**ISIT312 Big Data Management**

### Session 2, 2022

### Exercise 7

### Using Apache Pig Latin

**In this exercise you will learn how to use Apache Pig Latin for processing of the data files stored in HDFS.**

***Be careful when copying the Linux commands in this document to your working Terminal, because it is error-prone. Maybe you should type those commands by yourself.***

**Prologue**

Login to your system and start VirtualBox.

When ready start a virtual machine ISIT312-BigDataVM-07-SEP-2020.

**(1) How to start Hadoop?**

Open a new Terminal window and start Hadoop in the following way.

$HADOOP\_HOME/sbin/start-all.sh

When using Pig we have to additionally start History Server. Use the following command in a Terminal Window to start History Server.

$HADOOP\_HOME/sbin/m\*sh start historyserver

Create a text file orders.txt with the following contents:

bolt,James,200,2016,01,01

bolt,Peter,100,2017,01,30

bolt,Bob,300,2018,05,23

screw,James,20,2017,05,11

screw,Alice,55,2018,01,01

nut,Alice,23,2018,03,16

washer,James,45,2016,04,24

washer,Peter,100,2016,05,12

bolt,James,200,2018,01,05

bolt,Peter,100,2018,01,05

bolt,James,,2018,01,01

And load the file into HDFS into a location /user/bigdata .

**(2) How to start Grunt Shell ?**

To start Grunt Shell process the following command in a Terminal window.

$PIG\_HOME/bin/pig

Apache Pig command line interface (Grunt) should open a new line with a prompt grunt>.

As usual, we start from asking about help. Process help command at grunt> prompt. The outcomes are listed in Appendix A at the end of this document.

It is possible to type and to process Pig commands directly at grunt> prompt. For few simple commands it is probably all right to do so. However, the longer sequences to commands require application of Pig script.

**(3) How to process a sequence of Pig commands?**

It is possible to process a sequence of Pig commands separated with ';' as a value of -e switch of pig command. For example, it is possible to load into Pig container orders the contents of a file orders.txt located in HDFS and list the file with dump command as below.

$PIG\_HOME/bin/pig -e "orders = load '/user/bigdata/orders.txt' using PigStorage(','); dump orders;"

Of course, the best solution is to create Pig script file and process the file. Create a text file script.pig put into it the following lines.

orders = /user/bigdata/orders.txt' using PigStorage(',');

dump orders;

Then, save the file and process the following command at $ prompt in a Terminal window.

$PIG\_HOME/bin/pig -f script.pig

Note, that a clause PigStorage(',') determines a separator between the values in the rows of input data file. By default a separator is TAB. In our case the values are separated with a comma.

**(4) How to assign the names and types to columns in Pig data container ?**

Process the following command at grunt> prompt. A clause as ( … ) determines the names of columns and the types of columns.

orders = load '/user/bigdata/orders.txt' using PigStorage(',') as (item:chararray,customer:chararray,quantity:int,year:int,month:int,day:int);

To verify the results, process a command describe.

describe orders;

**(5) How to load a map into Pig storage ?**

Create a text file keyvalue.txt that contains the following lines.

[first-name#James,last-name#Bond,city#London,country#UK]

[first-name#Harry,last-name#Potter,city#Avondale,country#UK]

Next, load a file keyvalue.txt into HDFS folder /user/bigdata .

Then, process the following commands at grunt> prompt.

keyvalue = load '/user/bigdata/keyvalue.txt'as (department:chararray,personal:map[]);

describe keyvalue;

dump keyvalue;

A data container keyvalue contains two maps earlier loaded into HDFS.

**(6) How to load a bag with tuples into Pig storage ?**

Create a text file hobbies.txt with the following rows.

James,({painting},{swimming})

Harry,({cooking})

Robin,({})

The file contains information about the first names of people and their hobbies.

Next load a file hobbies.txt into HDFS folder /user/bigdata .

Then process the following commands at grunt> prompt.

hobbies = load '/user/bigdata/hobbies.txt' as

(firstname:chararray,hobbies:bag{t:(hobby:chararray)});

dump hobbies;

describe hobbies;

Note, that a name of a bag t must be included in a specification of bag structure. It is also possible to nest within a bag not only sets of values but also sets of tuples.

Create a text file nested.txt with the following contents.

James,({Ferrari,xyz123}{Honda,pkr856})

Harry,({Rolls Royce,xxx666})

Next load a file nested.txt into HDFS folder /user/bigdata .

Then process the following commands at grunt> prompt.

nested = load '/user/bigdata/nested.txt' as

(firstname:chararray,cars:bag{t:(manufacturer:chararray, rego:chararray)});

dump nested;

describe nested;

**(7) How to compute projections of a data container ?**

We start from describe command to refresh our memory on a structure of orders container create in step 3.

describe orders;

Assume that we would like to create a container items with single column item extracted from a container orders. Process the following commands at grunt> prompt.

items = foreach orders generate item;

dump items;

It is possible to remove duplicates with Remove duplications with distinct operation.

distinctitems = distinct items;

dump distinctitems;

describe distinctitems;

Projection on many columns

dates = foreach orders generate day, month, year;

dump dates;

**(8) How to perform selections from data container ?**

A filter command can be used to select all orders where quantity is greater than 100;

biggerorders = filter orders by quantity > 100;

dump biggerorders;

A useful example is to check the rows for nulls.

nulls = filter orders by quantity is null;

dump nulls;

**(9) How to split data containers ?**

Sometimes we would like to save the rows filtered from a data container into several other containers. For example, we split a container orders into a container orders2018 that contains orders submitted in 2018 and a container olderorders that contains other orders.

split orders into

orders2018 if year==2018,

olderorders otherwise;

dump orders2018;

**(10) How to compute an inner join ?**

Create a data set items.txt with the following contents

bolt,2.23

screw,3.5

nut,1.25

washer,2.5

nail,0.4

fastener,4.1

pin,10.05

coupler,9.95

and load it into HDFS into a folder /user/bigdata .

Next, create a new data container items in the following way.

items = load '/user/bigdata/items.txt' using PigStorage(',') as

(item:chararray,price:float);

dump items;

Now we implement an inner join operation to find the prices of all ordered products.

orders\_join\_items = join orders by item, items by item;

describe orders\_join\_items;

dump orders\_join\_items;

**(11) How to implement left outer join ?**

A left outer join operation joins all items with orders and includes into the result the items that have not been ordered so far extended with nulls in all columns from a container orders. Process the following commands.

leftouter = join items by item left outer, orders by item;

dump leftouter;

describe leftouter;

The results saved in leftouter data container can be used to find the names of items that have not been ordered yet, i.e. it is nothing else but implementation of *antijoin* operation. *Antijoin* operation, in contrast to join operation, finds all rows from the left argument of the operation that cannot be joined with the rows from the right argument of the operation. Process the following commands to find all items that have not been ordered yet.

notordered = filter leftouter by orders::item is null;

dump notordered;

**(12) How to implement non-equi join ?**

An inner join operation computed in a step 10 assumes that the rows are connect only when a value in a column item in a container items is the same as a value in a column item in a container orders. It is so called equi join. It is possible to implement a join operation that joins the rows from two containers that satisfy any condition different from equality condition. For example, find all pairs of items such that the first element in each pair has a price higher than the second element. Process the following sequence of commands and verify the results after each step.

newitems = load '/user/bigdata/items.txt' using PigStorage(',')

as (item:chararray,price:float);

crossjoin = cross items, newitems;

describe crossjoin;

result = filter crossjoin by items::price > newitems::price;

**(13) How to perform groupings and how to compute aggregation functions ?**

An operation group by can be used to restructure a container with flat tuples into a container with tuple nested with bags. Assume that we would like to aggregate all orders on the same items into the bags and assign these bags with the ordered item. This can be achieved in the following way.

ordergrp = group orders by item;

To find an internal structure of a data container ordergrp process a command

describe ordergrp;

and later on a command

dump ordergrp;

Now, it is possible to count the total number of orders in each bag to get the result identical to SELECT with GROUP BY clause of SQL.

itemscnt = foreach ordergrp generate group, COUNT(orders.item);

dump itemsscnt;

**(14) How to process CUBE and ROLLUP operators ?**

CUBE operator performs grouping over all subsets of a give set of values and saves the results in a bag.

Process the following commands.

ordcube = cube orders by CUBE(item,name);

describe ordcube;

dump ordcube;

Like with group operation it is possible to apply an aggregation function to the results.

cntcube = foreach ordcube generate group, COUNT(cube.item);

dump cntcube;

In the same way it is possible to process ROLLUP operator.

ordrollup = cube orders by ROLLUP(item,name);

dump ordrollup;

describe ordrollup;

cntrollup = foreach ordrollup generate group, COUNT(cube.item);

dump cntrollup;

**(15) How to unnest (flatten) data bags ?**

Consider a data container ordergrp created in a step (13).

describe ordergrp;

ordergrp: {group: chararray,orders: {(item: chararray,

name: chararray,quantity: int,year: int,month: int,day: int)}}

An operation flatten can be used to "ungroup" a nested structure. Process the following commands.

orderunnest = foreach ordergrp generate flatten (orders);

describe orderunnest;

dump orderunnest;

**(16) How to save the results in HDFS ?**

To save the contents of a data container created by processing Pig Latin commands use a command store.

store ordergrp into '/user/bigdata/orders' using PigStorage(',');

store ordcube into '/user/bigdata/ordcube' using PigStorage('|');

Next, in a new terminal window use the following command to list the contents of HDFS.

$HADOOP\_HOME/bin/Hadoop fs -ls /user/bigdata/orders

$HADOOP\_HOME/bin/Hadoop fs -cat /user/bigdata/orders/part-m-00000

**(17) How to process Hadoop commands in front of grunt> prompt ?**

To list the contents of HDFs process the following fs command at grunt> prompt.

fs -cat /user/bigdata/orders/part-m-00000

**Appendix A**

The outcomes of help command.

<pig latin statement>; - See the PigLatin manual for details: http://hadoop.apache.org/pig

File system commands:

fs <fs arguments> - Equivalent to Hadoop dfs command: http://hadoop.apache.org/common/docs/current/hdfs\_shell.html

Diagnostic commands:

describe <alias>[::<alias] - Show the schema for the alias. Inner aliases can be described as A::B.

explain [-script <pigscript>] [-out <path>] [-brief] [-dot|-xml] [-param <param\_name>=<param\_value>]

[-param\_file <file\_name>] [<alias>] - Show the execution plan to compute the alias or for entire script.

-script - Explain the entire script.

-out - Store the output into directory rather than print to stdout.

-brief - Don't expand nested plans (presenting a smaller graph for overview).

-dot - Generate the output in .dot format. Default is text format.

-xml - Generate the output in .xml format. Default is text format.

-param <param\_name - See parameter substitution for details.

-param\_file <file\_name> - See parameter substitution for details.

alias - Alias to explain.

dump <alias> - Compute the alias and writes the results to stdout.

Utility Commands:

exec [-param <param\_name>=param\_value] [-param\_file <file\_name>] <script> -

Execute the script with access to grunt environment including aliases.

-param <param\_name - See parameter substitution for details.

-param\_file <file\_name> - See parameter substitution for details.

script - Script to be executed.

run [-param <param\_name>=param\_value] [-param\_file <file\_name>] <script> -

Execute the script with access to grunt environment.

-param <param\_name - See parameter substitution for details.

-param\_file <file\_name> - See parameter substitution for details.

script - Script to be executed.

sh <shell command> - Invoke a shell command.

kill <job\_id> - Kill the hadoop job specified by the hadoop job id.

set <key> <value> - Provide execution parameters to Pig. Keys and values are case sensitive.

The following keys are supported:

default\_parallel - Script-level reduce parallelism. Basic input size heuristics used by default.

debug - Set debug on or off. Default is off.

job.name - Single-quoted name for jobs. Default is PigLatin:<script name>

job.priority - Priority for jobs. Values: very\_low, low, normal, high, very\_high. Default is normal

stream.skippath - String that contains the path. This is used by streaming.

any hadoop property.

help - Display this message.

history [-n] - Display the list statements in cache.

-n Hide line numbers.

quit - Quit the grunt shell.For a good start use a command help to get a pretty comprehensive help from HBase command Line Interface (CLI). A complete printout of help is listed at the end of this document.

*End of exercise 7*