Apache Pig

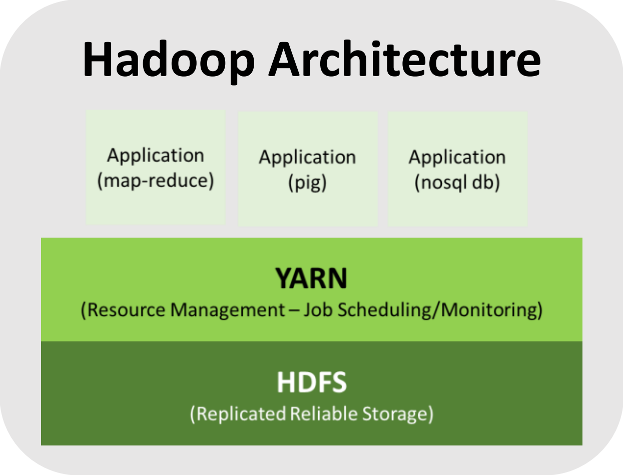
https://pig.apache.org/

Venkatesh Vinayakarao
venkateshv@cmi.ac.in
http://vvtesh.co.in

Chennai Mathematical Institute

Making Pig Fly – Thejas Nair.

Recap



Hadoop Architecture

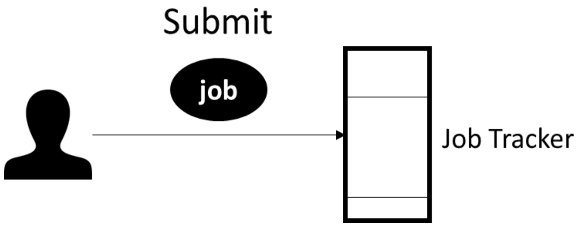
Application (map-reduce)

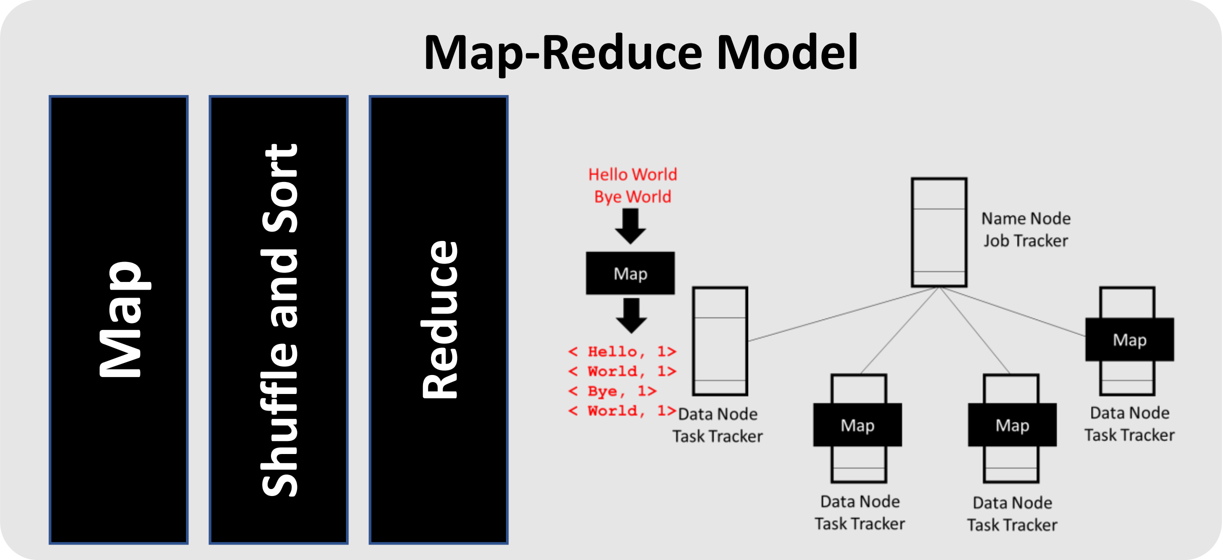
Application (pig)

Application (nosql db)

YARN (Resource Management – Job Scheduling/Monitoring)

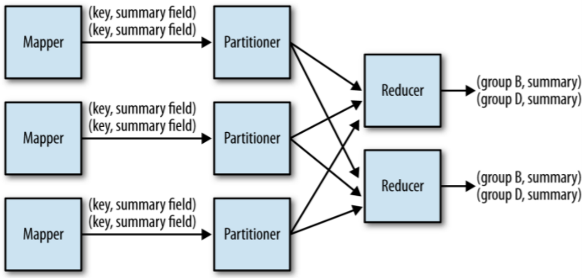
HDFS (Replicated Reliable Storage)



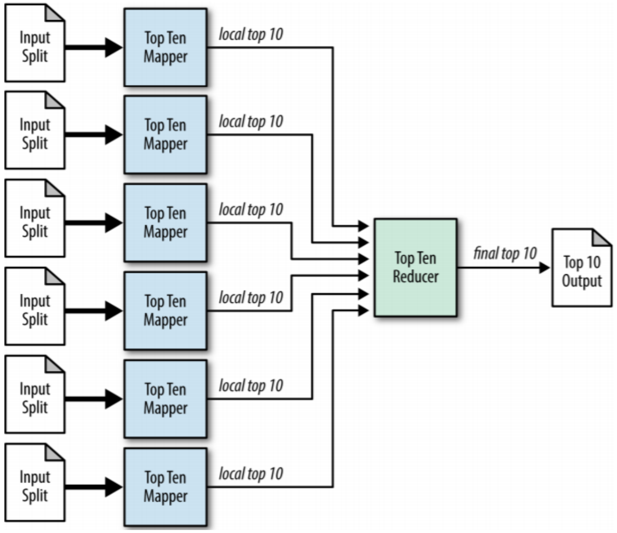


Map-Reduce Model

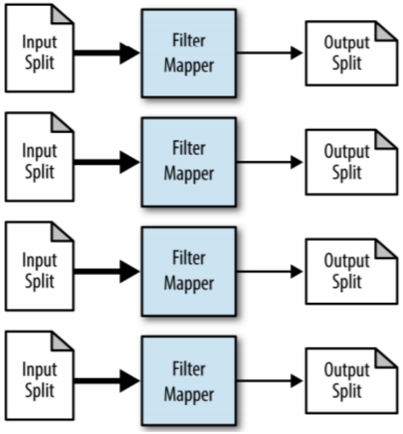
Map-Reduce Patterns



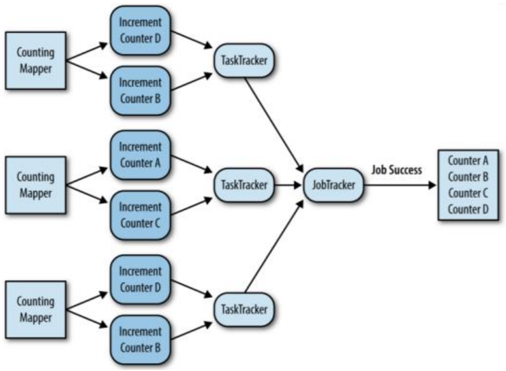
Summarization



Top 10

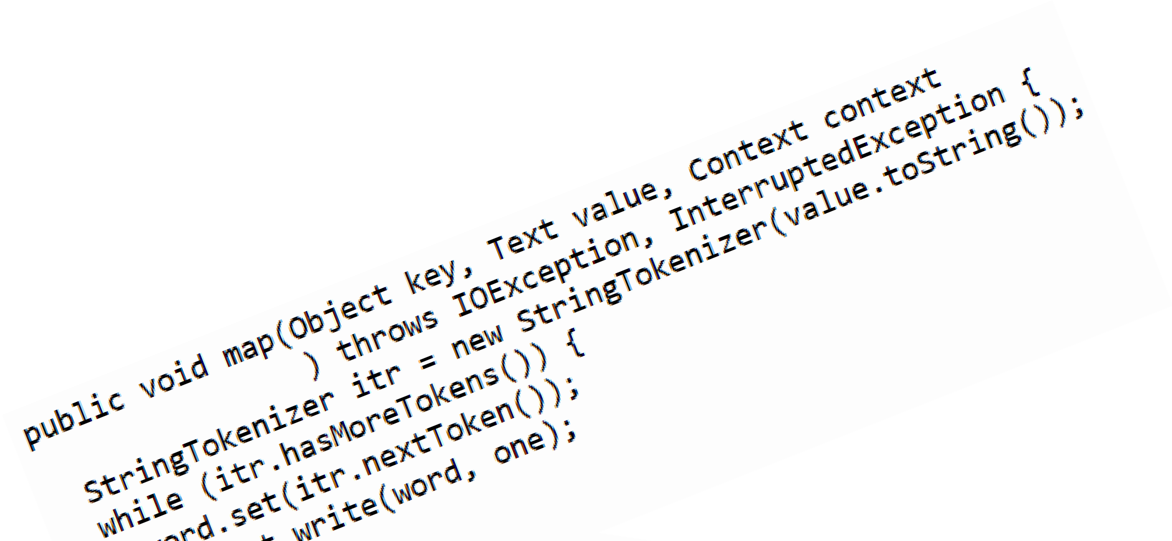


Filtering

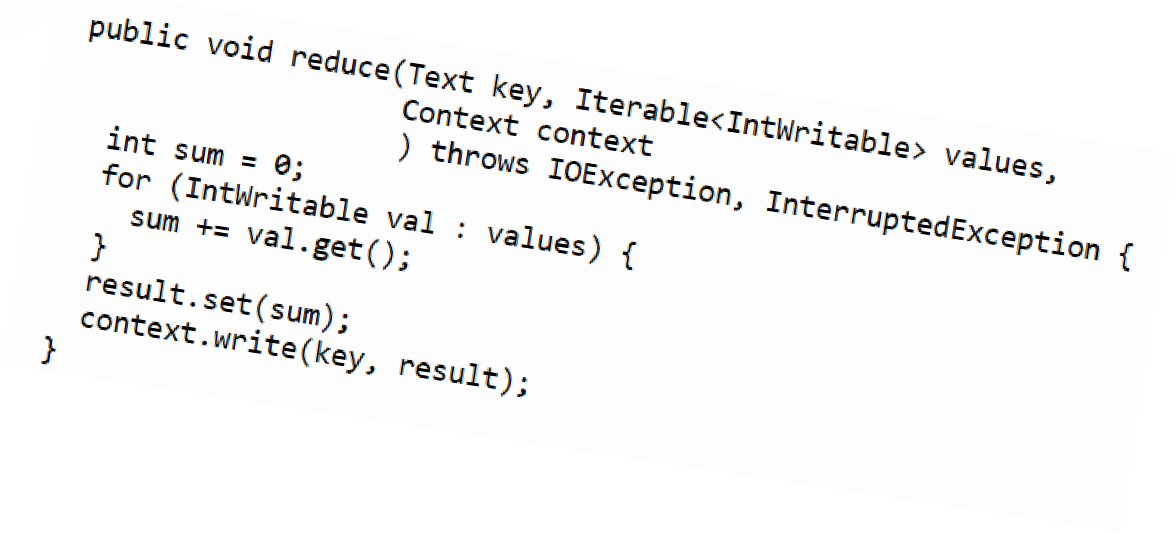


Counting

Code



```
public void map(Object key, Text value, Context context
                ) throws IOException, InterruptedException {
  StringTokenizer itr = new StringTokenizer(value.toString());
  while (itr.hasMoreTokens()) {
    word.set(itr.nextToken());
    context.write(word, one);
  }
}
```

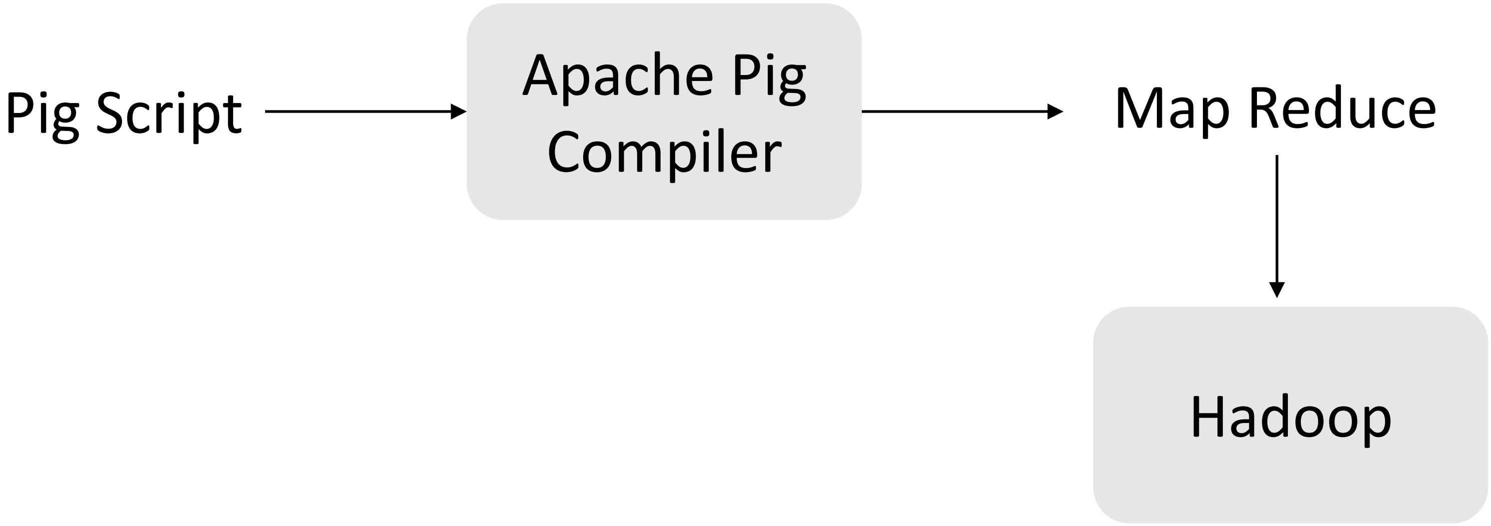


```
public void reduce(Text key, Iterable<IntWritable> values,
                   Context context
                   ) throws IOException, InterruptedException {
  int sum = 0;
  for (IntWritable val : values) {
    sum += val.get();
  }
  result.set(sum);
  context.write(key, result);
}
```

But…

What if…
We are not good at coding?

Scripting instead of Coding



A Sample Pig Script

LOAD Command Syntax

```
LOAD 'data' [USING function] [AS schema];
```

```
A = LOAD 'student' USING PigStorage()
                    AS (name:chararray, age:int, gpa:float);
B = FOREACH A GENERATE name;
DUMP B;
```

Read: https://pig.apache.org/docs/r0.16.0/basic.html#load

Benefits & Limitations

- Benefits
  - 10 lines of Pig Latin (approx.) = 200 lines in Java
  - 15 minutes in Pig Latin (approx.) = 3 hours in Java
    - Simple
    - Easy
    - Quick to Code
  - Provides in-built functions to load, process and print data.
  - Similar to SQL
    - Can perform join and order by
- Limitations
  - Slower than Map-Reduce

Pig in Real-World

- Yahoo uses it extensively (>70% of jobs)
- Facebook – Process Logs
- Twitter – Process Logs
- eBay – Data processing for intelligence
- …

Grunt Shell

```
$ pig -x local
... - Connecting to ...
grunt>
```

Or

```
pig –x local id.pig
```

Tutorial

- Download
  - wget http://www-us.apache.org/dist/pig/pig-0.17.0/pig-0.17.0.tar.gz
  - tar -xzf pig-0.17.0.tar.gz
  - cd bin
- Check
  - ./pig –version
- Execute
  - ./pig -x local
  - data = LOAD 'file1' using PigStorage(',') AS (name:chararray,age:int);
  - data1 = filter data by $1 > 2;
  - dump data1;
  - quit
- Don't forget the semicolon

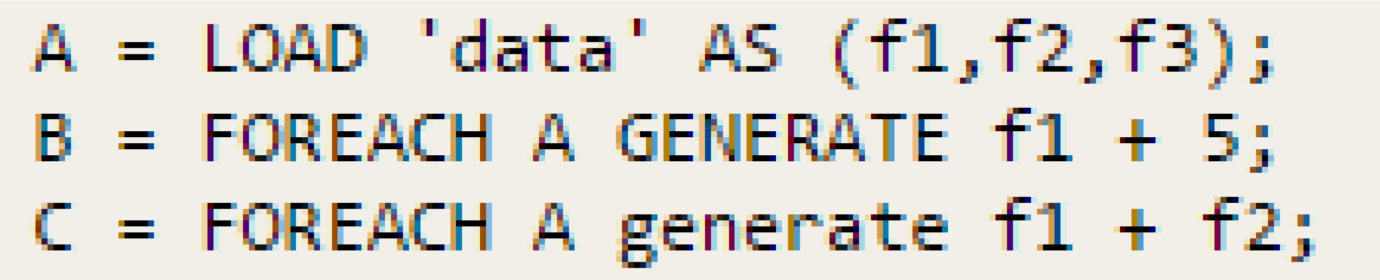
Pig Philosophy

- Pigs eat anything
  - Input can be of a variety of formats
- Pigs live anywhere
  - Not only for hadoop
- Pigs are domestic animals
  - Easy to master
- Pigs fly
  - Ultimately map-reduce code. Improving performance is a priority to the pig team.

Welcome to the World of Pig

- Pig Latin
  - For the language
- Grunt
  - For the shell
- Piggy-bank
  - For the shared reusable modules

More Examples



```
A = LOAD 'data' AS (f1,f2,f3);
B = FOREACH A GENERATE f1 + 5;
C = FOREACH A generate f1 + f2;
```

Referencing Fields

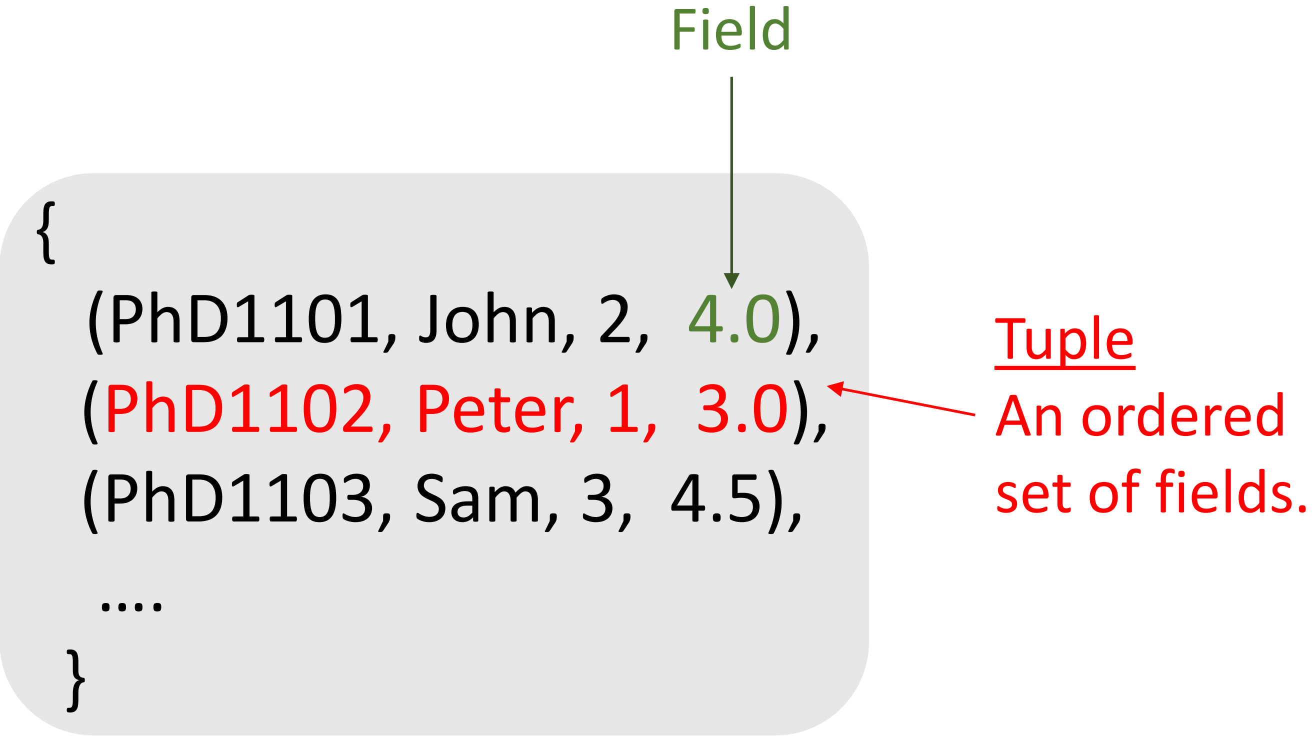
```
A = LOAD 'student' USING PigStorage() AS
        (name:chararray, age:int, gpa:float);
X = FOREACH A GENERATE name,$2;
DUMP X;
```

```
(John,4.0F)
(Mary,3.8F)
(Bill,3.9F)
(Joe,3.8F)
```

Data Types

- Scalar Types:
  - Int, long, float, double, boolean, null, chararray, bytearray;
- Complex Types:
  - Field, Tuple and Relation/Bag
  - Map [key#value]

Data Types in Pig Latin



Field

```
{
   (PhD1101, John, 2,  4.0),
   (PhD1102, Peter, 1,  3.0),
   (PhD1103, Sam, 3,  4.5),
    ....
 }
```

Tuple

An ordered set of fields.

Relation/Bag

An ordered set of tuples.

Load and Dump

```
A = LOAD 'data' AS (f1:int,f2:int,f3:int);
DUMP A;
```

```
(1,2,3)
(4,2,1)
(8,3,4)
(4,3,3)
(7,2,5)
(8,4,3)
```

Input

```
(3,8,9) (4,5,6)
(1,4,7) (3,7,5)
(2,5,8) (9,5,8)
```

```
A = LOAD 'data' AS (
        t1:tuple(t1a:int, t1b:int,t1c:int),
        t2:tuple(t2a:int,t2b:int,t2c:int)
        );
DUMP A;
```

Output

```
((3,8,9),(4,5,6))
((1,4,7),(3,7,5))
((2,5,8),(9,5,8))
```

Guess the output

```
X = FOREACH A GENERATE
t1.t1a,t2.$0;
DUMP X;
```

The Answer

```
X = FOREACH A GENERATE t1.t1a,t2.$0;
DUMP X;

(3,4)
(1,3)
(2,9)
```

Tuples

```
A = LOAD 'data' as (f1:int,
          f2:tuple(t1:int,t2:int,t3:int));
DUMP A;
```

```
(1,(1,2,3))
(2,(4,5,6))
(3,(7,8,9))
(4,(1,4,7))
(5,(2,5,8))
```

Map

Data

```
328;ADMIN HEARNG;[street#939 W El Camino,city#Chicago,state#IL]
43;ANIMAL CONTRL;[street#415 N Mary Ave,city#Chicago,state#IL]
```

Usage

```
grunt> departments = LOAD ‘somefile’
      AS (dept_id:int, dept_name:chararray, address:map[]);

grunt> dept_addr = FOREACH departments
      GENERATE dept_name,
                        address#'street' as street,
                        address#'city' as city,
                        address#'state' as state;
```

https://www.hadoopinrealworld.com/beginners-apache-pig-tutorial-map/

Operations

- Loading data
  - LOAD loads input data
  - Lines=LOAD ‘input/access.log’ AS (line: chararray);
- Projection
  - FOREACH … GENERTE … (similar to SELECT)
  - takes a set of expressions and applies them to every record.
- Grouping
  - GROUP collects together records with the same key
- Dump/Store
  - DUMP displays results to screen, STORE save results to file system
- Aggregation
  - AVG, COUNT, MAX, MIN, SUM

Example

- students = LOAD 'student.txt’ USING PigStorage('\t’) AS (studentid: int, name:chararray, age:int, gpa:double);
- studentid = FOREACH students GENERATE studentid, name;

Filter

Data:

```
year,product,quantity
----------------------
2000, iphone, 1000
2001, iphone, 1500
2002, iphone, 2000
```

```
grunt> A = LOAD '/user/hadoop/sales' USING PigStorage(',')
AS (year:int,product:chararray,quantity:int);
grunt> B = FILTER A BY quantity >= 1500;
grunt> DUMP B;
```

How to run Pig Scripts?

- Local mode
  - Local host and local file system is used
  - Neither Hadoop nor HDFS is required
  - Useful for prototyping and debugging
- MapReduce mode
  - Run on a Hadoop cluster and HDFS
- Batch mode - run a script directly
  - Pig –x local my_pig_script.pig
  - Pig –x mapreduce my_pig_script.pig
- Interactive mode use the Pig shell to run script
  - Grunt> Lines = LOAD '/input/input.txt' AS (line:chararray);
  - Grunt> Unique = DISTINCT Lines;
  - Grunt> DUMP Unique;

Flatten

Let the Input -> (a,(b,c)) be in A.

B = foreach A generate $0 , flatten ($1)

Output -> (a,b,c)

Tokenize

- Input
  - 001,Raj Reddy,21,Hyderabad
  - 002,Raj Chatterjee,22,Kolkata
  - 003,Raj Khanna,22,Delhi

```
grunt> student_details = LOAD
'hdfs://localhost:9000/pig_data/student_details.txt' USING
PigStorage(',') as (id:int, name:chararray, age:int,  city:chararray);
```

```
grunt> student_name_tokenize = foreach student_details  Generate
TOKENIZE(name);
```

```
grunt> Dump student_name_tokenize;
```

Output

```
({(Raj),(Reddy)})
({(Raj),(Chatterjee)})
({(Raj),(Khanna)})
```

Splits a string. Creates tuples of names. Outputs the bag.

Store

```
STORE student INTO '
hdfs://localhost:9000/pig_Output/ ' USING
PigStorage (',');
```

You can write your own functions! In this class, we will use the built-in PigStorage.

Word Count

```
Lines=LOAD ‘input/hadoop.log’ AS (line: chararray);
Words = FOREACH Lines GENERATE
            FLATTEN(TOKENIZE(line)) AS word;
Groups = GROUP Words BY word;
Counts = FOREACH Groups GENERATE  group,
            COUNT(Words);
Results = ORDER Words BY Counts DESC;
Top5 = LIMIT Results 5;
STORE Top5 INTO /output/top5words;
```

User Defined Functions

- What is UDF
  - Way to do an operation on a field or fields
  - Called from within a pig script
  - Currently all done in Java
- Why use UDF
  - You need to do more than grouping or filtering
  - Maybe more comfortable in Java land than in SQL/Pig Latin

UDF in Pig

```
-- myscript.pig
REGISTER myudfs.jar;
A = LOAD 'student_data' AS (name: chararray, age: int, gpa: float);
B = FOREACH A GENERATE myudfs.UPPER(name);
DUMP B;
```

UDFs can be written using a variety of languages including Python. See https://pig.apache.org/docs/r0.17.0/udf.html

Simple UDF

```
public class UPPER extends EvalFunc<String>   {
    public String exec(Tuple input) throws IOException {
      if (input == null || input.size() == 0)
         return null;
      try{
         String str = (String)input.get(0);
        return str.toUpperCase();
      } catch(Exception e)  {
         throw new IOException("Caught exception", e);
     }
 }  }
```

Source: https://pig.apache.org/docs/r0.10.0/udf.html

Creating the Jar

```
jar -cf exampleudf.jar exampleudf
```

Know where have you placed this jar.

In Pig Script:

- REGISTER ‘…path to jar’;
- DEFINE SIMPLEUPPER exampleudf.UPPER();
- … now you can use this method.

https://pig.apache.org/docs/latest/basic.html#define-udfs

Thank You!

Appendix: Presentations