About the Tutorial

Apache Spark is a lightning-fast cluster computing designed for fast computation. It was built on top of Hadoop MapReduce and it extends the MapReduce model to efficiently use more types of computations which includes Interactive Queries and Stream Processing.

This is a brief tutorial that explains the basics of Spark SQL programming.

Audience

This tutorial has been prepared for professionals aspiring to learn the basics of Big Data Analytics using Spark Framework and become a Spark Developer. In addition, it would be useful for Analytics Professionals and ETL developers as well.

Prerequisite

Before you start proceeding with this tutorial, we assume that you have prior exposure to Scala programming, database concepts, and any of the Linux operating system flavors.

Copyright & Disclaimer

© Copyright 2015 by Tutorials Point (I) Pvt. Ltd.

All the content and graphics published in this e-book are the property of Tutorials Point (I) Pvt. Ltd. The user of this e-book is prohibited to reuse, retain, copy, distribute or republish any contents or a part of contents of this e-book in any manner without written consent of the publisher.

We strive to update the contents of our website and tutorials as timely and as precisely as possible, however, the contents may contain inaccuracies or errors. Tutorials Point (I) Pvt. Ltd. provides no guarantee regarding the accuracy, timeliness or completeness of our website or its contents including this tutorial. If you discover any errors on our website or in this tutorial, please notify us at contact@tutorialspoint.com
# Table of Contents

About the Tutorial .................................................................................................................. i
Audience .................................................................................................................................. i
Prerequisite ............................................................................................................................. i
Copyright & Disclaimer .......................................................................................................... i
Table of Contents ................................................................................................................... ii

## 1. SPARK SQL – INTRODUCTION .............................................................................. 1

- Apache Spark ....................................................................................................................... 1
- Evolution of Apache Spark ................................................................................................. 1
- Features of Apache Spark ................................................................................................. 1
- Spark Built on Hadoop .................................................................................................... 2
- Components of Spark ..................................................................................................... 3

## 2. SPARK SQL – RDD ............................................................................................... 4

- Resilient Distributed Datasets .......................................................................................... 4
- Data Sharing is Slow in MapReduce ................................................................................ 4
- Iterative Operations on MapReduce ................................................................................ 4
- Interactive Operations on MapReduce ............................................................................ 5
- Data Sharing using Spark RDD ...................................................................................... 6
- Iterative Operations on Spark RDD ................................................................................ 6
- Interactive Operations on Spark RDD ............................................................................ 6

## 3. SPARK SQL – INSTALLATION ............................................................................. 8

- Step 1: Verifying Java Installation .................................................................................. 8
- Step 2: Verifying Scala installation ................................................................................. 8
- Step 3: Downloading Scala ............................................................................................. 8
- Step 4: Installing Scala .................................................................................................... 9
- Step 5: Downloading Apache Spark ............................................................................... 9

## 4. SPARK SQL – DATA TRANSFORMATION .................................................................

- Step 6: Configuring Spark .................................................................................................. 9
- Step 7: Understanding UDF ............................................................................................. 9
- Step 8: Creating UDF ....................................................................................................... 9
- Step 9: Using UDF ........................................................................................................... 10
- Step 10: Testing UDF ...................................................................................................... 10

## 5. SPARK SQL – SQL ................................................................................................ 11

- Step 11: Defining Table .................................................................................................... 11
- Step 12: Inserting Data .................................................................................................... 12
- Step 13: Querying Data .................................................................................................... 12
- Step 14: Updating Data ..................................................................................................... 13
- Step 15: Deleting Data ..................................................................................................... 13

## 6. SPARK SQL – DATA PROCESSING .......................................................................... 14

- Step 16: Aggregation ......................................................................................................... 14
- Step 17: Window Function ............................................................................................... 14
- Step 18: Grouping ............................................................................................................ 15
- Step 19: Joining ................................................................................................................ 15
- Step 20: Subquery ............................................................................................................ 16

## 7. SPARK SQL – DATA EXPLORATION .................................................................... 17

- Step 21: Data Exploration .................................................................................................. 17
- Step 22: Data Visualization ............................................................................................. 18

## 8. SPARK SQL – DATA SHARING ............................................................................ 19

- Step 23: Data Sharing ....................................................................................................... 19
- Step 24: Data Sharing using Spark RDD ........................................................................ 19
- Step 25: Data Sharing using MapReduce ...................................................................... 20

## 9. SPARK SQL – PERFORMANCE .............................................................................. 21

- Step 26: Optimizing Spark ............................................................................................... 21
- Step 27: Tuning Spark Parameters .................................................................................. 21
- Step 28: Monitoring Spark Performance ....................................................................... 22

## 10. SPARK SQL – SECURITY ...................................................................................... 23

- Step 29: Securing Spark .................................................................................................. 23
- Step 30: Authorization ..................................................................................................... 23
- Step 31: Encryption ........................................................................................................ 23

## 11. SPARK SQL – FUTURE .......................................................................................... 24

- Step 32: Future of Spark SQL .......................................................................................... 24
- Step 33: Future of Apache Spark ..................................................................................... 24
- Step 34: Future of Data Processing ................................................................................ 24

## 12. SPARK SQL – CONCLUSION .............................................................................. 25

- Step 35: Conclusion .......................................................................................................... 25
- Step 36: Summary ............................................................................................................ 25
- Step 37: Next Steps ........................................................................................................ 25

## References .......................................................................................................................... 26

## Index ................................................................................................................................... 27
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 6: Installing Spark</td>
<td>10</td>
</tr>
<tr>
<td>Step 7: Verifying the Spark Installation</td>
<td>10</td>
</tr>
<tr>
<td>4. SPARK SQL – FEATURES AND ARCHITECTURE</td>
<td>12</td>
</tr>
<tr>
<td>Features of Spark SQL</td>
<td>12</td>
</tr>
<tr>
<td>Spark SQL Architecture</td>
<td>13</td>
</tr>
<tr>
<td>5. SPARK SQL – DATA FRAMES</td>
<td>14</td>
</tr>
<tr>
<td>Features of DataFrame</td>
<td>14</td>
</tr>
<tr>
<td>SQLContext</td>
<td>14</td>
</tr>
<tr>
<td>DataFrame Operations</td>
<td>15</td>
</tr>
<tr>
<td>Running SQL Queries Programmatically</td>
<td>17</td>
</tr>
<tr>
<td>Inferring the Schema using Reflection</td>
<td>18</td>
</tr>
<tr>
<td>Programmatically Specifying the Schema</td>
<td>21</td>
</tr>
<tr>
<td>6. SPARK SQL – DATA SOURCES</td>
<td>25</td>
</tr>
<tr>
<td>JSON Datasets</td>
<td>25</td>
</tr>
<tr>
<td>DataFrame Operations</td>
<td>26</td>
</tr>
<tr>
<td>Hive Tables</td>
<td>27</td>
</tr>
<tr>
<td>Parquet Files</td>
<td>29</td>
</tr>
</tbody>
</table>
Industries are using Hadoop extensively to analyze their data sets. The reason is that Hadoop framework is based on a simple programming model (MapReduce) and it enables a computing solution that is scalable, flexible, fault-tolerant and cost effective. Here, the main concern is to maintain speed in processing large datasets in terms of waiting time between queries and waiting time to run the program.

Spark was introduced by Apache Software Foundation for speeding up the Hadoop computational computing software process.

As against a common belief, **Spark is not a modified version of Hadoop** and is not, really, dependent on Hadoop because it has its own cluster management. Hadoop is just one of the ways to implement Spark.

Spark uses Hadoop in two ways – one is **storage** and second is **processing**. Since Spark has its own cluster management computation, it uses Hadoop for storage purpose only.

**Apache Spark**

Apache Spark is a lightning-fast cluster computing technology, designed for fast computation. It is based on Hadoop MapReduce and it extends the MapReduce model to efficiently use it for more types of computations, which includes interactive queries and stream processing. The main feature of Spark is its **in-memory cluster computing** that increases the processing speed of an application.

Spark is designed to cover a wide range of workloads such as batch applications, iterative algorithms, interactive queries and streaming. Apart from supporting all these workload in a respective system, it reduces the management burden of maintaining separate tools.

**Evolution of Apache Spark**

Spark is one of Hadoop’s sub project developed in 2009 in UC Berkeley’s AMPLab by Matei Zaharia. It was Open Sourced in 2010 under a BSD license. It was donated to Apache software foundation in 2013, and now Apache Spark has become a top level Apache project from Feb-2014.

**Features of Apache Spark**

Apache Spark has following features.

- **Speed**: Spark helps to run an application in Hadoop cluster, up to 100 times faster in memory, and 10 times faster when running on disk. This is possible by reducing number of read/write operations to disk. It stores the intermediate processing data in memory.
• **Supports multiple languages:** Spark provides built-in APIs in Java, Scala, or Python. Therefore, you can write applications in different languages. Spark comes up with 80 high-level operators for interactive querying.

• **Advanced Analytics:** Spark not only supports ‘Map’ and ‘reduce’. It also supports SQL queries, Streaming data, Machine learning (ML), and Graph algorithms.

---

**Spark Built on Hadoop**

The following diagram shows three ways of how Spark can be built with Hadoop components.

![Spark Built on Hadoop Diagram](image)

There are three ways of Spark deployment as explained below.

• **Standalone:** Spark Standalone deployment means Spark occupies the place on top of HDFS (Hadoop Distributed File System) and space is allocated for HDFS, explicitly. Here, Spark and MapReduce will run side by side to cover all spark jobs on cluster.

• **Hadoop Yarn:** Hadoop Yarn deployment means, simply, spark runs on Yarn without any pre-installation or root access required. It helps to integrate Spark into Hadoop ecosystem or Hadoop stack. It allows other components to run on top of stack.

• **Spark in MapReduce (SIMR):** Spark in MapReduce is used to launch spark job in addition to standalone deployment. With SIMR, user can start Spark and uses its shell without any administrative access.
End of ebook preview

If you liked what you saw...

Buy it from our store @ https://store.tutorialspoint.com