SmartCat

DATA \rightarrow KNOWLEDGE \rightarrow POWER.

When DataFrames fail, resort to mapPartitions aka "What to do when Spark can't handle it"

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SmartCat.jo



Why this talk?



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Complex problem with an easy solution

(or not)



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Logically correct vs Correct



Logically correct solution

- Data analysis process (data exploration)
- Get to the correct output ASAP
- Validate result
- Run on subset (if possible)
 - Quick iterations
 - Tends to eliminate data issues





Correct solution

- Correct result
- Repeatable performance
- Scalable and optimized
- Proper data handling



Let's dig in



spark.read.jdbc

What in the world? Specify columnName for proper distribution numPartitions defines parallelism Query for bounds (upper and lower) val df = (spark.read.jdbc(url=jdbcUrl, table="some_table", columnName="some_column", lowerBound=1L, upperBound=100000L, numPartitions=100, connectionProperties=connectionProperties))





(Re)partitioning

df.repartition(100) - repartition to a number of partitions

df.repartition(100, col("some_column")) - repartition and split on column

df.coalesce(10) - coalesce (narrow dependency)





(Re)partitioning

Partition by a join field

Repartition is expensive but can help down the road

coalesce vs repartition

HashPartitioner

Number of partitions divisible by available cores

(usually from 2 to 10 x cores)





Data locality

PROCESS_LOCAL - data is in the same JVM

NODE_LOCAL - data is on the same node (HDFS, local executor)

RACK_LOCAL, ANY - data is not on the executors

NO_PREF - no locality preference





Data locality

Tasks (6)

Index 🔺	ID	Attempt	Status	Locality Level	Executor ID / Host
0	26688	0	SUCCESS	PROCESS_LOCAL	1 / 10.10.43.102
1	26689	0	SUCCESS	PROCESS_LOCAL	2 / 10.10.43.102
2	26690	0	SUCCESS	PROCESS_LOCAL	0 / 10.10.43.102
3	26691	0	SUCCESS	PROCESS_LOCAL	1 / 10.10.43.102
4	26692	0	SUCCESS	PROCESS_LOCAL	2 / 10.10.43.102
5	26693	0	SUCCESS	PROCESS_LOCAL	0 / 10.10.43.102





Work distribution

Summary

	RDD Blocks	Storage Memory	Disk Used	Cores	Active Tasks	Failed Tasks	Complete Tasks	Total Tasks	Task Time (GC Time)	Input	Shuffle Read
Active(4)	209	178.0 KB / 1465.2 MB	0.0 B	6	1	0	6030	6031	1.4 m (2.3 s)	0.0 B	0.0 B
Dead(0)	0	0.0 B / 0.0 B	0.0 B	0	0	0	0	0	0 ms (0 ms)	0.0 B	0.0 B
Total(4)	209	178.0 KB / 1465.2 MB	0.0 B	6	1	0	6030	6031	1.4 m (2.3 s)	0.0 B	0.0 B

Executors

Executor ID	Address	Status	RDD Blocks	Storage Memory	Disk Used	Cores	Active Tasks	Failed Tasks	Complete Tasks	Total Tasks	Task Time (GC Time)	Input	Shuffle Read	Shuffle Write
2	10.10.43.102:63674	Active	52	44.3 KB / 366.3 MB	0.0 B	2	0	0	2010	2010	28.2 s (446 ms)	0.0 B	0.0 B	0.0 B
1	10.10.43.102:63676	Active	52	44.3 KB / 366.3 MB	0.0 B	2	0	0	2010	2010	28.6 s (928 ms)	0.0 B	0.0 B	0.0 B
0	10.10.43.102:63675	Active	52	44.3 KB / 366.3 MB	0.0 B	2	1	0	2010	2011	28.2 s (941 ms)	0.0 B	0.0 B	0.0 B
driver	10.10.43.102:63664	Active	53	45.1 KB / 366.3 MB	0.0 B	0	0	0	0	0	0 ms (0 ms)	0.0 B	0.0 B	0.0 B



Work distribution

	RDD Blocks	Storage Memory	Disk Used	Cores	Active Tasks	Failed Tasks	Complete Tasks	Total Tasks	Task Time (GC Time)
Active(4)	148	126.0 KB / 1465.2 MB	0.0 B	6	6	0	15720	15726	2.9 m (2.5 s)
Dead(0)	0	0.0 B / 0.0 B	0.0 B	0	0	0	0	0	0 ms (0 ms)
Total(4)	148	126.0 KB / 1465.2 MB	0.0 B	6	6	0	15720	15726	2.9 m (2.5 s)

Executors

Summary

Executor ID	Address	Status	RDD Blocks	Storage Memory	Disk Used	Cores	Active Tasks	Failed Tasks	Complete Tasks	Total Tasks	Task Time (GC Time)	Ir
2	10.10.43.102:63674	Active	37	31.5 KB / 366.3 MB	0.0 B	2	2	0	5240	5242	57.5 s (503 ms)	0
1	10.10.43.102:63676	Active	37	31.5 KB / 366.3 MB	0.0 B	2	2	0	5240	5242	57.7 s (1.0 s)	0
0	10.10.43.102:63675	Active	37	31.5 KB / 366.3 MB	0.0 B	2	2	0	5240	5242	57.0 s (1.0 s)	0
driver	10.10.43.102:63664	Active	37	31.5 KB / 366.3 MB	0.0 B	0	0	0	0	0	0 ms (0 ms)	0



Broadcasting variables

Keeps a copy of data on each worker

Reduces the size of a serialized task as data is on the worker already Optimizes join operations



info@smartcat.io 😩 smartcat.io



Checkpointing

Truncate lineage graph Reliable - HDFS storage (sc.setCheckpointDir) Local - node local temp storage





Metrics



Spork 21126234 History Server

Event log directory: wasb:///hdp/spark2-events Last updated: 1/23/2018, 10:58:50 AM

Spark WebUI is your friend **Use Spark History Server** JSON metrics over REST API Collect JMX metrics (Dropwizard)

App ID	App Name	Started	Completed	Duration	Spark User	Last Updated	Event Log
application_1516290464268_0026	remotesparkmagics	2018-01-22 20:07:19	2018-01-22 20:24:43	17 min	livy	2018-01-22 20:24:43	Download
application_1516290464268_0009	PySparkShell	2018-01-18 17:53:40	2018-01-18 19:26:23	1.5 h	sshuser	2018-01-18 19:26:23	Download
application_1516290464268_0008	Spark sheli	2018-01-18 17:41:43	2018-01-18 17:45:16	3.6 min	sshuser	2018-01-18 17:45:16	Ocumined
application_1516290464268_0007	Spark shell	2018-01-18 17:40:02	2018-01-18 17:41:28	1.4 min	sshuser	2018-01-18 17:41:28	Downlinet
application_1516290464268_0006	PySparkShell	2018-01-18 17:25:06	2018-01-18 17:29:48	4.7 min	sshuser	2018-01-18 17:29:48	Downlinef
application_1516290464268_0005	Spark shell	2018-01-18 16:46:13	2018-01-18 17:16:26	30 min	sshuser	2018-01-18 17:16:26	Download
application_1516290464268_0004	PySparkShell	2018-01-18 16:19:55	2018-01-18 16:45:58	26 min	sshuser	2018-01-18 16:45:58	Download

Search

Showing 1 to 7 of 7 entries



Event timeline

Details for Stage 10265 (Attempt 0)

Total Time Across All Tasks: 21 ms Locality Level Summary: Process local: 6

DAG Visualization

Show Additional Metrics

- ▼ Event Timeline
- Enable zooming





Storage tab

RDD Name 🛦	Storage Level	Cached Partitions	Fraction Cached	Size in Memory	Size on Disk
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	67.1 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	59.5 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	66.1 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	65.9 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	61.7 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	63.4 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	76.4 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	61.8 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	70.9 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	66.1 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	58.7 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	59.9 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	69.5 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	71.8 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	55.5 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	65.3 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	61.6 KB	0.0 B
MapPartitionsRDD	Memory Serialized 1x Replicated	4	100%	62.3 KB	0.0 B





RDD storage details

Storage Level: Memory Deserialized 1x Replicated Cached Partitions: 2 Total Partitions: 2 Memory Size: 11.2 KB Disk Size: 0.0 B

Data Distribution on 4 Executors

Host	Memory Usage	
192.168.19.244:65021	5.5 KB (366.3 MB Remaining)	
192.168.19.244:65009	0.0 B (366.3 MB Remaining)	
192.168.19.244:65020	0.0 B (366.3 MB Remaining)	
192.168.19.244:65018	5.7 KB (366.3 MB Remaining)	

2 Partitions

Block Name	Storage Level	Size in Memory
rdd_1_0	Memory Deserialized 1x Replicated	5.5 KB
rdd_1_1	Memory Deserialized 1x Replicated	5.7 KB

But what if all fails?



What is Apache Spark?

Apache Spark[™] is a unified analytics engine for large-scale data processing.



Computer software



Apache Spark is an open-source cluster-computing framework. Originally developed at the University of California, Berkeley's AMPLab, the Spark codebase was later donated to the Apache Software Foundation, which has maintained it since. Wikipedia





Let's use it

Spark is a distributed computing framework Spark provides resource management Spark provides controllable work distribution Spark is highly configurable Why not?





MapPartitions function

```
/**
```

* Return a new RDD by applying a function to each partition of this RDD.

*

* `preservesPartitioning` indicates whether the input function preserves the partitioner, which * should be `false` unless this is a pair RDD and the input function doesn't modify the keys. */

```
def mapPartitions[U: ClassTag](
```

```
f: Iterator[T] => Iterator[U],
```

```
preservesPartitioning: Boolean = false): RDD[U]
```





MapPartitions function - indexed

/**

* Return a new RDD by applying a function to each partition of this RDD, while tracking the index* of the original partition.

*

* `preservesPartitioning` indicates whether the input function preserves the partitioner, which * should be `false` unless this is a pair RDD and the input function doesn't modify the keys. */

```
def mapPartitionsWithIndex[U: ClassTag](
```

```
f: (Int, Iterator[T]) => Iterator[U],
```

```
preservesPartitioning: Boolean = false): RDD[U]
```





MapPartitions example

```
def mapFunction(args): Iterator[Row] => Iterator[Row] = iterator => {
    // Processing based on the partition data
    // Example:
    // val ids = iterator.toList.map(row => row.getInt(0))
    // Processon_doWork(ids)
    iterator
}
```





Other usages

Applying custom processing code Running ML pipeline Using third party libraries Misc



How about them numbers?



Results

PROs

Processing time dropped from ~96 hours to ~3.5hours (28 times) Adding new entities doesn't significantly impact complexity/performance Additional control which we leveraged down the road We managed to use all the resources

CONs

We managed to use all the resources

Raised code complexity





Thank you

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