Data Science in Spark with *sparklyr* : : CHEAT SHEET

Intro

sparklyr is an R interface for Apache Spark™. ***sparklyr*** enables us to write all of our analysis code in R, but have the actual processing happen inside Spark clusters. Easily manipulate and model large-scale using R and Spark via *sparklyr.*

Import
- From R (**copy_to()**)
- Read a file (**spark_read_**)
- Read Hive table (**tbl()**)

Wrangle
- **dplyr** verb
- Feature transformer (**ft_**)
- Direct Spark SQL (**DBI**)

Visualize
- Collect result, plot in R
- Use **dbplot**

Model
- Spark MLlib (**ml_**)
- H2O Extension

Communicate
Collect results into R share using **rmarkdown**

R for Data Science, Grolemund & Wickham

Import

Import data into Spark, not R

READ A FILE INTO SPARK

Arguments that apply to all functions:
sc, name, path, options=list(), repartition=0, memory=TRUE, overwrite=TRUE

CSV	**spark_read_csv(** header = TRUE, columns=NULL, infer_schema=TRUE, delimiter = ",", quote= "\"", escape = "\\", charset = "UTF-8", null_value = NULL**)**
JSON	**spark_read_json()**
PARQUET	**spark_read_parquet()**
TEXT	**spark_read_text()**
HIVE TABLE	**spark_read_table()**
ORC	**spark_read_orc()**
LIBSVM	**spark_read_libsvm()**
JDBC	**spark_read_jdbc()**
DELTA	**spark_read_delta()**

R DATA FRAME INTO SPARK

dplyr::**copy_to(**dest, df, name**)**

FROM A TABLE IN HIVE

dplyr::**tbl(**scr, …**)** Creates a reference to the table without loading it into memory

Wrangle

DPLYR VERBS

Translates into Spark SQL statements

```
copy_to(sc, mtcars) %>%
  mutate(trm = ifelse(am == 0, "auto", "man")) %>%
  group_by(trm) %>%
  summarise_all(mean)
```

FEATURE TRANSFORMERS

ft_binarizer() - Assigned values based on threshold

ft_bucketizer() - Numeric column to discretized column

ft_count_vectorizer() - Extracts a vocabulary from document

ft_discrete_cosine_transform() - 1D discrete cosine transform of a real vector

ft_elementwise_product() - Element-wise product between 2 cols

ft_hashing_tf() - Maps a sequence of terms to their term frequencies using the hashing trick.

ft_idf() - Compute the Inverse Document Frequency (IDF) given a collection of documents

ft_imputer() - Imputation estimator for completing missing values, uses the mean or the median of the columns

ft_index_to_string() - Index labels back to label as strings

ft_interaction() - Takes in Double and Vector type columns and outputs a flattened vector of their feature interactions

ft_max_abs_scaler() - Rescale each feature individually to range [-1, 1]

ft_min_max_scaler() - Rescale each feature individually to a common range [min, max] linearly

ft_ngram() - Converts the input array of strings into an array of n-grams

ft_bucketed_random_projection_lsh()
ft_minhash_lsh() - Locality Sensitive Hashing functions for Euclidean distance and Jaccard distance (MinHash)

ft_normalizer() - Normalize a vector to have unit norm using the given p-norm

ft_one_hot_encoder()- Continuous to binary vectors

ft_pca() - Project vectors to a lower dimensional space of top k principal components

ft_quantile_discretizer() - Continuous to binned categorical values

ft_regex_tokenizer() - Extracts tokens either by using the provided regex pattern to split the text

ft_standard_scaler() - Removes the mean and scaling to unit variance using column summary statistics

ft_stop_words_remover() - Filters out stop words from input

ft_string_indexer() - Column of labels into a column of label indices.

ft_tokenizer() - Converts to lowercase and then splits it by white spaces

ft_vector_assembler() - Combine vectors into single row-vector

ft_vector_indexer() - Indexing categorical feature columns in a dataset of Vector

ft_vector_slicer() - Takes a feature vector and outputs a new feature vector with a subarray of the original features

ft_word2vec() - Word2Vec transforms a word into a code

Visualize

DPLYR + GGPLOT2

```
copy_to(sc, mtcars) %>%
  group_by(cyl) %>%
  summarise(mpg_m = mean(mpg)) %>%
  collect() %>%
  ggplot() +
    geom_col(aes(cyl, mpg_m))
```

Summarize in Spark
Collect results in R
Create plot

DBPLOT

```
copy_to(sc, mtcars) %>%
  dbplot_histogram(mpg) +
  labs(title = "Histogram of MPG")
```

dbplot_histogram(data, x, bins = 30, binwidth = NULL**)** - Calculates the histogram bins in Spark and plots in ggplot2

dbplot_raster(data, x, y, fill = n(), resolution = 100, complete = FALSE**)** - Visualize 2 continuous variables. Use instead of geom_point()

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Modeling

REGRESSION

ml_linear_regression() - Regression using linear regression.

ml_aft_survival_regression() - Parametric survival regression model named accelerated failure time (AFT) model

ml_generalized_linear_regression() - Generalized linear regression model

ml_isotonic_regression() - Currently implemented using parallelized pool adjacent violators algorithm. Only univariate (single feature) algorithm supported

ml_random_forest_regressor() - Regression using random forests.

CLASSIFICATION

ml_linear_svc() - Classification using linear support vector machines

ml_logistic_regression() - Logistic regression

ml_multilayer_perceptron_classifier() - Classification model based on the Multilayer Perceptron.

ml_naive_bayes() - Naive Bayes Classifiers. It supports Multinomial NB which can handle finitely supported discrete data

ml_one_vs_rest() - Reduction of Multiclass Classification to Binary Classification. Performs reduction using one against all strategy.

TREE

ml_decision_tree_classifier() | ml_decision_tree() | ml_decision_tree_regressor() - Classification and regression using decision trees

ml_gbt_classifier() | ml_gradient_boosted_trees() | ml_gbt_regressor() - Binary classification and regression using gradient boosted trees

ml_random_forest_classifier() - Classification and regression using random forests.

ml_feature_importances(model,...)ml_tree_feature_importance(model) - Feature Importance for Tree Models

CLUSTERING

ml_bisecting_kmeans() - A bisecting k-means algorithm based on the paper

ml_lda() | ml_describe_topics() | ml_log_likelihood() | ml_log_perplexity() | ml_topics_matrix() - LDA topic model designed for text documents.

ml_gaussian_mixture() - Expectation maximization for multivariate Gaussian Mixture Models (GMMs)

ml_kmeans() | ml_compute_cost() - K-means clustering with support for k-means

FP GROWTH

ml_fpgrowth() | ml_association_rules() | ml_freq_itemsets() - A parallel FP-growth algorithm to mine frequent itemsets.

FEATURE

ml_chisquare_test(x,features,label) - Pearson's independence test for every feature against the label

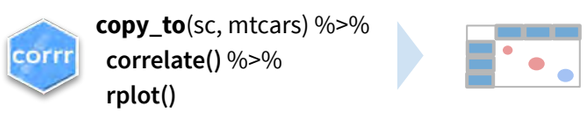
ml_default_stop_words() - Loads the default stop words for the given language

STATS

ml_summary() - Extracts a metric from the summary object of a Spark ML model

ml_corr() - Compute correlation matrix

correlate package integrates with sparklyr



RECOMMENDATION

ml_als() | ml_recommend() - Recommendation using Alternating Least Squares matrix factorization

EVALUATION

ml_clustering_evaluator() - Evaluator for clustering

ml_evaluate() - Compute performance metrics

ml_binary_classification_evaluator() | ml_binary_classification_eval() | ml_classification_eval() - A set of functions to calculate performance metrics for prediction models.

UTILITIES

ml_call_constructor() - Identifies the associated sparklyr ML constructor for the JVM

ml_model_data() - Extracts data associated with a Spark ML model

ml_standardize_formula() - Generates a formula string from user inputs, to be used in `ml_model` constructor

ml_uid() - Extracts the UID of an ML object.

Start a Spark session

YARN CLIENT

1. Install RStudio Server on one of the existing nodes, preferably an edge node
2. Locate path to the cluster's Spark Home Directory, it normally is "/usr/lib/spark"
3. Basic configuration example

```
conf <- spark_config()
conf$spark.executor.memory <- "300M"
conf$spark.executor.cores <- 2
conf$spark.executor.instances <- 3
conf$spark.dynamicAllocation.enabled<-"false"
```

4. Open a connection (some base configurations included in the example)

```
sc <- spark_connect(master = "yarn",
      spark_home = "/usr/lib/spark/",
      version = "2.1.0", config = conf)
```

YARN CLUSTER

1. Make sure to have copies of the yarn-site.xml and hive-site.xml files in the RStudio Server
2. Point environment variables to the correct paths

```
Sys.setenv(JAVA_HOME="[Path]")
Sys.setenv(SPARK_HOME ="[Path]")
Sys.setenv(YARN_CONF_DIR ="[Path]")
```

3. Open a connection

```
sc <- spark_connect(master = "yarn-cluster")
```

STANDALONE CLUSTER

1. Install RStudio Server on one of the existing nodes or a server in the same LAN
2. Install a local version of Spark:

```
spark_install (version = "2.0.1")
```

3. Open a connection

```
spark_connect(master="spark://host:port",
  version = "2.0.1",
  spark_home = spark_home_dir())
```

LOCAL MODE

No cluster required. Use for learning purposes only

1. Install a local version of Spark:

```
spark_install("2.3")
```

2. Open a connection

```
sc <- spark_connect(master="local")
```

KUBERNETES

1. Use the following to obtain the Host and Port

```
system2("kubectl", "cluster-info")
```

2. Open a connection

```
sc <- spark_connect(config =
      spark_config_kubernetes(
        "k8s://https://[HOST]>:[PORT]",
        account = "default",
        image = "docker.io/owner/repo:version",
        version = "2.3.1"))
```

MESOS

1. Install RStudio Server on one of the nodes
2. Open a connection

```
sc <- spark_connect(master="[Mesos URL]")
```

CLOUD

Databricks - spark_connect(**method = "databricks"**)

Qubole- spark_connect(**method = "qubole"**)

More Information

spark.rstudio.com

therinspark.com

RStudio