Spark

Config Setting & Case Study

Production 環境變數

```
# Spark
export SPARK_HOME=/etc/spark-2.1.0-bin-hadoop2.6/
export PATH=$PATH:$SPARK_HOME/bin
export PYTHONPATH=$SPARK_HOME/python/lib/pyspark.zip:$PYTHONPATH
export PYTHONPATH=$SPARK_HOME/python/lib/py4j-0.10.3-src.zip:$PYTHONPATH
export HADOOP_CONF_DIR=/source/hadoop/conf
```

啟動 jupyter

```
PYSPARK_DRIVER_PYTHON=jupyter
PYSPARK_DRIVER_PYTHON_OPTS="notebook --ip 88.8.146.34 --port 9999"
/etc/spark-2.1.0-bin-hadoop2.6/bin/pyspark
--name pyspark-miles
--master yarn
--deploy-mode client
--driver-cores 1
--driver-memory 2g
--executor-memory 8g
--executor-cores 4
--num-executors 16
```

資源就那麼多，要如何調配？

Spark-Submit Options

Driver：向RM進行資源的申請、任務的分配和監控等；當Executor部分運行完畢後，Driver負責將SparkContext關閉。

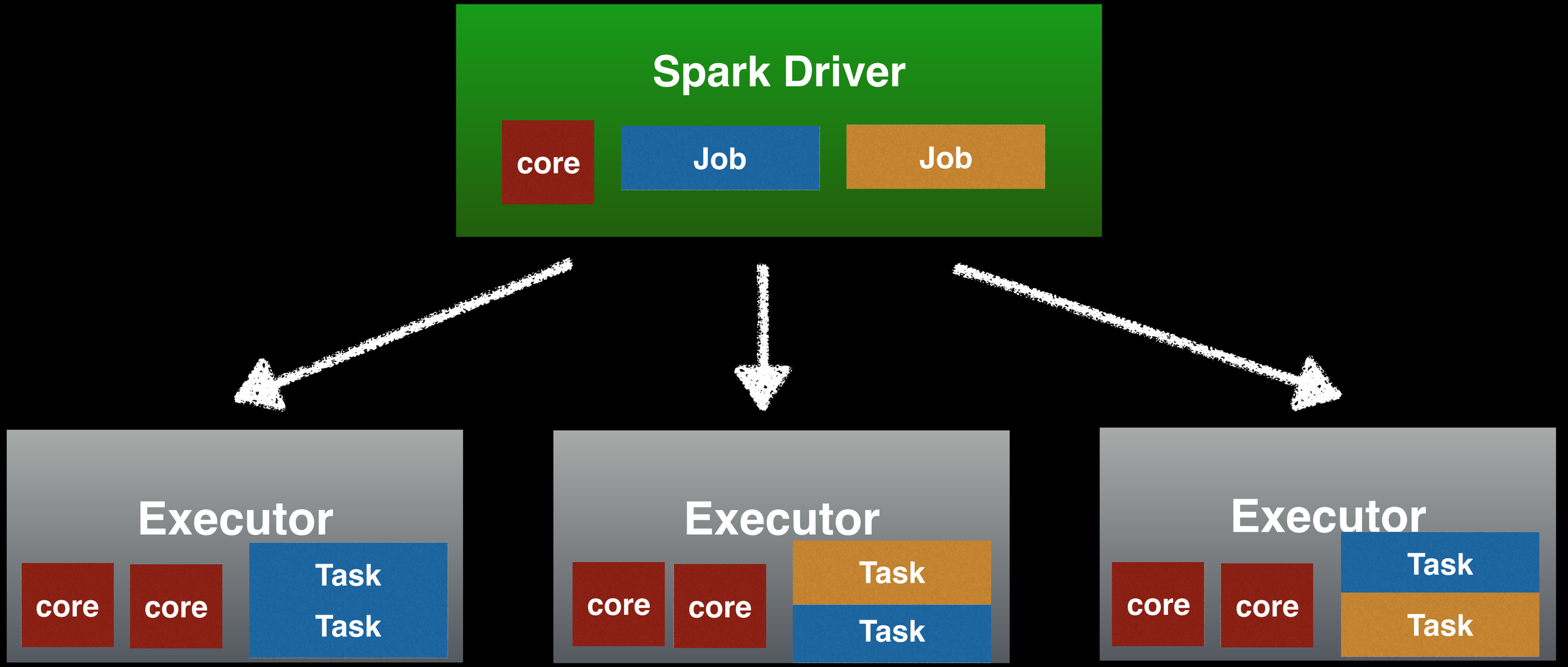
Executor：負責運行Task，並且負責將數據存在內存或者磁碟上。

Executor-cores：CPU core同一時間只能執行一個Task。

Job：包含多個Task組成的並行計算，往往由Spark Action催生，一個JOB包含多個RDD及作用於相應RDD上的各種Operation。

Stage：每個Job會被拆分很多組Task，每組任務被稱為Stage，也可稱TaskSet，一個作業分為多個階段。

Task： 被送到某個Executor上的工作任務。


Spark Driver
core
Job
Job
Executor
core
core
Task
Task
Executor
core
core
Task
Task
Executor
core
core
Task
Task

Spark-Submit Options

--master yarn (local)
--deploy mode client (cluster)
--driver-memory 2g
--driver-cores 1
--num-executors 16
--executor-cores 4
--executor-memory 2g
--py-files [‘hello.py’,’rc.py’]

Command-line: spark-submit

Set Spark Configuration

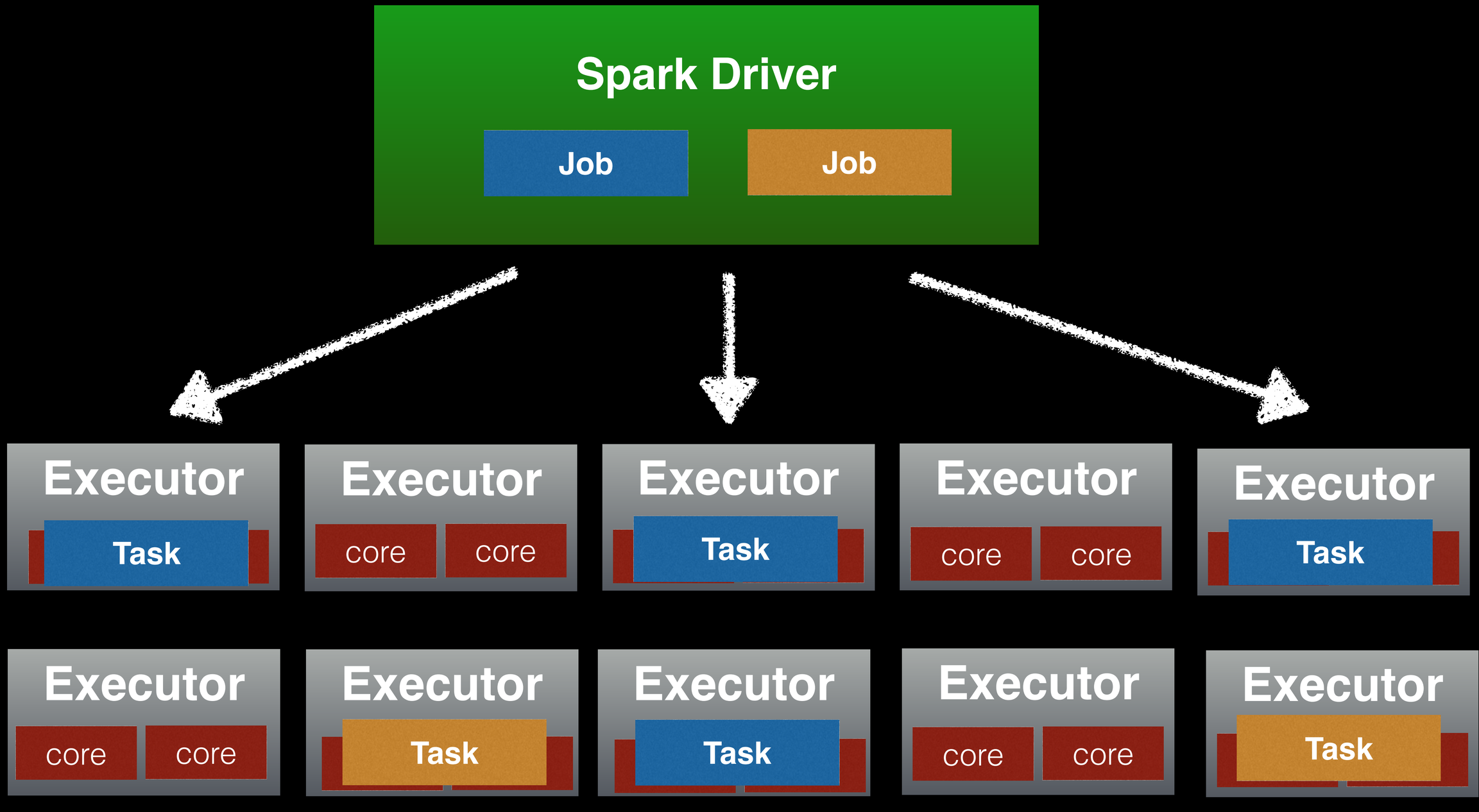
```
hc.setConf("hive.exec.dynamic.partition.mode", “nonstrict")

hc.setConf("spark.sql.parquet.compression.codec", "uncompressed")

hc.setConf(“spark.default.parallelism”,”2048”)

hc.setConf("spark.sql.shuffle.partitions", “4”)
```

Spark-Submit後會發生什麼事？


Spark Driver
Job
Job
Executor
Task
Executor
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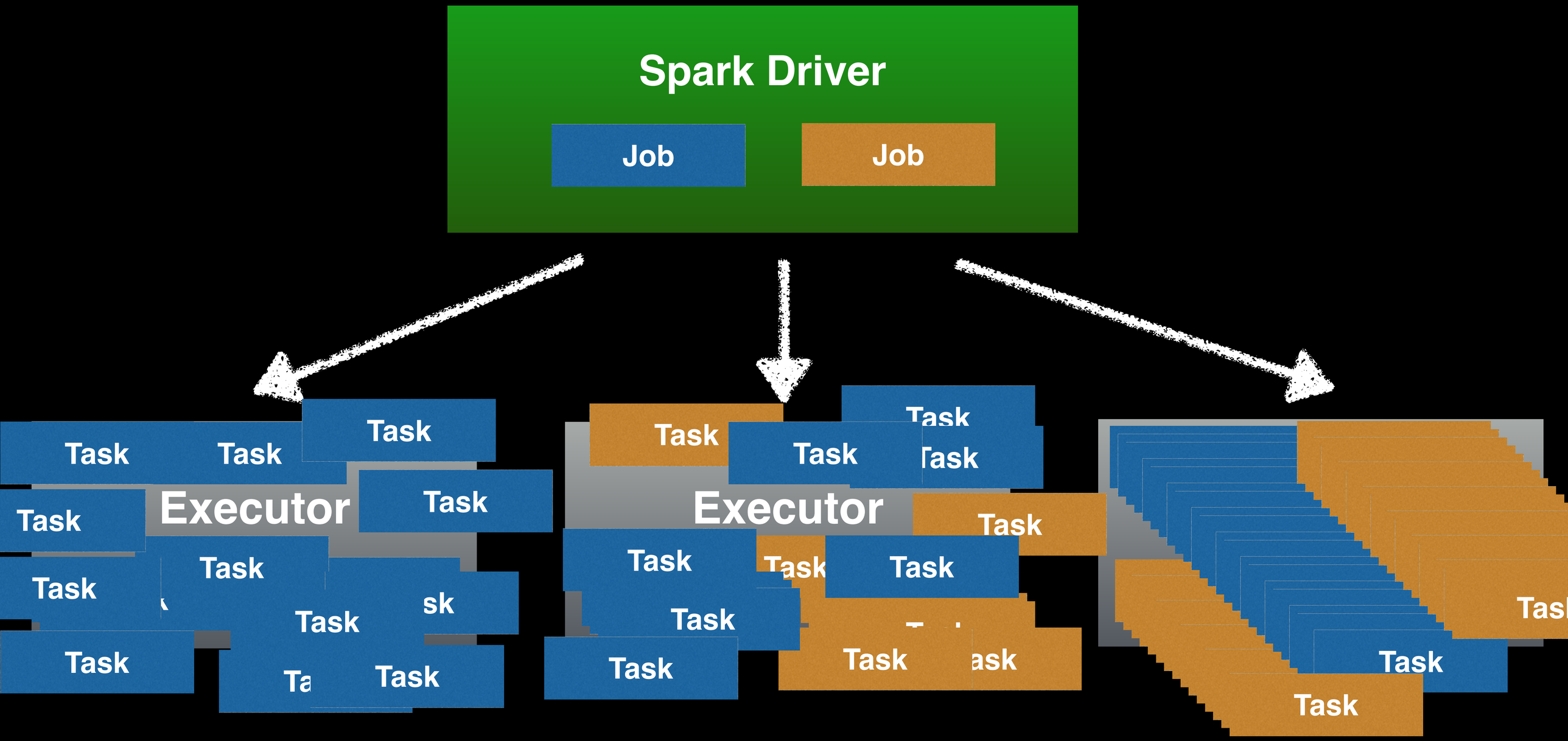
Task


Spark Driver
Job
Job
Executor
Executor
Task

最常發生的問題是？

Out of Memory!!!!!!!!

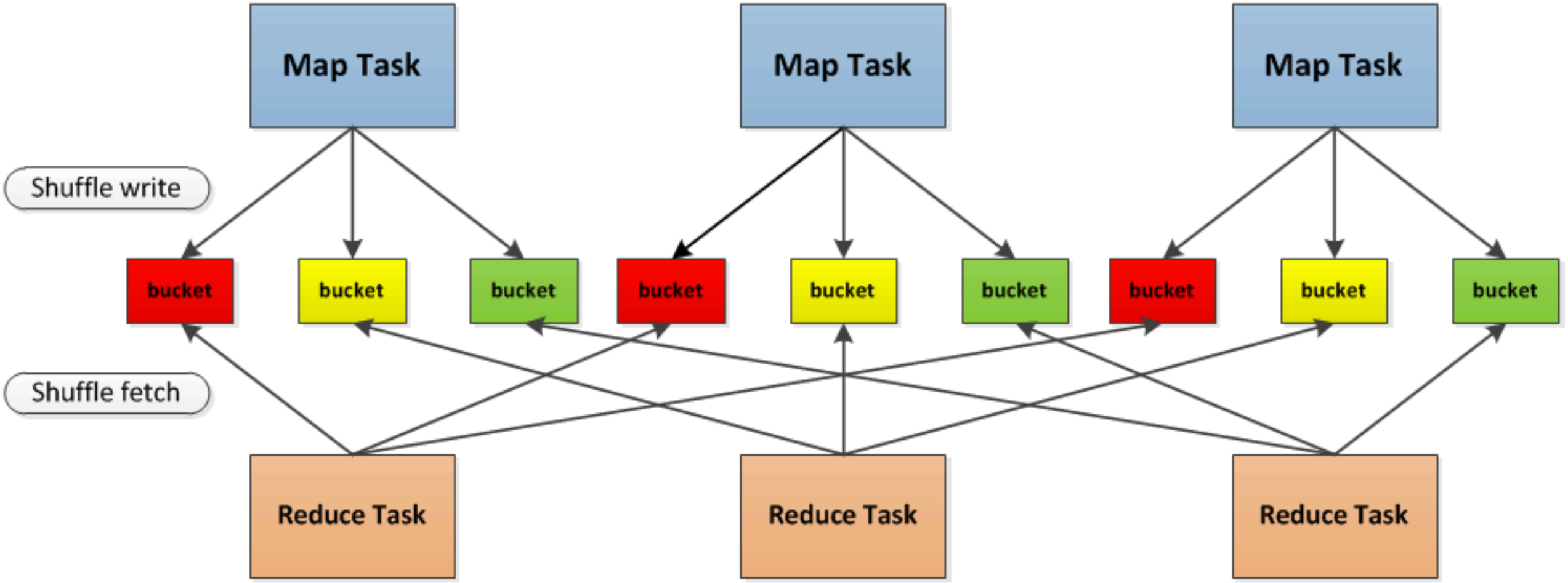
無限加大Memory吧！！！

不可能!?

無限加大Memory吧！！！

Shuffle

MapReduce框架中，Shuffle是連結Map和Reduce之間的橋樑，Map的輸出要用到Reduce中必須經過Shuffle這個環節，Shuffle的性能高低直接影響了整個程序性能。

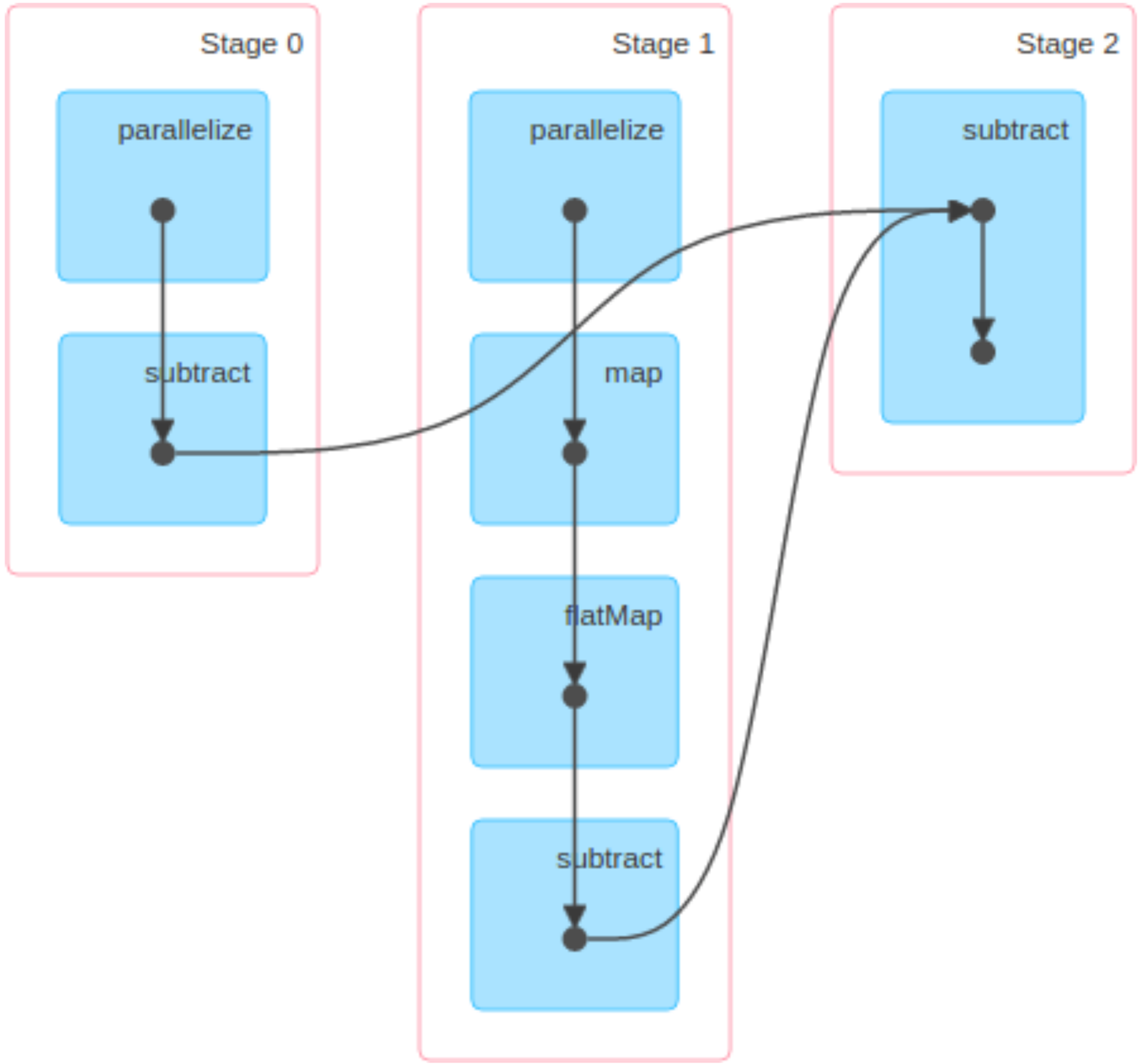


Shuffle就是各種需要重分區的算子之下的一個對數據重新组合的過程

Repartition

尋找質數

- 目標找出2到2000000所有質數
- 找出所有非質數
- 從2開始找出所有倍數，再找3所有倍數以此類推……



Stage 0

Tasks

Index ▲	ID	Attempt	Status	Locality Level	Executor ID / Host	Launch Time	Duration	GC Time	Write Time	Shuffle Write Size / Records	Errors
0	0	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:29	0.5 s	34 ms	12 ms	1008.3 KB / 249999	
1	1	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:29	0.6 s	34 ms	9 ms	1008.9 KB / 250000	
2	2	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:29	0.5 s	34 ms	12 ms	1008.8 KB / 250000	
3	3	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:29	0.5 s	34 ms	15 ms	1008.6 KB / 250000	
4	4	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:29	0.5 s	34 ms	10 ms	1008.9 KB / 250000	
5	5	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:29	0.6 s	34 ms	14 ms	1008.3 KB / 250000	
6	6	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:29	0.5 s	34 ms	13 ms	1008.9 KB / 250000	
7	7	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:29	0.5 s	34 ms	12 ms	1008.6 KB / 250000	

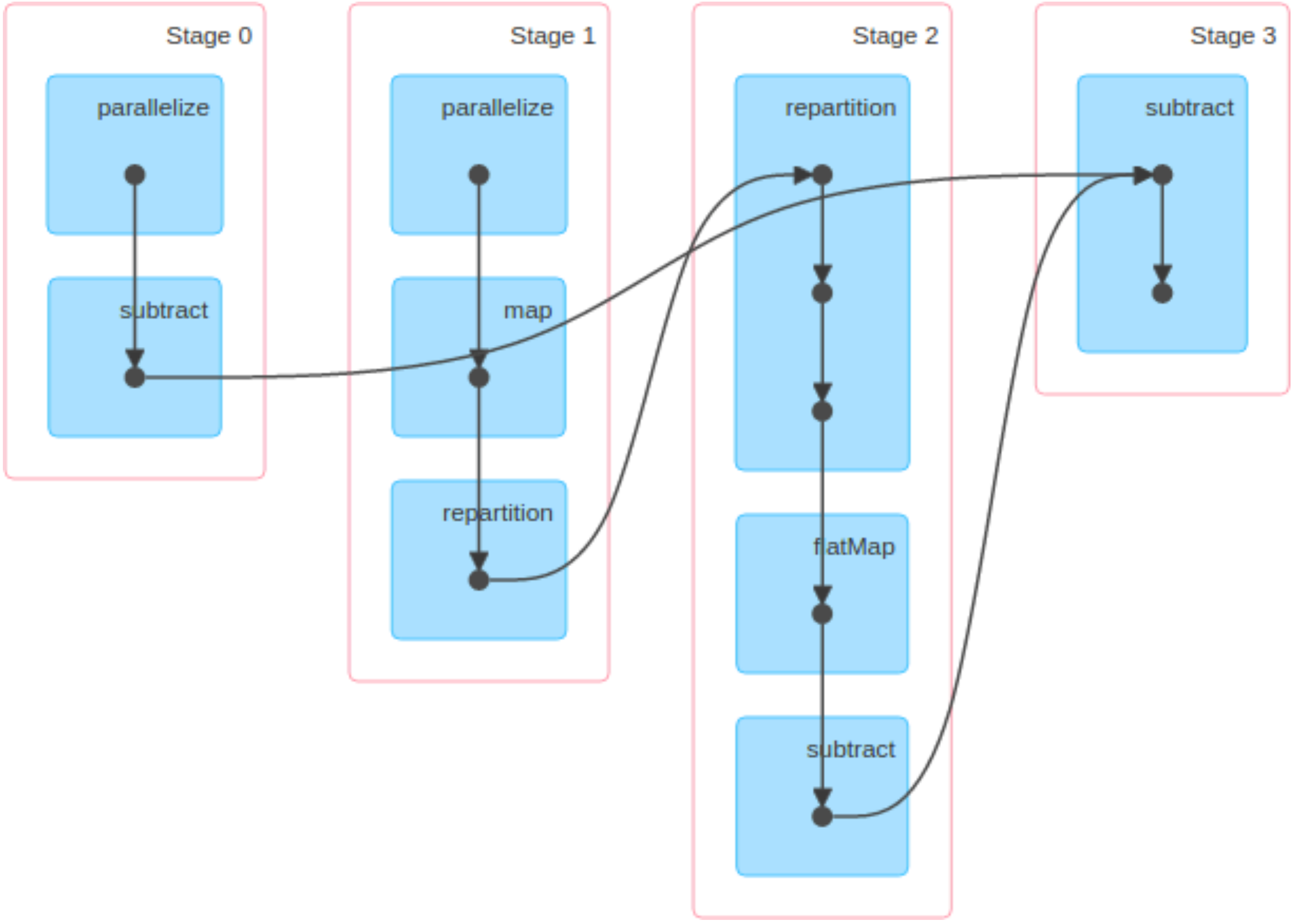
Stage 1

Tasks

Index ▲	ID	Attempt	Status	Locality Level	Executor ID / Host	Launch Time	Duration	GC Time	Write Time	Shuffle Write Size / Records	Errors
0	8	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:30	14 s	0.2 s	0.2 s	106.3 MB / 23640584	
1	9	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:30	1 s	0.1 s	22 ms	4.6 MB / 1019047	
2	10	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:30	0.8 s	0.1 s	5 ms	1683.9 KB / 416666	
3	11	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:30	0.6 s	0.1 s	4 ms	1008.9 KB / 250000	
4	12	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:30	0.4 s	96 ms		0.0 B / 0	
5	13	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:30	0.4 s	96 ms		0.0 B / 0	
6	14	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:30	0.3 s	96 ms		0.0 B / 0	
7	15	0	SUCCESS	PROCESS_LOCAL	driver / localhost	2016/05/05 14:42:30	0.2 s	90 ms		0.0 B / 0	

Repartition

- Spark Partition：數據中的基本組成單位
- 運算過程中數據量時大時小，選擇合適的partition數量關係重大，如果太多partition就導致有很多小任務和空任務產生；如果太少則導致運算資源沒法充分利用，必要時候可以使用repartition來調整，不過它也不是沒有代價的，其中一個最主要代價就是shuffle。
- 若Partition的數量要由**大改小**，則可使用coalesce這個指令不經過shuffle的過程。
- shuffle :是兩個 stage 之間的數據傳輸過程。


Stage 0
parallelize
subtract
Stage 1
parallelize
map
repartition
Stage 2
repartition
flatMap
subtract
Stage 3
subtract

Tasks

Index ▲	ID	Attempt	Status	Locality Level	Executor ID / Host	Launch Time	Duration	GC Time	Shuffle Read Size / Records	Write Time	Shuffle Write Size / Records	Errors
0	16	0	SUCCESS	NODE_LOCAL	driver / localhost	2016/05/05 14:50:17	5 s	0.2 s	2.7 MB / 250000	42 ms	14.2 MB / 3242491	
1	17	0	SUCCESS	NODE_LOCAL	driver / localhost	2016/05/05 14:50:17	5 s	0.2 s	2.7 MB / 250000	44 ms	13.9 MB / 3114793	
2	18	0	SUCCESS	NODE_LOCAL	driver / localhost	2016/05/05 14:50:17	5 s	0.2 s	2.7 MB / 250000	36 ms	13.5 MB / 3023100	
3	19	0	SUCCESS	NODE_LOCAL	driver / localhost	2016/05/05 14:50:17	5 s	0.2 s	2.7 MB / 250000	38 ms	13.3 MB / 2952632	
4	20	0	SUCCESS	NODE_LOCAL	driver / localhost	2016/05/05 14:50:17	5 s	0.2 s	2.7 MB / 250000	56 ms	12.7 MB / 2895958	
5	21	0	SUCCESS	NODE_LOCAL	driver / localhost	2016/05/05 14:50:17	4 s	0.2 s	2.7 MB / 249999	53 ms	12.9 MB / 2848739	
6	22	0	SUCCESS	NODE_LOCAL	driver / localhost	2016/05/05 14:50:17	5 s	0.2 s	2.7 MB / 250000	41 ms	16.6 MB / 3808486	
7	23	0	SUCCESS	NODE_LOCAL	driver / localhost	2016/05/05 14:50:17	5 s	0.2 s	2.7 MB / 250000	36 ms	15.2 MB / 3440098	