

Cheat Sheet for PySpark

Wenqiang Feng

E-mail: von198@gmail.com, Web: <http://web.utk.edu/~wfeng1>; <https://runawayhorse001.github.io/LearningApacheSpark>

Spark Configuration

```
from pyspark.sql import SparkSession
spark = SparkSession.builder
    .appName("Python Spark regression example")
    .config("config.option", "value").getOrCreate()
```

Loading Data

From RDDs

```
# Using parallelize()
df = spark.sparkContext.parallelize([(1, 'Joe', '70000', '1'),
    ('2', 'Henry', '80000', None)])
    .toDF(['Id', 'Name', 'Salary', 'DepartmentId'])
# Using createDataFrame()
df = spark.createDataFrame([(1, 'Joe', '70000', '1'),
    ('2', 'Henry', '80000', None)],
    ['Id', 'Name', 'Salary', 'DepartmentId'])
```

Id	Name	Salary	DepartmentId
1	Joe	70000	1
2	Henry	80000	null

From Data Sources

▷ From .csv

```
ds = spark.read.csv(path='Advertising.csv',
    sep=',', encoding='UTF-8', comment=None,
    header=True, inferSchema=True)
```

	TV	Radio	Newspaper	Sales
230.1	37.8	69.2	22.1	
44.5	39.3	45.1	10.4	

▷ From .json

```
df = spark.read.json('/home/feng/Desktop/data.json')
```

	id	location	timestamp
2957256202	[72.1, DE, 8086, 52...]	[2019-02-23 22:36:52]	
2957256203	[598.5, BG, 3963, 42...]	[2019-02-23 22:36:52]	

▷ From Database

```
user = 'username'; pw = 'password'
table_name = 'table_name'
url='jdbc:postgresql://###.###.###.###:5432/dataset?user='
    +user+'&password='+pw
p='driver': 'org.postgresql.Driver', 'password': pw, 'user': user
df = spark.read.jdbc(url=url, table=table_name, properties=p)
```

	TV	Radio	Newspaper	Sales
230.1	37.8	69.2	22.1	
44.5	39.3	45.1	10.4	

▷ From HDFS

```
from pyspark.conf import SparkConf
from pyspark.context import SparkContext
from pyspark.sql import HiveContext
sc = SparkContext('local', 'example')
hc = HiveContext(sc)
tf1 = sc.textFile("hdfs://###/user/data/file_name")
```

	TV	Radio	Newspaper	Sales
230.1	37.8	69.2	22.1	
44.5	39.3	45.1	10.4	

Auditing Data

Checking schema

```
df.printSchema()
root
 |-- _c0: integer (nullable = true)
 |-- TV: double (nullable = true)
 |-- Radio: double (nullable = true)
 |-- Newspaper: double (nullable = true)
 |-- Sales: double (nullable = true)
```

Checking missing value

```
from pyspark.sql.functions import count
def my_count(df):
    df.agg(*[count(c).alias(c) for c in df_in.columns]).show()
my_count(df_raw)
```

InvoiceNo	StockCode	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
541909	541909	541909	541909	541909	406829	541909

Checking statistical results

```
# function form my pyspark
df_raw.describe().show()
+-----+-----+-----+-----+
|summary|      TV|      Radio|    Newspaper|
+-----+-----+-----+-----+
| count|      200|        200|         200|
| mean| 147.0425| 23.264000000000002| 30.553999999999995|
| stddev|85.85423631490805|14.846809176168728| 21.77862083852283|
| min|      0.7|        0.0|         0.3|
| max|    296.4|        49.6|        114.0|
+-----+-----+-----+-----+
```

Manipulating Data (More details on next page)

Fixing missing value

Function	Description
df.na.fill()	#Replace null values
df.na.drop()	#Dropping any rows with null values.

Joining data

Description	Function
#Data join	left.join(right, key, how='*') * = left, right, inner, full

Wrangling with UDF

```
from pyspark.sql import functions as F
from pyspark.sql.types import DoubleType
# user defined function
def complexFun(x):
    return results
Fn = F.udf(lambda x: complexFun(x), DoubleType())
df.withColumn('2col', Fn(df.col))
```

Reducing features

```
df.select(featureNameList)
```

Modeling Pipeline

Deal with categorical feature and label data

```
# Deal with categorical feature data
from pyspark.ml.feature import VectorIndexer
featureIndexer = VectorIndexer(inputCol="features",
    outputCol="indexedFeatures",
    maxCategories=4).fit(data)
featureIndexer.transform(data).show(2, True)
```

	features	label	indexedFeatures
29	[1, 11, 14, 16, 1...]	no	[1, 11, 14, 16, 1...]

```
# Deal with categorical label data
labelIndexer=StringIndexer(inputCol='label',
    outputCol='indexedLabel').fit(data)
labelIndexer.transform(data).show(2, True)
```

	features	label	indexedLabel
29	[1, 11, 14, 16, 1...]	no	0.0

Splitting the data to training and test data sets

```
(trainingData, testData) = data.randomSplit([0.6, 0.4])
```

Importing the model

```
from pyspark.ml.classification import LogisticRegression
lr = LogisticRegression(featuresCol='indexedFeatures',
    labelCol='indexedLabel')
```

Converting indexed labels back to original labels

```
from pyspark.ml.feature import IndexToString
labelConverter = IndexToString(inputCol="prediction",
    outputCol="predictedLabel",
    labels=labelIndexer.labels)
```

Wrapping Pipeline

```
pipeline = Pipeline(stages=[labelIndexer, featureIndexer,
    lr, labelConverter])
```

Training model and making predictions

```
model = pipeline.fit(trainingData)
predictions = model.transform(testData)
predictions.select("features", "label", "predictedLabel").show(2)
```

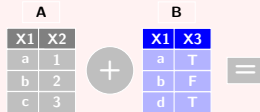
	features	label	predictedLabel
29	[0, 11, 13, 16, 1...]	no	no

Evaluating

```
from pyspark.ml.evaluation import *
evaluator = MulticlassClassificationEvaluator(
    labelCol="indexedLabel",
    predictionCol="prediction", metricName="accuracy")
accu = evaluator.evaluate(predictions)
print("Test Error: %g, AUC: %g"%(1-accu, Summary.areaUnderROC))
Test Error: 0.0986395, AUC: 0.886664269877
```

Data Wrangling: Combining DataFrame

Mutating Joins



Result

X1	X2	X3
a	1	T
b	2	F
c	3	T

Function

```
#Join matching rows from B to A
#dplyr::left_join(A, B, by = "x1")
A.join(B,'X1',how='left')
.orderBy('X1', ascending=True).show()
```

X1	X2	X3
a	1	T
b	2	F
c	null	T

```
#Join matching rows from A to B
#dplyr::right_join(A, B, by = "x1")
A.join(B,'X1',how='right')
.orderBy('X1', ascending=True).show()
```

X1	X2	X3
a	1	T
b	2	F

```
#Retain only rows in both sets
#dplyr::inner_join(A, B, by = "x1")
A.join(B,'X1',how='inner')
.orderBy('X1', ascending=True).show()
```

X1	X2	X3
a	1	T
b	2	F
c	3	null
d	null	T

```
#Retain all values,all rows
#dplyr::full_join(A, B, by = "x1")
A.join(B,'X1',how='full')
.orderBy('X1', ascending=True).show()
```

Filtering Joins

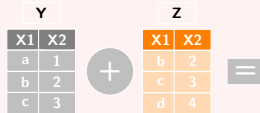
X1	X2
a	1
b	2

```
#All rows in A that have a match in B
#dplyr::semi_join(A, B, by = "x1")
a.join(b,'X1',how='left_semi')
.orderBy('X1', ascending=True).show()
```

X1	X2
C	3

```
#All rows in A, don't have a match in B
#dplyr::anti_join(A, B, by = "x1")
A.join(B,'X1',how='left_anti')
.orderBy('X1', ascending=True).show()
```

DataFrame Operations



Result

X1	X2
b	2
c	3

Function

```
#Rows that appear in both Y and Z
#dplyr::intersect(Y, Z)
Y.intersect(Z).show()
```

X1	X2
a	1
b	2
c	3
d	4

```
#Rows that appear in either or both Y and Z
#dplyr::union(Y, Z)
Y.union(Z).dropDuplicates()
.orderBy('X1', ascending=True).show()
```

X1	X2
a	1

```
#Rows that appear in Y but not Z
#dplyr::setdiff(Y, Z)
Y.subtract(Z).show()
```

Binding

X1	X2
a	1
b	2
c	3
b	2
c	3
d	4

```
#Append Z to Y as new rows
#dplyr::bind_rows(Y, Z)
Y.union(Z)
.orderBy('X1', ascending=True).show()
```

X1	X2	X1	X2
a	1	b	2
b	2	c	3
c	3	d	4

```
#Append Z to Y as new columns
#Caution: zipDataFrames form my package
#dplyr::bind_cols(Y, Z)
zipDataFrames(Y,Z).show()
```

Data Wrangling: Reshaping Data

Splitting

Change

key	value
1	1,2,3
2	4,5,6

Function

```
#ArrayType() tidyrr::separate ::separate one column into several
df.select("key", df.value[0], df.value[1], df.value[2]).show()
#StructType()
df2.select("key", 'value.*').show()
```

key	value
1	1,2,3
2	4,5,6

```
#Splitting one column into rows
df.select("key",F.split("values", ",").alias("values"),
F.posexplode(F.split("values",",")) .alias("pos", "val")
).drop("val")
.select("key",F.expr("values[pos]").alias("val")).show()
```

key	value
1	1,2,3
2	4,5,6

```
#Gather columns into rows
def to_long(df, by):
cols, dtypes = zip(*(c,t) for (c, t) in df.dtypes if c not in by))
# Spark SQL supports only homogeneous columns
assert len(set(dtypes))==1,"All columns have to be of the same type"
# Create and explode an array of (column_name, column_value) structs
kvs = explode(array([
struct(lit(c).alias("key"), col(c).alias("val")) for c in cols
])).alias("kvs")
return df.select(by + [kvs]).select(by + ["kvs.key", "kvs.val"])
```

Pivot

key	value
1	1,2,3
2	4,5,6

```
#Spread rows into columns
df.groupBy(['key'])
.pivot('col1').sum('col1').show()
```

Subset Observations (Rows)



Function

df.na.drop()

Description

#Omitting rows with null values

df.where()

#Filters rows using the given condition

df.filter()

#Filters rows using the given condition

df.distinct()

#Returns distinct rows in this DataFrame

df.sample()

#Returns a sampled subset of this DataFrame

df.sampleBy()

#Returns a stratified sample without replacement

Subset Variables (Columns)



Function

df.select()

Description

#Applies expressions and returns a new DataFrame

Make New Variables



Function

df.withColumn()

Examples

```
df.withColumn('new',1/df.col)

df.withColumn('new',F.log(df.col))

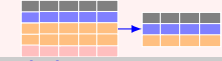
df.withColumn('id', pcf.monotonically_increasing_id())

df.withColumn("new", Fn('col')) #Fn:F.udf()

df.withColumn('new', F.when((df.c1>1)&(df.c2<2),1)
.when((df.c3>3),2).otherwise(3))
```

Data Wrangling: Reshaping Data

Summarise Data



Function

df.describe()

Description

#Computes simple statistics

Correlation.corr(df)

#Computes the correlation matrix

df.count()

#Count the number of rows



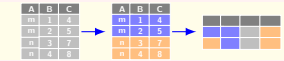
Description

#Sum

Demo

df.agg(F.max(df.C)).head()[0]#Similar for: F.min,max,avg,stddev

Group Data

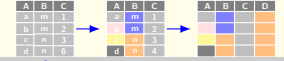


A	min_b	max_b	avg_c
m	1	2	4.5
n	3	4	7.5

```
df.groupBy(['A'])
.agg(F.min('B').alias('min_b'),
F.max('B').alias('max_b'),
F.avg('C').alias('avg_c')).show()
```

```
def quant_pd(val_list):
quant = np.round(np.percentile(val_list,
[20,50,75]),2)
return list(map(float,quant))
Fn = F.udf(quant_pd,ArrayType(FloatType()))
#GroupBy and aggregate
df.groupBy(['A'])
.agg(F.min('B').alias('min_b'),
F.max('B').alias('max_b'),
Fn(F.collect_list(col('C'))).alias('list_c'))
```

Windows



Result

A	B	C	D
a	m	1	0
b	m	2	1
c	n	3	0
d	n	6	3

Function

```
from pyspark.sql import Window
#Define windows for difference
w = Window.partitionBy(df.B)
D = df.C - F.max(df.C).over(w)
df.withColumn('D',D).show()

df = df.withColumn("D",
F.monotonically_increasing_id())
#Define windows for row_num
w = Window.orderBy("D")
df.withColumn("D", F.row_number().over(w))

#Define windows for rank
w = Window.partitionBy('B')
.orderBy(df.C.desc())
df.withColumn("D",rank().over(w)).show()
```

Rename Variables



Function

df.withColumnRenamed()#Renaming an existing column