Scaling Up

Pig

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Partly based on materials by Professors Guy Lebanon, Jeffrey Heer, John Stasko, Christos Faloutsos, Parishit Ram (GT PhD alum; SkyTree), Alex Gray
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)
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
• ...

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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;

grouped_records: {group: chararray,
filtered_records: {year: chararray, temperature: int, quality: int}}
Example Pig program

Find highest temperature by year

```
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;
```

<table>
<thead>
<tr>
<th>records</th>
<th>year:chararray</th>
<th>temperature:int</th>
<th>quality:int</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1949</td>
<td>78</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>111</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>9999</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>filtered_records</th>
<th>year:chararray</th>
<th>temperature:int</th>
<th>quality:int</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1949</td>
<td>78</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>111</td>
<td>1</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>max_temp</th>
<th>group:chararray</th>
<th>:int</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1949</td>
<td>111</td>
</tr>
</tbody>
</table>
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.

Much more to learn about Pig

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

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