Community Experience Distilled

Talend for Big Data

Access, transform, and integrate data using Talend's open source, extensible tools

Bahaaldine Azarmi

[PACKT] open source* PUBLISHING
community experience distilled

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Bahaaldine Azarmi is the cofounder of `reach5.co`. With his past experience of working at Oracle and Talend, he has specialized in real-time architecture using service-oriented architecture products, Big Data projects, and web technologies.

I like to thank my wife, Aurelia, for her support and patience throughout this project.

About the Reviewers

Simone Bianchi has a degree in Electronic Engineering from Italy, where he is living today, working as a programmer to develop web applications using technologies such as Java, JSP, jQuery, and Oracle. After having a brief experience with the Oracle Warehouse Builder tool, and as soon as the Talend solution came out, he started to extensively use this new tool in all his data migration/integration tasks as well as develop ETL layers in data warehouse projects. He also developed several Talend custom components such as tLogGrid, tDBFInput/Output, which you can download from the TalendForge site, and the ones to access/store data on the Web via SOAP/REST API.

I'd like to thank Packt Publishing to have chosen me to review this book, as well as the very kind people who work there, to have helped me to accomplish my first review at my best.

A special dedication to my father Americo, my mother Giuliana, my sisters Barbara and Monica, for all their support over the years, and finally to my little sweet nephew and niece, Leonardo and Elena, you are my constant source of inspiration.

Vikram Takkar is a freelance Business Intelligence and Data Integration professional with nine years of rich hands-on experience in multiple BI and ETL tools. He has a strong expertise in technologies such as Talend, Jaspersoft, Pentaho, Big Data-MongoDB, Oracle, and MySQL. He has managed and successfully executed multiple projects in data warehousing and data migration developed for both Unix and Windows environments. He has also worked as a Talend Data Integration trainer and facilitated training for various corporate clients in India, Europe, and the United States. He is an impressive communicator with strong leadership, analytical, and problem-solving skills. He is comfortable interacting with people across hierarchical levels for ensuring smooth project execution as per the client's specifications. Apart from this, he is a blogger and publishes articles and videos on open source BI and ETL tools along with supporting technologies on his YouTube channel at `www.youtube.com/vtakkar`. You can follow him on Twitter `@VikTakkar` and you can visit his blog at `www.vikramtakkar.com`.

I would like to thank the Packt Publishing team for again giving me the opportunity to review their book. Earlier, I reviewed their *Pentaho and Big Data Analytics* book.

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Preface

Data volume is growing fast. However, data integration tools are not scalable enough to process such an amount of data, and thus, more and more companies are thinking about starting Big Data projects—diving into the Hadoop ecosystem projects, understanding each technology, learning MapReduce, Hive SQL, and Pig-Latin—thereby becoming more of a burden more than a solution.

Software vendors such as Talend are trying to ease the deployment of Big Data by democratizing the use of Apache Hadoop projects through a set of graphical development components, which doesn't require the developer to be a Hadoop expert to kick off their project.

This book will guide you through a couple of hands-on techniques to get a better understanding of Talend Open Studio for Big Data.

What this book covers

Chapter 1, *Getting Started with Talend Big Data*, explains the structure of Talend products and then sets up your Talend environment and discovers Talend Studio for the first time.

Chapter 2, *Building Our First Big Data Job*, explains how we can start creating our first HDFS job and be sure our Talend Studio is integrated with our Hadoop cluster.

Chapter 3, *Formatting Data*, describes the basics of Twitter Sentiment Analysis and gives an introduction to format data with Apache Hive.

Chapter 4, *Processing Tweets with Apache Hive*, shows advanced features of Apache Hive, which helps to create the sentiment from extracted tweets.

Chapter 5, *Aggregate Data with Apache Pig*, finalizes the data processing done so far and reveals the top records using Talend Big Data Pig components.

Chapter 6, *Back to the SQL Database*, will guide you on how to work with the Talend Sqoop component in order to export data from HDFS to a SQL Database.

Chapter 7, *Big Data Architecture and Integration Patterns*, describes the most used patterns deployed in the context of Big Data projects in an enterprise.

Appendix, *Installing Your Hadoop Cluster with Cloudera CDH VM* describes the main steps to set up a Hadoop cluster based on Cloudera CDH4.3. You would learn how to go about installations and configuration.

What you need for this book

You will need a copy of the latest version of Talend Open Studio for Big Data, a copy of Cloudera CDH distribution, and a MySQL database.

Who this book is for

This book is for developers with an existing data integration background, who want to start their first Big Data project. Having a minimum of Java knowledge is a plus, while having an expertise in Hadoop is not required.

Conventions

In this book, you will find a number of styles of text that distinguish between different kinds of information. Here are some examples of these styles, and an explanation of their meaning.

Code words in text, database table names, folder names, filenames, file extensions, pathnames, dummy URLs, user input, and Twitter handles are shown as follows: The custom UDF is present in the `org.talend.demo` package and called `ExtractPattern`

A block of code is set as follows:

```
CREATE EXTERNAL TABLE hash_tags (
hash_tags_id string,
day_of_week string,
```

```
day_of_month string,
time string,
month string,
```

New terms and **important words** are shown in bold. Words that you see on the screen, in menus or dialog boxes for example, appear in the text like this: So my advice would be to create an account or click on **Ignore** if you already have one.

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Tips and tricks appear like this.

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1
Getting Started with Talend Big Data

In this chapter, we will learn how the Talend products are regrouped as an integration platform, and we'll set up our development environment to start building Big Data jobs.

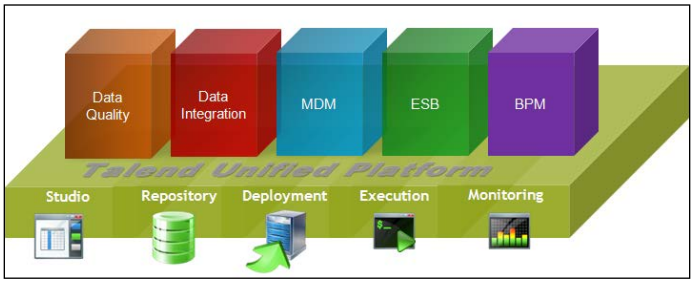
The following topics are covered:

- Talend Unified Platform structure
- Setting up our Talend development environment

Talend Unified Platform presentation

Talend is a French software vendor specialized in open source integration. Through its products, the company democratizes integration and enables IT users and organizations to deploy complex architectures in simpler and comprehensive ways.

Talend addresses all aspects of integration from the technical layer to the business layer, and all products are regrouped into one unique unified platform as shown in the following diagram:



Talend Unified Platform

Talend Unified Platform offers a unique Eclipse-based environment, which means that users can jump from one product to another just by clicking on the related perspective button without the need for changing tools. All jobs, services, and technical assets are designed in the same environment with the same methodology, deployed and executed in the same runtime, monitored and operated in the same management console.

- Talend Data Integration is the historical Talend product, which rapidly promoted Talend as a leader in its field. It allows developers to create the simplest integration jobs such as extracting data from a file and loading it to a database, and create complex data integration job orchestration, high volume integration with parallelization feature, and finally Big Data Integration mainly based on Hadoop projects. This book is essentially dedicated to this module and will give the reader a better understanding of the Talend Big Data usage module.
- Talend Data quality comes with additional analytics features mainly focused on data profiling in order to get a better understanding not only of the quality and reliability of your data, but also integration features such as data standardization, enrichment, matching, and survivorship based on largely adopted industry algorithms.
- Talend Enterprise Service Bus is mainly based on open source projects from the Apache Software Foundation such as Apache Karaf, Apache CXF, Apache Camel, and Apache ActiveMQ, all packed into a single comprehensive product, which speeds the deployment of Service Oriented Architecture composed of few services, to large and complex distributed instance architectures.

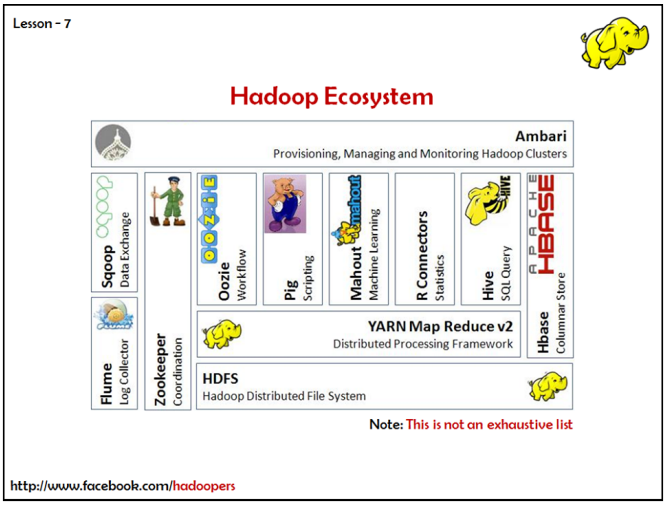
- Talend Master Data Management manages the best of all products and offers business customers all the features required to manage master data such as a business user interface, workflow and business processes, data quality controls, and role-based access management.
- Talend Business Process Management will help business users to graphically design their business processes composed of human tasks, events, and business activity monitoring. It also takes advantage of all existing integration services such ESB SOAP and REST Services or even Data Quality jobs, thanks to a comprehensive integration layer between all products.

Talend Unified Platform is part of the commercial subscription offer; however, all products are available under a community version called Talend Open Studio. As mentioned earlier, Talend Unified Platform is unified at every level, whereas Talend community version products are separate studios. It doesn't include teamwork module, and also advanced features such as administration console, clustering, and so on globally.

This book is focused on **Talend Open Studio for Big Data** (**TOSBD**), which adds to Talend Open Studio for Data Integration a set of components that enables developers to graphically design Hadoop jobs.

Knowing about the Hadoop ecosystem

To introduce the Hadoop projects ecosystem, I'd like to use the following diagram from the Hadooper's group on Facebook (`http://www.facebook.com/hadoopers`), which gives a big picture of the positioning of the most used Hadoop projects:



As you can see, there is a project for each task that you need to accomplish in a Hadoop cluster which is explained in the following points:

- HDFS is the main layer where the data is stored. We will see in the following chapter how to use TOSBD to read and write data in it. More information can be found at `http://hadoop.apache.org/docs/stable1/hdfs_design.html`.
- MapReduce is a framework used to process a large amount of data stored in HDFS, and it relies on a map function that processes key values pairs and a reduce function to merge all the values as the following publication explains `http://research.google.com/archive/mapreduce.html`.
- In this book, we will use a bunch of high-level projects over HDFS, such as Pig and HIVE, in order to generate the MapReduce code and manipulate the data in an easier way instead of coding the MapReduce itself.
- Other projects such as Flume or Sqoop are used for integration purpose with an industry framework and tools such as RDBMS in the case of Sqoop.

The more you get into Big Data projects, the more skills you need, the more time you need to ramp up on the different projects and framework. TOSBD will help to reduce this ramp up time by providing a comprehensive graphical set of tools that ease the pain of starting and developing such projects.

Prerequisites for running examples

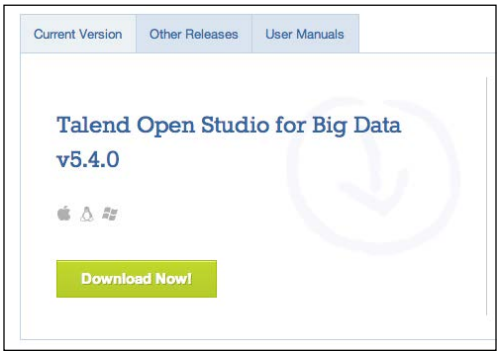
As described earlier in this chapter, this book will describe how to implement Big Data Hadoop jobs using TOSBD. For this the following technical assets will be needed:

- A Windows/Linux/Mac OS machine
- Oracle (Sun) Java JDK 7 is required to install and run TOSBD, and is available at `http://www.oracle.com/technetwork/java/javase/downloads/jdk7-downloads-1880260.html`
- Cloudera CDH Quick Start VM, a Hadoop distribution, which by default contains a ready-to-use single node Apache Hadoop is available at `http://www.cloudera.com/content/support/en/downloads/download-components/download-products.html?productID=F6mO278Rvo`
- A VMWare Player or VirtualBox free for personal use (for windows and linux only) to run the Cloudera VM available at `https://my.vmware.com/en/web/vmware/free#desktop_end_user_computing/vmware_player/6_0` and `https://www.virtualbox.org/wiki/Downloads`

- MySQL Database, an open source RDBMS, is available at `http://dev.mysql.com/downloads/mysql/`
- And obviously, TOSBD, which is described in the next part

Downloading Talend Open Studio for Big Data

Downloading a community version of Talend is pretty straightforward; just connect on `http://www.talend.com/download/big-data`, and scroll at the bottom of the page to see the download section as shown in the following screenshot:



Talend Open Studio for Big Data download section

The product is a generic bundle, which can be run either on Mac, Linux, or Windows. This book uses the last version of the product; just click on the **Download now** button to get the `TOS_BD-r110020-V5.4.0.zip` archive of TOSBD.

Installing TOSBD

All products of the Talend community version are of Eclipse-based tooling environment and packaged as archive. To install TOSBD, you only need to extract the archive preferably under a path, which doesn't contain any space, for example:

Operating system	Path
Mac, Linux	/home/username/talend/
Windows	C:\talend\

The result should be a directory called `TOS_BD-r110020-V5.4.0` under the example path.

Running TOSBD for the first time

As said earlier in the download section of this chapter, the product is generic and is packaged in one archive for several environments; thus, running TOSBD is just a matter of choosing the right executable file in the installation directory.

All executable filenames have the same syntax:

`TOS_BD-[Operating system]-[Architecture]-[Extension]`

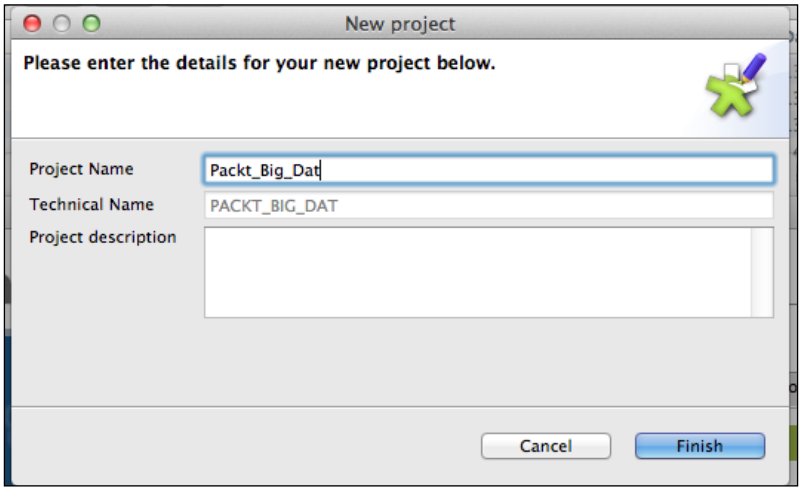
Then, to run `TOS_BD` on a 64-bit Windows machine, `TOS_BD-win-x86_64.exe` should be run, `TOS_BD-macosx-cocoa` for Mac, and so on. Just choose the one that fits your configuration.

The first time you run the studio, a window will pop up asking to accept the terms of use and license agreement; once accepted, the project configuration wizard will appear. It presents the existing project, in our case, only the default demo project exists. The wizard also proposes to import or create a project.

When you work with Talend products, all your developments are regrouped in a project, which is then stored in a workspace with other projects.

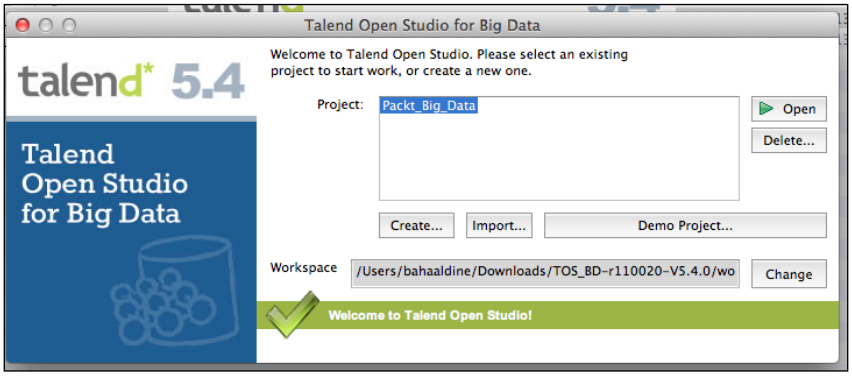
We are now going to create the project, which will contain all development done in this book. In the project wizard, perform the following steps:

- Click on the **Create** button to open the project details window as shown in the following screenshot:



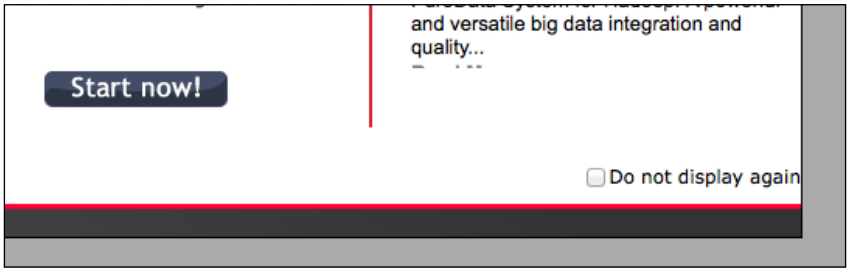
Project details window

- Name your project; I've set the name to `Packt_Big_Data`; you don't really need the underscores, but you might guess that's just a habit of mine.
- Click on **Finish**; you are now ready to run the studio:



TOSBD project configuration done

- A window will appear to let you create a Talend Forge account, which is really useful if you want to get the latest information on the products, interact with the products community, get access to the forum and also to the bug tracker (Jira), and more. So my advice would be to create an account or click on **Ignore** if you already have one.
- The studio will load all Big Data edition components and then open the welcome window, scroll down in the window, and check the **Do not display again** checkbox for the next studio boot as shown in the following screenshot:



Studio welcome page

- You are now ready to start developing your first Talend Big Data job!

Summary

So far, we have learned the difference between Talend Unified Platform and Talend Community Edition, and also how fast it is to set up a Talend Open Studio for Big Data development environment.

In the next chapter, we'll learn how to build our first job and discover a couple of best practices and all the main features of TOSBD.

2
Building Our First Big Data Job

This chapter will help you to understand how the development studio is organized and then how to use TOSBD components to build Big Data jobs.

In this chapter, we will cover the following:

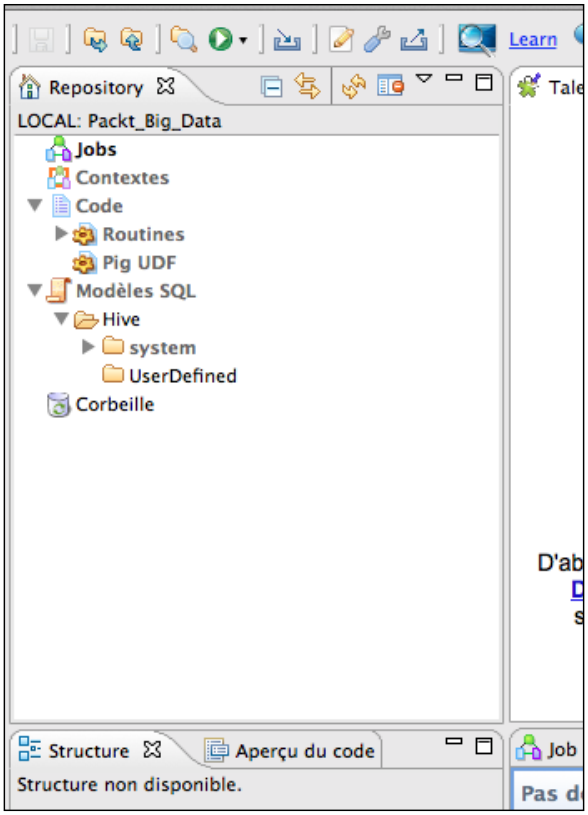
- TOSBD – the development environment
- Configuring the Hadoop HDFS connection
- Writing a simple job that writes data in Hadoop HDFS
- Running the job
- Checking the result in HDFS

TOSBD – the development environment

We are ready to start developing our Big Data jobs, but before diving into serious things, be my guest and have a nickel tour of the studio.

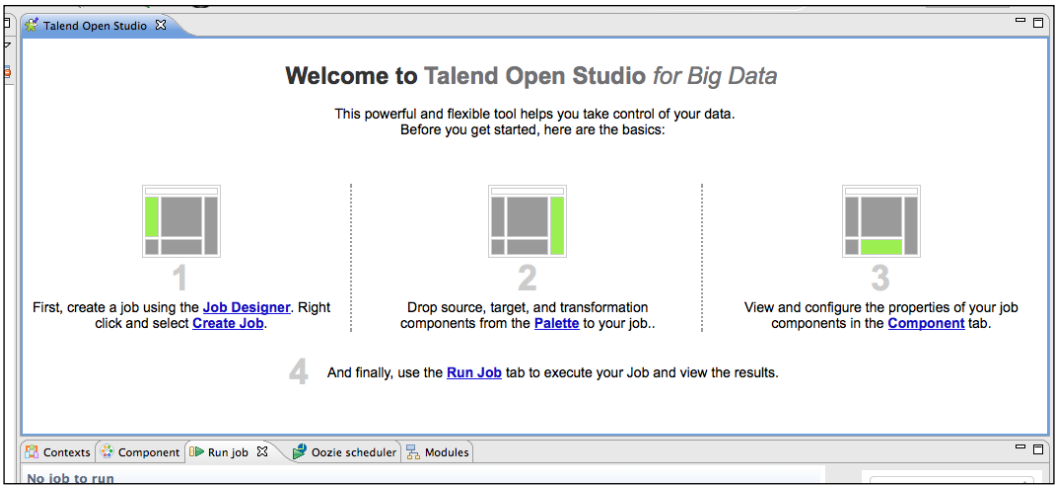
The studio is divided into the following parts:

- The **Repository** view on the left contains all the technical artifacts designed in the studio, such as jobs, context variables, code, and connection resources, as shown in the following screenshot:



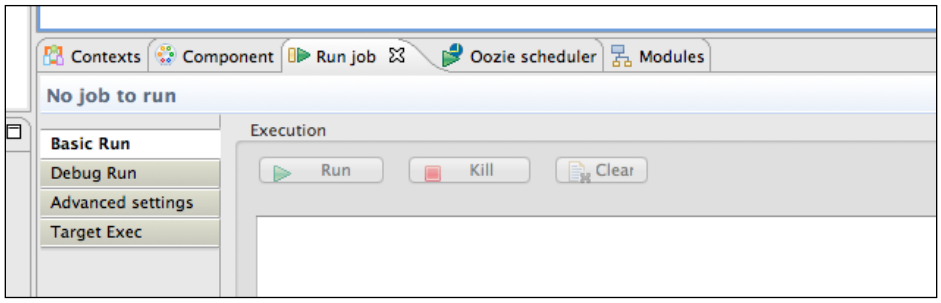
The TOSBD Studio's Repository view

- In the center, there is a design view in which the graphical implementation takes place, and various components are arranged to create a job according to the business logic. Here, the developer just drags and drops components from the **Palette** view to the design view and connects them to create a job, as shown in the following screenshot (remember that Talend is a code generator, so anything contained in the design view is actually a piece of the generated code. The design view contains a code; you can switch from the design view to read the generated code):



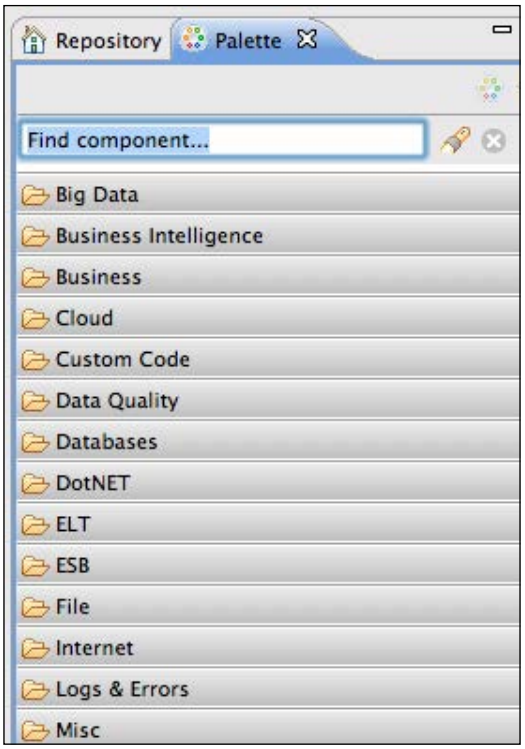
The design view

- The properties and controls view is where you will get all information on your job, used context, components, and modules, and also have the ability to run a job in the studio without having to deploy it, as shown in the following screenshot:



The properties and controls view

- The last view is the **Palette** view, which by default is placed on the left-hand side of the studio; I manually move it next to the **Repository** view for the convenience of design. You can see the **Palette** view in the following screenshot:



TOSBD's Palette view

- The **Palette** view contains all the 500+ Talend components required to create a job.
- The last detail is about the perspective buttons located in the top-right corner, where you can switch from a studio resolution to the others. The main benefit if you ever switch to the commercial edition is that you will be able to switch between two products just by clicking on the button.

A simple HDFS writer job

In this part, we will learn how to create a Talend job, which uses an HDFS component to write in the Hadoop distributed file system.

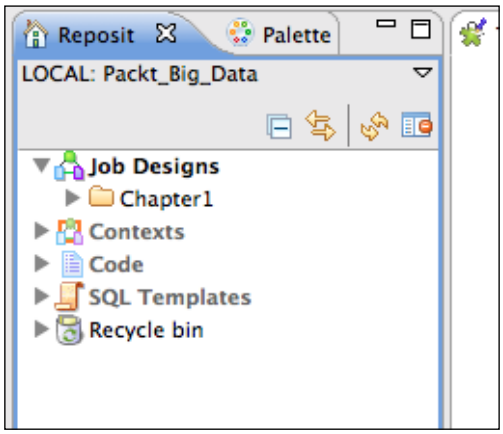
To do so, we'll need a Hadoop distribution, and fortunately, most of the software vendors are providing some quick-start virtual machines to be able to kick off a Big Data project.

From my side, I'm going to use a Cloudera CDH VM, which you also must have downloaded as mentioned in the previous chapter.

If you have installed and set up your VM as described in the *Appendix, Installing Your Hadoop Cluster with Cloudera CDH VM* you are ready to create your first job.

We will organize our studio's workspace and create a folder for each chapter by performing the following steps:

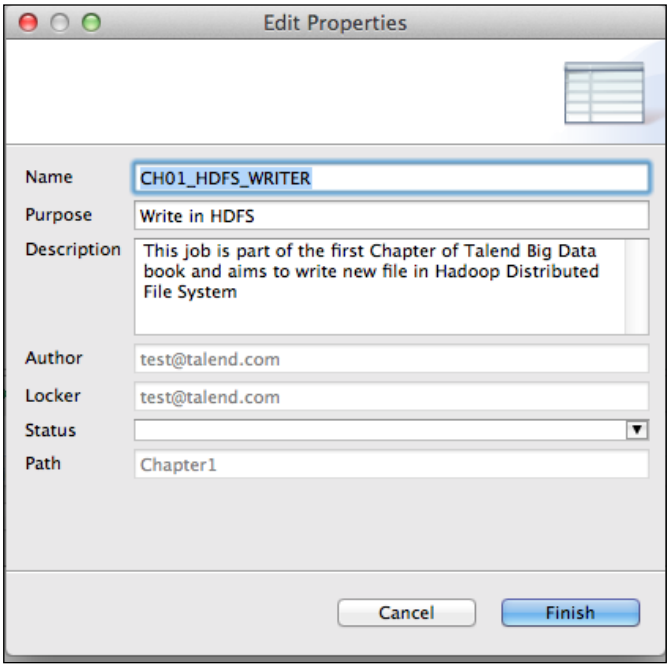
1. In the **Repository** view, right-click on **Jobs** and click on **Create Folder**.
2. Type `Chapter1` and click on **Finish**. You will be able to see the `Chapter1` folder, as shown in the following screenshot:



The workspace's structure

3. We will now create a new job in this new folder by right-clicking on it and choosing **Create Job**. A window will appear to give all the details of the job; just add the following properties and leave the rest blank, as they are not really useful, as shown in the next screenshot:
    - **Name**: `CH01_HDFS_WRITER`
    - **Goal**: `Write in HDFS`

- **Description**: This job is part of the previous chapter of the Talend Big Data book and aims to write a new file in the Hadoop distributed file system

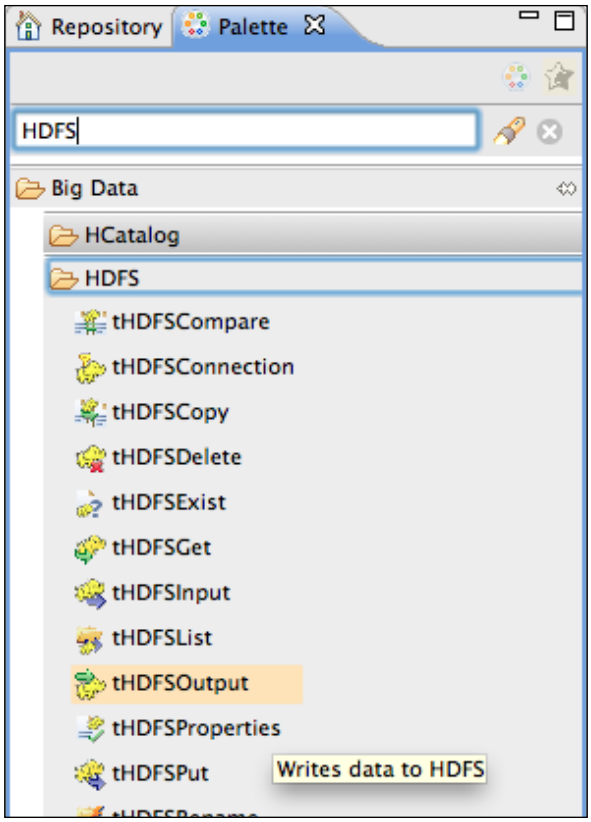


Create a new job

4. When your job is opened, you will see a complete list of components in the **Palette** view, from application components such as SAP connectors, to database, file, and so on. The complete list of components is available on this link: `http://talendforge.org/components/`.

   Take a deep breath; more than 500 components are waiting for you there!

5. For your brain sake, **Palette** contains a search box to filter the components; type `HDFS` as the keyword, and press *Enter* to see all the related components, as shown in the following screenshot:

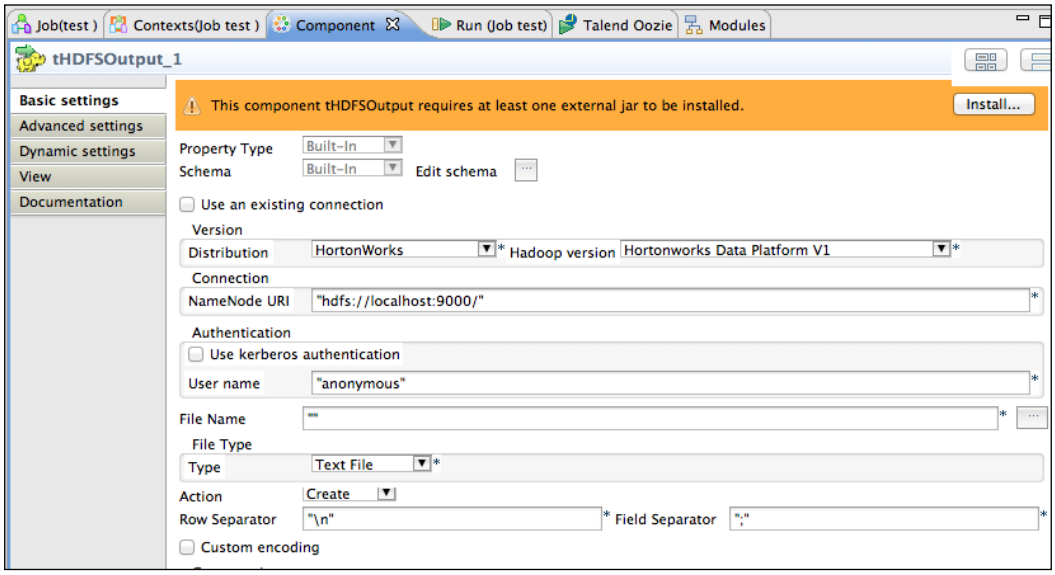


HDFS components

6. In Talend, reading and writing components end with the words `Input` and `Output` respectively. As we want to write in HDFS, we will use the `tHDFSOutput` component. Other components are described in detail in the documentation; their names give you a good idea of what they are used for.

Selecting a component and pressing *F1* will print the documentation related to the component, along with the complete description of all the properties and also example scenarios.

7. Drag-and-drop the **tHDFSOutput** component in the design view and double-click on the component; the properties view should show all the information of the component, as shown in the following screenshot:



tHDFSOutput properties

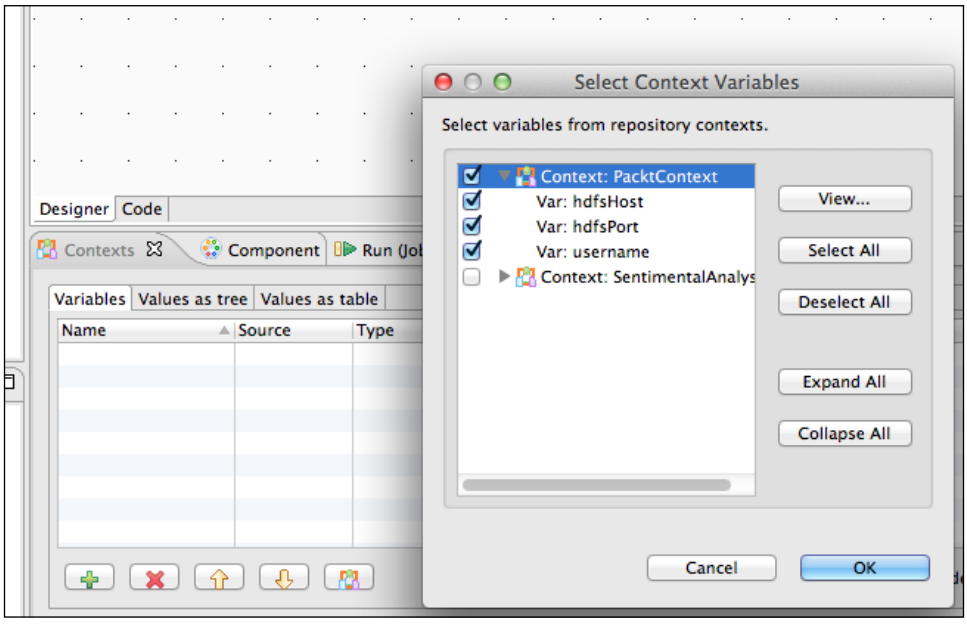
8. As you can see, the preceding view lets you configure the component properly, depending on the distribution you want to use, your Hadoop distribution, the security, and so on.
9. We will be notified that a JAR file is missing in the studio, in order to use the component. This is because some JAR files and drivers are provided under a license that cannot be embedded in the Talend package. We can embed them by performing the following steps:
    1. Click on the **Install** button.
    2. Then in the pop up, follow the instructions to download and install the JAR.
10. If everything went well during the installation, the notification should have disappeared.
11. So, the idea is to write in HDFS a simple file in a specific directory. To do that, we'll need to configure our component to fit our environment. Instead of hardcoding each property, we'll use the Talend Context feature to externalize all properties, and will enrich this context throughout the book. In the **Repository** view:

1. Right-click on the **Contexts** node and choose **Create context group**.
2. Name the group as `PacktContext` and click on the **Next** button.
3. Add three variables and switch to the **Values as Table** tab to set the following default values:

Name	Value
hdfsHost	CLOUDERA_VM_HOST_IP for example, `172.16.253.202`
hdfsPort	`8020`
username	`YOUR_USERNAME` (as seen in the VM setup Appendix) for example, `bahaaldine`

4. Click on the **Finish** button.

12. You will see throughout the book that contexts are really convenient and are anyway part of the Talend design's best practices. To use the context group in our job, just switch to the **Contexts** tab in the property view and click on **Select Context Group**, then select **PacktContext** and all the defined variables to add them to the job, as shown in the following screenshot:

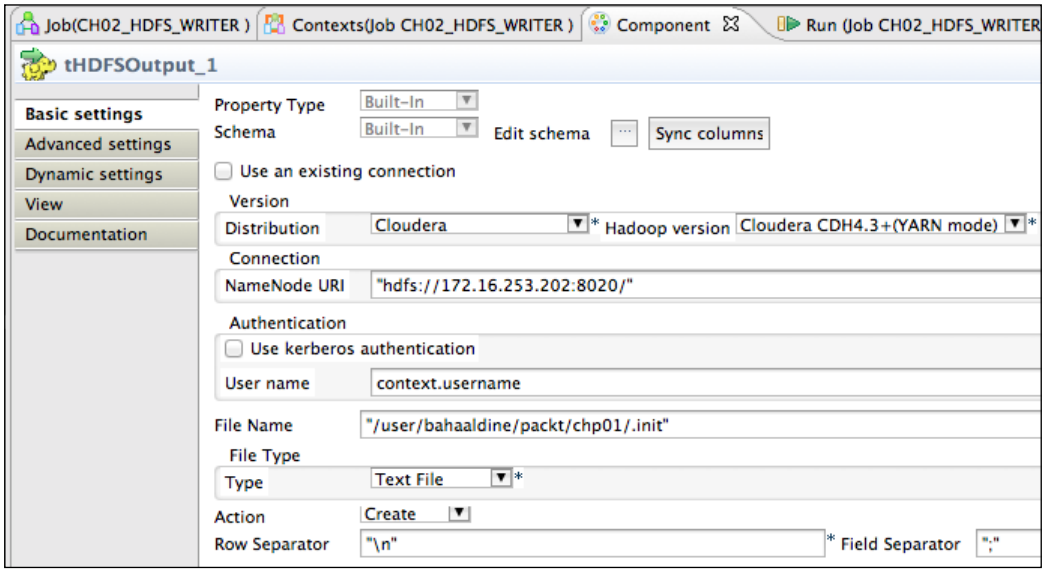


The Contexts tab and the Select Context Group

13. We are ready to configure the `tHDFSOutput` component by just setting the following properties and keeping the rest as default:

Name	Value
Distribution	`Cloudera`
Hadoop version	`Cloudera CDH4.3+(YARN mode)`
NameNode URI	`"hdfs://"+context.hdfsHost+":"+conte context.hdfsPort+"/"`
User name	`context.username`
File Name	`"/user/"+context.username+"/packt/ chp01/.init"`

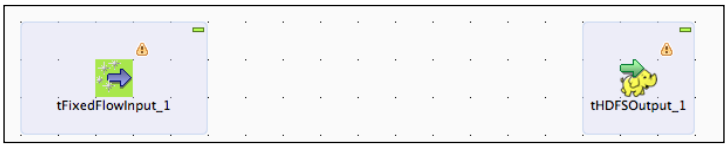
The following screenshot shows the **tHDFSOutput_1** component's properties, as discussed in the preceding table:



The tHDFSOutput_1 component's settings

As you can see in the property view, we will create subdirectories under `user/username/` and an empty file called `.init`.

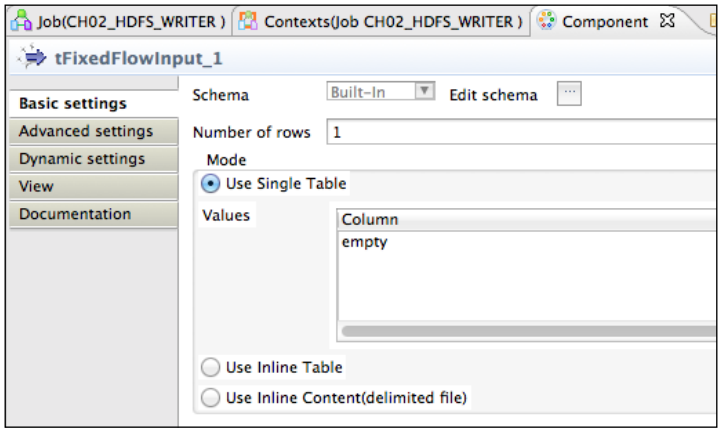
14. The job, as it is, cannot run; we need an entry point that triggers the `tHDFSOutput_1` component. To do that, we'll use the `tFixedFlowInput_1` component for which I recommend that you read the documentation. Basically, this component is used to start the job's data flow with a custom data schema, custom constant, or variable data row, and by setting the number of rows the component should iterate.
15. Search the component in the **Palette** view and drag-and-drop it in the design view, as shown in the following screenshot:



Two components to reign on HDFS

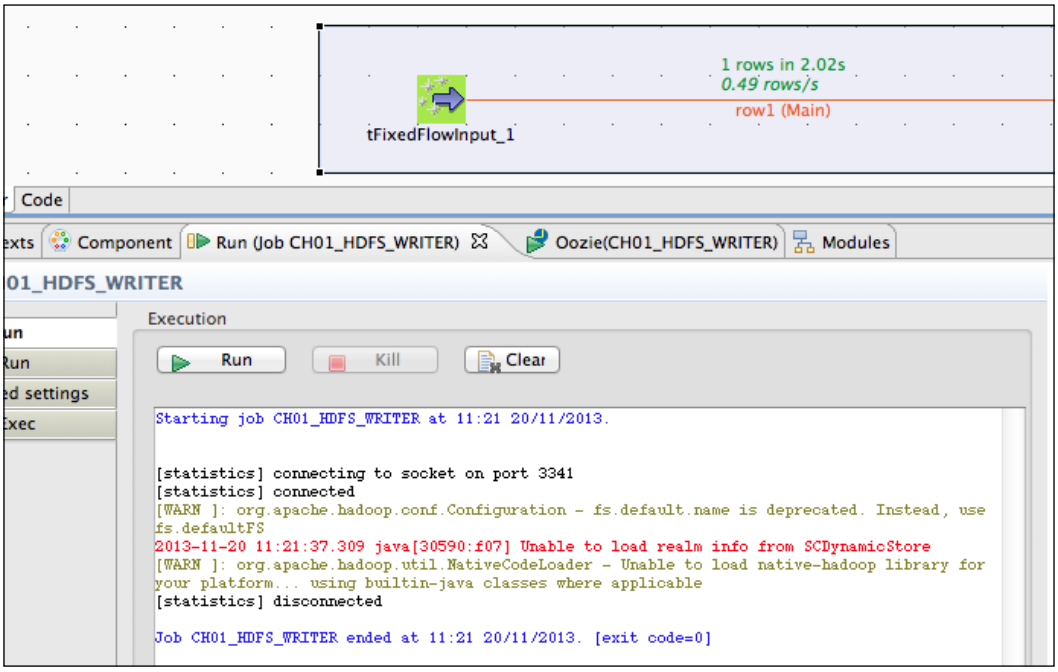
16. We need to configure the `tFixedFlowInput` component to send a row, which will trigger the writing of our second component. However, we don't need data in the row; we'll just create an empty row by performing the following steps:
    1. Click on the component, and in the **Component** tab of the property view, click on the **Edit schema** button.
    2. Add a new column called `empty`.
    3. Right-click on the component and choose **Row / Main**, and then connect it to **tHDFSOutput** to finish the job design.

    The following screenshot shows the **tFixedFlowInput_1** component's properties:



The tFixedFlowInput component's settings

17. We are now ready to run the job and see what happens on HDFS:
    1. In the property view, choose the **Run** tab and click on the **Run** button.
    2. You should get the following output:



HDFS write output

18. Finally, we'll check that the job has done its job!

Checking the result in HDFS

To check if everything went well, we need to browse to HDFS and see if the `empty.init` file has been created. To do so, connect via SSH or directly through a terminal in your Cloudera VM, and issue the following command:

```
$ hadoopfs –ls /user/bahaaldine/packt/chap01
```

The following output will appear:

```
-rw-r--r--   3 bahaaldinesupergroup          1 2013-11-20 02:15 /user/
bahaaldine/packt/chp01/.init
```

`hadoopfs` is the command-line utility to interact with HDFS; it supports all the basic shell commands such as `ls`, `tail`, `mkdir`, `cat`, and many others. For more information, I recommend that you read the documentation at `http://hadoop.apache.org/docs/r0.19.1/hdfs_shell.html`.

Summary

At this point, we have learned how to use the different views in TOSBD and how to build a job and configure its components. We have also discussed how to use the basic HDFS commands to interact with the filesystem.

In the next chapter, we will pass a level and focus on Twitter Sentiment Analysis.

3
Formatting Data

In this chapter, we will be introduced to Twitter Sentiment Analysis, and see how we can format raw tweets into usable tweets. We will:

- Start by writing data into our Hadoop distributed file system
- Set up our Apache Hive environment to keep a reliable data structure

Twitter Sentiment Analysis

Sentiment analysis is one of the topics that you may have met with some of the most popular social network analytics tools. The goal of such analysis is to determine what people are feeling regarding a specific topic.

Twitter is a good candidate for sentiment analysis because of the tweet structure. The following is the one from the provided data set:

```
Sun Mar 17 08:33:59 CET 2013 (Nats25) OH MY GOOOOOOOD! Why am
I awake L
```

We can see that the author is obviously not happy with the fact that he's awake so early on a Sunday morning. What if we could relate certain words or topics with certain emoticons? We could then get the mood of authors regarding their tweets. What if the word is a company name? Now you may understand the stakes behind the scene.

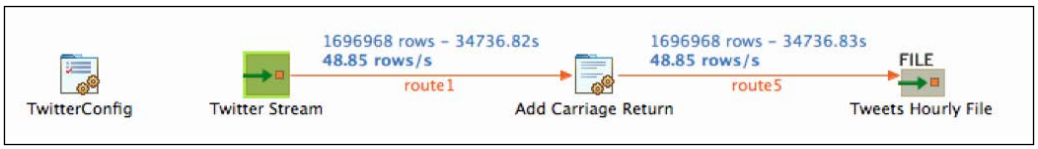
So, the purpose of all the later chapters is to create and set up all the required technical assets to implement the Twitter Sentimental Analysis. What we want here is to:

- Write tweet files on HDFS
- Transform the raw tweets into usable tweets using Apache Hive

- Extract hashtags, emoticons, and build sentiments still with Hive
- Reveal tops hashtags, emoticons, and sentiments with Apache Pig
- Export dry data to RDBMS wwith Apache Sqoop

Writing the tweets in HDFS

For convenience, we'll only work on one 60 MB tweet file, but real-life use cases are worked on several GB files. This file was generated with a Talend ESB Job that uses the Twitter streaming component, as shown in the following diagram:



If you have reached this part, this step should be easy because it's very close to what we did in the previous chapter.

The purpose here is to create a Job, which consumes our tweets like a file, but more than just consuming, we want to add some structure to our file before writing it to HDFS.

As you may have noticed in the previous part of this chapter, a tweet structure extracted with Talend ESB looks like the following one:

```
Sun Mar 17 08:33:59 CET 2013 (Nats25) OH MY GOOOOOOOD! Why am
I awake L
```

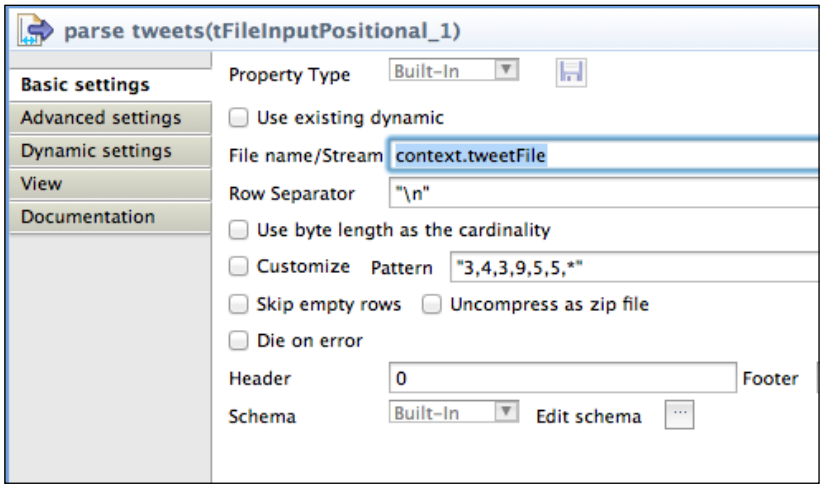
It contains:

- Day of the week
- Month
- Day of the month
- Time
- Zone
- Year
- Username
- Content

So, we will use a `tFileInputPositional` component to read our file and extract the columns of our tweets as follows:

1. Create a new Job called `CH02_01_HDFS_WRITING_TWEETS` under a new `Chapter2` folder.
2. Drag-and-drop a **tFileInputPositional** component from the palette.
3. Drag-and-drop an **HDFSOutput** component.

The first component reads data depending on the column position and length, so we need to create a schema and configure the column pattern. Double-click on the component and click on the **Edit schema** button in the component property view, as shown in the following screenshot:

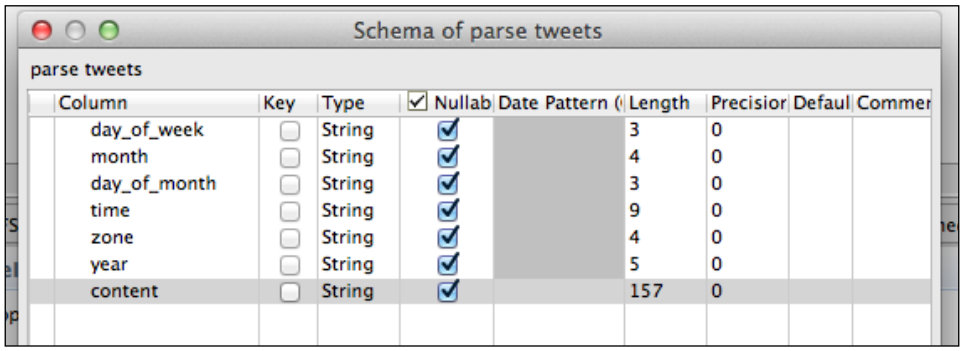


The Edit schema button

Click on the **Edit schema** button to add the following columns:

Name	Type
`day_of_week`	`String`
`month`	`String`
`day_of_month`	`String`
`time`	`String`
`zone`	`String`
`year`	`String`
`content`	`String`

The following screenshot shows the resulting schema configuration:



The tFileInputPositional schema

The following table contains a context variable whose value is set to the tweet files path. Create a new context variable and add the context with all variables to your Job:

Name	Type
`tweetFilePath`	`PATH_TO_YOUR_TWEET_FILE`

Finalize the component configuration with the following properties:

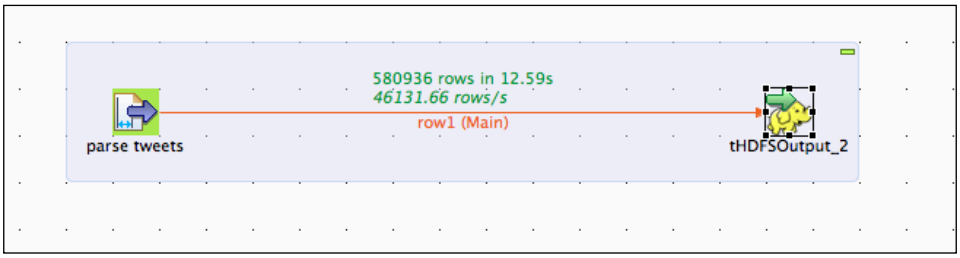
Name	Type
File name / Stream	`context.tweetFilePath`
Row separator	`\n`
Pattern	`"3,4,3,9,5,5,*"`

We now need to configure the `tHDFSOutput` component in the same way as we have done in *Chapter2, Building Our First Big Data Job,* but with one difference in the file path property, as given in the following table:

Name	Type
File name / Stream	`"/user/bahaaldine/packt/chp02/tweet.log "`

Link the `tFileInputPositional` component to the `tHDFSOutput` component and run the Job. Your Job should have sent all the tweets contained in the file.

The following diagram shows the Job execution; we can see that **580936** tweets had been written in HDFS.



Write tweets in HDFS

Do not hesitate to check in HDFS if the file has been properly written.

Setting our Apache Hive tables

Before trying to format our data, we need to create a data structure over HDFS to be able to manipulate the data in a convenient way. Apache Hive is a project of the Hadoop ecosystem, which adds an abstraction layer over HDFS and lets the user interact with the data using a SQL-like language called HiveQL. Because we don't want to directly request the big raw files stored in our Hadoop file system, we'll use Hive to:

- Create the tables representing the tweet structure contained in the files
- Format the data using **Hive User Defined Function** (**UDF**)

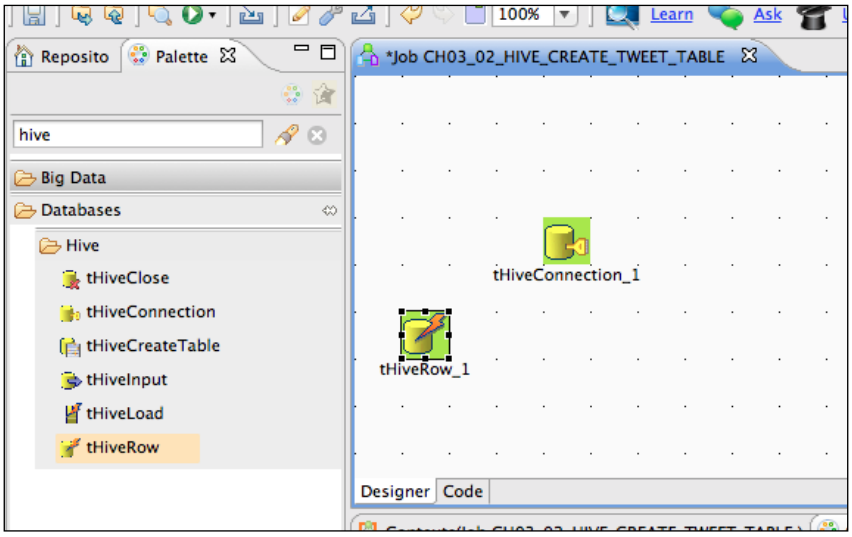
More information on Hive can be found at `http://hive.apache.org/`.

Let's dive into the first step and create a new Job to build our tweets table.

Since we have a better vision of the table, we should create a table to store our tweets. Thanks to the previous part in which we have seen all the required columns. We will create one table by performing the following steps:

1. Create a new Job `CH02_02_HIVE_CREATE_TWEET_TABLE` in the repository under the `Chapter2` folder.
2. Type `hive` as the keyword in the palette search box and press *Enter*.

3. Drag-and-drop one **tHiveConnection** component and three **tHiveRow** components in the design view, as shown in the following screenshot:



Creating our new Hive Job

Basically, we need to connect to Hive with the `tHiveConnection` component and then select the proper Hive database, drop the tweet table if it already exists, and recreate it. I usually create such a Job to not only create tables for the first instance but also recreate them to initialize my environment when needed. To get a better understanding of our Job, we'll rename the different components by performing the following steps:

1. Double-click on a component.
2. In the property view, choose the **Component** view panel and change the label format for each component as follows:
    - The `tHiveConnection` label should be renamed to `connection to hive`
    - The `tHiveRow` label should be renamed to `use default database`
    - The `tHiveRow` label should be renamed to `drop the table tweets`
    - The `tHiveRow` label should be renamed to `create the table tweets`

We'll use the context group that we have created in *Chapter 2*, *Building Our First Big Data Job*, and add the following variables related to Hive:

Name	Value
hiveHost	CLOUDERA_VM_HOST_IP ex: 172.16.253.202
hivePort	9083
JTHost	CLOUDERA_VM_HOST_IP ex: 172.16.253.202
JTPort	8021

As we are working in a pseudo-distributed mode with only one node, each service is hosted on the same VM so that the hosts are the same. But in the production mode, services can be distributed in several nodes, and the host and port can differ.

We'll use these variables to establish the connection to our Hive environment by performing the following steps:

1. In the property view **Contexts** tab, add the context and all available variables to the Job.
2. Double-click on the **tHiveConnection** component.
3. Set the following component properties:

Name	Value
Distribution	Cloudera
Hadoop Version	Cloudera CDH4.3+(YARN mode)
Connection mode	Embedded
Hive Server	Hive 1
Host	context.hiveHost
Port	context.hivePort
Set JobTracker URI	Checked with URI: context.JTHost+":"+context.JTPort
Set Namenode URI	Checked with URI: "hdfs://"+context.hdfsPort+":"+context.hdfsPort

You may have noticed that we need to install a JAR file to be able to use the `tHiveConnection` component; just click on the **Install Jar** button and follow the instructions.

Now that our Hive connection is properly configured, we can use this connection for each `tHiveRow` component by performing the following steps:

1. Double-click on the component.
2. In the property view, check the **Use an existing connection** checkbox.
3. Be sure **tHiveConnection 1** is selected in the drop-down list.

Each `tHiveRow` component basically consists of HiveQL queries that interact with our Hive server. Let's configure this component by performing the following steps:

1. The first Hive component selects the right database by using the following command:

   ```
   use default
   ```

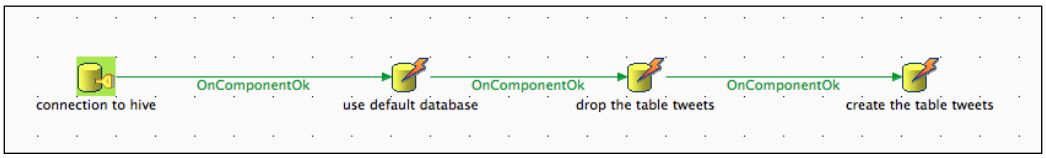
2. The second component drops the existing tweets table by using the following command:

   ```
   DROP TABLE IF EXISTS tweets
   ```

3. The third one create a new tweets table as follows:

   ```
   CREATE EXTERNAL TABLE tweets
   (day_of_week string, mont string, day_of_month string, time
   string, zone string, year string, username string, content string)
   ROW FORMAT DELIMITED FIELDS TERMINATED BY ';'
   LOCATION '/user/"+context.username+"/packt/chp02
   ```

4. We set the delimiter to the semicolon, and the data location to the directory where we have written the tweets file.
5. Connect the component by right-clicking on it and choosing **onComponent Ok** for each of them. At the end, your Job should look as follows:



Hive creates tweets table

Checking in Hive if the table has been created is pretty easy; just open a terminal in your Cloudera VM and issue the following commands:

- `$ hive`: This command connects to the Hive server and opens the Hive command-line tool
- `$ use default`: This command selects the database
- `$ desc tweets`: This command shows tweets table description and prints the following information:

```
hive> desc tweets
    > ;
OK
day_of_week     string
mont    string
day_of_month    string
time    string
zone    string
year    string
content string
hours   int
Time taken: 0.351 seconds
```

The Hive tweet table's description

Formatting tweets with Apache Hive

In this last part of the Hive integration process, we now need to create a formatted tweet table and separate the content into the following two parts:

- The effective content of the tweet
- The username of the tweet author

We are doing this because so far we only have the merged content and we couldn't determine who is the most active user on a specific topic. This is very useful, for example, for a political party to get a list of the tough leaders during the electoral period. As you understood the added value can be really significant, we need to proceed with the following steps to reach to this goal:

1. Right-click on **CH02_02_HIVE_CREATE_TWEET_TABLE** and duplicate it into a new `CH02_03_HIVE_FORMAT_DATA` Job under the `Chapter2` folder.
2. Modify the third `tHiveRow` component and change the dropped table name using the following command:

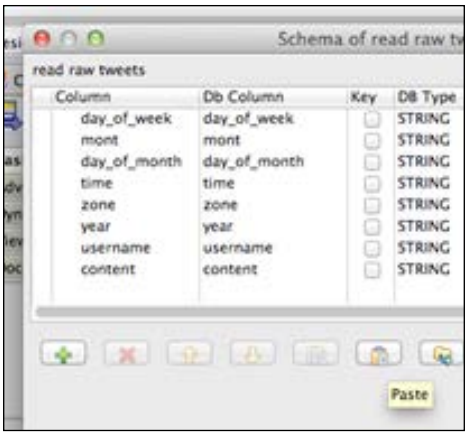
   ```
   DROP TABLE IF EXISTS formatted_tweets
   ```

3. Modify the request in the last `tHiveRow` component to change the table name, add a new username column, and change the data location folder using the following command:

```
CREATE EXTERNAL TABLE formatted_tweets (day_of_week string, mont
string, day_of_month string, time string, zone string, year
string, username string, content string) ROW FORMAT DELIMITED
FIELDS TERMINATED BY ';' LOCATION  '/user/"+context.username+"/
packt/chp02/formatedTweets"
```

So far, we only have the part that creates a `formatted_tweets` table over HDFS, but we need to use the Talend Hive ELT features to feed the formatted tweets HDFS folder. This is done by performing the following steps:

1. From the palette, drag-and-drop a **tHiveELTInput** component, a **tHiveELTMap** component, and a **tHiveELTOutput** component. ELT components, as compared to ETL components, execute the transformation / mapping code on the related technology server, whereas ETL components execute the processing code on Talend server. This means that, here, the Hive-generated transformation code will be executed on our Hadoop server.
2. In the `tHiveELTInput` component, we need to specify the source table name, which is `tweets` here, and specify the schema. To avoid creating each column manually again in the edit schema section, go to the previous `CH02_01` Job, click on **Edit schema** of the `tHDFSOutput` component, and copy all the columns present in the schema by selecting all the columns and using the Copy button next to the down arrow:



The Hive tweet table's description

3. Go back to our new Job, click on the **Edit schema** button of the `tELTInput` component, and paste the schema, as shown in the preceding screenshot.
4. Paste it also in the `tELTOutput` component and add a username column before the last content column.
5. Link the `tELTInput` component to the `tELTMap` component.
6. Link the `tELTMap` component to the `tELTOuput` component; the new output creation dialog will appear; name it like our new table `formatted_tweets`.
7. We need to map the source data to the target column; some are the same, whereas others need to call a Hive user-defined function. Instead of mapping them one by one, click on the **Auto Map** button in the top-right corner and then modify the mapping for the following columns:

Target	Source
`username`	`regexp_replace( split(tweets.content,'\\\\)')[0], '\\\\ (', '')`
`content`	`substr(tweets.content, locate(')', tweets.content)+2)`

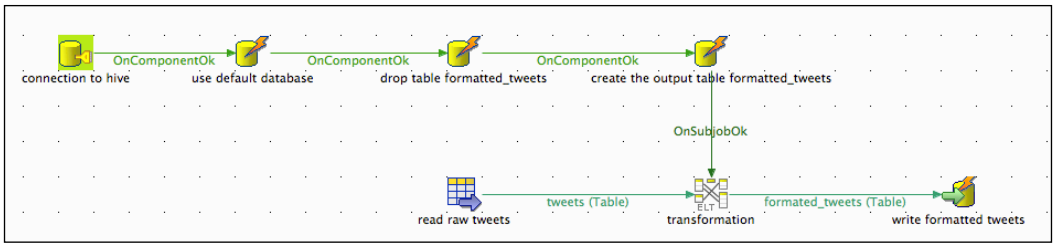
The first expression contains a nested `split` expression, which first splits the content where the first closing bracket occurs and gets the first element in the return array.

If we apply this to the previous example, we would get the following result : `(Nats25`

Then second part of the expression uses the `regexp_replace` function to delete the opening brackets. If we take the result of the first part, then we should get the username without any brackets, which is, `Nats25`.

The second expression is just a substr expression, which extracts the tweet content from the first closing bracket to the end of the tweet content.

You should have two parts in the Job, the first is the table initialization and the second is the table data feed. To link both of them, click on the last **tHiveRow** component and choose **Trigger/OnSubjob Ok** and link it to the **tELTHiveMap** component. Thus, the second part of the Job will be triggered when the first is finished.



The Hive tweet formatting Job

Run the Job and check in Hive if the table has been created and fed by issuing the following command in the Hive command-line tool:

```
$ select * from formatted_tweets
```

You should see that now, the username and the content are separated.

Summary

In this chapter, we have learned that TOSBD can help to graphically design the Hive data integration process and even go further by providing a graphical mapping tool to ease the transformation required in Twitter Sentiment Analysis. In the next chapter, we'll go a little bit deeper in using Hive, by introducing the concept of custom user-defined functions, and also a lateral view, to extract top values from our formatted data.

4
Processing Tweets with Apache Hive

In this chapter, we'll learn how to use tweets to highlight sentiments by performing the following actions:

- Extracting hashtags and emoticons from tweets
- Joining the newly created hashtags and emoticon tables to create sentiments

Extracting hashtags

In this part and the following one, we'll see how to extract data efficiently from tweets such as hashtags and emoticons. We need to do it because we want to be able to know what the most discussed topics are, and also get the mood across the tweets. And then, we'll want to join that information to get people's sentiments.

We'll start with hashtags; to do so, we need to do the following:

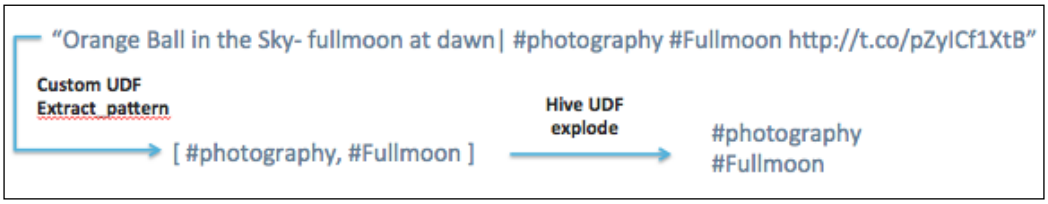
1. Create a new hashtag table.
2. Use a function that will extract the hashtags from the tweet string.
3. Feed the hashtag table with the result of the extracted function.

So, I have some bad news and good news:

- Bad news: Hive provides a lot of built-in user-defined functions, but unfortunately, it does not provide any function based on a regex pattern; we need to use a custom user-defined function to do that. This is such a bad news as you will learn how to do it.

- Good news: Hive provides an extremely efficient way to create a Hive table from an array. We'll then use the lateral view and the Explode Hive UDF to do that.

The following is the Hive-processing workflow that we are going to apply to our tweets:



Hive-processing workflow

The preceding diagram describes the workflow to be followed to extract the hashtags. The steps are basically as follows:

1. Receive the tweets.
2. Detect all the hashtags using the custom Hive user-defined function.
3. Obtain an array of hashtags.
4. Explode it and obtain a lateral view to feed our hashtags table.

This kind of processing is really useful if we want to have a feeling of what the top tweeted topics are, and is most of the time represented by a word cloud chart like the one shown in the following diagram:

Topic word cloud sample

Let's do this by creating a new `CH04_01_HIVE_PROCESSING_HASH_TAGS` job under a new `Chapter4` folder. This job will contain six components:

- One to connect to Hive; you can easily copy and paste the connection component from the `CH03_03_HIVE_FORMAT_DATA` job
- One `tHiveRow` to add the custom Hive UDF to the Hive runtime classpath

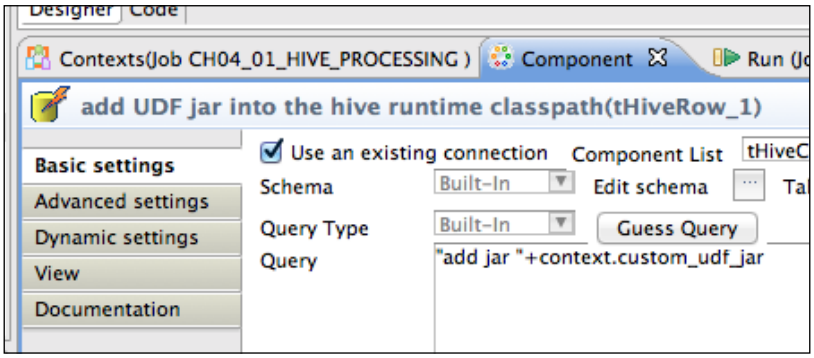
The following would be the steps to create a new job:

1. First, we will add the following context variable to our PacktContext group:

Name	Value
`custom_udf_jar`	`PATH_TO_THE_JAR` For example: `/Users/bahaaldine/here/is/the/jar/extractHashTags.jar`

   This new context variable is just the path to the Hive UDF JAR file provided in the source file

2. Now, we can add the `"add jar "+context.custom_udf_jar` Hive query in our `tHiveRow` component to load the JAR file in the classpath when the job is being run.
3. We use the `add jar` query so that Hive will load all the classes in the JAR file when the job starts, as shown in the following screenshot:



Adding a Custom UDF JAR to Hive classpath.

4. After the JAR file is loaded by the previous component, we need `tHiveRow` to register the custom UDF into the available UDF catalog. The custom UDF is a Java class with a bunch of methods that can be invoked from Hive-QL code. The custom UDF that we need is located in the `org.talend.demo` package of the JAR file and is named `ExtractPattern`. So we will simply add the `"create temporary function extract_patterns as 'org.talend.demo.ExtractPattern'"` configuration to the component.

   We use the `create temporary function` query to create a new `extract_patterns` function in Hive UDF catalog and give the implementation class contained in our package

5. We need one `tHiveRow` to drop the hashtags table if it exists. As we have done in the `CH03_02_HIVE_CREATE_TWEET_TABLE` job, just add the `"DROP TABLE IF EXISTS hash_tags"` drop statement to be sure that the table is removed when we relaunch the job.
6. We need one `tHiveRow` to create the hashtags table. We are going to create a new table to store the hashtags. For the purpose of simplicity, we'll only store the minimum time and description information as shown in the following table:

Name	Value
hash_tags_id	String
day_of_week	String
day_of_month	String
time	String
month	String
hash_tags_label	String

7. The essential information here is the `hash_tags_label` column, which contains the hashtag name. With this knowledge, the following is our create table query:

```
CREATE EXTERNAL TABLE hash_tags (
hash_tags_id string,
day_of_week string,
day_of_month string,
time string,
month string,
```

```
hash_tags_label string)
ROW FORMAT DELIMITED FIELDS TERMINATED BY ';' LOCATION
  '/user/"+context.hive_user+"/packt/chp04/hashtags'
```

Nothing new here, just a new table as we have created in the previous chapter.

8. Finally we need a `tHiveRow` component to feed the hashtags table. Here, we are going to use all the assets provided by the previous components as shown in the following query:

```
insert into table hash_tags
select
concat(formatted_tweets.day_of_week,   formatted_tweets.
day_of_month,
formatted_tweets.time, formatted_tweets.month) as hash_id,
formatted_tweets.day_of_week, formatted_tweets.day_of_month,
formatted_tweets.time,
formatted_tweets.month,
hash_tags_label
from formatted_tweets
LATERAL VIEW explode(
  extract_patterns(formatted_tweets.content,'#(\\\\w+)') )
hashTable as hash_tags_label
```

Let's analyze the query from the end to the beginning. The last part of the query uses the `extract_patterns` function to parse in the `formatted_tweets.content all` hashtags based on the regex `#(+)`.

In Talend, all strings are Java string objects. That's why we need here to escape all backslash. Hive also needs special character escape, that brings us to finally having four backslashes.

The `extract_patterns` command returns an array that we inject in the exploded Hive UDF in order to obtain a list of objects. We then pass them to the lateral view statement, which creates a new on-the-fly view called `hashTable` with one column `hash_tags_label`. Take a breath. We are almost done.

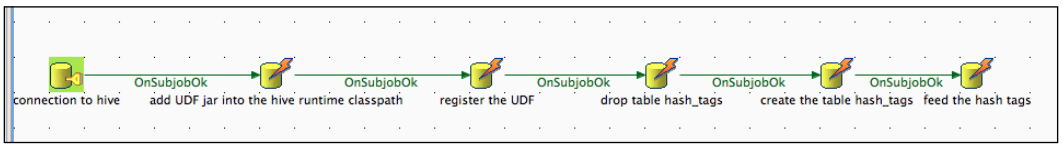
If we go one level up, we will see that we selected all the required columns for our new `hash_tags` table, do a concatenation of data to build `hash_id`, and dynamically select a runtime-built column called `hash_tags_label` provided by the lateral view.

Finally, all the selected data is inserted in the `hash_tags` table.

We just need to run the job, and then, using the following query, we will check in Hive if the new table contains our hashtags:

```
$ select * from hash_tags
```

The following diagram shows the complete hashtags-extracting job structure:



Hive processing job

Extracting emoticons

I think you have guessed that it is exactly the same job for emoticons. Instead of running into details for each step, like we did for the hashtags, it will be a good exercise for you to duplicate the hashtags job and adapt it for the emoticons, keeping in mind the following requirements:

- Create a new `CH04_01_HIVE_PROCESSING_EMOTICONS` job
- The emoticons table named `emoticons` has the following structure:

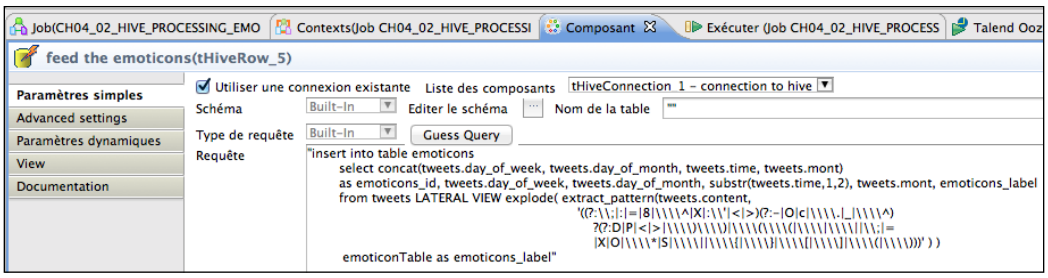
Name	Value
`emoticons_id`	`String`
`day_of_week`	`String`
`day_of_month`	`String`
`time`	`String`
`month`	`String`
`emoticons_label`	`String`

- The following is a regex pattern I've built for emoticons:

```
((?:\\;|:|=|8|\\\\^|X|:\\'|<|>)(?:-|O|c|\\\\.|_|\\\\^)?(?
:D|P|<|>|\\\\)\\\\)|\\\\(\\\\(|\\\\|\\\\||\\;|=|X|O|\\\\*
|S|\\\\||\\\\{|\\\\}|\\\\[|\\\\]|\\\\(|\\\\)))
```

One word crosses my mind when I read fat. In case you want to learn more about regular expressions, I recommend that you read a documentation from Mozilla at `https://developer.mozilla.org/en-US/docs/Web/JavaScript/Guide/Regular_Expressions`, which gives a detailed description of all regular expressions. Also, if you want to test your regex, then I recommend an online Ruby tool, which is really convenient and efficient for debugging, and can be found at `http://rubular.com/`.

- The following is a screenshot of what the `tHiveRow` configuration and whole query looks like:



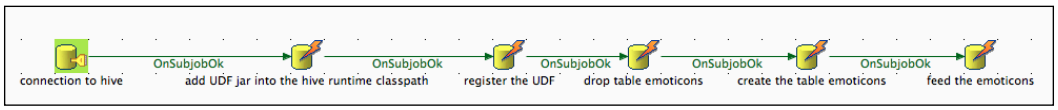
Emoticons extracting query

- Following is the request for your convenience:

```
insert into table emoticons

select concat(tweets.day_of_week, tweets.day_of_month, tweets.
time, tweets.mont)
as emoticons_id, tweets.day_of_week, tweets.day_of_month,
substr(tweets.time,1,2), tweets.mont, emoticons_label
from tweets LATERAL VIEW explode( extract_pattern(tweets.con
tent,'((?:\\;|:|=|8|\\\\^|X|:\\'|<|>)(?:-|O|c|\\\\.|_|\\\\^)
?(?:D|P|<|>|\\\\)\\\\)|\\\\(\\\\(|\\\\|\\\\\\\||\\;|=|X|O|\\\\*
|S|\\\\\\\||\\\\{|\\\\}|\\\\[|\\\\]|\\\\(|\\\\))' ) )
emoticonTable as emoticons_label
```

As I said, you will obtain exactly the same job structure as shown in the following diagram:



An emoticons-extracting job

At the end, you should obtain, as you did for the hashtags, an emoticons table with all emoticons in it. Run the following query to check it in Hive:

```
$ select * from emoticons
```

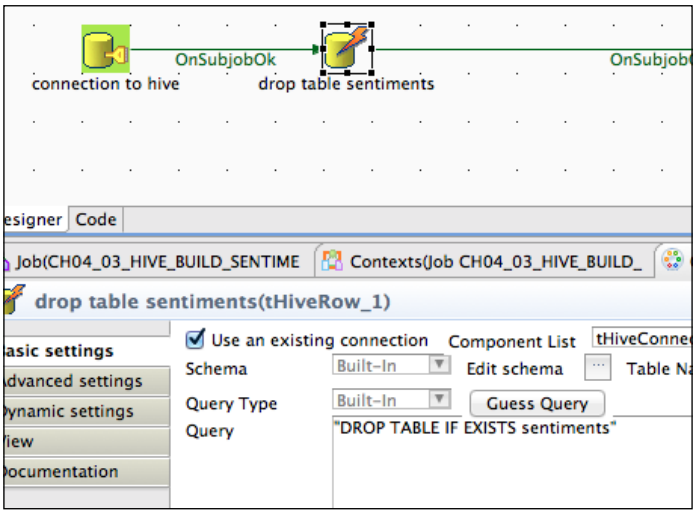
Joining the dots

This part is pretty straightforward because we only need to join our two hashtags and emoticons table to create the sentiment table, so we need the following components:

- A `tHiveConnection` component to connect to Hive; nothing new here, just copy and paste one of the previous connection components
- A `tHiveRow` component to drop the `sentiment` table if it exists; just add the following drop statement to remove the sentiment table each time you run the job:

  ```
  DROP TABLE IF EXISTS sentiments
  ```

- The following screenshot shows `tHiveRow` with the drop statement:



tHiveRow Sentiment drop component

- A `tHiveRow` component to create the sentiment table:

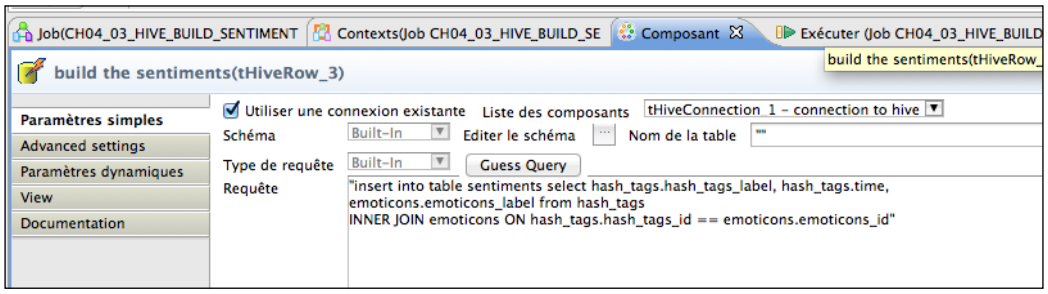
  ```
  CREATE EXTERNAL TABLE sentiments (
  hash_tags_label string,
  time string,
  ```

```
emoticons_label string)
ROW FORMAT DELIMITED   FIELDS TERMINATED BY ';'
LOCATION '/user/"+context.hive_user+"/packt/chp04/ /sentiments'
```

- A `tHiveRow` component to feed the sentiment table by joining the hashtags and emoticons tables:

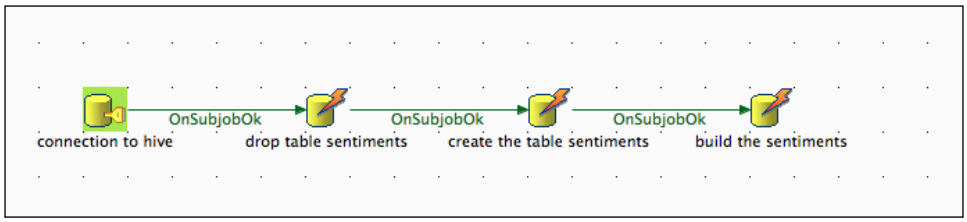
```
insert into table sentiments
select hash_tags.hash_tags_label,
hash_tags.time,
emoticons.emoticons_label
from hash_tags INNER JOIN emoticons
ON hash_tags.hash_tags_id == emoticons.emoticons_id
```

  This is still very simple; using the `INNER JOIN` statement, one subrequest will join the hashtags and emoticons tables and then select the `hash_tags_label` and the `emoticons_label` component, and one master request is used to insert the selected data in our new table.



Configuring the Hive join request to build sentiments

- The sentiment table job should have a structure as shown in the following diagram:



Sentiments table job builder

So simple and so fast! This is one of the benefits of developing with Talend, reusing assets. Most of the time, your job will use the same connection, the same data structure, the same context variables, and so on, so you then have several ways to reuse assets, and they are as follows:

- Define your connection and data structure in the repository and reuse them among your jobs
- Define the project and job templates and kick off a new development from that
- Duplicate existing jobs and modify them to fit the new needs

Most of the reusing features are only available in the enterprise version of the product, especially when it comes to the repository, which is just present in its lightest version in the product community versions. Basically, duplicating jobs and copying and pasting components are your only options in the community versions.

By now, you should have verified in Apache Hive that the sentiment table has been created correctly with a list of hashtags and the related emoticons.

You just need to run the following query to visualize the rows in the sentiment table:

```
$ select * from sentiments
```

Summary

By now, you should have a good overview of how to use Apache Hive features with Talend, from the ELT mode to the lateral view, passing by the custom Hive user-defined function. From the point of view of a use case, we have now reached the step where we need to reveal some added-value data from our Hive-based processing data. We will use other components in the next chapter, and we'll dive a bit into Apache Pig to reveal the top data.

5
Aggregate Data with Apache Pig

In this chapter, we'll learn how to highlight the top records including the following ones using Pig:

- The top Twitter users
- The top hashtags
- The top emoticons
- The top sentiments

Knowing about Pig

Like Apache Hive, Apache Pig is an abstraction layer in HDFS. It enables developers to process data stored in HDFS with a language called Pig Latin, which is completely different from HiveQL, but is an easy-to-use, optimized, and extensible programming language.

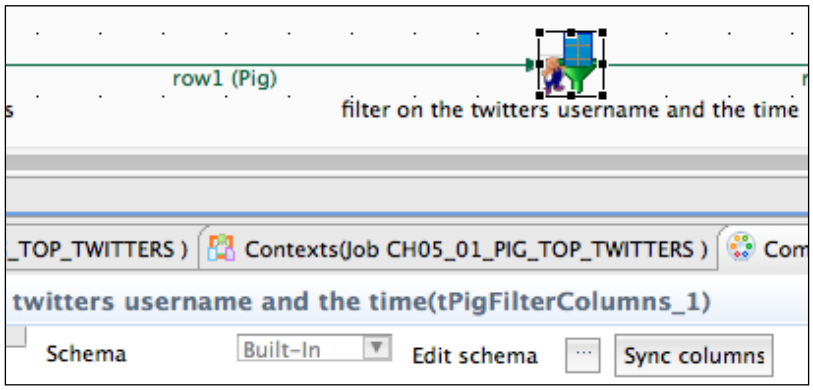
You will see that in Talend, the integration with Pig is better than for Hive, where, except for the `tHiveELT` component, we often have to write the HiveQL language. Talend ships out of the box Pig components that implement 90 percent of Pig's use cases.

For more information on Pig, I recommend that you go to `http://pig.apache.org/`.

So basically, what we want to do here is highlight the top data. The processing workflow would be as follows:

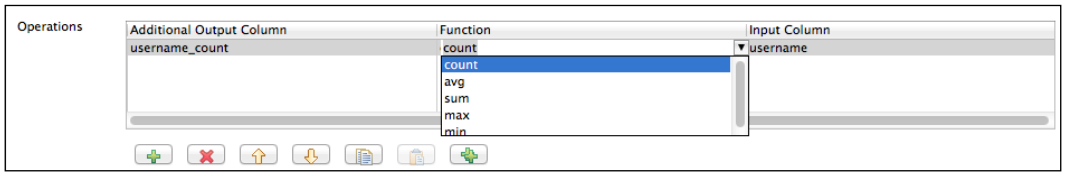
- Loading the data from HDFS
- Applying some filters on the loaded data

  A Talend Pig filtering component is shown in the following screenshot:



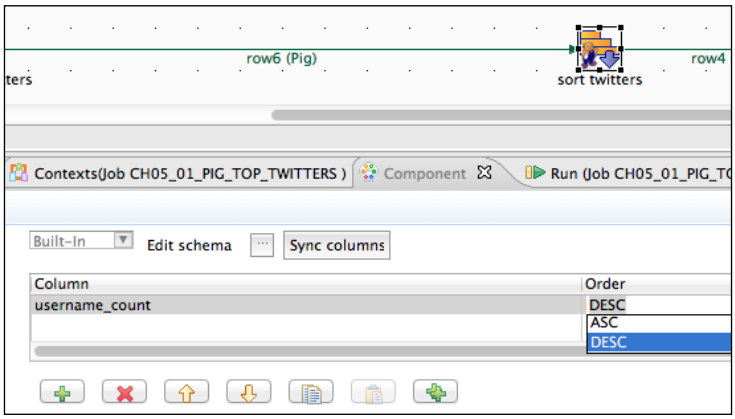
The Talend Pig filtering component

- Using grouping functions such as `count` to count the number of occurrences, or `max` to get the maximum among records, as shown in the following screenshot:



Pig grouping functions

- Sorting data in the descending mode, as shown in the following screenshot:



Talend Pig sorting component

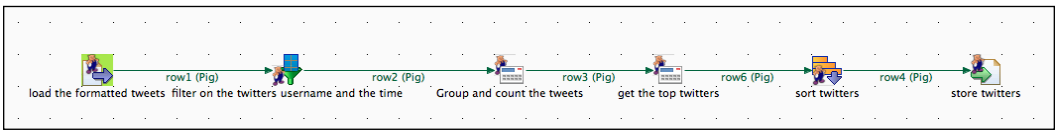
- Storing processed data in HDFS

We'll start by extracting the top Twitter users, then hashtags, emoticons, and finally the sentiments we have built.

Extracting the top Twitter users

As you may have understood, all jobs will have the same structure; I will describe in great detail this job and then give a big picture for the other parts.

At the end, your job should look as follows:



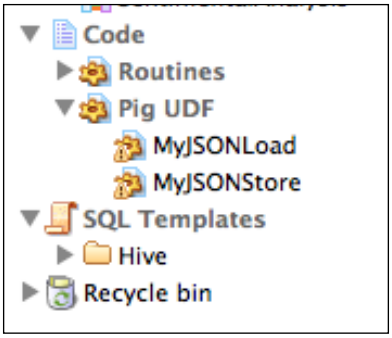
The top Twitter Pig job

The basic steps will be to load the data, filter columns, use aggregate functions, sort data, and store the resulting data.

To create the `CH05_01_PIG_TOP_TWITTERS` job under a new `chapter5` directory, we will need the following components:

- A `tPigLoad` component to load the data from HDFS.

  Actually, this component can load data from another type of storage; you can even extend your own loader or storer by implementing a Pig UDF given in the following screenshot:



Pig UDF

We need the following context variables to use this component:

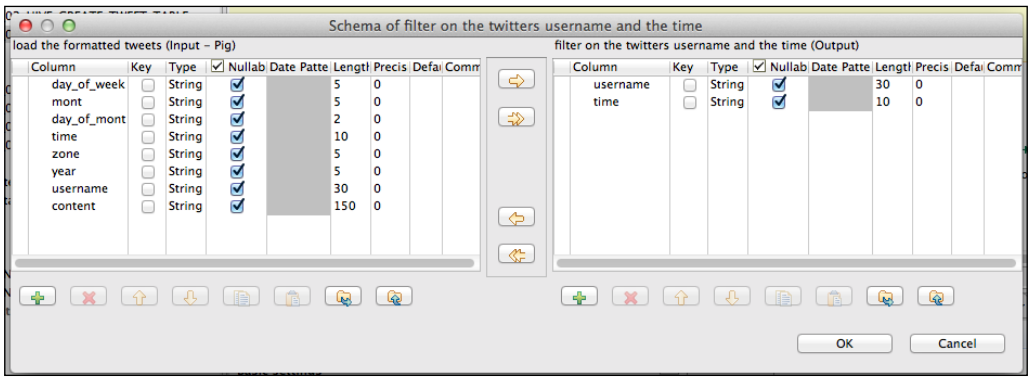
Name	Value
`resourceManagerHost`	CLOUDERA_HOST for example, `172.16.253.202`
`resourceManagerPort`	`8032`

These two variables are required to connect to the global resource manager, which is part of the new Hadoop cluster architecture that comes with YARN. Now, add the following configurations to the component:

Property	Value
Distribution	`Cloudera`
Version	`Cloudera 4.3+`
Namenode URI	`"hdfs://+context.hdfsHost+:context.hdfsPort"`
Resource Manager	`context.resourceManagerHost+":"+context.resourceManagerPort`
Input File URI	`"/user/"+context.username+"/packt/chp02/formatedData"`
Field separator	`";"`

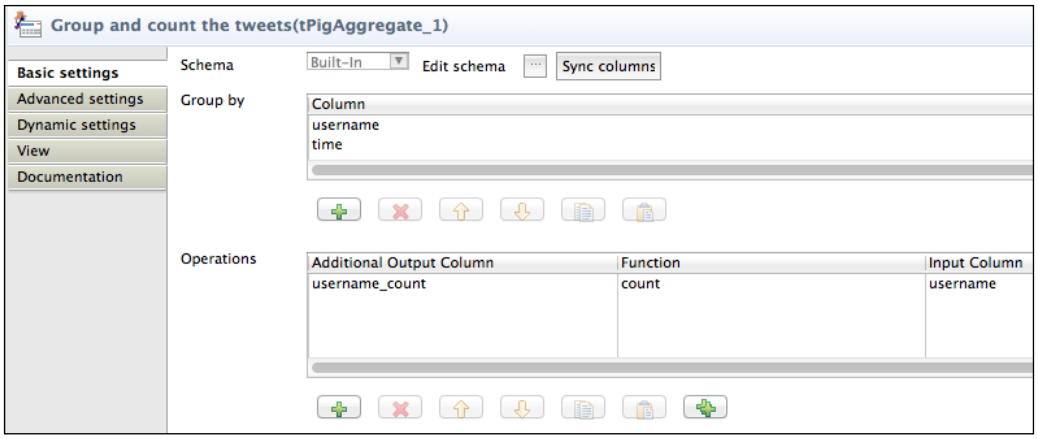
The component points to the file that contains all the formatted data obtained with the `CH03_03_HIVE_FORMAT_DATA` job.

- A `tPigFilterColumns` component to filter the `username` and `time` columns in order to get the top Twitter users across the time. You need to click on the **Edit schema** button and only retain the `username` and `time` columns. Don't forget that we are designing a Pig job, and that the goal is to generate the Pig code in our Talend Studio. Thus, it's not possible to use a usual Talend component such as `tFilterColumns` that does the same job as that of the `tPigFilterColumns` component, but doesn't generate Pig code.



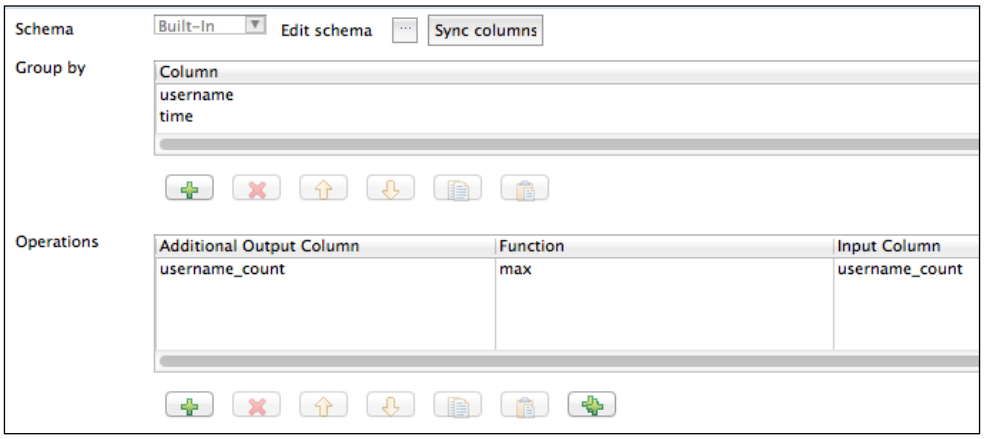
Filter columns

- A `tPigAggregate` component (`tPigAggregate_1`) to count the number of occurrences by `username`. We will group by `username` and `time`, and add the `count` operation on the `username` column to obtain the `username_count` column, as shown in the following screenshot:



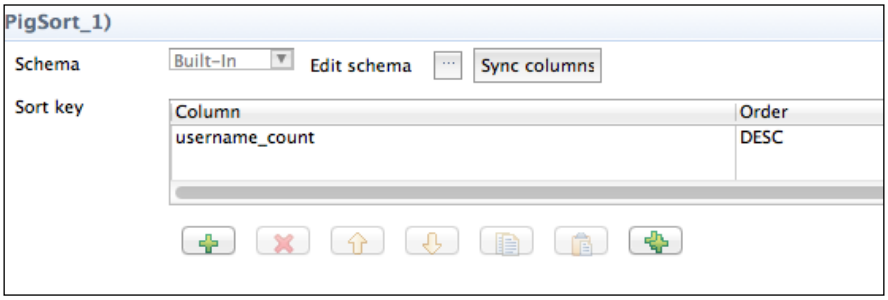
Count usernames by time

- A `tPigAggregate` component to get the username that appeared the most number of times. We will still group by `username` and `time`, and add the `max` operation on the `username_count` column, as shown in the following screenshot:



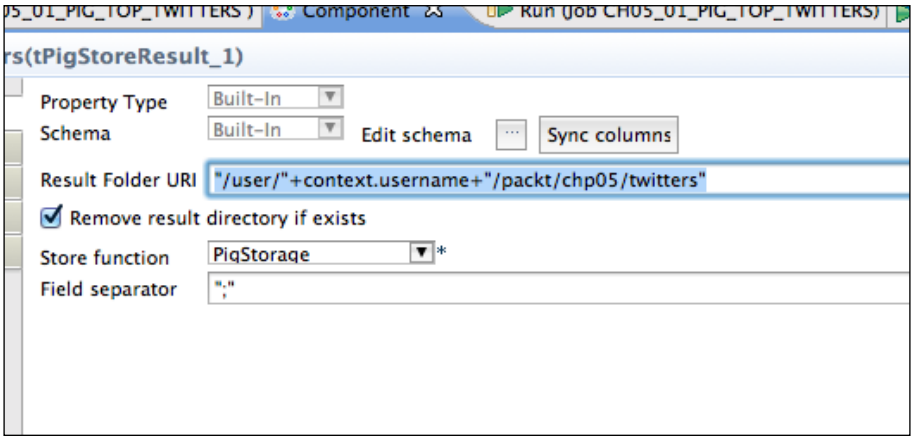
The top username by time

- A `tPigSort` component to get the list of usernames in the descending order. Here, we will just add the created `username_count` column ordered in the descending mode, as shown in the following screenshot:



Descending ordering

- A `tPigStoreResult` component to store the processed results. Finally, we'll just set the **Result Folder URI** field in the component, as shown in the following screenshot:



The tPigStoreResult component's settings

Run the job and check in HDFS by issuing the following command to be sure that we have the list of top Twitter users sorted by time:

```
$ hadoopfs -cat /user/bahaaldine/packt/chp05/twitters
```

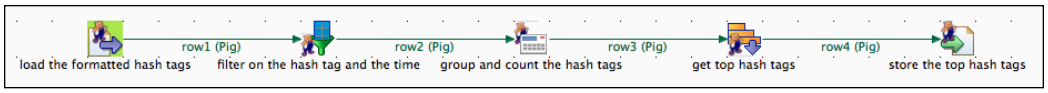
Finally, replace your username.

Extracting the top hashtags, emoticons, and sentiments

Now that you have understood the pattern used to design the job, you can duplicate it and reproduce the flow to highlight the hashtags, emoticons, and sentiments.

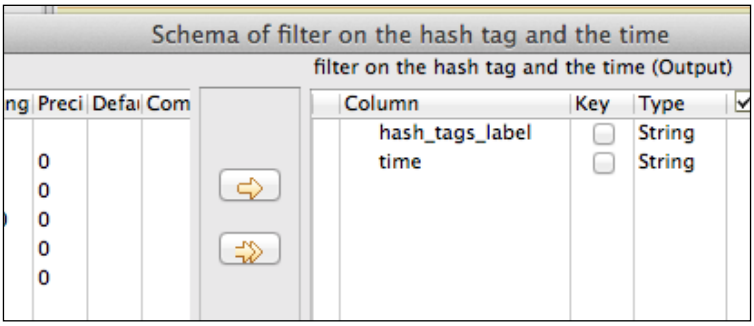
The following are the broad outlines for the hashtags', emoticons', and sentiments' Pig-processing jobs:

- We don't need the `max` grouping function as it will filter some records, and we want to keep all the records. The job structure of the top values is as follows:



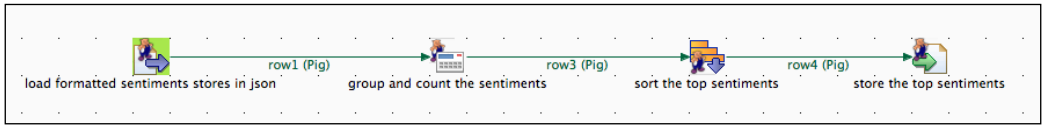
Top values' job structure

- The source columns to filter hashtags are `hash_tags_label` and `time`, and the ones to filter emoticons are `emoticon_label` and `time`. The source columns to filter hashtags are shown in the following screenshot:



The hashtag job's filtered columns

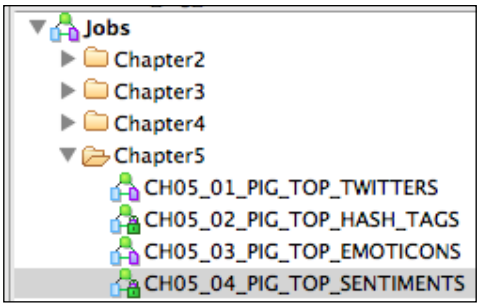
- The top sentiment job doesn't need to filter columns, as we only have the `hash_tag_label`, `emoticon_label`, and `time` columns, as shown in the following diagram:



Sentiment job structure

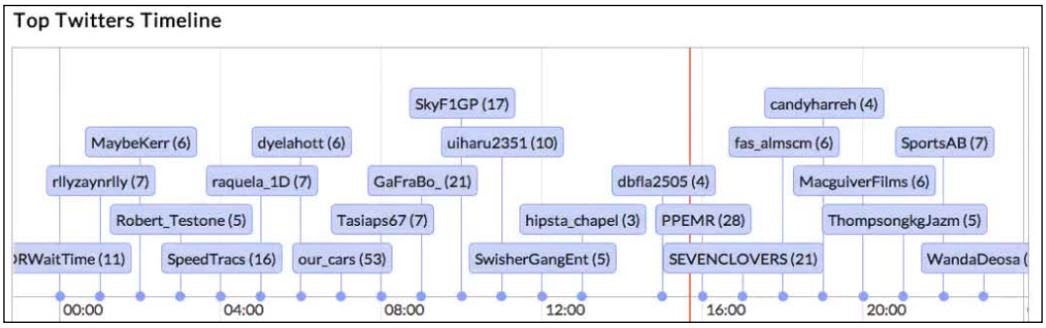
- For hashtags, store the data in `"/user/"+context.username+"/packt/chp05/hashtags"`.
- For emoticons, store the data in `"/user/"+context.username+"/packt/chp05/emoticons"`.
- For sentiments, store the data in `"/user/"+context.username+"/packt/chp05/sentiments"`.

At the end, you should have four jobs, one for the top Twitter users, one for the top hashtags, one for the top emoticons, and one for the top sentiments, as shown in the following screenshot:



A repository of top extracting jobs

From the point of view of the Twitter sentiment use case, as we have these top values, we can draw chart-like timelines, such as the Twitters timeline shown in the following diagram, which reveals the most active users for each hour:



Top Twitters Timeline

Summary

After Hive, we have seen in this chapter how to process data using Talend Pig components, and how filtering, grouping, and sorting can be achieved with some clicks.

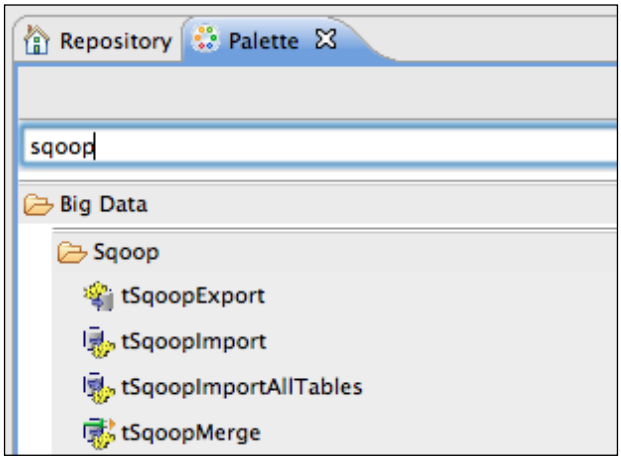
Now that our data is aggregated and ready to be used, we'll see in the next chapter how to export it to a traditional SQL RDBMS.

6
Back to the SQL Database

In this chapter, we'll learn how to work with the Talend Sqoop component in order to export data from HDFS to a SQL database.

Linking HDFS and RDBMS with Sqoop

Apache Sqoop is a project that enables developers to transfer data between their Hadoop cluster and relational database. Talend provides components to implement a data process based on Sqoop transfer, as shown in the following screenshot:



Sqoop components

Basically, what we want to do here is enable business analysts to use their preferred RDBMS-coupled tool to access our processed gold mine's data and build some added-value reports. Thus, we will mainly use the **tSqoopExport** component to export our top Twitter users, emoticons, hashtags, and sentiments to, for example, a MySQL database.

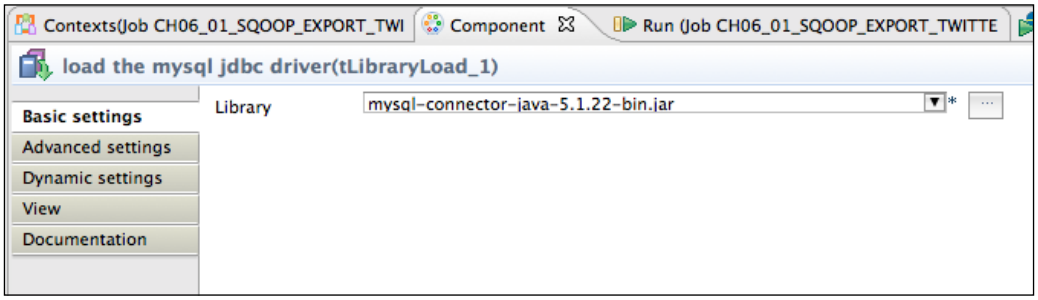
Exporting and importing data to a MySQL database

As you can imagine, exporting data using Sqoop will be pretty easy with Talend, so easy that it will require only the following components:

- A `tLibraryLoad` component to load our database library JAR file. Some components in Talend **Palette** are dedicated to a specific database, so when you use them in a job, all the required drivers are loaded without the need of thinking about it. For example, if I want to read a table in MySQL, I'll use the `tMySQLInput` component, which loads the MySQL JAR driver.

  Here, with Sqoop, as it's a generic component, we don't know in advance what kind of database we want to work with; that's why we have to manually load the JAR file with the `tLibraryLoad` component.

- A `tSqoopExport` component to export the data. The library load only requires to point on your database library JAR file, which can be chosen in the `tLibraryLoad` component's drop-down list, as shown in the following screenshot:



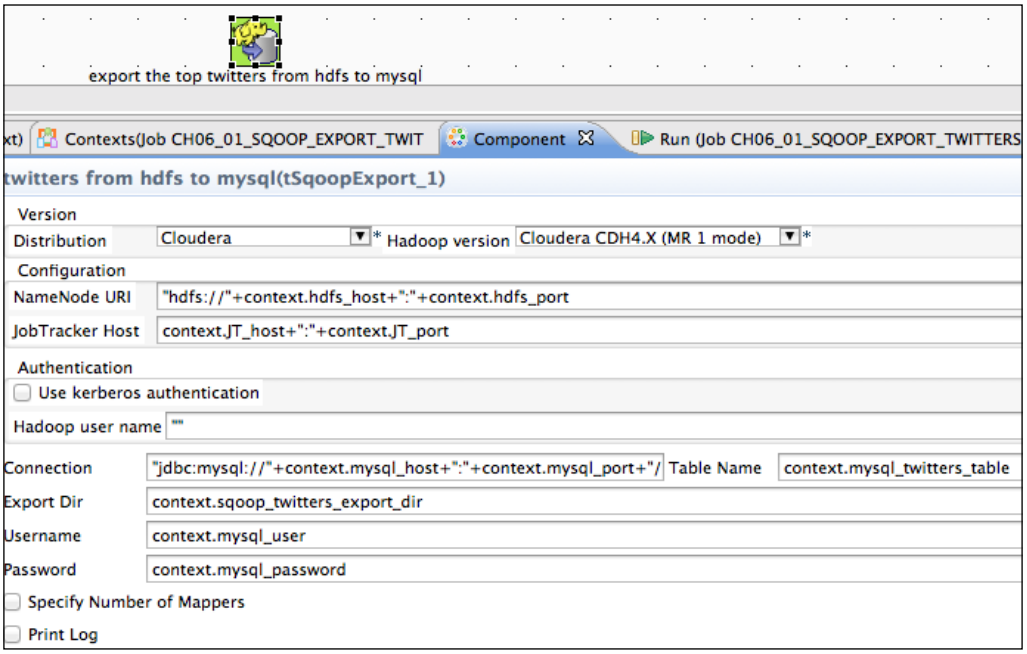
Database library

Just search in the drop-down list to check whether the library is shipped in the Studio, or click on the button next to the dropdown to manually add your JAR file. Here, I'm using the `mysql-connector-java-5.1.22-bin.jar` library to connect to MySQL.

Before configuring the `tSqoopExport` component, we will add to our existing context group the following context variables, which will be used to connect our database:

Name	Value
`mysql_host`	`MYSQL_HOST`
	for example, `172.16.253.203`
`mysql_port`	`MYSQL_PORT`
	for example, `3396`
`mysql_user`	`MYSQL_USER`
`mysql_password`	`MYSQL_PASSWORD`
`mysql_twitters_table`	`MYSQL_TWITTERS_TABLE`
	for example, `top_twitters`
`mysql_hash_tags_table`	`MYSQL_HASH_TAGS_TABLE`
	for example, `top_hash_tags`
`mysql_emoticons_table`	`MYSQL_EMOTICONS_TABLE`
	for example, `top_emoticons`
`mysql_sentiments_table`	`MYSQL_SENTIMENTS_TABLE`
	for example, `top_sentimentss`

Then, we just add the context group to our job, like we did in the previous hands-on chapter, and we will set up the `tSqoopExport` component's properties as shown in the following screenshot:



The Sqoop component's properties tab

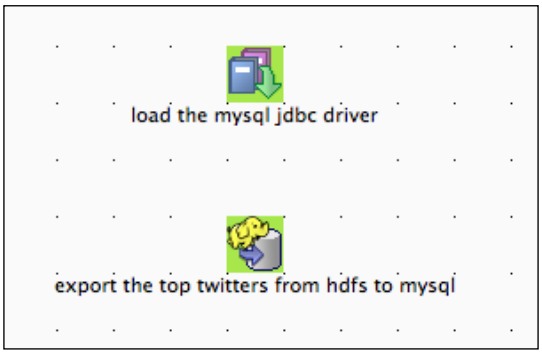
Here is the table of properties from where you can copy and paste easily:

Name	Value
Distribution	**Cloudera**
Hadoop version	**Cloudera CDH4.X (MR 1 mode)**
NameNode URI	`"hdfs://"+context.hdfsPort+":"+context.hdfsPort`
JobTracker Host	`context.JTHost+":"+context.JTPort`
Connection	`"jdbc:mysql://"+context.mysql_host+":"+context.mysql_port+"/"+context.mysql_database`

Name	Value
Table Name	`context.mysql_twitters_table`
Export Dir	`"/user/"+context.username+"/packt/chp02/formatedData"`
Username	`context.mysql_user`
Password	`context.mysql_password`

A word on the **Export Dir** variable: This variable defines the folder from where the data will be exported. In our case, it will be all the directories that we created in the previous hands-on chapter.

That's it. Your job should have the following structure:



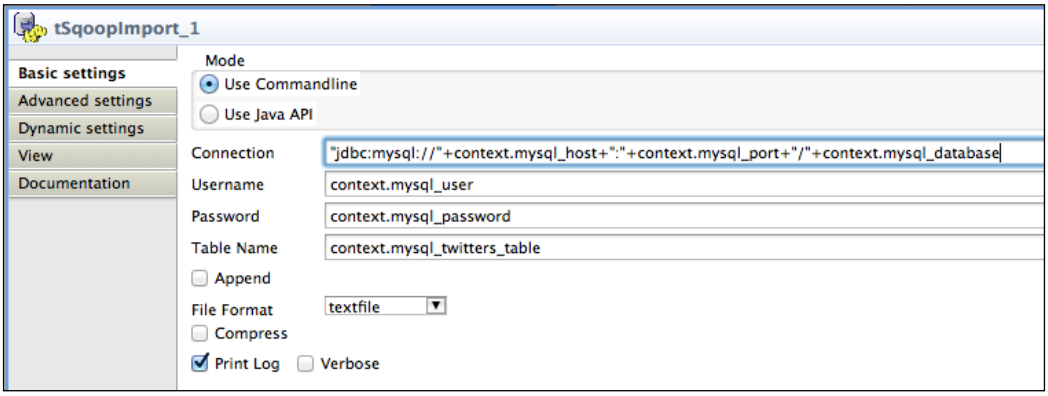
A Sqoop processing job

Here, we have completed the job for exporting the top Twitter users, and this is the same for the rest. You just need to change the Sqoop **Export Dir** property and the **Table Name** property in each case. As you may have understood, the MySQL table will have the exact same structure as that of the output of the Pig Jobs that we created in the previous chapter; so typically, if I stick to the `twitters` example, then the table creation script will be as follows:

```
CREATE TABLE `top_twitters` (
  `username` varchar(50) NOT NULL,
  `time` varchar(2) NOT NULL,
  `username_count` int(11) NOT NULL) ENGINE=InnoDB DEFAULT
CHARSET=latin1;
```

In the provided source files, you will find a SQL script to create all the tables.

Importing data is also really easy to implement; keep the same job structure and replace the `tSqoopExport` component with a `tSqoopImport` component, then set the component's properties. The following screenshot shows the `tSqoopImport` component's properties tab, which is almost the same that you have set for the `tSqoopExport` component:



The tSoopImport component's properties

Summary

Sqoop should satisfy those for whom SQL databases are essential for analysis. So far, you should be able to use the Talend Sqoop component and use your favorite RDBMS database to leverage all the processing you have done on your Hadoop cluster. In the next chapter, we'll go through the description of two common Big Data deployment patterns, the streaming pattern and the partitioning pattern.

7
Big Data Architecture and Integration Patterns

In this chapter, we'll see two examples of deployment based on Twitter Sentiment analysis:

- The streaming pattern
- The partitioning pattern

The streaming pattern

In a Big Data project, you have two common ways to write your data in the cluster:

- **Bulk mode**: In this mode, big files are punctually written and processed in the cluster. These are generally handled by background schedule jobs, for example a nightly scheduled job. We have seen how to design such a job in *Chapter 2*, *Building Our First Big Data Job*.
- **Streaming mode**: In this mode, the Hadoop cluster is coupled with a real-time technology layer such as Apache Flume or an **Enterprise Service Bus** (**ESB**) so that the files are polled and automatically written in real time as they are created. Depending on polling rules, you can configure the file, such as the file size.

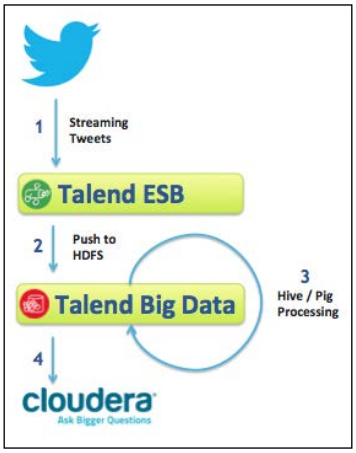
Here, we'll discuss how we can set up the streaming mode, and fortunately, Talend has an ESB in the stack, so we can stick to Talend to illustrate this pattern. We won't dive into ESB service implementation but just see how we can combine the two worlds and give our Twitter Sentiment Analysis a bit of real-time dynamics.

So, Talend ESB is based on Apache projects such as Apache Camel for the routing part. An ESB is mainly used for the following purposes:

- It eases integration between IT system applications
- Service enablement such as web services
- It acts as a single point of service accesses monitoring in the system

Here, we are using Talend ESB integration and service-enablement capabilities to stream tweets from Twitter using the Camel Twitter component, and then writing the data in a file that is then pushed in HDFS.

Talend ESB is then used to create a Twitter-to-HDFS service using the two worlds: Camel and HDFS data-integration components. The following diagram gives an overview of the data-flow process:

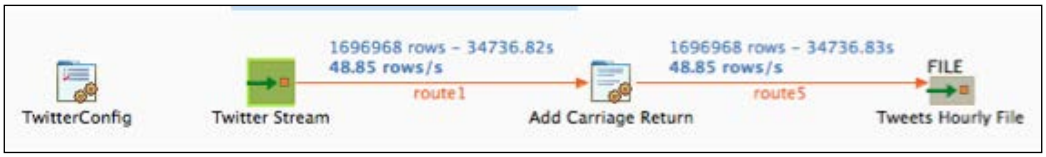


The data-flow process of the Streaming mode

As files are pushed in HDFS, all contained tweets continuously integrate the processing chain we have implemented so far. The data will then stay updated.

Talend ESB consists of two services:

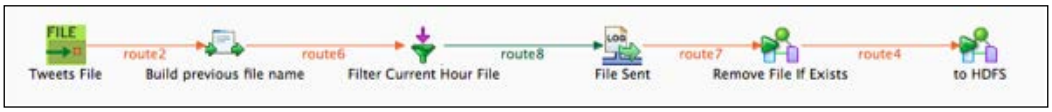
- The following are the components of the Twitter streaming service:



Streaming service

- The first **TwitterConfig** component imports all the required libraries to use the Camel Twitter component.
- The **Twitter Stream** component is the one that connects to Twitter and streams the tweets as they are sent by the user.
- The **Add Carriage Return** component adds a carriage return at the end of each tweet; otherwise, the tweets would be stored on the same line and that's not what we want here, to be able to process them line-by-line.
- The **Tweets Hourly File** component creates an hour-specific file. This means that if it's 10:00 am, then the tweets will be written in a `tweets-10.log` file

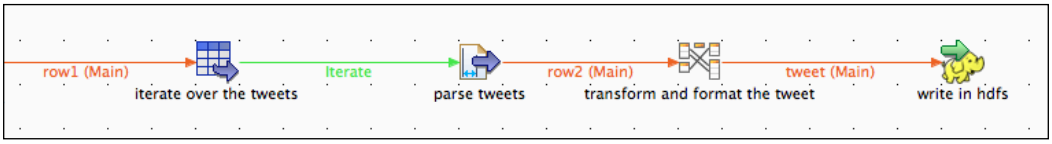
- The HDFS file writer service just polls a file every hour and pushes the file in HDFS using the `cTalendJob` component, which basically enables Talend ESB to call Talend Big Data components, such as the `tHDFSOutput` component as follows:



HDFS writer service

- The first **Tweets File** component polls the file created every hour.
- The **Build previous file name** component formats the filename.
- The **Filter Current Hour File** component filters the current hour file because the trick here is that every time an hour is reached, another file is created to receive the tweet of the current hour. So what we don't want here is to send the current hour file to HDFS but the previous hour file for which the streaming is finished.
- The **File Sent** component logs the fact that the file was sent.
- The **Remove File If Exists** component deletes the file from HDFS if it exists.

The content of the HDFS component is shown in the following diagram:



HDFS writer job

As you can see, you can jump from the ESB world to the data-processing world just through one component. It basically iterates through the tweets file with the **Iterate over the tweets** component, parses all the columns that were described in *Chapter 3*, *Formatting Data*, and contained in a tweet with the **parse tweets** component. Then, we make some transformation with the **transform and format the tweet** component to clean the data before using the **write in hdfs** component to write the file in HDFS.

By doing so, you get the streaming pattern using Talend ESB with the two services described previously and Talend Big Data with the subjobs that are using the Big Data components.

The partitioning pattern

If you have applied the streaming pattern to your project, your data is split into multiple files, which is periodically written in HDFS. This period can vary from seconds, minutes, hour, days, and so on. It depends on the data throughput that you want to capture.

But at the end, your file can be categorized depending on the time it appeared, for example, per hour, in the aim of accessing a precise period of time.

This data boxing is called partitioning, and if you are familiar with databases, you know that this concept is not new and lets the user submit an accurate query that contains a partitioning parameter.

The steps to implement this pattern in a Hadoop cluster are as follows:

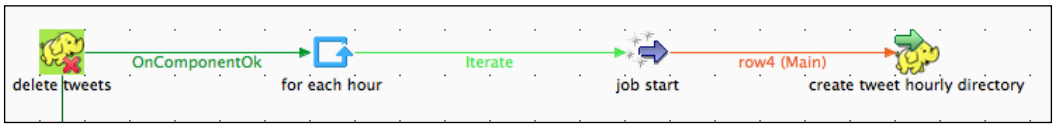
1. Setting up HDFS to store the data in an Hour-specific folder.
2. Setting up Hive to make it aware that the data is stored in the partition.

For the HDFS part, the following is a screenshot of what we want to obtain:

```
9 /user/bahaaldine/data/00
9 /user/bahaaldine/data/01
9 /user/bahaaldine/data/02
9 /user/bahaaldine/data/03
9 /user/bahaaldine/data/04
9 /user/bahaaldine/data/05
9 /user/bahaaldine/data/06
9 /user/bahaaldine/data/07
9 /user/bahaaldine/data/08
9 /user/bahaaldine/data/09
9 /user/bahaaldine/data/10
9 /user/bahaaldine/data/11
9 /user/bahaaldine/data/12
9 /user/bahaaldine/data/13
9 /user/bahaaldine/data/14
9 /user/bahaaldine/data/15
9 /user/bahaaldine/data/16
9 /user/bahaaldine/data/17
9 /user/bahaaldine/data/18
9 /user/bahaaldine/data/19
9 /user/bahaaldine/data/20
9 /user/bahaaldine/data/21
9 /user/bahaaldine/data/22
9 /user/bahaaldine/data/23
```

HDFS partitioning

You may have understood that we want a folder structure, which reflects that we are writing files every hour. Doing so with Talend is pretty easy; we just need to add to our HDFS writer job a loop logic to create a folder for each hour. This job, as explained in the previous chapter, is only called whenever you need to initialize your HDFS structure, basically before running any other jobs, as shown in the following diagram:



HDFS partitioning job

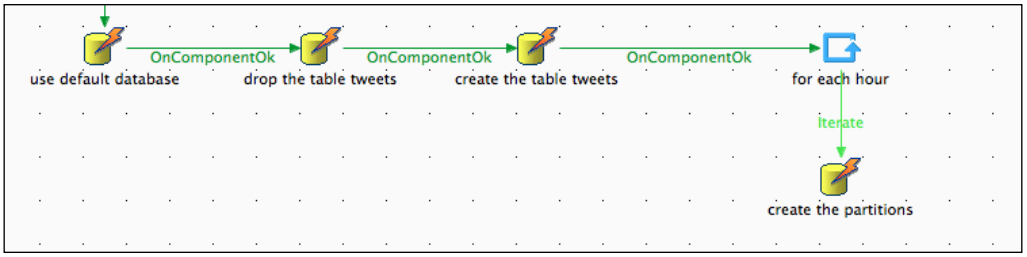
The first `tHDFSDelete` component deletes all the folders specified in the component's properties to initialize the HDFS store, the second is a `tLoop` component that iterates 24 times, the third `tFixedFlow` component is used to access a Talend global map, which contains the process variables to create a folder dynamically depending on the current iteration value as shown in the following code:

```
"/user/"+context.hdfs_user+"/data/" +
  (((Integer)globalMap.get("tLoop_1_CURRENT_VALUE"))-1<10?"0":"")
  +(((Integer)globalMap.get("tLoop_1_CURRENT_VALUE"))-1) +"/.init"
```

We add `0` when the hour is between 1 and 10 to get a consistent folder structure.

The last `tHDFSOutput` creates the folder with the previously generated path.

That's it for HDFS. Now, we just have to configure our Hive table to make it aware that the filesystem is partitioned. To do so, we'll add a branch to our Hive table creation job (`CH03_02_HIVE_CREATE_TWEET_TABLE`), to create a partition for each hour as shown in the following diagram:



A Hive-partitioning job (`CH03_02_HIVE_CREATE_TWEET_TABLE`)

As you have already guessed, we are again using the `tLoop` component to iterate 24 times and call the following `tHive` component, which creates the partitions.

The partition component consists of calling the `ADD PARTITION` Hive statement to create a partition for each hour:

```
ALTER TABLE tweets
  ADD PARTITION (hours = '" +
  (((Integer)globalMap.get("tLoop_1_CURRENT_ITERATION"))-
  1<10?"0":"")
  +(((Integer)globalMap.get("tLoop_1_CURRENT_ITERATION"))-1) + "')
  location '/user/"+context.hive_user+"/data/" +
  (((Integer)globalMap.get("tLoop_1_CURRENT_ITERATION"))-
  1<10?"0":"")
  +(((Integer)globalMap.get("tLoop_1_CURRENT_ITERATION"))-1) + "'"
```

The logic is the same for HDFS; you can now add an hour parameter to your query to get results depending on the time and optimize the query-execution time.

Summary

The integration pattern for Big Data helps architects get a base guidance to efficiently deploy a Big Data project in an IT system. There are plenty of possibilities in terms of deployment patterns, but keep in mind that Big Data must not be reduced as a simple data-processing system. It's a highly scalable distributed data-processing system, which needs to be used in a predefined business data-processing workflow.

Installing Your Hadoop Cluster with Cloudera CDH VM

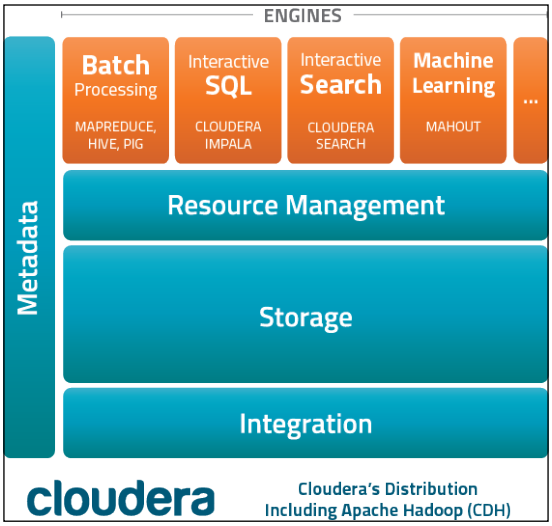
In this appendix, we will describe the main steps to set up a Hadoop cluster based on Cloudera CDH 4.3. We will cover the following topics:

- Where and which packages to download
- How to launch every service
- The configuration required

Downloading Cloudera CDH VM

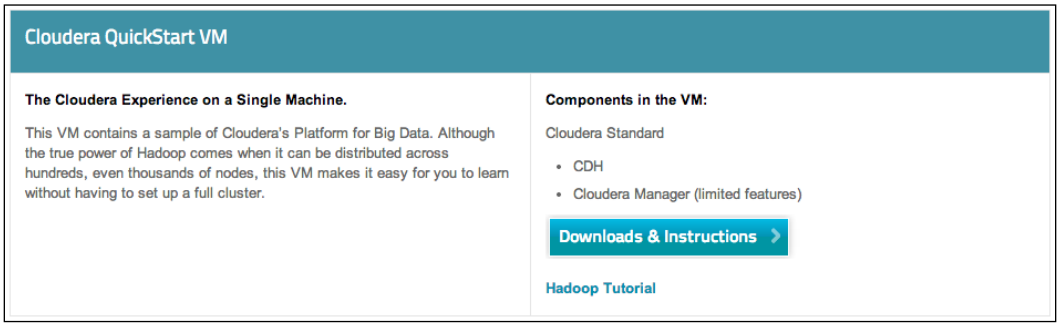
Cloudera CDH 4.3 VM is a ready-to-use Hadoop environment, which includes the most used Hadoop ecosystem projects out of the box.

If you want to quickly start a project with TOS Big Data, going through this appendix is highly recommended. The following is the structure of Cloudera CDH VM:



Cloudera CDH structure

CDH includes all assets needed to store, integrate, and manage your Hadoop cluster. To download the VM, just go to the `https://www.cloudera.com/content/support/en/downloads.html` page and click on **Download and Install**. There will be several download links on the page; just scroll and choose the one shown in the following screenshot:



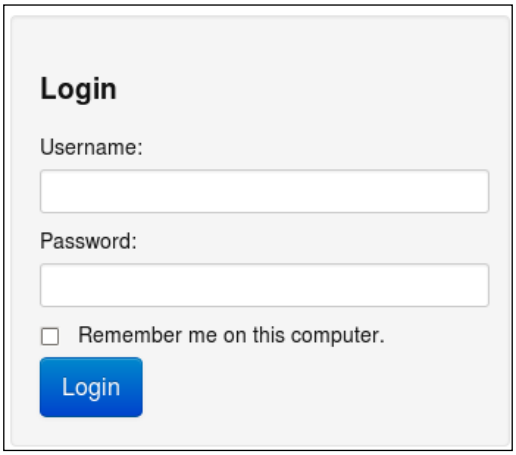
Cloudera CDH download section

Launching the VM for the first time

Once downloaded, extract the `cloudera-quickstart-vm-X.X.X-vmware` archive file and launch the virtual machine in VMware. If you need a free version of VMware, then your best option is the VMware player, which can be downloaded from the `https://my.vmware.com/web/vmware/free#desktop_end_user_computing/vmware_player/6_0` link.

If you need to refer to the documentation to set up the VM, then check the link `http://www.cloudera.com/content/cloudera-content/cloudera-docs/DemoVMs/Cloudera-QuickStart-VM/cloudera_quickstart_vm.html`.

When the VM has booted up, you should be able to access the Cloudera Manager console in the VM browser `http://localhost:7180/cmf`. A couple of minutes is required before CDH has finished launching all the services; just refresh the page periodically until you get the following login page:



The Cloudera Manager login screen

The default username and password are both `cloudera`. Click on the **Service** tab and be sure that the following list of services is started before continuing with this appendix:

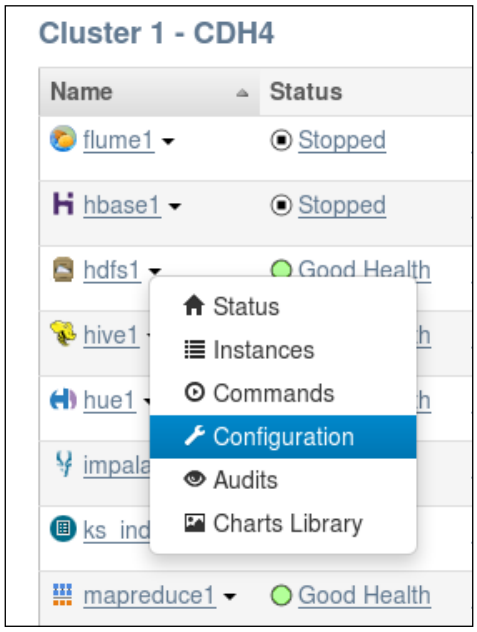
- `hdfs1`
- `hive1`
- `mapreduce1`
- `zookeeper1`

These services are required to be able to write in HDFS and play with Apache Hive as well as Apache Pig.

If any of the previously stated services are down, please read the documentation at `https://www.cloudera.com/content/support/en/documentation/manager/cloudera-manager-v4-latest.html` and fix the issue before continuing.

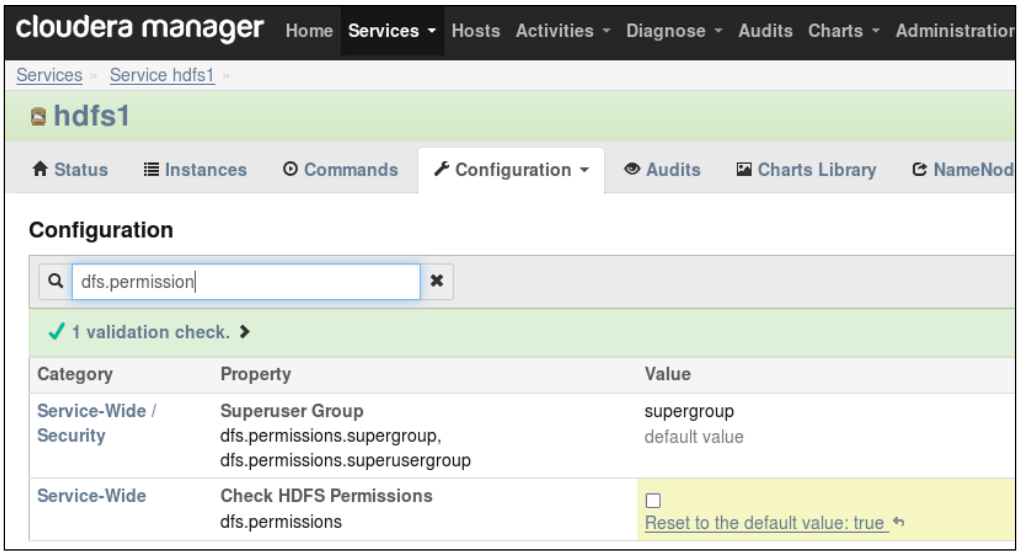
Basic required configuration

The hands-on technique requires us to create a new HDFS directory under which we will store all the data. We first need to change some permission property set in HDFS to do so. In the Cloudera Manager console, as shown in the following screenshot, click on the **hdfs1** service and then click on **Configuration**:



hdfs1 service configuration

In the search field, as shown in the following screenshot, type `dfs.persmission` and uncheck the checkbox next to the **Check HDFS Permissions** property:



HDFS permission

This configuration should not be considered for production mode, and it's only done here to ease the usage of VM through a hands-on approach. Here is a post from a Cloudera blog that explains how to deploy a highly available Hadoop production architecture, which can be found at `http://blog.cloudera.com/blog/2009/07/hadoop-ha-configuration/`.

We need to connect via SSH to create our user directory, so open a command line or ssh tool and run the following command:

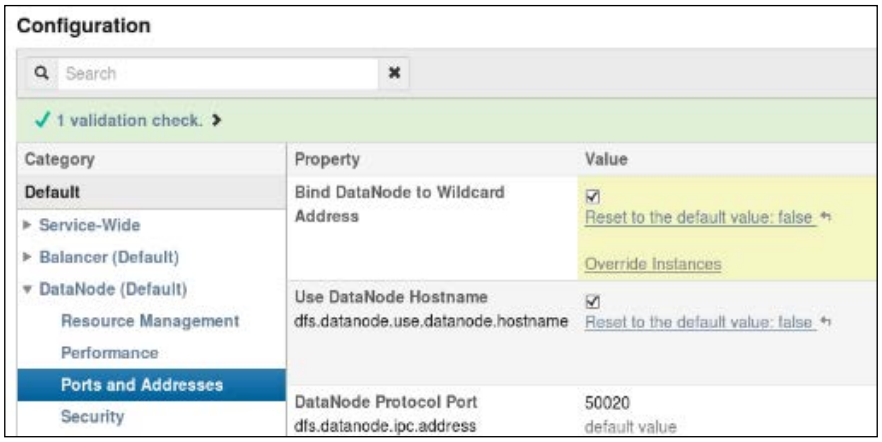
```
ssh cloudera@CLOUDERA_VM_HOST
password: cloudera
```

As you understood, the default Cloudera QuickStart VM SSH username and password is `cloudera/cloudera`.

Now that we are connected to the VM, we can create your user directory where we will store the data, in my case, the command line would be as follows:

```
hadoop fs -mkdir /user/bahaaldine
```

A last configuration is required for network purpose; you need to make the VM listen to other external IPs if you want to run Talend Studio outside Cloudera VM. In the `hdfs1` configuration, click on the **Ports and Addresses** icon and be sure that the first two properties are checked.



HDFS network configuration

That's it, you can now run TOS Big Data on your host machine and point to your Cloudera VM.

Summary

This appendix should have helped you to set up your Hadoop environment and be able to start implementing the different hands-on techniques that compose this book.

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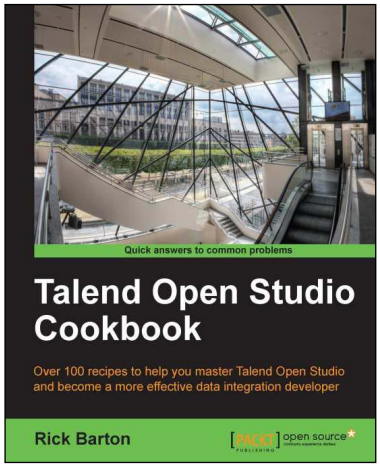

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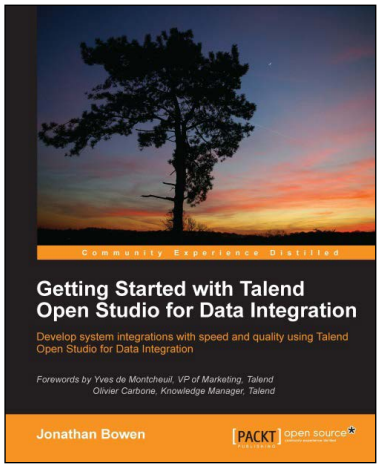

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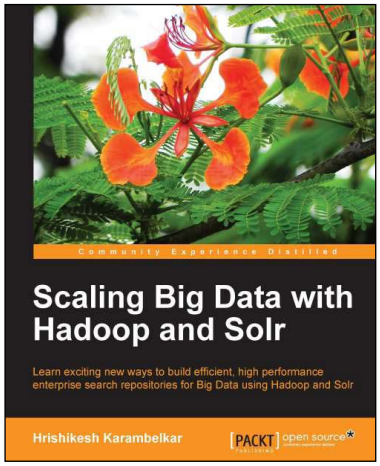

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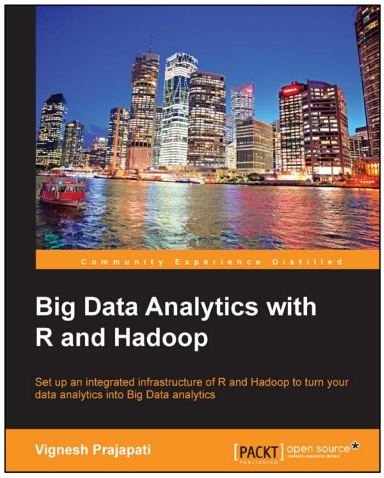

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