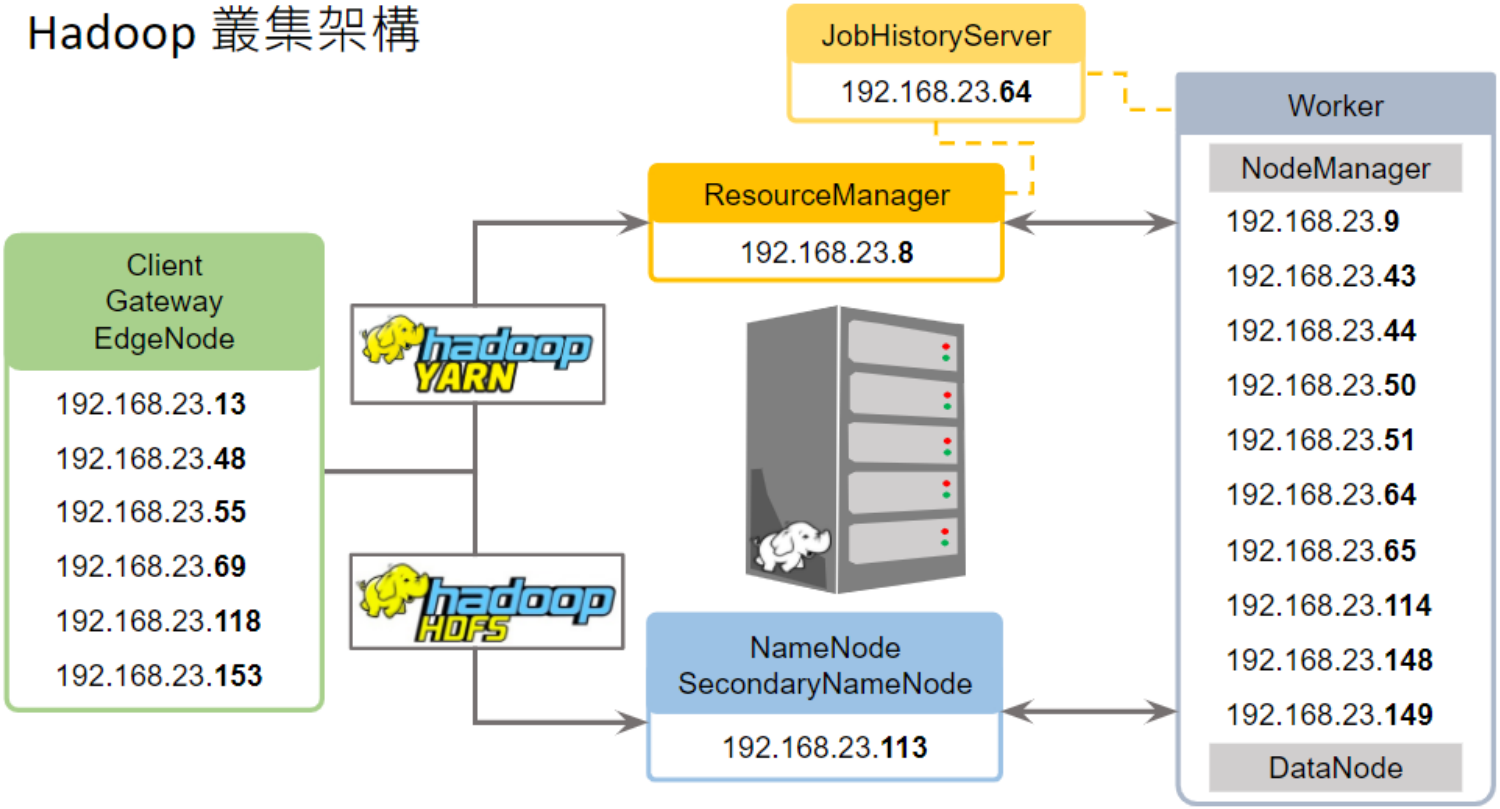
BDSE 15 第四組

Hadoop 大數據分析平台架設

聶廷宇
翁孟愉
曾于芮
謝謙謙
林容聖
彭于靜

Hadoop 叢集架構


JobHistoryServer
192.168.23.64
Worker
NodeManager
192.168.23.9
192.168.23.43
192.168.23.44
192.168.23.50
192.168.23.51
192.168.23.64
192.168.23.65
192.168.23.114
192.168.23.148
192.168.23.149
DataNode
ResourceManager
192.168.23.8
Client
Gateway
EdgeNode
192.168.23.13
192.168.23.48
192.168.23.55
192.168.23.69
192.168.23.118
192.168.23.153
hadoop YARN
hadoop HDFS
NameNode
SecondaryNameNode
192.168.23.113

Hadoop叢集架構簡介

		節點名稱	節點功能
Hadoop Cluster	檔案系統：HDFS	NameNode (*1)	• 負責管理和維護HDFS的名稱空間 • 控制檔案的任何讀寫動作 • 管理metadata
		Secondary NameNode (*1)	• 定期在HDFS執行namespaces的checkpoint • 合併NameNode的edit logs到fsimage檔案，並寫入硬碟或檔案系統
		DataNode (*10)	• 儲存真正的data
	運算框架：YARN	Resource Manager (*1)	• 負責整個集群的資源分配
		Node Manager (*10)	• 集群中的每個具體node的管理者 • 負責執行與管理node上的containers
	Log record	jobHistory (*1)	• 可通過web UI展示歷史作業日誌 (啟動時間、結束時間、各個任務的執行時間，各種Counter資料等)
Edge Nodes		Client (*6)	• Entry points to Hadoop cluster • Sparks jobs撒入點

啟動Hadoop

```
2020-12-15 11:32:25,027 INFO common.Storage: Storage directory /home/hadoop/data
/dfs/name has been successfully formatted.
```

NameNode電腦以hdfs namenode -format格式化的成功訊息

```
hadoop@bdse113:~/data/dfs/name/current$ cat VERSION
#Tue Dec 15 11:32:24 CST 2020
namespaceID=1768217276
blockpoolID=BP-1241192631-192.168.23.113-1608003144930
storageType=NAME_NODE
cTime=1608003144930
clusterID=CID-38713cfe-5729-4e63-bd42-04b17062a2ec
layoutVersion=-65
```

NameNode電腦於格式化HDFS後可在~/data/dfs/name/current查看VERSION以查詢clusterID

```
hadoop@bdse113:~/data/dfs/name/current$ jps
6665 SecondaryNameNode
6957 Jps
6382 NameNode
```

HDFS開啟，NameNode電腦以jps指令確認NameNode已開啟

```
hadoop@bdse114:/usr/local/hadoop/etc/hadoop$ jps
6117 Jps
5884 DataNode
```

HDFS開啟，Worker電腦以jps指令確認DataNode已開啟

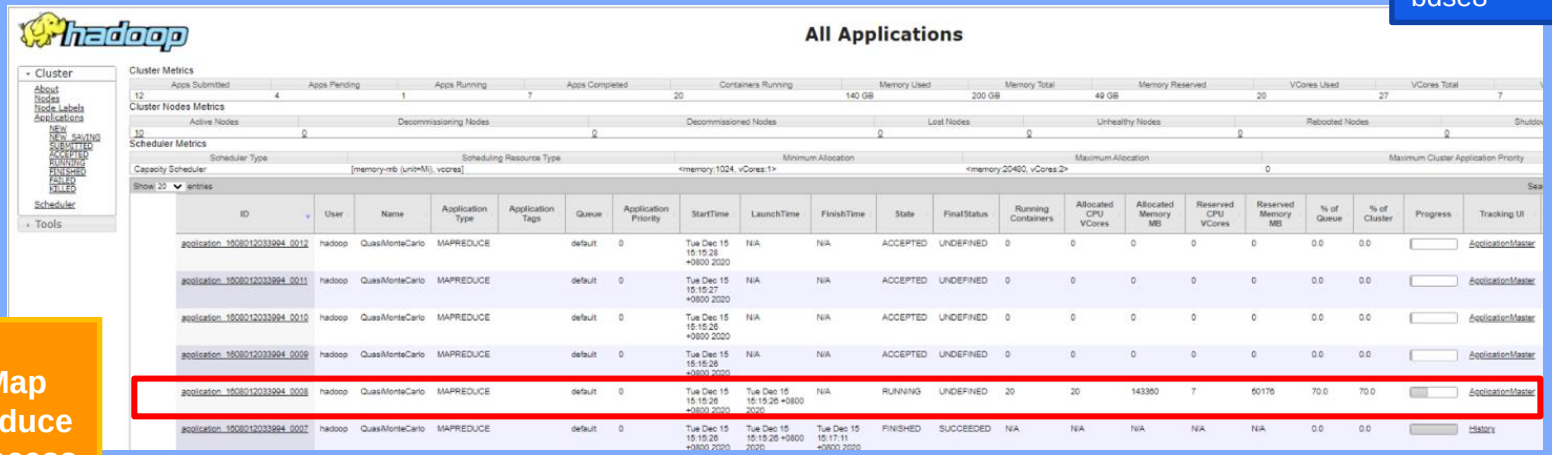
```
hadoop@bdse8:/usr/local/hadoop/logs$ jps
1937 ResourceManager
8173 Jps
```

YARN開啟，ResourceManager電腦以jps指令確認ResourceManager已開啟

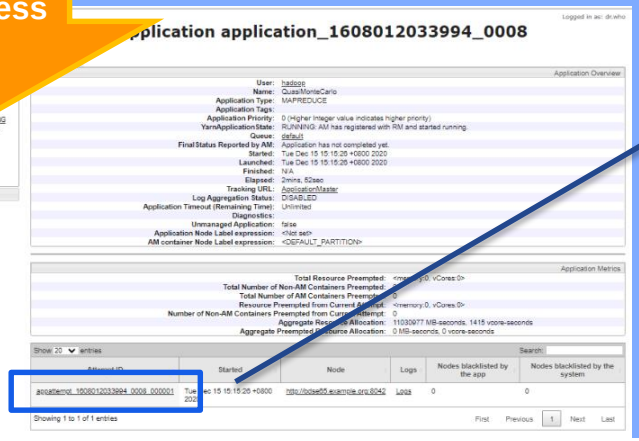
```
hadoop@bdse114:/usr/local/hadoop/etc/hadoop$ jps
9488 NodeManager
9640 Jps
5884 DataNode
```

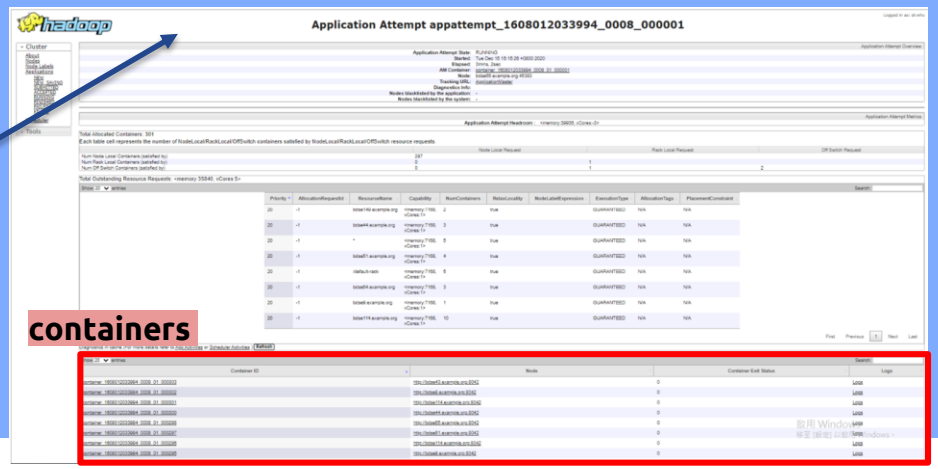
YARN開啟，Worker電腦以jps指令確認NodeManager已開啟

ResourceManager
bdse8



Map
Reduce
Process





程式Demo

In [2]:
```
# yarn mode
spark = SparkSession \
        .builder \
        .master("yarn") \
        .config('spark.executor.instances','9999') \
        .config('spark.executor.memory','2G') \
        .config('spark.executor.cores','1') \
        .appName("bdse118_Timmy") \
        .getOrCreate()
```

executor記憶體
仍有調整空間

In [7]:
```
import pyspark
df = spark.read.csv("/user/hadoop/OpenSky/"+csv2019[0], header=True, inferSchema=True)
for i in csv2019[1:]:
    dfTemp = spark.read.csv("/user/hadoop/OpenSky/"+i, header=True, inferSchema=True)
    df = df.union(dfTemp)
```

In [8]:
```
df.count(), len(df.columns)
```

Out[8]:
```
(30989481, 16)
```

In [10]:
```
%%time
df.groupBy("origin").count().show()
```

```
+------+-----+
|origin|count|
+------+-----+
|  LYBE|18160|
|  YTQY|  733|
|  3AK4|   44|
|  KPDK|22660|
|  KLCK| 2614|
|  RPUF|   86|
|  SDYJ|  588|
|  KAVP| 1586|
|  LOWK| 1023|
|  WN61|  994|
|  K08A|  462|
|  VA16| 1083|
|  4FL9| 1177|
|  FD49|  166|
|  EKRA|   39|
|  CL35|  375|
|  41NC|  150|
|  LOGP|  102|
|  LEIB| 2287|
|  1GE5|    5|
+------+-----+
only showing top 20 rows

CPU times: user 0 ns, sys: 4.04 ms, total: 4.04 ms
Wall time: 10.1 s
```

Spark on YARN
執行10秒

進行比較

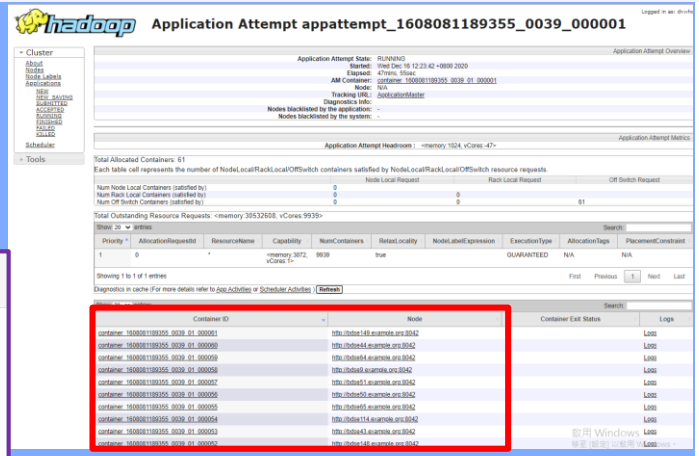
In [11]:
```
%%time
df.groupBy("origin").count().show()
```

```
+------+-----+
|origin|count|
+------+-----+
|  YTQY|  733|
|  VA16| 1083|
|  4FL9| 1177|
|  SDYJ|  588|
|  FD49|  166|
|  CL35|  375|
|  KAVP| 1586|
|  KPDK|22660|
|  KFSI|   12|
|  5MO3|   73|
|  KAXS|   64|
|  WN61|  994|
|  8LL0|   47|
|  SJPH|   18|
|  ESSX|  514|
|  KE41|   75|
|  K6G1|   94|
|  PAWD|   49|
|  K08A|  462|
|  NZWK|    8|
+------+-----+
only showing top 20 rows

CPU times: user 4.31 ms, sys: 1.79 ms, total: 6.1 ms
Wall time: 24.7 s
```

Spark Local
執行24秒

FinishTime	State	FinalStatus	Running Containers	Allocated CPU VCores	Allocated Memory MB	Reserved CPU VCores	Reserved Memory MB	% of Queue	% of Cluster
N/A	RUNNING	UNDEFINED	61	61	185344	6	18432	90.5	90.5



執行程式時，同步檢視container數量、記憶體用量以利後續調整

故障排除
Troubleshooting

執行情境：
於 Spark YARN 執行程式

遭遇問題：
無法識別bdse8.example.org

```
hadoop@bdse55: /usr/local/spark
resa@bdse55:~$ sudo -i
[sudo] password for resa:
root@bdse55:~# cp ~hadoop/hosts /etcls -l /etc/hosts
cp: target '/etc/hosts' is not a directory
root@bdse55:~# exit
logout
resa@bdse55:~$ su - hadoop
Password:
hadoop@bdse55:~$ cd $SPARK_HOME
hadoop@bdse55:/usr/local/spark$ bin/spark-submit --class org.apache.spark.exampl
es.SparkPi \
>     --master yarn
>     --deploy-mode
>     --driver-memor
>     --executor-mem
>     --executor-cor
>     --num-executor
>     examples/jars/
> 10
WARNING: An illegal
WARNING: Illegal ref
r/local/spark/jars/s
teBuffer(long,int)
WARNING: Please cons
nsafe.Platform
WARNING: Use --illeg
ive access operation
WARNING: All illegal
2020-12-15 17:00:25,
 library for your pl
2020-12-15 17:00:26,
se8.example.org:8032
2020-12-15 17:00:26,
```

```
hadoop@bdse55: /usr/local/spark
invoking ApplicationClientProtocolPBClientImpl.getClusterMetrics over null after 10 failover at
tempts. Trying to failover after sleeping for 18808ms.
2020-12-15 17:05:58,744 INFO retry.RetryInvocationHandler: java.net.UnknownHostException: Inval
id host name: local host is: (unknown); destination host is: "bdse8.example.org":8032; java.net
.UnknownHostException; For more details see:  http://wiki.apache.org/hadoop/UnknownHost, while
invoking ApplicationClientProtocolPBClientImpl.getClusterMetrics over null after 11 failover at
tempts. Trying to failover after sleeping for 31651ms.
2020-12-15 17:06:30,396 INFO retry.RetryInvocationHandler: java.net.UnknownHostException: Inval
id host name: local host is: (unknown); destination host is: "bdse8.example.org":8032; java.net
.UnknownHostException; For more details see:  http://wiki.apache.org/hadoop/UnknownHost, while
invoking ApplicationClientProtocolPBClientImpl.getClusterMetrics over null after 12 failover at
tempts. Trying to failover after sleeping for 22577ms.
2020-12-15 17:06:52,974 INFO retry.RetryInvocationHandler: java.net.UnknownHostException: Inval
id host name: local host is: (unknown); destination host is: "bdse8.example.org":8032; java.net
.UnknownHostException; For more details see:  http://wiki.apache.org/hadoop/UnknownHost, while
invoking ApplicationClientProtocolPBClientImpl.getClusterMetrics over null after 13 failover at
tempts. Trying to failover after sleeping for 15033ms.
2020-12-15 17:07:08,008 INFO retry.RetryInvocationHandler: java.net.UnknownHostException: Inval
id host name: local host is: (unknown); destination host is: "bdse8.example.org":8032; java.net
.UnknownHostException; For more details see:  http://wiki.apache.org/hadoop/UnknownHost, while
invoking ApplicationClientProtocolPBClientImpl.getClusterMetrics over null after 14 failover at
tempts. Trying to failover after sleeping for 26596ms.
2020-12-15 17:07:34,619 INFO retry.RetryInvocationHandler: java.net.UnknownHostException: Inval
id host name: local host is: (unknown); destination host is: "bdse8.example.org":8032; java.net
.UnknownHostException; For more details see:  http://wiki.apache.org/hadoop/UnknownHost, while
invoking ApplicationClientProtocolPBClientImpl.getClusterMetrics over null after 15 failover at
tempts. Trying to failover after sleeping for 24024ms.
2020-12-15 17:07:58,645 INFO retry.RetryInvocationHandler: java.net.UnknownHostExcep on: Invalid
host name: local host is: (unknown); destination host is: "bdse8.example.org":8032; java.net.Unkno
wnHostException; For more details see:  http://wiki.apache.org/hadoop/UnknownHost, while invoking
ApplicationClientProtocolPBClientImpl.getClusterMetrics over null after 16 failover attempts. Tryi
ng to failover after sleeping for 27794ms.
```

故障排除 Troubleshooting

原因偵查：
1. 檢查 yarn-site.xml 檔案內容
->設定正確
2. 改檢查 /etc/hosts
->發現沒有把 bdse8 加入檔案內

解決方法：
重新編輯 /etc/hosts 檔案內容
加入正確 cluster FQDN

修正後執行分析程式成功！

yarn-site.xml

```
hadoop@bdse55:/usr/local/hadoop/etc/hadoop$ tail -5 yarn
tail: cannot open 'yarn' for reading: No such file or directory
hadoop@bdse55:/usr/local/hadoop/etc/hadoop$ tail -5 yarn-site.xml
<property>
        <name>yarn.resourcemanager.hostname</name>
        <value>bdse8.example.org</value>
</property>
</configuration>
```

檔案內設定無誤

/etc/hosts

```
192.168.23.13 bdse13.example.org bdse13
192.168.23.48 bdse48.example.org bdse48
192.168.23.55 bdse55.example.org bdse55
192.168.23.69 bdse69.example.org bdse69
192.168.23.118 bdse118.example.org bdse118
192.168.23.153 bdse153.example.org bdse153
```

無bdse8

/etc/hosts

```
  GNU nano 4.8                                  /etc/hosts
127.0.0.1 localhost
# Momo
192.168.23.8 bdse8.example.org bdse8
192.168.23.9 bdse9.example.org bdse9
192.168.23.13 bdse13.example.org bdse13
# Ula
192.168.23.43 bdse43.example.org bdse43
192.168.23.44 bdse44.example.org bdse44
192.168.23.48 bdse48.example.org bdse48
# Yujui
192.168.23.50 bdse50.example.org bdse50
192.168.23.51 bdse51.example.org bdse51
192.168.23.55 bdse55.example.org bdse55
```

補上bdse8

故障排除 Troubleshooting

問題原因：

為提升叢集效能，將Spark程式庫統一上傳到HDFS。
但在執行分析程式(Spark on YARN mode)時，出現Exception。

解決方法：

1. 從Exception發現，Gateway接到自己的電腦，但正確應該是要接到NameNode那台電腦。
2. 在設定檔spark-defaults.conf中，找到有關叢集效能提升的程式碼，並做修正。

Exception

```
/usr/local/spark
ested more than the maximum memory capability of the cluster (20480 MB per cont
iner)
2020-12-16 10:23:36,537 INFO yarn.Client: Will allocate AM container, with 1408
MB memory including 384 MB overhead
2020-12-16 10:23:36,537 INFO yarn.Client: Setting up container launch context f
r our AM
2020-12-16 10:23:36,538 INFO yarn.Client: Setting up the launch environment for
our AM container
2020-12-16 10:23:36,547 INFO yarn.Client: Preparing resources for our AM contai
er
2020-12-16 10:23:36,616 INFO yarn.Client: Deleted staging directory hdfs://bdse
13.example.org/user/hadoop/.sparkStaging/application_1608081189355_0020
Exception in thread "main" java.net.ConnectException: Call From bdse69/192.168.
3.69 to bdse69.example.org:8020 failed on connection exception: java.net.Connec
Exception: Connection refused; For more details see:  http://wiki.apache.org/ha
oop/ConnectionRefused
        at java.base
nce0(Native Method)
        at java.base
nce(NativeConstructo
        at java.base
nstance(DelegatingCo
        at java.base
490)
        at org.apach
```

發現問題並解決

```
spark-defaults.conf                                    Modified
# Example:
# spark.master                     spark://master:7077
# spark.eventLog.enabled           true
# spark.eventLog.dir               hdfs://namenode:8021/directory
# spark.serializer                 org.apache.spark.serializer.KryoSerializer
# spark.driver.memory              5g
# spark.executor.extraJavaOptions  -XX:+PrintGCDetails -Dkey=value -Dnumbers="

spark.driver.extraJavaOptions="-Dio.netty.tryReflectionSetAccessible=true"
spark.executor.extraJavaOptions="-Dio.netty.tryReflectionSetAccessible=true"

spark.yarn.jars hdfs://bdse69.example.org/user/spark/share/jars/*
```

改成bdse113(本組NameNode)

Thanks!