Cheat Sheet for PySpark

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

```
+---+-----+-------+------------+
| Id| Name|Sallary|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.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|23.264000000000024|30.553999999999995|
| stddev|85.854236314908051|14.846809176168728| 21.778620838522831|
|    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|(29,[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|
+--------------------+-----+------------+
```

Spliting 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|
+--------------------+-----+--------------+
```

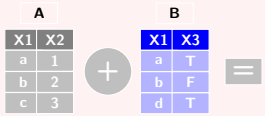
Evaluating

```
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

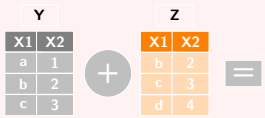
X1	X2
a	1
b	2

```
#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()
```

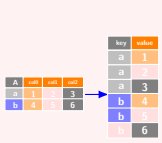
Data Wrangling: Reshaping Data

Spliting

Change **Function**

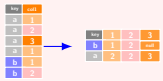
```
#ArrayType() tidyr::separate ::separate one column into several
df.select("key", df.value[0], df.value[1], df.value[2]).show()
#StructType()
df2.select('key', 'value.*').show()
```

```
#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()
```



```
#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



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

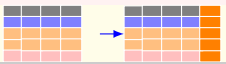
Subset Observations (Rows)

Function	Description
df.na.drop()	#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	Description
df.select()	#Applys expressions and returns a new DataFrame

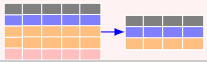
Make New Vaiables



Function	Examples
df.withColumn()	df.withColumn('new',1/df.col)
	df.withColumn('new',F.log(df.col))
	df.withColumn('id', psf.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

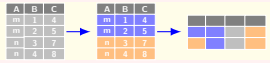
Summarise Data



Function	Description
df.describe()	#Computes simple statistics
Correlation.corr(df)	#Computes the correlation matrix
df.count()	#Count the number of rows

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

Group Data



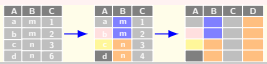
A	min_b	max_b	avg_c
m	1	2	4.5
n	3	4	7.5

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

A	min_b	max_b	list_c
m	1	2	[4,2,4,5,4,7,5]
n	3	4	[7,2,7,5,7,7,5]

```
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()
```

A	B	C	D
a	m	1	1
b	m	2	2
c	n	3	3
d	n	6	4

```
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))
```

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

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

Rename Vaiables

Function	Description
df.withColumnRenamed()	#Renaming an existing column