



IBM TRANSACTIONS FOR ANTI MONEY LAUNDERING (AML)

CIS 5560 INTRO TO BIG DATA SCIENCE

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AGENDA

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INTRODUCTION

- The IBM Transactions for Anti Money Laundering (AML) dataset is a synthetic dataset that contains financial transactions involving individuals, companies, and banks.
- The dataset contains both legitimate and laundering transactions that are labeled, making it ideal for training and testing Anti Money Laundering models.
- We chose "LI_Medium_Trans.csv," file from the Dataset which is of 2.98gb and has 11 Columns

DATASET SPECIFICATIONS

DATASET NAME: IBM Transactions for Anti Money Laundering (AML)

TOTAL DATASET SIZE: 2.98 GB

DATASET FORMAT: CSV

DATASET URL:

https://www.kaggle.com/datasets/ealtman2019/ibm-transactions-for-anti-money-laundering-aml?select=LI-Medium_Trans.csv



TECHNICAL SPECIFICATION

Hadoop Version: 3.1.2

No. of CPUs: 8

Py Spark version: 3.0.2

Nodes: 3

Total Storage:

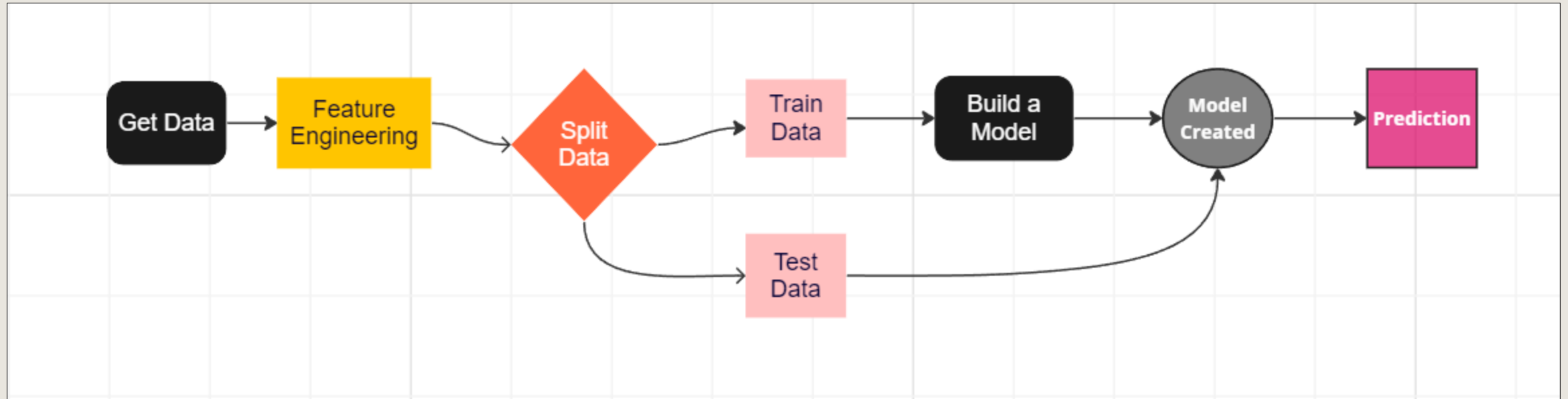
**Databricks Community
Version: 10.4 LTS**
(includes Apache Spark
3.1.1, Scala 2.12)

File System: DBFS (Data
Bricks File System)

Nodes: 1

Python Version: 3.10.4

PREDICTION SYSTEM FLOWCHART



CLASSIFICATION

The Classification algorithm is a Supervised Learning technique that is used to identify the category of new observations based on training data.

In Classification, a program learns from the given dataset or observations and then classifies new observation into a number of classes or groups. Such as, **Yes or No, 0 or 1**

SPLITTING THE DATASET

Sample Data

```
1 #Finding the count of training and testing rows
2 train_rows = train.count()
3 test_rows = test.count()
4 print("Training Rows:", train_rows, " Testing Rows:", test_rows)
```

► (4) Spark Jobs

Training Rows: 3994 Testing Rows: 1714

Full Data Set

```
>>> splits = data.randomSplit([0.7, 0.3])
>>> train = splits[0]
>>> test = splits[1].withColumnRenamed("label", "trueLabel")
>>> train_rows = train.count()
>>> test_rows = test.count()
>>> print("Training Rows:", train_rows, " Testing Rows:", test_rows)
Training Rows: 21882083 Testing Rows: 9373309
```




MACHINE LEARNING ALGORITHMS

- Logistic Regression
- Gradient Boost Tree
- Decision Tree
- Random Forest
- Factorization Machine
- Support Vector Machine

LOGISTIC REGRESSION

CV & TVS and their respective AUC Values:

```
1 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
2 auc_tvs_lr = evaluator.evaluate(prediction_lr_tvs)
3 print("AUC = ", auc_tvs_lr)
4
5 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
6 auc_cv_lr = evaluator.evaluate(prediction_lr_cv)
7 print("AUC = ", auc_cv_lr)
8
9 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
10 auc_lr = evaluator.evaluate(predicted)
11 print("AUC = ", auc_lr)
```

► (9) Spark Jobs

```
AUC = 0.5216146888078845
AUC = 0.5216146888078845
AUC = 0.5
```

Command took 1.33 seconds -- by lekha19202@gmail.com at 07/05/2023, 21:19:29 on Qs

GRADIENT BOOST TREE

CV & TVS and their respective AUC Values:

```
Cmd 39
```

```
1 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
2 auc_tvs_gbt = evaluator.evaluate(prediction_gbt_tvs)
3 print("AUC = ", auc_tvs_gbt)
4
5 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
6 auc_cv_gbt = evaluator.evaluate(prediction_gbt_cv)
7 print("AUC = ", auc_cv_gbt)
```

Python ▶ ▼ - ✕

▶ (6) Spark Jobs

AUC = 0.8959160253813969
AUC = 0.8959160253813969

Command took 0.98 seconds -- by lekha19202@gmail.com at 07/05/2023, 21:19:29 on Qs

```
Cmd 40
```

DECISION TREE

CV & TVS and their respective AUC Values:

```
1 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
2 auc_tvs_dt = evaluator.evaluate(predicted_dt_tvs)
3 print("AUC = ", auc_tvs_dt)
4
5 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
6 auc_cv_dt = evaluator.evaluate(predicted_dt_cv)
7 print("AUC = ", auc_cv_dt)
```

▶ (6) Spark Jobs

AUC = 0.5

AUC = 0.5

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RANDOM FOREST

CV & TVS and their respective AUC Values:

Cmd 32

```
1 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
2 auc_tvs1_rf = evaluator.evaluate(prediction)
3 print("AUC = ", auc_tvs1_rf)
4
5 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
6 auc_tvs_rf = evaluator.evaluate(predictiontvs)
7 print("AUC = ", auc_tvs_rf)
8
9 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
10 auc_cv_rf = evaluator.evaluate(predictionCV)
11 print("AUC = ", auc_cv_rf)
12
```

► (9) Spark Jobs

```
AUC = 0.917922235722965
AUC = 0.9269339813689754
AUC = 0.8963142972863507
```

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RANDOM FOREST

Running time for the entire dataset

```
>>> #tvs = TrainValidationSplit(estimator=pipeline, evaluator=BinaryClassificationEvaluator(labelCol="label", rawPredictionCol="pr
UnderROC"), estimatorParamMaps=paramGrid, trainRatio=0.8)
...
>>> model = pipeline.fit(train)

>>> #model = tvs.fit(train)
...
>>> end = time()
>>> phrase = 'Random Forest tvs testing'
>>> print('{} takes {} seconds'.format(phrase, (end - start))) #round(end - start, 2)))
Random Forest tvs testing takes 1861.5901260375977 seconds
>>>
```

```
>>>
>>> end = time()
>>> phrase = 'Random Forest tvs2 testing'
>>> print('{} takes {} seconds'.format(phrase, (end - start))) #round(end - start, 2)))
Random Forest tvs2 testing takes 313.30773091316223 seconds
>>>
```

```
> end = time()
> phrase = 'Random Forest testing'
> print('{} takes {} seconds'.format(phrase, (end - start))) #round(end - start, 2)))
Random Forest testing takes 301.2368438243866 seconds
>
```

FACTORIZATION MACHINE

CV & TVS and their respective AUC Values:

```
1 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
2 auc_tvs_fm = evaluator.evaluate(predicted_fm_tvs)
3 print("AUC = ", auc_tvs_fm)
4
5 evaluator = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
6 auc_cv_fm = evaluator.evaluate(predicted_fm_cv)
7 print("AUC = ", auc_cv_fm)
```

▶ (6) Spark Jobs

AUC = 0.7959497772377667

AUC = 0.7959497772377667

Command took 1.13 seconds -- by lekha19202@gmail.com at 07/05/2023, 21:19:29 on Qs

SUPPORT VECTOR MACHINE

CV & TVS and their respective AUC Values:

```
1 evaluatorSVM_tvs = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
2 auc_SVM_tvs = evaluatorSVM_tvs.evaluate(predictionSVM_tvs)
3 print("AUC = ", auc_SVM_tvs)
4
5 evaluatorSVM_cv = BinaryClassificationEvaluator(labelCol="trueLabel", rawPredictionCol="prediction", metricName="areaUnderROC")
6 auc_SVM_cv = evaluatorSVM_cv.evaluate(predictionSVM_cv)
7 print("AUC = ", auc_SVM_cv)
```

▶ (6) Spark Jobs

AUC = 0.5

AUC = 0.5

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FEATURE IMPORTANCE

```
1 import pandas as pd
2 featureImp = pd.DataFrame(list(zip(finalVect.getInputCols(), rfModel.featureImportances)), columns=["feature", "importance"])
3 featureImp.sort_values(by="importance", ascending=False)
```

Running command 27. Go to

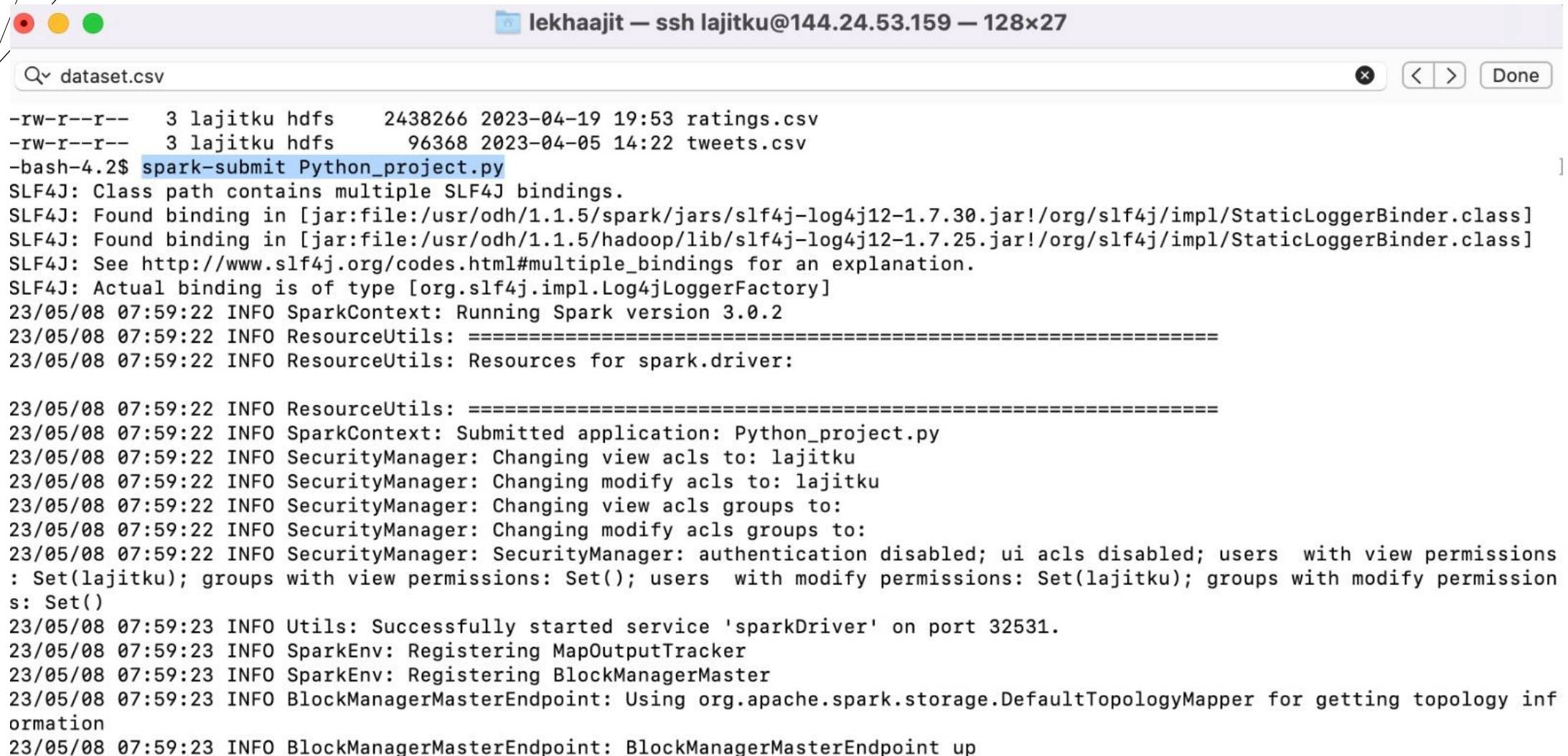
	feature	importance
0	TimestampIdx	0.354191
1	From Bank	0.258357
3	To Bank	0.211514
2	Account2	0.175938
0	From Bank	0.354191
1	To Bank	0.258357
3	Amount Paid	0.211514
2	Amount Received	0.175938

Feature Importance indicates how much each feature contributes to the model prediction. Basically, it determines the degree of usefulness of a specific variable for a current model and prediction.

ALGORITHMS COMPARISON

Algorithms	AUC		Computation Time	
	CV	TVS	CV	TVS
Gradient Boost Tree	0.895916	0.8959160	195.254653sec	71.486958sec
Random Forest	0.896314	0.926933	57.922800sec	5.795582Sec(Tvs) 24.588072Sec(Tvs2)
Factorization Machine	0.795949	0.795949	32.444634sec	14.9555480 sec
Decision Tree	0.5	0.5	448.105305sec	140.117408 sec
Logistic Regression	0.521614	0.521614	1566.377578sec	497.938576 sec
Support Vector Machine	0.5	0.5	138.414037sec	57.775793sec

IMPLEMENTATION IN SPARK ML

A terminal window titled 'lekhaajit — ssh lajitku@144.24.53.159 — 128x27' with a search bar containing 'dataset.csv'. The terminal shows the execution of 'spark-submit Python_project.py' and its output, including SLF4J warnings and Spark logs for running and submitting the application.

```
-rw-r--r-- 3 lajitku hdfs 2438266 2023-04-19 19:53 ratings.csv
-rw-r--r-- 3 lajitku hdfs 96368 2023-04-05 14:22 tweets.csv
-bash-4.2$ spark-submit Python_project.py
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/usr/odh/1.1.5/spark/jars/slf4j-log4j12-1.7.30.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/usr/odh/1.1.5/hadoop/lib/slf4j-log4j12-1.7.25.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explanation.
SLF4J: Actual binding is of type [org.slf4j.impl.Log4jLoggerFactory]
23/05/08 07:59:22 INFO SparkContext: Running Spark version 3.0.2
23/05/08 07:59:22 INFO ResourceUtils: =====
23/05/08 07:59:22 INFO ResourceUtils: Resources for spark.driver:

23/05/08 07:59:22 INFO ResourceUtils: =====
23/05/08 07:59:22 INFO SparkContext: Submitted application: Python_project.py
23/05/08 07:59:22 INFO SecurityManager: Changing view acls to: lajitku
23/05/08 07:59:22 INFO SecurityManager: Changing modify acls to: lajitku
23/05/08 07:59:22 INFO SecurityManager: Changing view acls groups to:
23/05/08 07:59:22 INFO SecurityManager: Changing modify acls groups to:
23/05/08 07:59:22 INFO SecurityManager: SecurityManager: authentication disabled; ui acls disabled; users with view permissions
: Set(lajitku); groups with view permissions: Set(); users with modify permissions: Set(lajitku); groups with modify permission
s: Set()
23/05/08 07:59:23 INFO Utils: Successfully started service 'sparkDriver' on port 32531.
23/05/08 07:59:23 INFO SparkEnv: Registering MapOutputTracker
23/05/08 07:59:23 INFO SparkEnv: Registering BlockManagerMaster
23/05/08 07:59:23 INFO BlockManagerMasterEndpoint: Using org.apache.spark.storage.DefaultTopologyMapper for getting topology inf
ormation
23/05/08 07:59:23 INFO BlockManagerMasterEndpoint: BlockManagerMasterEndpoint up
```

GITHUB LINK

<https://github.com/Lekha19202/CIS-5560-big-data-science-project>

REFERENCES

- Li, Susan. “Machine Learning with Pyspark and MLlib – Solving a Binary Classification Problem.” *Medium*, Towards Data Science, 7 May 2018, <https://towardsdatascience.com/machine-learning-with-pyspark-and-mlib-solving-a-binary-classification-problem-96396065d2aa>.
- “Regression Analysis.” *Corporate Finance Institute*, 3 May 2023, <https://corporatefinanceinstitute.com/resources/data-science/regression-analysis/>.
- Jagdeesh. “PySpark Decision Tree – How to Build and Evaluate Decision Tree Model for Classification Using PySpark MLlib.” *Machine Learning Plus*, 1 May 2023, <https://www.machinelearningplus.com/pyspark/pyspark-decision-tree/>.

- 1 — We learned how to compare the accuracy of different models based on AUC, Precision and Recall
- 2 — How to optimize computation time by changing the paramgrid parameters.
- 3 — How to increase the accuracy of the model.
- 4 — Building pipeline

SUMMARY

A series of white, overlapping geometric lines and polygons on a black background, located on the left side of the slide.

THANK YOU