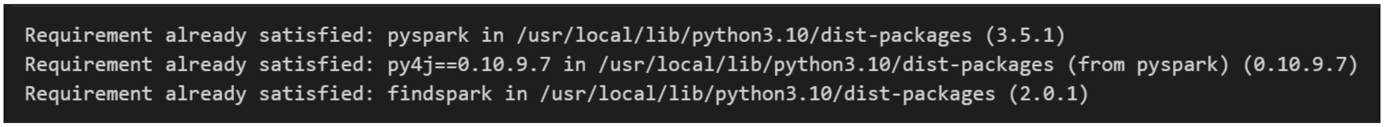
BDA Mini project CA2

Write MapReduce/Spark Program to perform

1. **Matrix Vector Multiplication**
   Code:

Locally installing Spark:

```
%pip install pyspark
%pip install findspark

import findspark
findspark.init()
from pyspark.sql import
SparkSession

spark = SparkSession.builder \
      .master('local[*]') \
      .appName('Basics') \
      .getOrCreate()
```

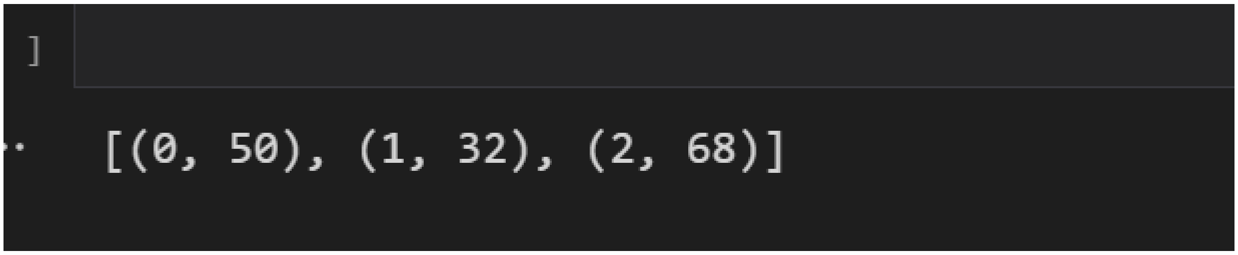


```
Requirement already satisfied: pyspark in /usr/local/lib/python3.10/dist-packages (3.5.1)
Requirement already satisfied: py4j==0.10.9.7 in /usr/local/lib/python3.10/dist-packages (from pyspark) (0.10.9.7)
Requirement already satisfied: findspark in /usr/local/lib/python3.10/dist-packages (2.0.1)
```

```
from pyspark.sql import
SparkSession

# Create SparkSession
spark = SparkSession.builder \

.appName("MatrixVectorMultiplicati
on") \
   .getOrCreate()

# Input matrix and vector
matrix = [
   [7, 8, 9],
   [4, 5, 6],
   [10, 11, 12]
]
```

```
vector = [1, 2, 3]

# Define the multiplication function
def multiply(row):
    matrix_row, values = row
    result = sum(value * vector[i] for i,
value in enumerate(values))
    return (matrix_row, result)

# Parallelize the matrix
matrix_rdd =
spark.sparkContext.parallelize(enum
erate(matrix))

# Perform matrix-vector
multiplication
result = matrix_rdd.map(multiply)

# Collect the result and print
print(result.collect())

# Stop the Spark Session
spark.stop()
```

Output:



```
[(0, 50), (1, 32), (2, 68)]
```

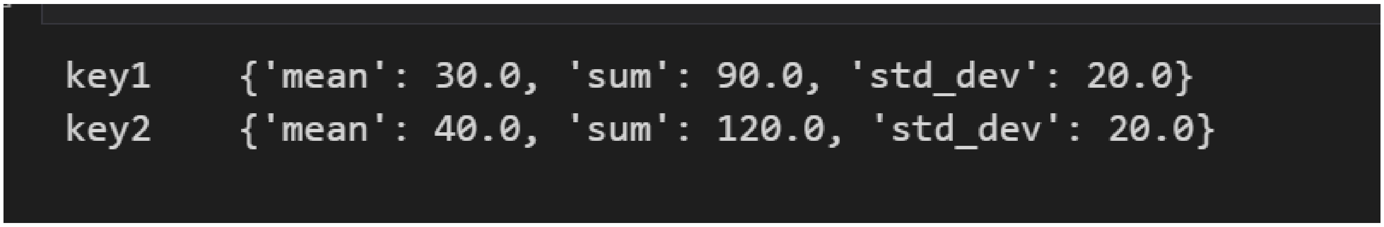
2. Aggregations - Mean, Sum, Std Deviation

Code:

```
from pyspark import SparkContext
from math import sqrt

# Dummy input data
input_data = [
    'key1\t10',
    'key2\t20',
    'key1\t30',
    'key2\t40',
    'key1\t50',
    'key2\t60',
]

def map_func(line):
    key, value = line.split('\t')
    return key, float(value)

def reduce_func(data):
    values = list(data)  # Convert data to list for clarity
    mean_val = sum(values) / len(values)
    sum_val = sum(values)
    if len(values) > 1:  # Check if there are more than one value for calculation
        std_dev_val = sqrt(sum((x - mean_val) ** 2 for x in values) / (len(values) - 1))
    else:
        std_dev_val = 0
    return {
        'mean': mean_val,
        'sum': sum_val,
        'std_dev': std_dev_val
    }

if __name__ == '__main__':
    sc = SparkContext('local', 'AggregationSpark')
    try:
        lines = sc.parallelize(input_data)
        mapped = lines.map(map_func)
        grouped = mapped.groupByKey()
        result = grouped.mapValues(list).mapValues(reduce_func)
        output = result.collect()
        for key, value in output:
```

```
        print(f'{key}\t{value}')
    finally:
      sc.stop()
```

Output:



```
key1    {'mean': 30.0, 'sum': 90.0, 'std_dev': 20.0}
key2    {'mean': 40.0, 'sum': 120.0, 'std_dev': 20.0}
```

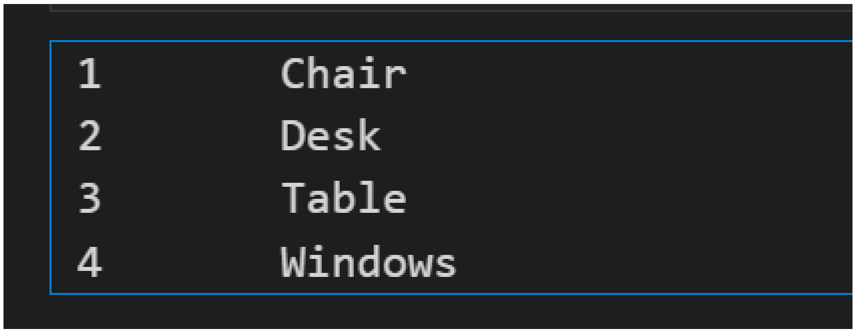
3. Sort the data

Code:

```
from pyspark.sql import
SparkSession

# Create a Spark session
spark = SparkSession.builder
\
    .appName("SortData") \
    .getOrCreate()

# Define dummy input data
dummy_data = [
    "3\tTable",
    "1\tChair",
    "2\tDesk",
    "4\tWindows"
]

# Create RDD from dummy
data
data_rdd =
spark.sparkContext.parallelize
(dummy_data)

# Sort the data based on the
first column
sorted_data =
data_rdd.sortBy(lambda x:
x.split('\t')[0])

# Collect and print the sorted
data
sorted_results =
sorted_data.collect()
for result in sorted_results:
    print(result)
```

```
# Stop the Spark session
spark.stop()
```

Output:



```
1        Chair
2        Desk
3        Table
4        Windows
```

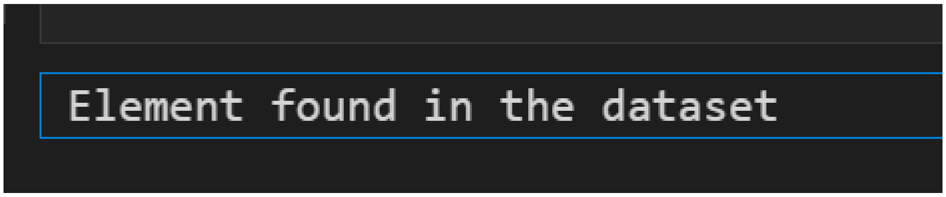
4. Search a data element

Code:

```
from pyspark import
SparkContext, SparkConf

# Create a Spark context
conf =
SparkConf().setAppName(
"SearchElement").setMast
er("local")
sc =
SparkContext(conf=conf)

# Define the data to be
searched
data = [1, 2, 3, 4, 5, 6, 7, 8,
9, 10]

# Parallelize the data into
RDD (Resilient
Distributed Dataset)
rdd = sc.parallelize(data)

# Define the search
function
def
search_element(element):
    return element == 10  #
Change the search element
as needed

# Map function to search
for the element in the
dataset
result =
rdd.map(search_element)
```

```
# Collect the results
search_result =
result.collect()

# Print the search result
if True in search_result:
    print("Element found in
the dataset")
else:
    print("Element not
found in the dataset")

# Stop the Spark context
sc.stop()
```

Output:



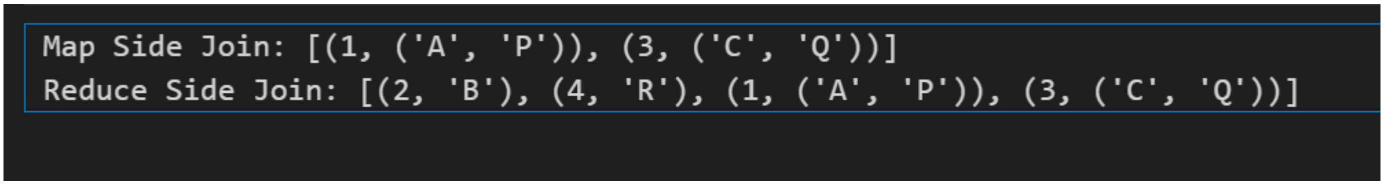
```
Element found in the dataset
```

5. Joins - Map Side and Reduce Side

Code:

```
from pyspark import
SparkContext

# Initialize
SparkContext
sc =
SparkContext("local",
"Joins")

# Create RDDs for
left and right datasets
left_data =
sc.parallelize([(1,
"A"), (2, "B"), (3,
"C")])
right_data =
sc.parallelize([(1,
"P"), (3, "Q"), (4,
"R")])

# Perform map-side
join
map_join =
left_data.join(right_da
ta)

# Perform reduce-side
join
reduce_join =
left_data.union(right_
data).reduceByKey(la
mbda x, y: (x, y))

# Print the results
print("Map Side
Join:",
map_join.collect())
print("Reduce Side
Join:",
reduce_join.collect())

# Stop SparkContext
sc.stop()
```

Output:



```
Map Side Join: [(1, ('A', 'P')), (3, ('C', 'Q'))]
Reduce Side Join: [(2, 'B'), (4, 'R'), (1, ('A', 'P')), (3, ('C', 'Q'))]
```