香港城市大學
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Parallel computing on Bike Sharing Demand Dataset

CS4480 Group Project – Group 14

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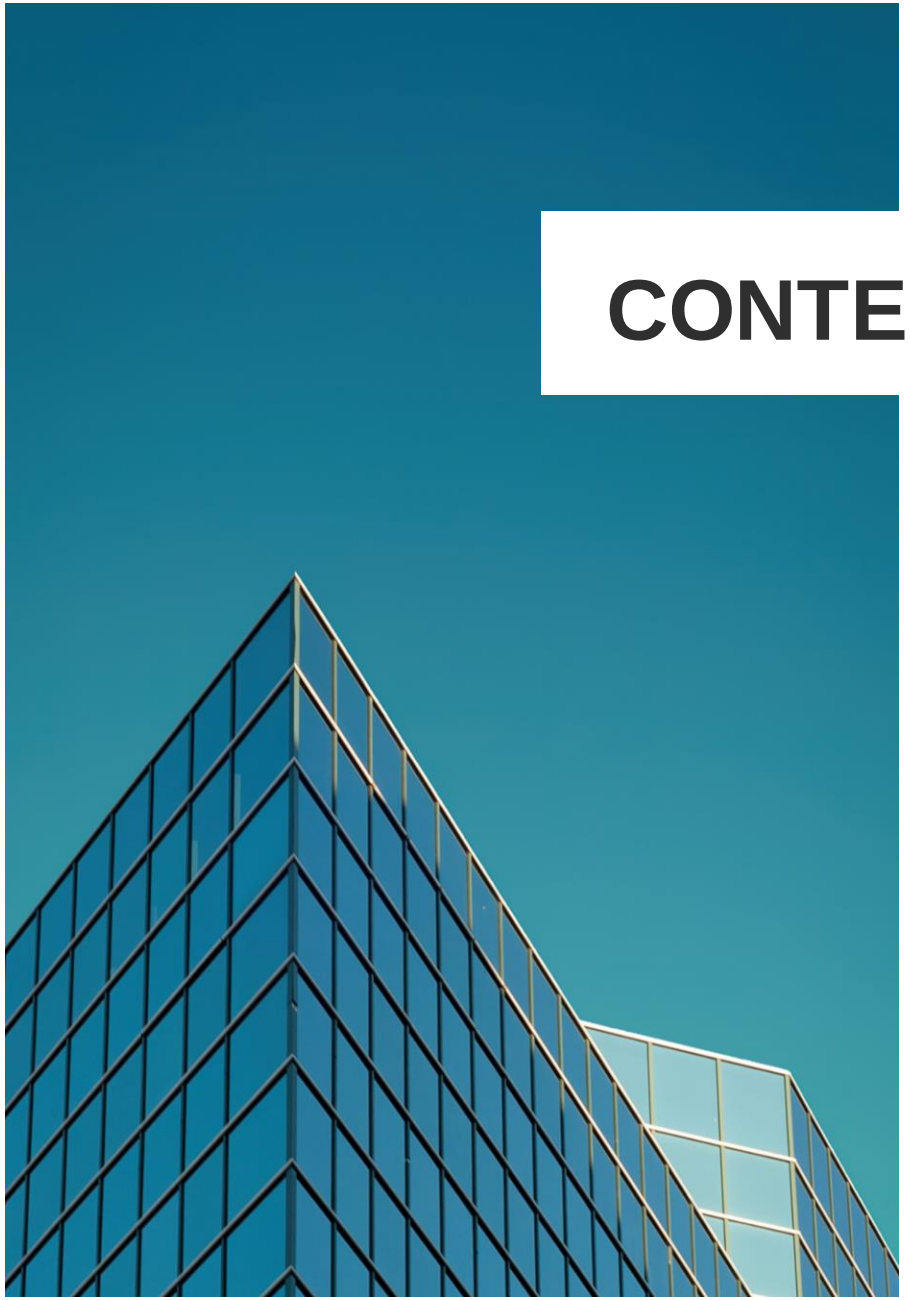


CONTENTS

Data Preprocessing Demand Dataset

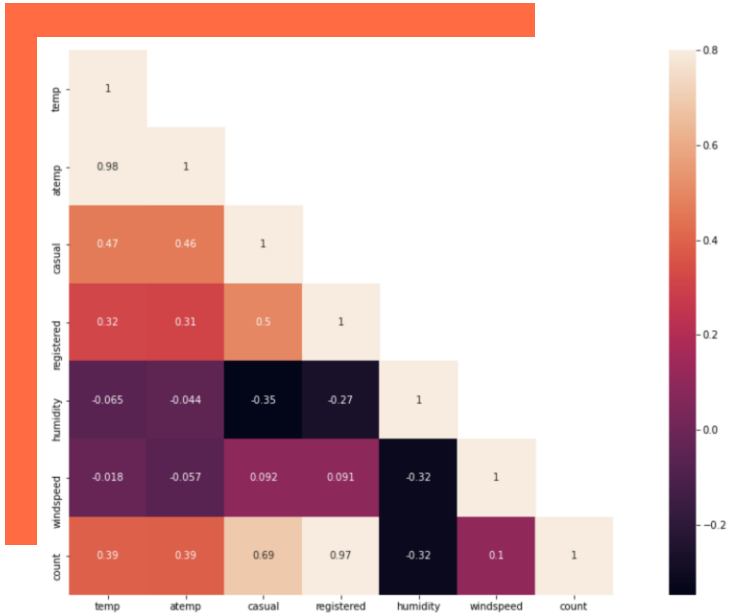
	date	hour	year	month	weekday	season	holiday	workingday	weather	temp	atemp	humidity	windspeed	casual	registered	count
0	2011-01-01	0	2011	1	7	1	0	0	1	9.84	14.395	81	0.0	3	13	16
1	2011-01-01	1	2011	1	7	1	0	0	1	9.02	13.635	80	0.0	8	32	40
2	2011-01-01	2	2011	1	7	1	0	0	1	9.02	13.635	80	0.0	5	27	32
3	2011-01-01	3	2011	1	7	1	0	0	1	9.84	14.395	75	0.0	3	10	13
4	2011-01-01	4	2011	1	7	1	0	0	1	9.84	14.395	75	0.0	0	1	1

Two-year historical log corresponding to years 2011 and 2012 from Capital Bikeshare system, Washington D.C., USA

Corresponding weather and seasonal information extracted from *freemeteo*

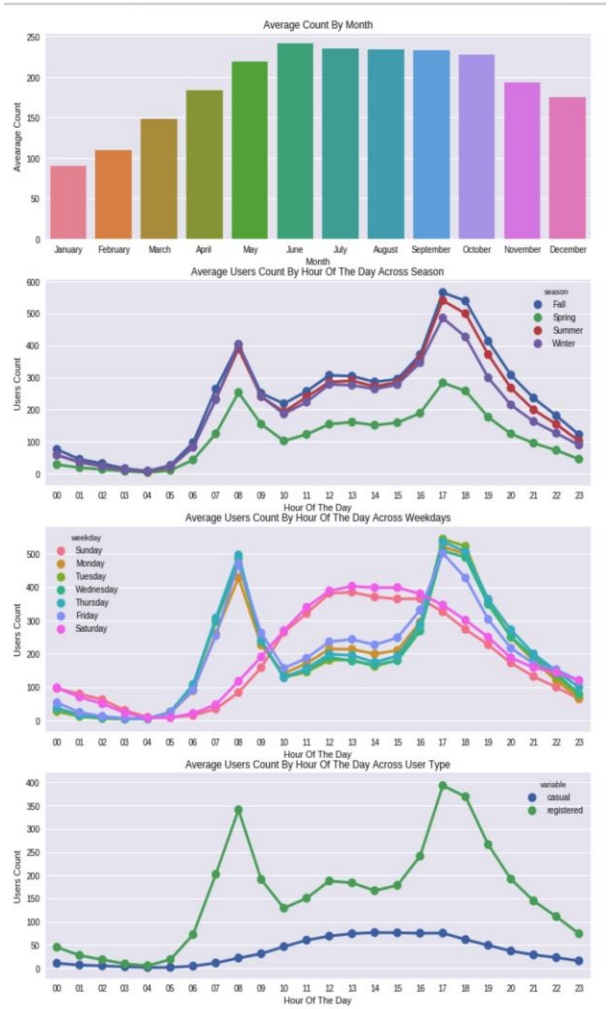
Data Source — http://capitalbikeshare.com/system-data. http://www.freemeteo.com.

Exploratory Data Analysis



Correlation Analysis:

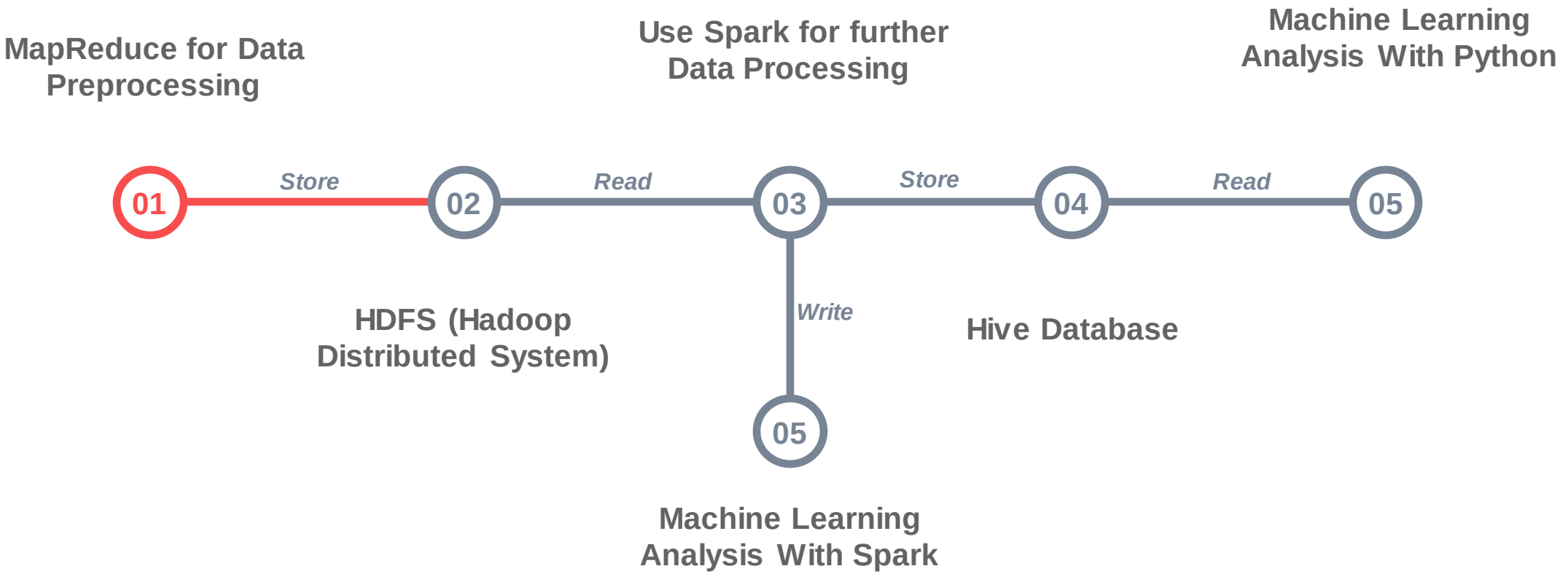
- Correlations between "*Count*" and other features
- Multicollinearity – "*temp*" & "*atemp*"



Rental Pattern Analysis:

- Higher demand in summer months
- Peak rental time of one day
- Rentals in weekend
- Peak user count of one day

Data Processing Stream



Data Preprocessing With MapReduce

Data Preprocessing:
- Missing Value Analysis
- Remove Outliers

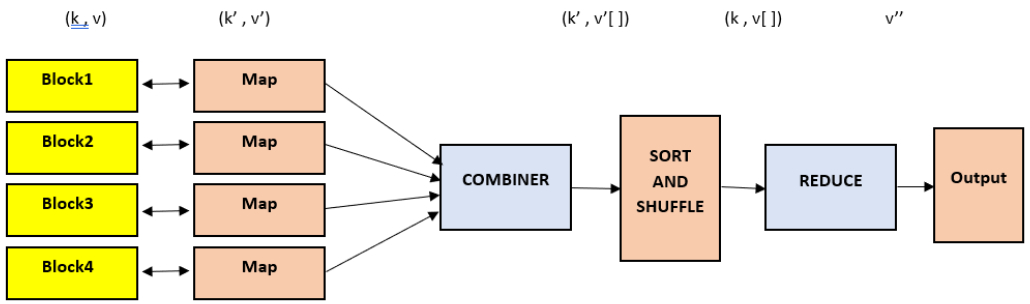
1. Input Data Splitting:
Input data is divided into multiple blocks.

2. Mapping:
- Map tasks process data blocks.
- Mapping transforms data into intermediate key-value pairs.
- Intermediate results are stored temporarily.

3. Partitioning and Sorting:
- Partitioning groups key-value pairs based on keys.
- Sorting arranges key-value pairs within partitions.

4. Reducing:
- Reduce tasks process intermediate results.
- Reduction merges key-value pairs with the same key.
- Final results are written to output.

Advantage:
- Scalability
- Fault-tolerance
- Parallel processing
- Flexibility

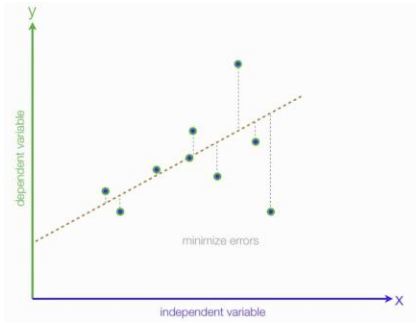


Further Data Processing with Spark and Hive

- Defined the schema to specify the structure of the data.
- Read the training and test data from HDFS using the specified schema.
- Conducted data preprocessing on the training and test data, including type conversion, date extraction, and feature selection.
- Saved the processed data into Hive tables for Machine Learning Analysis.

Machine Learning with Scala

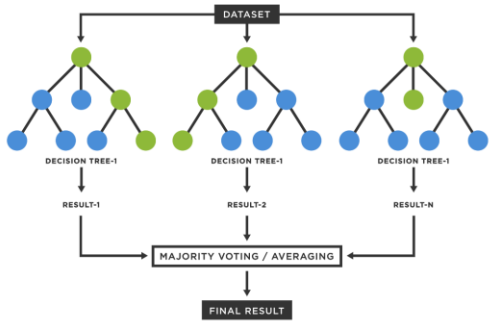
Forcasting by ML Methods



Linear Regression

- Simple and interpretable
- Low Memory Requirements

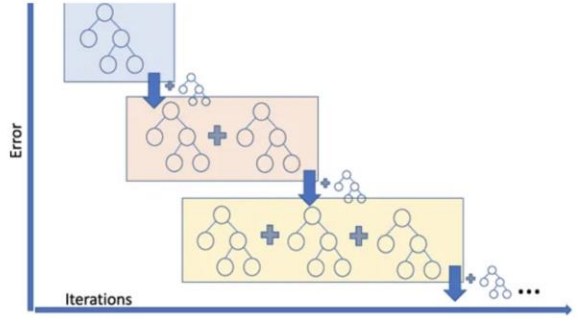
- Linear Assumption
- Bad performance on complex data



Random Forest

- Strong Performance
- Parallel Processing

- Computationally Intensive
- Long training time



Gradient Boosting

- High Predictive Power
- Parallel Processing

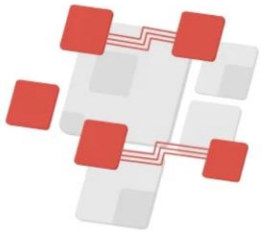
- Computationally Intensive
- Long training time

Machine Learning with Scala

Advantages of Scala

Concurrency

- Native language of Spark,
- Spark Core, Spark SQL, Spark Streaming, and MLlib
- Significantly accelerates the training phases for large dataset.



Scalability

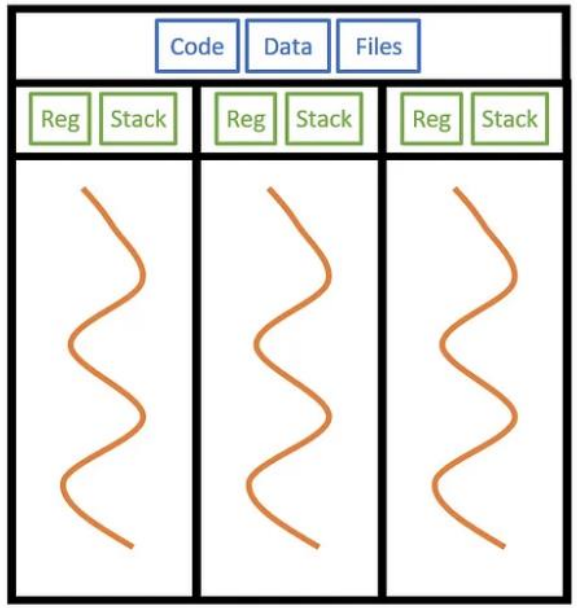
- Distributing the workload across multiple machines.
- Faster computing when dataset becomes larger

In-Memory processing

- Integrates well with Spark
- Spark could Minimize disk I/O operations, leading to faster execution

Deep Learning with Python

Multithreading



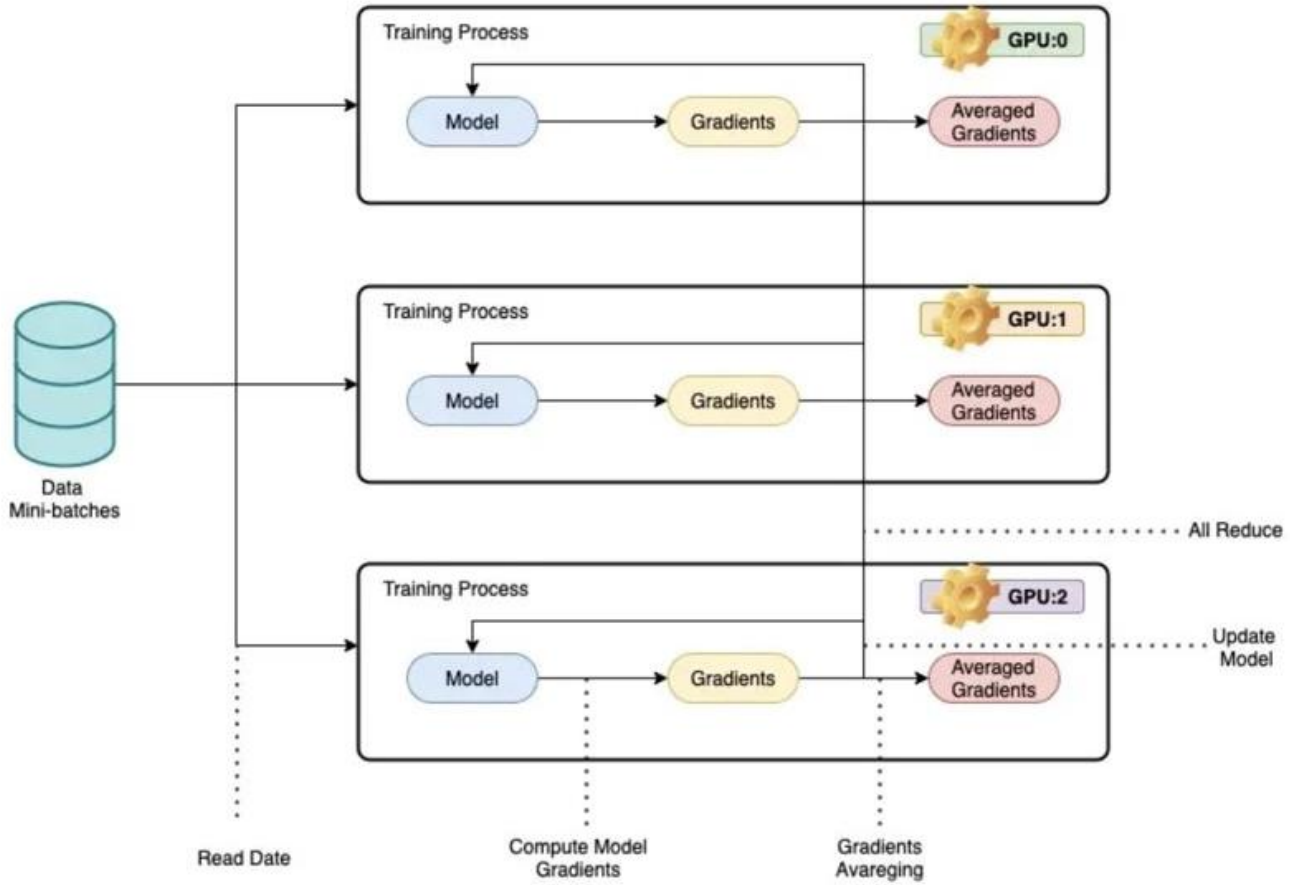

```
1 print("Time cost with parallel method:
```

```
Time cost with parallel method: 0.84s
```

```
1 print("Time cost without parallel meth
```

```
Time cost without parallel method: 2.27s
```

Model parallel



Much Faster!

Conclusion & Future Work

- Spark enables faster data processing through parallel computing and memory distribution. We can use it to speed up the whole process.
- Valuable insights for optimizing bike-sharing services and promoting sustainable urban transportation.
- We hope to improve our system in the future to achieve real-time data updates and demand forecasting.

Thank you for watching.