

April 10, 2023

1 Spark RDD and Runtime Calculation

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[1]: !apt-get install openjdk-8-jdk-headless -qq > /dev/null
!wget -q https://downloads.apache.org/spark/spark-3.2.3/spark-3.2.3-bin-hadoop3.
˓→2.tgz
!tar -xvf spark-3.2.3-bin-hadoop3.2.tgz
!pip install -q findspark
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spark-3.2.3-bin-hadoop3.2/
spark-3.2.3-bin-hadoop3.2/LICENSE
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spark-3.2.3-bin-hadoop3.2/R/lib/SparkR/
spark-3.2.3-bin-hadoop3.2/R/lib/SparkR/DESCRIPTION
spark-3.2.3-bin-hadoop3.2/R/lib/SparkR/INDEX
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tatusTrackerDemo.java
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vaALSExample.java
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vaBinarizerExample.java
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vaBisectingKMeansExample.java
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vaBucketedRandomProjectionLSHExample.java
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vaCountVectorizerExample.java
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vaDCTExample.java
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vaDecisionTreeClassificationExample.java
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vaDecisionTreeRegressionExample.java
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vaElementwiseProductExample.java
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vaEstimatorTransformerParamExample.java
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vaMinMaxScalerExample.java  
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vaModelSelectionViaCrossValidationExample.java  
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vaModelSelectionViaTrainValidationSplitExample.java  
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vaMulticlassLogisticRegressionWithElasticNetExample.java  
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vaMultilayerPerceptronClassifierExample.java  
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vaNGramExample.java  
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vaOneVsRestExample.java  
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vaPCAExample.java  
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vaSQLTransformerExample.java  
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vaTfIdfExample.java  
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vaTokenizerExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/ml/Ja  
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vaVarianceThresholdSelectorExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/ml/Ja  
vaVectorAssemblerExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/ml/Ja
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vaVectorIndexerExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/ml/Ja  
vaVectorSizeHintExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/ml/Ja  
vaVectorSlicerExample.java  
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vaWord2VecExample.java  
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hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib/  
spark-3.2.3-bin-  
hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib/JavaALS.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaAssociationRulesExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaBinaryClassificationMetricsExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaBisectingKMeansExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaChiSqSelectorExample.java  
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/JavaCorrelationsExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaDecisionTreeClassificationExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaDecisionTreeRegressionExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaElementwiseProductExample.java  
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/JavaGaussianMixtureExample.java  
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/JavaGradientBoostingClassificationExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaGradientBoostingRegressionExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaHypothesisTestingExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaHypothesisTestingKolmogorovSmirnovTestExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaIsotonicRegressionExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaKMeansExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaKernelDensityEstimationExample.java  
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/JavaLBFGSEExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaLatentDirichletAllocationExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib
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/JavaLogisticRegressionWithLBFGSExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaMultiLabelClassificationMetricsExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaMulticlassClassificationMetricsExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaNaiveBayesExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaPCAExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaPowerIterationClusteringExample.java  
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/JavaPrefixSpanExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaRandomForestClassificationExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaRandomForestRegressionExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/mllib  
/JavaRankingMetricsExample.java  
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/JavaSVMWithSGDExample.java  
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/JavaSimpleFPGrowth.java  
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/JavaStratifiedSamplingExample.java  
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/JavaStreamingTestExample.java  
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/JavaSummaryStatisticsExample.java  
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spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/J  
avaSQLDataSourceExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/J  
avaSparkSQLExample.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/J  
avaUserDefinedScalar.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/J  
avaUserDefinedTypedAggregation.java  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/J  
avaUserDefinedUntypedAggregation.java  
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hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/hive/  
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/h  
ive/JavaSparkHiveExample.java
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hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/streaming/
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treaming/JavaStructuredComplexSessionization.java
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/s
treaming/JavaStructuredKafkaWordCount.java
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treaming/JavaStructuredKerberizedKafkaWordCount.java
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/s
treaming/JavaStructuredNetworkWordCount.java
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/s
treaming/JavaStructuredNetworkWordCountWindowed.java
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/sql/s
treaming/JavaStructuredSessionization.java
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hadoop3.2/examples/src/main/java/org/apache/spark/examples/streaming/
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ming/JavaCustomReceiver.java
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/strea
ming/JavaDirectKafkaWordCount.java
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ming/JavaDirectKerberizedKafkaWordCount.java
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ming/JavaNetworkWordCount.java
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/strea
ming/JavaQueueStream.java
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spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/strea
ming/JavaSqlNetworkWordCount.java
spark-3.2.3-bin-hadoop3.2/examples/src/main/java/org/apache/spark/examples/strea
ming/JavaStatefulNetworkWordCount.java
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/als.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/avro_inputformat.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/kmeans.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/logistic_regression.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/aft_survival_regression.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/als_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/binarizer_example.py
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hadoop3.2/examples/src/main/python/ml/bisecting_k_means_example.py
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hadoop3.2/examples/src/main/python/ml/bucketed_random_projection_lsh_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/bucketizer_example.py
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spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/chi_square_test_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/chisq_selector_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/correlation_example.py
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hadoop3.2/examples/src/main/python/ml/count_vectorizer_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/cross_validator.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/dataframe_example.py
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hadoop3.2/examples/src/main/python/ml/elementwise_product_example.py
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hadoop3.2/examples/src/main/python/ml/estimator_transformer_param_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/feature_hasher_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/fm_classifier_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/fm_regressor_example.py
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hadoop3.2/examples/src/main/python/ml/gaussian_mixture_example.py
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hadoop3.2/examples/src/main/python/ml/gradient_boosted_tree_regressor_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/imputer_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/index_to_string_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/interaction_example.py
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hadoop3.2/examples/src/main/python/ml/isotonic_regression_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/kmeans_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/lda_example.py
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hadoop3.2/examples/src/main/python/ml/linear_regression_with_elastic_net.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/linearsvc.py
spark-3.2.3-bin-
hadoop3.2/examples/src/main/python/ml/logistic_regression_summary_example.py
spark-3.2.3-bin-
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spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/max_abs_scaler_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/min_hash_lsh_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/min_max_scaler_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/multiclass_logistic_regression_with_elastic_net.py
spark-3.2.3-bin-
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hadoop3.2/examples/src/main/python/ml/multilayer_perceptron_classification.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/n_gram_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/naive_bayes_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/normalizer_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/one_vs_rest_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/onehot_encoder_example.py
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spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/summarizer_example.py
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spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/tokenizer_example.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/train_validation_split.py
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hadoop3.2/examples/src/main/python/ml/univariate_feature_selector_example.py
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hadoop3.2/examples/src/main/python/ml/variance_threshold_selector_example.py
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hadoop3.2/examples/src/main/python/ml/vectorAssembler_example.py
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spark-3.2.3-bin-hadoop3.2/examples/src/main/python/ml/vector_slicer_example.py
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spark-3.2.3-bin-hadoop3.2/examples/src/main/python/mllib/binary_classification_m
etrics_example.py
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spark-3.2.3-bin-hadoop3.2/examples/src/main/python/mllib/correlations_example.py
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hadoop3.2/examples/src/main/python/mllib/decision_tree_classification_example.py
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hadoop3.2/examples/src/main/python/mllib/random_rdd_generation.py
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spark-3.2.3-bin-hadoop3.2/examples/src/main/python/sql/datasource.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/sql/hive.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/sql/streaming/
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hadoop3.2/examples/src/main/python/sql/streaming/structured.kafka_wordcount.py
spark-3.2.3-bin-
hadoop3.2/examples/src/main/python/sql/streaming/structured_network_wordcount.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/sql/streaming/structured_network_wordcount_windowed.py
spark-3.2.3-bin-
hadoop3.2/examples/src/main/python/sql/streaming/structured_sessionization.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/status_api_demo.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/streaming/
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/streaming/hdfs_wordcount.py
spark-3.2.3-bin-
hadoop3.2/examples/src/main/python/streaming/network_wordcount.py
spark-3.2.3-bin-
hadoop3.2/examples/src/main/python/streaming/network_wordjoinsentiments.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/streaming/queue_stream.py
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spark-3.2.3-bin-
hadoop3.2/examples/src/main/python/streaming/recoverable_network_wordcount.py
spark-3.2.3-bin-
hadoop3.2/examples/src/main/python/streaming/sql_network_wordcount.py
spark-3.2.3-bin-
hadoop3.2/examples/src/main/python/streaming/stateful_network_wordcount.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/transitive_closure.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/python/wordcount.py
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/RSparkSQLExample.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/data-manipulation.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/dataframe.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/als.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/bisectingKmeans.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/decisionTree.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/fmClassifier.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/fmRegressor.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/fpm.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/gaussianMixture.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/gbt.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/glm.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/isoreg.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/kmeans.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/kstest.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/lda.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/lm_with_elastic_net.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/logit.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/ml.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/mlp.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/naiveBayes.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/powerIterationClustering.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/prefixSpan.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/randomForest.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/survreg.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/ml/svmLinear.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/r/streaming/
spark-3.2.3-bin-
hadoop3.2/examples/src/main/r/streaming/structured_network_wordcount.R
spark-3.2.3-bin-hadoop3.2/examples/src/main/resources/
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spark-3.2.3-bin-hadoop3.2/examples/src/main/resources/META-
INF/services/org.apache.spark.sql.SparkSessionExtensionsProvider
spark-3.2.3-bin-hadoop3.2/examples/src/main/resources/META-
INF/services/org.apache.spark.sql.JdbcConnectionProvider
spark-3.2.3-bin-hadoop3.2/examples/src/main/resources/dir1/
spark-3.2.3-bin-hadoop3.2/examples/src/main/resources/dir1/dir2/

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spark-3.2.3-bin-hadoop3.2/examples/src/main/resources/dir1/dir2/file2.parquet
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spark-3.2.3-bin-hadoop3.2/examples/src/main/resources/users.avro
spark-3.2.3-bin-hadoop3.2/examples/src/main/resources/users.orc
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spark-3.2.3-bin-
hadoop3.2/examples/src/main/scala/org/apache/spark/examples/HdfsTest.scala
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hadoop3.2/examples/src/main/scala/org/apache/spark/examples/LocalALS.scala
spark-3.2.3-bin-
hadoop3.2/examples/src/main/scala/org/apache/spark/examples/LocalFileLR.scala
spark-3.2.3-bin-
hadoop3.2/examples/src/main/scala/org/apache/spark/examples/LocalKMeans.scala
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hadoop3.2/examples/src/main/scala/org/apache/spark/examples/LocalLR.scala
spark-3.2.3-bin-
hadoop3.2/examples/src/main/scala/org/apache/spark/examples/LocalPi.scala
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hadoop3.2/examples/src/main/scala/org/apache/spark/examples/LogQuery.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/Mult
iBroadcastTest.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/Simp
leSkewedGroupByTest.scala
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hx/Analytics.scala  
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hx/ComprehensiveExample.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/grap  
hx/ConnectedComponentsExample.scala  
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hx/SSSPExample.scala  
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hx/SynthBenchmark.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/grap  
hx/TriangleCountingExample.scala
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spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/ml/
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FTSurvivalRegressionExample.scala
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inarizerExample.scala
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isectionKMeansExample.scala
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ucketedRandomProjectionLSHExample.scala
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ucketizerExample.scala
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ataFrameExample.scala
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stimatorTransformerParamExample.scala
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MRegressorExample.scala
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PGrowthExample.scala
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eatureHasherExample.scala
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hadoop3.2/examples/src/main/scala/org/apache/spark/examples/ml/GBTExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/ml/G

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aussianMixtureExample.scala  
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radientBoostedTreeRegressorExample.scala  
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axAbsScalerExample.scala  
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utilayerPerceptronClassifierExample.scala  
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GramExample.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/ml/N
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aiveBayesExample.scala  
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neHotEncoderExample.scala  
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neVsRestExample.scala  
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ipelineExample.scala  
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uantileDiscretizerExample.scala  
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ummarizerExample.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/ml/T  
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spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/ml/V  
ectorSizeHintExample.scala  
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spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mlli  
b/DecisionTreeRegressionExample.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mlli  
b/DecisionTreeRunner.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mlli  
b/DenseKMeans.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mlli  
b/ElementwiseProductExample.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mlli  
b/FPGrowthExample.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mlli  
b/GaussianMixtureExample.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mlli  
b/GradientBoostedTreesRunner.scala  
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mlli
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b/GradientBoostingClassificationExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/GradientBoostingRegressionExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/HypothesisTestingExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/HypothesisTestingKolmogorovSmirnovTestExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/IsotonicRegressionExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/KMeansExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/KernelDensityEstimationExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/LBFGSExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/LDAExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/LatentDirichletAllocationExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/LogisticRegressionWithLBFGSExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/MovieLensALS.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/MultiLabelMetricsExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/MulticlassMetricsExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/MultivariateSummarizer.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/NaiveBayesExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/NormalizerExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/PCAOnRowMatrixExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/PCAOnSourceVectorExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/PMMLEModelExportExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/PowerIterationClusteringExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/PrefixSpanExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/RandomForestClassificationExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/RandomForestRegressionExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib

b/RandomRDDGeneration.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/RankingMetricsExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/RecommendationExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/SVDEExample.scala
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b/SVMWithSGDExample.scala
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b/SampledRDDs.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/SimpleFPGrowth.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/SparseNaiveBayes.scala
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b/StandardScalerExample.scala
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b/StratifiedSamplingExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/StreamingKMeansExample.scala
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b/StreamingLinearRegressionExample.scala
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b/StreamingLogisticRegression.scala
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b/StreamingTestExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/SummaryStatisticsExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/TFIDFExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/TallSkinnyPCA.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/TallSkinnySVD.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/mllib
b/Word2VecExample.scala
spark-3.2.3-bin-
hadoop3.2/examples/src/main/scala/org/apache/spark/examples/pythonconverters/
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/pyth
onconverters/AvroConverters.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
RDDRelation.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
SQLDataSourceExample.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
SimpleTypedAggregator.scala

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spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
SparkSQLExample.scala
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UserDefinedScalar.scala
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UserDefinedTypedAggregation.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
UserDefinedUntypedAggregation.scala
spark-3.2.3-bin-
hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/hive/
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
hive/SparkHiveExample.scala
spark-3.2.3-bin-
hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/jdbc/
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
jdbc/ExampleJdbcConnectionProvider.scala
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spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
streaming/StructuredComplexSessionization.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
streaming/StructuredKafkaWordCount.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
streaming/StructuredKerberizedKafkaWordCount.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
streaming/StructuredNetworkWordCount.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
streaming/StructuredNetworkWordCountWindowed.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/sql/
streaming/StructuredSessionization.scala
spark-3.2.3-bin-
hadoop3.2/examples/src/main/scala/org/apache/spark/examples/streaming/
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/stre
aming/CustomReceiver.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/stre
aming/DirectKafkaWordCount.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/stre
aming/DirectKerberizedKafkaWordCount.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/stre
aming/HdfsWordCount.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/stre
aming/NetworkWordCount.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/stre
aming/QueueStream.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/stre
aming/RawNetworkGrep.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/stre
aming/RecoverableNetworkWordCount.scala
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spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/streaming/SqlNetworkWordCount.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/streaming/StatefulNetworkWordCount.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/streaming/StreamingExamples.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/streaming/clickstream/
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/streaming/clickstream/PageViewGenerator.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scala/org/apache/spark/examples/streaming/clickstream/PageViewStream.scala
spark-3.2.3-bin-hadoop3.2/examples/src/main/scripts/
spark-3.2.3-bin-hadoop3.2/examples/src/main/scripts/getGpusResources.sh
spark-3.2.3-bin-hadoop3.2/jars/
spark-3.2.3-bin-hadoop3.2/jars/HikariCP-2.5.1.jar
spark-3.2.3-bin-hadoop3.2/jars/JLargeArrays-1.5.jar
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spark-3.2.3-bin-hadoop3.2/jars/RoaringBitmap-0.9.0.jar
spark-3.2.3-bin-hadoop3.2/jars/ST4-4.0.4.jar
spark-3.2.3-bin-hadoop3.2/jars/activation-1.1.1.jar
spark-3.2.3-bin-hadoop3.2/jars/aircompressor-0.21.jar
spark-3.2.3-bin-hadoop3.2/jars/algebra_2.12-2.0.1.jar
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spark-3.2.3-bin-hadoop3.2/jars/aopalliance-repackaged-2.6.1.jar
spark-3.2.3-bin-hadoop3.2/jars/arpack-2.2.1.jar
spark-3.2.3-bin-hadoop3.2/jars/arpack_combined_all-0.1.jar
spark-3.2.3-bin-hadoop3.2/jars/arrow-format-2.0.0.jar
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spark-3.2.3-bin-hadoop3.2/jars/arrow-memory-netty-2.0.0.jar
spark-3.2.3-bin-hadoop3.2/jars/arrow-vector-2.0.0.jar
spark-3.2.3-bin-hadoop3.2/jars/audience-annotations-0.5.0.jar
spark-3.2.3-bin-hadoop3.2/jars/automaton-1.11-8.jar
spark-3.2.3-bin-hadoop3.2/jars/avro-1.10.2.jar
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spark-3.2.3-bin-hadoop3.2/jars/curator-recipes-2.13.0.jar
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spark-3.2.3-bin-hadoop3.2/jars/hadoop-client-runtime-3.3.1.jar
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spark-3.2.3-bin-hadoop3.2/jars/json4s-core_2.12-3.7.0-M11.jar
spark-3.2.3-bin-hadoop3.2/jars/json4s-jackson_2.12-3.7.0-M11.jar
spark-3.2.3-bin-hadoop3.2/jars/json4s-scalap_2.12-3.7.0-M11.jar
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spark-3.2.3-bin-hadoop3.2/jars/jul-to-slf4j-1.7.30.jar
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spark-3.2.3-bin-hadoop3.2/python/test_support/sql/orc_partitioned/b=0/
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/orc_partitioned/b=0/c=0/
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spark-3.2.3-bin-hadoop3.2/python/test_support/sql/parquet_partitioned/year=2015/
month=10/day=26/.part-r-00005.gz.parquet.crc
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/parquet_partitioned/year=2015/
month=10/day=26/part-r-00005.gz.parquet
spark-3.2.3-bin-
hadoop3.2/python/test_support/sql/parquet_partitioned/year=2015/month=9/
spark-3.2.3-bin-
hadoop3.2/python/test_support/sql/parquet_partitioned/year=2015/month=9/day=1/
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/parquet_partitioned/year=2015/
month=9/day=1/.part-r-00007.gz.parquet.crc
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/parquet_partitioned/year=2015/
month=9/day=1/part-r-00007.gz.parquet
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/people.json
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/people1.json
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/people_array.json
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/people_array_utf16le.json
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/streaming/
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/streaming/text-test.txt
spark-3.2.3-bin-hadoop3.2/python/test_support/sql/text-test.txt
spark-3.2.3-bin-hadoop3.2/python/test_support/userlib-0.1.zip
spark-3.2.3-bin-hadoop3.2/python/test_support/userlibrary.py
spark-3.2.3-bin-hadoop3.2/sbin/
spark-3.2.3-bin-hadoop3.2/sbin/decommission-slave.sh
spark-3.2.3-bin-hadoop3.2/sbin/decommission-worker.sh
spark-3.2.3-bin-hadoop3.2/sbin/slaves.sh
spark-3.2.3-bin-hadoop3.2/sbin/spark-config.sh
spark-3.2.3-bin-hadoop3.2/sbin/spark-daemon.sh
spark-3.2.3-bin-hadoop3.2/sbin/spark-daemons.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-all.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-history-server.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-master.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-mesos-dispatcher.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-mesos-shuffle-service.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-slave.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-slaves.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-thriftserver.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-worker.sh
spark-3.2.3-bin-hadoop3.2/sbin/start-workers.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-all.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-history-server.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-master.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-mesos-dispatcher.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-mesos-shuffle-service.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-slave.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-slaves.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-thriftserver.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-worker.sh
spark-3.2.3-bin-hadoop3.2/sbin/stop-workers.sh
```

```
spark-3.2.3-bin-hadoop3.2/sbin/workers.sh  
spark-3.2.3-bin-hadoop3.2/yarn/  
spark-3.2.3-bin-hadoop3.2/yarn/spark-3.2.3-yarn-shuffle.jar
```

```
[2]: import os  
os.environ["JAVA_HOME"] = "/usr/lib/jvm/java-8-openjdk-amd64"  
os.environ["SPARK_HOME"] = "/content/spark-3.2.3-bin-hadoop3.2"
```

```
[3]: import findspark  
findspark.init()  
from pyspark.sql import SparkSession
```

```
[4]: import pyspark  
from pyspark.context import SparkContext  
from pyspark import SparkConf
```

```
[8]: from time import time  
from pyspark import SparkContext  
for j in range(1,10):  
    sc = SparkContext(master="local[%d]"%(j))  
    t0=time()  
    for i in range(10):  
        sc.parallelize([1,2]*1000000).reduce(lambda x,y:x+y)  
    print("%2d executors, time=%4.3f"%(j,time()-t0))  
    sc.stop()
```

```
1 executors, time=13.709  
2 executors, time=11.857  
3 executors, time=11.765  
4 executors, time=12.048  
5 executors, time=13.874  
6 executors, time=12.797  
7 executors, time=12.482  
8 executors, time=12.633  
9 executors, time=12.898
```