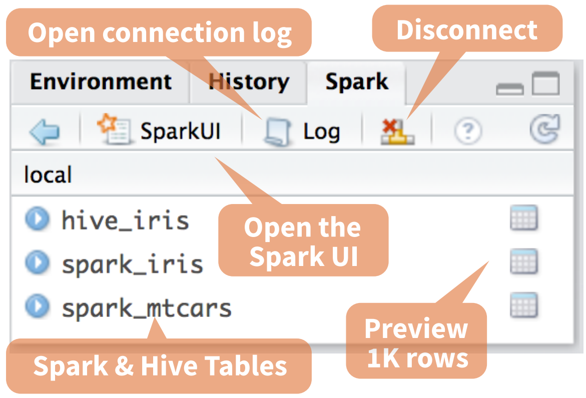
Data Science in Spark with Sparklyr : : **CHEAT SHEET**

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.

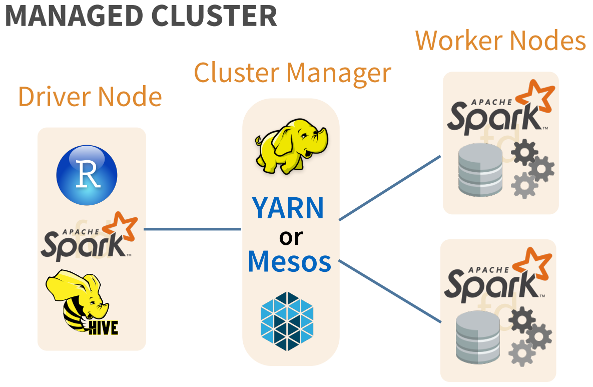
Starting with **version 1.044, RStudio Desktop, Server and Pro include integrated support for the sparklyr package**. You can create and manage connections to Spark clusters and local Spark instances from inside the IDE.

RStudio Integrates with sparklyr

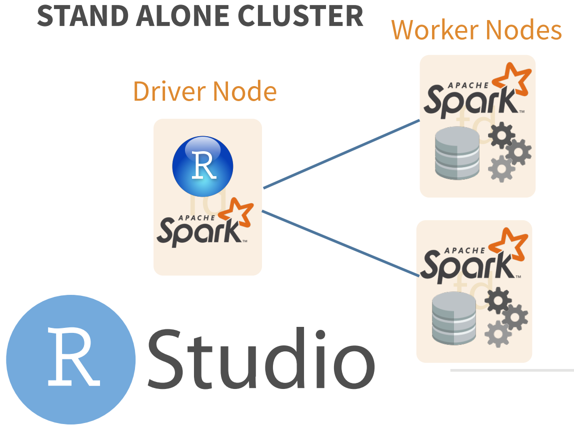


Cluster Deployment

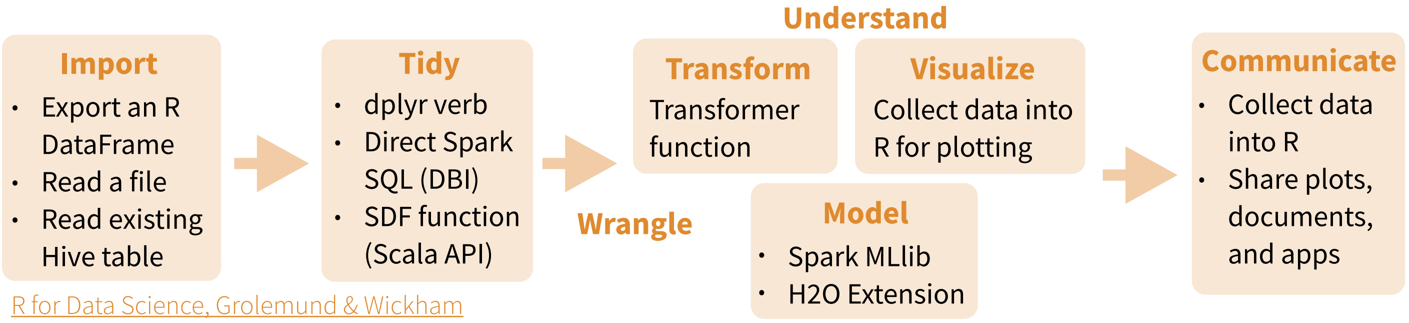
MANAGED CLUSTER



STAND ALONE CLUSTER



Data Science Toolchain with Spark + sparklyr



R for Data Science, Grolemund & Wickham

Getting Started

LOCAL MODE (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(method = "livy", master = "http://host:port")

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())

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

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)
```

Install Spark locally

```
spark_install("2.0.1")
```

Connect to local version

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

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

Copy data to Spark memory

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

Partition data

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

Create a hive metadata for each partition

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

Spark ML Decision Tree Model

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

```
test_iris <- tbl(sc,"spark_iris_test")
```

Create reference to Spark table

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

Bring data back into R memory for plotting

```
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)
```

Disconnect

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Reactivity

COPY A DATA FRAME 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**(scr, …)
Creates a reference to the table without loading it into memory

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")

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(inverse = FALSE)
Time domain to frequency domain

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

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 single row-vector

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

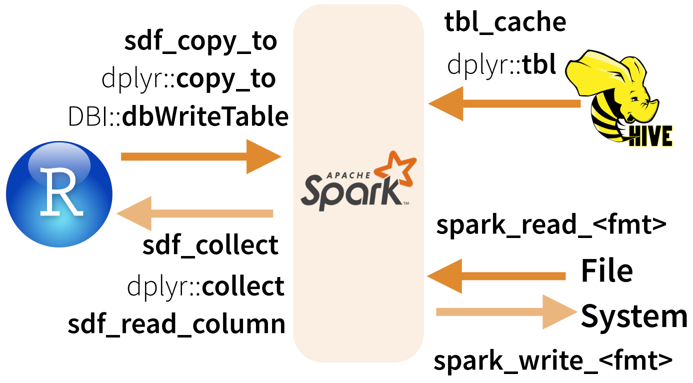
sdf_read_column(x, column)
Returns contents of a single column to R

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)

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_prepare_dataframe()
ml_prepare_response_features_intercept()
ml_options()
ml_model()

Model (MLlib)

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

ml_als_factorization(x, user.column = "user", rating.column = "rating", 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())

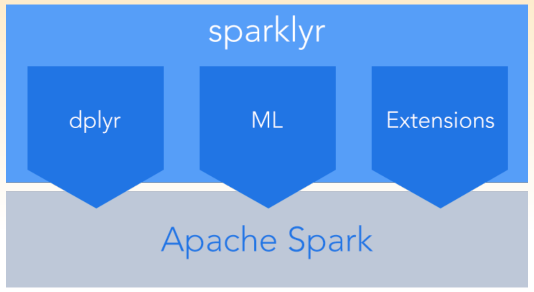
ml_survival_regression(x, response, features, intercept = TRUE,censor = "censor", iter.max = 100L, ml.options = ml_options())

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)

sparklyr is an R interface for Apache Spark



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