Problem Solving Recipes Learned from Supporting Spark

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SPARK SUMMIT
EAST 2017

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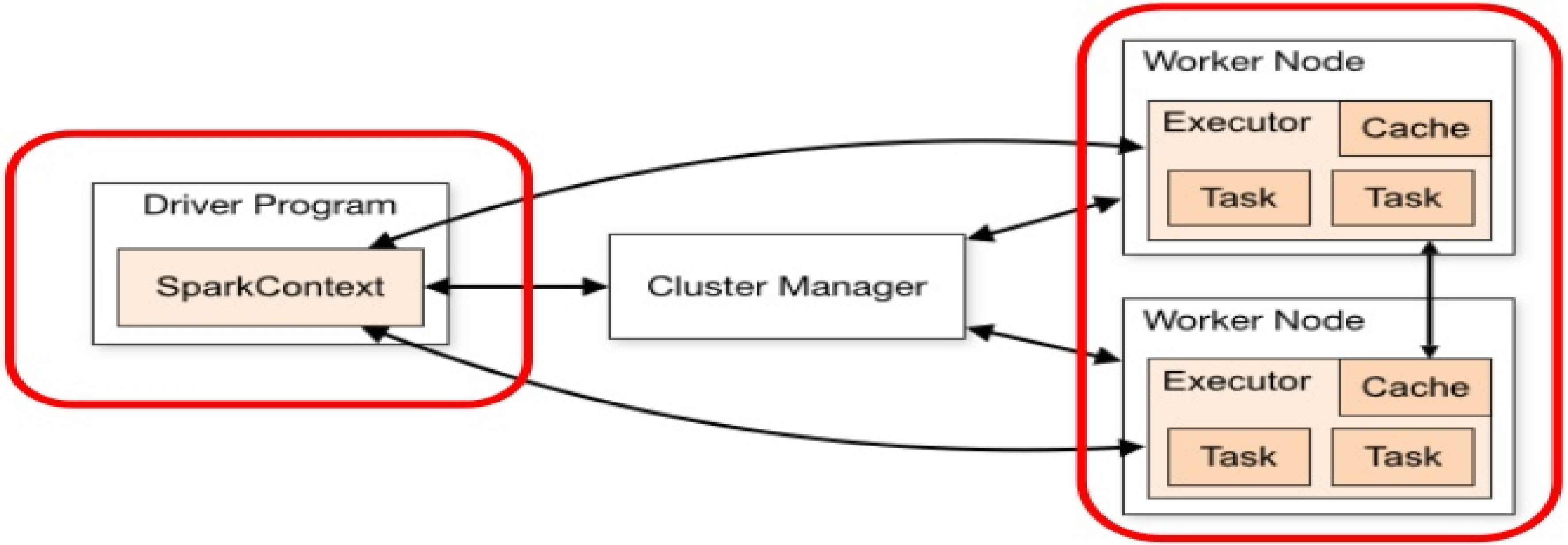
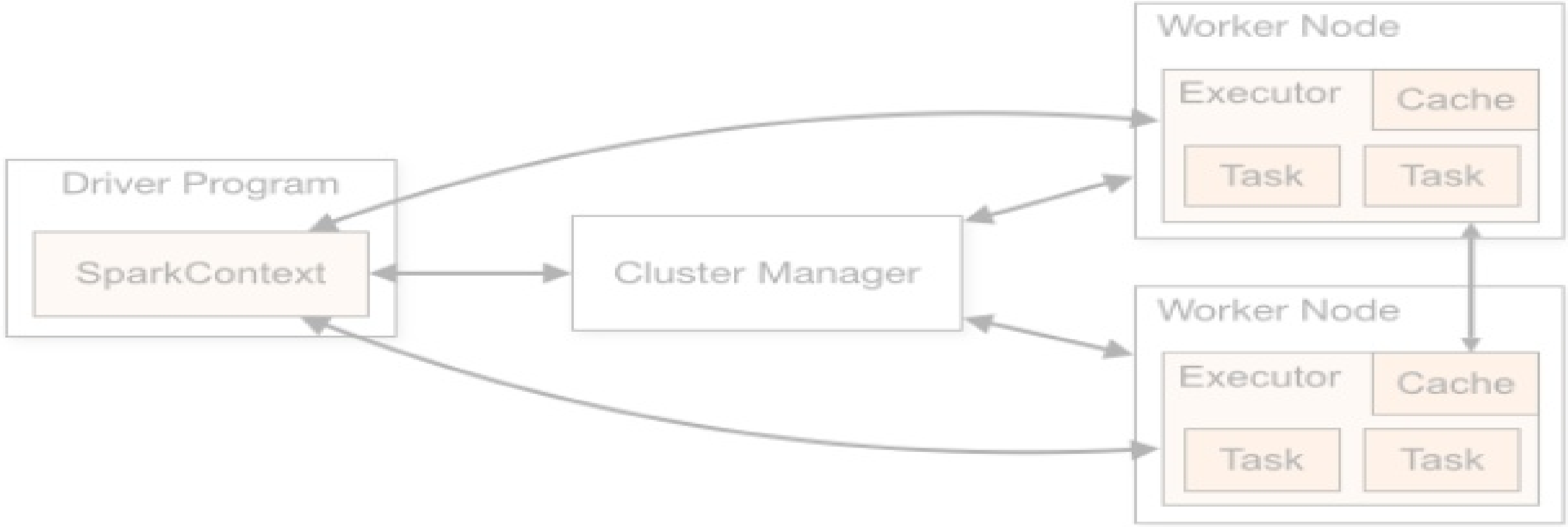
Prologue

Memory Problems?

Out Of Memory (OOM)

“Thrown when the Java Virtual Machine cannot allocate an object because it is ***out of memory****, and* ***no more memory could be made available by the garbage collector****.”*


Driver Program
SparkContext
Cluster Manager
Worker Node
Executor
Cache
Task
Task
Worker Node
Executor
Cache
Task
Task



`spark.memory.fraction vs spark.memory.storageFraction`

OOM Tips

- Don’t jump straight to parameter tuning
  - But if you do => Sparklint
- Be aware of execution time object creation

```
rdd.mapPartitions{ iterator =>  // fetch remote file }
```

OOM Tips

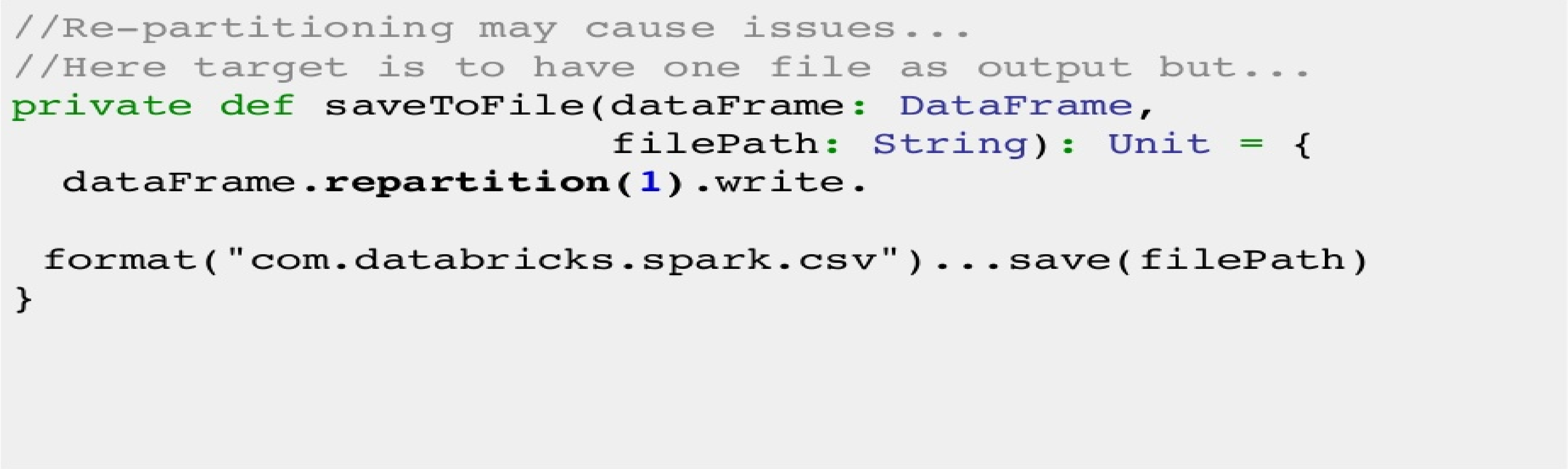
- Plan the resources needed from your cluster manager before deploying - when possible

EXAMPLE

YARN

- Cluster vs client mode
- yarn.nodemanager.resource.memory-mb
- yarn.scheduler.minimum-allocation-mb
- spark.yarn.driver.memoryOverhead

OOM



```
//Re-partitioning may cause issues...
//Here target is to have one file as output but...
private def saveToFile(dataFrame: DataFrame,
                       filePath: String): Unit = {
  dataFrame.repartition(1).write.

 format("com.databricks.spark.csv")...save(filePath)
}
```

NoSuchMethod

NoSuchMethod

"Thrown if an application tries to call a specified method of a class (either static or instance), and that ***class no longer has a definition*** *of that method. Normally, this error is caught by the compiler; this error can only occur* ***at run time if the definition of a class has incompatibly changed****."*

java.lang.NoSuchMethodError:
org.apache.commons.math3.util.MathArrays.natural

> "...spark 1.4.1 uses math3 3.1.1 which, as it turns out, doesn't have the `natural` method."

Dependency Collision

Compiled against **version A** Runtime used **version B**

Version B did not have the method!

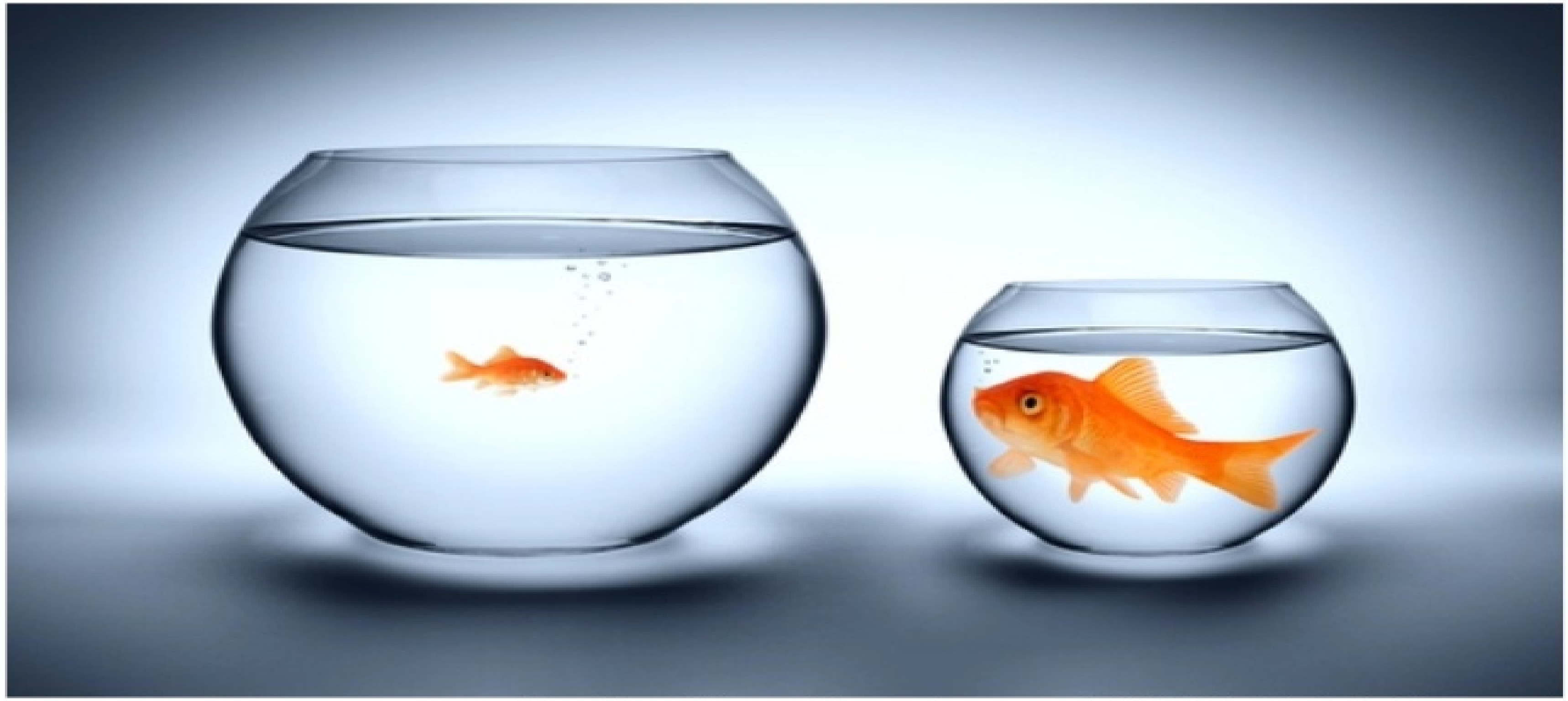
Solutions

- Upgrade Spark or downgrade your library
  - If you're lucky...
- Enforce lib load order

```
spark-submit --class "MAIN_CLASS"
  --driver-class-path commons-math3-3.3.jar YOURJAR.jar
```

- Shade your lib
  - sbt: https://github.com/sbt/sbt-assembly#shading
  - Maven: https://maven.apache.org/plugins/maven-shade-plugin/

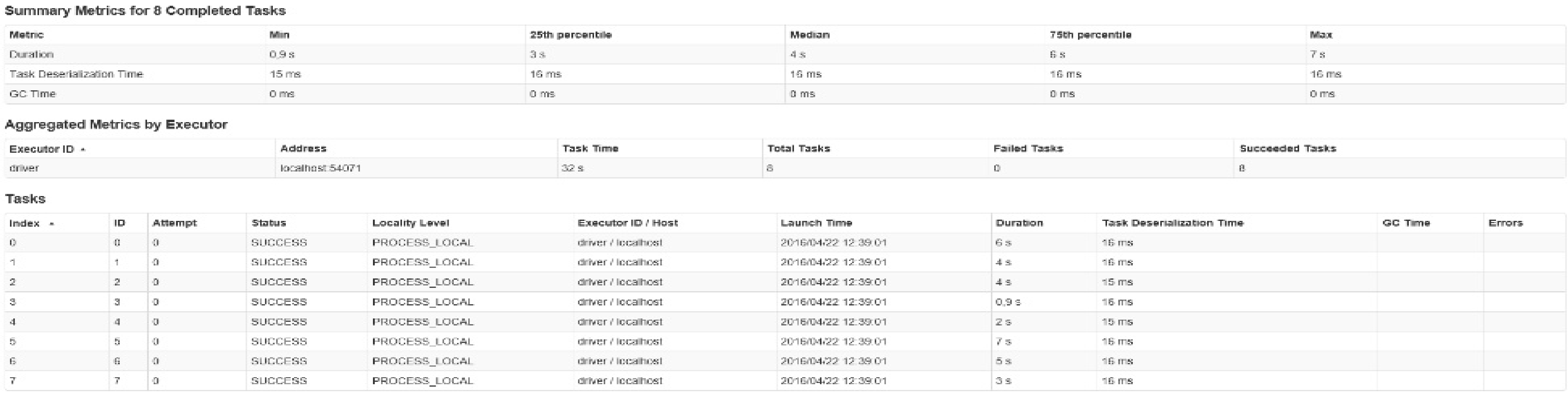
Perplexities of Size



https://josephderosa.files.wordpress.com/2016/04/too-big-by-half.jpg

Perplexities of Size

Perplexities of Size



Summary Metrics for 8 Completed Tasks

Metric	Min	25th percentile	Median	75th percentile	Max
Duration	0.9 s	3 s	4 s	6 s	7 s
Task Deserialization Time	15 ms	16 ms	16 ms	16 ms	16 ms
GC Time	0 ms	0 ms	0 ms	0 ms	0 ms

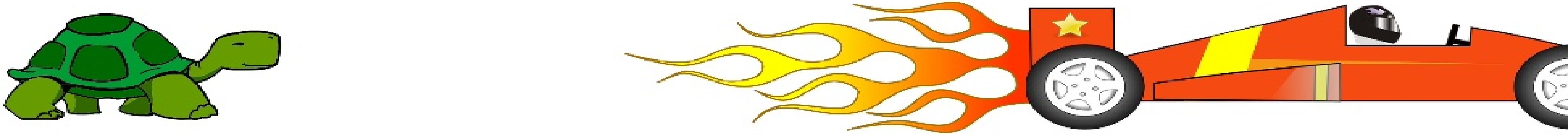
Aggregated Metrics by Executor

Executor ID ▲	Address	Task Time	Total Tasks	Failed Tasks	Succeeded Tasks
driver	localhost:54071	32 s	8	0	8

Tasks

Index ▲	ID	Attempt	Status	Locality Level	Executor ID / Host	Launch Time	Duration	Task Deserialization Time	GC Time	Errors
0	0	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/04/22 12:39:01	6 s	16 ms		
1	1	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/04/22 12:39:01	4 s	16 ms		
2	2	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/04/22 12:39:01	4 s	15 ms		
3	3	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/04/22 12:39:01	0.9 s	16 ms		
4	4	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/04/22 12:39:01	2 s	15 ms		
5	5	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/04/22 12:39:01	7 s	16 ms		
6	6	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/04/22 12:39:01	5 s	16 ms		
7	7	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/04/22 12:39:01	3 s	16 ms		

Struggles in Speculation



Struggles in Speculation

- `spark.speculation.interval`
- `spark.speculation.multiplier`
- `spark.speculation.quantile`

Strategizing Your Joins

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Common Issues

- Slow Joins
- Unavoidable Joins

Slow Joins

- Avoid shuffling if one side of the join is small enough

```
val df = largeDF.join(broadcast(smallDF), “key”)
```

- Check which strategy is actually used

```
df.explain
df.queryExecution.executedPlan
```

- For broadcast you should see :

```
 == Physical Plan ==
BroadcastHashJoin ... BuildRight
...
```

Join Strategies

- Broadcast
  - size < `SQLConf.AUTO_BROADCASTJOIN_THRESHOLD`
- Shuffle hash join
- Sort merge
  - `spark.sql.join.preferSortMergeJoin (default = true)`

Unavoidable Joins

```
val df = spark.sparkContext.parallelize(
  List(("Id1", 10, "London"), ("Id2", 20,  "Paris"), ("Id2", 1, "NY"), ("Id2", 20, "London"))
).toDF("GroupId", "Amount","City")
val grouped = df.groupBy("GroupId").agg(max("Amount"), first("City"))
grouped.collect().foreach(println)
```

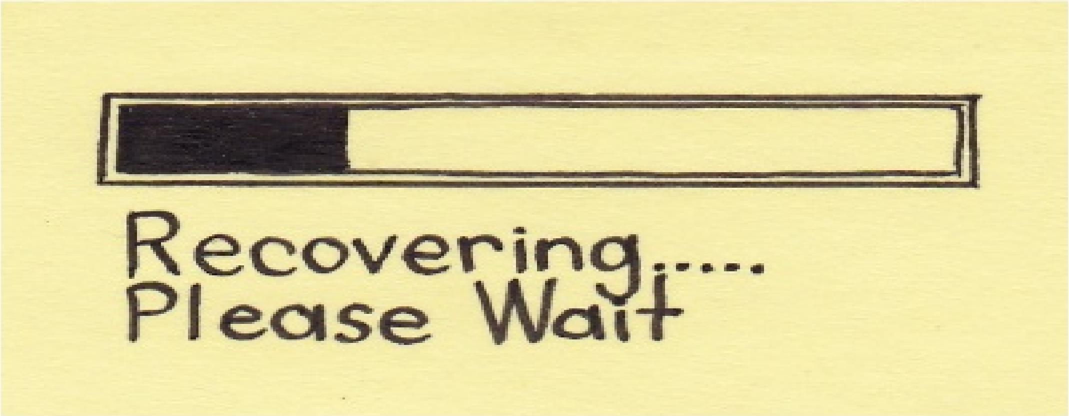
```
[Id1,10,London]
[Id2,20,Paris]
```

Joining is the only way to retain all related columns for

```
val joined = df.as("a").join(grouped.as("b"),
   $"a.GroupId" === $"b.GroupId" && $"a.Amount" === $"b.max(Amount)", "inner")
joined.collect().foreach(println)
```

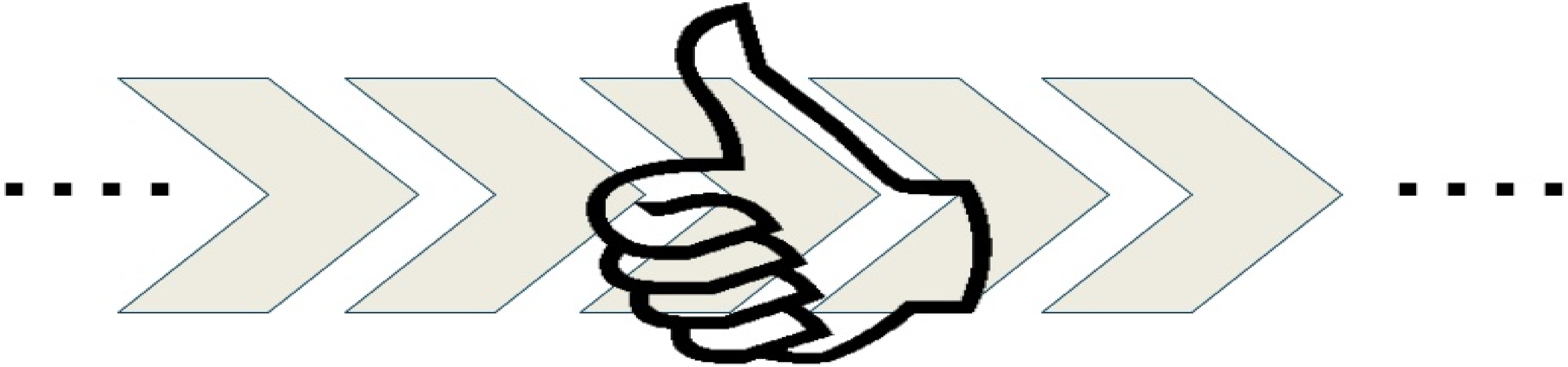
```
[Id1,10,London,Id1,10,London]
[Id2,20,Paris,Id2,20,Paris]
[Id2,20,London,Id2,20,Paris]
```

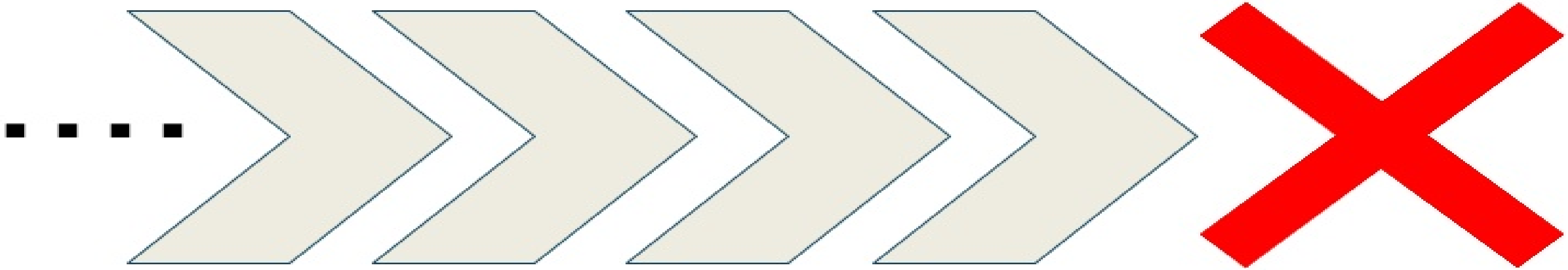
Safe Stream Recovery

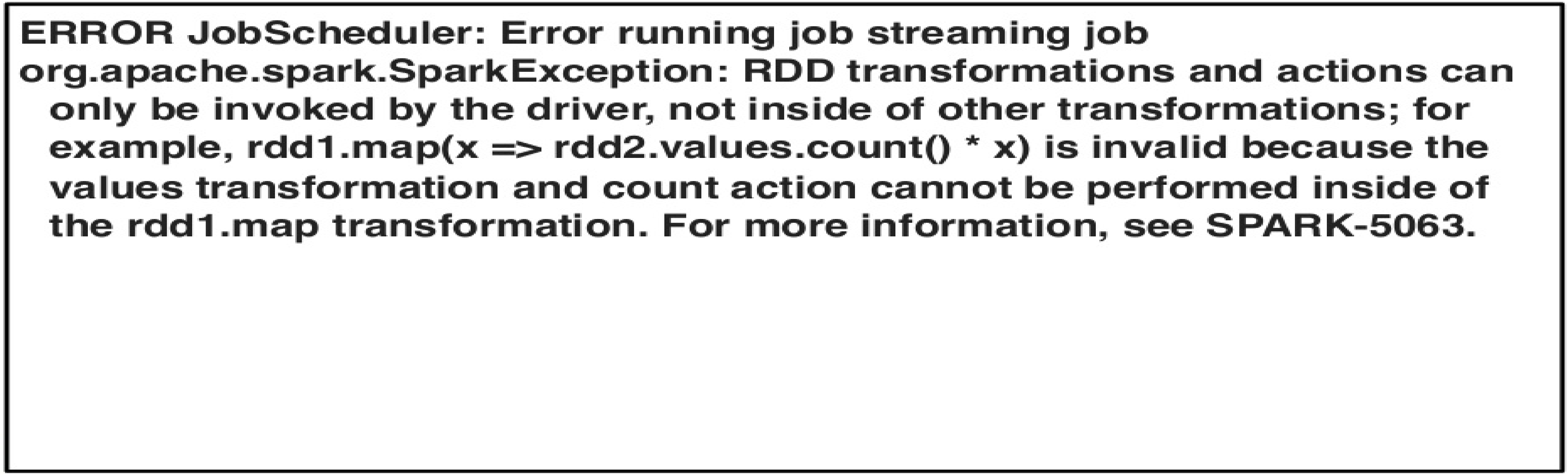


```
val products = ssc.cassandraTable[(Int, String, Float)]
 (...)
  .map{ case (id, name, price) => (id, (name, price)) }
  .cache

orders.transform(rdd => {
  rdd.join(products)
})
```







```
ERROR JobScheduler: Error running job streaming job
org.apache.spark.SparkException: RDD transformations and actions can
  only be invoked by the driver, not inside of other transformations; for
  example, rdd1.map(x => rdd2.values.count() * x) is invalid because the
  values transformation and count action cannot be performed inside of
  the rdd1.map transformation. For more information, see SPARK-5063.
```

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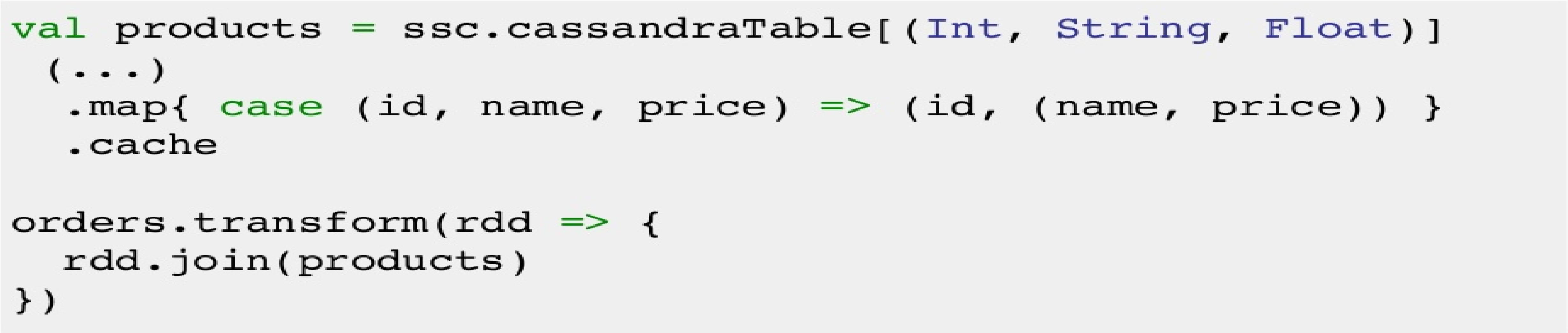

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val products = ssc.cassandraTable[(Int, String, Float)]
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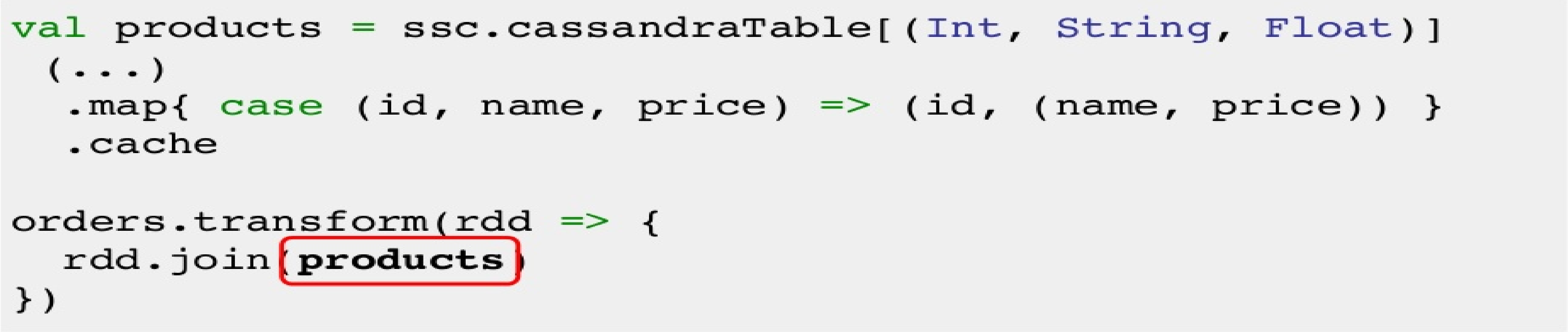
  .cache

orders.transform(rdd => {
  rdd.join(products)
})
```



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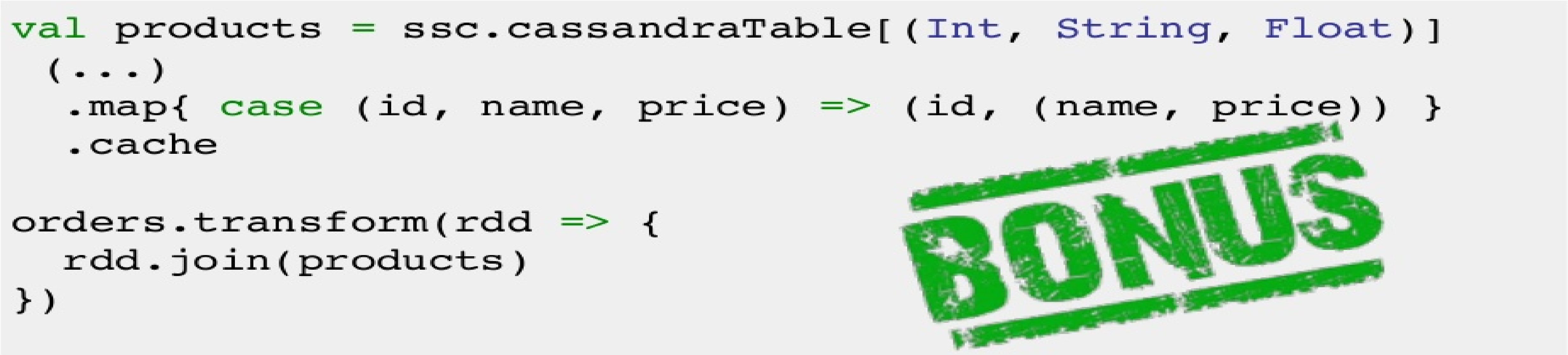
val products = ssc.cassandraTable[(Int, String, Float)]
 (...)
  .map{ case (id, name, price) => (id, (name, price)) }
  .cache

orders.transform(rdd => {
  rdd.join(products)
})
```

```
orders.transform(rdd => {
  val products = rdd.sparkContext.cassandraTable(…).map(…)
  rdd.join(products)
})
```

```
orders.transform(rdd => {
  val products = rdd.sparkContext.cassandraTable(…).map(…)
  rdd.join(products)
})
```



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val products = ssc.cassandraTable[(Int, String, Float)]
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  .map{ case (id, name, price) => (id, (name, price)) }
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orders.transform(rdd => {
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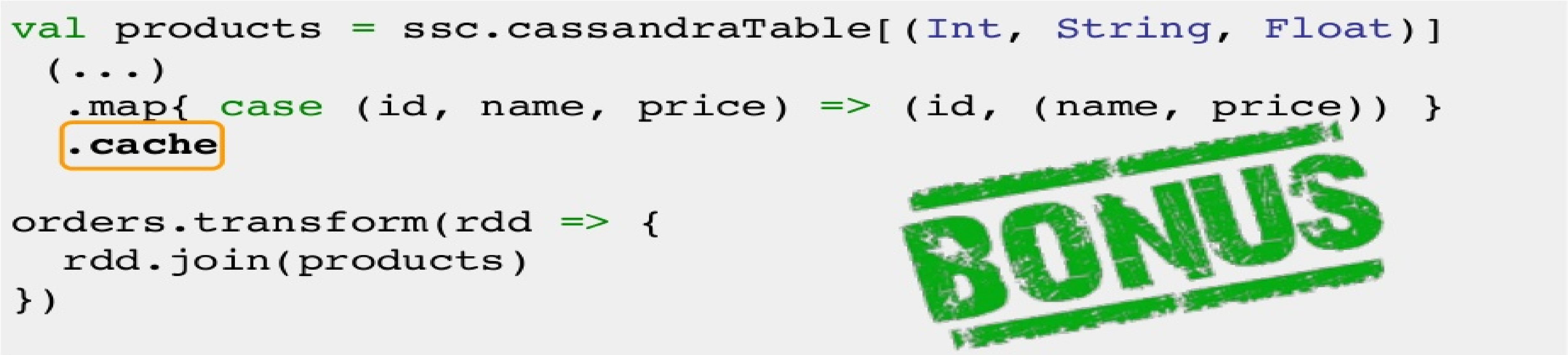

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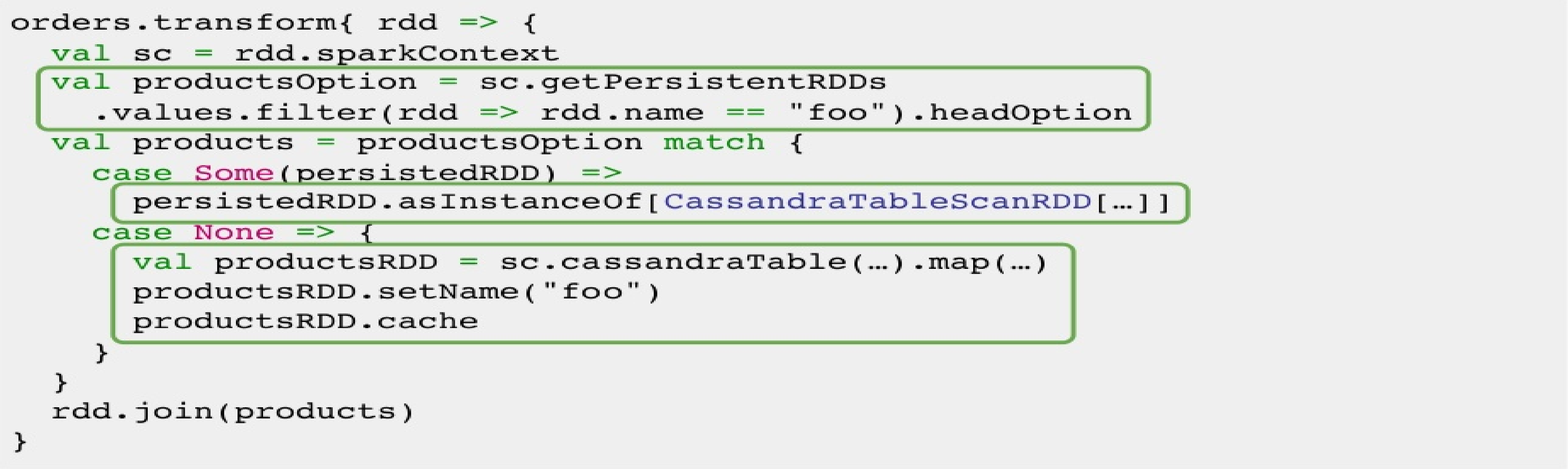
 (...)
  .map{ case (id, name, price) => (id, (name, price)) }
  .cache

orders.transform(rdd => {
  rdd.join(products)
})
```

BONUS



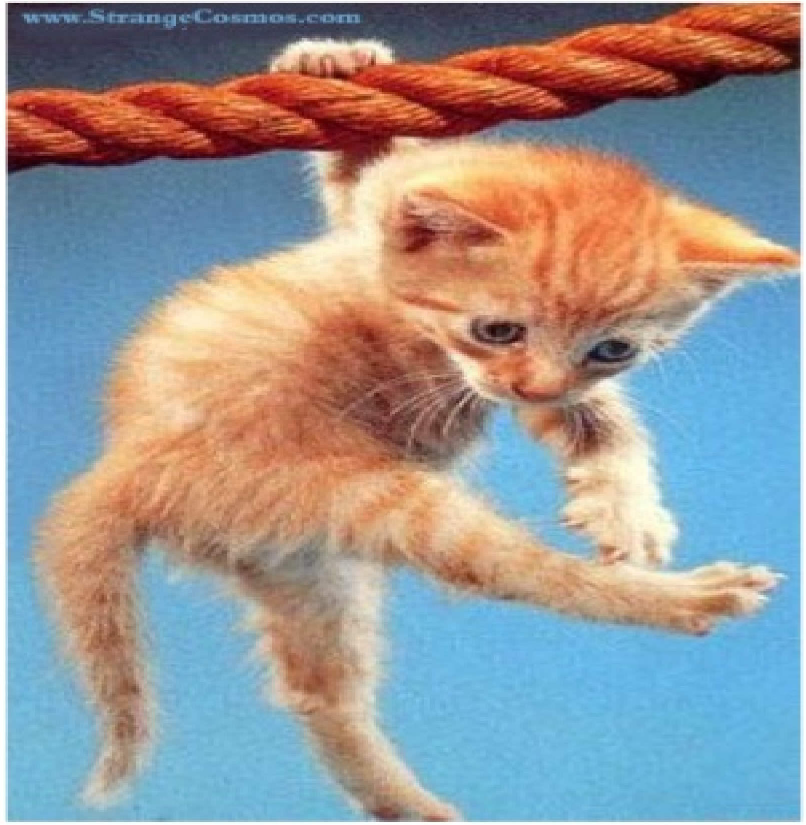
```
orders.transform{ rdd => {
  val sc = rdd.sparkContext
  val productsOption = sc.getPersistentRDDs
    .values.filter(rdd => rdd.name == "foo").headOption
  val products = productsOption match {
    case Some(persistedRDD) =>
      persistedRDD.asInstanceOf[CassandraTableScanRDD[…]]
    case None => {
      val productsRDD = sc.cassandraTable(…).map(…)
      productsRDD.setName("foo")
      productsRDD.cache
    }
  }
  rdd.join(products)
}
```

Safe Stream Recovery

```
orders.transform{ rdd => {
  val sc = rdd.sparkContext
  val productsOption = sc.getPersistentRDDs
    .values.filter(rdd => rdd.name == "foo").headOption
  val products = productsOption match {
    case Some(persistedRDD) =>
      persistedRDD.asInstanceOf[CassandraTableScanRDD[…]]
    case None => {
      val productsRDD = sc.cassandraTable(…).map(…)
      productsRDD.setName("foo")
      productsRDD.cache
    }
  }
  rdd.join(products)
}
```

✓

Handling S3 w/o Hanging



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Simple Streaming

```
val ssc = new StreamingContext(sc, Seconds(10))
val lines = ssc.textFileStream("s3n://some/folder")
lines.print
```

Simple Streaming, Right???

```
val ssc = new StreamingContext(sc, Seconds(10))
val lines = ssc.textFileStream("s3n://some/folder")
lines.print
```

Wrong!!!

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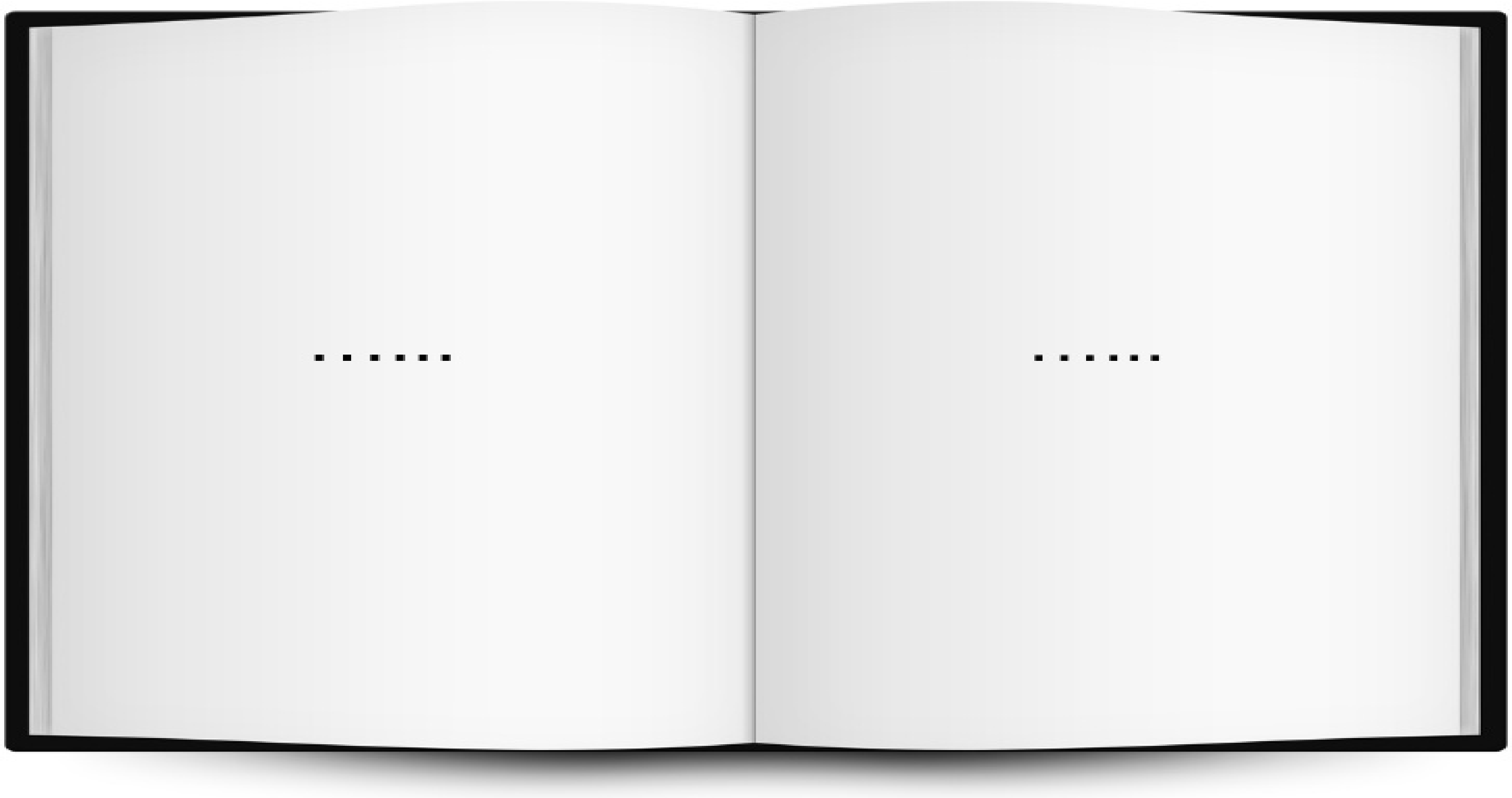
Solutions

- Pace it with a script
- Custom s3n handler
- Explicit file handling
  - http://stackoverflow.com/a/34681877/779513
- Increase the heap
- Complain



THANK YOU.

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