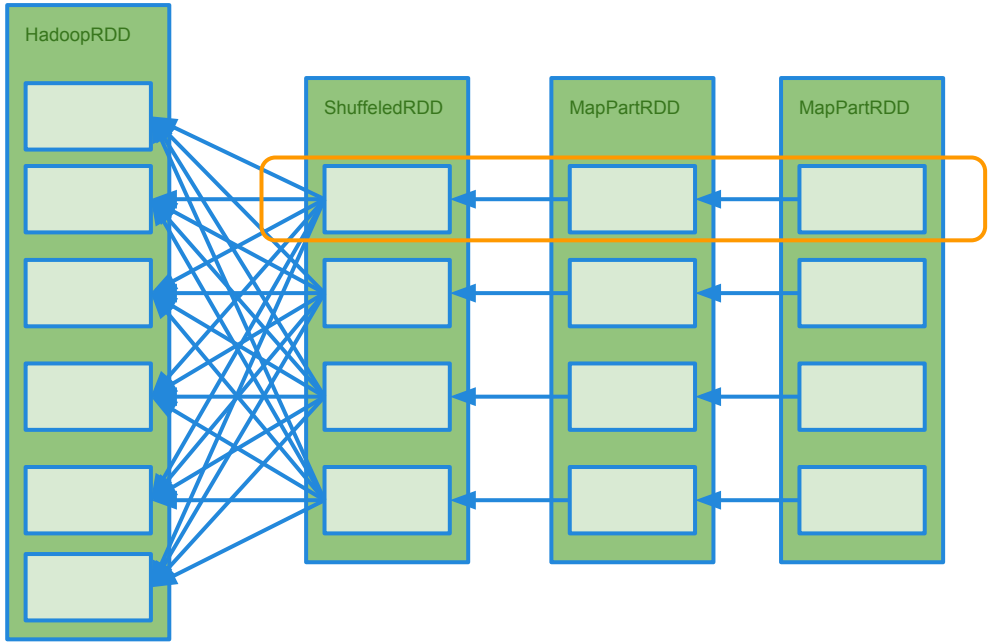

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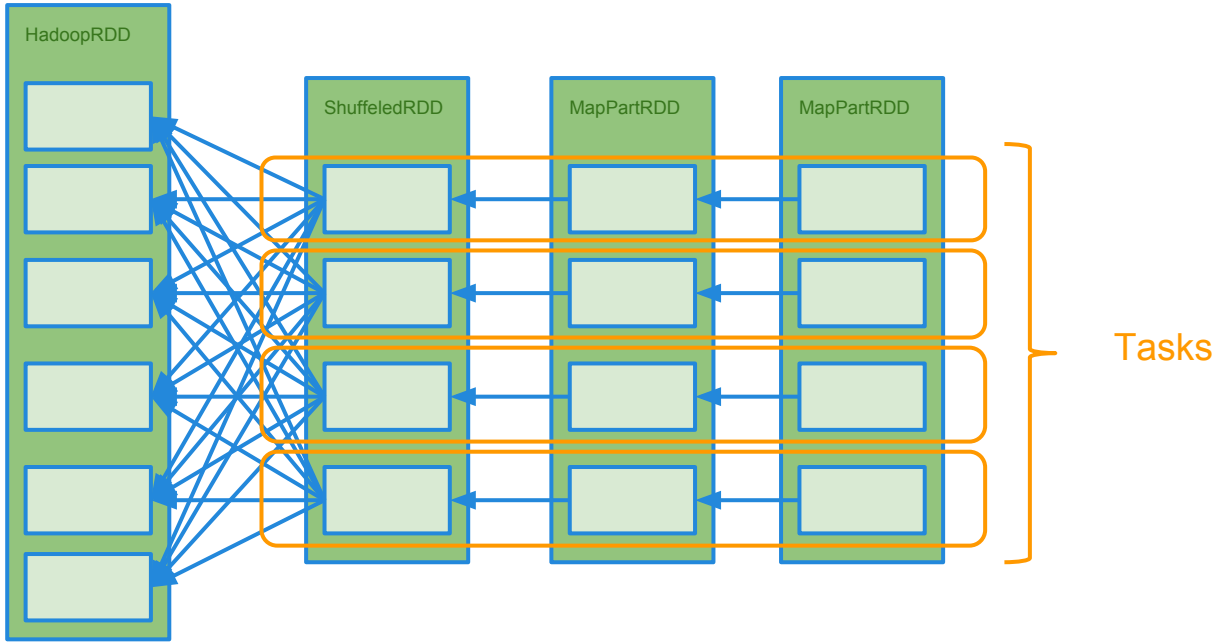

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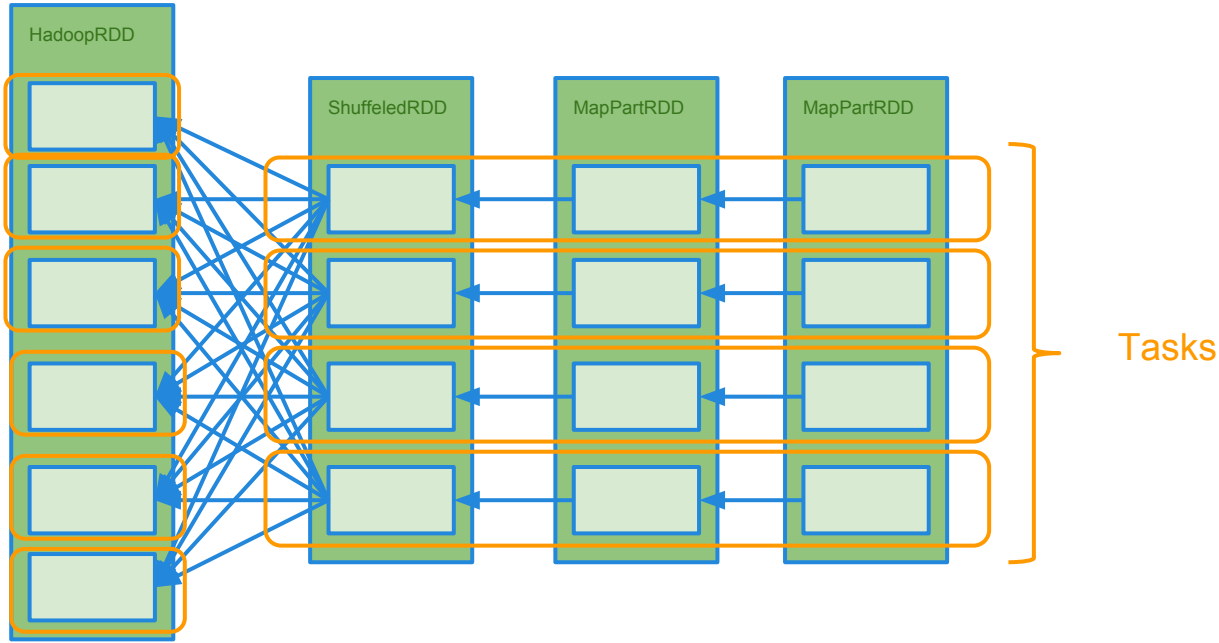

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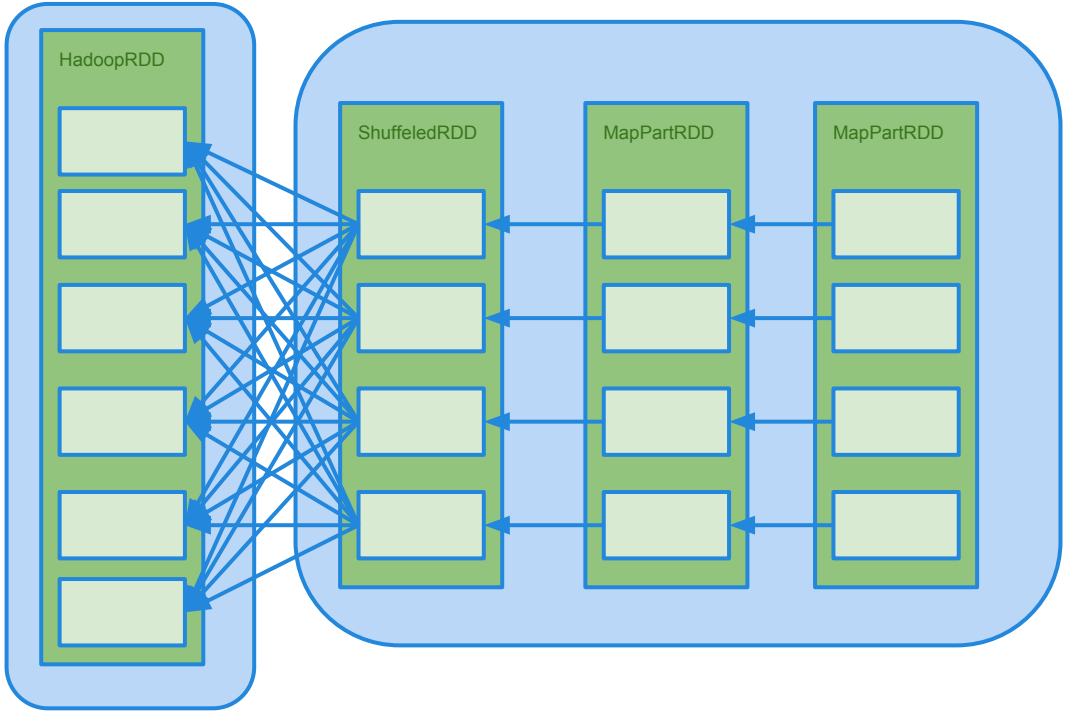

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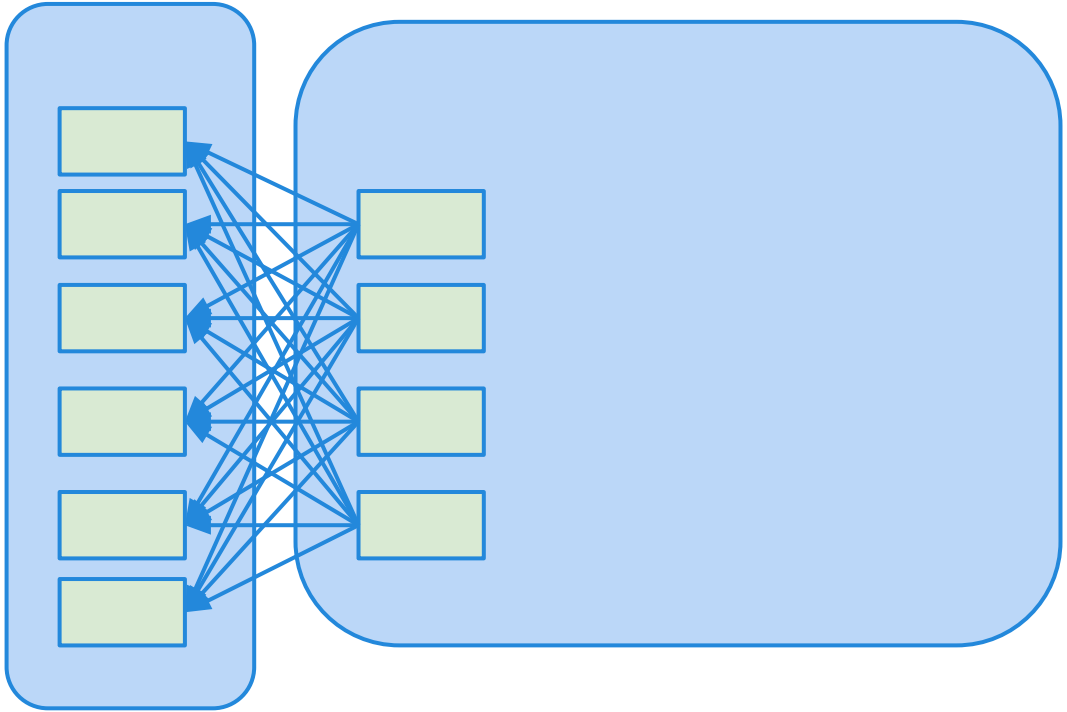

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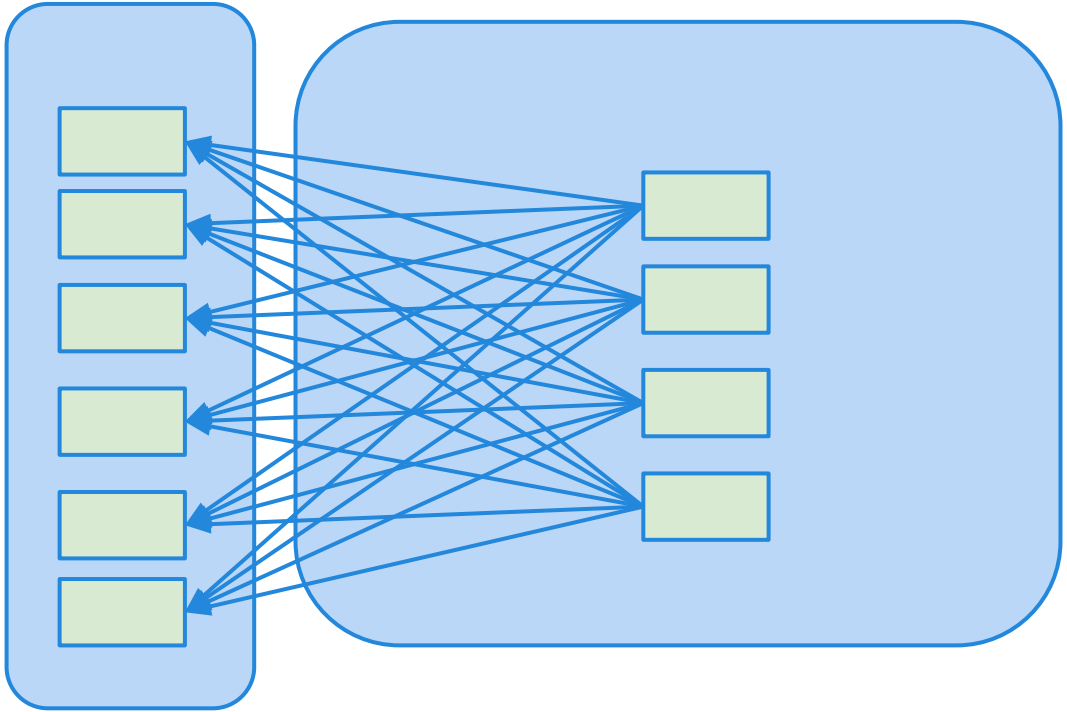

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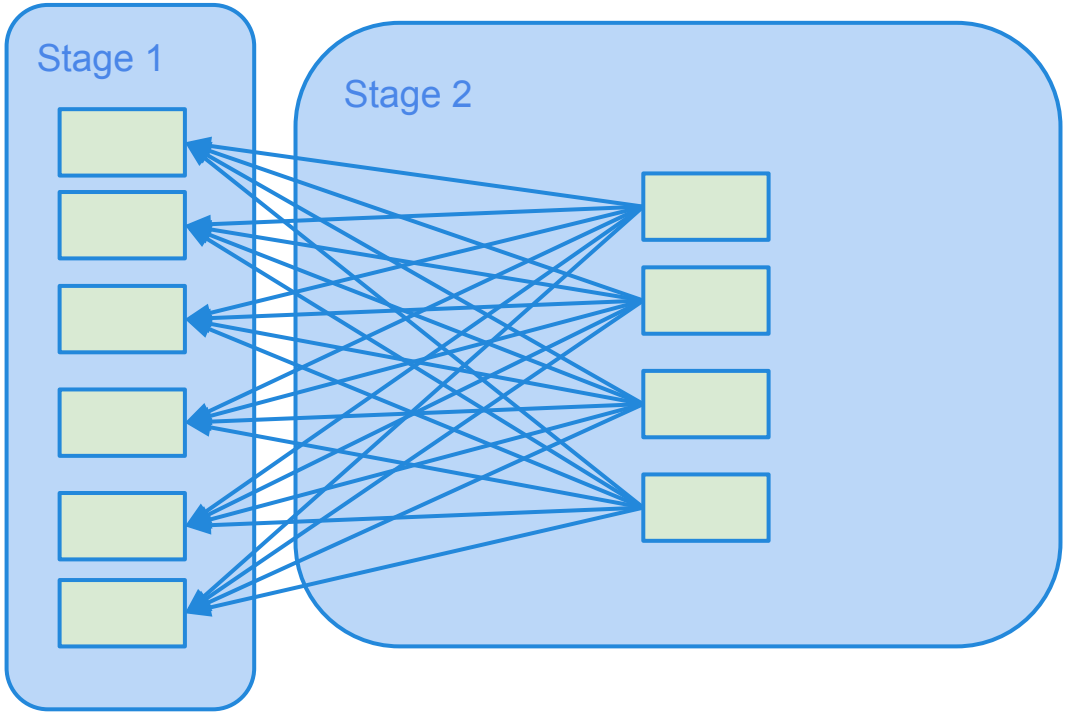

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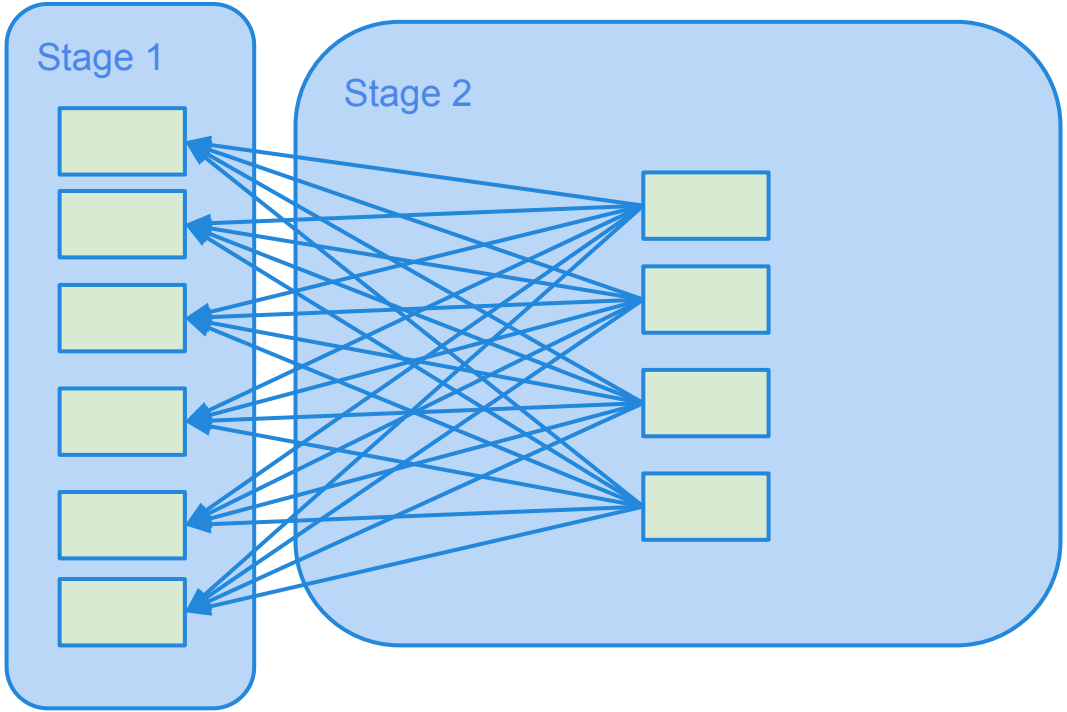

Two important concepts:

1. shuffle write
2. shuffle read

toDebugString

```
val events = sc.textFile(“hdfs://journal/*”)
    .groupBy(extractDate _)
    .map { case (date, events) => (date, events.size) }
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    }
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scala> events.toDebugString
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res5: String =
(4) MapPartitionsRDD[22] at filter at <console>:50 []
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What is a RDD?

RDD needs to hold 3 chunks of information in order to do its work:

1. pointer to his parent
2. how its internal data is partitioned
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Running Job aka materializing DAG

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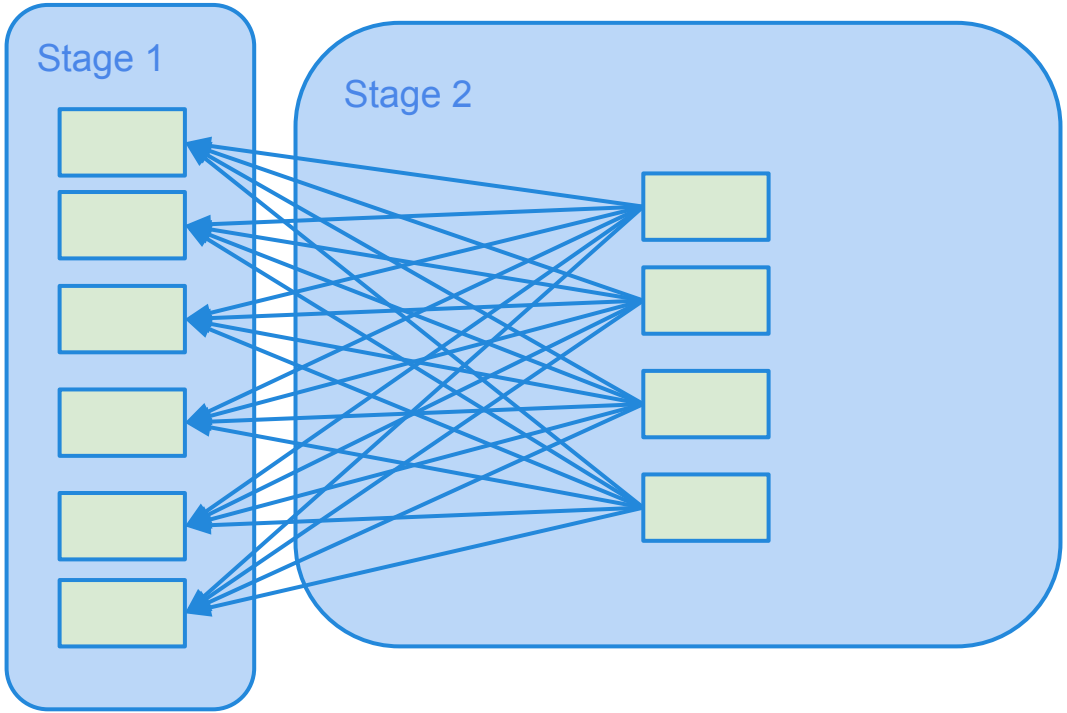
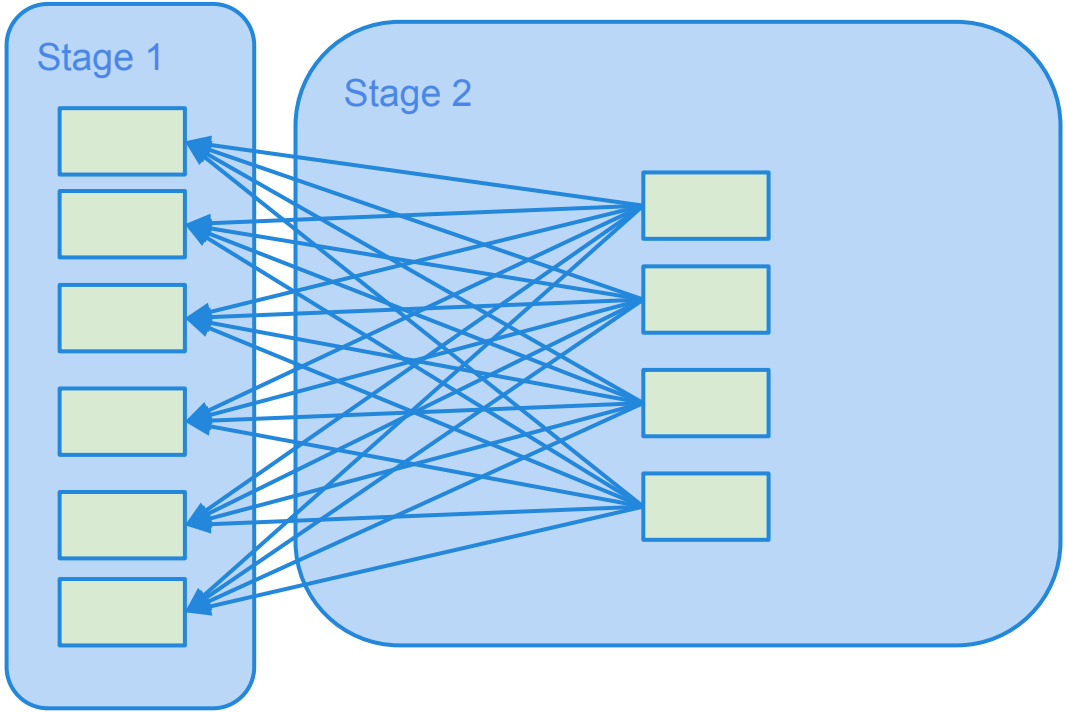
sc.textFile()     .groupBy()     .map { }     .filter { }
```



Running Job aka materializing DAG

```
sc.textFile()     .groupBy()     .map { }     .filter { }     .collect()
```



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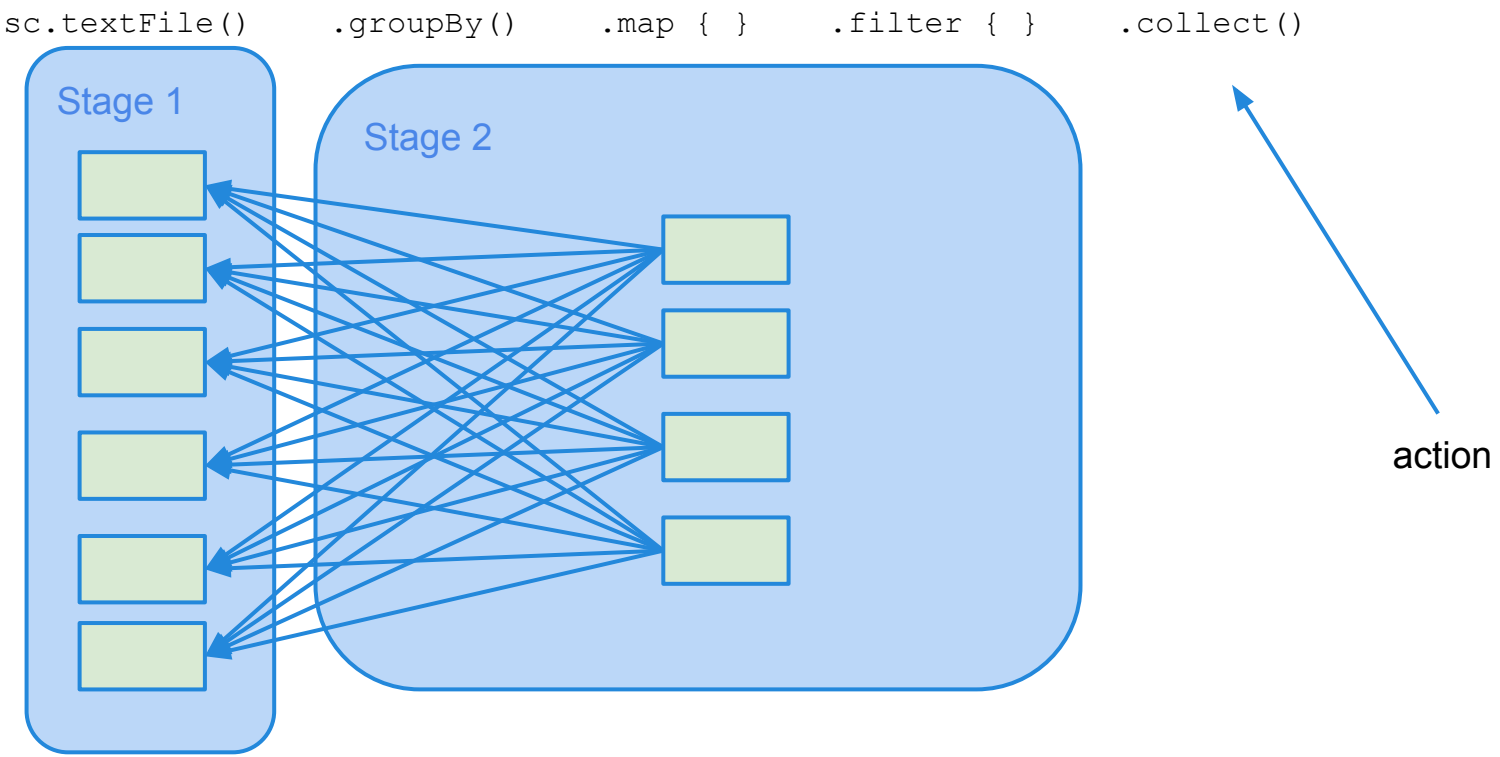

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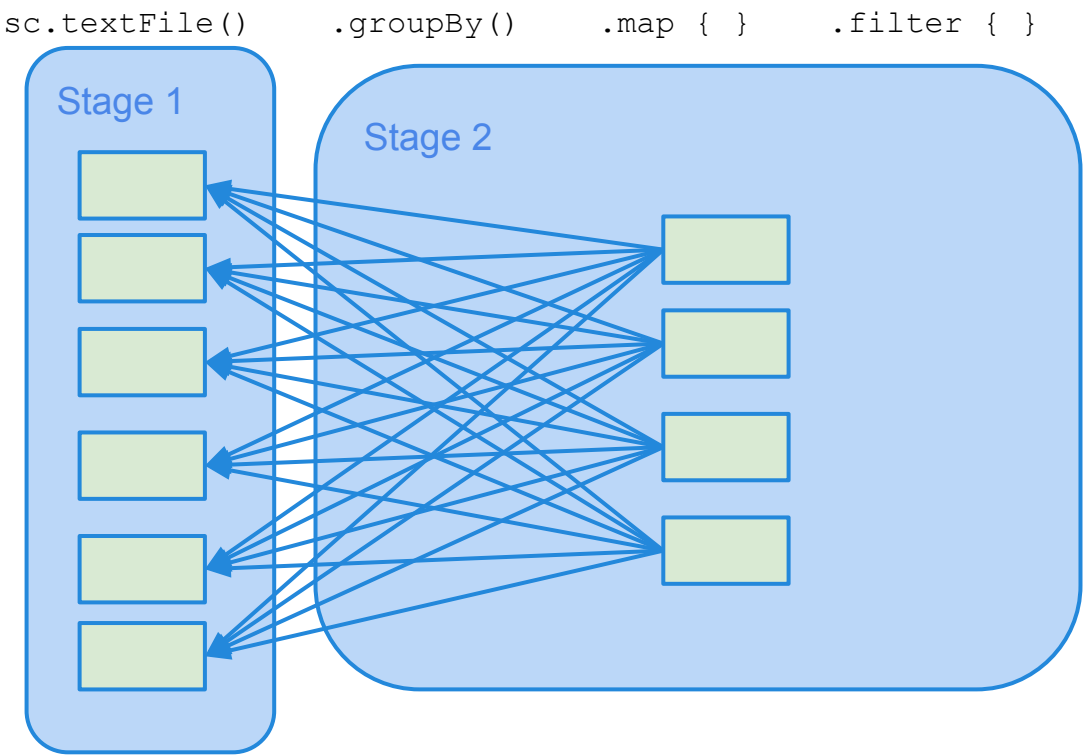

action

Actions are implemented using **sc.runJob** method

Running Job aka materializing DAG

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/**
* Run a function on a given set of partitions in an RDD and return the results as an array.
*/
def runJob[T, U](



  ): Array[U]
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* Run a function on a given set of partitions in an RDD and return the results as an array.
*/
def runJob[T, U](
  rdd: RDD[T],
  partitions: Seq[Int],
  func: Iterator[T] => U,
  ): Array[U]
```

Running Job aka materializing DAG

```scala
/**
* Return an array that contains all of the elements in this RDD.
*/
def collect(): Array[T] = {
    val results = sc.runJob(this, (iter: Iterator[T]) => iter.toArray)
    Array.concat(results: _*)
}
```

Multiple jobs for single action

```
/**
* Take the first num elements of the RDD. It works by first scanning one partition, and use the  results from that partition to estimate the number of additional partitions needed to satisfy the limit.
*/
def take(num: Int): Array[T] = {
    (….)
     val left = num - buf.size
     val res = sc.runJob(this, (it: Iterator[T]) => it.take(left).toArray, p, allowLocal = true)
    (….)
     res.foreach(buf ++= _.take(num - buf.size))
     partsScanned += numPartsToTry
     (….)
     buf.toArray
}
```

Lets test what we've learned

Towards efficiency

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val events = sc.textFile(“hdfs://journal/*”)
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events.count
```

Stage 1

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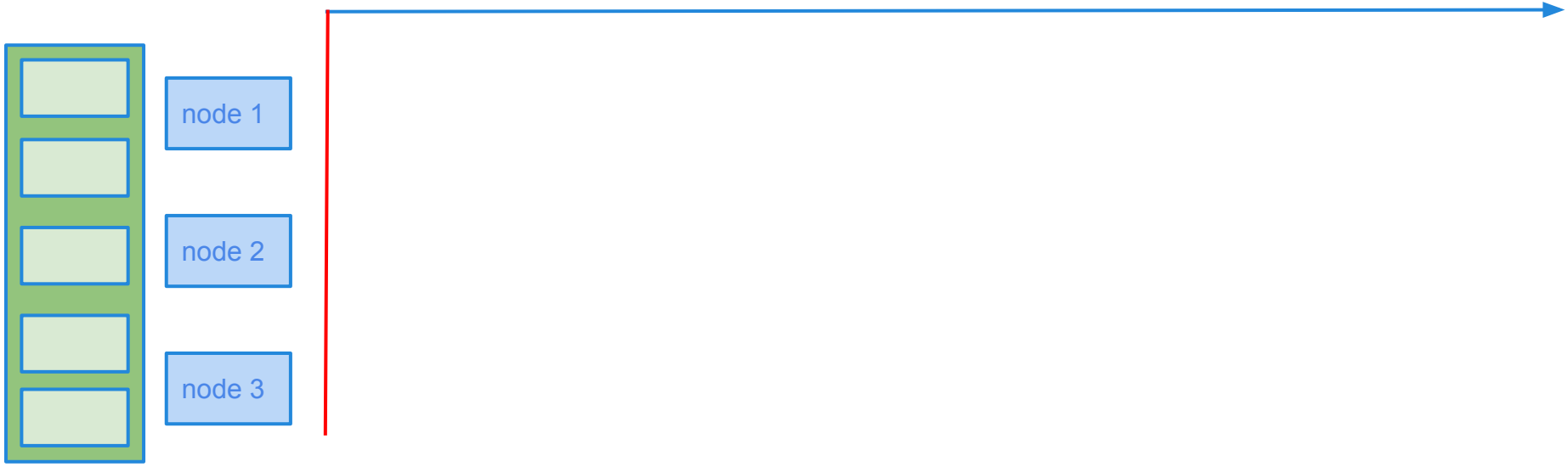

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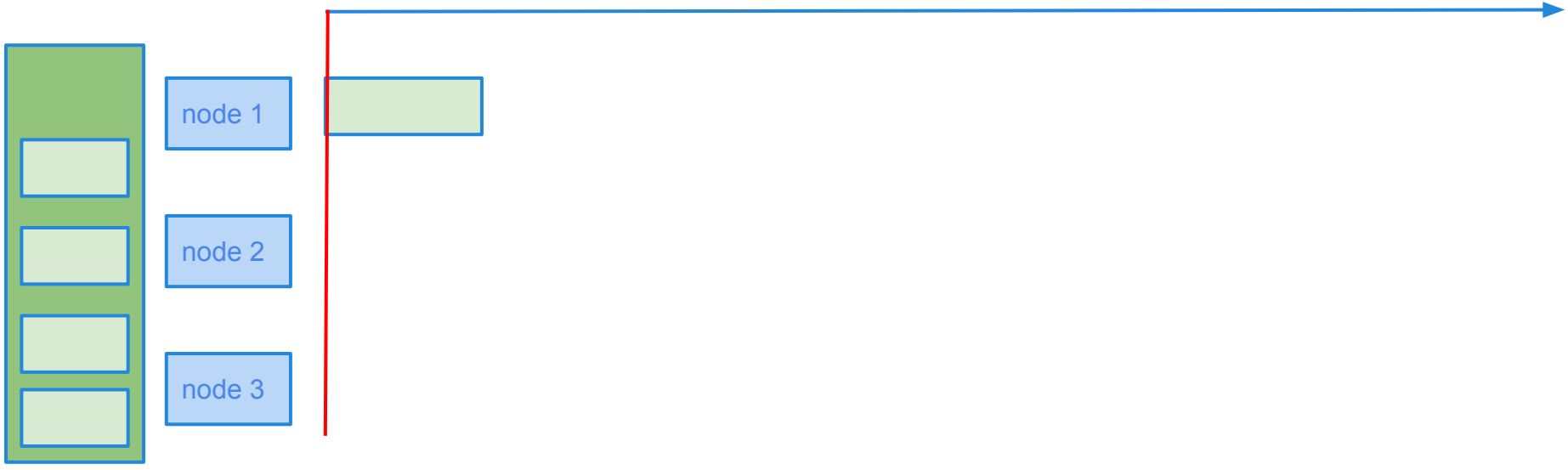

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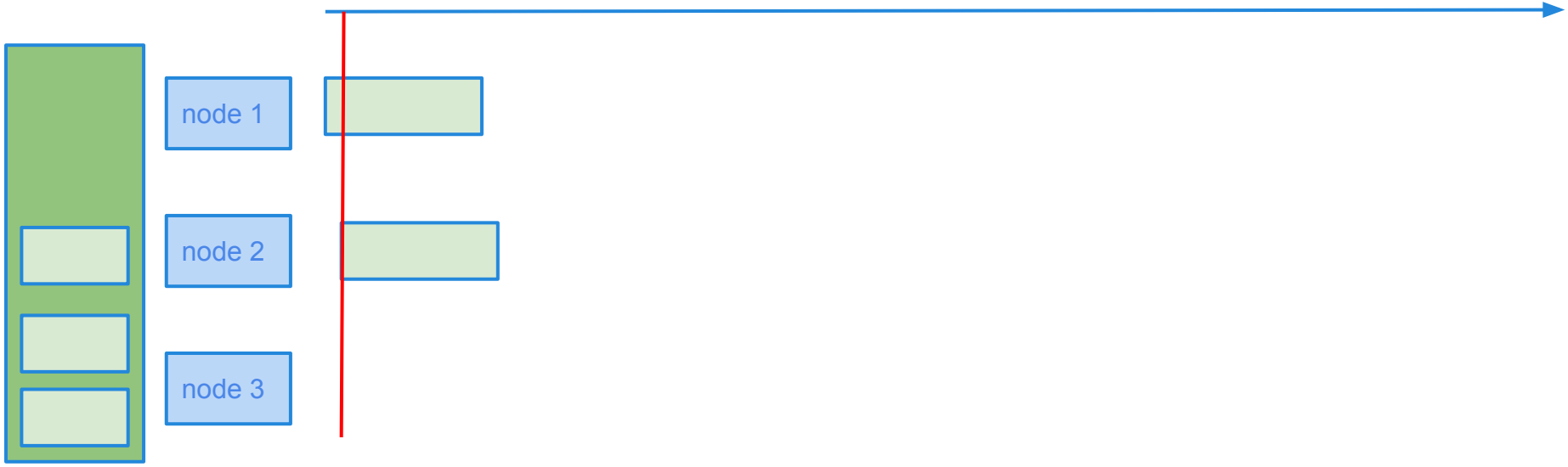

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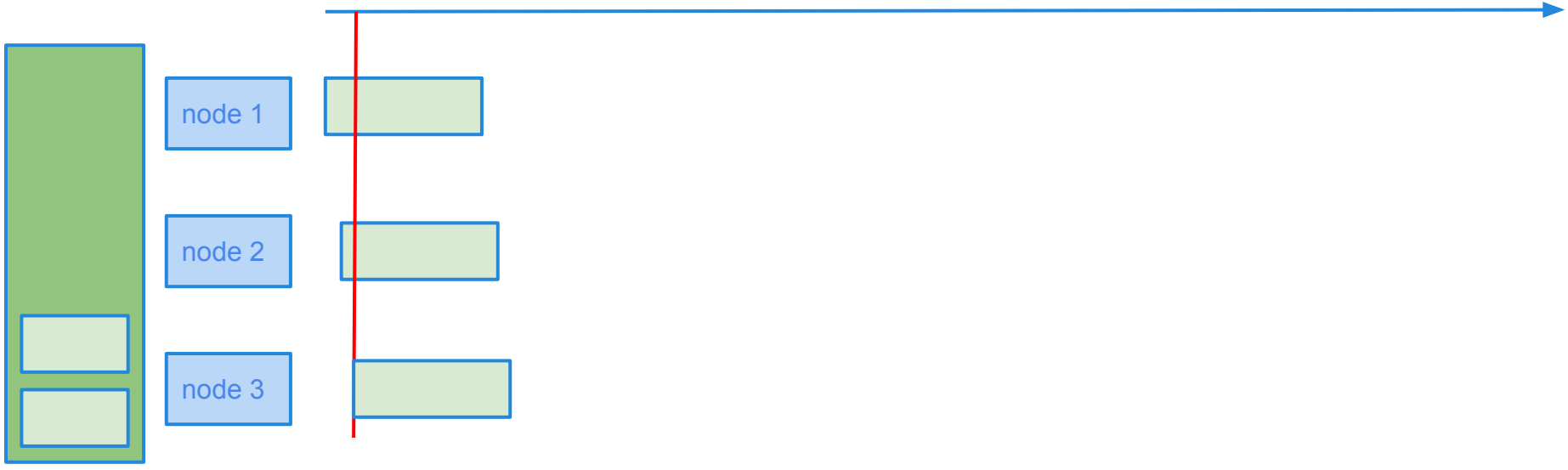

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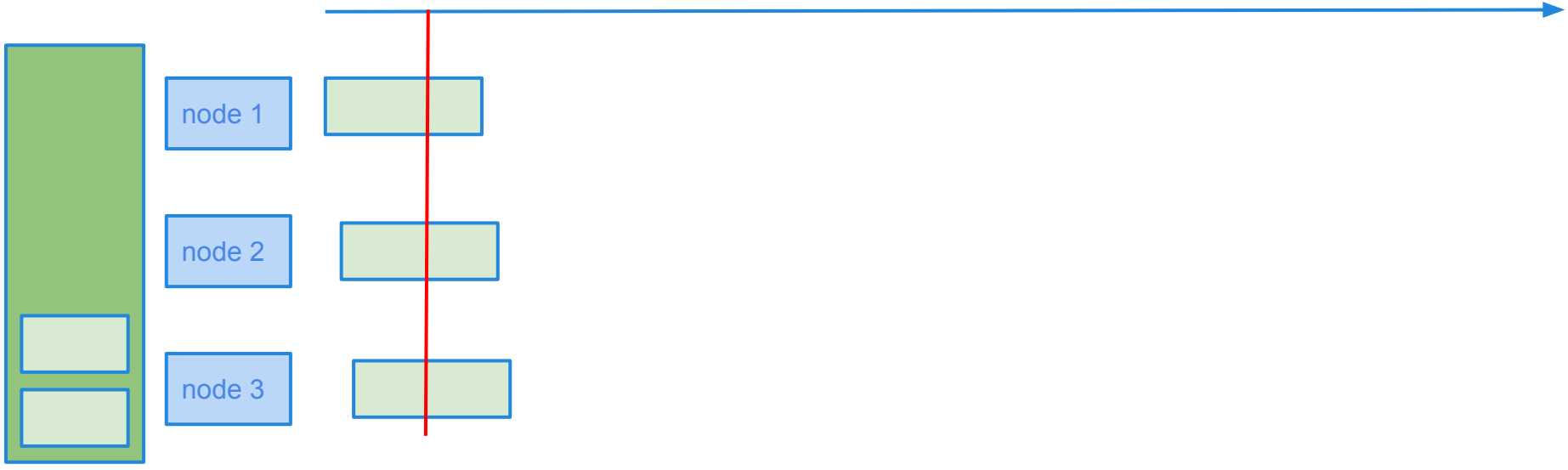

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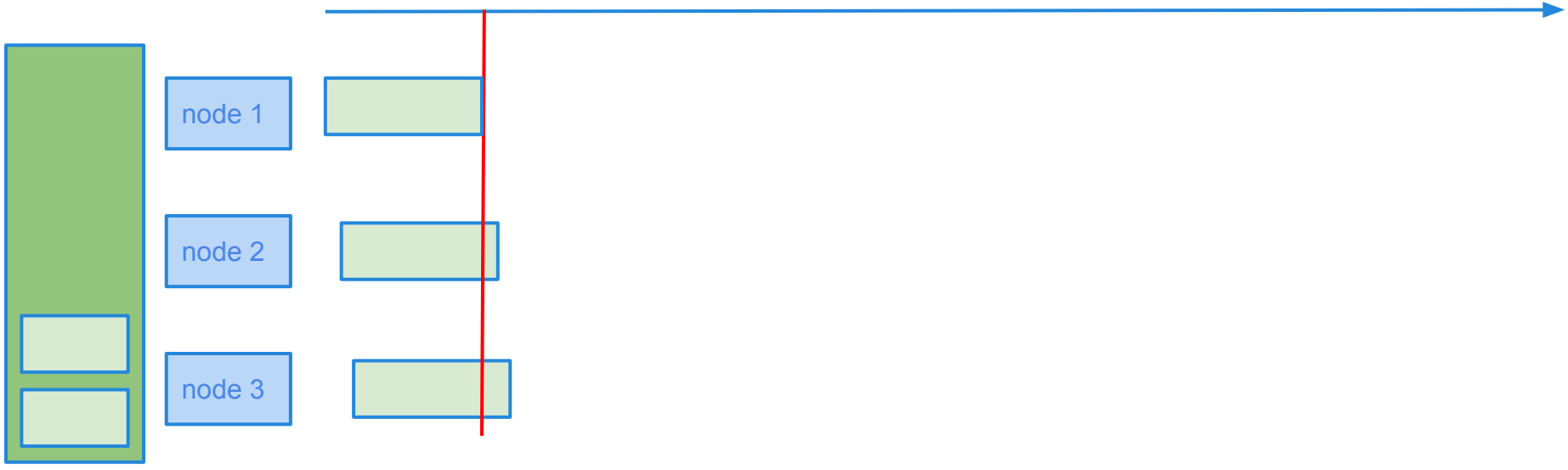

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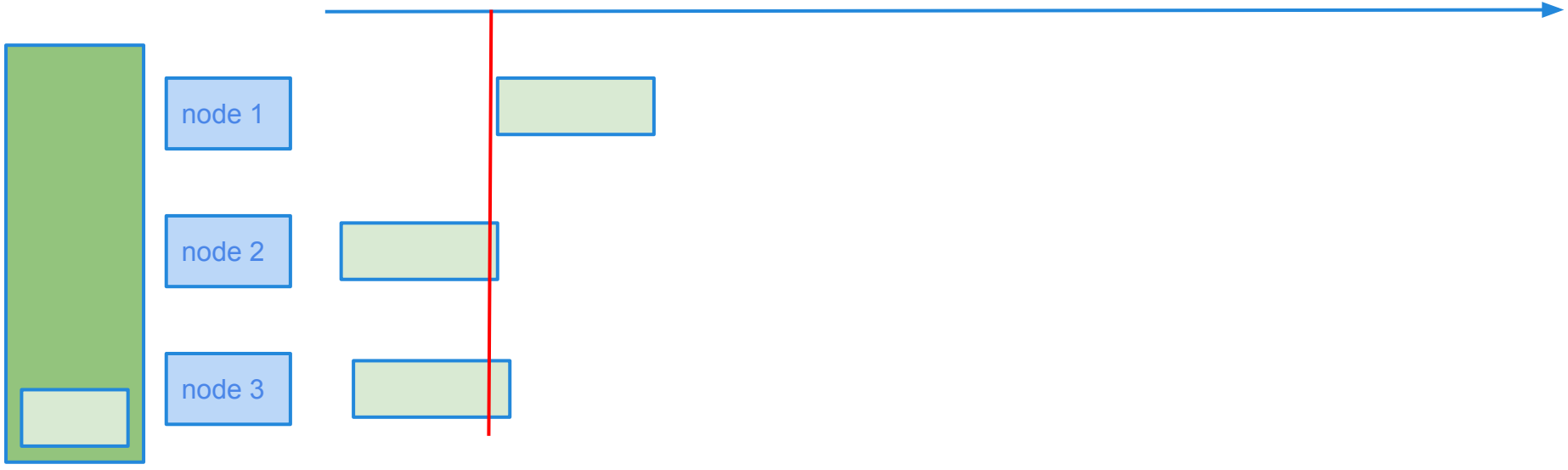

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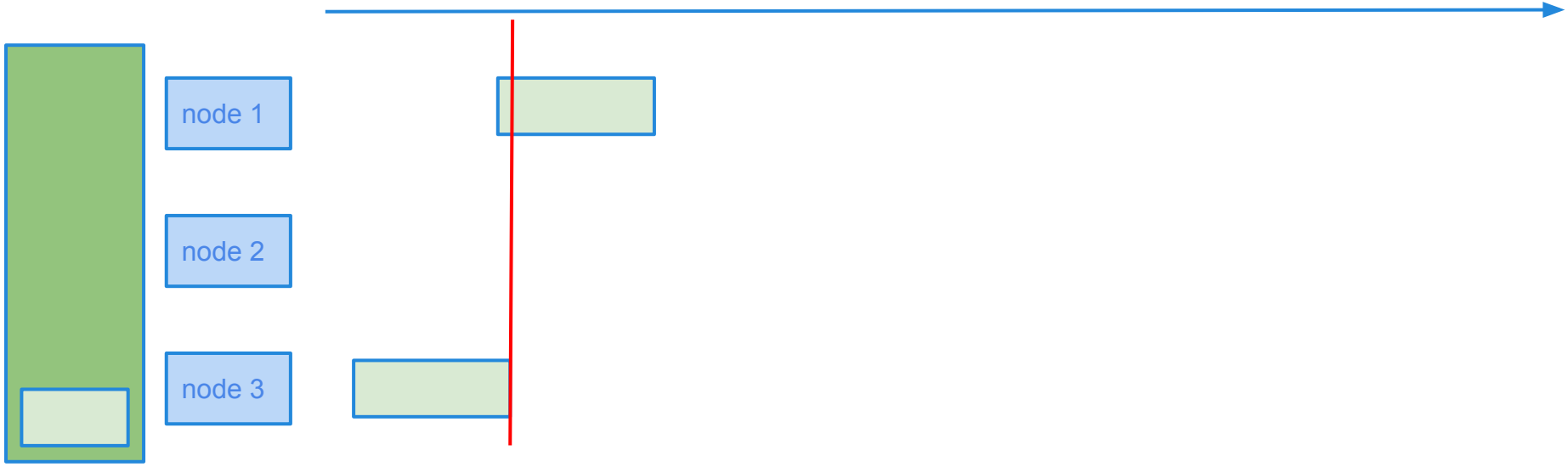

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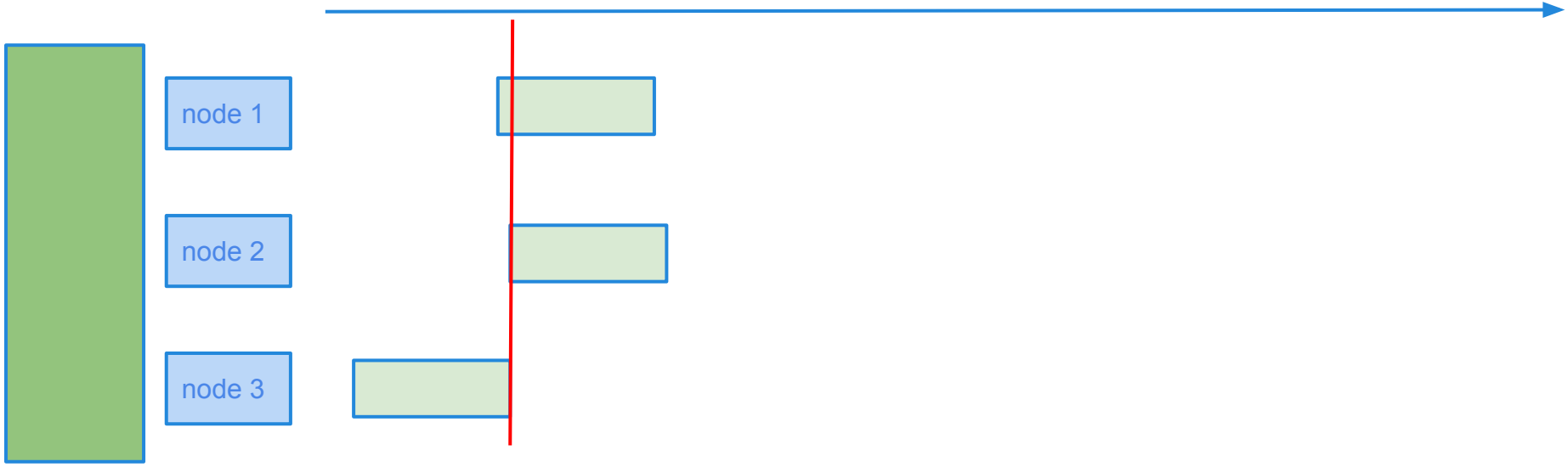

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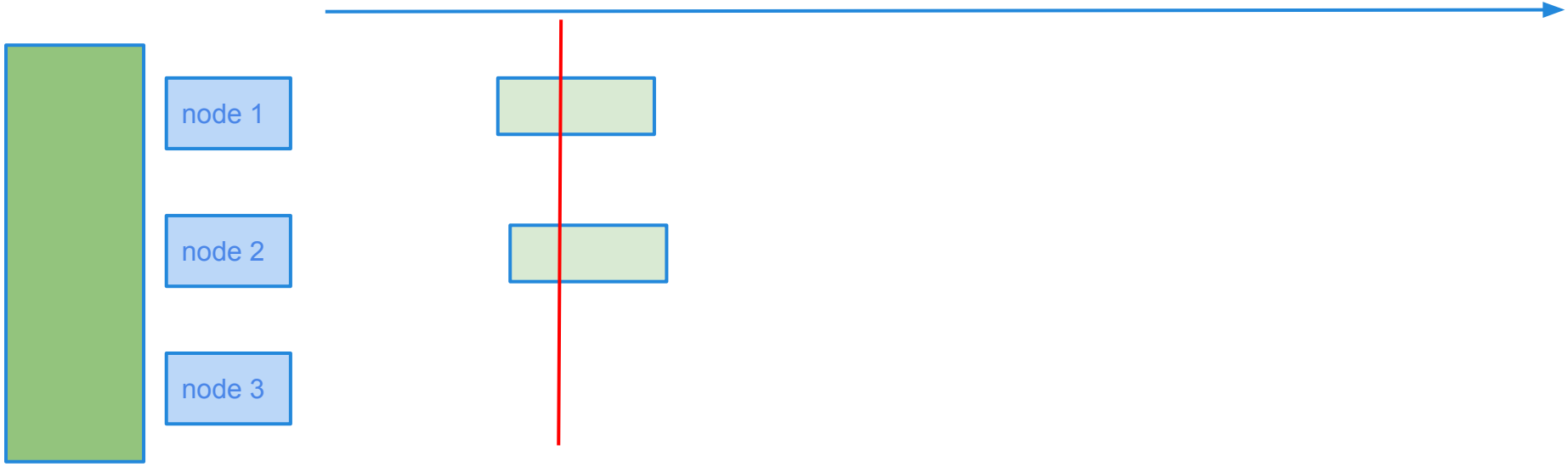

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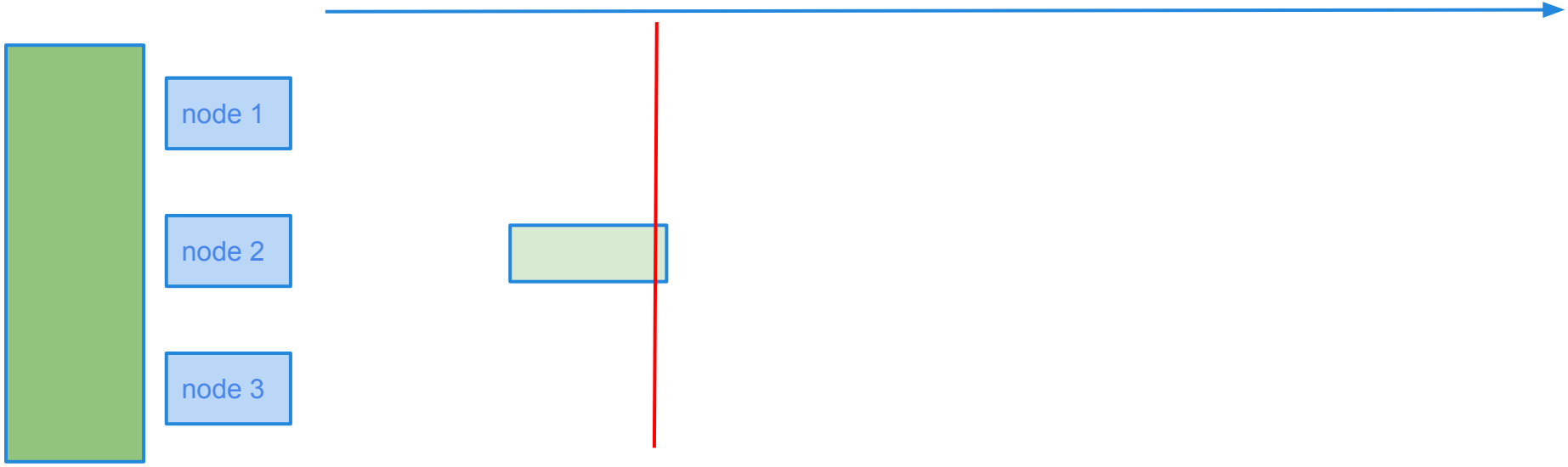

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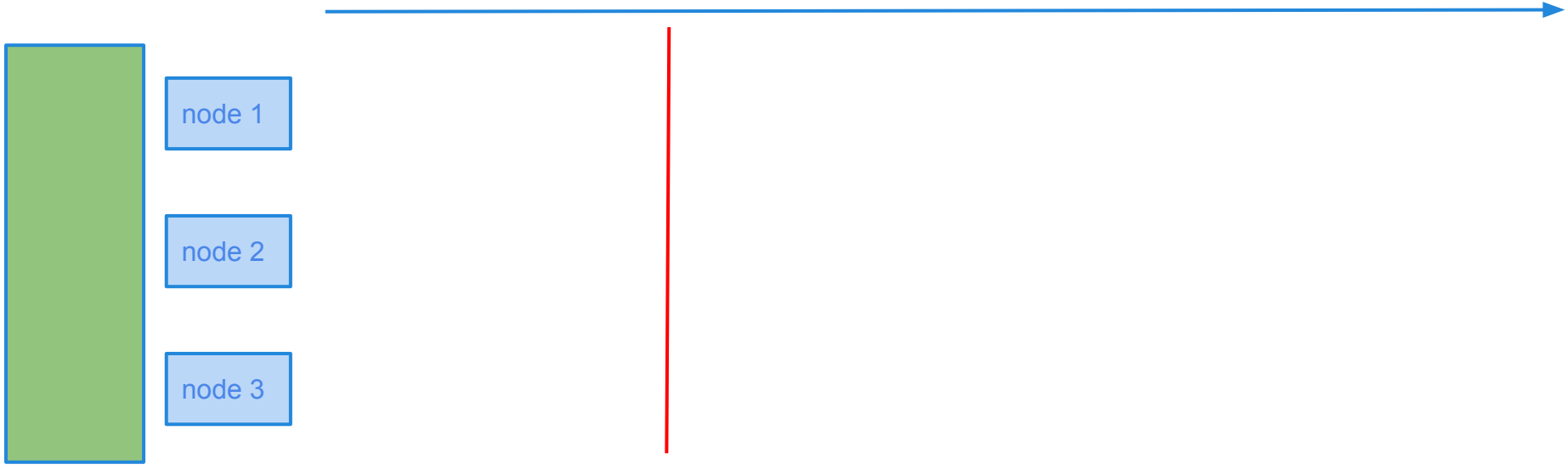


Everyday I'm Shuffling

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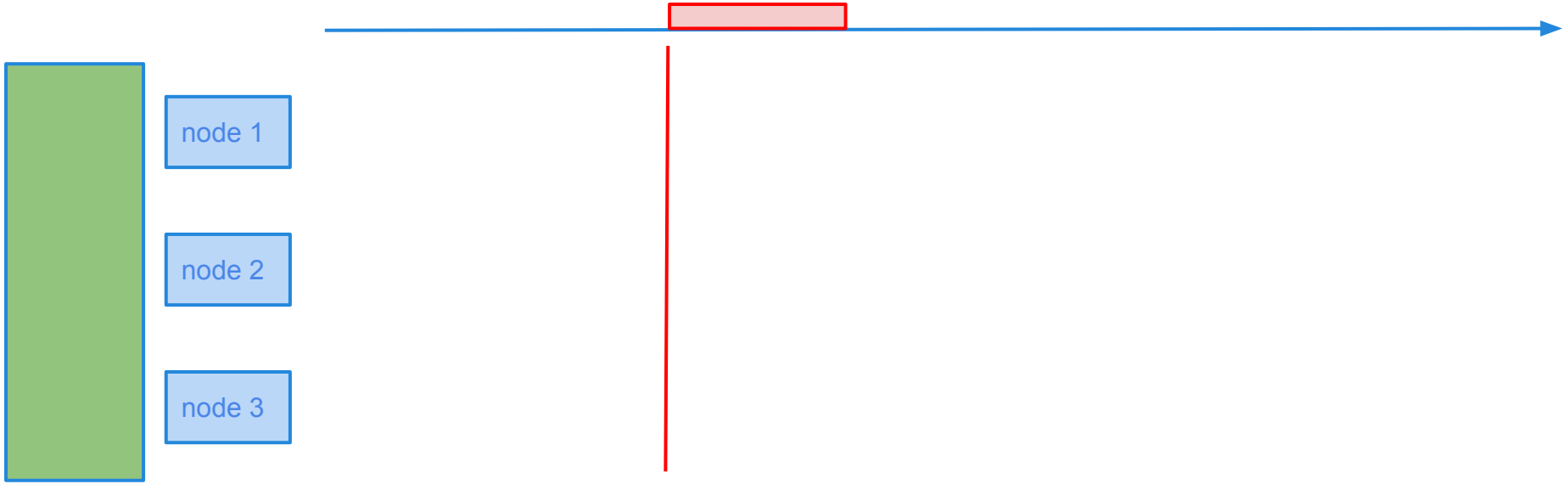

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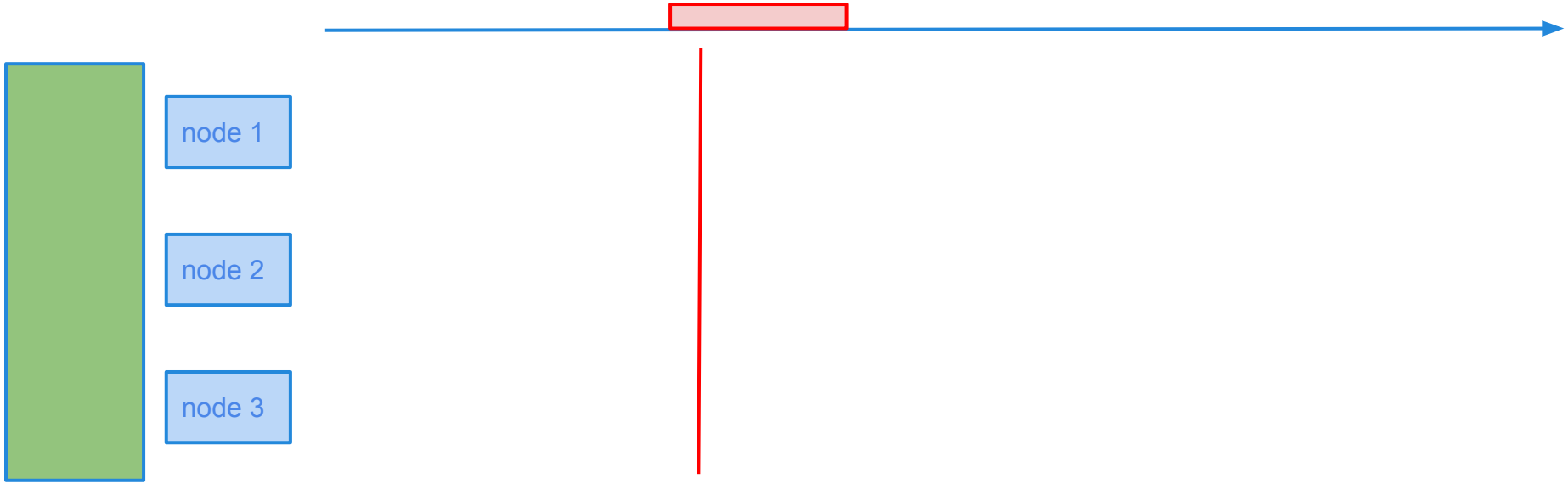

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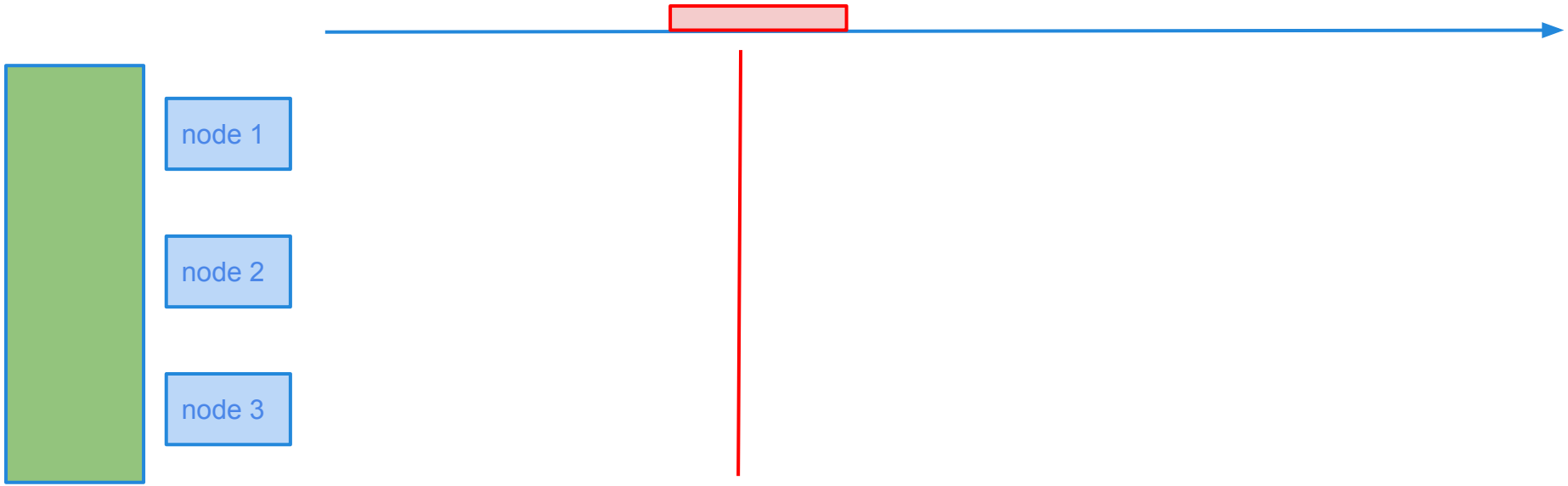

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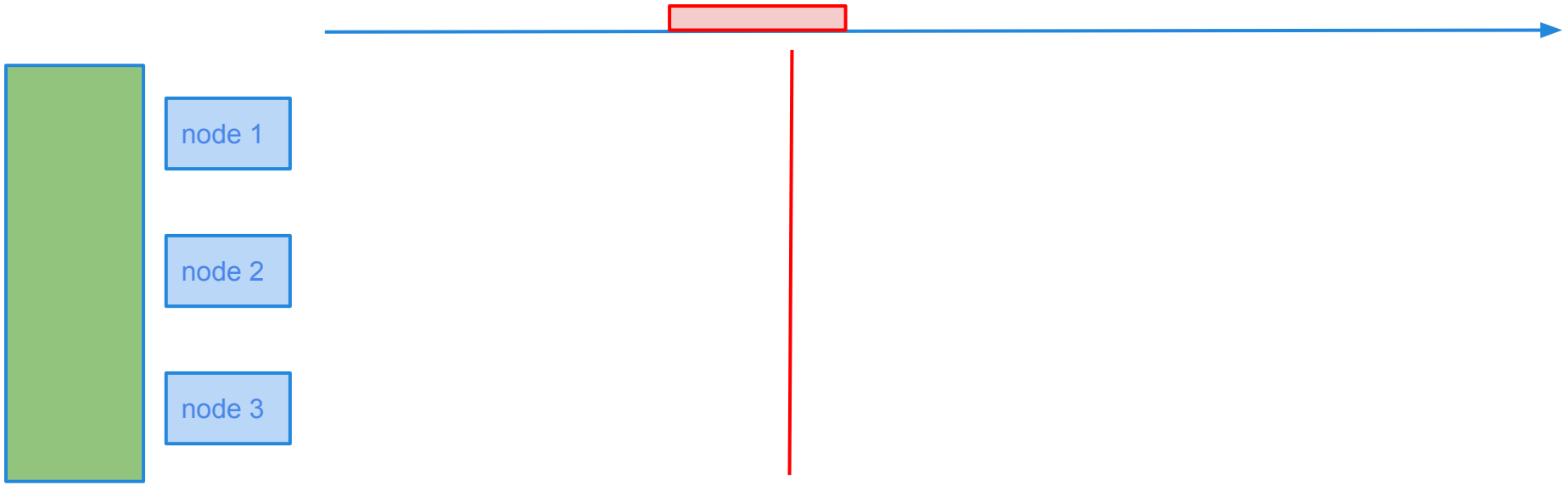

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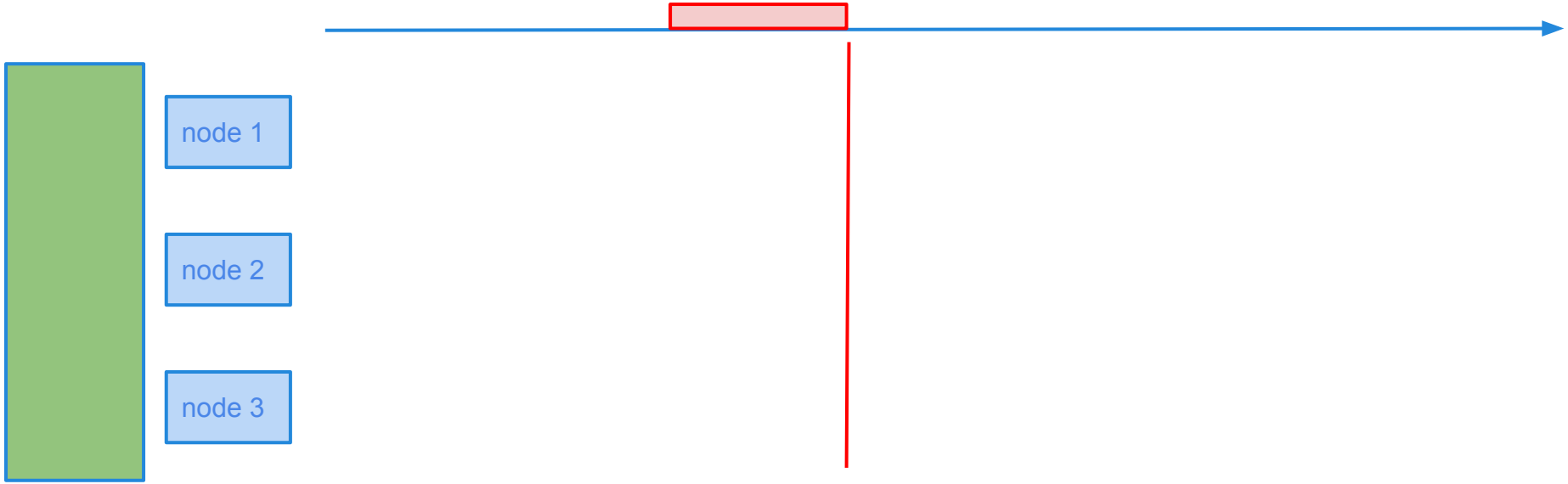

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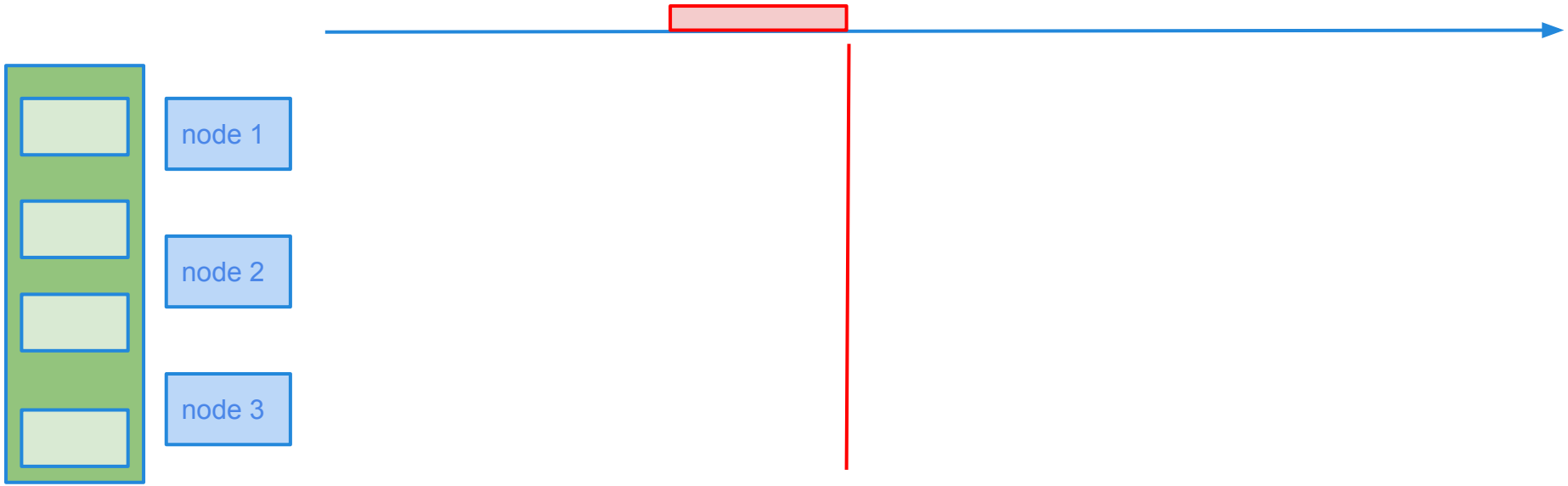

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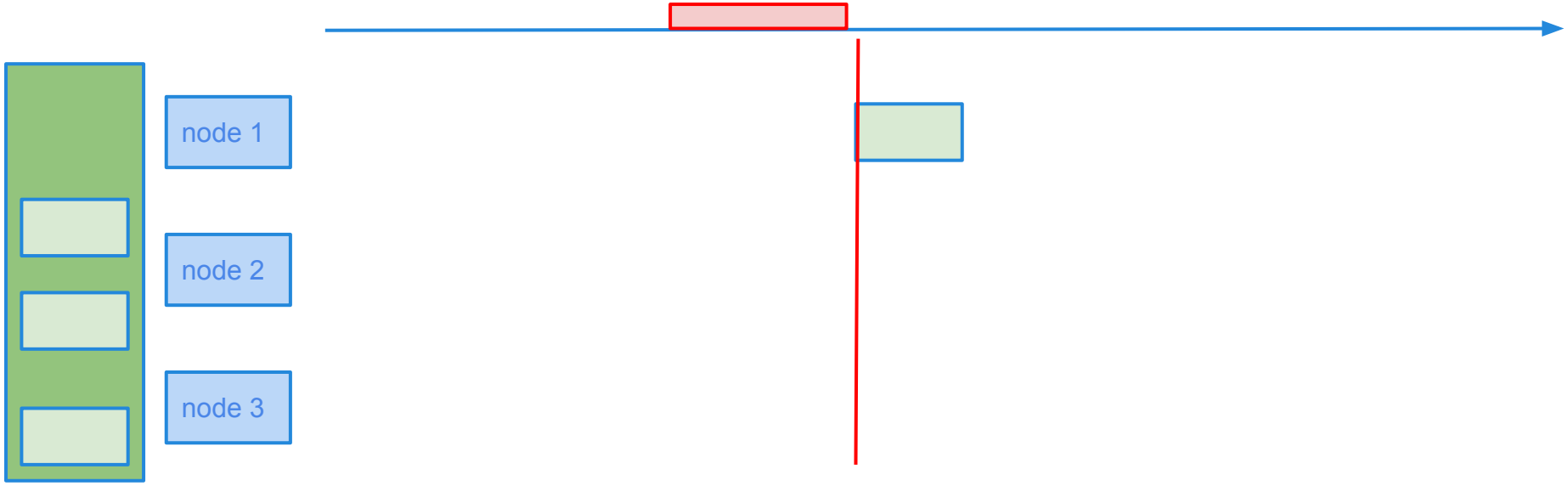

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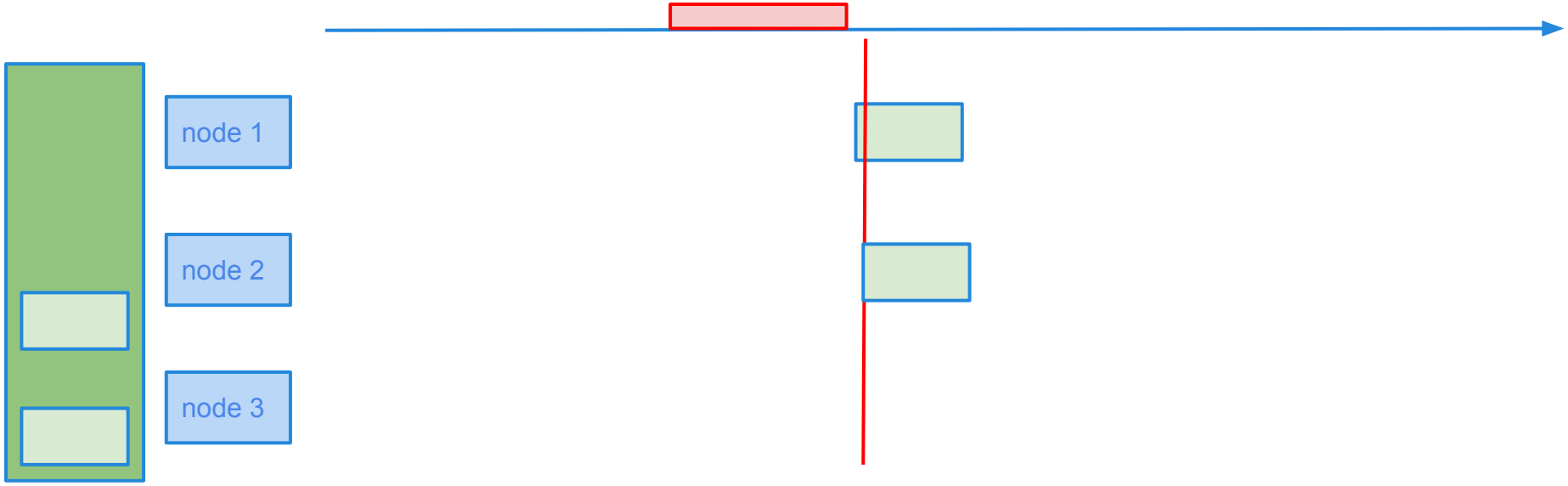

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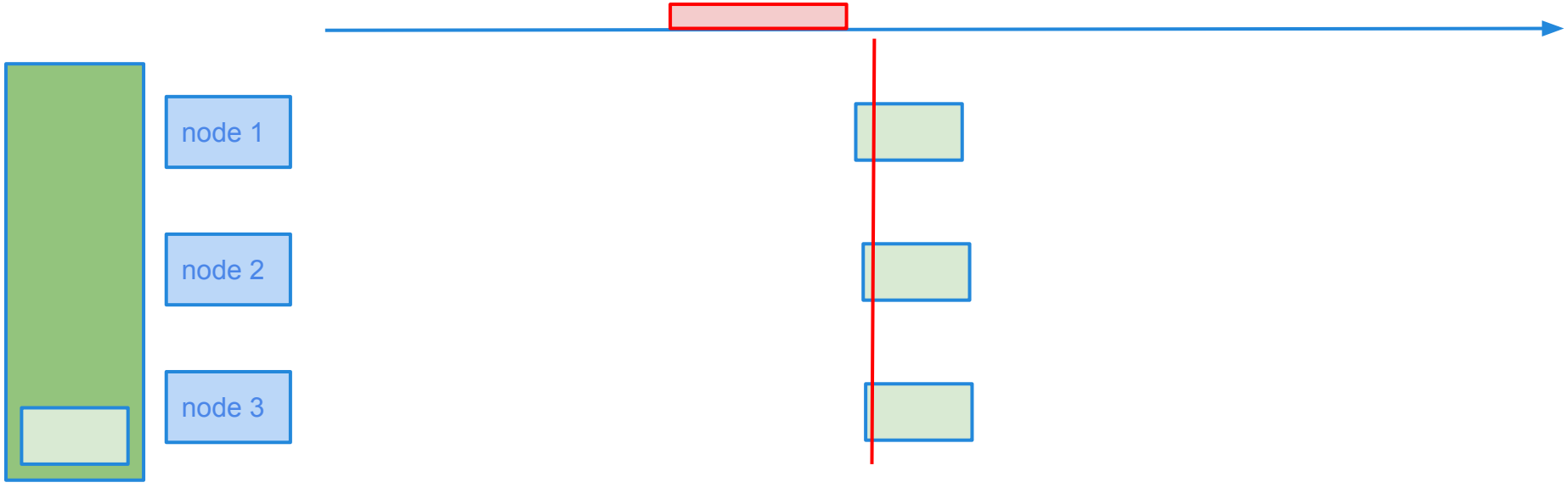

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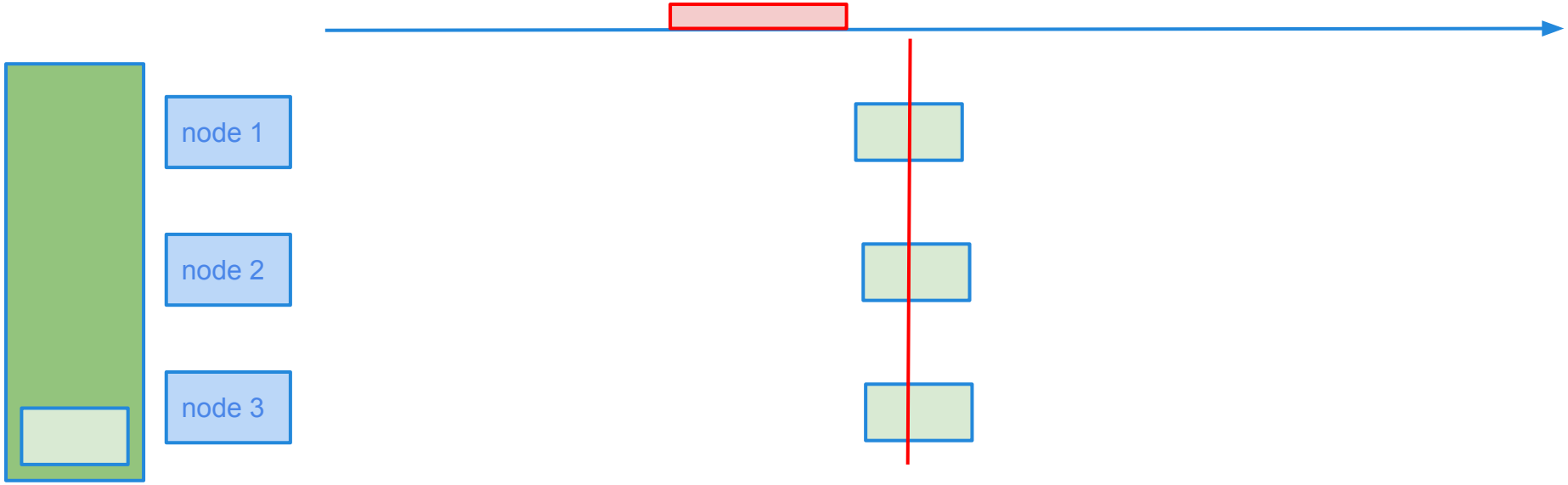

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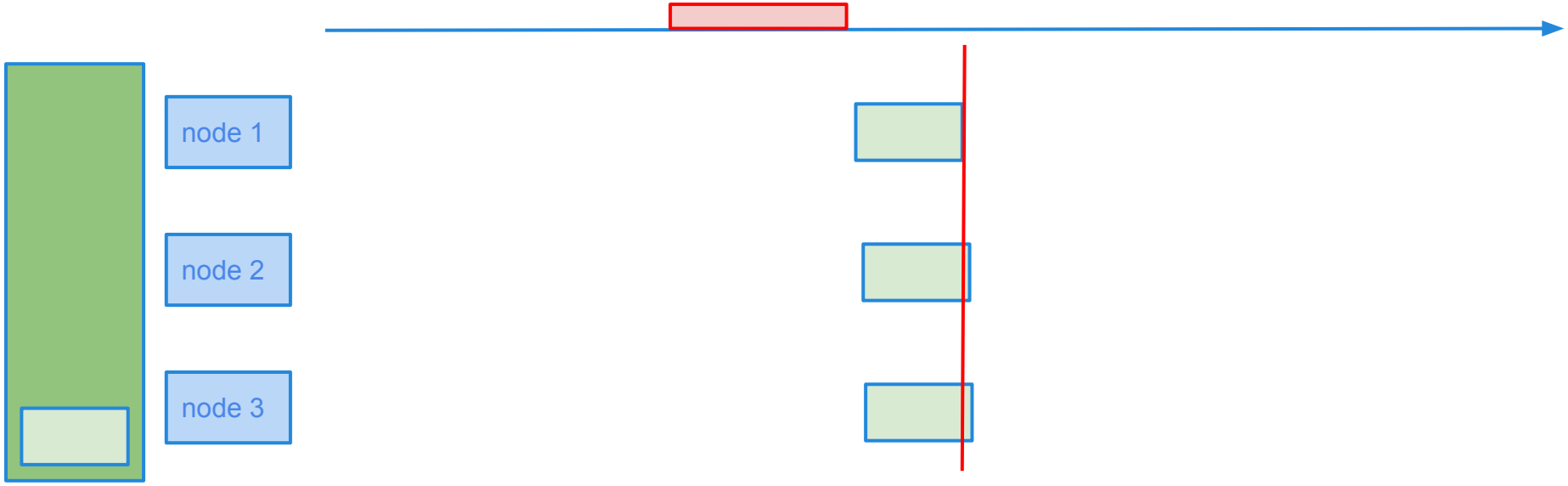

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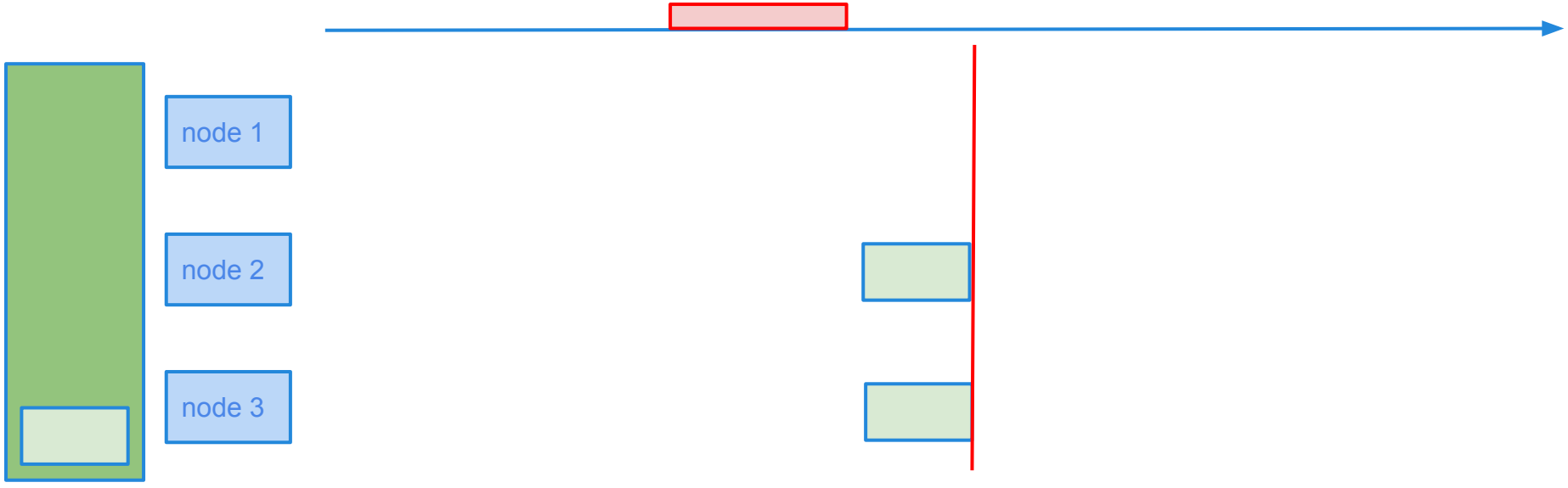

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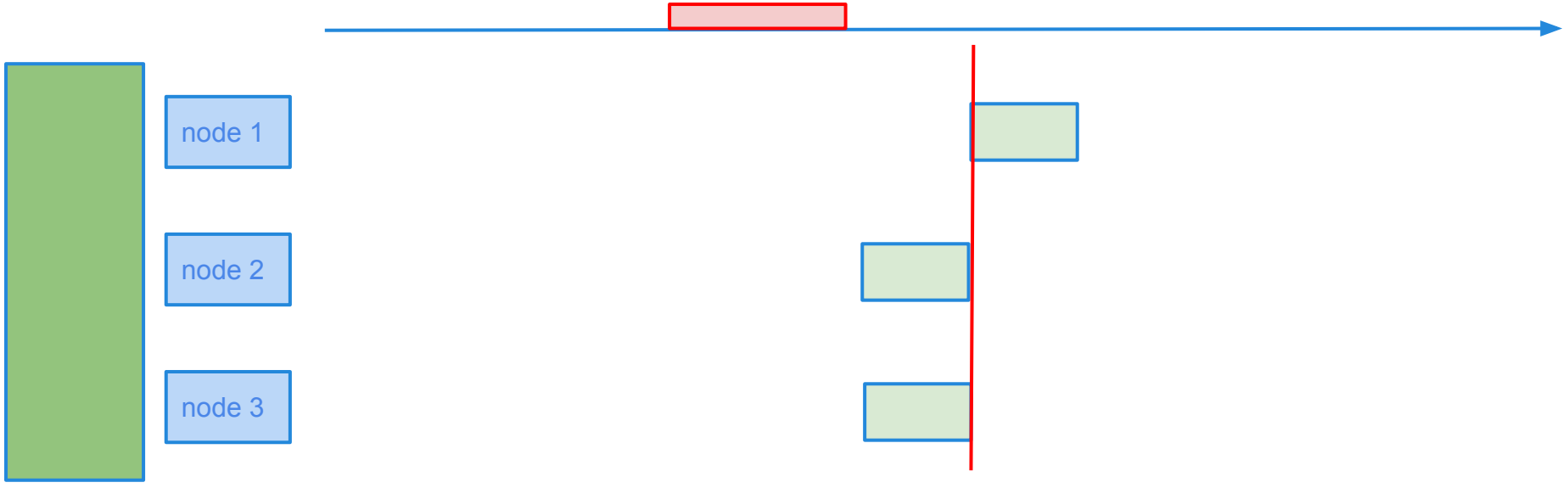

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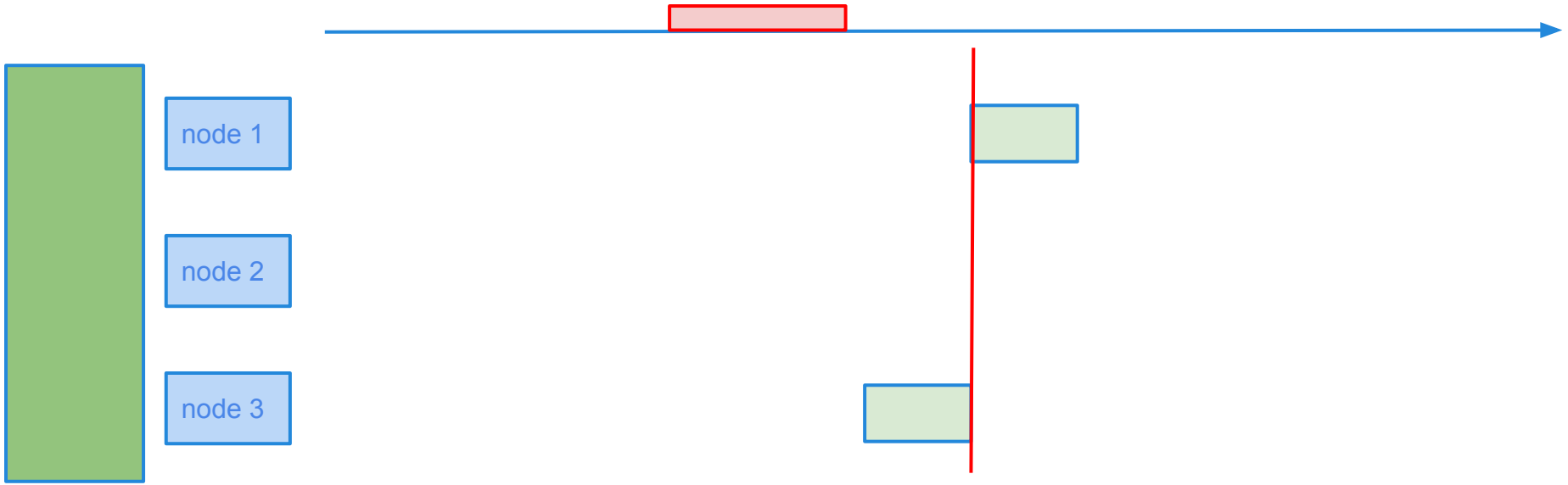

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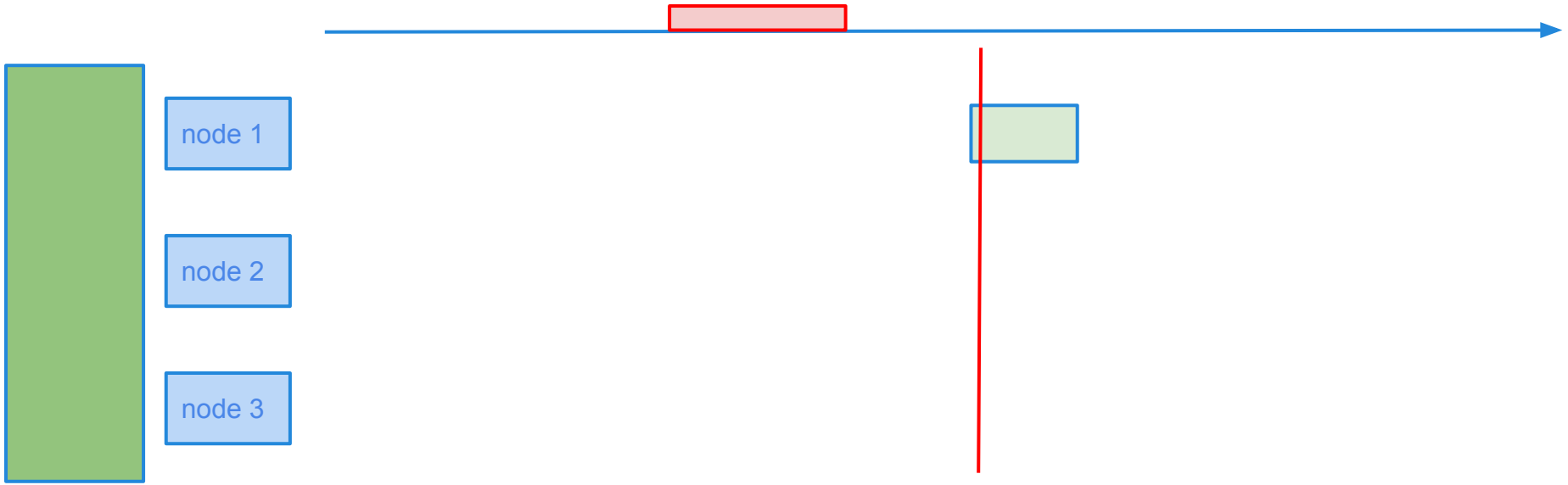

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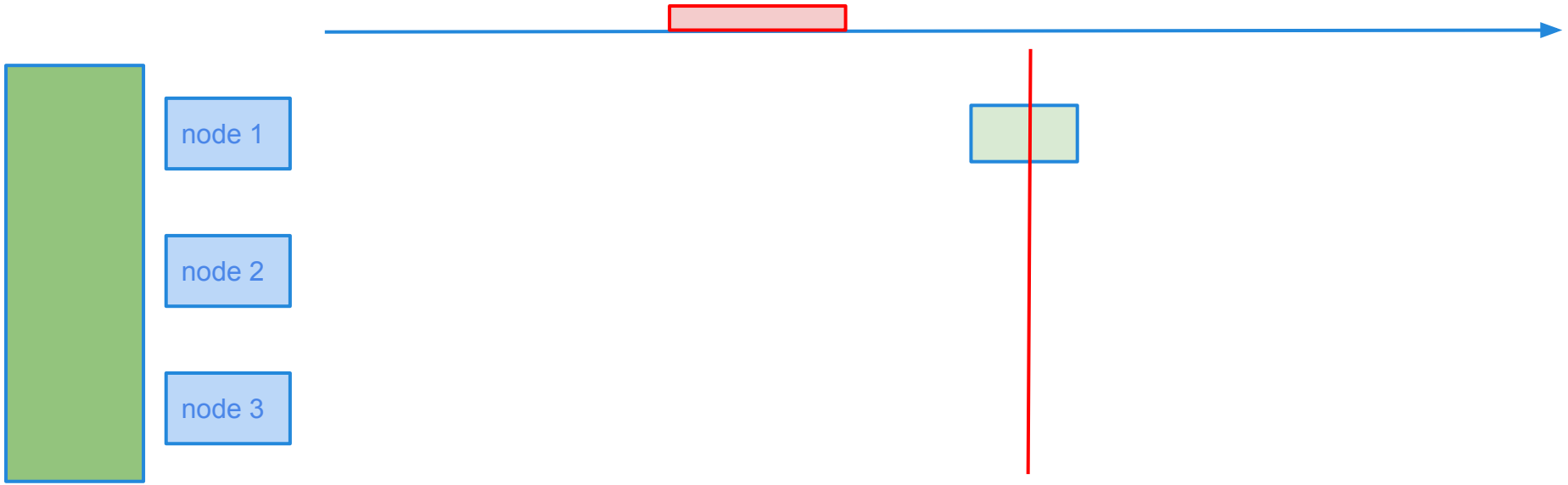

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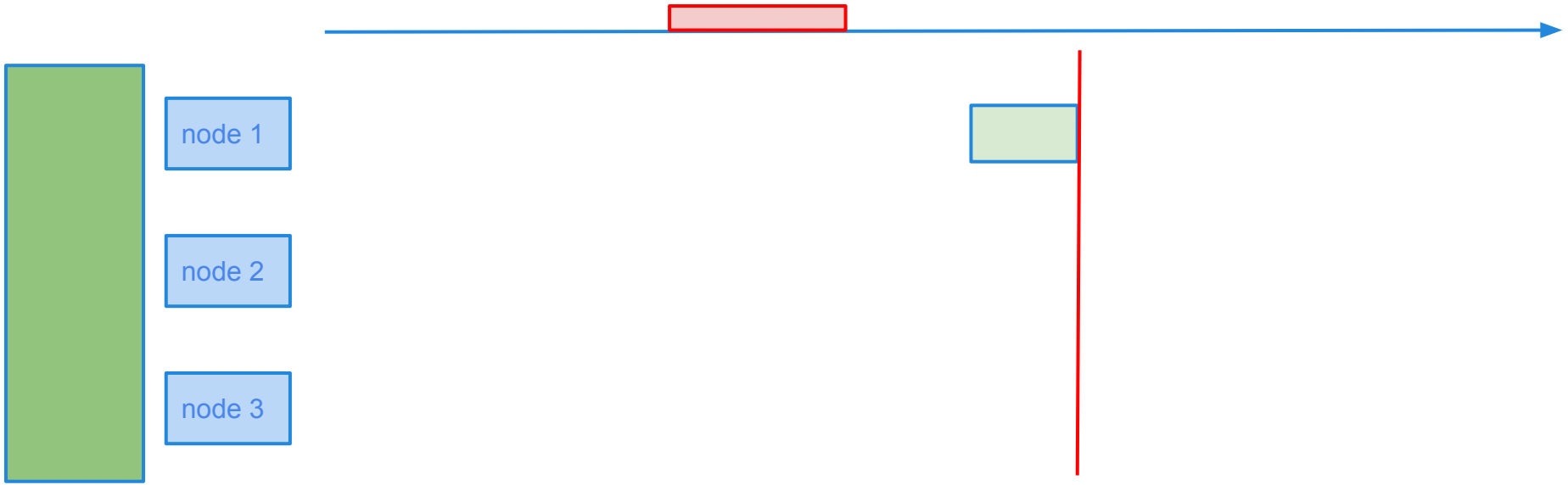

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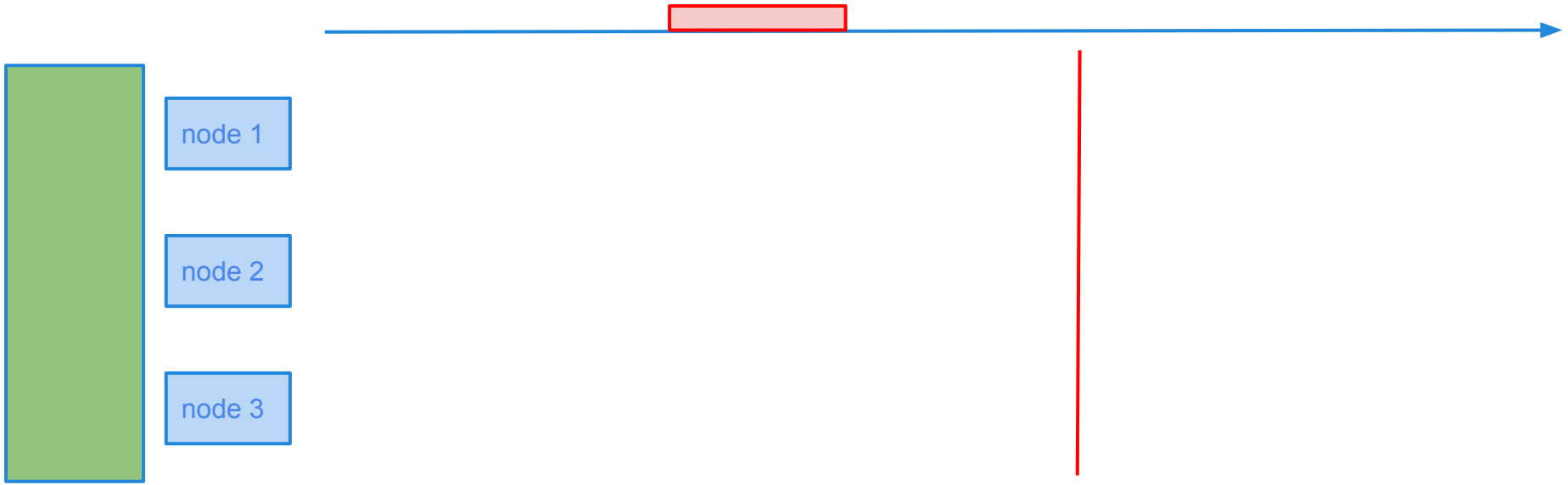

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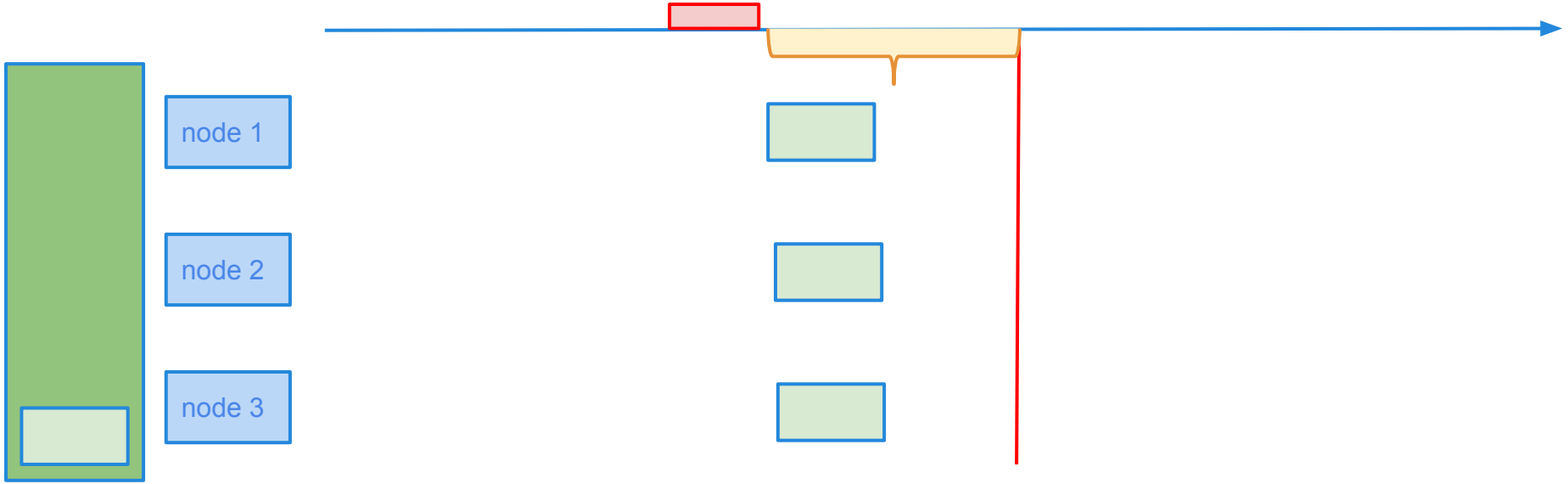

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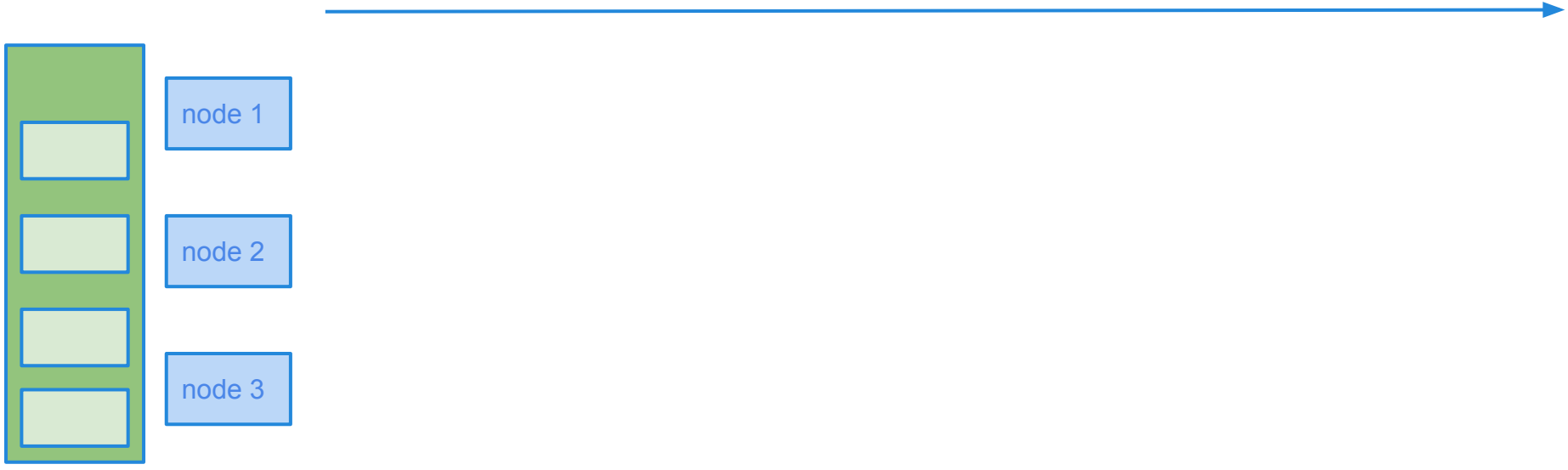

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    .groupBy(extractDate _,  6)
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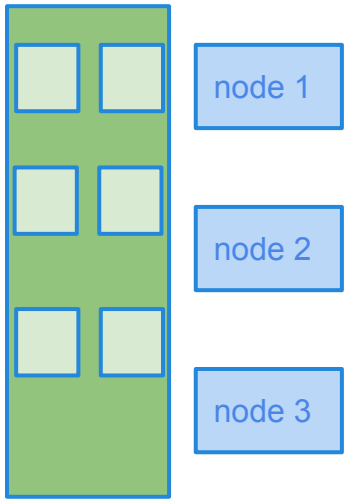

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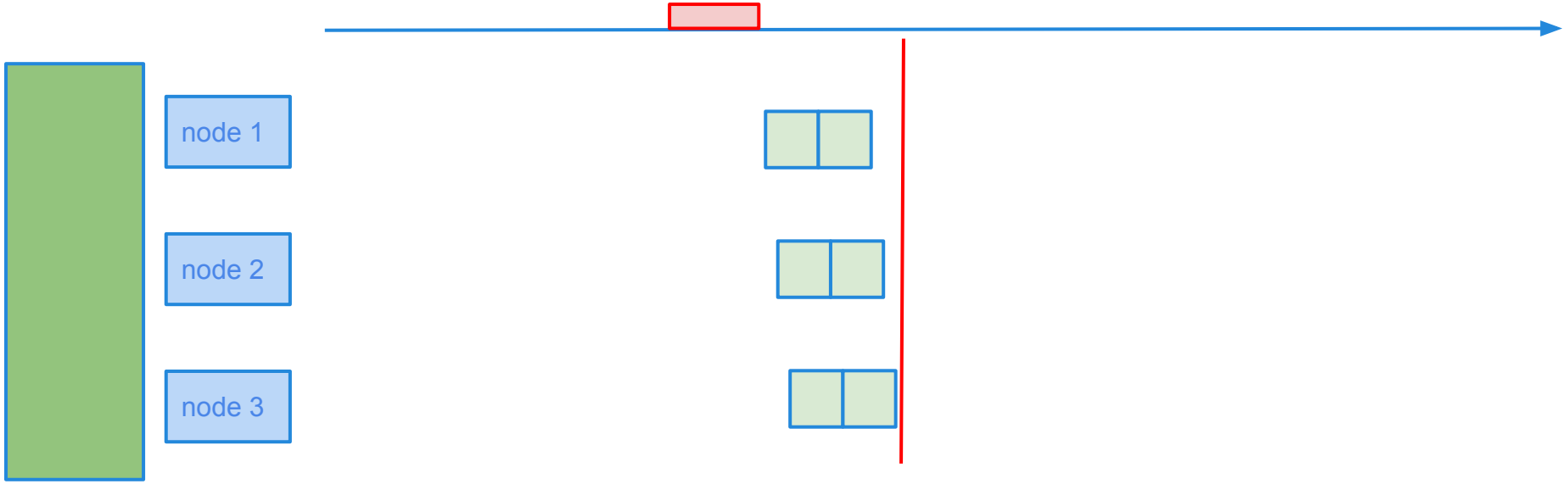

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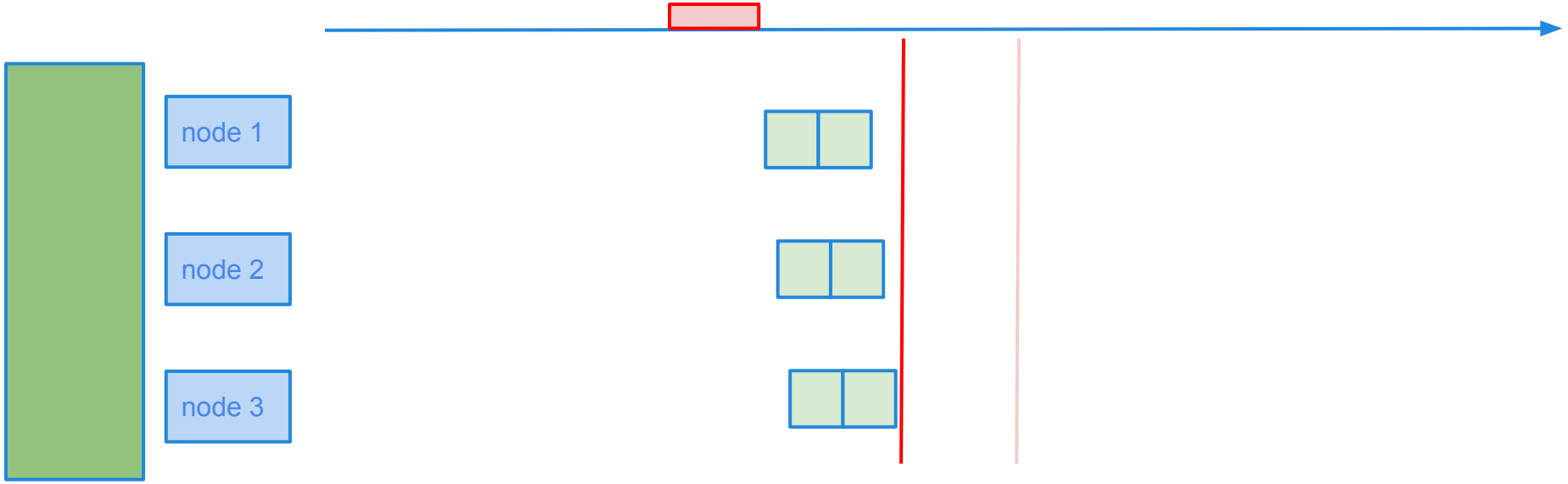

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val events = sc.textFile(“hdfs://journal/*”)
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```
val events = sc.textFile(“hdfs://journal/*”)  // here small number of partitions, let’s say 4
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```
val events = sc.textFile("hdfs://journal/*")   // here small number of partitions, let's say 4
      .repartition(256)                        // note, this will cause a shuffle
      .map( e => (extractDate(e), e))
```

A bit more about partitions

```
val events = sc.textFile(“hdfs://journal/*”) // here a lot of partitions, let’s say 1024
    .filter {  LocalDate.parse(extractDate _) isAfter LocalDate.of(2015,3,1) }
    .map( e => (extractDate(e), e))
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A bit more about partitions

```
val events = sc.textFile("hdfs://journal/*") // here a lot of partitions, let's say 1024
    .filter {  LocalDate.parse(extractDate _) isAfter LocalDate.of(2015,3,1) }
    .coalesce(64)    // this will NOT shuffle
    .map( e => (extractDate(e), e))
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Example: Usage of RDD within other RDD. Invalid since only the driver can call operations on RDDS (not other workers)

rdd.map((k,v) => otherRDD.get(k)) -> rdd.join(otherRdd)

rdd.map(e => otherRdd.map {}) -> rdd.cartesian(otherRdd)

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- Pretty soon my blog & github :)

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