Data Science Course Exercise Workbook

Introduction to HDFS and MapReduce

Course Material

Stuart Brown, April 2017

Data Science – Introduction to HDFS

Stuart Brown, April 2017

08

**Fall**

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# Summary and Intro

This workbooks aim is to aid and facilitate Data Science trainees learning. This workbook will cover aspects from the 3rd and 4th lecture slides for the Data Science course:

1. Introduction to HDFS

2. Introduction to DEDPQ MapReduce

This workbook and subsequent workbooks will act as a record of the trainees work, learnings and understanding.

You should aim to complete all questions.

# Section 1: Introduction to HDFS

# **Exercise 1: Stock Data Ingestion Task**

This exercise is formed of 7 tasks that will involve transferring data into your personal HDFS location. Data in HDFS receives the benefits of being on distributed storage and of Hadoops accessibility and fault tolerance. Applications that we will be using later in the course (HIVE, PIG, and SPARK) will be utilising the HDFS as they are part of the Apache Hadoop ecosystem.

Please write the commands you used. It will be beneficial!

#### Task 1:

Start the Hadoop Services. You will be starting Hadoop to store, for example, large amounts of financial data.

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#### Task 2:

In the HDFS create a directory “firstname.lastname” in the user directory. By creating a personal storage repository within HDFS, you will have a place to store the financial data

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#### Task 3:

Create further subdirectories for some Apple stock data (stocks/apple). It is always a good idea to have a clean file system structure which leads to good data management.

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#### Task 4:

On the local file system there should be a DataSets folder you can verify this by:

**ls /PublicStorage/**

In there should be stock data folder and in that a file called: “appl\_daily.csv”

Load this file into the HDFS directory you just created.

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#### Task 5:

Transfer the other stock csv’s into /stocks/<name>.

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#### Task 6:

Ensure that you have full permissions on these files. This is so you can keep accessing the files later on without issue.

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#### Task 7:

Create a backup of the stocks data that can be used for archive or auditing purposes.

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# **Exercise 2: HDFS Project**

As you may have felt from section 1, ingesting files individually can be rather tiresome. At least with only 7 files it was manageable, but what if you had 20? 50? 1000?

Clearly we need a script that will do the data ingestion for us. Time to practise those unix skills!

#### Project Task:

1. Create a script that will transfer data files into hdfs.
2. This script should place existent, sized files into an individually appropriate directory on hdfs based on the file name.
3. Status messages and flow control should also be included.
4. An archive of the files should also be created.

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# Section 2: HDFS & DEDPQ MapReduce

The following exercises are set to test your knowledge about HDFS and MapReduce. You will need to conduct some research in order to formulate accurate/appropriate answers.

# **Exercise 1: MapReduce**

This exercise follows on from the lecture content.

#### Question 1:

Detail 3 aspects of MapReduce?

\_\_ map stage, shuffle stage, and reduce stage. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#### Question 2:

What is the role of the Job and Task Tracker daemons.

#### Question 3:

Outline the process of a MapReduce Task.

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#### Question 4:

What are 3 advantages of the MapReduce methodology.

1. \_ Scalability. ...
2. Flexibility. ...
3. Security and Authentication. ...
4. Cost-effective Solution. ...
5. Fast. ...
6. Simple Model of Programming. ...
7. Parallel Processing. ...
8. Availability and Resilient Nature. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#### Question 5:

What value does YARN add to the Hadoop Core?

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#### Question 6:

What are the 4 step to writing a MapReduce job and how do applications like HIVE and PIG ease the process.

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# **Exercise 2: Interview Questions**

In this section you will be provided with interview style questions about Hadoop, HDFS and MapReduce. You will need to research into these answers.

#### Question 1:

What is Hadoop Map Reduce ?

\_ Hadoop MapReduce is a software framework for easily writing applications which process vast amounts of data (multi-terabyte data-sets) in-parallel on large clusters (thousands of nodes) of commodity hardware in a reliable, fault-tolerant manner. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#### Question 2:

How does Hadoop MapReduce work?

\_ MapReduce assigns fragments of data across the nodes in a Hadoop cluster. The goal is to split a dataset into chunks and use an algorithm to process those chunks at the same time. The parallel processing on multiple machines greatly increases the speed of handling even petabytes of data \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#### Question 3:

Explain what is shuffling in MapReduce ?

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#### Question 4:

 Explain what is distributed Cache in MapReduce Framework?

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#### Question 5:

Explain what is NameNode in Hadoop?

#### NameNode is the master node in the Apache Hadoop HDFS Architecture that maintains and manages the blocks present on the DataNodes (slave nodes). NameNode is a very highly available server that manages the File System Namespace and controls access to files by

#### Question 6:

 Explain what is JobTracker in Hadoop? What are the actions followed by Hadoop?

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#### Question 7:

Explain what is heartbeat in HDFS?

\_ A heartbeat is **a signal that is generated at regular intervals to indicate that something is working correctly**. 2. Heartbeat is a program that runs specialized scripts automatically whenever a system is initialized or rebooted.

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#### Question 8:

What happens when a datanode fails ?

\_\_ As soon as the datanodes are declared dead. Data blocks on the failed Datanode are replicated on other Datanodes based on the specified replication factor in hdfs-site. xml file. Once the failed datanodes comes back the Name node will manage the replication factor again. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#### Question 9:

Explain what is Speculative Execution?

\_ Speculative execution is an optimization technique in which a processor (CPU) performs a series of tasks before it is prompted to, in order to have the information ready if it is required at any point.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#### Question 10:

 Explain what is difference between an Input Split and HDFS Block?

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#### Question 11:

Mention what are the main configuration parameters that user need to specify to run Mapreduce Job ?

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#### Question 12:

Explain how JobTracker schedules a task ?

Keeps track of the heart beats

JobTracker finds the best TaskTracker nodes to execute tasks based on the data locality (proximity of the data) and the available slots to execute a task on a given node. JobTracker monitors the individual TaskTrackers and the submits back the overall status of the job back to the client.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#### Question 13:

Explain what is Hadoop?

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#### Question 14:

Mention what is the difference between an RDBMS and Hadoop?

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#### Question 15:

Mention Hadoop core components?

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#### Question 16:

What is the DataNode in Hadoop?

\_\_ DataNodes are the slave nodes in HDFS. Unlike NameNode, DataNode is a commodity hardware, that is, a non-expensive system which is not of high quality or high-availability. The DataNode is a block server that stores the data in the local file ext3 or ext4.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#### Question 17:

When Namenode is down what happens to job tracker?

\_ the namenode is the addressbook so if this is doen the whole system is down.

clients.Question 18:

Explain how indexing in HDFS is done?

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#### Question 19:

Explain is it possible to search for files using wildcards?

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#### Question 20:

List out Hadoop’s three configuration files?

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#### Question 21:

Mention what is rack awareness?

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#### Question 22:

Explain what is a Task Tracker in Hadoop?

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#### Question 23:

Mention what daemons run on a master node and slave nodes?

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#### Question 24:

Explain what is storage and compute nodes?

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#### Question 25:

Mention what is the best way to copy files between HDFS clusters?

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#### Question 26:

Mention what are the three modes in which Hadoop can be run?

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#### Question 27:

Mention how many InputSplits is made by a Hadoop Framework?

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#### Question 28:

Mention what is distributed cache in Hadoop?

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#### Question 29:

Explain what is “map” and what is "reducer" in Hadoop?

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# Summary

You should now be able to navigate the HDFS, transfer bulk data into it and have a thorough understanding of the Hadoop core and the daemon processes that support the application.