http://poloclub.gatech.edu/cse6242

CSE6242 / CX4242: Data & Visual Analytics

Scaling Up

Pig

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Pig

http://pig.apache.org

High-level language

- instead of writing low-level map and reduce functions

Easier to **program, understand and maintain**

Created at Yahoo!

Produces sequences of Map-Reduce programs

(Lets you do “joins” much more easily)

Pig

http://pig.apache.org

Your **data analysis task** becomes a **data flow** sequence (i.e., **data transformations**)

Input ➡ **data flow** ➡ output

You specify **data flow** in **Pig Latin** (Pig's language). Then, Pig turns the data flow into a sequence of MapReduce jobs automatically!

Pig: 1st Benefit

Write only a **few lines** of Pig Latin

Typically, MapReduce development cycle is long

- Write mappers and reducers
- Compile code
- Submit jobs
- ...

Pig: 2nd Benefit

Pig can perform a **sample run** on representative subset of your input data automatically!

Helps debug your code in smaller scale (much faster!), before applying on full data

What Pig is good for?

Batch processing

- Since it's built on top of MapReduce
- Not for random query/read/write

May be **slower** than MapReduce programs coded from scratch

- You trade ease of use + coding time for some execution speed

How to run Pig

Pig is a client-side application
(run on your computer)

Nothing to install on Hadoop cluster

How to run Pig: 2 modes

Local Mode

- Run on your computer (e.g., laptop)
- Great for trying out Pig on small datasets

MapReduce Mode

- Pig translates your commands into MapReduce jobs
- Remember you can have a single-machine cluster set up on your computer

Difference between PIG local and mapreduce mode: http://stackoverflow.com/questions/11669394/difference-between-pig-local-and-mapreduce-mode

Pig program: 3 ways to write

Script

Grunt (interactive shell)

- Great for debugging

Embedded (into Java program)

- Use PigServer class (like JDBC for SQL)
- Use PigRunner to access Grunt

Grunt (interactive shell)

Provides **code completion**

Press **Tab** key to complete Pig Latin keywords and functions

Let’s see an example Pig program run with Grunt

- Find highest temperature by year

Example Pig program

Find highest temperature by year

```
records = LOAD 'input/ ncdc/ micro-tab/ sample.txt'
  AS (year:chararray, temperature:int, quality:int);

filtered_records =
  FILTER records BY temperature != 9999
  AND (quality = = 0 OR quality = = 1 OR
       quality = = 4 OR quality = = 5 OR
       quality = = 9);

grouped_records = GROUP filtered_records BY year;

max_temp = FOREACH grouped_records GENERATE
  group, MAX(filtered_records.temperature);

DUMP max_temp;
```

Example Pig program

Find highest temperature by year

```
grunt>
records = LOAD 'input/ncdc/micro-tab/sample.txt'
  AS (year:chararray, temperature:int, quality:int);
```

```
grunt> DUMP records;
```

```
(1950,0,1)
(1950,22,1)
(1950,-11,1)
(1949,111,1)
(1949,78,1)
```

called a “tuple”

```
grunt> DESCRIBE records;
```

```
records: {year: chararray, temperature: int, quality: int}
```

Example Pig program

Find highest temperature by year

```
grunt>
filtered_records =
  FILTER records BY temperature != 9999
  AND (quality == 0 OR quality == 1 OR
       quality == 4 OR quality == 5 OR
       quality == 9);
```

```
grunt> DUMP filtered_records;
```

```
(1950,0,1)
(1950,22,1)
(1950,-11,1)
(1949,111,1)
(1949,78,1)
```

In this example, no tuple is filtered out

Example Pig program

Find highest temperature by year

```
grunt> grouped_records = GROUP filtered_records BY year;

grunt> DUMP grouped_records;
```

```
(1949,{(1949,111,1), (1949,78,1)})
(1950,{(1950,0,1),(1950,22,1),(1950,-11,1)})
```

called a "bag"
= unordered collection of tuples

```
grunt> DESCRIBE grouped_records;
```

alias that Pig created

```
grouped_records: {group: chararray,
filtered_records: {year: chararray, temperature:
int, quality: int}}
```

Example Pig program

Find highest temperature by year

```
(1949,{(1949,111,1), (1949,78,1)})
(1950,{(1950,0,1),(1950,22,1),(1950,-11,1)})
```

```
grouped_records: {group: chararray, filtered_records: {year:
chararray, temperature: int, quality: int}}
```

```
grunt> max_temp = FOREACH grouped_records GENERATE
  group, MAX(filtered_records.temperature);

grunt> DUMP max_temp;
```

```
(1949,111)
(1950,22)
```

Run Pig program on a subset of your data

You saw an example run on a tiny dataset

How to do that for a larger dataset?

- Use the **ILLUSTRATE** command to generate sample dataset

Run Pig program on a subset of your data

```
grunt> ILLUSTRATE max_temp;
```

records	year:chararray	temperature:int	quality:int
	1949	78	1
	1949	111	1
	1949	9999	1

filtered_records	year:chararray	temperature:int	quality:int
	1949	78	1
	1949	111	1

grouped_records	group:chararray	filtered_records:bag{:tuple(year:chararray, temperature:int,quality:int)}
	1949	{(1949, 78, 1), (1949, 111, 1)}

max_temp	group:chararray	:int
	1949	111

How does Pig compare to SQL?

SQL: “fixed” schema

PIG: loosely defined schema, as in

```
records = LOAD 'input/ncdc/micro-tab/sample.txt'
AS (year:chararray, temperature:int, quality:int);
```

How does Pig compare to SQL?

SQL: supports fast, random access
(e.g., <10ms, but of course depends on hardware, data size, and query complexity too)

PIG: batch processing

Pig vs SQL

1. Pig Latin is **procedural**, where SQL is **declarative**.
2. Pig Latin allows pipeline **developers to decide where to checkpoint data** in the pipeline.
3. Pig Latin allows the developer to select specific operator implementations directly **rather than relying on the optimizer**.
4. Pig Latin supports **splits** in the pipeline.
5. Pig Latin allows developers to **insert their own code** almost anywhere in the data pipeline.

http://yahoohadoop.tumblr.com/post/98294444546/comparing-pig-latin-and-sql-for-constructing-data

Much more to learn about Pig

Relational Operators, Diagnostic Operators (e.g., describe, explain, illustrate), utility commands (cat, cd, kill, exec), etc.

Table 11-1. Pig Latin relational operators

Category	Operator	Description
Loading and storing	LOAD	Loads data from the filesystem or other storage into a relation
	STORE	Saves a relation to the filesystem or other storage
	DUMP	Prints a relation to the console
Filtering	FILTER	Removes unwanted rows from a relation
	DISTINCT	Removes duplicate rows from a relation
	FOREACH...GENERATE	Adds or removes fields from a relation
	MAPREDUCE	Runs a MapReduce job using a relation as input
	STREAM	Transforms a relation using an external program
	SAMPLE	Selects a random sample of a relation
Grouping and joining	JOIN	Joins two or more relations
	COGROUP	Groups the data in two or more relations
	GROUP	Groups the data in a single relation
	CROSS	Creates the cross-product of two or more relations
Sorting	ORDER	Sorts a relation by one or more fields
	LIMIT	Limits the size of a relation to a maximum number of tuples
Combining and splitting	UNION	Combines two or more relations into one
	SPLIT	Splits a relation into two or more relations