spark

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#Instalamos Spark

[ ]:
```
#Bibliotecas para poder trabajar con Spark
!sudo apt update
!apt-get install openjdk-8-jdk-headless -qq > /dev/null
!wget -q https://downloads.apache.org/spark/spark-3.5.0//spark-3.5.
↪0-bin-hadoop3.tgz
!tar xf spark-3.5.0-bin-hadoop3.tgz
```

```
Get:1 https://cloud.r-project.org/bin/linux/ubuntu jammy-cran40/ InRelease
[3,626 B]
Get:2 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu2204/x86_64
InRelease [1,581 B]
Get:3 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Hit:4 http://archive.ubuntu.com/ubuntu jammy InRelease
Get:5 http://archive.ubuntu.com/ubuntu jammy-updates InRelease [119 kB]
Get:6 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu2204/x86_64
Packages [555 kB]
Get:7 http://archive.ubuntu.com/ubuntu jammy-backports InRelease [109 kB]
Hit:8 https://ppa.launchpadcontent.net/c2d4u.team/c2d4u4.0+/ubuntu jammy
InRelease
Get:9 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages
[1,009 kB]
Get:10 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [1,398
kB]
Get:11 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages
[1,131 kB]
Get:12 http://archive.ubuntu.com/ubuntu jammy-updates/restricted amd64 Packages
[1,330 kB]
Get:13 http://archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages
[1,274 kB]
Get:14 https://ppa.launchpadcontent.net/deadsnakes/ppa/ubuntu jammy InRelease
[18.1 kB]
Get:15 https://ppa.launchpadcontent.net/graphics-drivers/ppa/ubuntu jammy
InRelease [24.3 kB]
Hit:16 https://ppa.launchpadcontent.net/ubuntugis/ppa/ubuntu jammy InRelease
```

```
Get:17 https://ppa.launchpadcontent.net/deadsnakes/ppa/ubuntu jammy/main amd64
Packages [27.7 kB]
Get:18 https://ppa.launchpadcontent.net/graphics-drivers/ppa/ubuntu jammy/main
amd64 Packages [40.1 kB]
Fetched 7,150 kB in 4s (1,715 kB/s)
Reading package lists… Done
Building dependency tree… Done
Reading state information… Done
18 packages can be upgraded. Run 'apt list --upgradable' to see them.
```

[ ]:
```
#Configuración de Spark con Python
!pip install -q findspark
!pip install pyspark
```

```
Collecting pyspark
  Downloading pyspark-3.5.0.tar.gz (316.9 MB)
                           316.9/316.9

MB 4.8 MB/s eta 0:00:00
  Preparing metadata (setup.py) … done
Requirement already satisfied: py4j==0.10.9.7 in /usr/local/lib/python3.10/dist-
packages (from pyspark) (0.10.9.7)
Building wheels for collected packages: pyspark
  Building wheel for pyspark (setup.py) … done
  Created wheel for pyspark: filename=pyspark-3.5.0-py2.py3-none-any.whl
size=317425344
sha256=0b59b6c812e7c9d32c7117fe6d5eabacc6df987978adb655a9b0b01e86ddb595
  Stored in directory: /root/.cache/pip/wheels/41/4e/10/c2cf2467f71c678cfc8a6b9a
c9241e5e44a01940da8fbb17fc
Successfully built pyspark
Installing collected packages: pyspark
Successfully installed pyspark-3.5.0
```

[ ]:
```
#Estableciendo variable de entorno
import os
os.environ["JAVA_HOME"] = "/usr/lib/jvm/java-8-openjdk-amd64"
os.environ["SPARK_HOME"] = "/content/spark-3.5.0-bin-hadoop3"

#Buscando e inicializando la instalación de Spark
import findspark
findspark.init()
findspark.find()

#Probando PySparl
from pyspark.sql import DataFrame, SparkSession
from typing import List
import pyspark.sql.types as T
import pyspark.sql.functions as F
```

```python
spark = SparkSession \
        .builder \
        .appName("Hola mundo Spark") \
        .getOrCreate()

spark
```

[ ]: <pyspark.sql.session.SparkSession at 0x7d174810a0e0>

1 Regresion Linear

[ ]:
```python
import matplotlib.pyplot as plt
from pyspark.ml.evaluation import RegressionEvaluator
from pyspark.ml.regression import LinearRegression
```

[ ]:
```python
# Load training data
training = spark.read.format("libsvm")\
    .load("spark-3.5.0-bin-hadoop3/data/mllib/sample_linear_regression_data.
 ↪txt")

lr = LinearRegression(maxIter=10, regParam=0.3, elasticNetParam=0.8)
```

[ ]:
```python
# Fit the model
lrModel = lr.fit(training)

# Print the coefficients and intercept for linear regression
print("Coefficients: %s" % str(lrModel.coefficients))
print("Intercept: %s" % str(lrModel.intercept))
```

```
Coefficients: [0.0,0.3229251667740594,-0.3438548034562219,1.915601702345841,0.05
288058680386255,0.765962720459771,0.0,-0.15105392669186676,-0.21587930360904645,
0.2202536918881343]
Intercept: 0.15989368442397356
```

[ ]:
```python
# Summarize the model over the training set and print out some metrics
trainingSummary = lrModel.summary
print("numIterations: %d" % trainingSummary.totalIterations)
print("objectiveHistory: %s" % str(trainingSummary.objectiveHistory))
trainingSummary.residuals.show()
print("RMSE: %f" % trainingSummary.rootMeanSquaredError)
print("r2: %f" % trainingSummary.r2)
```

```
numIterations: 6
objectiveHistory: [0.49999999999999994, 0.4967620357443381, 0.49363616643404634,
0.4936351537897608, 0.4936351214177871, 0.49363512062528014, 0.4936351206216114]
```

```
+--------------------+
|           residuals|
+--------------------+
|  -9.889232683103197|
|  0.5533794340053553|
|  -5.204019455758822|
| -20.566686715507508|
|    -9.4497405180564|
|  -6.909112502719487|
|  -10.00431602969873|
|  2.0623978070504845|
|  3.1117508432954772|
|  -15.89360822941938|
|  -5.036284254673026|
|  6.4832158769943335|
|  12.429497299109002|
|  -20.32003219007654|
|    -2.0049838218725|
| -17.867901734183793|
|   7.646455887420495|
| -2.2653482182417406|
|-0.10308920436195645|
|  -1.380034070385301|
+--------------------+
only showing top 20 rows

RMSE: 10.189077
r2: 0.022861
```

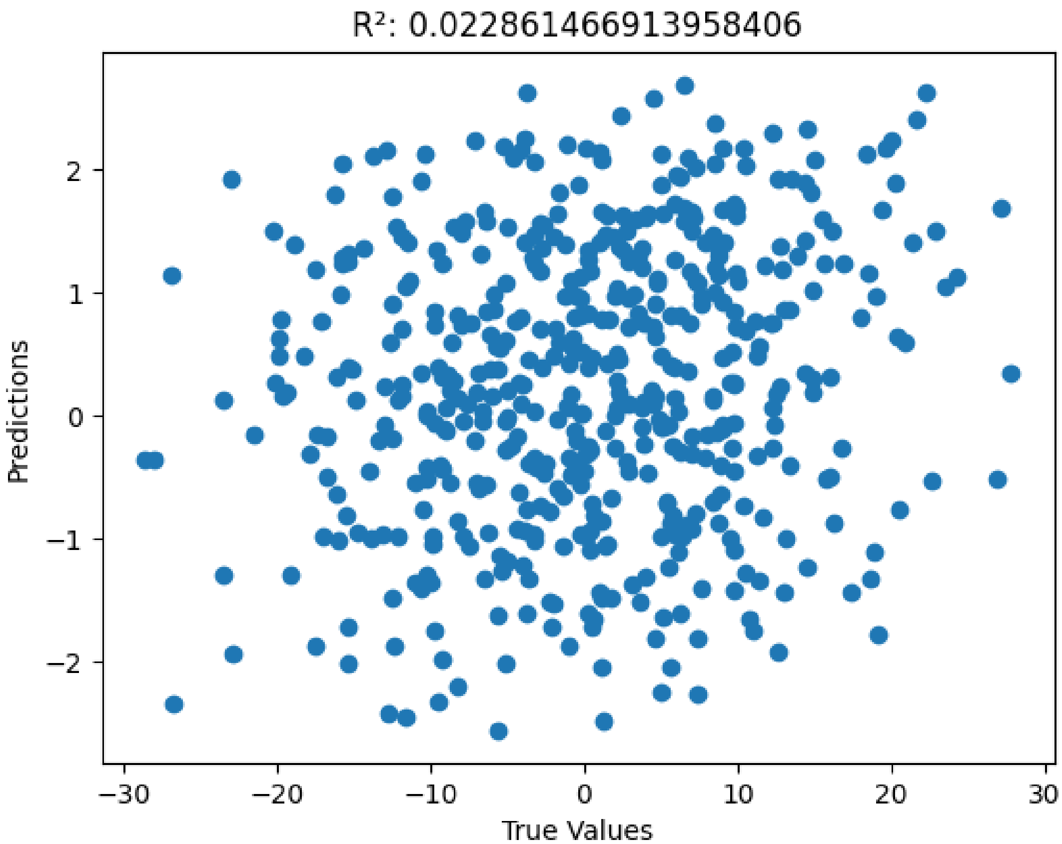
[ ]:

```python
# Make predictions on the training data
predictions = lrModel.transform(training)

# Calculate R²
evaluator = RegressionEvaluator(labelCol="label", predictionCol="prediction",␣
 ↪metricName="r2")
r2 = evaluator.evaluate(predictions)
print("R²:", r2)

# Plot R²
plt.figure()
plt.scatter(predictions.select("label").collect(), predictions.
 ↪select("prediction").collect())
plt.title(f"R²: {r2}")
plt.xlabel("True Values")
plt.ylabel("Predictions")
plt.show()
```

```
R²: 0.022861466913958406
```



2 Clasificacion: Regresion Logistica

[ ]:
```
from pyspark.ml.classification import LogisticRegression
from pyspark.ml.evaluation import MulticlassClassificationEvaluator
```

[ ]:
```
# Load training data
training = spark.read.format("libsvm").load("/content/spark-3.5.0-bin-hadoop3/
 ↪data/mllib/sample_libsvm_data.txt")

lr = LogisticRegression(maxIter=10, regParam=0.3, elasticNetParam=0.8)
```

[ ]:
```
# Fit the model
lrModel = lr.fit(training)

# Print the coefficients and intercept for logistic regression
print("Coefficients: " + str(lrModel.coefficients))
print("Intercept: " + str(lrModel.intercept))
```

```
Coefficients: (692,[272,300,323,350,351,378,379,405,406,407,428,433,434,435,455,
```

```
456,461,462,483,484,489,490,496,511,512,517,539,540,568],[-7.520689871384186e-05
,-8.115773146847071e-05,3.814692771846355e-05,0.00037764905404243413,0.000340514
83661944043,0.0005514455157343107,0.0004085386116096918,0.0004197467332749 46,0.0
008119171358670032,0.00050277083726687 53,-2.392926040660163e-05,0.00057450480209
02295,0.0009037546426803719,7.818229700243984e-05,-2.1787551952912656e-05,-3.402
1658217896046e-05,0.0004966517360637638,0.0008190557828370373,-8.017982139522677
e-05,-2.743169403783598e-05,0.00048108322262389907,0.00048408017626778754,-8.926
47292001121e-06,-0.0003414881233042733,-8.950592574121474e-05,0.0004864546911689
2124,-8.478698005186183e-05,-0.00042347832158317684,-7.296535777631314e-05])
Intercept: -0.599146028640144
```

[ ]:
```python
# We can also use the multinomial family for binary classification
mlr = LogisticRegression(maxIter=10, regParam=0.3, elasticNetParam=0.8,␣
 ↪family="multinomial")

# Fit the model
mlrModel = mlr.fit(training)

# Print the coefficients and intercepts for logistic regression with␣
 ↪multinomial family
print("Multinomial coefficients: " + str(mlrModel.coefficientMatrix))
print("Multinomial intercepts: " + str(mlrModel.interceptVector))
```

```
Multinomial coefficients: 2 X 692 CSRMatrix
(0,272) 0.0001
(0,300) 0.0001
(0,350) -0.0002
(0,351) -0.0001
(0,378) -0.0003
(0,379) -0.0002
(0,405) -0.0002
(0,406) -0.0004
(0,407) -0.0002
(0,433) -0.0003
(0,434) -0.0005
(0,435) -0.0001
(0,456) 0.0
(0,461) -0.0002
(0,462) -0.0004
(0,483) 0.0001
..
..
Multinomial intercepts: [0.2750587585718083,-0.2750587585718083]
```

[ ]:
```python
# Make predictions on the training data
predictions = lrModel.transform(training)
```

```
# Create a MulticlassClassificationEvaluator to compute accuracy
evaluator = MulticlassClassificationEvaluator(labelCol="label",␣
↪predictionCol="prediction", metricName="accuracy")
accuracy = evaluator.evaluate(predictions)
print("Accuracy:", accuracy)

# Create a confusion matrix
confusion_matrix = predictions.groupBy("label", "prediction").count()
confusion_matrix.show()

# Alternatively, you can create a Pandas DataFrame for better visualization
confusion_matrix_pd = confusion_matrix.toPandas()
print("Confusion Matrix:")
print(confusion_matrix_pd)
```

```
Accuracy: 0.99
+-----+----------+-----+
|label|prediction|count|
+-----+----------+-----+
|  1.0|       1.0|   56|
|  1.0|       0.0|    1|
|  0.0|       0.0|   43|
+-----+----------+-----+

Confusion Matrix:
   label  prediction  count
0    1.0         1.0     56
1    1.0         0.0      1
2    0.0         0.0     43
```

3 Agrupacion: K-Means

[ ]:
```
from pyspark.ml.clustering import KMeans
from pyspark.ml.evaluation import ClusteringEvaluator
```

[ ]:
```
# Loads data.
dataset = spark.read.format("libsvm").load("/content/spark-3.5.0-bin-hadoop3/
↪data/mllib/sample_kmeans_data.txt")

# Trains a k-means model.
kmeans = KMeans().setK(2).setSeed(1)
model = kmeans.fit(dataset)

# Make predictions
predictions = model.transform(dataset)
```

```
# Evaluate clustering by computing Silhouette score
evaluator = ClusteringEvaluator()

silhouette = evaluator.evaluate(predictions)
print("Silhouette with squared euclidean distance = " + str(silhouette))
```

```
Silhouette with squared euclidean distance = 0.9997530305375207
```

[ ]:
```
# Shows the result.
centers = model.clusterCenters()
print("Cluster Centers: ")
for center in centers:
    print(center)
```

```
Cluster Centers:
[9.1 9.1 9.1]
[0.1 0.1 0.1]
```

[ ]:
```
import matplotlib.pyplot as plt
import numpy as np

# Get the cluster assignments from the predictions
cluster_assignments = predictions.select("prediction").rdd.map(lambda row:␣
 ↪row[0]).collect()

# Convert the features to a NumPy array for visualization
features = np.array(predictions.select("features").rdd.map(lambda row: row[0]).
 ↪collect())

# Separate the points by cluster
clusters = [[] for _ in range(model.getK())]
for i, cluster_id in enumerate(cluster_assignments):
    clusters[cluster_id].append(features[i])

# Convert the clusters to NumPy arrays for plotting
cluster_arrays = [np.array(cluster) for cluster in clusters]

# Plot the clusters
for i, cluster in enumerate(cluster_arrays):
    plt.scatter(cluster[:, 0], cluster[:, 1], label=f'Cluster {i}')

# Plot cluster centers
centers = np.array(centers)
plt.scatter(centers[:, 0], centers[:, 1], c='k', marker='x', s=200,␣
 ↪label='Cluster Centers')

plt.title("K-Means Clustering")
```

```
plt.legend()
plt.show()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-32-75790c3d2932> in <cell line: 12>()
     11 clusters = [[] for _ in range(model.getK())]
     12 for i, cluster_id in enumerate(cluster_assignments):
---> 13     clusters[cluster_id].append(features[i])
     14 
     15 # Convert the clusters to NumPy arrays for plotting

TypeError: list indices must be integers or slices, not float
```

[ ]: