UNIVERSITÄT BONN

SMART DATA ANALYTICS
FROM DATA TO KNOWLEDGE

MA-INF 4223 - Lab Distributed Big Data Analytics

Spark Fundamentals II

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Lesson objectives

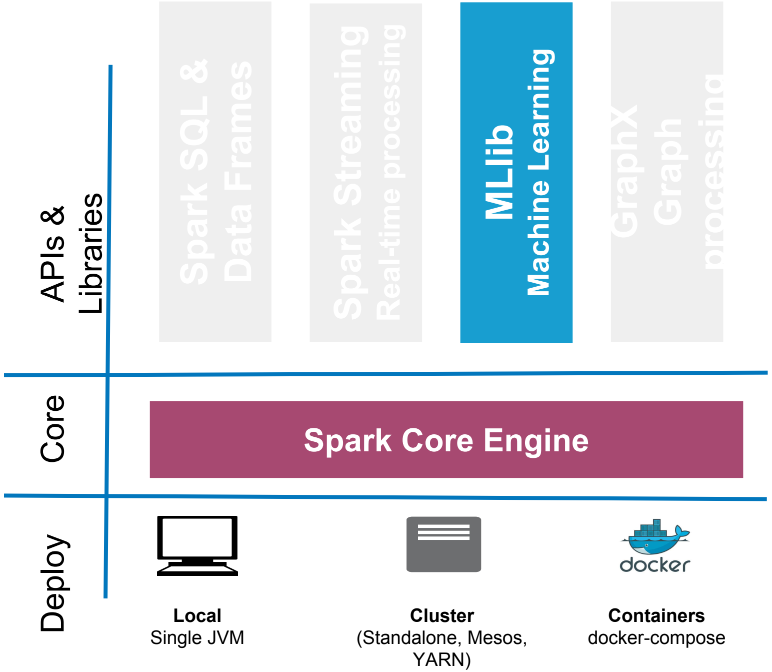
- After completing this lesson, you should be able to:
  - Understand and use
    - Spark MLlib

Spark ML

Overview

- MLlib: Machine Learning in Apache Spark

Spark ML



APIs & Libraries

Spark SQL & Data Frames

Spark Streaming Real-time processing

MLlib Machine Learning

GraphX Graph processing

Core

Spark Core Engine

Deploy

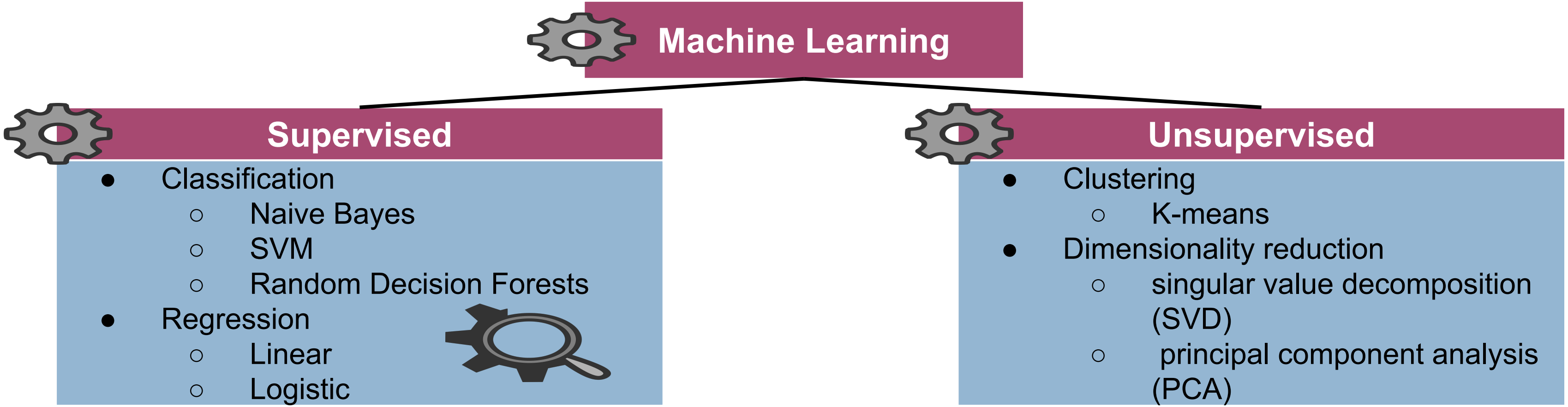
Local
Single JVM

Cluster
(Standalone, Mesos, YARN)

Containers
docker-compose

ML Algorithms overview

- Machine learning are separated in two major types of algorithms :
  - Supervised - labeled data in which both, input and output are provided to the algorithm
  - Unsupervised - do not have the outputs in advance



Machine Learning

Supervised

- Classification
  - Naive Bayes
  - SVM
  - Random Decision Forests
- Regression
  - Linear
  - Logistic

Unsupervised

- Clustering
  - K-means
- Dimensionality reduction
  - singular value decomposition (SVD)
  - principal component analysis (PCA)

Spark ML

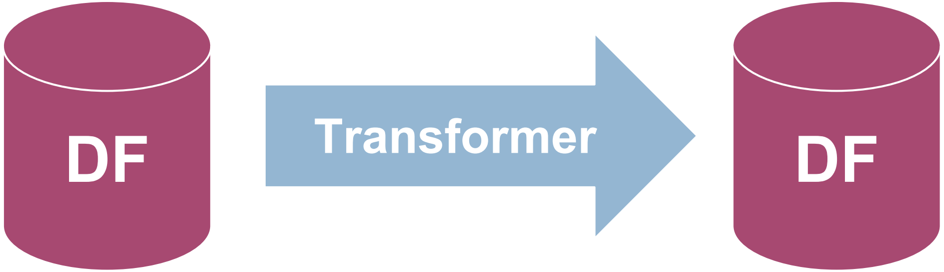
- MLlib is a standard component of Spark providing machine learning primitives on top of Spark
- It is scalable machine learning, statistics, math libraries
- Supports out-of-the-box most popular machine learning algorithms like Linear regression, Logistic regression, Decision Trees
- Is available in Scala, Java, Python, and R

Spark ML-pipelines

- Uniform set of APIs for creating and tuning data processing/machine learning pipelines
- Core concepts:
  - DataFrame: RDD with names columns. SQL-like syntax and other core RDD operations
  - Transformer: DataFrame => DataFrame. Eg., features to predictions(classifier)
  - Estimator: DataFrame => Transformer. e.g., learning algorithm
  - Param: map of params
  - Pipeline: Chain of Transformers and Estimators. Specifies the data flow

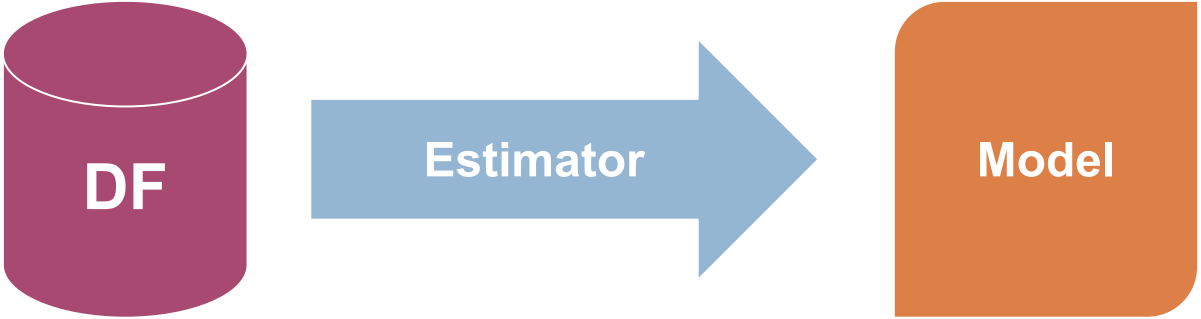
Spark ML-pipelines

- Transformer
  - A Transformer is an abstraction which uses an algorithm to transform one DataFrame to another
  - It implements a method `transform()`



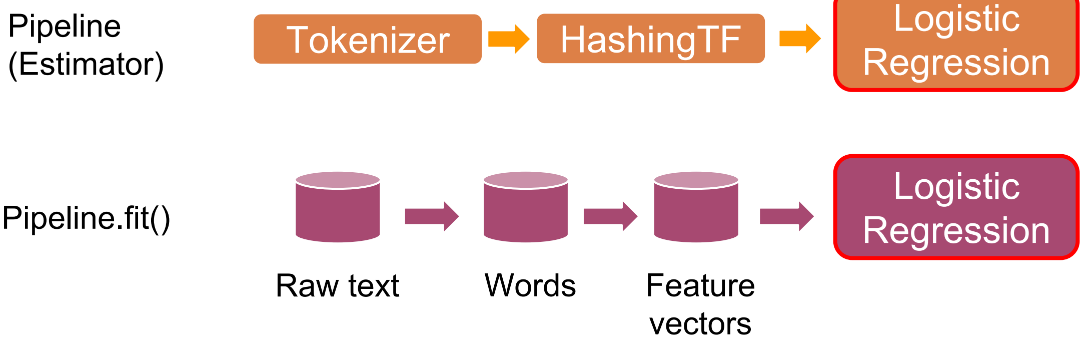
Spark ML-pipelines

- Estimator
  - An Estimator abstraction uses an algorithm which is fitted into a DataFrame returning a model
  - It implements a method `fit()`



Spark ML-pipelines Example

- Split text into words => convert numerical features => generate a prediction model



Pipeline (Estimator)

Tokenizer → HashingTF → Logistic Regression

Pipeline.fit()

Raw text → Words → Feature vectors → Logistic Regression

```
val tokenizer = new Tokenizer().setInputCol("text").setOutputCol("words")
val hashingTF = new HashingTF().setNumFeatures(1000).setInputCol(tokenizer.getOutputCol)
.setOutputCol("features")
val lr = new LogisticRegression().setMaxIter(10).setRegParam(0.01)
val pipeline = new Pipeline().setStages(Array(tokenizer, hashingTF, lr))
val model = pipeline.fit(training.toDF)
val test = sc.parallelize(Seq(
Document(4L, "spark i j k"),
Document(5L, "l m n"),
Document(6L, "mapreduce spark"),
Document(7L, "apache hadoop")))
val predictions = model.transform(test.toDF)
```

References

[1]. MLlib: Machine Learning in Apache Spark by Meng, Xiangrui, Joseph K. Bradley, Burak Yavuz, Evan R. Sparks, Shivaram Venkataraman, Davies Liu, Jeremy Freeman, D. B. Tsai, Manish Amde, Sean Owen, Doris Xin, Reynold Xin, Michael J. Franklin, Reza Bosagh Zadeh, Matei Zaharia and Ameet Talwalkar *in Journal of Machine Learning Research 17*, 2016.

[2]. “Machine Learning Library (MLlib) Guide” - http://spark.apache.org/docs/latest/ml-guide.html

THANK YOU !

http://sda.cs.uni-bonn.de/teaching/dbda/

- http://sda.cs.uni-bonn.de/
- https://github.com/SANSA-Stack
- https://github.com/big-data-europe
- https://github.com/SmartDataAnalytics

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