Big Data- Hadoop_Final Project

Music Data Analysis using Hadoop

Section – 1

Project Overview

A leading music-catering company is planning to analyze large amount of data received from varieties of sources, namely mobile app and website to track the behavior of users, classify users, calculate royalties associated with the song and make appropriate business strategies. The file server receives data files periodically after every 3 hours.

1.1 Fields present in the data files

Data files contain below fields.

Column Name/Field Name	Column Description/Field Description
User_id	Unique identifier of every user
Song_id	Unique identifier of every song
Artist_id	Unique identifier of the lead artist of the song
Timestamp	Timestamp when the record was generated
Start_ts	Start timestamp when the song started to play
End_ts	End timestamp when the song was stopped
Geo_cd	Can be 'A' for USA region, 'AP' for asia pacific region, 'J' for Japan region, 'E' for europe and 'AU' for australia region
Station_id	Unique identifier of the station from where the song was played
Song_end_type	How the song was terminated. 0 means completed successfully 1 means song was skipped 2 means song was paused 3 means other type of failure like device issue, network error etc.
Like	0 means song was not liked 1 means song was liked
Dislike	0 means song was not disliked 1 means song was disliked

1.2 LookUp Tables

There are some existing look up tables present in NoSQL databases. They play an important role in data enrichment and analysis.

Table Name	Description
Station_Geo_Map	Contains mapping of a geo_cd with station_id
Subscribed_Users	Contains user_id, subscription_start_date and subscription_end_date. Contains details only for subscribed users
Song_Artist_Map	Contains mapping of song_id with artist_id alongwith royalty associated with each play of the song
User_Artist_Map	Contains an array of artist_id(s) followed by a user_id

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1.3 DATASET

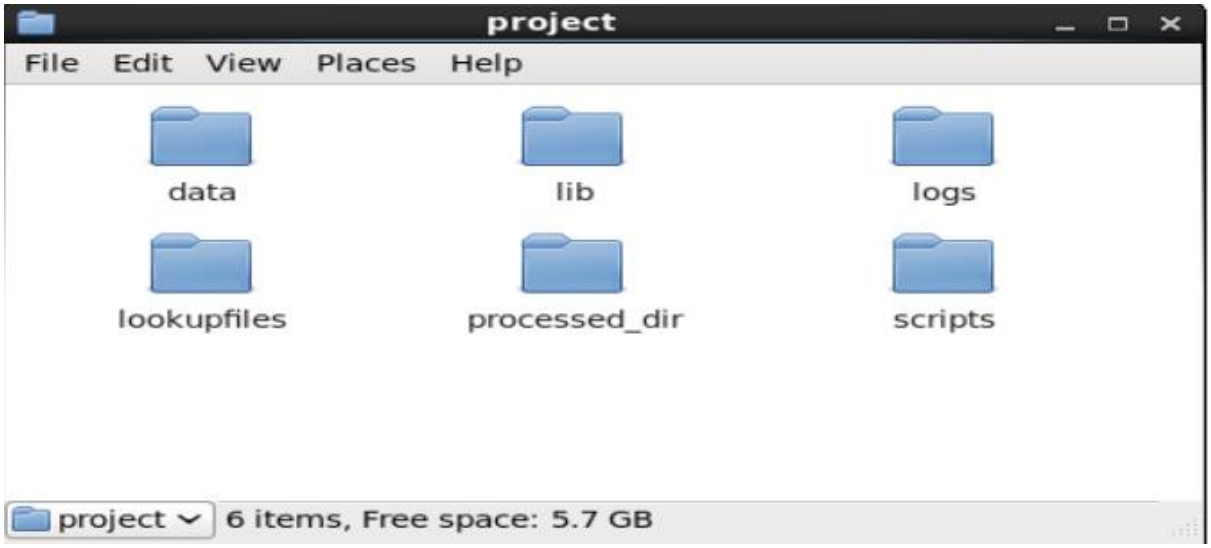
1. Data coming from web applications reside in /data/web and has xml format.

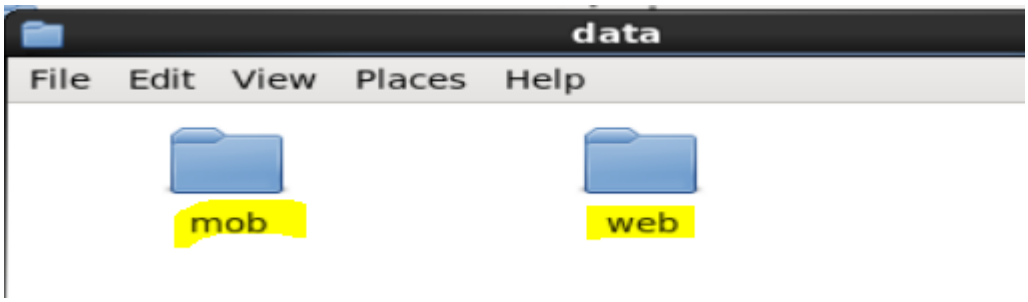
2. Data coming from mobile applications reside in /data/mob and has csv format.

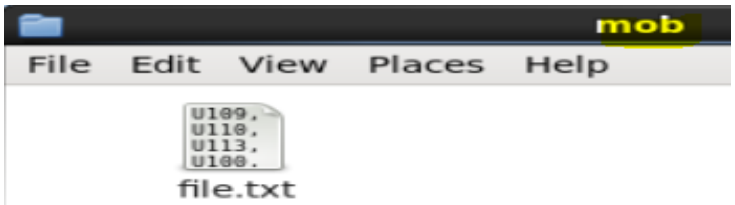
3. Data present in lookup directory should be used in HBase.

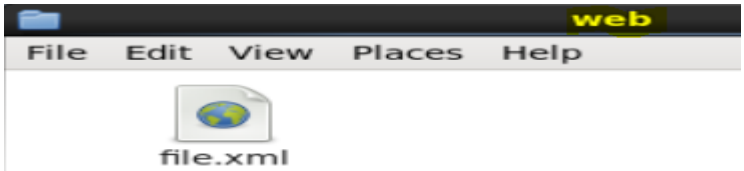
Below is the link for same.

https://drive.google.com/drive/folders/0B_P3pWagdIrrMjJGVlNsSUEtbG8?usp=sharing









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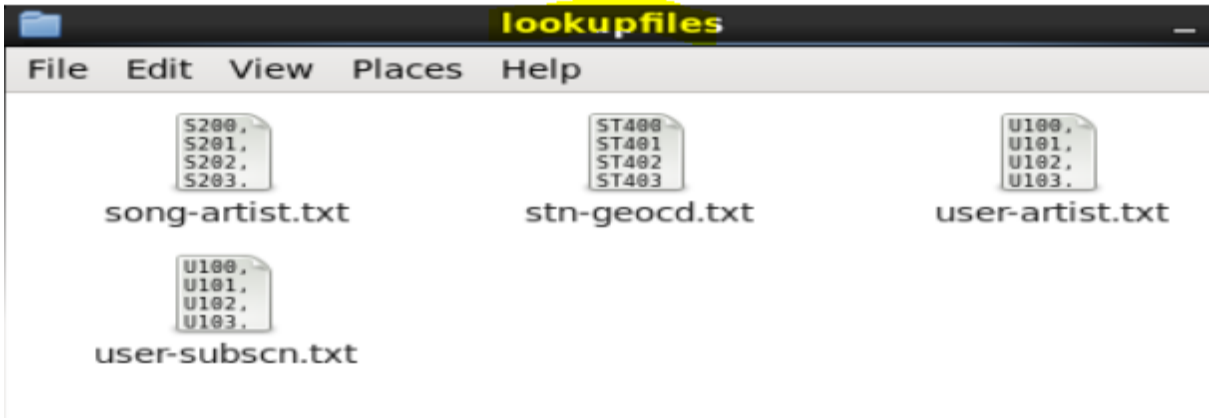


1.4 Data Enrichment Rules for data enrichment,

1. If any of like or dislike is NULL or absent, consider it as 0.

2. If fields like Geo_cd and Artist_id are NULL or absent, consult the lookup tables for fields Station_id and Song_id respectively to get the values of Geo_cd and Artist_id.

3. If corresponding lookup entry is not found, consider that record to be invalid.

NULL or absent field	Look up field	Look up table (Table from which record can be updated)
Geo_cd	Station_id	Station_Geo_Map
Artist_id	Song_id	Song_Artist_Map

1.5 Data Analysis (SHOULD BE IMPLEMETED IN SPARK)

1. Determine top 10 station_id(s) where maximum number of songs were played, which were liked by unique users.

2. Determine total duration of songs played by each type of user, where type of user can be 'subscribed' or 'unsubscribed'. An unsubscribed user is the one whose record is either not present in Subscribed_users lookup table or has subscription_end_date earlier than the timestamp of the song played by him.

3. Determine top 10 connected artists. Connected artists are those whose songs are most listened by the unique users who follow them.

4. Determine top 10 songs who have generated the maximum revenue. Royalty applies to a song only if it was liked or was completed successfully or both.

5. Determine top 10 unsubscribed users who listened to the songs for the longest duration.

1.6 Challenges and Optimizations:

1. LookUp tables are in NoSQL databases. Integrate them with the actual data flow.

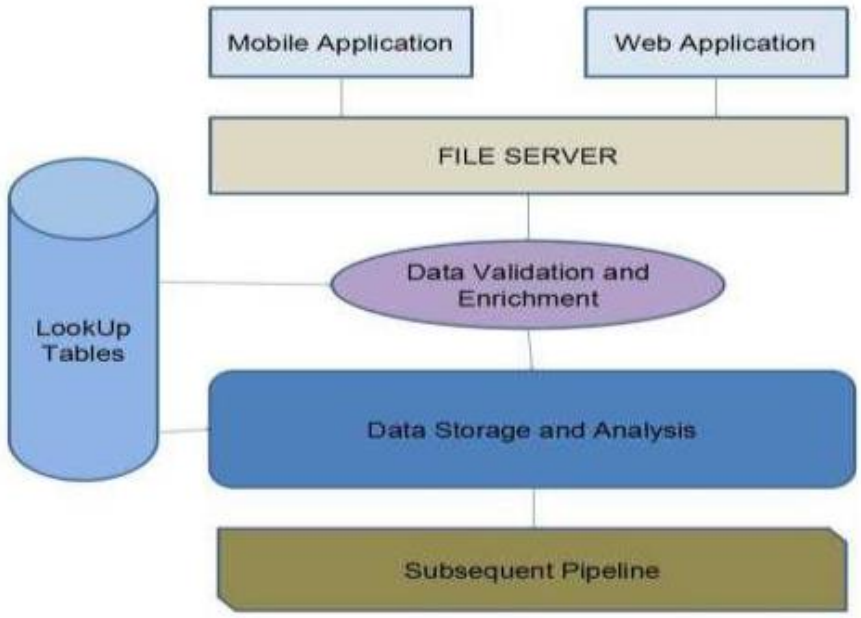
2. Try to make joins as less expensive as possible.

3. Data Cleaning, Validation, Enrichment, Analysis and Post Analysis have to be automated. Try using schedulers.

4. Appropriate logs have to maintain to track the behaviour and overcome failures in the pipeline.

1.7 Flow of operations

A schematic flow of operations is shown below



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Section -2 –

Design of the Project 2.1 Low Level Design

The following flowchart shows the Low Level design of this project,

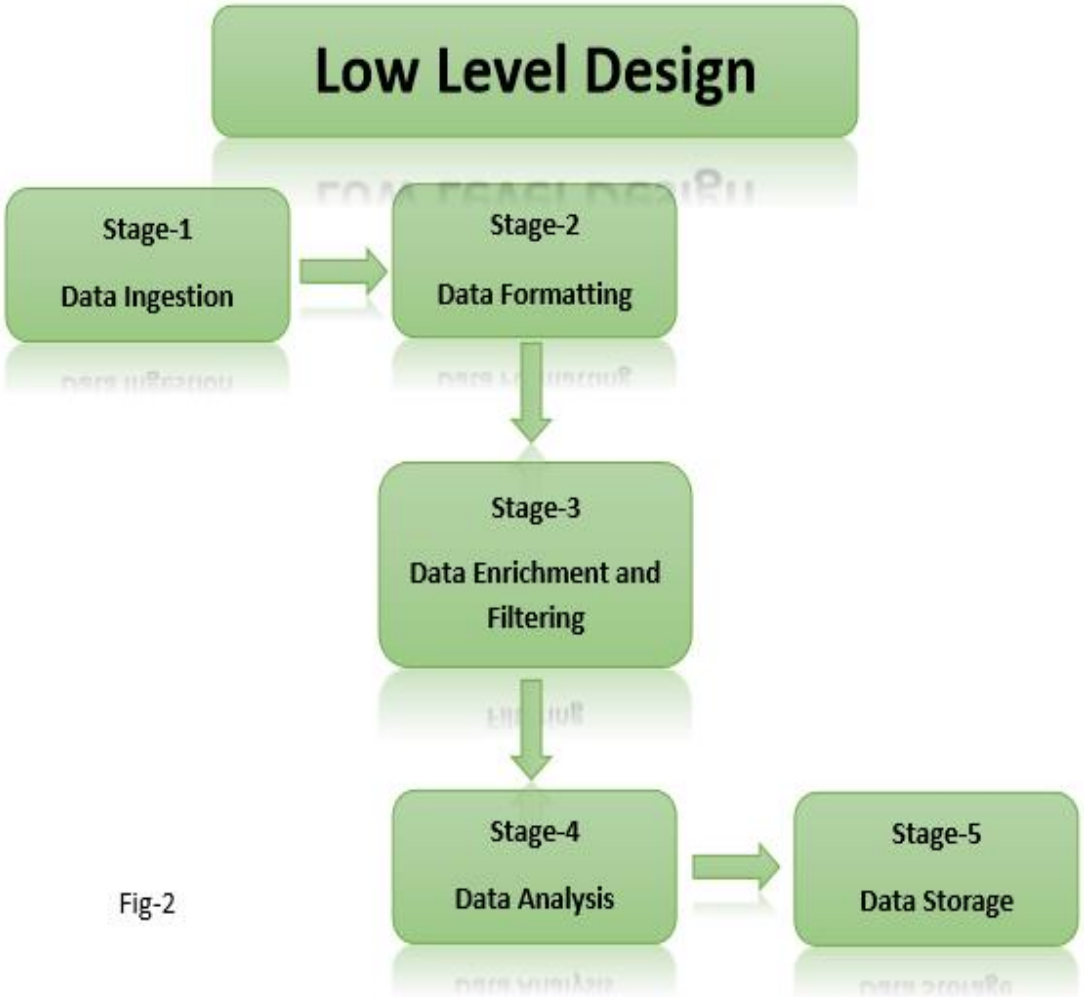

Fig-2

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2.2 High Level Design

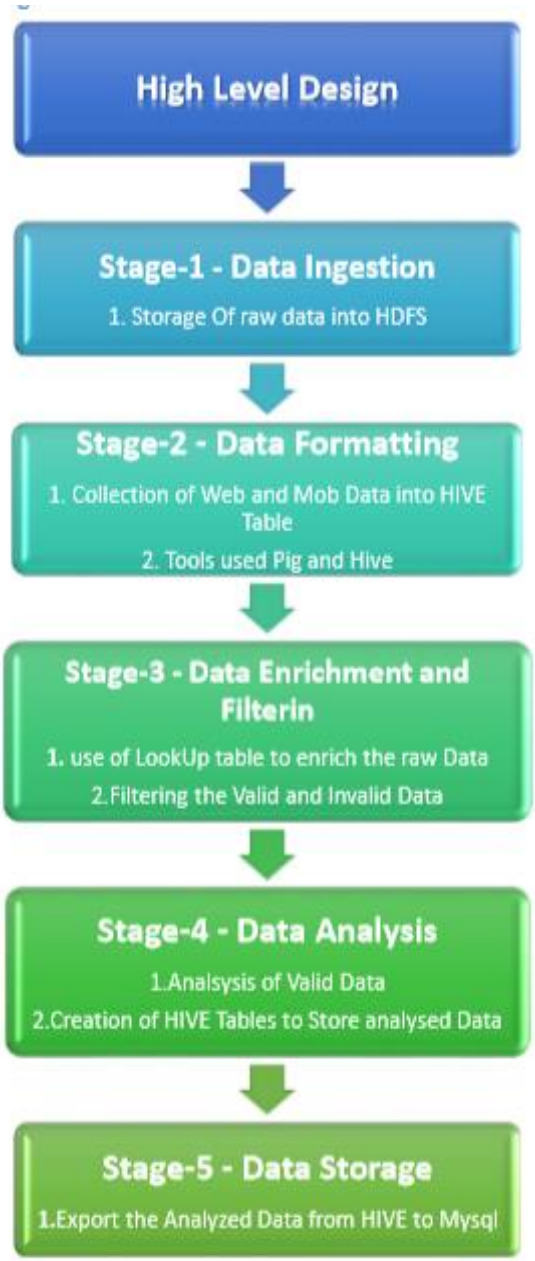

Fig-3

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Section-3-Hadoop Eco-System Implementation

1. We have created a batch file **"start-daemon.sh"** which starts the daemons such as hive, hbase, Mysql and rest of the all hadoop daemons.
   Batch file script,

start-daemons.sh

```
#!/bin/bash

if [ -f "/home/acadgild/project/logs/current-batch.txt" ]
then
 echo "Batch File Found!"
else
 echo -n "1" > "/home/acadgild/project/logs/current-batch.txt"
fi

chmod 775 /home/acadgild/project/logs/current-batch.txt
batchid=`cat /home/acadgild/project/logs/current-batch.txt`
LOGFILE=/home/acadgild/project/logs/log_batch_$batchid

echo "Starting daemons" >> $LOGFILE

# To Start Hadoop Daemons:
start-all.sh

# To start the HMASTER service:
start-hbase.sh

# To Start the JobHistory server Services:
mr-jobhistory-daemon.sh start historyserver

# To Start the mysql service
sudo service mysqld start

# To Start HIVE metastore:
hive --service metastore
```

2. **Starting all daemons, sh start-daemon.sh**

As per the batch file script all the hadoop daemons and the Hive, MySql and Hive daemons are started shown in the below screen shot,

```
[acadgild@localhost ~]$ sh /home/acadgild/project/scripts/start-daemons.sh
Batch File Found!
This script is Deprecated. Instead use start-dfs.sh and start-yarn.sh
18/09/08 23:48:57 WARN util.NativeCodeLoader: Unable to load native-hadoop libra
ry for your platform... using builtin-java classes where applicable
Starting namenodes on [localhost]
localhost: starting namenode, logging to /home/acadgild/install/hadoop/hadoop-2.
6.5/logs/hadoop-acadgild-namenode-localhost.localdomain.out
localhost: starting datanode, logging to /home/acadgild/install/hadoop/hadoop-2.
6.5/logs/hadoop-acadgild-datanode-localhost.localdomain.out
Starting secondary namenodes [0.0.0.0]
0.0.0.0: starting secondarynamenode, logging to /home/acadgild/install/hadoop/ha
doop-2.6.5/logs/hadoop-acadgild-secondarynamenode-localhost.localdomain.out
18/09/08 23:49:22 WARN util.NativeCodeLoader: Unable to load native-hadoop libra
ry for your platform... using builtin-java classes where applicable
starting yarn daemons
starting resourcemanager, logging to /home/acadgild/install/hadoop/hadoop-2.6.5/
logs/yarn-acadgild-resourcemanager-localhost.localdomain.out
localhost: starting nodemanager, logging to /home/acadgild/install/hadoop/hadoop
-2.6.5/logs/yarn-acadgild-nodemanager-localhost.localdomain.out
localhost: starting zookeeper, logging to /home/acadgild/install/hbase/hbase-1.2
.6/logs/hbase-acadgild-zookeeper-localhost.localdomain.out
starting master, logging to /home/acadgild/install/hbase/hbase-1.2.6/logs/hbase-
```

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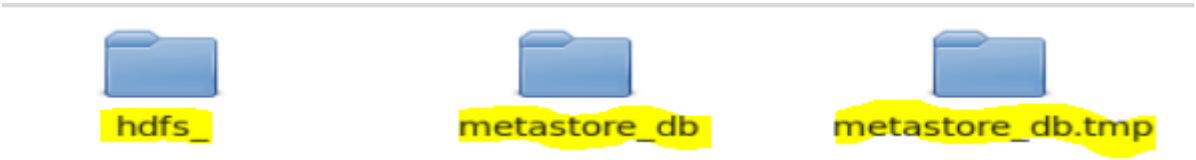
```
starting historyserver, logging to /home/acadgild/install/hadoop/hadoop-2.6.5/lo
gs/mapred-acadgild-historyserver-localhost.localdomain.out
Starting mysqld:                                           [  OK  ]
2018-09-08 23:50:06: Starting Hive Metastore Server
/home/acadgild/install/hive/apache-hive-2.3.2-bin/bin/ext/metastore.sh: line 29:
 export: ` -Dproc_metastore  -Dlog4j.configurationFile=hive-log4j2.properties  -
Djava.util.logging.config.file=/home/acadgild/install/hive/apache-hive-2.3.2-bin
/conf/parquet-logging.properties  ': not a valid identifier
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/home/acadgild/install/hive/apache-hive-2.3.2-
bin/lib/log4j-slf4j-impl-2.6.2.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/home/acadgild/install/hadoop/hadoop-2.6.5/sha
re/hadoop/common/lib/slf4j-log4j12-1.7.5.jar!/org/slf4j/impl/StaticLoggerBinder.
class]
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explanation.
SLF4J: Actual binding is of type [org.apache.logging.slf4j.Log4jLoggerFactory]
2018-09-08T23:50:20,587 INFO [main] org.apache.hadoop.hive.conf.HiveConf - Found
 configuration file file:/home/acadgild/install/hive/apache-hive-2.3.2-bin/conf/
hive-site.xml
2018-09-08T23:50:27,057 INFO [main] org.apache.hadoop.hive.metastore.HiveMetaSto
re - STARTUP_MSG:
/************************************************************
STARTUP_MSG: Starting HiveMetaStore
STARTUP_MSG:   host = localhost/127.0.0.1
```

2. We can see the list active services using the jps command, see below screen shot and also Starting the hive metastore created a metastore_db in the location where we desired,

```
[acadgild@localhost ~]$ jps
3649 NodeManager
4561 RunJar
4267 HMaster
4171 HQuorumPeer
3211 DataNode
3403 SecondaryNameNode
3547 ResourceManager
5148 Jps
3087 NameNode
4495 JobHistoryServer
4383 HRegionServer
```



4. The **start-daemon.sh** script will check whether the **current-batch.txt** file is available in the logs folder or not. If not it will create the file and dump value '1' in that file and create LOGFILE with the **current batchid.**

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Section-4 –Data Ingestion, Formatting, Enrichment and Filtering

4.1 Stage – 1 – Data Ingestion By using the "populate-lookup.sh" script we will create lookup tables in Hbase. These tables have to be used in, Data formatting, Data enrichment and Analysis stage

Lookup Tables

Sl.no	Table Name	Description	Related File
1	station-geo-map	Contains mapping of a **geo_cd** with **station_id**	stn-geocd.txt
2	subscribed-users	Contains **user_id, subscription_start_date** and **subscription_end_date.** Contains details only for subscribed users	user-subscn.txt
3	song-artist-map	Contains mapping of **song_id** with **artist_id** Along with royalty associated with each play of the song	song-artist.txt
4	user-artist-map	Contains an array of **artist_id(**s) followed by a **user_id**	user-artist.txt

Table-1

"populate-lookup.sh" script

The "**populate-lookup.sh**" shell script creates the above 4 lookup tables in the Hbase and populate the data into the lookup tables from the dataset files.

In the below screen shots, we can see the create-lookup.sh scripts and the following screen shots shows the tables creation and population of the data in the Hbase. Also, the values loaded into the Hbase Tables are also shown, please see the below screen shots.

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populate-lookup.sh

```
#!/bin/bash

batchid=`cat /home/acadgild/project/logs/current-batch.txt`

LOGFILE=/home/acadgild/project/logs/log_batch_$batchid

echo "Creating LookUp Tables" >> $LOGFILE

echo "create 'station-geo-map', 'geo'" | hbase shell
echo "create 'subscribed-users', 'subscn'" | hbase shell
echo "create 'song-artist-map', 'artist'" | hbase shell


echo "Populating LookUp Tables" >> $LOGFILE

file="/home/acadgild/project/lookupfiles/stn-geocd.txt"
while IFS= read -r line
do
 stnid=`echo $line | cut -d',' -f1`
 geocd=`echo $line | cut -d',' -f2`
 echo "put 'station-geo-map', '$stnid', 'geo:geo_cd', '$geocd'" | hbase shell
done <"$file"


file="/home/acadgild/project/lookupfiles/song-artist.txt"
while IFS= read -r line
do
 songid=`echo $line | cut -d',' -f1`
 artistid=`echo $line | cut -d',' -f2`
 echo "put 'song-artist-map', '$songid', 'artist:artistid', '$artistid'" | hbase shell
done <"$file"


file="/home/acadgild/project/lookupfiles/song-artist.txt"
while IFS= read -r line
do
 songid=`echo $line | cut -d',' -f1`
 artistid=`echo $line | cut -d',' -f2`
 echo "put 'song-artist-map', '$songid', 'artist:artistid', '$artistid'" | hbase shell
done <"$file"


file="/home/acadgild/project/lookupfiles/user-subscn.txt"
while IFS= read -r line
do
 userid=`echo $line | cut -d',' -f1`
 startdt=`echo $line | cut -d',' -f2`
 enddt=`echo $line | cut -d',' -f3`
 echo "put 'subscribed-users', '$userid', 'subscn:startdt', '$startdt'" | hbase shell
 echo "put 'subscribed-users', '$userid', 'subscn:enddt', '$enddt'" | hbase shell
done <"$file"

hive -f /home/acadgild/project/scripts/user-artist.hql
```

Run the script: ./populate-lookup.sh

```
[acadgild@localhost ~]$ sh /home/acadgild/project/scripts/populate-lookup.sh
2018-09-08 23:54:30,125 WARN  [main] util.NativeCodeLoader: Unable to load nativ
e-hadoop library for your platform... using builtin-java classes where applicabl
e
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/home/acadgild/install/hbase/hbase-1.2.6/lib/s
lf4j-log4j12-1.7.5.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/home/acadgild/install/hadoop/hadoop-2.6.5/sha
re/hadoop/common/lib/slf4j-log4j12-1.7.5.jar!/org/slf4j/impl/StaticLoggerBinder.
class]
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explanation.
SLF4J: Actual binding is of type [org.slf4j.impl.Log4jLoggerFactory]
HBase Shell; enter 'help<RETURN>' for list of supported commands.
Type "exit<RETURN>" to leave the HBase Shell
Version 1.2.6, rUnknown, Mon May 29 02:25:32 CDT 2017

create 'station-geo-map', 'geo'
0 row(s) in 3.1530 seconds

Hbase::Table - station-geo-map
2018-09-08 23:54:45,239 WARN  [main] util.NativeCodeLoader: Unable to load nativ
e-hadoop library for your platform... using builtin-java classes where applicabl
e
SLF4J: Class path contains multiple SLF4J bindings.
```

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```
create 'subscribed-users', 'subscn'
0 row(s) in 1.7980 seconds

Hbase::Table - subscribed-users
2018-09-08 23:54:58,773 WARN  [main] util.NativeCodeLoader: Unal
e-hadoop library for your platform... using builtin-java classes
e
```

```
create 'song-artist-map', 'artist'
0 row(s) in 1.8870 seconds

Hbase::Table - song-artist-map
2018-09-08 23:55:13,171 WARN  [main] util.Nati
e-hadoop library for your platform... using bu
```

```
put 'station-geo-map', 'ST400', 'geo:geo_cd', 'A'
0 row(s) in 0.9730 seconds
```

```
put 'song-artist-map', 'S202', 'artist:artistid', 'A302'
0 row(s) in 0.6970 seconds
```

```
put 'subscribed-users', 'U100', 'subscn:startdt', '1465230523'
0 row(s) in 0.5150 seconds
```

```
Logging initialized using configuration in jar:file:/home/acadgild/install/hive/
apache-hive-2.3.2-bin/lib/hive-common-2.3.2.jar!/hive-log4j2.properties Async: t
rue
OK
Time taken: 21.748 seconds
OK
Time taken: 0.071 seconds
OK
Time taken: 5.026 seconds
Loading data to table project.users_artists
OK
Time taken: 8.278 seconds
```

We can see the lookup tables created using the “populate-lookup.sh” in the below screen shot,

Lookup Tables in the hbase shell,

```
hbase(main):001:0> list
TABLE
bulktable
clicks
clicks1
plants
song-artist-map
station-geo-map
subscribed-users
7 row(s) in 1.0390 seconds

=> ["bulktable", "clicks", "clicks1", "plants", "song-artist-map", "station-geo-
map", "subscribed-users"]
```

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The values loaded in the Lookup tables are shown below,

song-artist-map

```
hbase(main):002:0> scan 'song-artist-map'
ROW                    COLUMN+CELL
 S200                  column=artist:artistid, timestamp=1536431307664, value=A30
                       0
 S201                  column=artist:artistid, timestamp=1536431320389, value=A30
                       1
 S202                  column=artist:artistid, timestamp=1536431333004, value=A30
                       2
 S203                  column=artist:artistid, timestamp=1536431345899, value=A30
                       3
 S204                  column=artist:artistid, timestamp=1536431358653, value=A30
                       4
 S205                  column=artist:artistid, timestamp=1536431371190, value=A30
                       1
 S206                  column=artist:artistid, timestamp=1536431384035, value=A30
                       2
 S207                  column=artist:artistid, timestamp=1536431396771, value=A30
                       3
 S208                  column=artist:artistid, timestamp=1536431409984, value=A30
                       4
 S209                  column=artist:artistid, timestamp=1536431422326, value=A30
                       5
10 row(s) in 0.4220 seconds
```

station-geo-map

```
hbase(main):003:0> scan 'station-geo-map'
ROW                    COLUMN+CELL
 ST400                 column=geo:geo_cd, timestamp=1536431116927, value=A
 ST401                 column=geo:geo_cd, timestamp=1536431129347, value=AU
 ST402                 column=geo:geo_cd, timestamp=1536431141865, value=AP
 ST403                 column=geo:geo_cd, timestamp=1536431154611, value=J
 ST404                 column=geo:geo_cd, timestamp=1536431168157, value=E
 ST405                 column=geo:geo_cd, timestamp=1536431180666, value=A
 ST406                 column=geo:geo_cd, timestamp=1536431192822, value=AU
 ST407                 column=geo:geo_cd, timestamp=1536431206290, value=AP
 ST408                 column=geo:geo_cd, timestamp=1536431218499, value=E
 ST409                 column=geo:geo_cd, timestamp=1536431231455, value=E
 ST410                 column=geo:geo_cd, timestamp=1536431243954, value=A
 ST411                 column=geo:geo_cd, timestamp=1536431256698, value=A
 ST412                 column=geo:geo_cd, timestamp=1536431268827, value=AP
 ST413                 column=geo:geo_cd, timestamp=1536431281830, value=J
 ST414                 column=geo:geo_cd, timestamp=1536431294734, value=E
15 row(s) in 0.1340 seconds
```

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subscribed-users

```
hbase(main):004:0> scan 'subscribed-users'
ROW                    COLUMN+CELL
 U100                  column=subscn:enddt, timestamp=1536431446966, value=146
                       5130523
 U100                  column=subscn:startdt, timestamp=1536431434484, value=1
                       465230523
 U101                  column=subscn:enddt, timestamp=1536431473347, value=147
                       5130523
 U101                  column=subscn:startdt, timestamp=1536431459505, value=1
                       465230523
 U102                  column=subscn:enddt, timestamp=1536431498428, value=147
                       5130523
 U102                  column=subscn:startdt, timestamp=1536431486043, value=1
                       465230523
 U103                  column=subscn:enddt, timestamp=1536431523614, value=147
                       5130523
 U103                  column=subscn:startdt, timestamp=1536431510669, value=1
                       465230523
 U104                  column=subscn:enddt, timestamp=1536431549489, value=147
                       5130523
 U104                  column=subscn:startdt, timestamp=1536431536755, value=1
                       465230523
 U105                  column=subscn:enddt, timestamp=1536431575466, value=147
                       5130523
 U105                  column=subscn:startdt, timestamp=1536431562508, value=1
                       465230523
 U106                  column=subscn:enddt, timestamp=1536431602204, value=148
                       5130523
 U106                  column=subscn:startdt, timestamp=1536431588815, value=1
                       465230523
 U107                  column=subscn:enddt, timestamp=1536431628433, value=145
                       5130523
 U107                  column=subscn:startdt, timestamp=1536431615180, value=1
                       465230523
 U108                  column=subscn:enddt, timestamp=1536431657411, value=146
                       5230623
 U108                  column=subscn:startdt, timestamp=1536431643225, value=1
                       465230523
 U109                  column=subscn:enddt, timestamp=1536431684886, value=147
                       5130523
 U109                  column=subscn:startdt, timestamp=1536431671469, value=1
                       465230523
 U110                  column=subscn:enddt, timestamp=1536431713667, value=147
                       5130523
```

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```
 U110                 column=subscn:enddt, timestamp=1536431713667, value=147
                      5130523
 U110                 column=subscn:startdt, timestamp=1536431698933, value=1
                      465230523
 U111                 column=subscn:enddt, timestamp=1536431741647, value=147
                      5130523
 U111                 column=subscn:startdt, timestamp=1536431727804, value=1
                      465230523
 U112                 column=subscn:enddt, timestamp=1536431774030, value=147
                      5130523
 U112                 column=subscn:startdt, timestamp=1536431756332, value=1
                      465230523
 U113                 column=subscn:enddt, timestamp=1536431805069, value=148
                      5130523
 U113                 column=subscn:startdt, timestamp=1536431789462, value=1
                      465230523
 U114                 column=subscn:enddt, timestamp=1536431834210, value=146
                      8130523
 U114                 column=subscn:startdt, timestamp=1536431819885, value=1
                      465230523
15 row(s) in 0.2580 seconds
```

We have successfully created the lookup tables in the Hbase.
The populate-lookup.sh also creates a lookup table **"users_artists"** in the HIVE, loading the data from the **user-artist.txt,** the below screen shot shows that the table has been created in the HIVE.

```
Logging initialized using configuration in jar:file:/home/acadgild/install/hive/
apache-hive-2.3.2-bin/lib/hive-common-2.3.2.jar!/hive-log4j2.properties Async: t
rue
OK
Time taken: 21.748 seconds
OK
Time taken: 0.071 seconds
OK
Time taken: 5.026 seconds
Loading data to table project.users_artists
OK
Time taken: 8.278 seconds
You have new mail in /var/spool/mail/acadgild
```

```
sing Hive 1.X releases.
hive> show databases;
OK
custom
default
project
Time taken: 40.762 seconds, Fetched: 3 row(s)
```

```
hive> use project;
OK
Time taken: 0.145 seconds
```

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hive> Select * From users_artists;

```
hive> show tables;
OK
users_artists
Time taken: 0.161 seconds, Fetched: 1 row(s)
hive> select * from users_artists;
OK
U100    ["A300","A301","A302"]
U101    ["A301","A302"]
U102    ["A302"]
U103    ["A303","A301","A302"]
U104    ["A304","A301"]
U105    ["A305","A301","A302"]
U106    ["A301","A302"]
U107    ["A302"]
U108    ["A300","A303","A304"]
U109    ["A301","A303"]
U110    ["A302","A301"]
U111    ["A303","A301"]
U112    ["A304","A301"]
U113    ["A305","A302"]
U114    ["A300","A301","A302"]
Time taken: 9.456 seconds, Fetched: 15 row(s)
```

Now we need to link theses lookup tables in hive using the Hbase Storage Handler.
With the help of **"data_enrichment_filtering_schema.sh"** file we will create hive tables on the top of Hbase tables using **"create_hive_hbase_lookup.hql"**

<u>Creating Hive Tables on the top of Hbase:</u>

In this section with the help of Hbase storage handler & SerDe properties we are creating the hive external tables by matching the columns of Hbase tables to hive tables.

Run the script: ./data_enrichment_filtering_schema.sh,

```
#!/bin/bash

batchid=`cat /home/acadgild/project/logs/current-batch.txt`
LOGFILE=/home/acadgild/project/logs/log_batch_$batchid

echo "Creating hive tables on top of hbase tables for data enrichment and filtering..." >> $LOGFILE

hive -f /home/acadgild/project/scripts/create_hive_hbase_lookup.hql
```

The script will run the **"create_hive_hbase_lookup.hql"** which will create the HIVE external tables with the help of Hbase storage handler & SerDe properties. The hive external tables will match the columns of Hbase tables to HIVE tables.

create_hive_hbase_lookup.hql

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```
USE project;
create external table if not exists station_geo_map
(
station_id String,
geo_cd string
)
STORED BY 'org.apache.hadoop.hive.hbase.HBaseStorageHandler'
with serdeproperties
("hbase.columns.mapping"=":key,geo:geo_cd")
tblproperties("hbase.table.name"="station-geo-map");

create external table if not exists subscribed_users
(
user_id STRING,
subscn_start_dt STRING,
subscn_end_dt STRING
)
STORED BY 'org.apache.hadoop.hive.hbase.HBaseStorageHandler'
with serdeproperties
("hbase.columns.mapping"=":key,subscn:startdt,subscn:enddt")
tblproperties("hbase.table.name"="subscribed-users");

create external table if not exists song_artist_map
(
song_id STRING,
artist_id STRING
)
STORED BY 'org.apache.hadoop.hive.hbase.HBaseStorageHandler'
with serdeproperties
("hbase.columns.mapping"=":key,artist:artistid")
tblproperties("hbase.table.name"="song-artist-map");
```

The below screenshot we can see tables getting created in hive by running the **"data_enrichement_filtering_schema.sh file"**

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```
[acadgild@localhost ~]$ sh /home/acadgild/project/scripts/data_enrichment_f
iltering_schema.sh
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/home/acadgild/install/hive/apache-hive-2
.3.2-bin/lib/log4j-slf4j-impl-2.6.2.jar!/org/slf4j/impl/StaticLoggerBinder.
class]
SLF4J: Found binding in [jar:file:/home/acadgild/install/hadoop/hadoop-2.6.
5/share/hadoop/common/lib/slf4j-log4j12-1.7.5.jar!/org/slf4j/impl/StaticLog
gerBinder.class]
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explana
tion.
SLF4J: Actual binding is of type [org.apache.logging.slf4j.Log4jLoggerFacto
ry]

Logging initialized using configuration in jar:file:/home/acadgild/install/
hive/apache-hive-2.3.2-bin/lib/hive-common-2.3.2.jar!/hive-log4j2.propertie
s Async: true
OK
Time taken: 32.075 seconds
OK
Time taken: 16.2 seconds
OK
Time taken: 0.529 seconds
OK
Time taken: 0.474 seconds
You have new mail in /var/spool/mail/acadgild
```

Hive>Show Tables;

```
hive> show tables;
OK
song_artist_map
station_geo_map
subscribed_users
users_artists
Time taken: 0.871 seconds, Fetched: 4 row(s)
```

hive>Select * From song_artist_map

```
hive> select * from song_artist_map;
OK
S200    A300
S201    A301
S202    A302
S203    A303
S204    A304
S205    A301
S206    A302
S207    A303
S208    A304
S209    A305
Time taken: 15.159 seconds, Fetched: 10 row(s)
```

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hive>Select * From station_geo_map

```
hive> select * from station_geo_map;
OK
ST400	A
ST401	AU
ST402	AP
ST403	J
ST404	E
ST405	A
ST406	AU
ST407	AP
ST408	E
ST409	E
ST410	A
ST411	A
ST412	AP
ST413	J
ST414	E
Time taken: 0.898 seconds, Fetched: 15 row(s)
```

hive>Select * From Subscribed_users

```
hive> select * from subscribed_users;
OK
U100	1465230523	1465130523
U101	1465230523	1475130523
U102	1465230523	1475130523
U103	1465230523	1475130523
U104	1465230523	1475130523
U105	1465230523	1475130523
U106	1465230523	1485130523
U107	1465230523	1455130523
U108	1465230523	1465230623
U109	1465230523	1475130523
U110	1465230523	1475130523
U111	1465230523	1475130523
U112	1465230523	1475130523
U113	1465230523	1485130523
U114	1465230523	1468130523
Time taken: 1.079 seconds, Fetched: 15 row(s)
```

<u>4.2 Stage – 2 - Data Formatting</u>

In this stage we are merging the data coming from both web applications and mobile applications and create a common table for analyzing purpose and create partitioned data based on batchid, since we are running this scripts for every 3 hours.

Run the script: ./dataformatting.sh

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```
#!/bin/bash

batchid=`cat /home/acadgild/project/logs/current-batch.txt`
LOGFILE=/home/acadgild/project/logs/log_batch_$batchid

echo "Placing data files from local to HDFS..." >> $LOGFILE

hadoop fs -rm -r /user/acadgild/project/batch${batchid}/web/
hadoop fs -rm -r /user/acadgild/project/batch${batchid}/formattedweb/
hadoop fs -rm -r /user/acadgild/project/batch${batchid}/mob/

hadoop fs -mkdir -p /user/acadgild/project/batch${batchid}/web/
hadoop fs -mkdir -p /user/acadgild/project/batch${batchid}/mob/

hadoop fs -put /home/acadgild/project/data/web/* /user/acadgild/project/batch${batchid}/web/
hadoop fs -put /home/acadgild/project/data/mob/* /user/acadgild/project/batch${batchid}/mob/

echo "Running pig script for data formatting..." >> $LOGFILE

pig -param batchid=$batchid /home/acadgild/project/scripts/dataformatting.pig

echo "Running hive script for formatted data load..." >> $LOGFILE

hive -hiveconf batchid=$batchid -f /home/acadgild/project/scripts/formatted_hive_load.hql
```

We are running two scripts to format the data. They are:

1. **Dataformatting.pig**
2. **Formatted_hive_load.hql**

Pig script to parse the data from coming from web_data.xml to csv format and partition both web and mob data based on based on batch ID's

<u>Dataformatting.pig</u>

```
REGISTER /home/acadgild/project/lib/piggybank.jar;

DEFINE XPath org.apache.pig.piggybank.evaluation.xml.XPath();

A =  LOAD '/user/acadgild/project/batch${batchid}/web/' using org.apache.pig.piggybank.storage.XMLLoader('record') as (x:chararray);

B = FOREACH A GENERATE TRIM(XPath(x, 'record/user_id')) AS user_id,
    TRIM(XPath(x, 'record/song_id')) AS song_id,
    TRIM(XPath(x, 'record/artist_id')) AS artist_id,
    ToUnixTime(ToDate(TRIM(XPath(x, 'record/timestamp')),'yyyy-MM-dd HH:mm:ss')) AS timestamp,
    ToUnixTime(ToDate(TRIM(XPath(x, 'record/start_ts')),'yyyy-MM-dd HH:mm:ss')) AS start_ts,
    ToUnixTime(ToDate(TRIM(XPath(x, 'record/end_ts')),'yyyy-MM-dd HH:mm:ss')) AS end_ts,
    TRIM(XPath(x, 'record/geo_cd')) AS geo_cd,
    TRIM(XPath(x, 'record/station_id')) AS station_id,
    TRIM(XPath(x, 'record/song_end_type')) AS song_end_type,
    TRIM(XPath(x, 'record/like')) AS like,
    TRIM(XPath(x, 'record/dislike')) AS dislike;

STORE B INTO '/user/acadgild/project/batch${batchid}/formattedweb/' USING PigStorage(',');
```

<u>formatted_hive_load.hql</u>

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```
set hive.support.sql11.reserved.keywords=false;
USE project;

CREATE TABLE IF NOT EXISTS formatted_input
(
user_id STRING,
song_id STRING,
artist_id STRING,
timestp STRING,
start_ts STRING,
end_ts STRING,
geo_cd STRING,
station_id STRING,
song_end_type INT,
like INT,
dislike INT
)
PARTITIONED BY
(batchid INT)
ROW FORMAT DELIMITED
FIELDS TERMINATED BY ',';

LOAD DATA INPATH '/user/acadgild/project/batch${hiveconf:batchid}/formattedweb/'
INTO TABLE formatted_input PARTITION (batchid=${hiveconf:batchid});

LOAD DATA INPATH '/user/acadgild/project/batch${hiveconf:batchid}/mob/'
INTO TABLE formatted_input PARTITION (batchid=${hiveconf:batchid});
```

In the below screenshot we can see the data both the scripts in action, first pig script will parse the data and then hive script will load the data into hive terminal successfully.

Pig script successful completion,

```
[acadgild@localhost ~]$ sh /home/acadgild/project/scripts/dataformatting.sh
18/09/09 02:15:09 WARN util.NativeCodeLoader: Unable to load native-hadoop
library for your platform... using builtin-java classes where applicable
rm: `/user/acadgild/project/batch2/web/': No such file or directory
18/09/09 02:15:16 WARN util.NativeCodeLoader: Unable to load native-hadoop
library for your platform... using builtin-java classes where applicable
rm: `/user/acadgild/project/batch2/formattedweb/': No such file or director
y
18/09/09 02:15:20 WARN util.NativeCodeLoader: Unable to load native-hadoop
library for your platform... using builtin-java classes where applicable
rm: `/user/acadgild/project/batch2/mob/': No such file or directory
18/09/09 02:15:24 WARN util.NativeCodeLoader: Unable to load native-hadoop
library for your platform... using builtin-java classes where applicable
18/09/09 02:15:28 WARN util.NativeCodeLoader: Unable to load native-hadoop
library for your platform... using builtin-java classes where applicable
18/09/09 02:15:34 WARN util.NativeCodeLoader: Unable to load native-hadoop
library for your platform... using builtin-java classes where applicable
18/09/09 02:16:21 WARN util.NativeCodeLoader: Unable to load native-hadoop
library for your platform... using builtin-java classes where applicable
18/09/09 02:16:31 INFO pig.ExecTypeProvider: Trying ExecType : LOCAL
18/09/09 02:16:31 INFO pig.ExecTypeProvider: Trying ExecType : MAPREDUCE
```

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```
HadoopVersion   PigVersion      UserId  StartedAt       FinishedAt      Fea
tures
2.6.5   0.16.0  acadgild        2018-09-09 02:16:46     2018-09-09 02:20:37
UNKNOWN

Success!

Job Stats (time in seconds):
JobId   Maps    Reduces MaxMapTime      MinMapTime      AvgMapTime      Med
ianMapTime      MaxReduceTime   MinReduceTime   AvgReduceTime   MedianReduc
etime   Alias   Feature Outputs
job_1536430769011_0001  1       0       68      68      68      68      0 0
0       0       A,B     MAP_ONLY        /user/acadgild/project/batch2/forma
ttedweb,

Input(s):
Successfully read 20 records (7105 bytes) from: "/user/acadgild/project/bat
ch2/web"

Output(s):
Successfully stored 20 records (1235 bytes) in: "/user/acadgild/project/bat
ch2/formattedweb"
```

In the above screenshot we can see the **dataformatting.pig** along with the **formatted_hive_load.hql** executed successfully.

The output of dataformatting.sh script in HDFS folders:

```
[acadgild@localhost ~]$ hadoop fs -ls /user/acadgild/project
18/09/10 22:57:15 WARN util.NativeCodeLoader: Unable to load native-hadoop libra
ry for your platform... using builtin-java classes where applicable
Found 1 items
drwxr-xr-x   - acadgild supergroup          0 2018-09-10 22:46 /user/acadgild/pr
oject/batch2
You have new mail in /var/spool/mail/acadgild
```

```
[acadgild@localhost ~]$ hadoop fs -ls /user/acadgild/project/batch2
18/09/10 22:58:46 WARN util.NativeCodeLoader: Unable to load native-hadoop libra
ry for your platform... using builtin-java classes where applicable
Found 3 items
drwxr-xr-x   - acadgild supergroup          0 2018-09-10 22:46 /user/acadgild/pr
oject/batch2/formattedweb
drwxr-xr-x   - acadgild supergroup          0 2018-09-10 22:45 /user/acadgild/pr
oject/batch2/mob
drwxr-xr-x   - acadgild supergroup          0 2018-09-10 22:45 /user/acadgild/pr
oject/batch2/web
You have new mail in /var/spool/mail/acadgild
[acadgild@localhost ~]$ hadoop fs -ls /user/acadgild/project/batch2/formattedweb
18/09/10 22:59:11 WARN util.NativeCodeLoader: Unable to load native-hadoop libra
ry for your platform... using builtin-java classes where applicable
Found 2 items
-rw-r--r--   1 acadgild supergroup          0 2018-09-10 22:46 /user/acadgild/pr
oject/batch2/formattedweb/_SUCCESS
-rw-r--r--   1 acadgild supergroup       1235 2018-09-10 22:46 /user/acadgild/pr
oject/batch2/formattedweb/part-m-00000
```

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The output of the **formattedweb** data obtained from the **Dataformatting.pig** is shown in the below screen shot,

Command,

hadoop fs -cat /user/acadgild/project/batch1/formattedweb/*

```
[acadgild@localhost ~]$ hadoop fs -cat /user/acadgild/project/batch2/formattedwe
b/*
18/09/10 23:01:49 WARN util.NativeCodeLoader: Unable to load native-hadoop libra
ry for your platform... using builtin-java classes where applicable
U110,S206,A302,1462863262,1462863262,1494297562,E,ST410,0,1,1
U106,S207,A301,1494297562,1494297562,1465490556,AP,ST409,3,0,1
U100,S210,A303,1462863262,1468094889,1465490556,AP,ST405,3,1,0
U118,S203,A300,1465490556,1462863262,1468094889,E,ST411,0,1,1
U119,S205,A305,1462863262,1494297562,1462863262,E,ST403,3,1,0
,S209,A303,1462863262,1494297562,1462863262,A,ST401,2,0,1
U107,S204,A302,1462863262,1465490556,1494297562,AP,ST404,3,1,0
U104,S207,A305,1462863262,1465490556,1465490556,AU,ST407,0,0,0
U114,S209,A304,1462863262,1465490556,1462863262,,ST401,0,1,0
U100,S201,,1465490556,1462863262,1462863262,E,ST413,3,0,1
U101,S202,A300,1462863262,1462863262,1494297562,A,ST411,0,1,0
U116,S207,A305,1468094889,1468094889,1494297562,A,ST411,2,0,1
U111,S205,A302,1465490556,1494297562,1468094889,U,ST402,2,0,0
U119,S210,A303,1494297562,1494297562,1468094889,U,ST401,0,1,0
U110,S206,A305,1462863262,1465490556,1462863262,E,ST404,0,0,0
U119,S205,A305,1468094889,1462863262,1465490556,A,ST403,1,0,0
U119,S209,A303,1494297562,1468094889,1462863262,U,ST404,2,1,1
U103,S208,A303,1462863262,1465490556,1468094889,A,ST403,3,1,0
U116,S208,A305,1465490556,1494297562,1465490556,E,ST406,3,0,1
U111,S200,A303,1462863262,1494297562,1465490556,E,ST402,1,1,0
```

```
2018-09-11 02:52:11,548 [main] INFO  org.apache.hadoop.yarn.client.RMProxy - Connecting to ResourceManager at localhost/127.0.0.1:8032
2018-09-11 02:52:11,560 [main] INFO  org.apache.hadoop.mapred.ClientServiceDelegate - Application state is completed. FinalApplicationStatus=SUCCEEDED. Redirecting to j
ob history server
2018-09-11 02:52:11,659 [main] INFO  org.apache.hadoop.yarn.client.RMProxy - Connecting to ResourceManager at localhost/127.0.0.1:8032
2018-09-11 02:52:11,676 [main] INFO  org.apache.hadoop.mapred.ClientServiceDelegate - Application state is completed. FinalApplicationStatus=SUCCEEDED. Redirecting to j
ob history server
2018-09-11 02:52:11,767 [main] INFO  org.apache.hadoop.yarn.client.RMProxy - Connecting to ResourceManager at localhost/127.0.0.1:8032
2018-09-11 02:52:11,778 [main] INFO  org.apache.hadoop.mapred.ClientServiceDelegate - Application state is completed. FinalApplicationStatus=SUCCEEDED. Redirecting to j
ob history server
2018-09-11 02:52:11,880 [main] INFO  org.apache.pig.backend.hadoop.executionengine.mapReduceLayer.MapReduceLauncher - Success!
2018-09-11 02:52:12,029 [main] INFO  org.apache.pig.Main - Pig script completed in 2 minutes, 2 seconds and 863 milliseconds (122863 ms)
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/home/acadgild/install/hive/apache-hive-2.3.2-bin/lib/log4j-slf4j-impl-2.6.2.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/home/acadgild/install/hadoop/hadoop-2.6.5/share/hadoop/common/lib/slf4j-log4j12-1.7.5.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explanation.
SLF4J: Actual binding is of type [org.apache.logging.slf4j.Log4jLoggerFactory]

Logging initialized using configuration in jar:file:/home/acadgild/install/hive/apache-hive-2.3.2-bin/lib/hive-common-2.3.2.jar!/hive-log4j2.properties Async: true
OK
Time taken: 16.633 seconds
OK
Time taken: 5.716 seconds
OK
Time taken: 1.169 seconds
Loading data to table project.formatted_input partition (batchid=2)
OK
Time taken: 4.237 seconds
Loading data to table project.formatted_input partition (batchid=2)
OK
Time taken: 2.166 seconds
You have new mail in /var/spool/mail/acadgild
```

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```
hive> show tables;
2018-09-11 02:33:55,808 main ERROR Unable to move file /tmp/acadgild/hive.log
18-09-10 to /tmp/acadgild/hive.log.2018-09-10: java.nio.file.NoSuchFileExcept
 /tmp/acadgild/hive.log.2018-09-10 -> /tmp/acadgild/hive.log.2018-09-10
2018-09-11 02:33:55,813 main ERROR Unable to copy file /tmp/acadgild/hive.log
18-09-10 to /tmp/acadgild/hive.log.2018-09-10: java.nio.file.NoSuchFileExcept
 /tmp/acadgild/hive.log.2018-09-10
OK
formatted_input
song_artist_map
station_geo_map
subscribed_users
users_artists
Time taken: 1.677 seconds, Fetched: 5 row(s)
hive> describe formatted input;
OK
user_id                 string
song_id                 string
artist_id               string
timestamp_ts            string
start_ts                string
end_ts                  string
geo_cd                  string
station_id              string
song_end_type           int
like_fs                 int
dislike_fs              int
batchid                 int

# Partition Information
# col_name              data_type               comment

batchid                 int
Time taken: 1.834 seconds, Fetched: 17 row(s)
```

```
hive> select * from formatted_input;
OK
U117    S209    A304    1495130523      1485130523      1465230523      U       ST414   0       0       0       2
U111    S206    A304    1475130523      1485130523      1465230523      AU      ST403   2       1       0       2
U109    S200    A302    1495130523      1475130523      1465130523      U       ST408   2       0       0       2
U102    S203    A304    1465230523      1485130523      1485130523      U       ST406   3       0       0       2
U113    S208    A301    1465130523      1465130523      1475130523      A       ST400   2       0       0       2
        S207    A302    1475130523      1465230523      1475130523      U       ST410   1       1       1       2
U112    S209    A305    1465230523      1485130523      1465130523      U       ST407   2       0       0       2
U106    S200    A304    1465230523      1465230523      1465130523      AU      ST410   3       0       0       2
U120    S205    A302    1465230523      1465130523      1485130523              ST403   2       0       0       2
U108    S207            1475130523      1465130523      1475130523      U       ST402   1       0       1       2
U105    S206    A300    1465130523      1465230523      1475130523      U       ST406   3       0       0       2
U119    S202    A302    1465130523      1465230523      1475130523      A       ST412   2       1       0       2
U117    S209    A305    1475130523      1475130523      1485130523      A       ST413   2       1       1       2
U119    S208    A301    1465230523      1475130523      1485130523      AP      ST408   1       1       1       2
U120    S204    A300    1495130523      1465230523      1465230523      AP      ST412   3       1       0       2
U117    S205    A305    1465130523      1475130523      1475130523      E       ST413   3       0       0       2
U117    S207    A303    1475130523      1465130523      1475130523      U       ST409   1       0       1       2
U106    S204    A300    1495130523      1465130523      1465130523      E       ST403   3       1       1       2
U113    S203    A303    1495130523      1465230523      1465130523      E       ST409   1       1       1       2
U120    S209    A301    1465130523      1475130523      1465230523      AU      ST415   3       1       0       2
U110    S206    A302    1462863262      1462863262      1494297562      E       ST410   0       1       1       2
U106    S207    A301    1494297562      1494297562      1465490556      AP      ST409   3       0       1       2
U100    S210    A303    1462863262      1468094889      1465490556      AP      ST405   3       1       0       2
U118    S203    A300    1465490556      1462863262      1468094889      E       ST411   0       1       1       2
U119    S205    A305    1462863262      1494297562      1462863262      E       ST403   3       1       0       2
        S209    A303    1462863262      1494297562      1462863262      A       ST401   2       0       1       2
U107    S204    A302    1462863262      1465490556      1494297562      AP      ST404   3       1       0       2
U104    S207    A305    1462863262      1465490556      1465490556      AU      ST407   0       0       0       2
U114    S209    A304    1462863262      1465490556      1462863262              ST401   0       1       0       2
U100    S201            1465490556      1462863262      1462863262      E       ST413   3       0       1       2
U101    S202    A300    1462863262      1462863262      1494297562      A       ST411   0       1       0       2
U116    S207    A305    1468094889      1468094889      1494297562      A       ST411   2       0       1       2
U111    S205    A302    1465490556      1494297562      1468094889      U       ST402   2       0       0       2
U119    S210    A303    1494297562      1494297562      1468094889      U       ST401   0       1       0       2
U110    S206    A305    1462863262      1465490556      1462863262      E       ST404   0       0       0       2
U119    S205    A305    1468094889      1462863262      1465490556      A       ST403   1       0       0       2
U119    S209    A303    1494297562      1468094889      1462863262      U       ST404   2       1       1       2
U103    S208    A303    1462863262      1465490556      1468094889      A       ST403   3       1       0       2
U116    S208    A305    1465490556      1494297562      1465490556      E       ST406   3       0       1       2
U111    S200    A303    1462863262      1494297562      1465490556      E       ST402   1       1       0       2
Time taken: 0.588 seconds, Fetched: 40 row(s)
```

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Music Data Analysis using Hadoop

4.3 Stage – 3 - Data Enrichment & Filtering

In this stage, we will enrich the data coming from web and mobile applications using the lookup table stored in Hbase and divide the records based on the enrichment rules into 'pass' and 'fail' records.

Rules for data enrichment,

1. If any of like or dislike is NULL or absent, consider it as 0. 2. If fields like Geo_cd and Artist_id are NULL or absent, consult the lookup tables for fields Station_id and Song_id respectively to get the values of Geo_cd and Artist_id. 3. If corresponding lookup entry is not found, consider that record to be invalid

So based on the enrichment rules we will fill the null geo_cd and artist_id values with the help of corresponding lookup values in song-artist-map and station-geo-map tables in Hive-Hbase tables.

data_enrichment.sh

```
#!/bin/bash

batchid=`cat /home/acadgild/project/logs/current-batch.txt`
LOGFILE=/home/acadgild/project/logs/log_batch_$batchid
VALIDDIR=/home/acadgild/project/processed_dir/valid/batch_$batchid
INVALIDDIR=/home/acadgild/project/processed_dir/invalid/batch_$batchid

echo "Running hive script for data enrichment and filtering..." >> $LOGFILE

hive -hiveconf batchid=$batchid -f /home/acadgild/project/scripts/data_enrichment.hql

if [ ! -d "$VALIDDIR" ]
then
mkdir -p "$VALIDDIR"
fi

if [ ! -d "$INVALIDDIR" ]
then
mkdir -p "$INVALIDDIR"
fi

echo "Copying valid and invalid records in local file system..." >> $LOGFILE

hadoop fs -get /user/hive/warehouse/project.db/enriched_data/batchid=$batchid/status=pass/* $VALIDDIR
hadoop fs -get /user/hive/warehouse/project.db/enriched_data/batchid=$batchid/status=fail/* $INVALIDDIR
```

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```
set hive.support.sql11.reserved.keywords=false;
SET hive.auto.convert.join=false;
SET hive.exec.dynamic.partition.mode=nonstrict;

USE project;

CREATE TABLE IF NOT EXISTS enriched_data
(
user_id STRING,
song_id STRING,
artist_id STRING,
timestamp_ts STRING,
start_ts STRING,
end_ts STRING,
geo_cd STRING,
station_id STRING,
song_end_type INT,
like_fs INT,
dislike_fs INT
)
PARTITIONED BY
(batchid INT,
status STRING)
STORED AS ORC;

INSERT OVERWRITE TABLE enriched_data
PARTITION (batchid,status)
SELECT
i.user_id,
i.song_id,
IF(i.artist_id is NULL OR i.artist_id='',sa.artist_id,i.artist_id) AS artist_id,
i.timestamp_ts,
```

data_enrichment.hql

```
i.start_ts,
i.end_ts,
IF(i.geo_cd is NULL OR i.geo_cd='',sg.geo_cd,i.geo_cd) AS geo_cd,
i.station_id,
IF (i.song_end_type IS NULL,3,i.song_end_type) AS song_end_type,
IF (i.like_fs IS NULL,0,i.like_fs) AS like_fs,
IF (i.dislike_fs IS NULL,0,i.dislike_fs) AS dislike_fs,
i.batchid,
IF((i.like_fs=1 AND i.dislike_fs=1)
OR i.user_id IS NULL
OR i.song_id IS NULL
OR i.timestamp_ts IS NULL
OR i.start_ts IS NULL
OR i.end_ts IS NULL
OR i.user_id=''
OR i.song_id=''
OR i.timestamp_ts=''
OR i.start_ts=''
OR i.end_ts=''
OR sg.geo_cd=''
OR sg.geo_cd IS NULL
OR sa.artist_id IS NULL
OR sa.artist_id='','fail','pass') AS status
FROM formatted_input i
LEFT OUTER JOIN station_geo_map sg ON i.station_id = sg.station_id
LEFT OUTER JOIN song_artist_map sa ON i.song_id = sa.song_id
WHERE i.batchid=2;
```

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```
[acadgild@localhost scripts]$ sh /home/acadgild/project/scripts/data_enrichment.sh
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/home/acadgild/install/hive/apache-hive-2.3.2-bin/lib/log4j-slf4j-impl-2.6.2.jar!/org/slf4j
SLF4J: Found binding in [jar:file:/home/acadgild/install/hadoop/hadoop-2.6.5/share/hadoop/common/lib/slf4j-log4j12-1.7.5.jar!
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explanation.
SLF4J: Actual binding is of type [org.apache.logging.slf4j.Log4jLoggerFactory]

Logging initialized using configuration in jar:file:/home/acadgild/install/hive/apache-hive-2.3.2-bin/lib/hive-common-2.3.2.
```

```
No Stats for project@formatted_input, Columns: start_ts, song_id, user_id, end_ts, dislike, station_id, timestamp_t, geo_cd,
No Stats for project@station_geo_map, Columns: station_id, geo_cd
No Stats for project@song_artist_map, Columns: song_id, artist_id
WARNING: Hive-on-MR is deprecated in Hive 2 and may not be available in the future versions. Consider using a different execu
Query ID = acadgild_20180917002421_d252ae6f-956b-451f-b34e-69d255a60c86
Total jobs = 2
Launching Job 1 out of 2
Number of reduce tasks not specified. Estimated from input data size: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Starting Job = job_1537110040827_0003, Tracking URL = http://localhost:8088/proxy/application_1537110040827_0003/
Kill Command = /home/acadgild/install/hadoop/hadoop-2.6.5/bin/hadoop job  -kill job_1537110040827_0003
Hadoop job information for Stage-1: number of mappers: 3; number of reducers: 1
2018-09-17 00:24:52,092 Stage-1 map = 0%,  reduce = 0%
2018-09-17 00:25:42,124 Stage-1 map = 67%,  reduce = 0%, Cumulative CPU 5.89 sec
2018-09-17 00:25:47,337 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 11.27 sec
2018-09-17 00:26:01,075 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 14.31 sec
MapReduce Total cumulative CPU time: 14 seconds 310 msec
Ended Job = job_1537110040827_0003
Launching Job 2 out of 2
Number of reduce tasks not specified. Estimated from input data size: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Starting Job = job_1537110040827_0004, Tracking URL = http://localhost:8088/proxy/application_1537110040827_0004/
Kill Command = /home/acadgild/install/hadoop/hadoop-2.6.5/bin/hadoop job  -kill job_1537110040827_0004
Hadoop job information for Stage-2: number of mappers: 2; number of reducers: 1
2018-09-17 00:26:27,373 Stage-2 map = 0%,  reduce = 0%
2018-09-17 00:26:51,888 Stage-2 map = 50%,  reduce = 0%, Cumulative CPU 2.98 sec
2018-09-17 00:26:54,052 Stage-2 map = 100%,  reduce = 0%, Cumulative CPU 7.2 sec
2018-09-17 00:27:08,007 Stage-2 map = 100%,  reduce = 68%, Cumulative CPU 12.01 sec
2018-09-17 00:27:09,306 Stage-2 map = 100%,  reduce = 100%, Cumulative CPU 13.15 sec
MapReduce Total cumulative CPU time: 13 seconds 150 msec
```

At the end script will automatically divide the records based on status pass & fail and dump the result into **processed_dir folder with valid and invalid folders.**

```
[acadgild@localhost ~]$ cd project/processed_dir
[acadgild@localhost processed_dir]$ ls -l invalid
total 8
drwxrwxr-x. 2 acadgild acadgild 4096 Sep 16 22:54 batch_1
drwxrwxr-x. 2 acadgild acadgild 4096 Sep 17 00:40 batch_2
[acadgild@localhost processed_dir]$ ls -l valid
total 8
drwxrwxr-x. 2 acadgild acadgild 4096 Sep 16 22:54 batch_1
drwxrwxr-x. 2 acadgild acadgild 4096 Sep 17 00:40 batch_2
```

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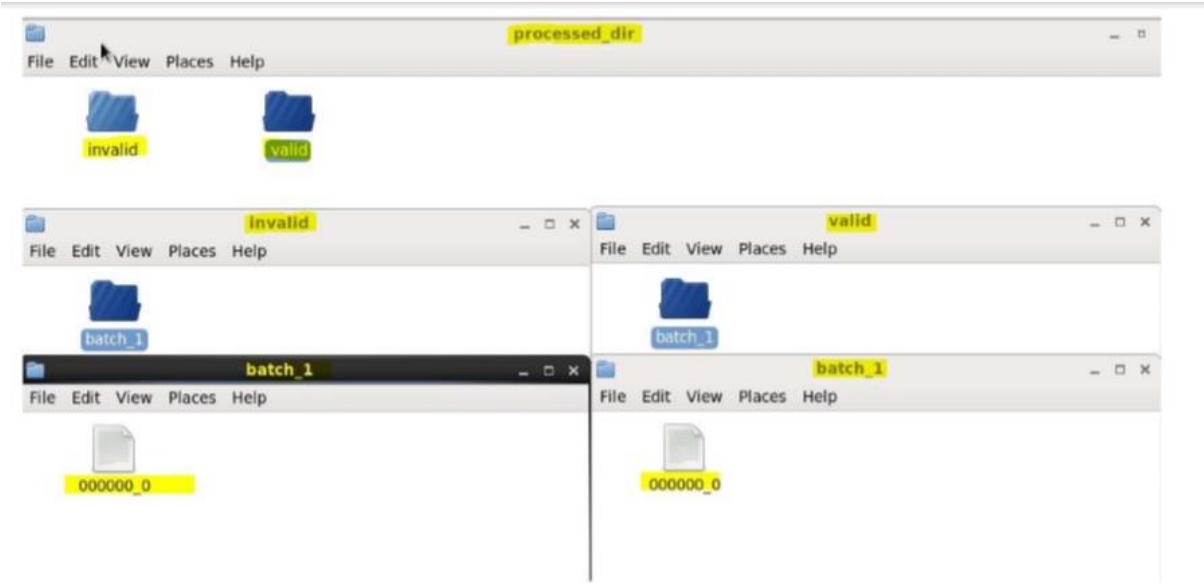

In the below screenshot we have data for enriched_data table where we filled the null values of **artist_id and geo_cd of formatted input with the help of lookup tables,**

Hive > select * from enriched_data;

```
hive> select * from enriched_data;
OK
U101    S201    A305    1465130523      1475130523      1465130523      AP      ST405   3       1       1       2       fail
U118    S204    A305    1475130523      1485130523      1485130523      E       ST412   0       1       1       2       fail
U119    S204    A304    1462863262      1468094889      1462863262      A       ST402   0       1       1       2       fail
U100    S204    A301    1462863262      1494297562      1494297562      AP      ST408   2       1       1       2       fail
U110    S204    A304    1468094889      1494297562      1494297562      E       ST406   3       1       1       2       fail
        S205    A303    1465490556      1468094889      1468094889      U       ST403   3       1       0       2       fail
U119    S206    A301    1468094889      1494297562      1468094889      AP      ST400   3       1       1       2       fail
U100    S207    A303    1462863262      1465490556      1494297562      A       ST415   3       0       0       2       fail
U108    S208    A301    1468094889      1465490556      1468094889      E       ST415   1       0       1       2       fail
U103    S208    A303    1494297562      1494297562      1494297562      AP      ST404   1       1       1       2       fail
        S209    A301    1475130523      1465130523      1485130523      U       ST404   0       0       1       2       fail
U113    S209    A300    1465130523      1485130523      1465130523      U       ST415   1       0       0       2       fail
U109    S210    NULL    1465130523      1475130523      1465130523      AP      ST410   0       1       0       2       fail
U104    S210    A305    1462863262      1494297562      1494297562      AU      ST401   1       1       0       2       fail
U113    S210    A304    1465130523      1485130523      1475130523      AP      ST400   0       0       1       2       fail
U109    S200    A300    1475130523      1475130523      1465230523      U       ST407   3       1       0       2       pass
U117    S201    A305    1465130523      1475130523      1475130523      E       ST411   2       0       1       2       pass
U118    S202    A304    1495130523      1465130523      1465230523      E       ST407   2       1       0       2       pass
U100    S202    A304    1475130523      1465230523      1465230523      A       ST407   3       1       0       2       pass
U101    S202    A302    1465130523      1465230523      1475130523      J       ST413   3       0       1       2       pass
U110    S202    A305    1465130523      1475130523      1485130523      AP      ST404   3       0       0       2       pass
U120    S204    A305    1465230523      1485130523      1475130523      AU      ST404   2       0       0       2       pass
U106    S204    A305    1494297562      1465490556      1468094889      AP      ST407   0       0       0       2       pass
U115    S205    A305    1495130523      1475130523      1465230523      AU      ST400   1       0       0       2       pass
U112    S205    A302    1462863262      1465490556      1465490556      U       ST406   1       1       0       2       pass
U103    S206    A305    1468094889      1462863262      1465490556      U       ST407   3       0       0       2       pass
U118    S206    A304    1465130523      1485130523      1465230523      E       ST402   0       0       0       2       pass
U108    S206    A303    1494297562      1462863262      1468094889      AP      ST405   3       0       1       2       pass
U110    S207    A300    1495130523      1485130523      1465130523      A       ST404   0       0       1       2       pass
U107    S208    A303    1465130523      1475130523      1465130523      AU      ST400   1       0       1       2       pass
U117    S208    A303    1495130523      1485130523      1465130523      AU      ST411   2       1       0       2       pass
U108    S208    A305    1465130523      1465130523      1485130523      U       ST410   3       0       1       2       pass
U109    S208    A303    1494297562      1468094889      1465490556      AP      ST406   2       0       0       2       pass
U113    S208    A302    1465490556      1494297562      1494297562      A       ST405   1       0       0       2       pass
U100    S208    A300    1462863262      1465490556      1462863262      AP      ST405   0       1       0       2       pass
U120    S208    A304    1494297562      1462863262      1462863262      U       ST402   1       0       0       2       pass
U120    S209    A304    1494297562      1465490556      1462863262      AU      ST402   3       1       0       2       pass
U104    S209    A300    1465490556      1494297562      1465490556      A       ST411   2       0       1       2       pass
U115    S209    A305    1465490556      1465490556      1462863262      U       ST414   0       1       0       2       pass
U109    S209    A304    1465230523      1475130523      1485130523      E       ST402   2       1       0       2       pass
Time taken: 0.35 seconds, Fetched: 40 row(s)
```

4.4 Stage – 4 - Data Analysis

In this stage we will do analysis on enriched data using Spark SQL and run the program using Spark Submit command.

Before running the spark-submit command we have to zip –d command to remove the bad manifests in created spark project jar file to avoid the invalid Signature exception.

We used two spark-submits for analysis.

a. Spark_analysis for creating tables for each query/problem statement.

b. Spark_analysis_2 for displaying results for each query in terminal.

Data_analysis.sh

data_analysis.sh

```
#!/bin/bash

batchid=`cat /home/acadgild/project/logs/current-batch.txt`
LOGFILE=/home/acadgild/project/logs/log_batch_$batchid

echo "Running hive script for data analysis..." >> $LOGFILE

hive -hiveconf batchid=$batchid -f /home/acadgild/project/scripts/data_analysis.hql

sh /home/acadgild/project/scripts/data_export.sh

echo "Incrementing batchid..." >> $LOGFILE

batchid=`expr $batchid + 1`
echo -n $batchid > /home/acadgild/project/logs/current-batch.txt
```

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```
set hive.support.sql11.reserved.keywords=false;
SET hive.auto.convert.join=false;
USE project;

CREATE TABLE IF NOT EXISTS top_10_stations
(
station_id STRING,
total_distinct_songs_played INT,
distinct_user_count INT
)
PARTITIONED BY (batchid INT)
ROW FORMAT DELIMITED
FIELDS TERMINATED BY ','
STORED AS TEXTFILE;

INSERT OVERWRITE TABLE top_10_stations
PARTITION(batchid=${hiveconf:batchid})
SELECT
station_id,
COUNT(DISTINCT song_id) AS total_distinct_songs_played,
COUNT(DISTINCT user_id) AS distinct_user_count
FROM enriched_data
WHERE status='pass'
AND batchid=${hiveconf:batchid}
AND like=1
GROUP BY station_id
ORDER BY total_distinct_songs_played DESC
LIMIT 10;
```

Table Creation in HIVE and Data analysis using HIVE,

```
Number of reduce tasks not specified. Estimated from input data size: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Starting Job = job_1516485910189_0029, Tracking URL = http://localhost:8088/proxy/application_1516485910189_0029/
Kill Command = /home/acadgild/hadoop-2.7.2/bin/hadoop job  -kill job_1516485910189_0029
Hadoop job information for Stage-2: number of mappers: 1; number of reducers: 1
2018-01-22 10:37:36,483 Stage-2 map = 0%,  reduce = 0%
2018-01-22 10:37:50,781 Stage-2 map = 100%,  reduce = 0%, Cumulative CPU 2.26 sec
2018-01-22 10:38:06,474 Stage-2 map = 100%,  reduce = 100%, Cumulative CPU 4.34 sec
MapReduce Total cumulative CPU time: 4 seconds 340 msec
Ended Job = job_1516485910189_0029
Launching Job 3 out of 3
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Starting Job = job_1516485910189_0030, Tracking URL = http://localhost:8088/proxy/application_1516485910189_0030/
Kill Command = /home/acadgild/hadoop-2.7.2/bin/hadoop job  -kill job_1516485910189_0030
Hadoop job information for Stage-3: number of mappers: 1; number of reducers: 1
2018-01-22 10:38:30,610 Stage-3 map = 0%,  reduce = 0%
2018-01-22 10:38:41,945 Stage-3 map = 100%,  reduce = 0%, Cumulative CPU 1.8 sec
2018-01-22 10:38:56,880 Stage-3 map = 100%,  reduce = 100%, Cumulative CPU 4.73 sec
MapReduce Total cumulative CPU time: 4 seconds 730 msec
Ended Job = job_1516485910189_0030
Loading data to table project.top_10_unsubscribed_users partition (batchid=7)
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 9.36 sec   HDFS Read: 14798 HDFS Write: 96 SUCCESS
Stage-Stage-2: Map: 1  Reduce: 1   Cumulative CPU: 4.34 sec   HDFS Read: 5072 HDFS Write: 96 SUCCESS
Stage-Stage-3: Map: 1  Reduce: 1   Cumulative CPU: 4.73 sec   HDFS Read: 6582 HDFS Write: 69 SUCCESS
Total MapReduce CPU Time Spent: 18 seconds 430 msec
OK
Time taken: 177.031 seconds
```

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Music Data Analysis using Hadoop

```
hive> show tables;
OK
connected_artists
enriched_data
formatted_input
song_artist_map
station_geo_map
subscribed_users
top_10_royalty_songs
top_10_stations
top_10_unsubscribed_users
users_artists
users_behaviour
Time taken: 0.366 seconds, Fetched: 11 row(s)
hive> select * from connected_artists;
OK
A303    2       2
A302    2       2
A300    1       2
Time taken: 0.507 seconds, Fetched: 3 row(s)
hive> select * from top_10_stations;
OK
ST407   2       3       2
ST414   1       1       2
ST411   1       1       2
ST402   1       2       2
ST406   1       1       2
ST405   1       1       2
Time taken: 0.397 seconds, Fetched: 6 row(s)
hive> select * from users_artists;
OK
U100    ["A300","A301","A302"]
U101    ["A301","A302"]
U102    ["A302"]
U103    ["A303","A301","A302"]
U104    ["A304","A301"]
U105    ["A305","A301","A302"]
U106    ["A301","A302"]
U107    ["A302"]
U108    ["A300","A303","A304"]
U109    ["A301","A303"]
U110    ["A302","A301"]
U111    ["A303","A301"]
U112    ["A304","A301"]
U113    ["A305","A302"]
U114    ["A300","A301","A302"]
Time taken: 0.347 seconds, Fetched: 15 row(s)
```

```
hive> select * from top_10_royalty_songs;
OK
S208    22627294        2
S207    20000000        2
S206    19900000        2
S209    15254588        2
S200    9900000 2
S204    2604333 2
S202    100000  2
S205    0       2
Time taken: 0.342 seconds, Fetched: 8 row(s)
hive> select * from top_10_unsubscribed_users;
OK
U117    20000000        2
U118    20000000        2
U110    20000000        2
U120    12627294        2
U115    12527294        2
U107    10000000        2
U108    5231627 2
U109    2604333 2
U106    2604333 2
U100    0       2
Time taken: 0.402 seconds, Fetched: 10 row(s)
```

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Music Data Analysis using Hadoop

Query-

1: Determine top 10 station_id(s) where maximum number of songs were played, which were liked by unique users.

```
hive> select station_id from top_10_stations;
OK
ST407
ST414
ST411
ST402
ST406
ST405
Time taken: 0.269 seconds, Fetched: 6 row(s)
```

Query-

2: Determine total duration of songs played by each type of user, where type of user can be 'subscribed' or 'unsubscribed'. An unsubscribed user is the one whose record is either not present in Subscribed_users lookup table or has subscription_end_date earlier than the timestamp of the song played by him.

```
SUBSCRIBED      93861594
UNSUBSCRIBED    105594881
```

Query-

3: Determine top 10 connected artists. Connected artists are those whose songs are most listened by the unique users who follow them

```
OK
A303
A302
A300
```

Query-

4: Determine top 10 songs who have generated the maximum revenue. Royalty applies to a song only if it was liked or was completed successfully or both

```
S208
S207
S206
S209
S200
S204
S202
S205
```

Query-

5: Determine top 10 unsubscribed users who listened to the songs for the longest duration.

```
U117
U118
U110
U120
U115
U107
U108
U109
U106
U100
```

4.5 Stage – 5 – Data Storage in MYSQL Using the bash file shown below, data_export.sh we are going to export the data from the hive tables into mysql using Sqoop export.

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data_export.sh

```
#!/bin/bash

#This script is not working.
#Either change table to text or use STRING as type of partitioned column

batchid=`cat /home/acadgild/project/logs/current-batch.txt`
LOGFILE=/home/acadgild/project/logs/log_batch_$batchid

echo "Creating mysql tables if not present..." >> $LOGFILE

mysql < /home/acadgild/project/scripts/create_schema.sql

echo "Running sqoop job for data export..." >> $LOGFILE

sqoop export --connect jdbc:mysql://localhost/project --username root --password acadgild --table top_10_stations --export-
dir hdfs://localhost:9000/user/hive/warehouse/project.db/top_10_stations/batchid=$batchid --input-fields-terminated-by ',' -
m 1

sqoop export --connect jdbc:mysql://localhost/project --username root --password acadgild --table users_behaviour  --export-
dir hdfs://localhost:9000/user/hive/warehouse/project.db/users_behaviour/batchid=$batchid --input-fields-terminated-by ',' -
m 1

sqoop export --connect jdbc:mysql://localhost/project --username root --password acadgild --table connected_artists --
export-dir hdfs://localhost:9000/user/hive/warehouse/project.db/connected_artists/batchid=$batchid --input-fields-
terminated-by ',' -m 1

sqoop export --connect jdbc:mysql://localhost/project --username root --password acadgild --table top_10_royalty_songs --
export-dir hdfs://localhost:9000/user/hive/warehouse/project.db/top_10_royalty_songs/batchid=$batchid --input-fields-
terminated-by ',' -m 1
```

create_schema.sql – Make sure that you logged in to MySql. The below schema will create the database and tables in the MySQl.

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create_schema.sql

```sql
CREATE DATABASE IF NOT EXISTS project;

USE project;

CREATE TABLE IF NOT EXISTS top_10_stations
(
station_id VARCHAR(50),
total_distinct_songs_played INT,
distinct_user_count INT
);

CREATE TABLE IF NOT EXISTS users_behaviour
(
user_type VARCHAR(50),
duration BIGINT
);

CREATE TABLE IF NOT EXISTS connected_artists
(
artist_id VARCHAR(50),
user_count INT
);

CREATE TABLE IF NOT EXISTS top_10_royalty_songs
(
song_id VARCHAR(50),
duration BIGINT
);

CREATE TABLE IF NOT EXISTS top_10_unsubscribed_users
```

<u>Now we can see the data exported successfully into the MYSQL Database for all the 5 queries.</u>

```
 stack guard. The VM will try to fix the stack guard now.
It's highly recommended that you fix the library with 'execstack -c <libfile>', or link it with '-z noexecstack'.
18/01/24 09:57:24 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applic
able
Found 1 items
drwxrwxr-x   - acadgild supergroup          0 2018-01-24 09:34 hdfs://localhost:9000/user/hive/warehouse/project.db/top_10_stations/batchid=1
[acadgild@localhost ~]$ sqoop export --connect jdbc:mysql://localhost/project --username root --password acadgild --table top_10_stations --exp
ort-dir hdfs://localhost:9000/user/hive/warehouse/project.db/top_10_stations/batchid=1 --input-fields-terminated-by ',' -m 1
Warning: /home/acadgild/sqoop-1.4.6.bin__hadoop-2.0.4-alpha/../hcatalog does not exist! HCatalog jobs will fail.
Please set $HCAT_HOME to the root of your HCatalog installation.
Warning: /home/acadgild/sqoop-1.4.6.bin__hadoop-2.0.4-alpha/../accumulo does not exist! Accumulo imports will fail.
Please set $ACCUMULO_HOME to the root of your Accumulo installation.
Warning: /home/acadgild/sqoop-1.4.6.bin__hadoop-2.0.4-alpha/../zookeeper does not exist! Accumulo imports will fail.
Please set $ZOOKEEPER_HOME to the root of your Zookeeper installation.
2018-01-24 09:58:23,657 INFO  [main] sqoop.Sqoop: Running Sqoop version: 1.4.6
2018-01-24 09:58:23,694 WARN  [main] tool.BaseSqoopTool: Setting your password on the command-line is insecure. Consider using -P instead.
2018-01-24 09:58:24,084 INFO  [main] manager.MySQLManager: Preparing to use a MySQL streaming resultset.
2018-01-24 09:58:24,085 INFO  [main] tool.CodeGenTool: Beginning code generation
2018-01-24 09:58:24,696 INFO  [main] manager.SqlManager: Executing SQL statement: SELECT t.* FROM `top_10_stations` AS t LIMIT 1
2018-01-24 09:58:24,767 INFO  [main] manager.SqlManager: Executing SQL statement: SELECT t.* FROM `top_10_stations` AS t LIMIT 1
2018-01-24 09:58:24,810 INFO  [main] orm.CompilationManager: HADOOP_MAPRED_HOME is /home/acadgild/hadoop-2.7.2
Note: /tmp/sqoop-acadgild/compile/f1ae2653abc7121116a39d1b97e8735b/top_10_stations.java uses or overrides a deprecated API.
Note: Recompile with -Xlint:deprecation for details.
2018-01-24 09:58:29,735 INFO  [main] orm.CompilationManager: Writing jar file: /tmp/sqoop-acadgild/compile/f1ae2653abc7121116a39d1b97e8735b/top
_10_stations.jar
2018-01-24 09:58:29,763 INFO  [main] mapreduce.ExportJobBase: Beginning export of top_10_stations
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/home/acadgild/hbase-1.0.3/lib/slf4j-log4j12-1.7.7.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/home/acadgild/hadoop-2.7.2/share/hadoop/common/lib/slf4j-log4j12-1.7.10.jar!/org/slf4j/impl/StaticLoggerBind
er.class]
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explanation.
Java HotSpot(TM) Client VM warning: You have loaded library /home/acadgild/hadoop-2.7.2/lib/native/libhadoop.so.1.0.0 which might have disabled
 stack guard. The VM will try to fix the stack guard now.
It's highly recommended that you fix the library with 'execstack -c <libfile>', or link it with '-z noexecstack'.
2018-01-24 09:58:30,180 WARN  [main] util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classe
s where applicable
2018-01-24 09:58:30,199 INFO  [main] Configuration.deprecation: mapred.jar is deprecated. Instead, use mapreduce.job.jar
2018-01-24 09:58:32,079 INFO  [main] Configuration.deprecation: mapred.reduce.tasks.speculative.execution is deprecated. Instead, use mapreduce
```

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The sqoop export command exported the tables from the hive and it stored in the Mysql. The below screen shot show the successful Sqoop export from hive to mysql. The data stored in the Mysql is shown in the successive screen shots,
The data base project had been exported from the hive and the below screen shot shows the data base presence, output from top_10_stations, connected_artists shown below,

```
mysql> use project;
Database changed
mysql> show tables;
+---------------------------+
| Tables_in_project         |
+---------------------------+
| connected_artists         |
| top_10_royalty_songs      |
| top_10_stations           |
| top_10_unsubscribed_users |
| users_behaviour           |
+---------------------------+
5 rows in set (0.00 sec)

mysql> Select * From top_10_stations;
+------------+----------------------------+---------------------+
| station_id | total_distinct_songs_played | distinct_user_count |
+------------+----------------------------+---------------------+
| ST407      |                          2 |                   3 |
| ST414      |                          1 |                   1 |
| ST411      |                          1 |                   1 |
| ST402      |                          1 |                   2 |
| ST406      |                          1 |                   1 |
| ST405      |                          1 |                   1 |
+------------+----------------------------+---------------------+
6 rows in set (0.00 sec)

mysql> Select * From connected_artists;
+-----------+------------+
| artist_id | user_count |
+-----------+------------+
| A303      |          2 |
| A302      |          2 |
| A300      |          1 |
+-----------+------------+
3 rows in set (0.00 sec)
```

top_10_royalty_songs,

```
mysql> Select * From top_10_royalty_songs;
+---------+----------+
| song_id | duration |
+---------+----------+
| S208    | 22627294 |
| S207    | 20000000 |
| S206    | 19900000 |
| S209    | 15254588 |
| S200    |  9900000 |
| S204    |  2604333 |
| S202    |   100000 |
| S205    |        0 |
+---------+----------+
8 rows in set (0.00 sec)
```

Output from top_10_unsubscribed_users and users_behaviour

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```
mysql> Select * From top_10_unsubscribed_users;
+---------+----------+
| user_id | duration |
+---------+----------+
| U117    | 20000000 |
| U118    | 20000000 |
| U110    | 20000000 |
| U120    | 12627294 |
| U115    | 12527294 |
| U107    | 10000000 |
| U108    |  5231627 |
| U109    |  2604333 |
| U106    |  2604333 |
| U100    |        0 |
+---------+----------+
10 rows in set (0.01 sec)

mysql> Select * From users_behaviour;
+--------------+-----------+
| user_type    | duration  |
+--------------+-----------+
| SUBSCRIBED   |  93861594 |
| UNSUBSCRIBED | 105594881 |
+--------------+-----------+
2 rows in set (0.00 sec)
```

Job Scheduling:

We can check logs to track the behavior of the operations we have done on the data and overcome failures in the pipeline and we can see the batchid incremented value in currentbatch.txt

```
[acadgild@localhost project]$ cd logs
[acadgild@localhost logs]$ ls -l
total 36
-rwxrwxr-x. 1 acadgild acadgild    1 Sep 17 01:27 current-batch.txt
-rw-rw-r--. 1 acadgild acadgild  679 Jan 24  2018 derby.log
drwxrwxr-x. 3 acadgild acadgild 4096 Jan 24  2018 hdfs:
-rw-rw-r--. 1 acadgild acadgild   77 Jan 24  2018 log_batch_1
-rw-rw-r--. 1 acadgild acadgild 1265 Sep 17 01:27 log_batch_2
-rw-rw-r--. 1 acadgild acadgild   77 Sep 17 01:27 log_batch_2???
-rw-rw-r--. 1 acadgild acadgild   34 Sep 19 09:34 log_batch_3
-rw-rw-r--. 1 acadgild acadgild  154 Sep 19 12:49 log_batch_3???
drwxrwxr-x. 5 acadgild acadgild 4096 Jan 24  2018 metastore_db
[acadgild@localhost logs]$ cat current-batch.txt
```

The log file captured all the data and steps we performed so far,

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```
3[acadgild@localhost logs]$ cat log_batch_2
Starting daemons
Creating LookUp Tables
Populating LookUp Tables
Starting daemons
Creating LookUp Tables
Populating LookUp Tables
Starting daemons
Starting daemons
Placing data files from local to HDFS...
Running pig script for data formatting...
Running hive script for formatted data load...
Running hive script for data enrichment and filtering...
Copying valid and invalid records in local file system...
Deleting older valid and invalid records from local file system...
Placing data files from local to HDFS...
Running pig script for data formatting...
Running hive script for formatted data load...
Running hive script for data enrichment and filtering...
Copying valid and invalid records in local file system...
Deleting older valid and invalid records from local file system...
Running hive script for data enrichment and filtering...
Copying valid and invalid records in local file system...
Deleting older valid and invalid records from local file system...
Running hive script for data enrichment and filtering...
Copying valid and invalid records in local file system...
Running hive script for data enrichment and filtering...
Copying valid and invalid records in local file system...
Running hive script for data analysis...
Incrementing batchid...
```

Wrapping all the scripts inside the single script file and scheduling this file to run at the periodic interval of every 3 hours. wrapper.sh

```
#!/bin/bash
#All the below scripts will work based on the data provided by acadgild as data/web/file.xml and data/mob/file.txt

python /home/acadgild/project/scripts/generate_web_data.py

python /home/acadgild/project/scripts/generate_mob_data.py

sh /home/acadgild/project/scripts/start-daemons.sh

sh /home/acadgild/project/scripts/populate-lookup.sh

sh /home/acadgild/project/scripts/dataformatting.sh

sh /home/acadgild/project/scripts/data_enrichment.sh

sh /home/acadgild/project/scripts/data_analysis.sh
```

The wrapper.sh will be running for every 3 hours as per the job scheduling done below, as per the above order the wrapper.sh will run the scripts.

Creating Crontab to schedule the wrapper.sh script to run for every 3 hour interval.

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```
[acadgild@localhost logs]$ crontab -e
no crontab for acadgild - using an empty one
```

```
#do this for every 3 hours
* */3 * * * date>>/home/acadgild/project/scripts/wrapper.sh >> /home/acadgild/project/scripts/jobsheduling.log
:wq!
```

```
[acadgild@localhost logs]$ crontab -e
no crontab for acadgild - using an empty one
crontab: installing new crontab
[acadgild@localhost logs]$
```

<u>The crontab job scheduler will run the wrappr.sh every 3 hours and for every 3 hours we will get incremental batch ID's. Hence, as per the request this job scheduling has been done.</u>

```
Deleting older valid and invalid records from local file system...
Running hive script for data analysis...
Incrementing batchid...
[acadgild@localhost logs]$ cd
[acadgild@localhost ~]$ crontab -l
#do this for every 3 hours
* */3 * * * date>>/home/acadgild/project/scripts/wrapper.sh >> /home/acadgild/project/scripts/jobsheduling.log
[acadgild@localhost ~]$
```