Scala

Web Log Processing

```
import org.apache.log4j.{Level, Logger}
import org.apache.spark.sql.{Column, SparkSession}
import org.apache.spark.sql.functions._
```

This imports Level and Logger from org.apache.log4j, Column and SparkSession from org.apache.spark.sql, and all functions from org.apache.spark.sql.functions. This way, you can directly use functions like regexp_extract, sum, col, to_date, udf, to_timestamp, desc, dayofyear, and year without specifying the package each time.

```
// Create a SparkSession with the given application name "WebLog" and set the master to run locally using all available cores.
val spark = SparkSession.builder()
  .appName("WebLog")        // Setting the application name
  .master("local[*]")       // Running Spark in local mode using all available cores
  .getOrCreate()            // Creating the SparkSession if it doesn't exist, or getting the existing one

// Read the content of a CSV file located at "weblog.csv" into a DataFrame
val base_df = spark.read.text("/home/deptii/Web_Log/weblog.csv")

// Print the schema of the DataFrame
base_df.printSchema()

import spark.implicits._
base_df.show(3, false)
```

The provided code performs the following tasks:

1. **Import Spark implicits**: `import spark.implicits._` imports the implicit methods available in Spark. These implicits allow you to implicitly convert standard Scala objects into DataFrame operations.
2. **Read a CSV file into a DataFrame**: `val base_df = spark.read.text("/home/deptii/Web_Log/weblog.csv")` reads the content of a CSV file located at "weblog.csv" into a DataFrame named `base_df`. Since `.read.text()` is used, each line of the text file will be treated as a separate record in the DataFrame, and there will be a single column named "value" containing the content of each line.
3. **Print DataFrame schema**: `base_df.printSchema()` prints the schema of the DataFrame `base_df`. This shows the data types of each column in the DataFrame.

4. **Display DataFrame content**: `base_df.show(3, false)` displays the first 3 rows of the DataFrame `base_df`. The `false` parameter indicates that the truncation of the displayed data should be disabled. So, it displays the entire content of each row.

```
val parsed_df = base_df.select(
   regexp_extract($"value", """^(\S+)""", 1).alias("host"),
   regexp_extract($"value", """\[(\d{2}/\w{3}/\d{4}:\d{2}:\d{2}:\d{2})""", 1).as("timestamp"),
   regexp_extract($"value", """\s(\S+)\s+HTTP""", 1).as("path"),
   regexp_extract($"value", """,(\d+)$""", 1).cast("int").alias("status")
)
```

Certainly, let's break down each regular expression used in the code:

1. **Host Regex**:
    - `^(\S+)`
        - `^` asserts the start of the line.
        - `(\S+)` captures one or more non-whitespace characters.
    - This regex captures the host part of the log entry, which is typically the IP address or hostname.
2. **Timestamp Regex**:
    - `\[(\d{2}/\w{3}/\d{4}:\d{2}:\d{2}:\d{2})`
        - `\[` matches the opening square bracket `[`.
        - `(\d{2}/\w{3}/\d{4}:\d{2}:\d{2}:\d{2})` captures the timestamp in the format `dd/MMM/yyyy:HH:mm:ss`.
            - `\d{2}` matches two digits for the day.
            - `\w{3}` matches three word characters for the month abbreviation (e.g., Jan, Feb).
            - `\d{4}` matches four digits for the year.
            - `:\d{2}` matches two digits for the hour.
            - `:\d{2}` matches two digits for the minutes.
            - `:\d{2}` matches two digits for the seconds.
    - This regex captures the timestamp part of the log entry enclosed within square brackets.

3. **Path Regex**:
    - `\s(\S+)\s+HTTP`
        - `\s` matches a whitespace character.
        - `(\S+)` captures one or more non-whitespace characters, which represent the path.
        - `\s+HTTP` matches one or more whitespace characters followed by "HTTP".
    - This regex captures the path part of the log entry, which represents the URL or endpoint accessed.
4. **Status Regex**:
    - `,\d+$`
        - `,` matches the comma character.
        - `\d+` matches one or more digits.
        - `$` asserts the end of the line.
    - This regex captures the status code at the end of the log entry, typically separated by a comma. It then converts it to an integer.

```
// Function to count null values in a column
def countNulls(colName: String): Column = sum(col(colName).isNull.cast("int")).alias(colName)

// Check if the initial dataset contains any null values
val baseNullCount = base_df.filter($"value".isNull).count()
println(s"Number of bad rows in the initial dataset: $baseNullCount")

// Filter out rows with null values in specific columns in the parsed dataset
val requiredColumns = Seq("host", "timestamp", "path", "status")
val badRows = parsed_df.filter(requiredColumns.map(colName => col(colName).isNull).reduce(_ || _))
println(s"Number of bad rows: ${badRows.count()}")

// Count number of null values in each column
val nullCounts = parsed_df.columns.map(colName => countNulls(colName))
parsed_df.select(nullCounts: _*).show()

// Check for bad status in the base dataset
val badStatusRows = base_df.select(regexp_extract($"value","""([^\d]+)$""",1).as("bad_status"))
                        .filter($"bad_status".notEqual(""))
println(s"Number of bad rows with bad status: ${badStatusRows.count()}")
badStatusRows.show(5)
```

Explanation:

1. The `countNulls` function counts the number of null values in a given column.

2. The initial check for null values in the `base_df` dataset and printing the count.
3. Filtering out rows with null values in specific columns in the `parsed_df` dataset.
4. Counting the number of null values in each column of the `parsed_df`.
5. Checking for bad status in the `base_df` dataset and printing the count.

```
// Clean the dataset by removing rows with null values
val cleaned_df = parsed_df.na.drop()

// Check if any null values remain in specific columns
val nullCount = cleaned_df.filter($"host".isNull || $"timestamp".isNull || $"path".isNull ||
$"status".isNull).count()
println(s"The count of null values: $nullCount")

// Compare row count before and after cleaning
val rowCountBefore = parsed_df.count()
val rowCountAfter = cleaned_df.count()
println(s"Before: $rowCountBefore | After: $rowCountAfter")

/*
   Parsing the timestamp
*/

// Try to cast the timestamp column to date
// Null values may result if Spark is unable to convert a date value
cleaned_df.select(to_date($"timestamp")).show(2)

// Fix the timestamp column format
val month_map = Map("Jan" -> 1, "Feb" -> 2, "Mar" -> 3, "Apr" -> 4, "May" -> 5, "Jun" -> 6,
"Jul" -> 7, "Aug" -> 8,
                  "Sep" -> 9, "Oct" -> 10, "Nov" -> 11, "Dec" -> 12)

def parse_clf_time(s: String): String = {
   "%3$s-%2$s-%1$s %4$s:%5$s:%6$s".format(s.substring(0,2), month_map(s.substring(3,6)),
s.substring(7,11),
                                        s.substring(12,14), s.substring(15,17), s.substring(18))
}

val toTimestamp = udf[String, String](parse_clf_time(_))
val logs_df = cleaned_df.select($"*",
to_timestamp(toTimestamp($"timestamp")).alias("time")).drop("timestamp")
logs_df.printSchema()
logs_df.show(2)

// Cache the dataset for faster subsequent actions
logs_df.cache()
```

1. Problem Statement No. 05

Write a Scala Program to process a log file of a system and perform following analytics on the given dataset.
(I) Display the list of top 10 frequent hosts.
(II) Display the list of top 5 URLs or paths
(III) Display the number of unique Hosts

```
import org.apache.spark.sql.functions._

// (I) Display the list of top 10 frequent hosts
val top10Hosts = logs_df.groupBy($"host").count().orderBy(desc("count")).limit(10)
println("Top 10 frequent hosts:")
top10Hosts.show()

// (II) Display the list of top 5 URLs or paths
val top5Paths = logs_df.groupBy($"path").count().orderBy(desc("count")).limit(5)
println("Top 5 URLs or paths:")
top5Paths.show()

// (III) Display the number of unique Hosts
val uniqueHostsCount = logs_df.select(countDistinct($"host")).collect()(0)(0)
println(s"Number of unique hosts: $uniqueHostsCount")
```

2. Problem Statement No. 06

Write a Scala Program to process a log file of a system and perform following analytics on the given dataset.
(I) Display the count of 404 Response Codes
(II) Display the list of Top Twenty-five 404 Response Code Hosts
(III) Display the number of Unique Daily Hosts

```
import org.apache.spark.sql.functions._

// (I) Display the count of 404 Response Codes
val count404 = logs_df.filter($"status" === 404).count()
println(s"Count of 404 Response Codes: $count404")

// (II) Display the list of Top Twenty-five 404 Response Code Hosts
val top25Hosts404 = logs_df.filter($"status" ===
404).groupBy($"host").count().orderBy(desc("count")).limit(25)
println("Top Twenty-five 404 Response Code Hosts:")
top25Hosts404.show()

// (III) Display the number of Unique Daily Hosts
val uniqueDailyHosts = logs_df.groupBy(to_date($"time").alias("date"),
$"host").agg(countDistinct($"host")).groupBy("date").count()
println("Number of Unique Daily Hosts:")
uniqueDailyHosts.show()
```

3. Problem Statement No. 17

1. Write a Scala program that counts the number of occurrences of each word in the given input file using Spark framework.

2. Write a Scala Program to find out if the number is Positive, Negative or Zero.

```
// Open the file "wcount.txt" in the Vim text editor
vim wcount.txt

// Launch the Spark shell to interactively run Spark applications
spark-shell

// Read the contents of the file "wcount.txt" into an RDD named inputfile
val inputfile = sc.textFile("wcount.txt")

// Perform word count on the inputfile RDD:
// 1. Split each line into words
// 2. Map each word to a tuple (word, 1) for counting
// 3. Reduce the tuples by key (word) to get the count of each word
val counts = inputfile.flatMap(line => line.split(" ")).map(word => (word,1)).reduceByKey(_+_)

// Print debug information about the RDD counts, showing its lineage and dependencies
counts.toDebugString

// Cache the RDD counts into memory for faster subsequent operations
counts.cache

// Save the RDD counts as text files in a directory named "Output"
counts.saveAsTextFile("Output")
```

```
object NumberType {
  def main(args: Array[String]): Unit = {
    // Input number
    println("Enter a number:")
    val number = scala.io.StdIn.readDouble()

    // Determine number type
    val result = if (number > 0) "Positive" else if (number < 0) "Negative" else "Zero"

    // Print the result
    println(s"The number $number is $result.")
  }
}
```

4. Problem Statement No. 18
1. Write a Scala program that counts the number of occurrences of each word in the given input file using Spark framework.
2. Write a Scala Program to find out the largest of two numbers.

```
object LargestNumber {
  def main(args: Array[String]): Unit = {
    // Input two numbers
    println("Enter the first number:")
    val num1 = scala.io.StdIn.readDouble()

    println("Enter the second number:")
    val num2 = scala.io.StdIn.readDouble()

    // Determine the largest number
    val largest = if (num1 > num2) num1 else num2

    // Print the result
    println(s"The largest number is: $largest")
  }
}
```

Hadoop

7. Problem Statement No. 13,14,19

Write a code in JAVA for a simple Word Count application that counts the number of occurrences of each word in a given input set using the Hadoop Map-Reduce framework on local-standalone set-up.

```
# Switch to the user 'hadoop' with the environment variables set to that user
su – hadoop

# Change directory to a directory named 'hadoop'
cd hadoop

# Open the Vim text editor to create/edit a file named 'input.txt'
vim input.txt

# Start all Hadoop daemons by running the 'start-all.sh' script
start-all.sh

# Create a directory named 'wordcount' in the Hadoop Distributed File System (HDFS)
hdfs dfs -mkdir /wordcount

# Copy a file named 'input.txt' from the local file system to the 'wordcount' directory in
HDFS
hdfs dfs -put /home/hadoop/hadoop/input.txt /wordcount
```

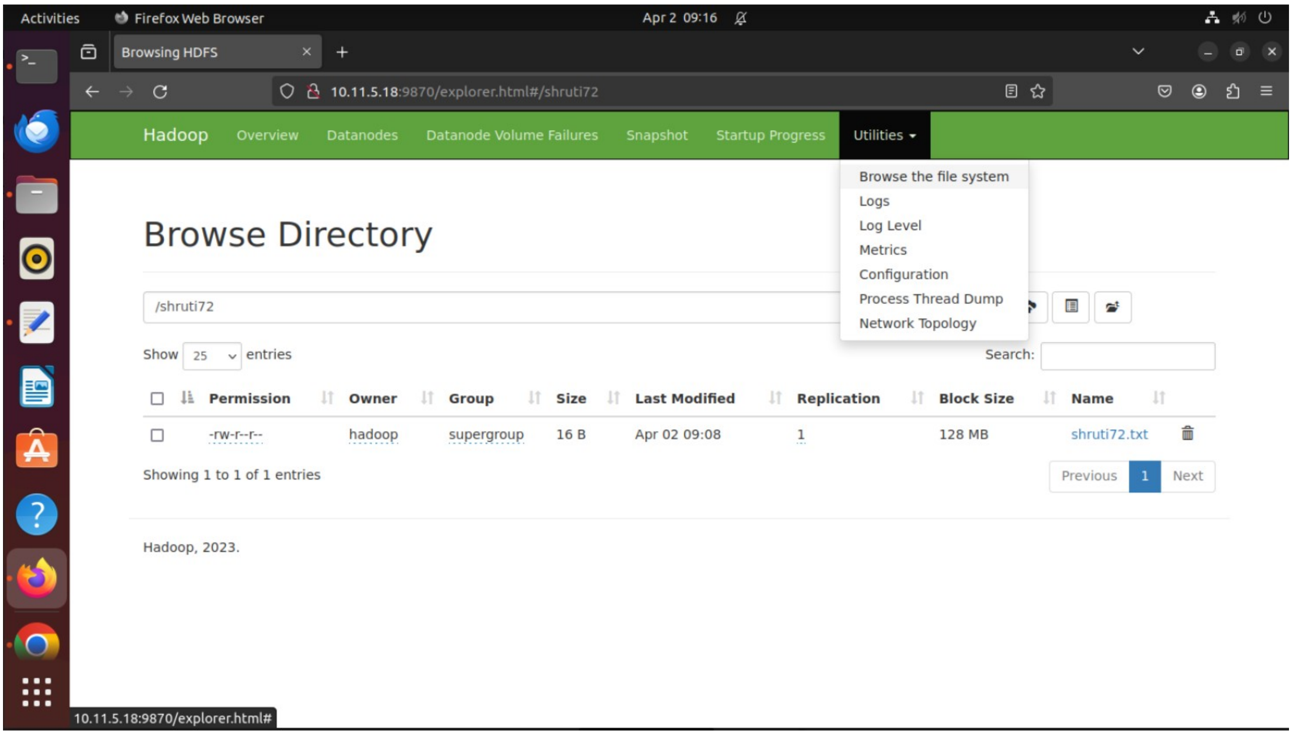
```
nano Mapper1.java
nano Reducer1.java
nano WC_Runner.java

# Compile the Java files (Mapper1.java, Reducer1.java, WC_Runner.java)
# and specify the classpath using the output of the `hadoop classpath` command
# The `-d .` flag specifies the output directory as the current directory
javac -classpath "$(hadoop classpath)" -d . Mapper1.java Reducer1.java WC_Runner.java

# Create a JAR file named "Wordcount.jar" containing the compiled Java classes
# The `jar` command is used to create, modify, or extract files from JAR archives
# The `-cvf` options specify the action (create), verbose output, and file name
# The `com` directory contains the compiled Java classes
jar -cvf Wordcount.jar com
```

```
# Run a Hadoop job using the JAR file "/home/hadoop/hadoop/Wordcount.jar"
# The main class of the job is "com.wc.WC_Runner"
# The input file is "/test.wc/input.txt" and the output directory is "/output"
hadoop jar /home/hadoop/hadoop/Wordcount.jar com.wc.WC_Runner /test.wc/input.txt /output

# After the Hadoop job completes, display the contents of the output file
# The `hdfs dfs -cat` command is used to display the contents of files in HDFS
# In this case, we are displaying the contents of the file "part-00000" in the "/output" directory
hadoop$ hdfs dfs -cat /output/part-00000
```



Browse Directory

/shruti72

Show 25 entries

☐	Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
☐	-rw-r--r--	hadoop	supergroup	16 B	Apr 02 09:08	1	128 MB	shruti72.txt

Showing 1 to 1 of 1 entries

Hadoop, 2023.