

Hadoop HDFS 練習

0.啟動 Hadoop

`source /opt/hadoop/etc/hadoop/hadoop-env.sh`

`start-all.sh`

1. **mkdir**，利用 `mkdir` 創資料夾

創二個 HDFS 目錄(hadoop1 和 hadoop2)

`hadoop fs -mkdir /hadoop1 /hadoop2`

```
bao@master:~$ hadoop fs -mkdir /hadoop1 /hadoop2
```

2. **ls**，利用 `ls` 查看 hdfs 有哪些資料夾

查看剛剛創建的 2 個資料夾

`hadoop fs -ls /`

`hadoop dfs -ls /`

```
bao@master:~$ hadoop fs -ls /
Found 2 items
drwxr-xr-x - bao supergroup      0 2020-02-26 18:26 /hadoop1
drwxr-xr-x - bao supergroup      0 2020-02-26 18:26 /hadoop2
```

利用 `http://master:9870` 查看剛剛創建的資料夾

(點選 Utilities - Browse the filesystem)

Browse Directory

/								Go!			
Show	25	entries	Search:								
<input type="checkbox"/>	Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name			
<input type="checkbox"/>	drwxr-xr-x	bao	supergroup	0 B	Feb 26 18:26	0	0 B	hadoop1			
<input type="checkbox"/>	drwxr-xr-x	bao	supergroup	0 B	Feb 26 18:26	0	0 B	hadoop2			
Showing 1 to 2 of 2 entries									Previous	1	Next


Hadoop, 2019.

3. **put**，利用 `put` 把本機檔案放到 hdfs 上

創一個 txt 檔

`sudo gedit test1.txt`

```
bao@master:~$ sudo gedit test1.txt
```



透過 `put` 指令把檔案放到 hdfs 上

`hadoop fs -put test1.txt /hadoop1`

```
bao@master:~$ hadoop fs -put test1.txt /hadoop1
2020-02-26 17:00:31,805 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
```

利用 ls 指令確認

hadoop fs -ls /hadoop1

```
bao@master:~$ hadoop fs -ls /hadoop1
Found 1 items
-rw-r--r--  2 bao supergroup          31 2020-02-26 17:00 /hadoop1/test1.txt
```

4. **get**，利用 get 把 hdfs 上的檔案下載到本機

hadoop fs -get /hadoop1/test1.txt fromHDFS.txt

```
bao@master:~$ hadoop fs -get /hadoop1/test1.txt fromHDFS.txt
2020-02-26 17:05:39,065 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
bao@master:~$ ls
core      Documents  examples.desktop  hdfs  Pictures  Templates  tmp
Desktop   Downloads  fromHDFS.txt      Music  Public    test1.txt  Videos
```

5. **cat**，透過 cat 指令確認檔案是否一樣

cat fromHDFS.txt

```
bao@master:~$ cat fromHDFS.txt
2020
Cloud Computing
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```

6. **rm**，利用 rm 把 hdfs 上的檔案刪除

hadoop fs -rm /hadoop1/test1.txt

```
bao@master:~$ hadoop fs -rm /hadoop1/test1.txt
Deleted /hadoop1/test1.txt
```

7. **rm -r**，利用 rm -r 刪掉整個資料夾

hadoop fs -rm -r /hadoop1

```
bao@master:~$ hadoop fs -rm -r /hadoop1
Deleted /hadoop1
```

#練習:

創一個檔案為 test1.txt 並把它放到 hdfs 上的/hadoop2 資料夾

```
bao@master:~$ hadoop fs -put test1.txt /hadoop2
2020-02-26 18:30:24,382 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
bao@master:~$ hadoop fs -ls /hadoop2
Found 1 items
-rw-r--r--  2 bao supergroup          31 2020-02-26 18:30 /hadoop2/test1.txt
```

8. **cat**，利用 cat 查看 hdfs 上的檔案內容

hadoop fs -cat /hadoop2/test1.txt

```
bao@master:~$ hadoop fs -cat /hadoop2/test1.txt
2020-02-26 17:29:01,586 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
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```

9. **ls -R**，利用 ls -R 查看所有在 hdfs 上的檔案和資料夾

```
bao@master:~$ hadoop fs -ls -R /
drwxr-xr-x  - bao supergroup          0 2020-02-26 17:24 /hadoop2
-rw-r--r--  2 bao supergroup        31 2020-02-26 17:24 /hadoop2/test1.txt
```

10. **chgrp**，利用 chgrp 改變文件所屬的群組

hadoop fs -chgrp root /hadoop2/test1.txt

```
bao@master:~$ hadoop fs -ls /hadoop2/test1.txt
-rw-r--r--  2 bao supergroup        31 2020-02-26 17:24 /hadoop2/test1.txt
bao@master:~$ hadoop fs -chgrp root /hadoop2/test1.txt
bao@master:~$ hadoop fs -ls /hadoop2/test1.txt
-rw-r--r--  2 bao root              31 2020-02-26 17:24 /hadoop2/test1.txt
```

11. **chmod**，利用 chmod 改變文件的權限

hadoop fs -chmod 700 /hadoop2/test1.txt

```
bao@master:~$ hadoop fs -ls /hadoop2/test1.txt
-rw-r--r--  2 bao root              31 2020-02-26 17:24 /hadoop2/test1.txt
bao@master:~$ hadoop fs -chmod 700 /hadoop2/test1.txt
bao@master:~$ hadoop fs -ls /hadoop2/test1.txt
-rwx-----  2 bao root              31 2020-02-26 17:24 /hadoop2/test1.txt
```

#練習:

創建一個資料夾/hadoop3 到 hdfs，利用 ls 指令查看目前 hdfs 上全部檔案和資料夾

```
bao@master:~$ hadoop fs -mkdir /hadoop3
bao@master:~$ hadoop fs -ls -R /
drwxr-xr-x  - bao supergroup          0 2020-02-26 17:24 /hadoop2
-rwx-----  2 bao root              31 2020-02-26 17:24 /hadoop2/test1.txt
drwxr-xr-x  - bao supergroup          0 2020-02-26 17:59 /hadoop3
```

12. **cp**，將文件從 HDFS 原本路徑複製到 HDFS 目標路徑

hadoop fs -cp /hadoop2/test1.txt /hadoop3

```
bao@master:~$ hadoop fs -ls -R /
drwxr-xr-x  - bao supergroup          0 2020-02-26 18:30 /hadoop2
-rwx-----  2 bao root              31 2020-02-26 18:30 /hadoop2/test1.txt
drwxr-xr-x  - bao supergroup          0 2020-02-27 11:36 /hadoop3
bao@master:~$ hadoop fs -cp /hadoop2/test1.txt /hadoop3
2020-02-27 11:36:54,223 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
2020-02-27 11:36:54,362 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
bao@master:~$ hadoop fs -ls -R /
drwxr-xr-x  - bao supergroup          0 2020-02-26 18:30 /hadoop2
-rwx-----  2 bao root              31 2020-02-26 18:30 /hadoop2/test1.txt
drwxr-xr-x  - bao supergroup          0 2020-02-27 11:36 /hadoop3
-rw-r--r--  2 bao supergroup        31 2020-02-27 11:36 /hadoop3/test1.txt
```

13. **du**，顯示目錄中所有文件的大小

hadoop fs -du /hadoop2

```
bao@master:~$ hadoop fs -du /hadoop2
31 62 /hadoop2/test1.txt
```

14. **du -s**，顯示該目錄/文件的總大小

```
bao@master:~$ hadoop fs -du -s /hadoop2
31 62 /hadoop2
```

15. **expunge**，清空垃圾桶

```
bao@master:~$ hadoop fs -expunge
```

16. **getmerge**，將來源目錄 <src> 下所有文件集合到本機 <localdst> 檔案內

語法：hadoop fs -getmerge <src> <localdst>

在本機創 in1 資料夾，新增 2 檔案 input1 和 input2 存到 in1 資料夾，用 put 把 in1 資料夾丟到 hdfs 的 hadoop2

```
mkdir -p in1
```

```
echo "this is one;" > in1/input1
```

```
echo "this is two;" > in1/input2
```

```
hadoop fs -put in1 /hadoop2
```

```
bao@master:~$ mkdir -p in1
bao@master:~$ echo "this is one;" > in1/input1
bao@master:~$ echo "this is two;" > in1/input2
bao@master:~$ hadoop fs -put in1 /hadoop2
2020-02-27 11:56:14,239 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localHostTrusted = false, remoteHostTrusted = false
2020-02-27 11:56:15,132 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localHostTrusted = false, remoteHostTrusted = false
```

接著利用 getmerge 把 in1 裡面的檔案存成 merge.txt 下載到本機，查看結果：

```
hadoop fs -getmerge /hadoop2/in1 merge.txt
```

```
cat merge.txt
```

```
bao@master:~$ hadoop fs -getmerge /hadoop2/in1 merge.txt
2020-02-27 11:57:43,508 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localHostTrusted = false, remoteHostTrusted = false
bao@master:~$ ls
Desktop    examples.desktop  in1      Pictures  test1.txt
Documents  fromHDFS.txt      merge.txt Public     tmp
Downloads  hdfs             Music    Templates Videos
bao@master:~$ cat merge.txt
this is one;
this is two;
```

17. **moveFromLocal**，將 local 端的資料夾剪下移動到 HDFS 上

```
hadoop fs -moveFromLocal in1 /hadoop3
```

```
bao@master:~$ ls
Desktop    examples.desktop  in1      Pictures  test1.txt
Documents  fromHDFS.txt      merge.txt Public     tmp
Downloads  hdfs             Music    Templates Videos
bao@master:~$ hadoop fs -moveFromLocal in1 /hadoop3
2020-02-27 12:01:35,103 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localHostTrusted = false, remoteHostTrusted = false
2020-02-27 12:01:35,231 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localHostTrusted = false, remoteHostTrusted = false
bao@master:~$ ls
Desktop    examples.desktop  merge.txt Public     tmp
Documents  fromHDFS.txt      Music    Templates Videos
Downloads  hdfs             Pictures test1.txt
bao@master:~$ hadoop fs -ls /hadoop3
Found 2 items
drwxr-xr-x  - bao supergroup          0 2020-02-27 12:01 /hadoop3/in1
-rw-r--r--  2 bao supergroup          31 2020-02-27 11:36 /hadoop3/test1.txt
```

18. **stat**，印出時間資訊

```
hadoop fs -stat /hadoop3
```

```
bao@master:~$ hadoop fs -stat /hadoop3
2020-02-27 04:01:35
```

19. **tail**，將文件的最後 1k 內容輸出

語法：hadoop fs -tail [-f] 檔案 (-f 參數用來顯示如果檔案增大，則秀出被 append 上得內容)

把/opt/hadoop/LICENSE.txt 檔案上傳 hdfs 上 hadoop3 資料夾，利用 tail 查看文件最後 1K 內容

hadoop fs -put /opt/hadoop/LICENSE.txt /hadoop3

hadoop fs -tail /hadoop3/LICENSE.txt

```
bao@master:~$ hadoop fs -put /opt/hadoop/LICENSE.txt /hadoop3
2020-02-27 12:08:11,562 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
bao@master:~$ hadoop fs -tail /hadoop3/LICENSE.txt
2020-02-27 12:08:27,132 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
      this trademark restriction does not form part of this License.

      Creative Commons may be contacted at https://creativecommons.org/.
-----
For: hadoop-hdfs-project/hadoop-hdfs/src/main/java/org/apache/hadoop/hdfs
/server/datanode/checker/AbstractFuture.java and
hadoop-hdfs-project/hadoop-hdfs/src/main/java/org/apache/hadoop/hdfs
/server/datanode/checker/TimeoutFuture.java

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License for the specific language governing permissions and limitations under
the License.
```

20. **test**，測試檔案，**-e** 檢查檔案是否存在(0=存在, 1=否)，**-z** 檢查文件是否為空(0=空, 1=不為空)，**-d** 檢查是否為目錄(0=存在, 1=否)，利用 echo \$? 來看回傳值為 0 or 1

-e

hadoop -test -e /hadoop3/test1.txt

echo \$?

```
bao@master:~$ hadoop fs -ls -R /
drwxr-xr-x - bao supergroup      0 2020-02-27 11:56 /hadoop2
drwxr-xr-x - bao supergroup      0 2020-02-27 11:56 /hadoop2/in1
-rw-r--r-- 2 bao supergroup     14 2020-02-27 11:56 /hadoop2/in1/input1
-rw-r--r-- 2 bao supergroup     14 2020-02-27 11:56 /hadoop2/in1/input2
-rwx----- 2 bao root          31 2020-02-26 18:30 /hadoop2/test1.txt
drwxr-xr-x - bao supergroup      0 2020-02-27 12:08 /hadoop3
-rw-r--r-- 2 bao supergroup    150569 2020-02-27 12:08 /hadoop3/LICENSE.txt
drwxr-xr-x - bao supergroup      0 2020-02-27 12:01 /hadoop3/in1
-rw-r--r-- 2 bao supergroup     14 2020-02-27 12:01 /hadoop3/in1/input1
-rw-r--r-- 2 bao supergroup     14 2020-02-27 12:01 /hadoop3/in1/input2
-rw-r--r-- 2 bao supergroup     31 2020-02-27 11:36 /hadoop3/test1.txt
bao@master:~$ hadoop fs -test -e /hadoop3/test1.txt
bao@master:~$ echo $?
0
bao@master:~$ hadoop fs -test -e /hadoop3/test2.txt
bao@master:~$ echo $?
1
```


-Z

hadoop fs -test -z /hadoop3/
echo \$?

```
bao@master:~$ hadoop fs -ls -R /
drwxr-xr-x - bao supergroup 0 2020-02-27 11:56 /hadoop2
drwxr-xr-x - bao supergroup 0 2020-02-27 11:56 /hadoop2/in1
-rw-r--r-- 2 bao supergroup 14 2020-02-27 11:56 /hadoop2/in1/input1
-rw-r--r-- 2 bao supergroup 14 2020-02-27 11:56 /hadoop2/in1/input2
-rwx----- 2 bao root 31 2020-02-26 18:30 /hadoop2/test1.txt
drwxr-xr-x - bao supergroup 0 2020-02-27 12:08 /hadoop3
-rw-r--r-- 2 bao supergroup 150569 2020-02-27 12:08 /hadoop3/LICENSE.txt
drwxr-xr-x - bao supergroup 0 2020-02-27 12:01 /hadoop3/in1
-rw-r--r-- 2 bao supergroup 14 2020-02-27 12:01 /hadoop3/in1/input1
-rw-r--r-- 2 bao supergroup 14 2020-02-27 12:01 /hadoop3/in1/input2
-rw-r--r-- 2 bao supergroup 31 2020-02-27 11:36 /hadoop3/test1.txt
bao@master:~$ hadoop fs -test -z /hadoop3/
bao@master:~$ echo $?
0
bao@master:~$ hadoop fs -test -z /hadoop3/test1.txt
bao@master:~$ echo $?
1
```

-d

hadoop fs -test -d /hadoop2 ; echo \$?

```
bao@master:~$ hadoop fs -ls /
Found 2 items
drwxr-xr-x - bao supergroup 0 2020-02-27 11:56 /hadoop2
drwxr-xr-x - bao supergroup 0 2020-02-27 12:08 /hadoop3
bao@master:~$ hadoop fs -test -d /hadoop2 ; echo $?
0
bao@master:~$ hadoop fs -test -d /hadoop4 ; echo $?
1
```

21. **text**，將檔案（如壓縮檔, textrecordinginputstream）輸出為純文字格式

語法：hadoop fs -text <src>

創一個 test1.txt，把 test1.txt 壓縮成 test1.tar.gz，上傳到 hadoop3

tar zcvf test1.tar.gz test1.txt

hadoop fs -put test1.tar.gz /hadoop3

```
bao@master:~$ ls
Desktop    examples.desktop  merge.txt  Public    tmp
Documents  fromHDFS.txt      Music      Templates Videos
Downloads  hdfs              Pictures   test1.txt
bao@master:~$ tar zcvf test1.tar.gz test1.txt
test1.txt
bao@master:~$ ls
Desktop    examples.desktop  merge.txt  Public    test1.txt
Documents  fromHDFS.txt      Music      Templates tmp
Downloads  hdfs              Pictures   test1.tar.gz Videos
bao@master:~$ hadoop fs -put test1.tar.gz /hadoop3
2020-02-27 12:27:42,005 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
```

```
hadoop fs -text /hadoop3/test1.tar.gz
```

22. touchz，建立一個空文件

```
hadoop fs -touchz /hadoop4
```

#觀察 block 分佈情形

1. 產生目錄

```
hadoop fs -mkdir /tmp
```

2. 產生一個 100MB 的檔案

```
dd if=/dev/zero of=100mb.img bs=1M count=100
```

```
hadoop fs -put 100mb.img /tmp
```

```

bao@master:~$ dd if=/dev/zero of=100mb.img bs=1M count=100
100+0 records in
100+0 records out
104857600 bytes (105 MB, 100 MiB) copied, 0.0931984 s, 1.1 GB/s
bao@master:~$ ls
100mb.img  Downloads          hdfs              Pictures          test1.tar.gz  Videos
Desktop    examples.desktop  merge.txt         Public            test1.txt
Documents  fromHDFS.txt      Music             Templates         tmp
bao@master:~$ hadoop fs -put 100mb.img /tmp
2020-02-27 12:38:29,845 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
bao@master:~$ hadoop fs -ls /tmp
Found 1 items
-rw-r--r--  2 bao supergroup  104857600 2020-02-27 12:38 /tmp/100mb.img

```


利用 hdfs fsck...觀察分布情形

hdfs fsck /tmp/100mb.img -files -blocks -locations

```
bao@master:~$ hdfs fsck /tmp/100mb.img -files -blocks -locations
Connecting to namenode via http://master:9870/fsck?ugi=bao&files=1&blocks=1&locations=1&path=%2Ftmp%2F100mb.img
FSCK started by bao (auth:SIMPLE) from /192.168.91.128 for path /tmp/100mb.img at Thu Feb 27 13:27:35 CST 2020
/tmp/100mb.img 104857600 bytes, replicated: replication=2, 1 block(s): Under replicated BP-134250155-192.168.91.128-1582540231094:blk_1073741835_1011. Target Replicas is 2 but found 1 live replica(s), 0 decommissioned replica(s), 0 decommissioning replica(s).
0. BP-134250155-192.168.91.128-1582540231094:blk_1073741835_1011 len=104857600 Live_repl=1 [DatanodeInfoWithStorage[192.168.91.128:9866,DS-9f88aa5b-f8e7-4e33-b50a-59b35c781f2e,DISK]]

Status: HEALTHY
Number of data-nodes: 1
Number of racks: 1
Total dirs: 0
Total symlinks: 0

Replicated Blocks:
Total size: 104857600 B
Total files: 1
Total blocks (validated): 1 (avg. block size 104857600 B)
Minimally replicated blocks: 1 (100.0 %)
Over-replicated blocks: 0 (0.0 %)
Under-replicated blocks: 1 (100.0 %)
Mis-replicated blocks: 0 (0.0 %)
Default replication factor: 2
Average block replication: 1.0
Missing blocks: 0
Corrupt blocks: 0
Missing replicas: 1 (50.0 %)

Erasure Coded Block Groups:
Total size: 0 B
Total files: 0
Total block groups (validated): 0
Minimally erasure-coded block groups: 0
Over-erasure-coded block groups: 0
Under-erasure-coded block groups: 0
Unsatisfactory placement block groups: 0
Average block group size: 0.0
Missing block groups: 0
Corrupt block groups: 0
Missing internal blocks: 0
FSCK ended at Thu Feb 27 13:27:35 CST 2020 in 38 milliseconds

The filesystem under path '/tmp/100mb.img' is HEALTHY
```

3. 修改副本個數再觀察一次，利用-setrep 修改副本個數

`hadoop fs -setrep 3 /tmp/100mb.img`

```
bao@master:~$ hadoop fs -setrep 3 /tmp/100mb.img
Replication 3 set: /tmp/100mb.img

bao@master:~$ hdfs fsck /tmp/100mb.img -files -blocks -locations
Connecting to namenode via http://master:9870/fsck?ugi=bao&files=1&blocks=1&locations=1&path=%2Ftmp%2F100mb.img
FSCK started by bao (auth:SIMPLE) from /192.168.91.128 for path /tmp/100mb.img at Thu Feb 27 14:58:31 CST 2020
/tmp/100mb.img 104857600 bytes, replicated: replication=3, 1 block(s): Under replicated BP-134250155-192.168.91.128-1582540231094:blk_1073741835_1011. Target Replicas is 3 but found 1 live replica(s), 0 decommissioned replica(s), 0 decommissioning replica(s).
0. BP-134250155-192.168.91.128-1582540231094:blk_1073741835_1011 len=104857600 Live_repl=1 [DatanodeInfoWithStorage[192.168.91.128:9866,DS-9f88aa5b-f8e7-4e33-b50a-59b35c781f2e,DISK]]

Status: HEALTHY
Number of data-nodes: 1
Number of racks: 1
Total dirs: 0
Total symlinks: 0

Replicated Blocks:
Total size: 104857600 B
Total files: 1
Total blocks (validated): 1 (avg. block size 104857600 B)
Minimally replicated blocks: 1 (100.0 %)
Over-replicated blocks: 0 (0.0 %)
Under-replicated blocks: 1 (100.0 %)
Mis-replicated blocks: 0 (0.0 %)
Default replication factor: 2
Average block replication: 1.0
Missing blocks: 0
Corrupt blocks: 0
Missing replicas: 2 (66.666664 %)

Erasure Coded Block Groups:
Total size: 0 B
Total files: 0
Total block groups (validated): 0
Minimally erasure-coded block groups: 0
Over-erasure-coded block groups: 0
Under-erasure-coded block groups: 0
Unsatisfactory placement block groups: 0
Average block group size: 0.0
Missing block groups: 0
Corrupt block groups: 0
Missing internal blocks: 0
FSCK ended at Thu Feb 27 14:58:31 CST 2020 in 125 milliseconds

The filesystem under path '/tmp/100mb.img' is HEALTHY
```

#字數統計(WordCount)

創一個檔案

```
echo "Cloud computing class" > input
```

```
bao@master:~$ echo "Cloud computing class" > input
bao@master:~$ ls
100mb.img  Downloads      hdfs      Music      Templates    tmp
Desktop    examples.desktop  input     Pictures   test1.tar.gz  Videos
Documents  fromHDFS.txt     merge.txt Public      test1.txt
```

接著在 hdfs 創一個資料夾，把檔案丟上去

```
hadoop fs -mkdir /input
```

```
hadoop fs -put input /input
```

```
bao@master:~$ hadoop fs -mkdir /input
bao@master:~$ hadoop fs -put input /input
2020-02-27 14:11:49,848 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
```

將產生的結果存到 output

```
hadoop jar /opt/hadoop/share/hadoop/mapreduce/hadoop-mapreduce-examples-
```

```
3.2.1.jar wordcount /input output
```

執行完成畫面

```
Map-Reduce Framework
  Map input records=1
  Map output records=3
  Map output bytes=34
  Map output materialized bytes=46
  Input split bytes=95
  Combine input records=3
  Combine output records=3
  Reduce input groups=3
  Reduce shuffle bytes=46
  Reduce input records=3
  Reduce output records=3
  Spilled Records=6
  Shuffled Maps =1
  Failed Shuffles=0
  Merged Map outputs=1
  GC time elapsed (ms)=389
  CPU time spent (ms)=2450
  Physical memory (bytes) snapshot=441409536
  Virtual memory (bytes) snapshot=5312307200
  Total committed heap usage (bytes)=292552704
  Peak Map Physical memory (bytes)=251396096
  Peak Map Virtual memory (bytes)=2653122560
  Peak Reduce Physical memory (bytes)=190013440
  Peak Reduce Virtual memory (bytes)=2659184640
Shuffle Errors
  BAD_ID=0
  CONNECTION=0
  IO_ERROR=0
  WRONG_LENGTH=0
  WRONG_MAP=0
  WRONG_REDUCE=0
File Input Format Counters
  Bytes Read=22
File Output Format Counters
  Bytes Written=28
```

hadoop fs -ls -R output

發現所有的執行成果會記錄在 part-r-*，使用 cat 指令查看檔案內容

hadoop fs -cat output/*

```
bao@master:~$ hadoop fs -ls -R output
-rw-r--r--  2 bao supergroup          0 2020-02-27 14:17 output/_SUCCESS
-rw-r--r--  2 bao supergroup       28 2020-02-27 14:17 output/part-r-00000
bao@master:~$ hadoop fs -cat output/*
2020-02-27 14:23:56,900 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localHostTrusted = false, remoteHostTrusted = false
Cloud      1
class      1
computing   1
```

範例二：用標準表示法過濾內容 grep

grep 命令是擷取文件裡特定字元，在 Hadoop example 中此指令擷取文件中有此指定文字的字串，作計數統計

利用剛創建的 input，從/input 目錄中所有檔案中找出符合 cl 後面接 a-z 字母一個以上字串

hadoop jar /opt/hadoop/share/hadoop/mapreduce/hadoop-mapreduce-examples-3.2.1.jar grep /input output2 'cl[a-z.]+'

```
bao@master:~$ hadoop jar /opt/hadoop/share/hadoop/mapreduce/hadoop-mapreduce-examples-3.2.1.jar grep /input output2 'cl[a-z.]+'
```

執行畫面

```
Map-Reduce Framework
  Map input records=1
  Map output records=1
  Map output bytes=14
  Map output materialized bytes=22
  Input split bytes=126
  Combine input records=0
  Combine output records=0
  Reduce input groups=1
  Reduce shuffle bytes=22
  Reduce input records=1
  Reduce output records=1
  Spilled Records=2
  Shuffled Maps =1
  Failed Shuffles=0
  Merged Map outputs=1
  GC time elapsed (ms)=72
  CPU time spent (ms)=3430
  Physical memory (bytes) snapshot=474251264
  Virtual memory (bytes) snapshot=5312106496
  Total committed heap usage (bytes)=374341632
  Peak Map Physical memory (bytes)=286478336
  Peak Map Virtual memory (bytes)=2652938240
  Peak Reduce Physical memory (bytes)=187772928
  Peak Reduce Virtual memory (bytes)=2659168256
Shuffle Errors
  BAD_ID=0
  CONNECTION=0
  IO_ERROR=0
  WRONG_LENGTH=0
  WRONG_MAP=0
  WRONG_REDUCE=0
File Input Format Counters
  Bytes Read=108
File Output Format Counters
  Bytes Written=8
```

結果畫面

```
bao@master:~$ hadoop fs -ls output2
Found 2 items
-rw-r--r--    2 bao supergroup          0 2020-02-27 14:51 output2/_SUCCESS
-rw-r--r--    2 bao supergroup          8 2020-02-27 14:51 output2/part-r-00000
bao@master:~$ hadoop fs -cat output2/*
2020-02-27 14:53:11,426 INFO sasl.SaslDataTransferClient: SASL encryption trust
check: localhostTrusted = false, remoteHostTrusted = false
1      class
```