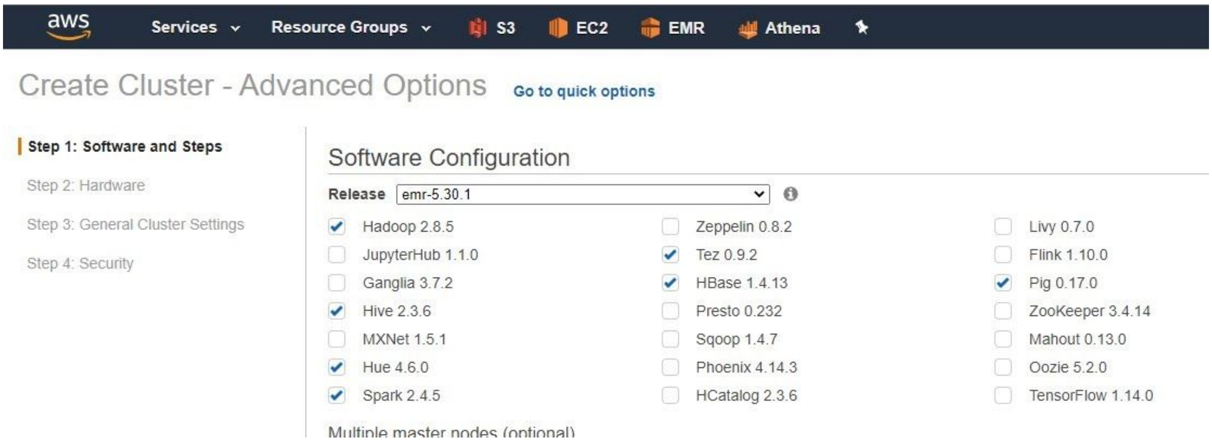
PLEASE HAVE IN MIND THAT THIS FILE WILL BE UPDATED.

THIS IS JUST QUICK RECAP WHAT THE APP DOES AND HOW IT IS WORKING FOR NOW.

Create AWS basic environment

1. Create cluster



Create Cluster - Advanced Options

Go to quick options

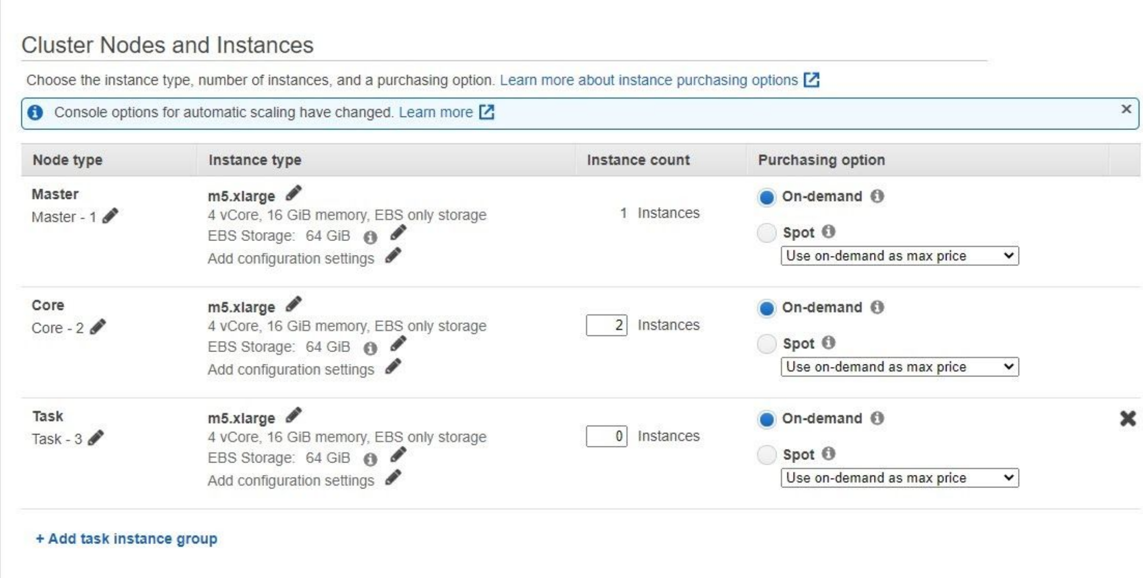
- Step 1: Software and Steps
- Step 2: Hardware
- Step 3: General Cluster Settings
- Step 4: Security

Software Configuration

Release emr-5.30.1

- ☑ Hadoop 2.8.5
- □ JupyterHub 1.1.0
- □ Ganglia 3.7.2
- ☑ Hive 2.3.6
- □ MXNet 1.5.1
- ☑ Hue 4.6.0
- ☑ Spark 2.4.5
- □ Zeppelin 0.8.2
- ☑ Tez 0.9.2
- ☑ HBase 1.4.13
- □ Presto 0.232
- □ Sqoop 1.4.7
- □ Phoenix 4.14.3
- □ HCatalog 2.3.6
- □ Livy 0.7.0
- □ Flink 1.10.0
- ☑ Pig 0.17.0
- □ ZooKeeper 3.4.14
- □ Mahout 0.13.0
- □ Oozie 5.2.0
- □ TensorFlow 1.14.0

Multiple master nodes (optional)



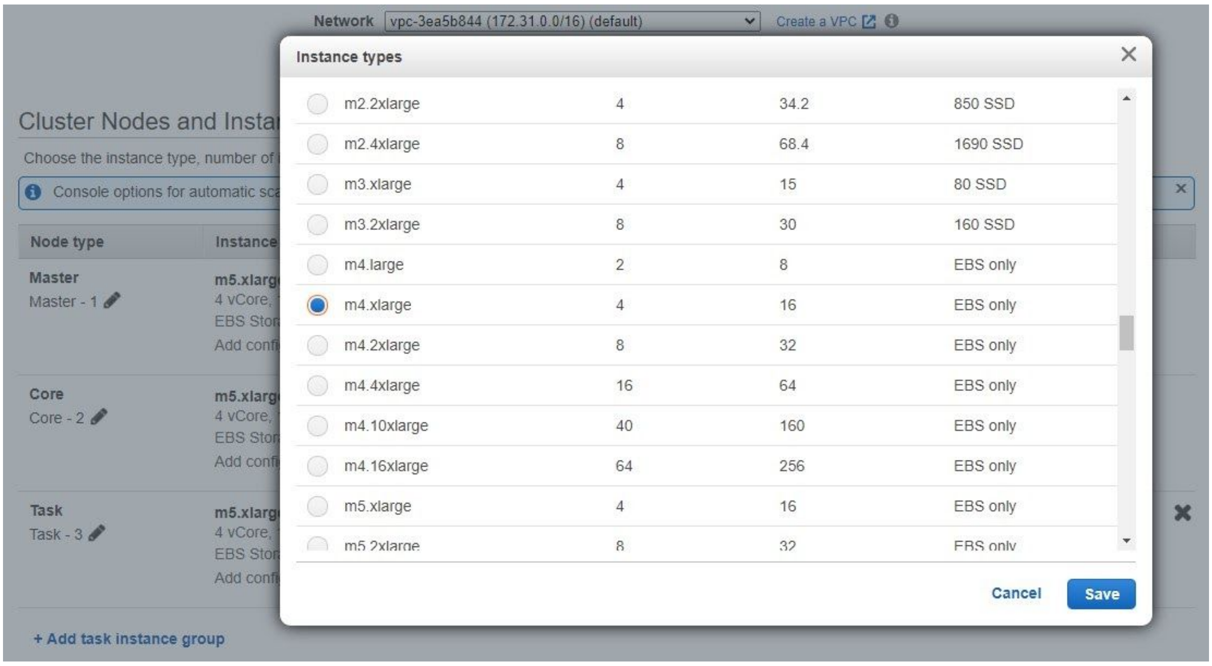
Cluster Nodes and Instances

Choose the instance type, number of instances, and a purchasing option. Learn more about instance purchasing options

Console options for automatic scaling have changed. Learn more

Node type	Instance type	Instance count	Purchasing option
Master Master - 1	**m5.xlarge** 4 vCore, 16 GiB memory, EBS only storage EBS Storage: 64 GiB Add configuration settings	1 Instances	● On-demand ○ Spot Use on-demand as max price
Core Core - 2	**m5.xlarge** 4 vCore, 16 GiB memory, EBS only storage EBS Storage: 64 GiB Add configuration settings	2 Instances	● On-demand ○ Spot Use on-demand as max price
Task Task - 3	**m5.xlarge** 4 vCore, 16 GiB memory, EBS only storage EBS Storage: 64 GiB Add configuration settings	0 Instances	● On-demand ○ Spot Use on-demand as max price

+ Add task instance group

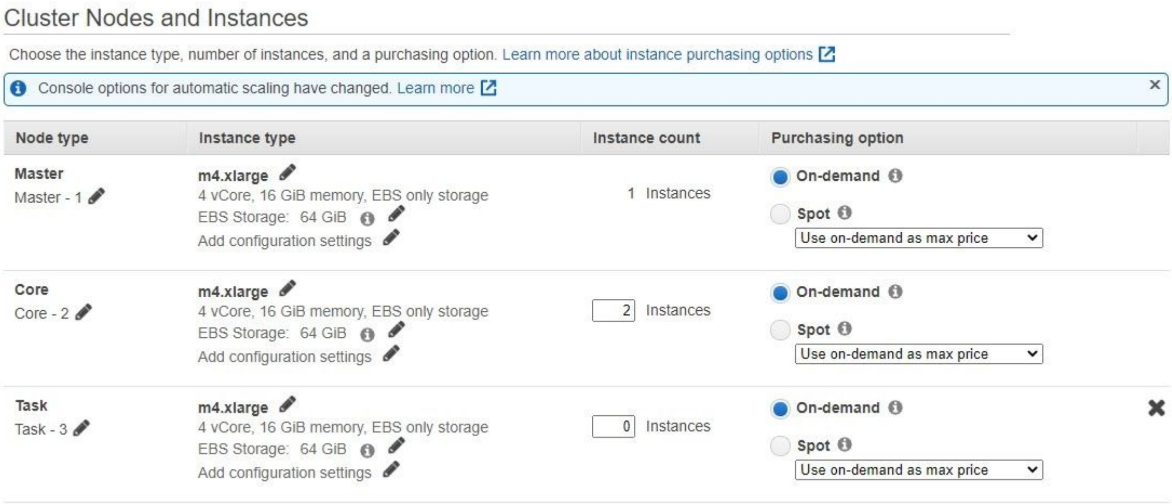


Network vpc-3ea5b844 (172.31.0.0/16) (default) Create a VPC

Instance types

○	m2.2xlarge	4	34.2	850 SSD
○	m2.4xlarge	8	68.4	1690 SSD
○	m3.xlarge	4	15	80 SSD
○	m3.2xlarge	8	30	160 SSD
○	m4.large	2	8	EBS only
●	m4.xlarge	4	16	EBS only
○	m4.2xlarge	8	32	EBS only
○	m4.4xlarge	16	64	EBS only
○	m4.10xlarge	40	160	EBS only
○	m4.16xlarge	64	256	EBS only
○	m5.xlarge	4	16	EBS only
○	m5.2xlarge	8	32	EBS only

Cancel Save

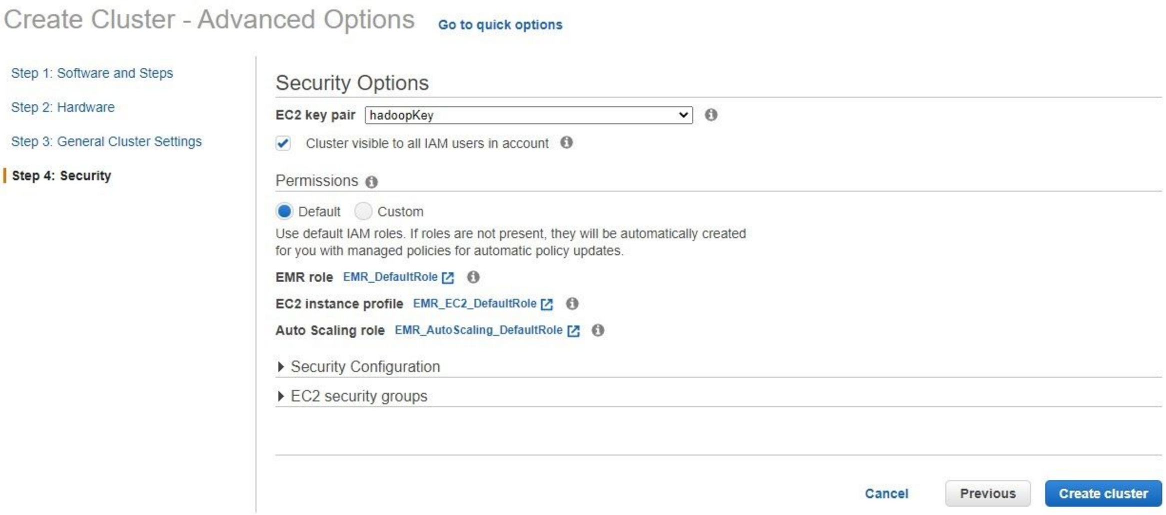


Cluster Nodes and Instances

Choose the instance type, number of instances, and a purchasing option. Learn more about instance purchasing options

Console options for automatic scaling have changed. Learn more

Node type	Instance type	Instance count	Purchasing option
Master Master - 1	**m4.xlarge** 4 vCore, 16 GiB memory, EBS only storage EBS Storage: 64 GiB Add configuration settings	1 Instances	● On-demand ○ Spot Use on-demand as max price
Core Core - 2	**m4.xlarge** 4 vCore, 16 GiB memory, EBS only storage EBS Storage: 64 GiB Add configuration settings	2 Instances	● On-demand ○ Spot Use on-demand as max price
Task Task - 3	**m4.xlarge** 4 vCore, 16 GiB memory, EBS only storage EBS Storage: 64 GiB Add configuration settings	0 Instances	● On-demand ○ Spot Use on-demand as max price



Create Cluster - Advanced Options

Security Options

EC2 key pair hadoopKey

☑ Cluster visible to all IAM users in account

Permissions

● Default ○ Custom

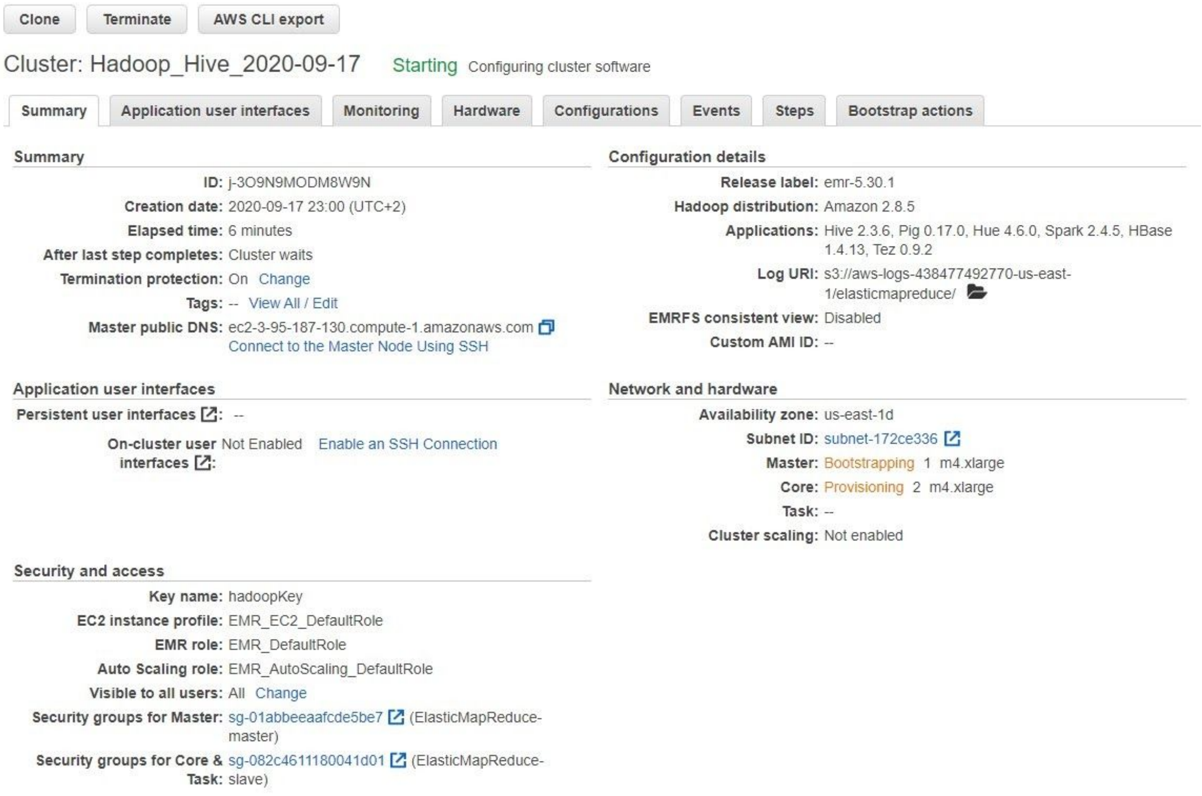
Use default IAM roles. If roles are not present, they will be automatically created for you with managed policies for automatic policy updates.

EMR role EMR_DefaultRole

EC2 instance profile EMR_EC2_DefaultRole

Auto Scaling role EMR_AutoScaling_DefaultRole

2. Modify Security Groups



Cluster: Hadoop_Hive_2020-09-17 Starting Configuring cluster software

Summary

ID: j-3O9N9MODM8W9N
Creation date: 2020-09-17 23:00 (UTC+2)
Elapsed time: 6 minutes
After last step completes: Cluster waits
Termination protection: On Change
Tags: -- View All / Edit
Master public DNS: ec2-3-95-187-130.compute-1.amazonaws.com
Connect to the Master Node Using SSH

Configuration details

Release label: emr-5.30.1
Hadoop distribution: Amazon 2.8.5
Applications: Hive 2.3.6, Pig 0.17.0, Hue 4.6.0, Spark 2.4.5, HBase 1.4.13, Tez 0.9.2
Log URI: s3://aws-logs-438477492770-us-east-1/elasticmapreduce/
EMRFS consistent view: Disabled
Custom AMI ID: --

Application user interfaces

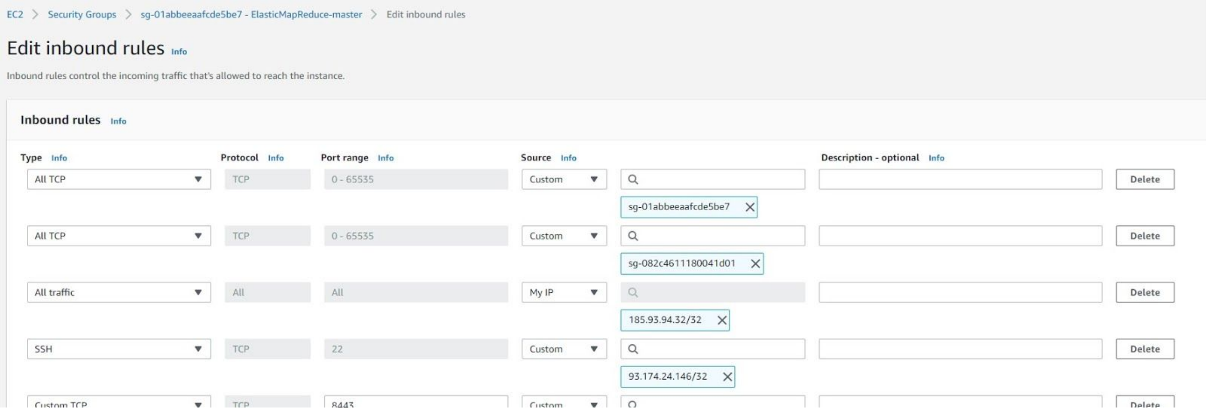
Persistent user interfaces: --
On-cluster user interfaces: Not Enabled Enable an SSH Connection

Network and hardware

Availability zone: us-east-1d
Subnet ID: subnet-172ce336
Master: Bootstrapping 1 m4.xlarge
Core: Provisioning 2 m4.xlarge
Task: --
Cluster scaling: Not enabled

Security and access

Key name: hadoopKey
EC2 instance profile: EMR_EC2_DefaultRole
EMR role: EMR_DefaultRole
Auto Scaling role: EMR_AutoScaling_DefaultRole
Visible to all users: All Change
Security groups for Master: sg-01abbeeaafcde5be7 (ElasticMapReduce-master)
Security groups for Core & Task: sg-082c4611180041d01 (ElasticMapReduce-slave)

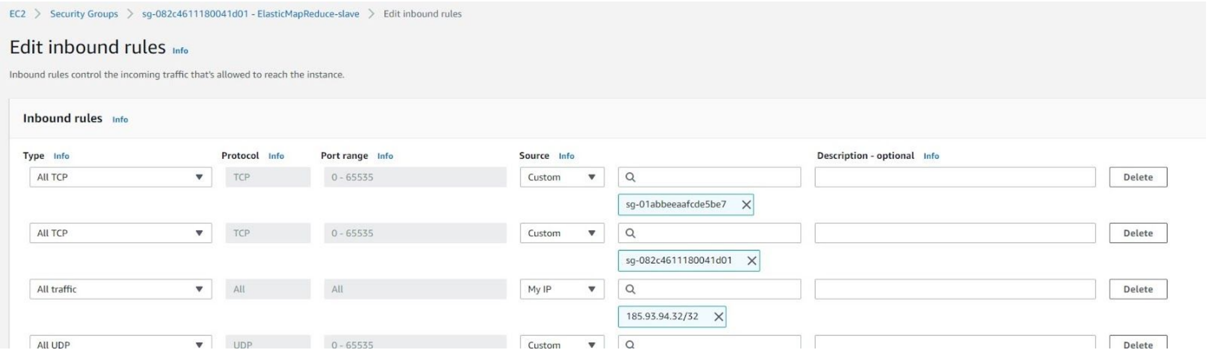

EC2 > Security Groups > sg-01abbeeaafcde5be7 - ElasticMapReduce-master > Edit inbound rules

Edit inbound rules Info

Inbound rules control the incoming traffic that's allowed to reach the instance.

Inbound rules Info

Type	Protocol	Port range	Source		Description - optional	
All TCP	TCP	0 - 65535	Custom	sg-01abbeeaafcde5be7		Delete
All TCP	TCP	0 - 65535	Custom	sg-082c4611180041d01		Delete
All traffic	All	All	My IP	185.93.94.32/32		Delete
SSH	TCP	22	Custom	93.174.24.146/32		Delete
Custom TCP	TCP	8443	Custom			Delete


EC2 > Security Groups > sg-082c4611180041d01 - ElasticMapReduce-slave > Edit inbound rules

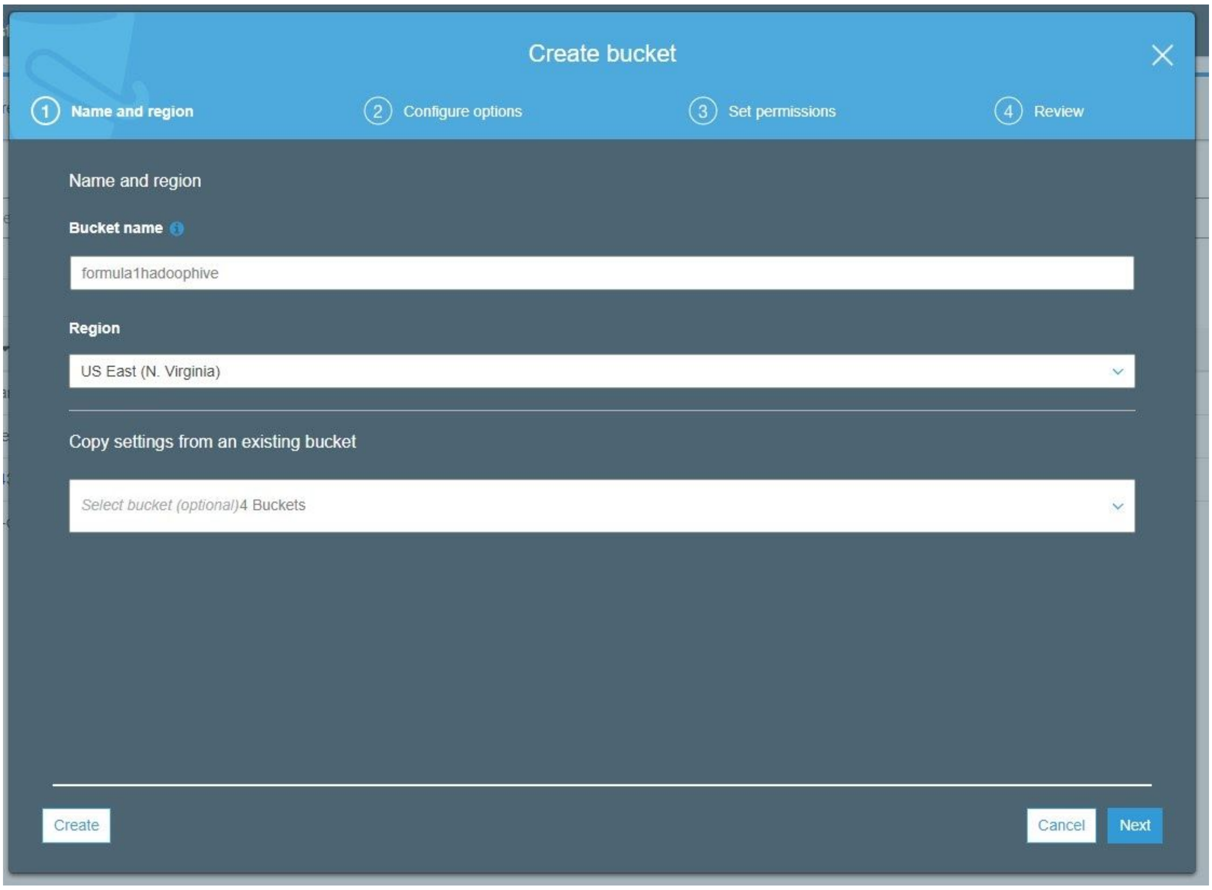
Edit inbound rules Info

Inbound rules control the incoming traffic that's allowed to reach the instance.

Inbound rules Info

Type	Protocol	Port range	Source		Description - optional	
All TCP	TCP	0 - 65535	Custom	sg-01abbeeaafcde5be7		Delete
All TCP	TCP	0 - 65535	Custom	sg-082c4611180041d01		Delete
All traffic	All	All	My IP	185.93.94.32/32		Delete
All UDP	UDP	0 - 65535	Custom			Delete

3. Create bucket on S3 and load data



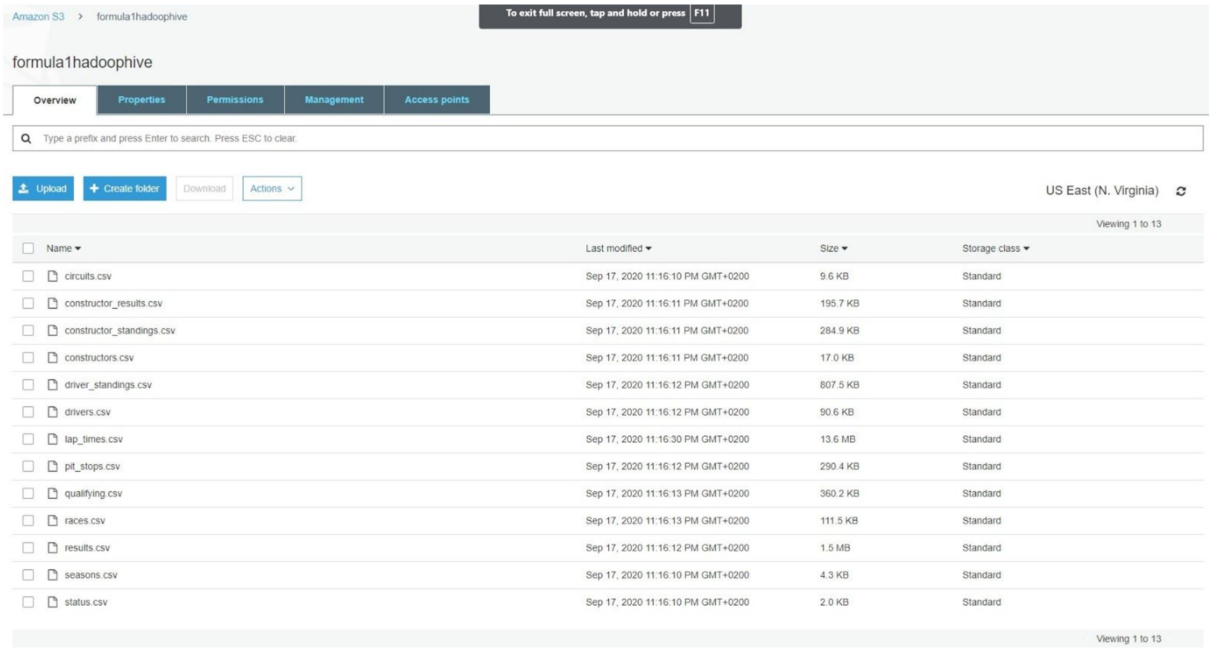
Name and region

Bucket name: formula1hadoophive

Region: US East (N. Virginia)

Copy settings from an existing bucket

Select bucket (optional)4 Buckets



Amazon S3 > formula1hadoophive
To exit full screen, tap and hold or press F11
Overview
Properties
Permissions
Management
Access points
Type a prefix and press Enter to search. Press ESC to clear.
Upload
Create folder
Download
Actions

formula1hadoophive

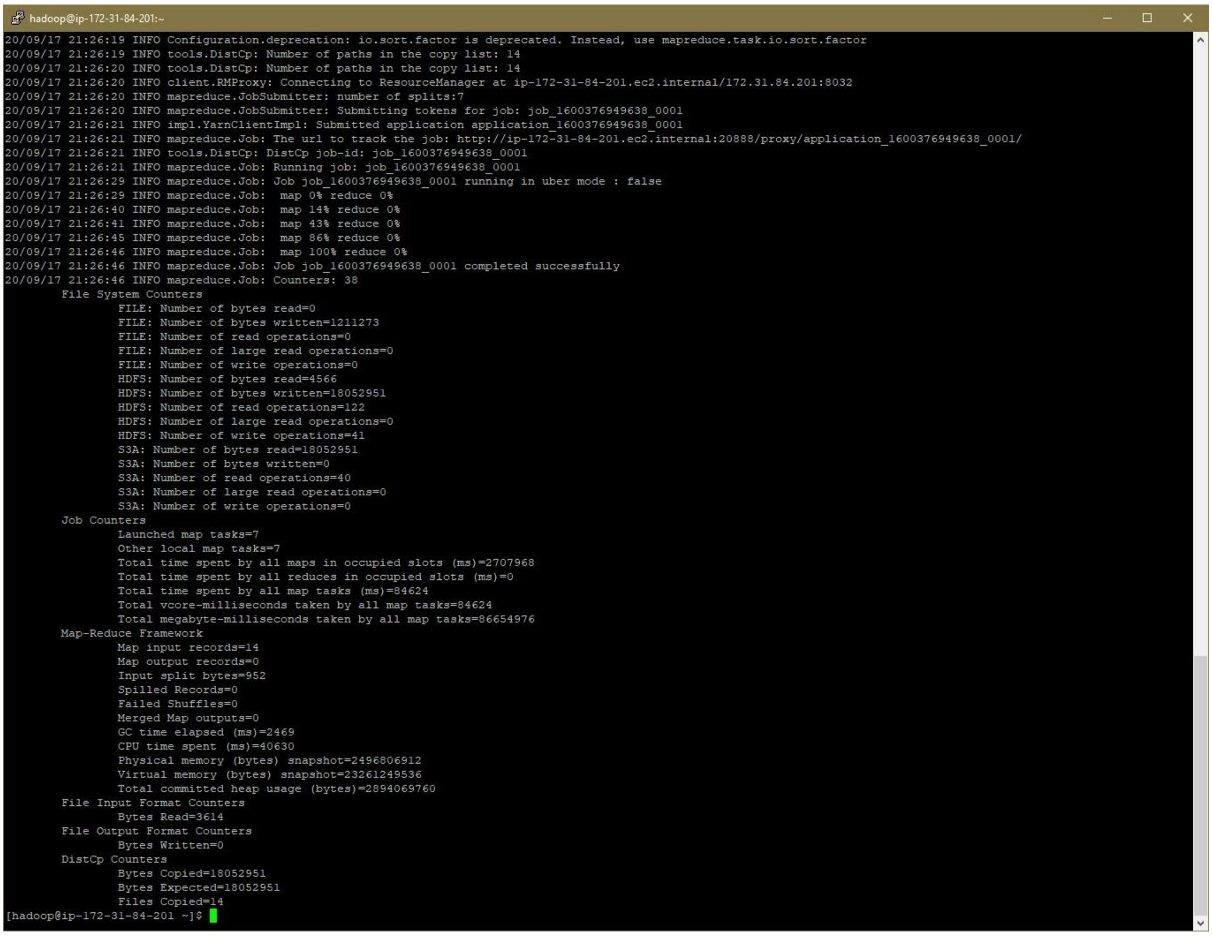
US East (N. Virginia)

Viewing 1 to 13

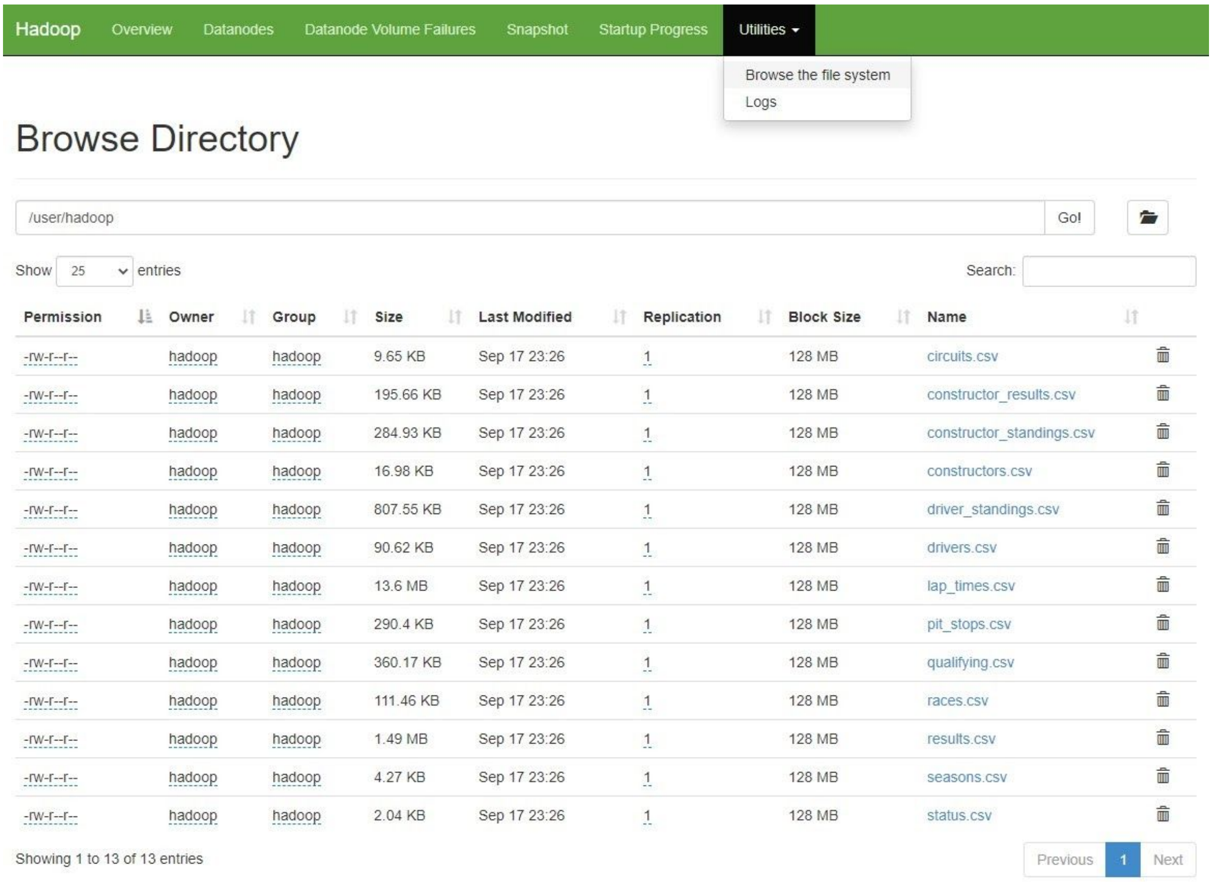
Name	Last modified	Size	Storage class
circuits.csv	Sep 17, 2020 11:16:10 PM GMT+0200	9.6 KB	Standard
constructor_results.csv	Sep 17, 2020 11:16:11 PM GMT+0200	195.7 KB	Standard
constructor_standings.csv	Sep 17, 2020 11:16:11 PM GMT+0200	284.9 KB	Standard
constructors.csv	Sep 17, 2020 11:16:11 PM GMT+0200	17.0 KB	Standard
driver_standings.csv	Sep 17, 2020 11:16:12 PM GMT+0200	807.5 KB	Standard
drivers.csv	Sep 17, 2020 11:16:12 PM GMT+0200	90.6 KB	Standard
lap_times.csv	Sep 17, 2020 11:16:30 PM GMT+0200	13.6 MB	Standard
pit_stops.csv	Sep 17, 2020 11:16:12 PM GMT+0200	290.4 KB	Standard
qualifying.csv	Sep 17, 2020 11:16:13 PM GMT+0200	360.2 KB	Standard
races.csv	Sep 17, 2020 11:16:13 PM GMT+0200	111.5 KB	Standard
results.csv	Sep 17, 2020 11:16:12 PM GMT+0200	1.5 MB	Standard
seasons.csv	Sep 17, 2020 11:16:10 PM GMT+0200	4.3 KB	Standard
status.csv	Sep 17, 2020 11:16:10 PM GMT+0200	2.0 KB	Standard

Viewing 1 to 13

4. Copy files from S3 to HDFS



```
20/09/17 21:26:19 INFO Configuration.deprecation: io.sort.factor is deprecated. Instead, use mapreduce.task.io.sort.factor
20/09/17 21:26:19 INFO tools.DistCp: Number of paths in the copy list: 14
20/09/17 21:26:20 INFO tools.DistCp: Number of paths in the copy list: 14
20/09/17 21:26:20 INFO client.RMProxy: Connecting to ResourceManager at ip-172-31-84-201.ec2.internal/172.31.84.201:8032
20/09/17 21:26:20 INFO mapreduce.JobSubmitter: number of splits:7
20/09/17 21:26:20 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1600376949638_0001
20/09/17 21:26:21 INFO impl.YarnClientImpl: Submitted application application_1600376949638_0001
20/09/17 21:26:21 INFO mapreduce.Job: The url to track the job: http://ip-172-31-84-201.ec2.internal:20888/proxy/application_1600376949638_0001/
20/09/17 21:26:21 INFO tools.DistCp: DistCp job-id: job_1600376949638_0001
20/09/17 21:26:21 INFO mapreduce.Job: Running job: job_1600376949638_0001
20/09/17 21:26:29 INFO mapreduce.Job: Job job_1600376949638_0001 running in uber mode : false
20/09/17 21:26:29 INFO mapreduce.Job:  map 0% reduce 0%
20/09/17 21:26:40 INFO mapreduce.Job:  map 14% reduce 0%
20/09/17 21:26:41 INFO mapreduce.Job:  map 43% reduce 0%
20/09/17 21:26:45 INFO mapreduce.Job:  map 86% reduce 0%
20/09/17 21:26:46 INFO mapreduce.Job:  map 100% reduce 0%
20/09/17 21:26:46 INFO mapreduce.Job: Job job_1600376949638_0001 completed successfully
20/09/17 21:26:46 INFO mapreduce.Job: Counters: 38
        File System Counters
                FILE: Number of bytes read=0
                FILE: Number of bytes written=1211273
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=4566
                HDFS: Number of bytes written=18052951
                HDFS: Number of read operations=122
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=41
                S3A: Number of bytes read=18052951
                S3A: Number of bytes written=0
                S3A: Number of read operations=40
                S3A: Number of large read operations=0
                S3A: Number of write operations=0
        Job Counters
                Launched map tasks=7
                Other local map tasks=7
                Total time spent by all maps in occupied slots (ms)=2707968
                Total time spent by all reduces in occupied slots (ms)=0
                Total time spent by all map tasks (ms)=84624
                Total vcore-milliseconds taken by all map tasks=84624
                Total megabyte-milliseconds taken by all map tasks=86654976
        Map-Reduce Framework
                Map input records=14
                Map output records=0
                Input split bytes=952
                Spilled Records=0
                Failed Shuffles=0
                Merged Map outputs=0
                GC time elapsed (ms)=2469
                CPU time spent (ms)=40630
                Physical memory (bytes) snapshot=2496806912
                Virtual memory (bytes) snapshot=23261249536
                Total committed heap usage (bytes)=2894069760
        File Input Format Counters
                Bytes Read=3614
        File Output Format Counters
                Bytes Written=0
        DistCp Counters
                Bytes Copied=18052951
                Bytes Expected=18052951
                Files Copied=14
[hadoop@ip-172-31-84-201 ~]$
```

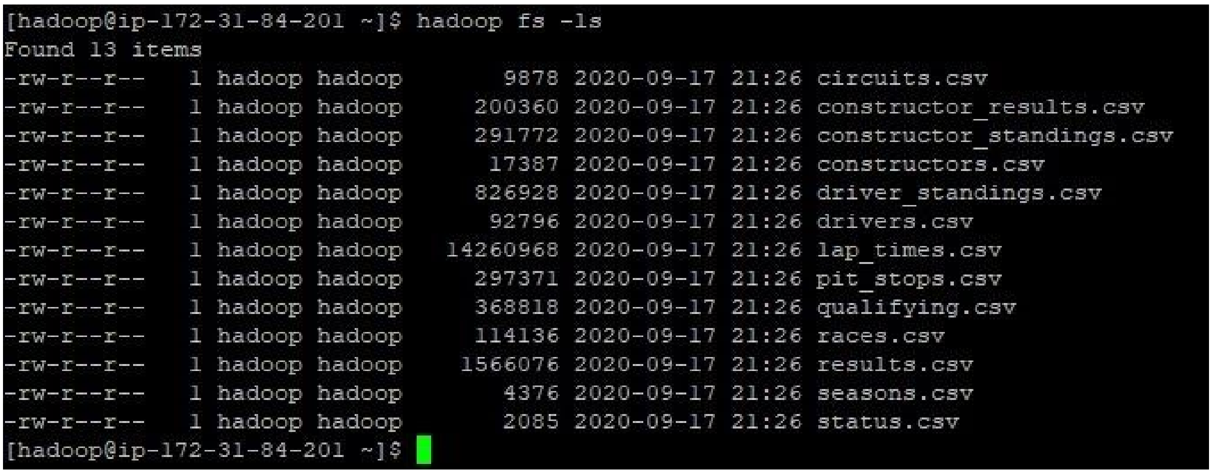


Browse Directory

/user/hadoop

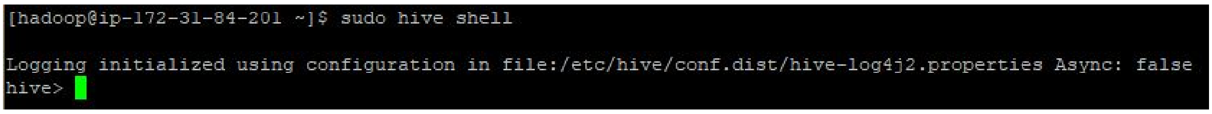
Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
-rw-r--r--	hadoop	hadoop	9.65 KB	Sep 17 23:26	1	128 MB	circuits.csv
-rw-r--r--	hadoop	hadoop	195.66 KB	Sep 17 23:26	1	128 MB	constructor_results.csv
-rw-r--r--	hadoop	hadoop	284.93 KB	Sep 17 23:26	1	128 MB	constructor_standings.csv
-rw-r--r--	hadoop	hadoop	16.98 KB	Sep 17 23:26	1	128 MB	constructors.csv
-rw-r--r--	hadoop	hadoop	807.55 KB	Sep 17 23:26	1	128 MB	driver_standings.csv
-rw-r--r--	hadoop	hadoop	90.62 KB	Sep 17 23:26	1	128 MB	drivers.csv
-rw-r--r--	hadoop	hadoop	13.6 MB	Sep 17 23:26	1	128 MB	lap_times.csv
-rw-r--r--	hadoop	hadoop	290.4 KB	Sep 17 23:26	1	128 MB	pit_stops.csv
-rw-r--r--	hadoop	hadoop	360.17 KB	Sep 17 23:26	1	128 MB	qualifying.csv
-rw-r--r--	hadoop	hadoop	111.46 KB	Sep 17 23:26	1	128 MB	races.csv
-rw-r--r--	hadoop	hadoop	1.49 MB	Sep 17 23:26	1	128 MB	results.csv
-rw-r--r--	hadoop	hadoop	4.27 KB	Sep 17 23:26	1	128 MB	seasons.csv
-rw-r--r--	hadoop	hadoop	2.04 KB	Sep 17 23:26	1	128 MB	status.csv

Showing 1 to 13 of 13 entries



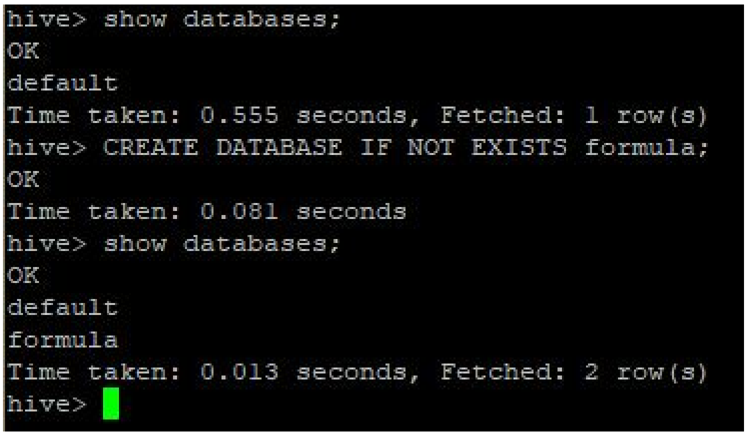
```
[hadoop@ip-172-31-84-201 ~]$ hadoop fs -ls
Found 13 items
-rw-r--r--   1 hadoop hadoop       9878 2020-09-17 21:26 circuits.csv
-rw-r--r--   1 hadoop hadoop     200360 2020-09-17 21:26 constructor_results.csv
-rw-r--r--   1 hadoop hadoop     291772 2020-09-17 21:26 constructor_standings.csv
-rw-r--r--   1 hadoop hadoop      17387 2020-09-17 21:26 constructors.csv
-rw-r--r--   1 hadoop hadoop     826928 2020-09-17 21:26 driver_standings.csv
-rw-r--r--   1 hadoop hadoop      92796 2020-09-17 21:26 drivers.csv
-rw-r--r--   1 hadoop hadoop   14260968 2020-09-17 21:26 lap_times.csv
-rw-r--r--   1 hadoop hadoop     297371 2020-09-17 21:26 pit_stops.csv
-rw-r--r--   1 hadoop hadoop     368818 2020-09-17 21:26 qualifying.csv
-rw-r--r--   1 hadoop hadoop     114136 2020-09-17 21:26 races.csv
-rw-r--r--   1 hadoop hadoop    1566076 2020-09-17 21:26 results.csv
-rw-r--r--   1 hadoop hadoop       4376 2020-09-17 21:26 seasons.csv
-rw-r--r--   1 hadoop hadoop       2085 2020-09-17 21:26 status.csv
[hadoop@ip-172-31-84-201 ~]$
```

5. Open Hive shell



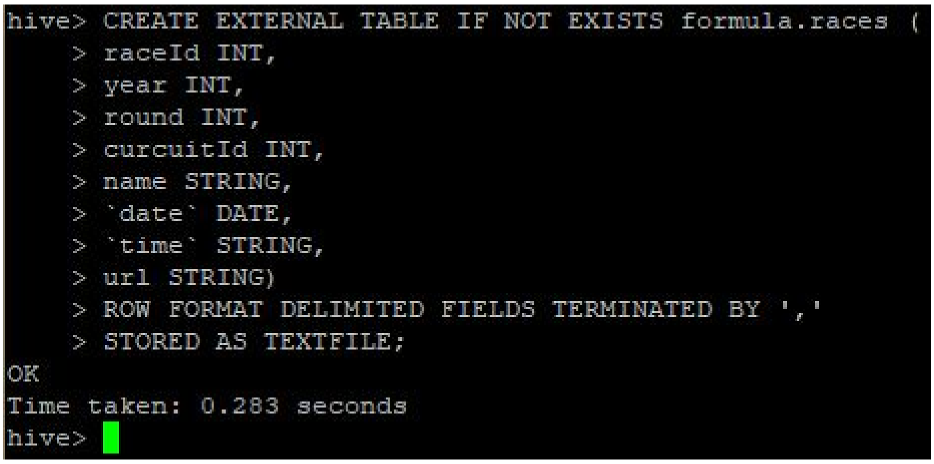
```
[hadoop@ip-172-31-84-201 ~]$ sudo hive shell

Logging initialized using configuration in file:/etc/hive/conf.dist/hive-log4j2.properties Async: false
hive> 
```

6. Create database



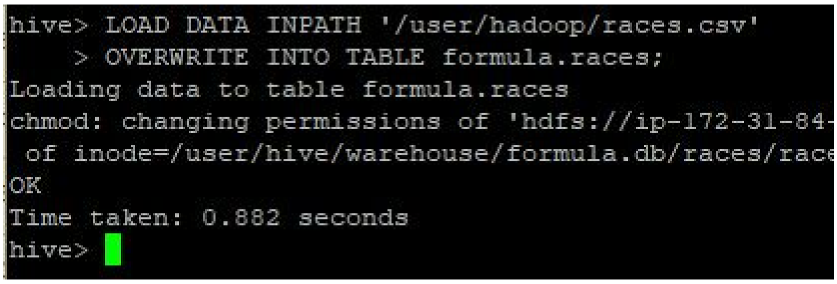
```
hive> show databases;
OK
default
Time taken: 0.555 seconds, Fetched: 1 row(s)
hive> CREATE DATABASE IF NOT EXISTS formula;
OK
Time taken: 0.081 seconds
hive> show databases;
OK
default
formula
Time taken: 0.013 seconds, Fetched: 2 row(s)
hive> 
```

7. Create temp table (csv)



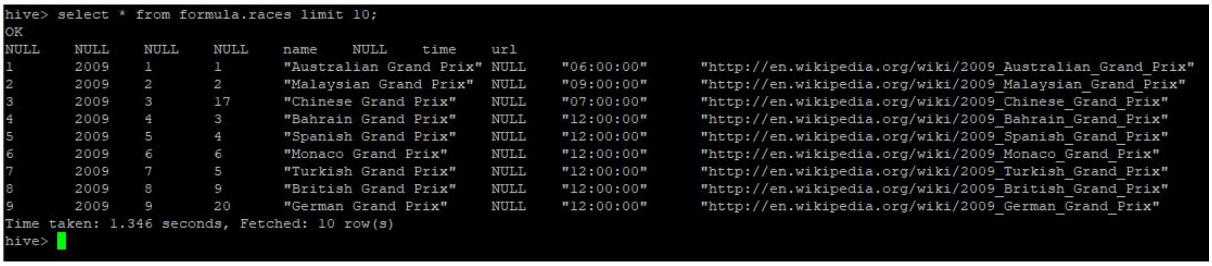
```
hive> CREATE EXTERNAL TABLE IF NOT EXISTS formula.races (
    > raceId INT,
    > year INT,
    > round INT,
    > curcuitId INT,
    > name STRING,
    > `date` DATE,
    > `time` STRING,
    > url STRING)
    > ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
    > STORED AS TEXTFILE;
OK
Time taken: 0.283 seconds
hive> 
```

8. Load data to table (csv)



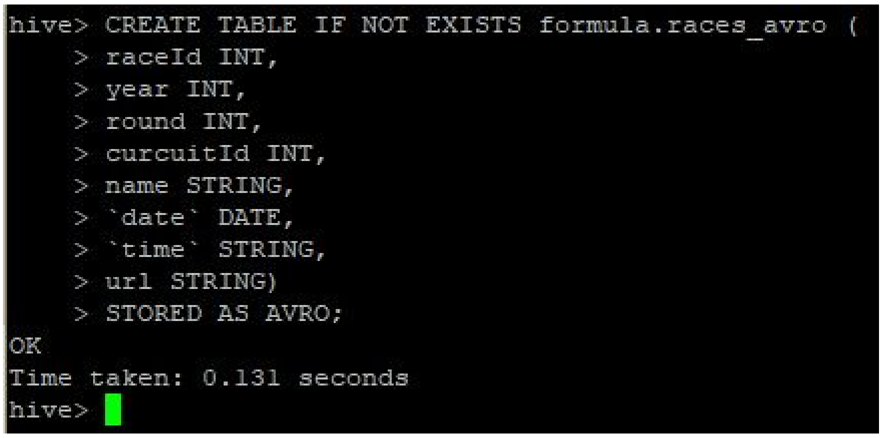
```
hive> LOAD DATA INPATH '/user/hadoop/races.csv'
    > OVERWRITE INTO TABLE formula.races;
Loading data to table formula.races
chmod: changing permissions of 'hdfs://ip-172-31-84-
 of inode=/user/hive/warehouse/formula.db/races/race
OK
Time taken: 0.882 seconds
hive> 
```

9. Verify data



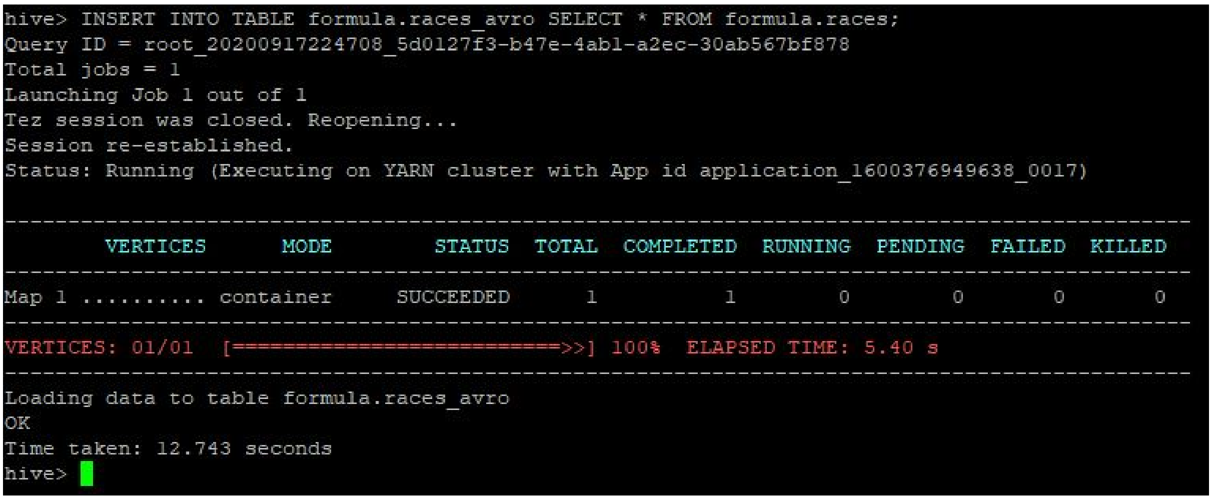
```
hive> select * from formula.races limit 10;
OK
NULL    NULL    NULL    NULL    name    NULL    time    url
1       2009    1       1       "Australian Grand Prix" NULL    "06:00:00"      "http://en.wikipedia.org/wiki/2009_Australian_Grand_Prix"
2       2009    2       2       "Malaysian Grand Prix"  NULL    "09:00:00"      "http://en.wikipedia.org/wiki/2009_Malaysian_Grand_Prix"
3       2009    3       17      "Chinese Grand Prix"    NULL    "07:00:00"      "http://en.wikipedia.org/wiki/2009_Chinese_Grand_Prix"
4       2009    4       3       "Bahrain Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Bahrain_Grand_Prix"
5       2009    5       4       "Spanish Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Spanish_Grand_Prix"
6       2009    6       6       "Monaco Grand Prix"     NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Monaco_Grand_Prix"
7       2009    7       5       "Turkish Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Turkish_Grand_Prix"
8       2009    8       9       "British Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_British_Grand_Prix"
9       2009    9       20      "German Grand Prix"     NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_German_Grand_Prix"
Time taken: 1.346 seconds, Fetched: 10 row(s)
hive>
```

10. Create AVRO table



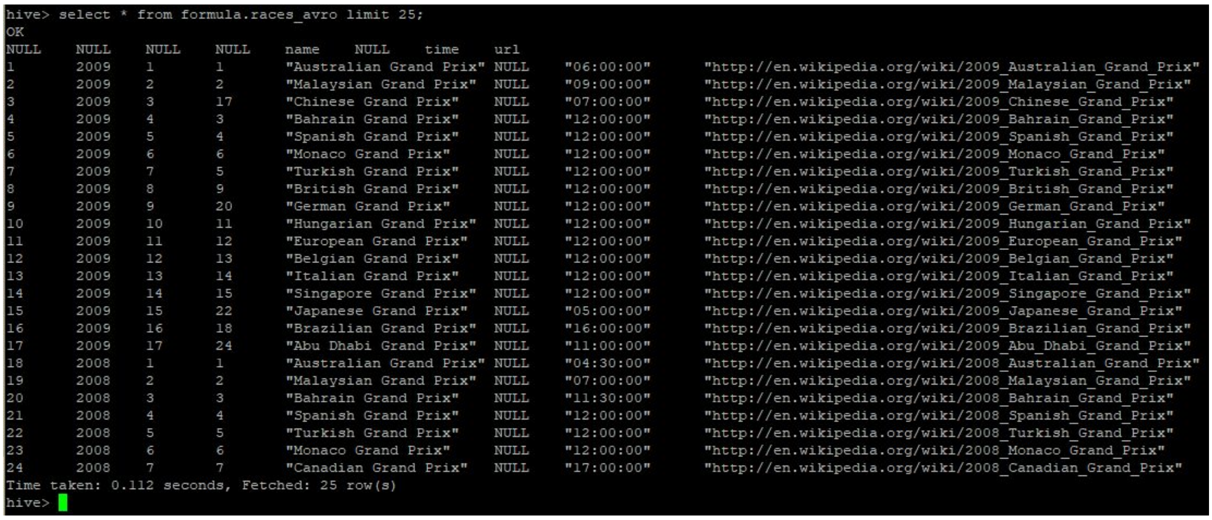
```
hive> CREATE TABLE IF NOT EXISTS formula.races_avro (
    > raceId INT,
    > year INT,
    > round INT,
    > curcuitId INT,
    > name STRING,
    > `date` DATE,
    > `time` STRING,
    > url STRING)
    > STORED AS AVRO;
OK
Time taken: 0.131 seconds
hive>
```

11. Load data from temp table (csv) to AVRO table

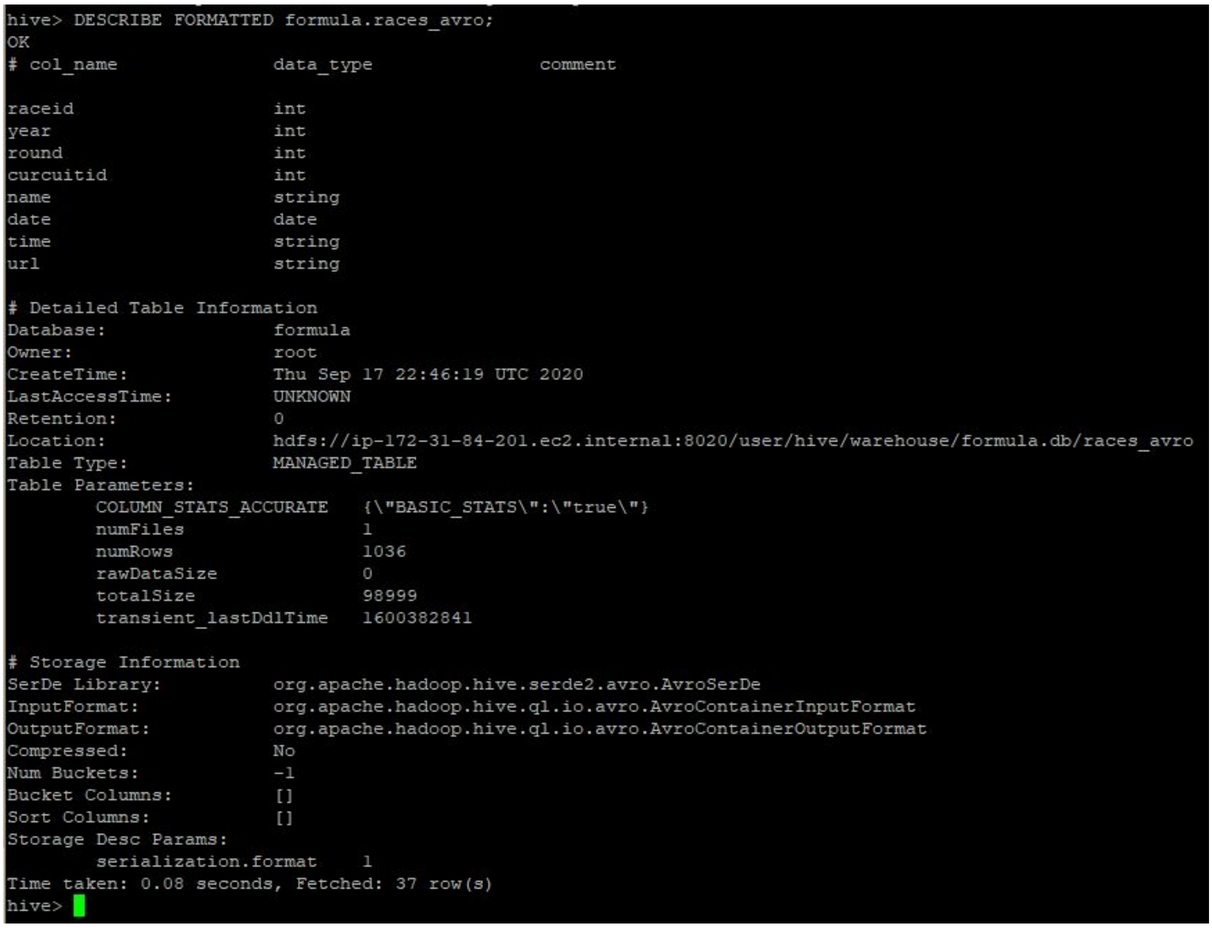


```
hive> INSERT INTO TABLE formula.races_avro SELECT * FROM formula.races;
Query ID = root_20200917224708_5d0127f3-b47e-4ab1-a2ec-30ab567bf878
Total jobs = 1
Launching Job 1 out of 1
Tez session was closed. Reopening...
Session re-established.
Status: Running (Executing on YARN cluster with App id application_1600376949638_0017)

----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1 .......... container     SUCCEEDED      1          1        0        0       0       0
----------------------------------------------------------------------------------------------
VERTICES: 01/01  [==========================>>] 100%  ELAPSED TIME: 5.40 s
----------------------------------------------------------------------------------------------
Loading data to table formula.races_avro
OK
Time taken: 12.743 seconds
hive>
```

12. Ready to write SQL!



```
hive> select * from formula.races_avro limit 25;
OK
NULL    NULL    NULL    NULL    name    NULL    time    url
1       2009    1       1       "Australian Grand Prix" NULL    "06:00:00"      "http://en.wikipedia.org/wiki/2009_Australian_Grand_Prix"
2       2009    2       2       "Malaysian Grand Prix"  NULL    "09:00:00"      "http://en.wikipedia.org/wiki/2009_Malaysian_Grand_Prix"
3       2009    3       17      "Chinese Grand Prix"    NULL    "07:00:00"      "http://en.wikipedia.org/wiki/2009_Chinese_Grand_Prix"
4       2009    4       3       "Bahrain Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Bahrain_Grand_Prix"
5       2009    5       4       "Spanish Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Spanish_Grand_Prix"
6       2009    6       6       "Monaco Grand Prix"     NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Monaco_Grand_Prix"
7       2009    7       5       "Turkish Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Turkish_Grand_Prix"
8       2009    8       9       "British Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_British_Grand_Prix"
9       2009    9       20      "German Grand Prix"     NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_German_Grand_Prix"
10      2009    10      11      "Hungarian Grand Prix"  NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Hungarian_Grand_Prix"
11      2009    11      12      "European Grand Prix"   NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_European_Grand_Prix"
12      2009    12      13      "Belgian Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Belgian_Grand_Prix"
13      2009    13      14      "Italian Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Italian_Grand_Prix"
14      2009    14      15      "Singapore Grand Prix"  NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2009_Singapore_Grand_Prix"
15      2009    15      22      "Japanese Grand Prix"   NULL    "05:00:00"      "http://en.wikipedia.org/wiki/2009_Japanese_Grand_Prix"
16      2009    16      18      "Brazilian Grand Prix"  NULL    "16:00:00"      "http://en.wikipedia.org/wiki/2009_Brazilian_Grand_Prix"
17      2009    17      24      "Abu Dhabi Grand Prix"  NULL    "11:00:00"      "http://en.wikipedia.org/wiki/2009_Abu_Dhabi_Grand_Prix"
18      2008    1       1       "Australian Grand Prix" NULL    "04:30:00"      "http://en.wikipedia.org/wiki/2008_Australian_Grand_Prix"
19      2008    2       2       "Malaysian Grand Prix"  NULL    "07:00:00"      "http://en.wikipedia.org/wiki/2008_Malaysian_Grand_Prix"
20      2008    3       3       "Bahrain Grand Prix"    NULL    "11:30:00"      "http://en.wikipedia.org/wiki/2008_Bahrain_Grand_Prix"
21      2008    4       4       "Spanish Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2008_Spanish_Grand_Prix"
22      2008    5       5       "Turkish Grand Prix"    NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2008_Turkish_Grand_Prix"
23      2008    6       6       "Monaco Grand Prix"     NULL    "12:00:00"      "http://en.wikipedia.org/wiki/2008_Monaco_Grand_Prix"
24      2008    7       7       "Canadian Grand Prix"   NULL    "17:00:00"      "http://en.wikipedia.org/wiki/2008_Canadian_Grand_Prix"
Time taken: 0.112 seconds, Fetched: 25 row(s)
hive>
```



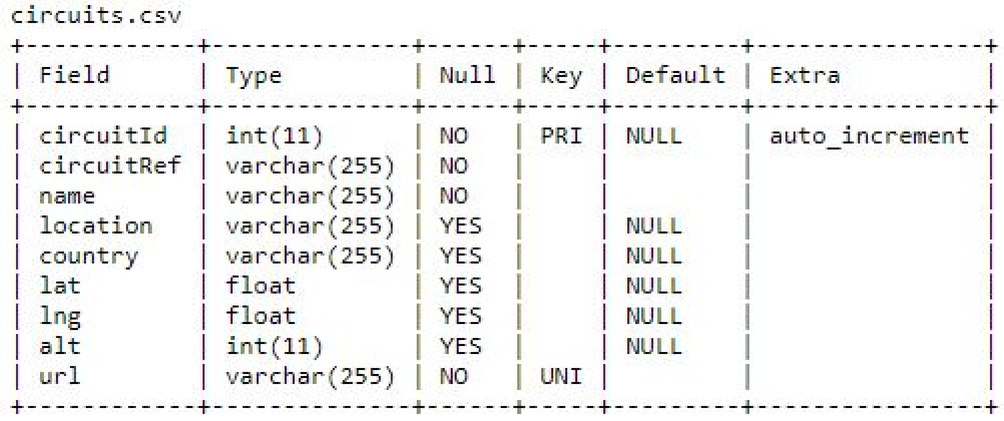
```
hive> DESCRIBE FORMATTED formula.races_avro;
OK
# col_name              data_type               comment

raceid                  int
year                    int
round                   int
curcuitid               int
name                    string
date                    date
time                    string
url                     string

# Detailed Table Information
Database:               formula
Owner:                  root
CreateTime:             Thu Sep 17 22:46:19 UTC 2020
LastAccessTime:         UNKNOWN
Retention:              0
Location:               hdfs://ip-172-31-84-201.ec2.internal:8020/user/hive/warehouse/formula.db/races_avro
Table Type:             MANAGED_TABLE
Table Parameters:
        COLUMN_STATS_ACCURATE   {\"BASIC_STATS\":\"true\"}
        numFiles                1
        numRows                 1036
        rawDataSize             0
        totalSize               98999
        transient_lastDdlTime   1600382841

# Storage Information
SerDe Library:          org.apache.hadoop.hive.serde2.avro.AvroSerDe
InputFormat:            org.apache.hadoop.hive.ql.io.avro.AvroContainerInputFormat
OutputFormat:           org.apache.hadoop.hive.ql.io.avro.AvroContainerOutputFormat
Compressed:             No
Num Buckets:            -1
Bucket Columns:         []
Sort Columns:           []
Storage Desc Params:
        serialization.format    1
Time taken: 0.08 seconds, Fetched: 37 row(s)
hive>
```

Data model

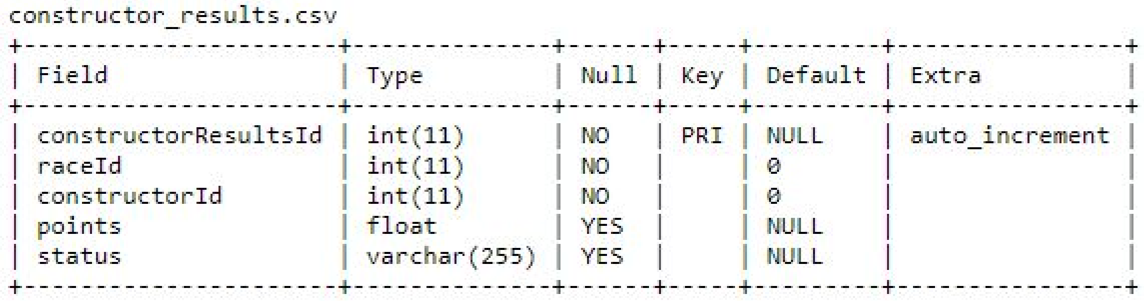
Tables

1. circuits
2. constructorResults
3. constructorStandings
4. constructors
5. driverStandings
6. drivers
7. lapTimes
8. pitStops
9. qualifying
10. races
11. results
12. seasons
13. status

Tables details

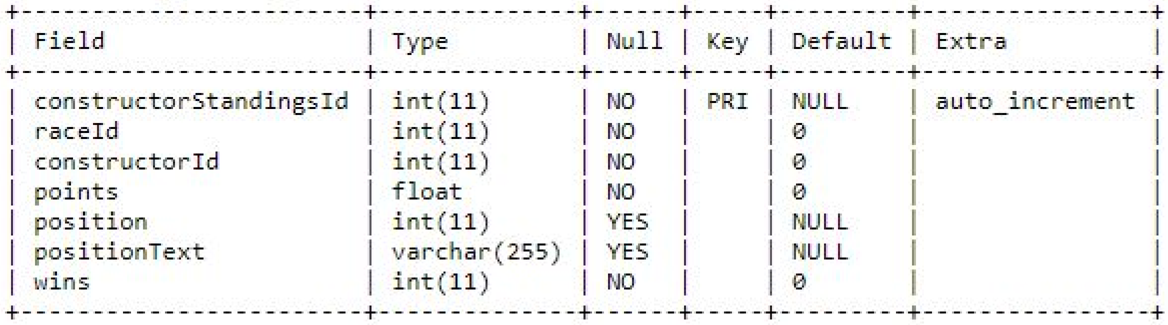


```
circuits.csv
+------------+--------------+------+-----+---------+----------------+
| Field      | Type         | Null | Key | Default | Extra          |
+------------+--------------+------+-----+---------+----------------+
| circuitId  | int(11)      | NO   | PRI | NULL    | auto_increment |
| circuitRef | varchar(255) | NO   |     |         |                |
| name       | varchar(255) | NO   |     |         |                |
| location   | varchar(255) | YES  |     | NULL    |                |
| country    | varchar(255) | YES  |     | NULL    |                |
| lat        | float        | YES  |     | NULL    |                |
| lng        | float        | YES  |     | NULL    |                |
| alt        | int(11)      | YES  |     | NULL    |                |
| url        | varchar(255) | NO   | UNI |         |                |
+------------+--------------+------+-----+---------+----------------+
```



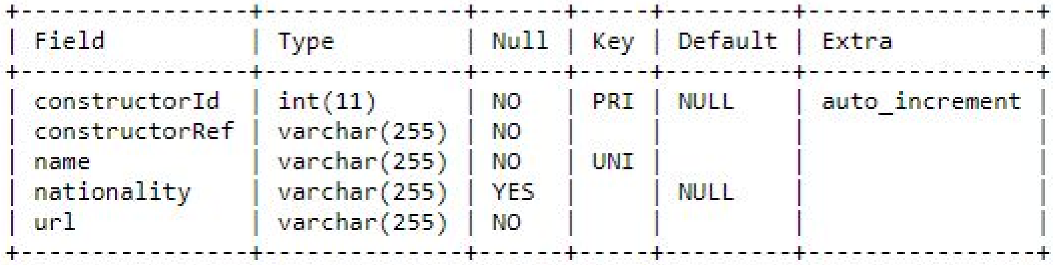
```
constructor_results.csv
+----------------------+--------------+------+-----+---------+----------------+
| Field                | Type         | Null | Key | Default | Extra          |
+----------------------+--------------+------+-----+---------+----------------+
| constructorResultsId | int(11)      | NO   | PRI | NULL    | auto_increment |
| raceId               | int(11)      | NO   |     | 0       |                |
| constructorId        | int(11)      | NO   |     | 0       |                |
| points               | float        | YES  |     | NULL    |                |
| status               | varchar(255) | YES  |     | NULL    |                |
+----------------------+--------------+------+-----+---------+----------------+
```

constructor_standings.csv



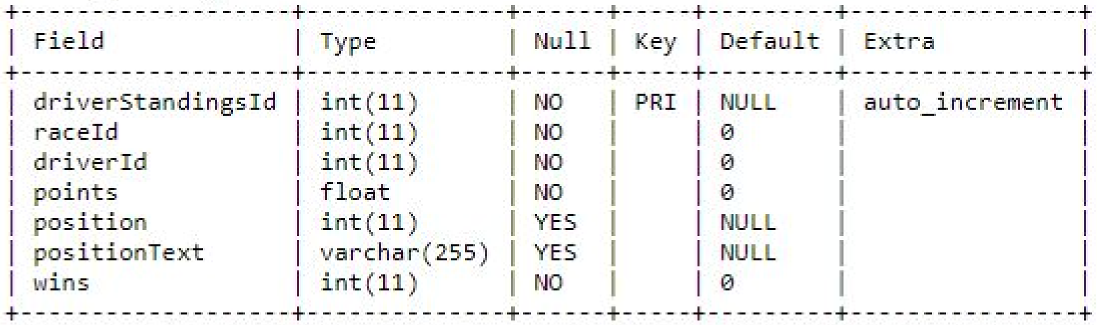
```
+------------------------+--------------+------+-----+---------+----------------+
| Field                  | Type         | Null | Key | Default | Extra          |
+------------------------+--------------+------+-----+---------+----------------+
| constructorStandingsId | int(11)      | NO   | PRI | NULL    | auto_increment |
| raceId                 | int(11)      | NO   |     | 0       |                |
| constructorId          | int(11)      | NO   |     | 0       |                |
| points                 | float        | NO   |     | 0       |                |
| position               | int(11)      | YES  |     | NULL    |                |
| positionText           | varchar(255) | YES  |     | NULL    |                |
| wins                   | int(11)      | NO   |     | 0       |                |
+------------------------+--------------+------+-----+---------+----------------+
```

constructors.csv



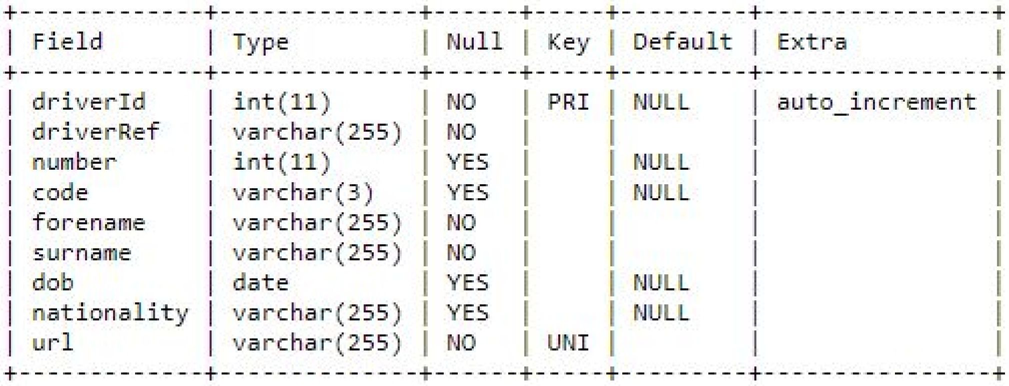
```
+----------------+--------------+------+-----+---------+----------------+
| Field          | Type         | Null | Key | Default | Extra          |
+----------------+--------------+------+-----+---------+----------------+
| constructorId  | int(11)      | NO   | PRI | NULL    | auto_increment |
| constructorRef | varchar(255) | NO   |     |         |                |
| name           | varchar(255) | NO   | UNI |         |                |
| nationality    | varchar(255) | YES  |     | NULL    |                |
| url            | varchar(255) | NO   |     |         |                |
+----------------+--------------+------+-----+---------+----------------+
```

driver_standings.csv

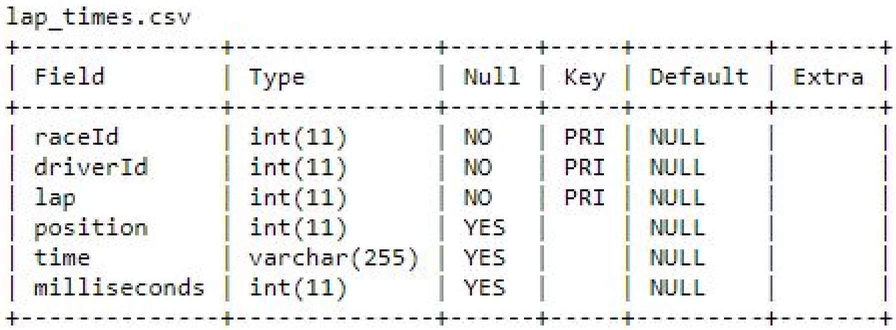


```
+-------------------+--------------+------+-----+---------+----------------+
| Field             | Type         | Null | Key | Default | Extra          |
+-------------------+--------------+------+-----+---------+----------------+
| driverStandingsId | int(11)      | NO   | PRI | NULL    | auto_increment |
| raceId            | int(11)      | NO   |     | 0       |                |
| driverId          | int(11)      | NO   |     | 0       |                |
| points            | float        | NO   |     | 0       |                |
| position          | int(11)      | YES  |     | NULL    |                |
| positionText      | varchar(255) | YES  |     | NULL    |                |
| wins              | int(11)      | NO   |     | 0       |                |
+-------------------+--------------+------+-----+---------+----------------+
```

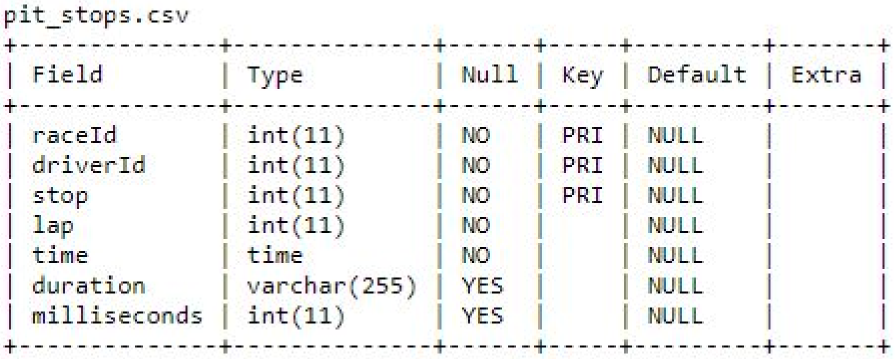
drivers.csv



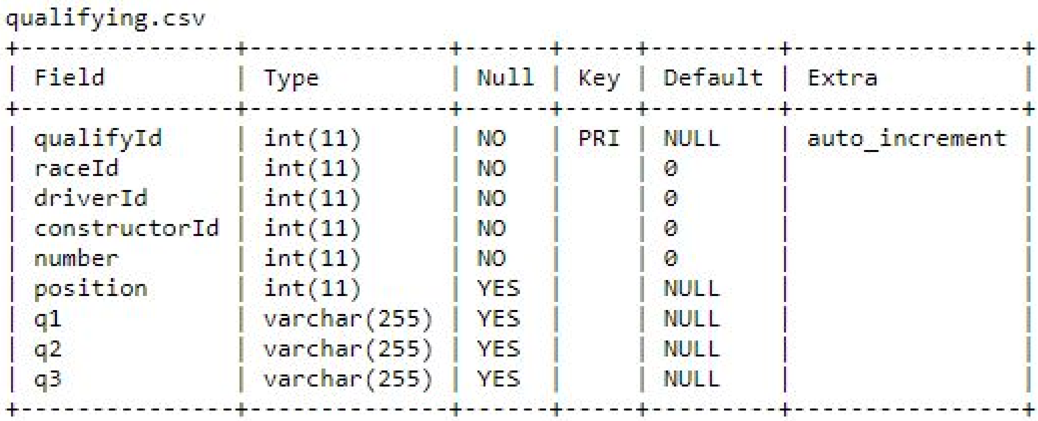
```
+-------------+--------------+------+-----+---------+----------------+
| Field       | Type         | Null | Key | Default | Extra          |
+-------------+--------------+------+-----+---------+----------------+
| driverId    | int(11)      | NO   | PRI | NULL    | auto_increment |
| driverRef   | varchar(255) | NO   |     |         |                |
| number      | int(11)      | YES  |     | NULL    |                |
| code        | varchar(3)   | YES  |     | NULL    |                |
| forename    | varchar(255) | NO   |     |         |                |
| surname     | varchar(255) | NO   |     |         |                |
| dob         | date         | YES  |     | NULL    |                |
| nationality | varchar(255) | YES  |     | NULL    |                |
| url         | varchar(255) | NO   | UNI |         |                |
+-------------+--------------+------+-----+---------+----------------+
```



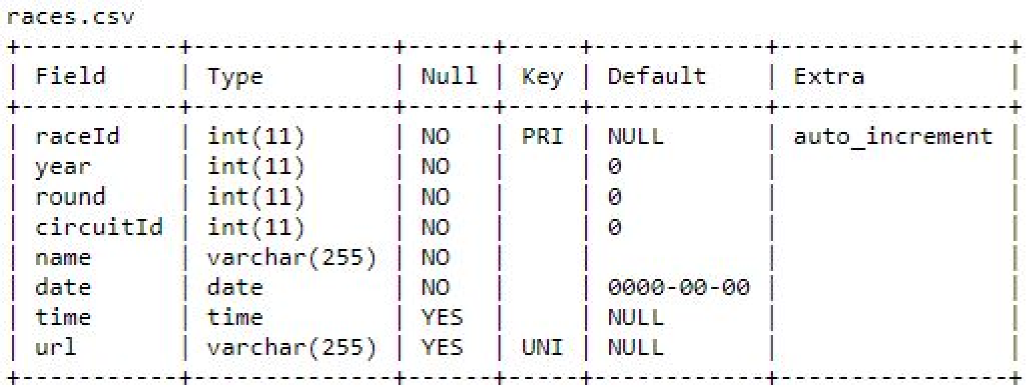
```
lap_times.csv
+--------------+--------------+------+-----+---------+-------+
| Field        | Type         | Null | Key | Default | Extra |
+--------------+--------------+------+-----+---------+-------+
| raceId       | int(11)      | NO   | PRI | NULL    |       |
| driverId     | int(11)      | NO   | PRI | NULL    |       |
| lap          | int(11)      | NO   | PRI | NULL    |       |
| position     | int(11)      | YES  |     | NULL    |       |
| time         | varchar(255) | YES  |     | NULL    |       |
| milliseconds | int(11)      | YES  |     | NULL    |       |
+--------------+--------------+------+-----+---------+-------+
```



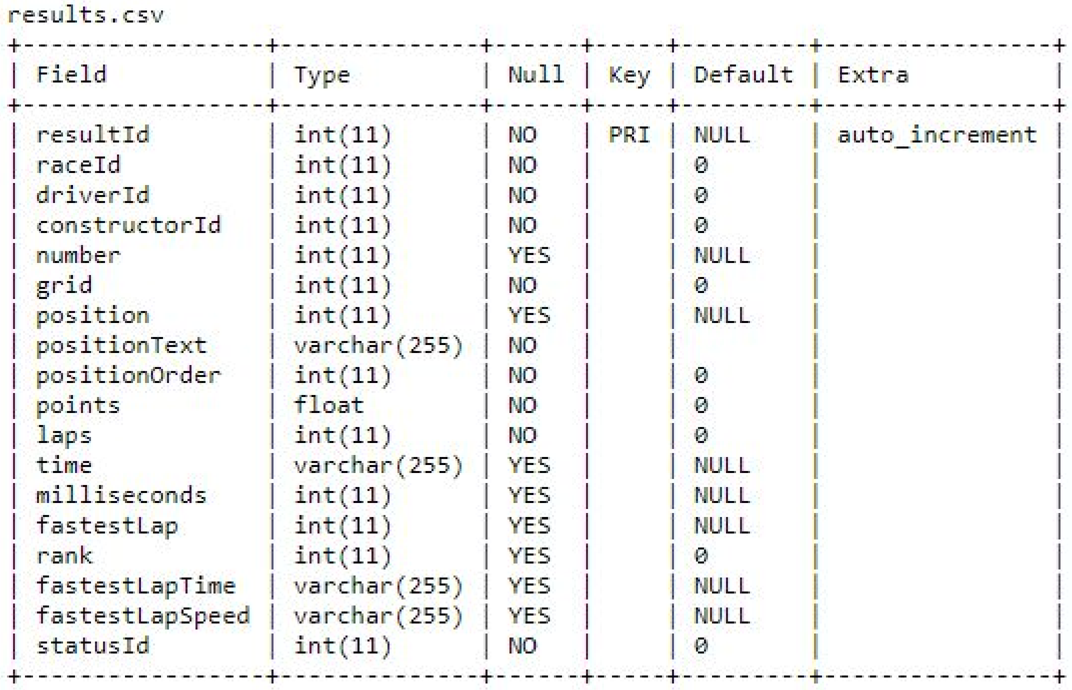
```
pit_stops.csv
+--------------+--------------+------+-----+---------+-------+
| Field        | Type         | Null | Key | Default | Extra |
+--------------+--------------+------+-----+---------+-------+
| raceId       | int(11)      | NO   | PRI | NULL    |       |
| driverId     | int(11)      | NO   | PRI | NULL    |       |
| stop         | int(11)      | NO   | PRI | NULL    |       |
| lap          | int(11)      | NO   |     | NULL    |       |
| time         | time         | NO   |     | NULL    |       |
| duration     | varchar(255) | YES  |     | NULL    |       |
| milliseconds | int(11)      | YES  |     | NULL    |       |
+--------------+--------------+------+-----+---------+-------+
```



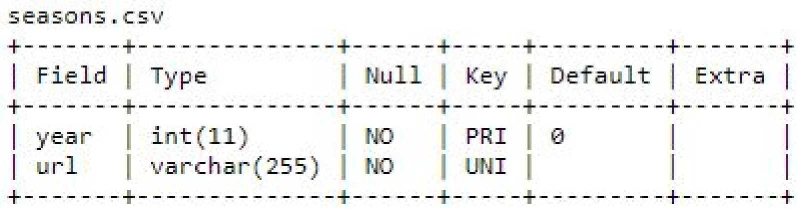
```
qualifying.csv
+---------------+--------------+------+-----+---------+----------------+
| Field         | Type         | Null | Key | Default | Extra          |
+---------------+--------------+------+-----+---------+----------------+
| qualifyId     | int(11)      | NO   | PRI | NULL    | auto_increment |
| raceId        | int(11)      | NO   |     | 0       |                |
| driverId      | int(11)      | NO   |     | 0       |                |
| constructorId | int(11)      | NO   |     | 0       |                |
| number        | int(11)      | NO   |     | 0       |                |
| position      | int(11)      | YES  |     | NULL    |                |
| q1            | varchar(255) | YES  |     | NULL    |                |
| q2            | varchar(255) | YES  |     | NULL    |                |
| q3            | varchar(255) | YES  |     | NULL    |                |
+---------------+--------------+------+-----+---------+----------------+
```



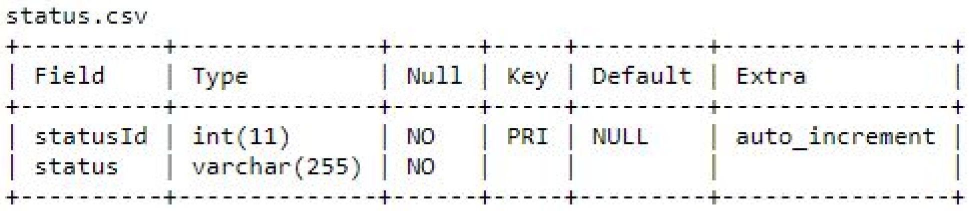
```
races.csv
+-----------+--------------+------+-----+------------+----------------+
| Field     | Type         | Null | Key | Default    | Extra          |
+-----------+--------------+------+-----+------------+----------------+
| raceId    | int(11)      | NO   | PRI | NULL       | auto_increment |
| year      | int(11)      | NO   |     | 0          |                |
| round     | int(11)      | NO   |     | 0          |                |
| circuitId | int(11)      | NO   |     | 0          |                |
| name      | varchar(255) | NO   |     |            |                |
| date      | date         | NO   |     | 0000-00-00 |                |
| time      | time         | YES  |     | NULL       |                |
| url       | varchar(255) | YES  | UNI | NULL       |                |
+-----------+--------------+------+-----+------------+----------------+
```



```
results.csv
+-----------------+--------------+------+-----+---------+----------------+
| Field           | Type         | Null | Key | Default | Extra          |
+-----------------+--------------+------+-----+---------+----------------+
| resultId        | int(11)      | NO   | PRI | NULL    | auto_increment |
| raceId          | int(11)      | NO   |     | 0       |                |
| driverId        | int(11)      | NO   |     | 0       |                |
| constructorId   | int(11)      | NO   |     | 0       |                |
| number          | int(11)      | YES  |     | NULL    |                |
| grid            | int(11)      | NO   |     | 0       |                |
| position        | int(11)      | YES  |     | NULL    |                |
| positionText    | varchar(255) | NO   |     |         |                |
| positionOrder   | int(11)      | NO   |     | 0       |                |
| points          | float        | NO   |     | 0       |                |
| laps            | int(11)      | NO   |     | 0       |                |
| time            | varchar(255) | YES  |     | NULL    |                |
| milliseconds    | int(11)      | YES  |     | NULL    |                |
| fastestLap      | int(11)      | YES  |     | NULL    |                |
| rank            | int(11)      | YES  |     | 0       |                |
| fastestLapTime  | varchar(255) | YES  |     | NULL    |                |
| fastestLapSpeed | varchar(255) | YES  |     | NULL    |                |
| statusId        | int(11)      | NO   |     | 0       |                |
+-----------------+--------------+------+-----+---------+----------------+
```



```
seasons.csv
+-------+--------------+------+-----+---------+-------+
| Field | Type         | Null | Key | Default | Extra |
+-------+--------------+------+-----+---------+-------+
| year  | int(11)      | NO   | PRI | 0       |       |
| url   | varchar(255) | NO   | UNI |         |       |
+-------+--------------+------+-----+---------+-------+
```



```
status.csv
+----------+--------------+------+-----+---------+----------------+
| Field    | Type         | Null | Key | Default | Extra          |
+----------+--------------+------+-----+---------+----------------+
| statusId | int(11)      | NO   | PRI | NULL    | auto_increment |
| status   | varchar(255) | NO   |     |         |                |
+----------+--------------+------+-----+---------+----------------+
```

Data model

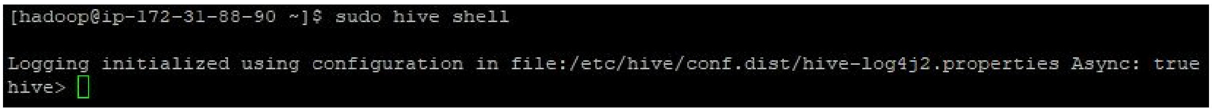
to be done

Challenges

View examples (standard Hive shell vs Beeline shell)

Hive shell

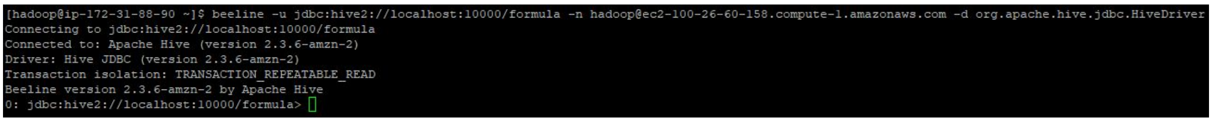
Getting ready to start scripting Hive is simply as write
sudo hive shell
and we are ready to go. However, sometimes results of our queries could be not well formatted which I'll show on the first query below.



```
[hadoop@ip-172-31-88-90 ~]$ sudo hive shell

Logging initialized using configuration in file:/etc/hive/conf.dist/hive-log4j2.properties Async: true
hive> 
```

Beeline

To start scripting Hive could be more convenient in the beeline console. Beeline is a JDBC client using HiveServer2, so first it is required to connect to the database which we would like to query. To connect we need to write:
beeline -u jdbc:hive2://localhost:10000/formula -n
hadoop@ec2-xxx-xx-xx-xxx.compute-1.amazonaws.com -d org.apache.hive.jdbc.HiveDriver



```
[hadoop@ip-172-31-88-90 ~]$ beeline -u jdbc:hive2://localhost:10000/formula -n hadoop@ec2-100-26-60-158.compute-1.amazonaws.com -d org.apache.hive.jdbc.HiveDriver
Connecting to jdbc:hive2://localhost:10000/formula
Connected to: Apache Hive (version 2.3.6-amzn-2)
Driver: Hive JDBC (version 2.3.6-amzn-2)
Transaction isolation: TRANSACTION_REPEATABLE_READ
Beeline version 2.3.6-amzn-2 by Apache Hive
0: jdbc:hive2://localhost:10000/formula> 
```

Queries

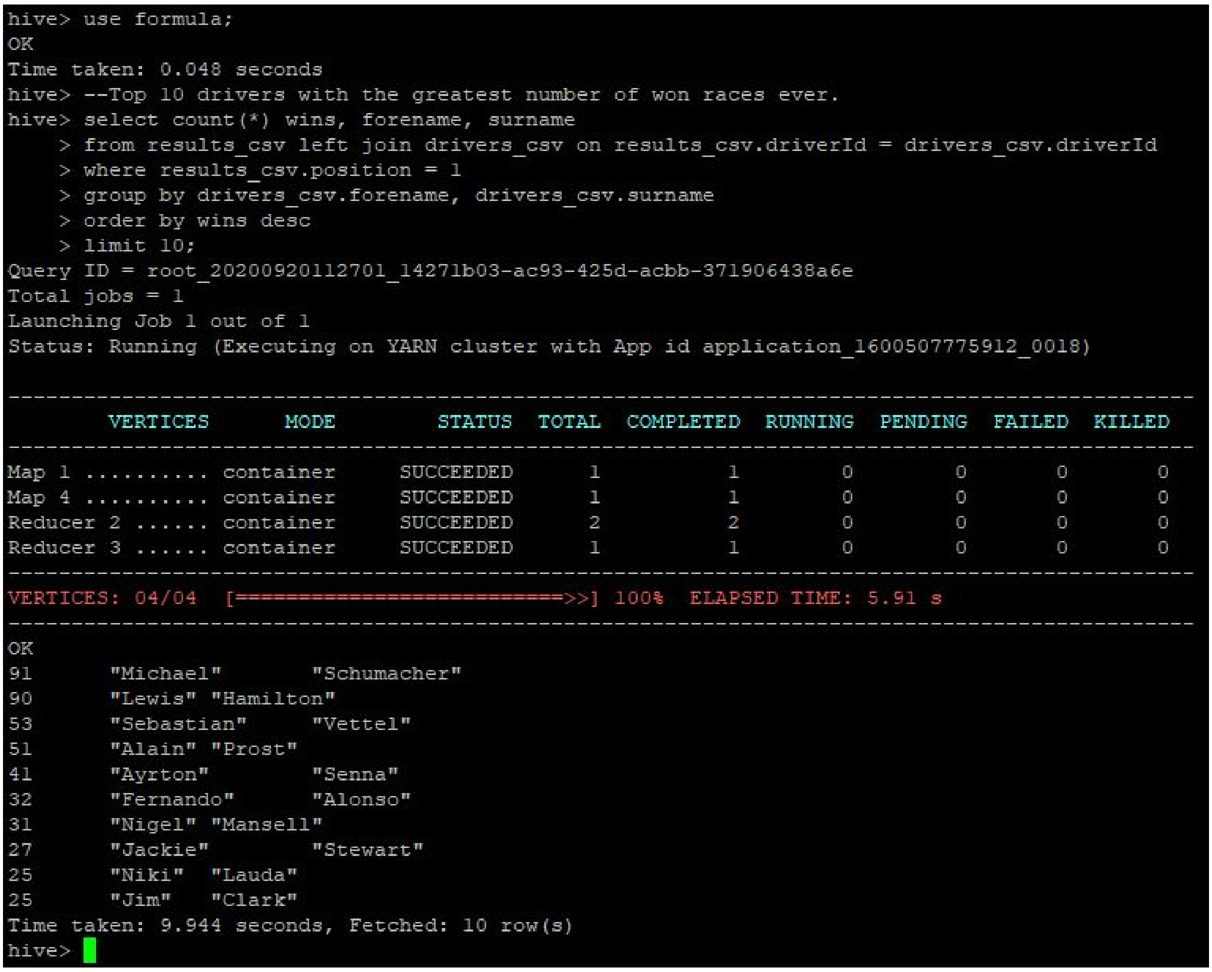
1. Top 10 drivers with the greatest number of won races ever.

Query

```
--Top 10 drivers with the greatest number of won races ever.
use formula;
select count(*) wins, forename, surname
from results_csv left join drivers_csv on results_csv.driverId =
drivers_csv.driverId
where results_csv.position = 1
group by drivers_csv.forename, drivers_csv.surname
order by wins desc
limit 10;
```

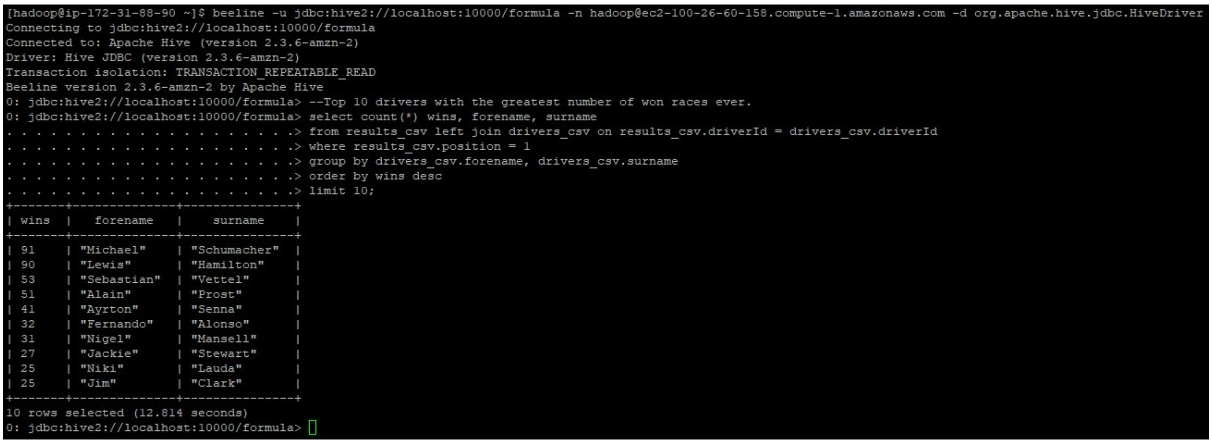
Results

Standard Hive shell



```
hive> use formula;
OK
Time taken: 0.048 seconds
hive> --Top 10 drivers with the greatest number of won races ever.
hive> select count(*) wins, forename, surname
    > from results_csv left join drivers_csv on results_csv.driverId = drivers_csv.driverId
    > where results_csv.position = 1
    > group by drivers_csv.forename, drivers_csv.surname
    > order by wins desc
    > limit 10;
Query ID = root_20200920112701_14271b03-ac93-425d-acbb-371906438a6e
Total jobs = 1
Launching Job 1 out of 1
Status: Running (Executing on YARN cluster with App id application_1600507775912_0018)

----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1 .......... container     SUCCEEDED      1          1        0        0       0       0
Map 4 .......... container     SUCCEEDED      1          1        0        0       0       0
Reducer 2 ...... container     SUCCEEDED      2          2        0        0       0       0
Reducer 3 ...... container     SUCCEEDED      1          1        0        0       0       0
----------------------------------------------------------------------------------------------
VERTICES: 04/04  [==========================>>] 100%  ELAPSED TIME: 5.91 s
----------------------------------------------------------------------------------------------
OK
91      "Michael"       "Schumacher"
90      "Lewis" "Hamilton"
53      "Sebastian"     "Vettel"
51      "Alain" "Prost"
41      "Ayrton"        "Senna"
32      "Fernando"      "Alonso"
31      "Nigel" "Mansell"
27      "Jackie"        "Stewart"
25      "Niki"  "Lauda"
25      "Jim"   "Clark"
Time taken: 9.944 seconds, Fetched: 10 row(s)
hive>
```

Beeline



```
[hadoop@ip-172-31-88-90 ~]$ beeline -u jdbc:hive2://localhost:10000/formula -n hadoop@ec2-100-26-60-158.compute-1.amazonaws.com -d org.apache.hive.jdbc.HiveDriver
Connecting to jdbc:hive2://localhost:10000/formula
Connected to: Apache Hive (version 2.3.6-amzn-2)
Driver: Hive JDBC (version 2.3.6-amzn-2)
Transaction isolation: TRANSACTION_REPEATABLE_READ
Beeline version 2.3.6-amzn-2 by Apache Hive
0: jdbc:hive2://localhost:10000/formula> --Top 10 drivers with the greatest number of won races ever.
0: jdbc:hive2://localhost:10000/formula> select count(*) wins, forename, surname
. . . . . . . . . . . . . . . . . . . .> from results_csv left join drivers_csv on results_csv.driverId = drivers_csv.driverId
. . . . . . . . . . . . . . . . . . . .> where results_csv.position = 1
. . . . . . . . . . . . . . . . . . . .> group by drivers_csv.forename, drivers_csv.surname
. . . . . . . . . . . . . . . . . . . .> order by wins desc
. . . . . . . . . . . . . . . . . . . .> limit 10;
+-------+--------------+---------------+
| wins  |   forename   |    surname    |
+-------+--------------+---------------+
| 91    | "Michael"    | "Schumacher"  |
| 90    | "Lewis"      | "Hamilton"    |
| 53    | "Sebastian"  | "Vettel"      |
| 51    | "Alain"      | "Prost"       |
| 41    | "Ayrton"     | "Senna"       |
| 32    | "Fernando"   | "Alonso"      |
| 31    | "Nigel"      | "Mansell"     |
| 27    | "Jackie"     | "Stewart"     |
| 25    | "Niki"       | "Lauda"       |
| 25    | "Jim"        | "Clark"       |
+-------+--------------+---------------+
10 rows selected (12.814 seconds)
0: jdbc:hive2://localhost:10000/formula>
```

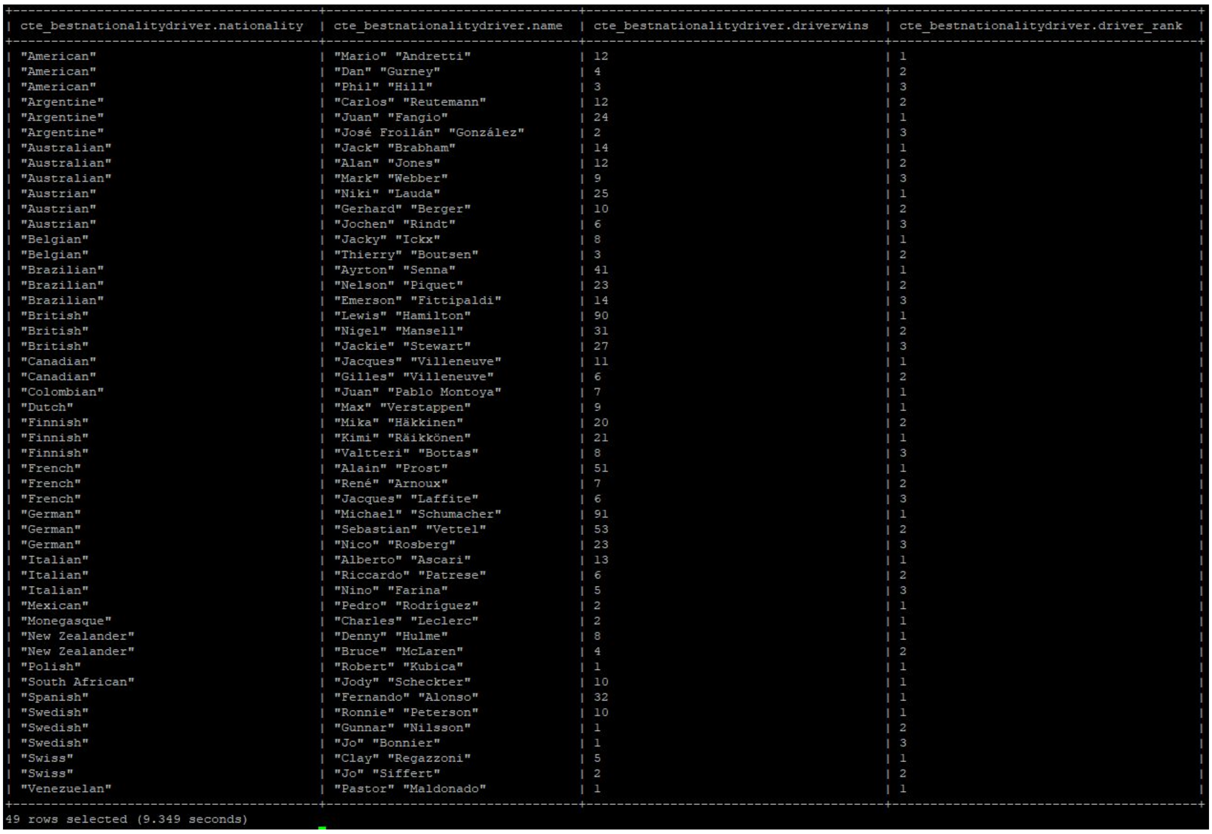
2. Top 3 best drivers in the history for each country.

Query

--Top 3 best drivers in the history for each country.

```
use formula;
with cte_bestNationalityDriver as
      (select t.nationality, t.name, driverWins,
      row_number() over (partition by t.nationality order by driverWins
      esc) driver_rank from
            (select count(*) driverWins, concat(forename, ' ', surname)
            name, nationality
            from results_avro left join drivers_avro on
            results_avro.driverId = drivers_avro.driverId
            where results_avro.position = 1
            group by drivers_avro.nationality, drivers_avro.forename,
            drivers_avro.surname) t
      order by t.nationality)
select * from cte_bestNationalityDriver where driver_rank in (1, 2, 3);
```

Results



```
+----------------------------------------+----------------------------------+---------------------------------------+----------------------------------------+
| cte_bestnationalitydriver.nationality  | cte_bestnationalitydriver.name   | cte_bestnationalitydriver.driverwins  | cte_bestnationalitydriver.driver_rank  |
+----------------------------------------+----------------------------------+---------------------------------------+----------------------------------------+
| "American"                             | "Mario" "Andretti"               | 12                                    | 1                                      |
| "American"                             | "Dan" "Gurney"                   | 4                                     | 2                                      |
| "American"                             | "Phil" "Hill"                    | 3                                     | 3                                      |
| "Argentine"                            | "Carlos" "Reutemann"             | 12                                    | 2                                      |
| "Argentine"                            | "Juan" "Fangio"                  | 24                                    | 1                                      |
| "Argentine"                            | "José Froilán" "González"        | 2                                     | 3                                      |
| "Australian"                           | "Jack" "Brabham"                 | 14                                    | 1                                      |
| "Australian"                           | "Alan" "Jones"                   | 12                                    | 2                                      |
| "Australian"                           | "Mark" "Webber"                  | 9                                     | 3                                      |
| "Austrian"                             | "Niki" "Lauda"                   | 25                                    | 1                                      |
| "Austrian"                             | "Gerhard" "Berger"               | 10                                    | 2                                      |
| "Austrian"                             | "Jochen" "Rindt"                 | 6                                     | 3                                      |
| "Belgian"                              | "Jacky" "Ickx"                   | 8                                     | 1                                      |
| "Belgian"                              | "Thierry" "Boutsen"              | 3                                     | 2                                      |
| "Brazilian"                            | "Ayrton" "Senna"                 | 41                                    | 1                                      |
| "Brazilian"                            | "Nelson" "Piquet"                | 23                                    | 2                                      |
| "Brazilian"                            | "Emerson" "Fittipaldi"           | 14                                    | 3                                      |
| "British"                              | "Lewis" "Hamilton"               | 90                                    | 1                                      |
| "British"                              | "Nigel" "Mansell"                | 31                                    | 2                                      |
| "British"                              | "Jackie" "Stewart"               | 27                                    | 3                                      |
| "Canadian"                             | "Jacques" "Villeneuve"           | 11                                    | 1                                      |
| "Canadian"                             | "Gilles" "Villeneuve"            | 6                                     | 2                                      |
| "Colombian"                            | "Juan" "Pablo Montoya"           | 7                                     | 1                                      |
| "Dutch"                                | "Max" "Verstappen"               | 9                                     | 1                                      |
| "Finnish"                              | "Mika" "Häkkinen"                | 20                                    | 2                                      |
| "Finnish"                              | "Kimi" "Räikkönen"               | 21                                    | 1                                      |
| "Finnish"                              | "Valtteri" "Bottas"              | 8                                     | 3                                      |
| "French"                               | "Alain" "Prost"                  | 51                                    | 1                                      |
| "French"                               | "René" "Arnoux"                  | 7                                     | 2                                      |
| "French"                               | "Jacques" "Laffite"              | 6                                     | 3                                      |
| "German"                               | "Michael" "Schumacher"           | 91                                    | 1                                      |
| "German"                               | "Sebastian" "Vettel"             | 53                                    | 2                                      |
| "German"                               | "Nico" "Rosberg"                 | 23                                    | 3                                      |
| "Italian"                              | "Alberto" "Ascari"               | 13                                    | 1                                      |
| "Italian"                              | "Riccardo" "Patrese"             | 6                                     | 2                                      |
| "Italian"                              | "Nino" "Farina"                  | 5                                     | 3                                      |
| "Mexican"                              | "Pedro" "Rodríguez"              | 2                                     | 1                                      |
| "Monegasque"                           | "Charles" "Leclerc"              | 2                                     | 1                                      |
| "New Zealander"                        | "Denny" "Hulme"                  | 8                                     | 1                                      |
| "New Zealander"                        | "Bruce" "McLaren"                | 4                                     | 2                                      |
| "Polish"                               | "Robert" "Kubica"                | 1                                     | 1                                      |
| "South African"                        | "Jody" "Scheckter"               | 10                                    | 1                                      |
| "Spanish"                              | "Fernando" "Alonso"              | 32                                    | 1                                      |
| "Swedish"                              | "Ronnie" "Peterson"              | 10                                    | 1                                      |
| "Swedish"                              | "Gunnar" "Nilsson"               | 1                                     | 2                                      |
| "Swedish"                              | "Jo" "Bonnier"                   | 1                                     | 3                                      |
| "Swiss"                                | "Clay" "Regazzoni"               | 5                                     | 1                                      |
| "Swiss"                                | "Jo" "Siffert"                   | 2                                     | 2                                      |
| "Venezuelan"                           | "Pastor" "Maldonado"             | 1                                     | 1                                      |
+----------------------------------------+----------------------------------+---------------------------------------+----------------------------------------+
49 rows selected (9.349 seconds)
```

3. The first vs. the fastest driver for each race in the previous season (2019)

Query

to be updated soon

Results

Visualization

to be done