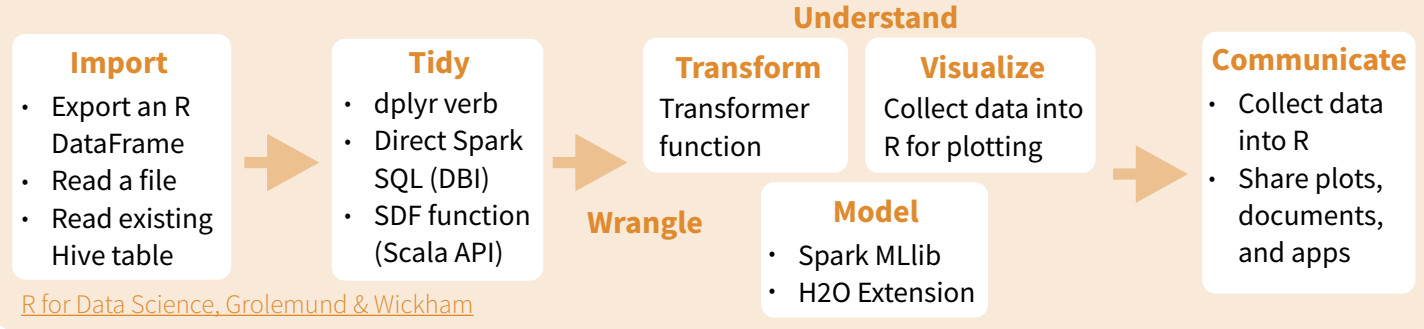


Data Science in Spark

with sparklyr Cheat Sheet



Data Science Toolchain with Spark + sparklyr



Using sparklyr

A brief example of a data analysis using Apache Spark, R and sparklyr in local mode

```

library(sparklyr); library(dplyr); library(ggplot2);
library(tidyr);
set.seed(100)

spark_install("2.0.1")
sc <- spark_connect(master = "local")

import_iris <- copy_to(sc, iris, "spark_iris",
  overwrite = TRUE)

partition_iris <- sdf_partition(
  import_iris, training=0.5, testing=0.5)

sdf_register(partition_iris,
  c("spark_iris_training", "spark_iris_test"))

tidy_iris <- tbl(sc, "spark_iris_training") %>%
  select(Species, Petal_Length, Petal_Width)

model_iris <- tidy_iris %>%
  ml_decision_tree(response="Species",
  features=c("Petal_Length", "Petal_Width"))

test_iris <- tbl(sc, "spark_iris_test")

pred_iris <- sdf_predict(
  model_iris, test_iris) %>%
  collect

pred_iris %>%
  inner_join(data.frame(prediction=0:2,
  lab=model_iris$model.parameters$labels)) %>%
  ggplot(aes(Petal_Length, Petal_Width, col=lab)) +
  geom_point()

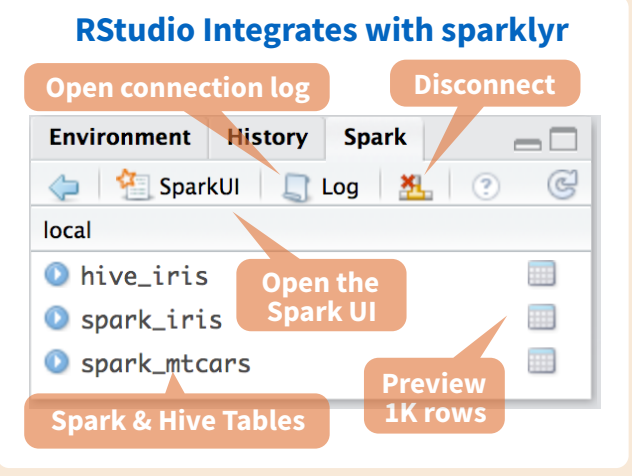
spark_disconnect(sc)
  
```

Intro

sparklyr is an R interface for Apache Spark™, it provides a complete **dplyr** backend and the option to query directly using **Spark SQL** statement. With sparklyr, you can orchestrate distributed machine learning using either **Spark's MLlib** or **H2O Sparkling Water**.



Starting with **version 1.044**, **RStudio Desktop, Server and Pro** include integrated support for the **sparklyr** package. You can create and manage connections to Spark clusters and local Spark instances from inside the IDE.



Getting started

Local Mode

Easy setup; no cluster required

1. Install a local version of Spark:
spark_install("2.0.1")
2. Open a connection
sc <- spark_connect(master = "local")

On a Mesos Managed Cluster

1. Install RStudio Server or Pro on one of the existing nodes
2. Locate path to the cluster's Spark directory
3. Open a connection
spark_connect(master="[mesos URL]", version = "1.6.2", spark_home = [Cluster's Spark path])

Using Livy (Experimental)

1. The Livy REST application should be running on the cluster
2. Connect to the cluster
sc <- spark_connect(master = "http://host:port", method = "livy")

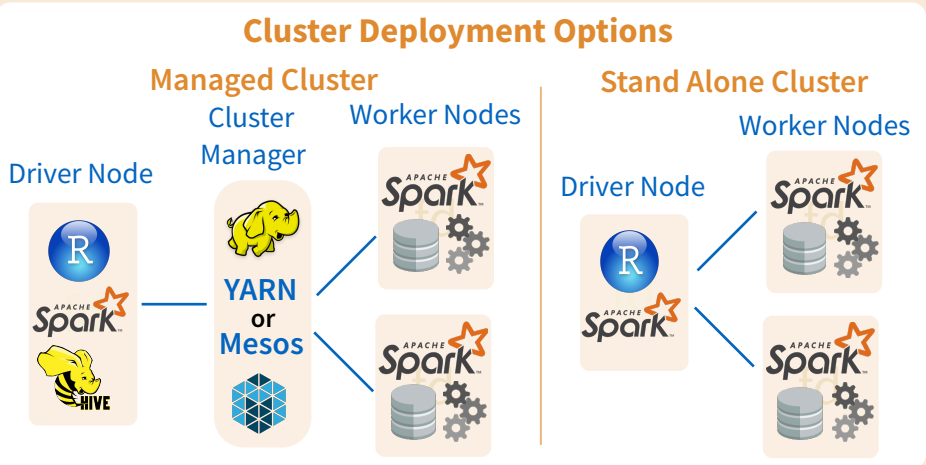
On a YARN Managed Cluster

1. Install RStudio Server or RStudio Pro 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. Open a connection
spark_connect(master="yarn-client", version = "1.6.2", spark_home = [Cluster's Spark path])

On a Spark Standalone Cluster

1. Install RStudio Server or RStudio Pro 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())

Cluster Deployment



Tuning Spark

Example Configuration

```

config <- spark_config()
config$spark.executor.cores <- 2
config$spark.executor.memory <- "4G"
sc <- spark_connect(master = "yarn-client", config = config, version = "2.0.1")
  
```

Important Tuning Parameters with defaults

- spark.yarn.am.cores
- spark.yarn.am.memory 512m

Important Tuning Parameters with defaults continued

- spark.executor.heartbeatInterval 10s
- spark.network.timeout 120s
- spark.executor.memory 1g
- spark.executor.cores 1
- spark.executor.extraJavaOptions
- spark.executor.instances
- sparklyr.shell.executor-memory
- sparklyr.shell.driver-memory

spark_disconnect(sc)

Disconnect

Import

Copy a DataFrame into Spark

```
sdf_copy_to(sc, iris, "spark_iris")
```

```
sdf_copy_to(sc, x, name, memory, repartition,
overwrite)
```

Import into Spark from a File

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`()

Spark SQL commands

```
DBI::dbWriteTable(
sc, "spark_iris", iris)
```

```
DBI::dbWriteTable(conn, name,
value)
```

From a table in Hive

```
my_var <- tbl_cache(sc,
name= "hive_iris")
```

```
tbl_cache(sc, name, force = TRUE)
Loads the table into memory
```

```
my_var <- dplyr::tbl(sc,
name= "hive_iris")
```

```
dplyr::tbl(sc, ...)
```

Creates a reference to the table
without loading it into memory

Visualize & Communicate

Download data to R memory

```
r_table <- collect(my_table)
plot(Petal_Width~Petal_Length, data=r_table)
```

```
dplyr::collect(x)
```

Download a Spark DataFrame to an R DataFrame

```
sdf_read_column(x, column)
```

Returns contents of a single column to R

Save from Spark to File System

Arguments that apply to all functions: **x, path**

CSV `spark_read_csv`(header = TRUE,
delimiter = ";", quote = "\"", escape = "\\",
charset = "UTF-8", null_value = NULL)

JSON `spark_read_json`(mode = NULL)

PARQUET `spark_read_parquet`(mode = NULL)

Model (MLlib)

```
ml_decision_tree(my_table, response="Species", features=
c("Petal_Length", "Petal_Width"))
```

```
ml_als_factorization(x, rating.column = "rating", user.column =
"user", item.column = "item", rank = 10L, regularization.parameter =
0.1, iter.max = 10L, ml.options = ml_options())
```

```
ml_decision_tree(x, response, features, max.bins = 32L, max.depth
= 5L, type = c("auto", "regression", "classification"), ml.options =
ml_options())
```

Same options for: **ml_gradient_boosted_trees**

```
ml_generalized_linear_regression(x, response, features,
intercept = TRUE, family = gaussian(link = "identity"), iter.max =
100L, ml.options = ml_options())
```

```
ml_kmeans(x, centers, iter.max = 100, features = dplyr::tbl_vars(x),
compute.cost = TRUE, tolerance = 1e-04, ml.options = ml_options())
```

```
ml_lda(x, features = dplyr::tbl_vars(x), k = length(features), alpha =
(50/k) + 1, beta = 0.1 + 1, ml.options = ml_options())
```

```
ml_linear_regression(x, response, features, intercept = TRUE,
alpha = 0, lambda = 0, iter.max = 100L, ml.options = ml_options())
```

Same options for: **ml_logistic_regression**

```
ml_multilayer_perceptron(x, response, features, layers, iter.max
= 100, seed = sample(.Machine$integer.max, 1), ml.options =
ml_options())
```

```
ml_naive_bayes(x, response, features, lambda = 0, ml.options =
ml_options())
```

```
ml_one_vs_rest(x, classifier, response, features, ml.options =
ml_options())
```

```
ml_pca(x, features = dplyr::tbl_vars(x), ml.options = ml_options())
```

```
ml_random_forest(x, response, features, max.bins = 32L,
max.depth = 5L, num.trees = 20L, type = c("auto", "regression",
"classification"), ml.options = ml_options())
```

```
ml_survival_regression(x, response, features, intercept =
TRUE, censor = "censor", iter.max = 100L, ml.options =
ml_options())
```

```
ml_binary_classification_eval(predicted_tbl_spark, label,
score, metric = "areaUnderROC")
```

```
ml_classification_eval(predicted_tbl_spark, label, predicted_lbl,
metric = "f1")
```

```
ml_tree_feature_importance(sc, model)
```

Wrangle

Spark SQL via dplyr verbs

Translates into Spark SQL statements

```
my_table <- my_var %>%
filter(Species=="setosa") %>%
sample_n(10)
```

Direct Spark SQL commands

```
my_table <- DBI::dbGetQuery(sc, "SELECT *
FROM iris LIMIT 10")
```

```
DBI::dbGetQuery(conn, statement)
```

Scala API via SDF functions

```
sdf_mutate(.data)
```

Works like dplyr mutate function

```
sdf_partition(x, ..., weights = NULL, seed
= sample(.Machine$integer.max, 1))
```

```
sdf_partition(x, training = 0.5, test = 0.5)
```

```
sdf_register(x, name = NULL)
```

Gives a Spark DataFrame a table name

```
sdf_sample(x, fraction = 1, replacement =
TRUE, seed = NULL)
```

```
sdf_sort(x, columns)
```

Sorts by >=1 columns in ascending order

```
sdf_with_unique_id(x, id = "id")
```

Add unique ID column

```
sdf_predict(object, newdata)
```

Spark DataFrame with predicted values

ML Transformers

```
ft_binarizer(my_table, input.col="Petal_
Length", output.col="petal_large",
threshold=1.2)
```

Arguments that apply to all functions:
x, input.col = NULL, output.col = NULL

```
ft_binarizer(threshold = 0.5)
```

Assigned values based on threshold

```
ft_bucketizer(splits)
```

Numeric column to discretized column

```
ft_discrete_cosine_transform(invers
e = FALSE)
```

Time domain to frequency domain

```
ft_elementwise_product(scaling.col)
Element-wise product between 2
columns
```

```
ft_index_to_string()
```

Index labels back to label as strings

```
ft_one_hot_encoder()
```

Continuous to binary vectors

```
ft_quantile_discretizer(n.buckets
= 5L)
```

Continuous to binned categorical
values

```
ft_sql_transformer(sql)
```

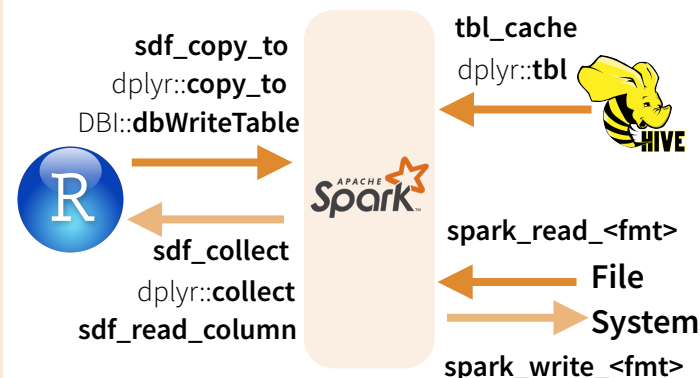
```
ft_string_indexer(params = NULL)
```

Column of labels into a column of
label indices.

```
ft_vector_assembler()
```

Combine vectors into a single row-
vector

Reading & Writing from Apache Spark



Extensions

Create an R package that calls the full Spark API &
provide interfaces to Spark packages.

Core Types

```
spark_connection() Connection between R and the
Spark shell process
```

```
spark_jobj() Instance of a remote Spark object
```

```
spark_dataframe() Instance of a remote Spark
DataFrame object
```

Call Spark from R

```
invoke() Call a method on a Java object
```

```
invoke_new() Create a new object by invoking a
constructor
```

```
invoke_static() Call a static method on an object
```

Machine Learning Extensions

```
ml_create_dummy_variables() ml_options()
```

```
ml_prepare_dataframe() ml_model()
```

```
ml_prepare_response_features_intercept()
```

sparklyr

is an R
interface
for

