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

Connect

DATABRICKS CONNECT (v2)

1. Open your .Renviron file: `usethis::edit_r_environ()`
2. In the .Renviron file add your Databricks Host Url and Token (PAT):
   - `DATABRICKS_HOST = [Your Host URL]`
   - `DATABRICKS_TOKEN = [Your PAT]`
3. Install extension: `install.packages("pysparklyr")`
4. Open connection:

```
sc <- spark_connect(
cluster_id = "[Your cluster's ID]",
method = "databricks_connect"
)
```

= Supported in Databricks Connect v2

STANDALONE CLUSTER

1. Install RStudio Server on one of the existing nodes or a server in the same LAN
2. Open a connection

```
spark_connect(master="spark://host:port",
   version = "3.2",
   spark_home = [path to Spark])
```

YARN CLIENT

1. Install RStudio Server on 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

```
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")
```

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"
 ))
```

LOCAL MODE

No cluster required. Use for learning purposes only

1. Install a local version of Spark: `spark_install()`
2. Open a connection

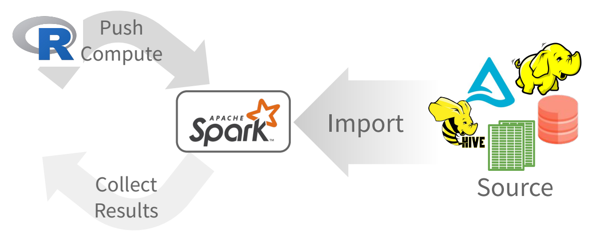
```
sc <- spark_connect(master="local")
```

CLOUD

Azure - `spark_connect(method = "synapse")`

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

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()**
DELTA	**spark_read_delta()**

FROM A TABLE

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

dbplyr::**in_catalog()** - Enables a three part table address

```
x <- tbl(sc,in_catalog("catalog", "schema", "table"))
```

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

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

Visualize
- Collect result, plot in R

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

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

R for Data Science, Grolemund & Wickham

R DATA FRAME INTO SPARK

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

Apache Arrow accelerates data transfer between R and Spark. To use, simply load the library

```
library(sparklyr)
library(arrow)
```

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)
```

TIDYR

pivot_longer() - Collapse several columns into two.

pivot_wider() - Expand two columns into several.

nest() / unnest() - Convert groups of cells into list-columns, and vice versa.

unite() / separate() - Split a single column into several columns, and vice versa.

fill() - Fill NA with the previous value

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 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 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)

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

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_robust_scaler() - Removes the median and scales according to standard scale.

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

Modeling

REGRESSION

ml_linear_regression() - Linear regression.

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

ml_generalized_linear_regression() - GLM

ml_isotonic_regression() - Uses parallelized pool adjacent violators algorithm.

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() - Based on the Multilayer Perceptron.

ml_naive_bayes() - It supports Multinomial NB which can handle finitely supported discrete data

ml_one_vs_rest() - Reduction of Multiclass, 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() | **ml_tree_feature_importance()** - 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()** | **ml_compute_silhouette_measure()** - Clustering with support for k-means

ml_power_iteration() - For clustering vertices of a graph given pairwise similarities as edge properties.

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.

FREQUENT PATTERN

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

ml_freq_seq_patterns() | **ml_prefixspan()** - PrefixSpan algorithm for mining frequent itemsets.

STATS

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

ml_corr() - Compute correlation matrix

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

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

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

ML Pipelines

*Easily create a formal Spark Pipeline models using R. Save the Pipeline in native Sacala. It will have **no dependencies** on R.*

INITIALIZE AND TRAIN

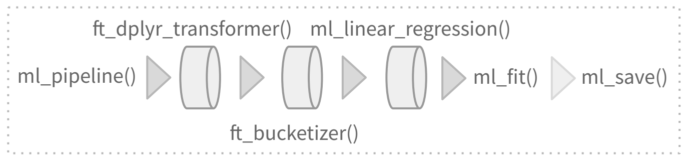
ml_pipeline() - Initializes a new Spark Pipeline

ml_fit() - Trains the model, outputs a Spark Pipeline Model.

SAVE AND RETRIEVE

ml_save() - Saves into a format that can be read by Scala and PySpark .

ml_read() - Reads Spark object into sparklyr.



spark.posit.co/guides/pipelines

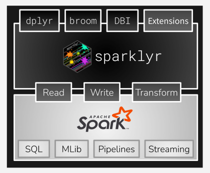
Distributed R

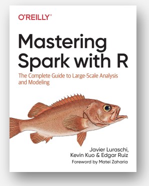
Run arbitrary R code at scale inside your cluster with **spark_apply()**. Useful when there you need functionality only available in R, and to solve 'embarrassingly parallel problems'

spark_apply(x, f, columns = NULL, memory = TRUE, group_by = NULL, name = NULL, barrier = NULL, fetch_result_as_sdf = TRUE)

```
copy_to(sc, mtcars) %>%
  spark_apply(
    nrow, # R only function
    group_by = "am",
    columns = "am double, x long"
    )
```

More Info





spark.posit.co   therinspark.com