Working with Hive

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Data types

- All the data types in Hive are classified into four types, given as follows:
  - Column Types
  - Literals
  - Null Values
  - Complex Types

Column Types

- Column type are used as column data types of Hive. They are as follows:
  - Integral Types
    - Integer type data can be specified using integral data types, INT. When the data range exceeds the range of INT, you need to use BIGINT and if the data range is smaller than the INT, you use SMALLINT. TINYINT is smaller than SMALLINT.

Integral Types

Type	Postfix	Example
TINYINT	Y	10Y
SMALLINT	S	10S
INT	-	10
BIGINT	L	10L

String Types

String type data types can be specified using single quotes (' ') or double quotes (" "). It contains two data types: VARCHAR and CHAR. Hive follows C-types escape characters.

Data Type	Length
VARCHAR	1 to 65535
CHAR	255

Column Types

- **Timestamp**
  - It supports traditional UNIX timestamp with optional nanosecond precision. It supports java.sql.Timestamp format “YYYY-MM-DD HH:MM:SS.fffffffff” and format “yyyy-mm-dd hh:mm:ss.fffffffff”.
- **Dates**
  - DATE values are described in year/month/day format in the form {{YYYY--MM--DD}}.
- **Decimals**
  - The DECIMAL type in Hive is as same as Big Decimal format of Java. It is used for representing immutable arbitrary precision. The syntax and example is as follows:

```
DECIMAL(precision, scale)
```

```
decimal(10,0)
```

Union Types

- Union is a collection of heterogeneous data types. You can create an instance using create union. The syntax and example is as follows:

```
UNIONTYPE <int, double, array<string>,
struct<a:int,b:string>>
{0:1}
{1:2.0}
{2:["three","four"]}
{3:{"a":5,"b":"five"}}
{2:["six","seven"]}
{3:{"a":8,"b":"eight"}}
{0:9}
{1:10.0}
```

Literals

- The following literals are used in Hive:
- **Floating Point Types**
  - Floating point types are nothing but numbers with decimal points. Generally, this type of data is composed of DOUBLE data type.
- **Decimal Type**
  - Decimal type data is nothing but floating point value with higher range than DOUBLE data type. The range of decimal type is approximately -10^{-308} to 10^{308} .
- **Null Value**
  - Missing values are represented by the special value NULL.

Complex Types

- The Hive complex data types are as follows:
- **Arrays**
  - Arrays in Hive are used the same way they are used in Java.

    Syntax: `ARRAY<data_type>`
- **Maps**
  - Maps in Hive are similar to Java Maps.

    Syntax: `MAP<primitive_type, data_type>`
- **Structs**
  - Structs in Hive is similar to using complex data with comment.

    Syntax: `STRUCT<col_name : data_type [COMMENT col_comment], ...>`

Database Operations

Hive is a database technology that can define databases and tables to analyze structured data. The theme for structured data analysis is to store the data in a tabular manner, and pass queries to analyze it. This chapter explains how to create Hive database. Hive contains a default database named **default**.

Create Database

- Create Database is a statement used to create a database in Hive.
- A database in Hive is a namespace or a collection of tables. The syntax for this statement is as follows:

```
CREATE DATABASE|SCHEMA [IF NOT EXISTS]
<database name>;
```

Here, IF NOT EXISTS is an optional clause, which notifies the user that a database with the same name already exists. We can use SCHEMA in place of DATABASE in this command.

Create Database

- The following query is executed to create a database named mydb:

```
hive> CREATE DATABASE [IF NOT EXISTS] mydb;
```

or

```
hive> CREATE SCHEMA mydb;
```

- The following query is used to verify a databases list:

```
hive> SHOW DATABASES;
default
mydb
```

Drop Database

- Drop Database is a statement that drops all the tables and deletes the database.
  - Its syntax is as follows:

```
DROP DATABASE StatementDROP
(DATABASE|SCHEMA) [IF EXISTS]
database_name [RESTRICT|CASCADE];
```

- The following queries are used to drop a database. Let us assume that the database name is mydb.

```
hive> DROP DATABASE IF EXISTS mydb;
```

Drop Database

- The following query drops the database using CASCADE. It means dropping respective tables before dropping the database.

```
hive> DROP DATABASE IF EXISTS userdb
CASCADE;
```

- The following query drops the database using SCHEMA.

```
hive> DROP SCHEMA userdb;
```

- This clause was added in Hive 0.6.

Create Table

- Create Table is a statement used to create a table in Hive. The syntax and example are as follows:
- Syntax:

```
CREATE [TEMPORARY] [EXTERNAL] TABLE [IF
NOT EXISTS] [db_name.] table_name
[(col_name data_type [COMMENT
col_comment], ...)]
[COMMENT table_comment]
[ROW FORMAT row_format]
[STORED AS file_format]
```

Create Table : Example

Sr. No.	Field Name	Data type
1	Eid	Int
2	Name	String
3	Salary	Float
4	Designation	String

Create Table : Example

- The following query creates a table named employee using the above data.

```
hive> CREATE TABLE IF NOT EXISTS
employee ( eid int, name String,
> salary String, destination String)
> COMMENT 'Employee details'
> ROW FORMAT DELIMITED
> FIELDS TERMINATED BY '\t'
> LINES TERMINATED BY '\n'
> STORED AS TEXTFILE;
```

Load data statement

- Generally, after creating a table in SQL, we can insert data using the Insert statement. But in Hive, we can insert data using the LOAD DATA statement.
- While inserting data into Hive, it is better to use LOAD DATA to store bulk records.
- There are two ways to load data: one is from local file system and second is from Hadoop file system.
- Syntax:
  - LOAD DATA [LOCAL] INPATH 'filepath' [OVERWRITE] INTO TABLE tablename [PARTITION (partcol1=val1, partcol2=val2 ...)]

Load data statement

```
1201    Gopal    45000    Technical manager
1202    Manisha  45000    Proof reader
1203    Masthanvali       40000    Technical writer
1204    Krian    40000    Hr Admin
1205    Kranthi  30000    Op Admin
```

LOAD DATA LOCAL INPATH '/home/rashmi/sample.txt'
> OVERWRITE INTO TABLE employee;

Alter Table

ALTER TABLE name RENAME TO new_name

ALTER TABLE name ADD COLUMNS (col_spec[, col_spec ...])

ALTER TABLE name DROP [COLUMN] column_name

ALTER TABLE name CHANGE column_name new_name new_type

ALTER TABLE name REPLACE COLUMNS (col_spec[, col_spec ...])

Alter Table – Rename to...

```
ALTER TABLE employee RENAME TO emp;
```

Change statement

The following table contains the fields of **employee** table and it shows the fields to be changed (in bold).

Field Name	Convert from Data Type	Change Field Name	Convert to Data Type
eid	int	eid	int
name	String	**ename**	String
salary	**Float**	salary	**Double**
designation	String	designation	String

Change statement example

- `hive> ALTER TABLE employee CHANGE name ename String;`

- `hive> ALTER TABLE employee CHANGE salary salary Double;`

Add column statement

- ```
  hive> ALTER TABLE employee ADD COLUMNS (
  > dept STRING COMMENT 'Department name');
  ```
  ```

Replace statement

```
hive> ALTER TABLE employee REPLACE COLUMNS
(
> eid INT empid Int,
> ename STRING name String);
```

Drop table statement

- The syntax is as follows:
  - `DROP TABLE [IF EXISTS] table_name;`
- The following query drops a table named employee:
  - `hive> DROP TABLE IF EXISTS employee;`

Partitioning

- Hive organizes tables into partitions. It is a way of dividing a table into related parts based on the values of partitioned columns such as date, city, and department. Using partition, it is easy to query a portion of the data.
- Tables or partitions are sub-divided into buckets, to provide extra structure to the data that may be used for more efficient querying.
- Bucketing works based on the value of hash function of some column of a table.

Partitioning - Example

- ALTER TABLE table_name ADD [IF NOT EXISTS] PARTITION partition_spec [LOCATION 'location1'] partition_spec [LOCATION 'location2'] ...;

- partition_spec: (p_column = p_col_value, p_column =p_col_value, ...)

```
hive> select * from file;
OK
102     Rajesh  IT      2010
103     Suresh  CS      2012
103     Awez    CS      2012
104     Parmeet CS      2010
Time taken: 0.074 seconds, Fetched: 4 row(s)
```

Built-in operators

- There are four types of operators in Hive:
    1. Relational Operators
    2. Arithmetic Operators
    3. Logical Operators
    4. Complex Operators

Relational operators

- A = B
- A != B
- A < B
- A = B
- A >= B
- A <= B
- A IS NULL
- A IS NOT NULL

Relational operators – Example

```
hive> select * from file where yoj<2011;
OK
102     Rajesh  IT      2010
104     Parmeet CS      2010
Time taken: 0.11 seconds, Fetched: 2 row(s)
hive> select * from file where dept='CS';
OK
103     Suresh  CS      2012
103     Awez    CS      2012
104     Parmeet CS      2010
Time taken: 0.084 seconds, Fetched: 3 row(s)
hive> select * from file where dept!='CS';
OK
102     Rajesh  IT      2010
Time taken: 0.124 seconds, Fetched: 1 row(s)
hive>
```

Arithmetic operators

- A + B
- A – B
- A * B
- A / B
- A % B
- A & B
- A | B
- A ^ B
- ~A

Arithmetic operators

```
hive> SELECT id+1, dept FROM file;
OK
103     IT
104     CS
104     CS
105     CS
Time taken: 0.068 seconds, Fetched: 4 row(s)
hive> SELECT id, yoj%2000 FROM file;
OK
102     10
103     12
103     12
104     10
Time taken: 0.076 seconds, Fetched: 4 row(s)
hive>
```

Logical operators

- A AND B
- A && B
- A OR B
- A || B
- NOT A
- !A

Logical operators

```
hive> SELECT * from file where id!=103 OR name IS NOT NULL;
OK
102     Rajesh  IT      2010
103     Suresh  CS      2012
103     Awez    CS      2012
104     Parmeet CS      2010
Time taken: 0.107 seconds, Fetched: 4 row(s)
hive> SELECT * from file where dept='CS' AND yoj=2012;
OK
103     Suresh  CS      2012
103     Awez    CS      2012
Time taken: 0.069 seconds, Fetched: 2 row(s)
hive>
```

Built-in functions

Return Type	Signature	Description
BIGINT	round(double a)	It returns the rounded BIGINT value of the double.
BIGINT	floor(double a)	It returns the maximum BIGINT value that is equal or less than the double.
BIGINT	ceil(double a)	It returns the minimum BIGINT value that is equal or greater than the double.
double	rand(), rand(int seed)	It returns a random number that changes from row to row.
string	concat(string A, string B,...)	It returns the string resulting from concatenating B after A.

Built-in functions

string	substr(string A, int start)	It returns the substring of A starting from start position till the end of string A.
string	substr(string A, int start, int length)	It returns the substring of A starting from start position with the given length.
string	upper(string A)	It returns the string resulting from converting all characters of A to upper case.
string	ucase(string A)	Same as above.
string	lower(string A)	It returns the string resulting from converting all characters of B to lower case.

Built-in functions

string	lcase(string A)	Same as above.
string	trim(string A)	It returns the string resulting from trimming spaces from both ends of A.
string	ltrim(string A)	It returns the string resulting from trimming spaces from the beginning (left hand side) of A.
string	rtrim(string A)	It returns the string resulting from trimming spaces from the end (right hand side) of A.

Built-in functions – Example

```
hive> SELECT concat(name, dept), ucase(name) from file;
OK
RajeshIT        RAJESH
SureshCS        SURESH
AwezCS  AWEZ
ParmeetCS       PARMEET
Time taken: 0.059 seconds, Fetched: 4 row(s)
hive> SELECT round(2.6) from file;
OK
3.0
3.0
3.0
3.0
Time taken: 0.219 seconds, Fetched: 4 row(s)
hive>
```

Aggregate functions

Return Type	Signature	Description
BIGINT	count(*), count(expr),	count(*) - Returns the total number of retrieved rows.
DOUBLE	sum(col), sum(DISTINCT col)	It returns the sum of the elements in the group or the sum of the distinct values of the column in the group.
DOUBLE	avg(col), avg(DISTINCT col)	It returns the average of the elements in the group or the average of the distinct values of the column in the group.
DOUBLE	min(col)	It returns the minimum value of the column in the group.
DOUBLE	max(col)	It returns the maximum value of the column in the group.

Examples

- SELECT count(*) from file;
- SELECT sum(id) from file;
- SELECT avg(yoj) from file;
- SELECT max(yoj) from file;

Views

- Views are generated based on user requirements. You can save any result set data as a view.
- The usage of view in Hive is same as that of the view in SQL. It is a standard RDBMS concept.
- We can execute all DML operations on a view.
- Creating a view:

```
CREATE VIEW [IF NOT EXISTS] view_name
[(column_name [COMMENT column_comment], ...) ]
[COMMENT table_comment]
AS SELECT ...
```

Views – example

```
hive> CREATE VIEW file_2010 AS
    > SELECT * FROM file
    > where yoj=2010;
OK
Time taken: 0.103 seconds
hive> select * from file_2010;
OK
102     Rajesh  IT      2010
104     Parmeet CS      2010
Time taken: 0.08 seconds, Fetched: 2 row(s)
hive>
```

Dropping a view

- Use the following syntax to drop a view:

```
DROP VIEW view_name
```

- The following query drops a view named as file_2010:

```
hive> DROP VIEW file_2010;
```

Index

- An Index is nothing but a pointer on a particular column of a table.
- Creating an index means creating a pointer on a particular column of a table.
-
- hive> CREATE INDEX index_yoj ON TABLE file(yoj)

  > AS 'org.apache.hadoop.hive.ql.index.compact.CompactIndexHandler' WITH DEFERRED REBUILD;

Index – Example

```
hive> CREATE INDEX in_salary ON TABLE file(yoj)
    > AS 'org.apache.hadoop.hive.ql.index.compact.CompactIndexHandler' WITH DEFERRED REBUILD;
OK
Time taken: 0.485 seconds
hive> show tables;
OK
class
emp_30000
file
file1
file_2010
tushar__file_in_salary__
tushar__file_index_salary__
Time taken: 0.019 seconds, Fetched: 7 row(s)
hive> drop index tushar__file_in_salary__ on file;
OK
Time taken: 0.027 seconds
hive>
```

Drop index

- The following syntax is used to drop an index:

```
DROP INDEX <index_name> ON <table_name>
```

- The following query drops an index named index_salary:

```
hive> DROP INDEX index_salary ON employee;
```

Select … order by

- The ORDER BY clause is used to retrieve the details based on one column and sort the result set by ascending or descending order.
- Syntax:

```
SELECT [ALL | DISTINCT] select_expr, select_expr, ...
FROM table_reference
[WHERE where_condition]
[GROUP BY col_list]
[HAVING having_condition]
[ORDER BY col_list]]
[LIMIT number];
```

Select … order by- Example

```
hive> select * from file order by yoj;
Query ID = hduser_20160703164810_7d84d930-f1dd-4ed3-9410-1f09af20a74d
Total jobs = 1
Launching Job 1 out of 1
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>
Job running in-process (local Hadoop)
2016-07-03 16:48:13,401 Stage-1 map = 100%,  reduce = 100%
Ended Job = job_local590275424_0005
MapReduce Jobs Launched:
Stage-Stage-1:  HDFS Read: 6000 HDFS Write: 0 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
104     Parmeet CS      2010
102     Rajesh  IT      2010
103     Awez    CS      2012
103     Suresh  CS      2012
Time taken: 2.462 seconds, Fetched: 4 row(s)
```

Select… group by

- The GROUP BY clause is used to group all the records in a result set using a particular collection column. It is used to query a group of records.
- Syntax:

```
SELECT [ALL | DISTINCT] select_expr, select_expr, ...
FROM table_reference
[WHERE where_condition]
[GROUP BY col_list]
[HAVING having_condition]
[ORDER BY col_list]]
[LIMIT number];
```

Select… group by – example

```
hive> select dept, count(*) from file group by dept;
Query ID = hduser_20160703165351_da8962c1-3407-49bd-bd57-c463d2aab7ff
Total jobs = 1
Launching Job 1 out of 1
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>
Job running in-process (local Hadoop)
2016-07-03 16:53:53,780 Stage-1 map = 100%,  reduce = 100%
Ended Job = job_local1959421652_0007
MapReduce Jobs Launched:
Stage-Stage-1:  HDFS Read: 6300 HDFS Write: 0 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
CS      3
IT      1
Time taken: 1.86 seconds, Fetched: 2 row(s)
```

Joins

- JOINS is a clause that is used for combining specific fields from two tables by using values common to each one.
- It is used to combine records from two or more tables in the database.
- It is more or less similar to SQL JOINS.

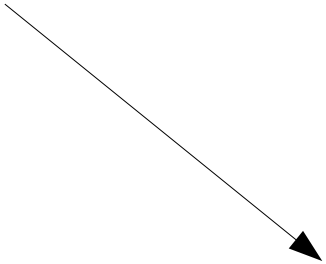
Joins – Examples

```
hive> select * from customer;
OK
1       Kavita  24      Sangvi  34000
2       Chatur  23      Kothrud 35000
3       Fatema  31      Lohgad  20000
4       Rohan   27      Pune Station    22000
Time taken: 0.061 seconds, Fetched: 4 row(s)
```

```
hive> select * from orders;
OK
102     NULL    3       1200
104     NULL    3       3400
105     NULL    4       2150
106     NULL    2       3420
Time taken: 0.057 seconds, Fetched: 4 row(s)
```

Joins – Examples

```
hive> SELECT c.ID, c.NAME, c.AGE, o.AMOUNT
    > FROM CUSTOMER c JOIN ORDERS o
    > ON (c.ID = o.c_id);
Query ID = hduser_20160703175303_ac7c2fcc-c9f2-
Total jobs = 1
```



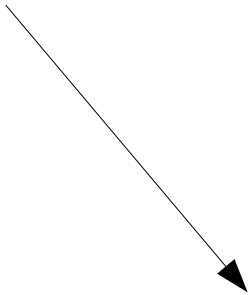
```
Total MapReduce CPU Time Spent: 0 msec
OK
2       Chatur  23      3420
3       Fatema  31      1200
3       Fatema  31      3400
4       Rohan   27      2150
Time taken: 9.21 seconds, Fetched: 4 row(s)
```

Left outer join

- The HiveQL LEFT OUTER JOIN returns all the rows from the left table, even if there are no matches in the right table.
- This means, if the ON clause matches 0 (zero) records in the right table, the JOIN still returns a row in the result, but with NULL in each column from the right table.
- A LEFT JOIN returns all the values from the left table, plus the matched values from the right table, or NULL in case of no matching JOIN predicate.

Left outer join

```
hive> select c.ID, c.NAME, o.AMOUNT
    > FROM CUSTOMER c
    > LEFT OUTER JOIN ORDERS o
    > ON (c.ID = o.C_ID);
```



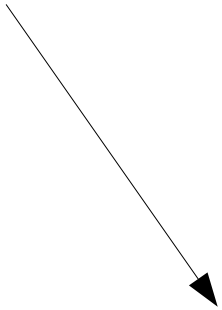
```
MapReduce Jobs Launched:
Stage-Stage-3:  HDFS Read: 106 HDFS Write: 0 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
1       Kavita  NULL
2       Chatur  3420
3       Fatema  1200
3       Fatema  3400
4       Rohan   2150
Time taken: 11.194 seconds, Fetched: 5 row(s)
```

Right outer join

- The HiveQL RIGHT OUTER JOIN returns all the rows from the right table, even if there are no matches in the left table.
- If the ON clause matches 0 (zero) records in the left table, the JOIN still returns a row in the result, but with NULL in each column from the left table.
- A RIGHT JOIN returns all the values from the right table, plus the matched values from the left table, or NULL in case of no matching join predicate.

Right outer join – Example

```
hive> select c.ID, c.NAME, o.AMOUNT
    > FROM CUSTOMER c
    > RIGHT OUTER JOIN ORDERS o
    > ON (c.ID = o.C_ID);
```

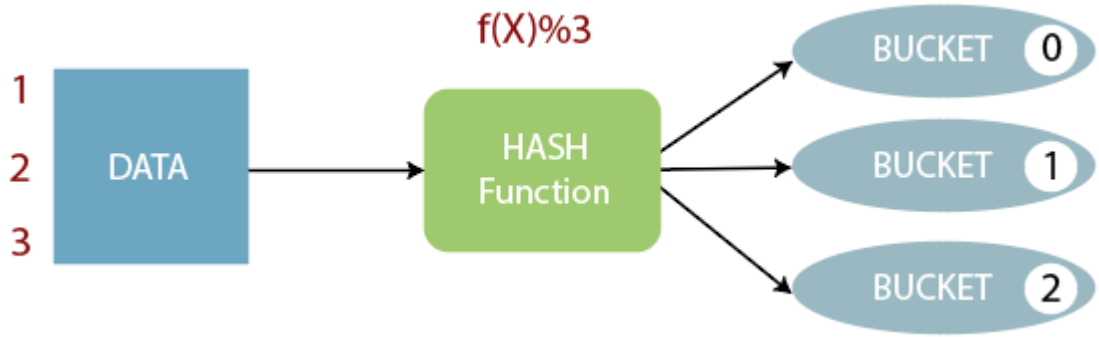


```
Stage-Stage-3:  HDFS Read: 162 HDFS Write: 0 SUCCESS
Total MapReduce CPU Time Spent: 0 msec
OK
3       Fatema  1200
3       Fatema  3400
4       Rohan   2150
2       Chatur  3420
Time taken: 18.488 seconds, Fetched: 4 row(s)
```

Bucketing

- The bucketing in Hive is a data organizing technique.
- It is similar to partitioning in Hive with an added functionality that it divides large datasets into more manageable parts known as buckets.
- So, we can use bucketing in Hive when the implementation of partitioning becomes difficult.
- However, we can also divide partitions further in buckets.

Working of Bucketing



- The concept of bucketing is based on the hashing technique.
- Here, modules of current column value and the number of required buckets is calculated (let say, F(x) % 3).
- Now, based on the resulted value, the data is stored into the corresponding bucket.

Bucketing Example

- Create a dummy table to store the data.

```
hive> create table emp_demo (Id int, Name string ,
Salary float)
row format delimited
fields terminated by ',' ;
hive> load data local inpath
'/home/mitu/emp_details' into table emp_demo;
```

Bucketing Example

- Enable the bucketing by using the following command: -

```
hive> set hive.enforce.bucketing = true;
```

- Create a bucketing table by using the following command: -

```
hive> create table emp_bucket(Id int, Name
string , Salary float)
clustered by (Id) into 3 buckets
row format delimited
fields terminated by ',' ;
```

Bucketing Example

- Now, insert the data of dummy table into the bucketed table.

```
hive> insert overwrite table emp_bucket select
* from emp_demo;
```

- Here, we can see that the data is divided into three buckets on HDFS.

Bucketing Example

- Let's retrieve the data of bucket 0 using HDFS cat command.

  According to hash function :

  6%3=0

  3%3=0
- So, these columns stored in bucket 0.

Bucketing Example

- Let's retrieve the data of bucket 1.
- According to hash function :

  7%3=1

  4%3=1

  1%3=1
- So, these columns stored in bucket 1.

Bucketing Example

- Let's retrieve the data of bucket 2.

  According to hash function :

  8%3=2

  5%3=2

  2%3=2
- So, these columns stored in bucket 2.

Sub Queries or Nested Queries

- A Query present within a Query is known as a sub query. The main query will depend on the values returned by the subqueries.
- Subqueries can be classified into two types
  - Subqueries in FROM clause
  - Subqueries in WHERE clause

Sub Queries or Nested Queries

- When to use:
  - To get a particular value combined from two column values from different tables
  - Dependency of one table values on other tables
  - Comparative checking of one column values from other tables.

Sub Queries or Nested Queries

- Syntax: Subquery in FROM clause

```
SELECT <column names 1, 2…n>From (SubQuery)
<TableName_Main >
```

- Subquery in WHERE clause

```
SELECT <column names 1, 2…n>
From<TableName_Main>WHERE col1 IN (SubQuery);
```

- Example:

```
SELECT col1 FROM (SELECT a+b AS col1 FROM t1)
t2
```

Execute Hive Script

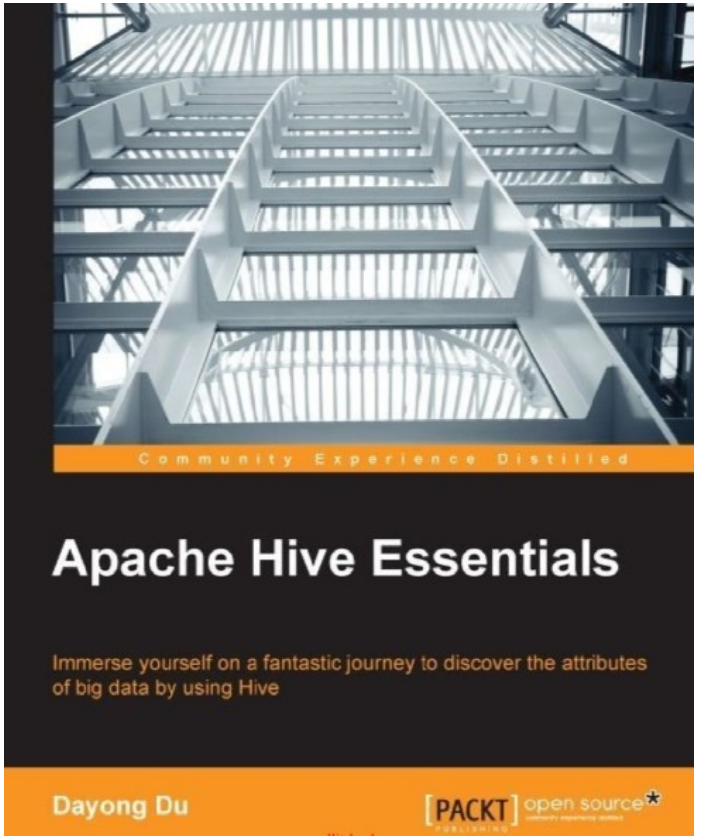
- Execute the hive script using the following command:
- Command:

```
hive -f /home/mitu/sample.sql
```

- While executing the script, make sure that you give the entire path of the script location.
- As the sample script is present in the current directory, I haven't provided the complete path of the script.

References


Data Warehouse and Query Language for Hadoop
Programming
Hive
O'REILLY
Jason Rutherglen,
Dean Wampler &
Edward Capriolo


Community Experience Distilled
Apache Hive Essentials
Immerse yourself on a fantastic journey to discover the attributes of big data by using Hive
Dayong Du
PACKT open source

Thank you

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