Big Data Programming for Data Scientists

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Preface

This is a Quarto book.

To learn more about Quarto books visit https://quarto.org/docs/books.

1 Introduction

1.1 Using Spark for exploratory data analysis

1.1.1 What is Spark?

> From its humble beginnings in the AMPLab at U.C. Berkeley in 2009, Apache Spark has become one of the key big data distributed processing frameworks in the world. Spark can be deployed in various ways, provides native bindings for the Java, Scala, Python, and R programming languages, and supports SQL, streaming data, machine learning, and graph processing. You'll find it used by banks, telecommunications companies, games companies, governments, and all major tech giants such as Apple, Facebook, IBM, and Microsoft. ref

Databricks provides an excellent overview as well.

1.1.2 Rules of thumb for Spark

We are learning to use Spark as Data Scientists or Analysts that need tools for exploring and analyzing data that pushes the boundaries of our local memory. As we explore this space, we will need to keep in mind a few rules of thumb that should guide our use of Spark.

1.1.2.1 The Spark APIs let you use your language of preference

You can use Java, Scala, Python, or R to access Spark. Like Goldilocks and the Three Bears, we want the language that is not 'too hot' or 'too cold' for data science use. Java is a bit too verbose for day-to-day data science work. Scala is fast but still a little verbose. Python is a little slower but ingrained in the data science community, and R is less easy to implement in a production environment.

- **pyspark (just right)**: The pyspark package looks to be the 'just the right amount' of the Spark APIs.

- **sparkR (a little cold)**: Apache has developed an R package that is the official R connection to Spark.

- **sparklyr (RStudio's warm-up)**: If you are experienced with the Tidyverse, then RStudio's sparklyr could pull you away from pyspark.

You can read a comparison of sparkR and sparklyr here.

1.1.2.2 Use DataFrames (ignore RDDs)

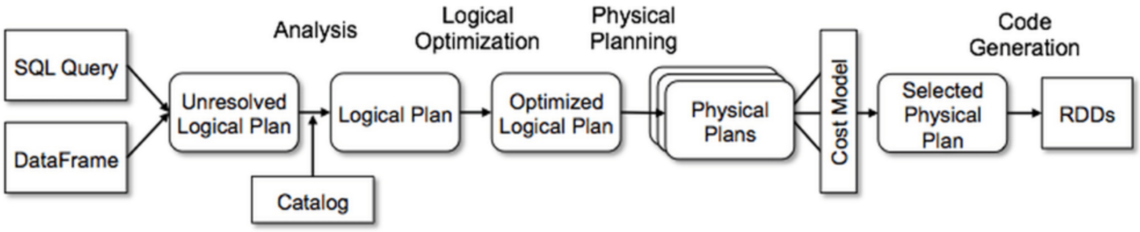
For day-to-day data science use, `DataFrames` are the option you should choose.

1. Spark has built a framework to optimize Resilient Distributed Dataset (RDD) use when we program with `DataFrame` methods.
2. Spark internally stores `DataFrames` in a binary format, so there is no need to serialize and deserialize data as it moves over the cluster.

Databricks provides a Deep Dive into Spark SQL's Catalyst Optimizer and A Tale of Three Apache Spark APIs: RDDs vs. DataFrames and Datasets to help you understand more depth on the relationship between `DataFrames`.

We pulled the bullets and image below from the Databricks articles.

> - If you want unification and simplification of APIs across Spark Libraries, use DataFrame or Dataset.
> - If you are an R user, use DataFrames.
> - If you are a Python user, use DataFrames and resort back to RDDs if you need more control.



1.1.2.3 Write and Read serialized data formats

The Apache Parquet format is optimal for most data science applications. It is a serialized columnar format that provides speed and size benefits for big data applications. The following table compares the savings and the speedup obtained by converting data into Parquet from CSV.

Dataset	Size on Amazon S3	Query Run Time	Data Scanned	Cost
Data stored as CSV files	1 TB	236 seconds	1.15 TB	$5.75
Data stored in Apache Parquet Format	130 GB	6.78 seconds	2.51 GB	$0.01
Savings	87% less when using Parquet	34x faster	99% less data scanned	99.7% savings

You could use Avro with Spark as well. It is stored in rows, much like a `.csv` file, but is serialized.

1.2 DataBricks

1.2.1 Navigation

- This file provides a high-level overview of Databricks.
- The HTML folder contains notebooks that can be imported into Databricks. All HTML files in that folder can be imported individually, or you can use `examples.dbc` to import them all at once.

1.2.2 The elevator pitches

Check out these branded videos.

> It's time for DataBricks!
>
> Databricks is the AI Company

Here is a bit more nerdy DS/CS pitch from their website

> With origins in academia and the open-source community, Databricks was founded in 2013 by the original creators of Apache Spark™, Delta Lake, and MLflow. As the world's first and only lakehouse platform in the cloud, Databricks combines the best of data warehouses and data lakes to offer an open and unified platform for data and AI.
>
> Introduction to Databricks Unified Data Platform: 5 min demo