Machine Learning & Spark

Kristie Wirth
Adam Richards

https://spark.apache.org/docs/latest/ml-guide.html

Objectives

- Describe one difference between Spark & Sklearn.
- Explain the concept of a transformer.
- Explain the concept of an estimator.

Machine Learning on Spark

- Algorithms: common learning algorithms such as classification, regression, clustering, and collaborative filtering
- Featurization: feature extraction, transformation, dimensionality reduction, and selection
- Pipelines: tools for constructing, evaluating, and tuning ML Pipelines
- Persistence: saving and load algorithms, models, and Pipelines
- Utilities: linear algebra, statistics, data handling, etc.

Timing of Algorithms in Spark

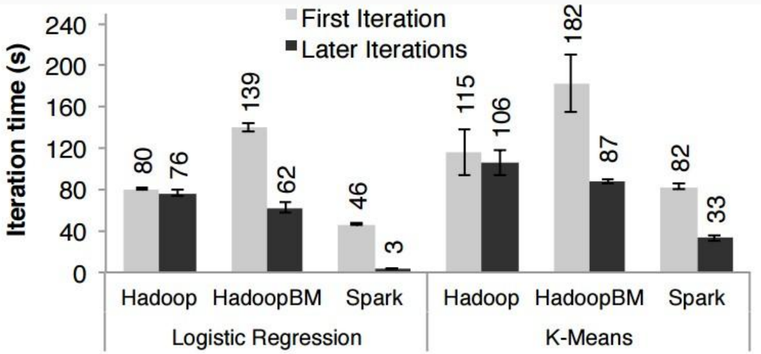
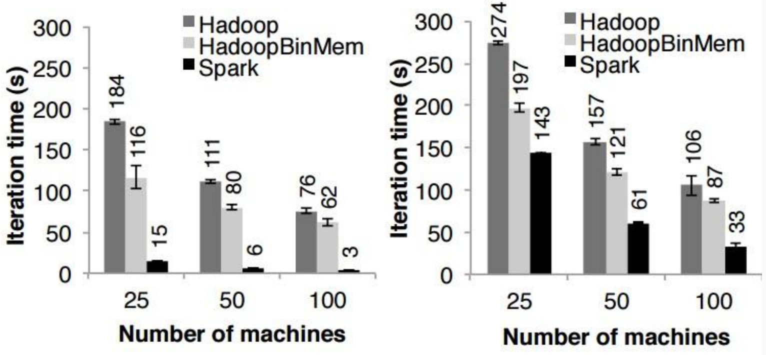


Figure 7: Duration of the first and later iterations in Hadoop, HadoopBinMem and Spark for logistic regression and k-means using 100 GB of data on a 100-node cluster.



(a) Logistic Regression

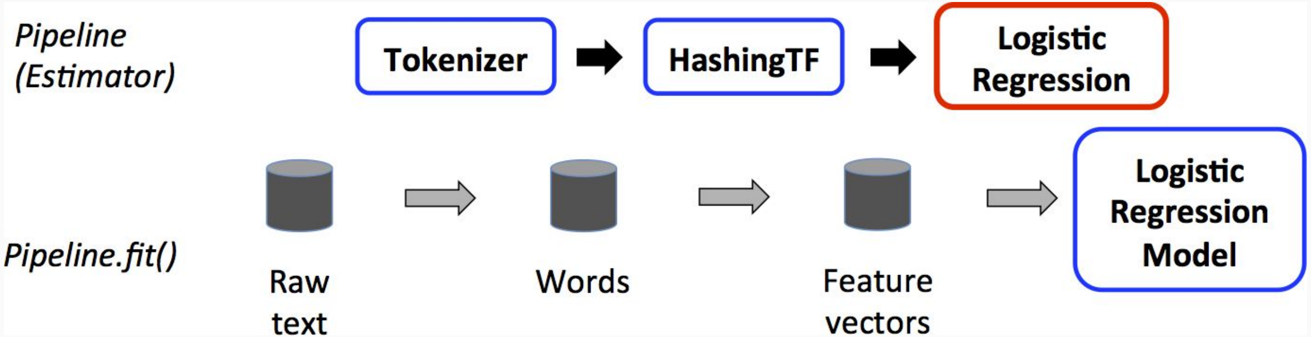
(b) K-Means

Figure 8: Running times for iterations after the first in Hadoop, HadoopBinMem, and Spark. The jobs all processed 100 GB.

Spark Machine Learning Pipeline Terms

- Pipeline
  - Running a sequence of algorithms in a set order to process & learn from data
  - Many Data Science workflows can be described as a pipeline, i.e. just a sequential application of various Transforms and Estimators
- Transformers
  - They implement a transform() method
  - They convert one DataFrame into another, usually by adding columns
  - For example, this is how you get predictions, through using a transform method and adding a column of predictions to your DataFrame
  - Examples of transformers: VectorAssembler, Tokenizer, StopWordsRemover, and many more
- Estimators
  - Any algorithm that fits or trains on data
  - They implement a fit() method whose argument is a DataFrame
  - The output of fit() is another type called a Model, which is actually a Transformer
  - Examples of estimators: LogisticRegression, DecisionTreeRegressor, and many more

Example of a Pipeline



Blue = Transformers | Red = Estimator | Cylinders = DataFrames

1. Tokenizer**.transform()** - splits the raw text documents into words and **adds a new column** with those words to the DataFrame
2. HashingTF**.transform()** - converts the word column into feature vectors and **adds a new column** with those vectors to the DataFrame
3. LogisticRegression**.fit()** - **trains on the data** and produces a Logistic Regression Model

Machine Learning Libraries

- In the past, there was a trade-off between using the two different machine learning libraries available - Spark MLlib and Spark ML
- The terms ‘MLlib’ & ‘ML’ can be used in a few different ways depending on what you’re reading and the Spark version you’re looking at
- Spark is now using the dataframe-based API as the default API
- The RDD-based API is expected to be removed in Spark 3.0
- You can read more here: https://spark.apache.org/docs/latest/ml-guide.html

Check In Questions

- Describe one difference between Spark & Sklearn.
- What is a transformer?
- What is an estimator?

Machine Learning Jupyter Notebook

Take some time to slowly go through the ML Jupyter Notebook. Do this before you work on the pair!

Additional Resources

- Pyspark machine learning reference: http://spark.apache.org/docs/latest/api/python/pyspark.ml.html
- Machine learning with Spark examples and code reference: https://spark.apache.org/docs/latest/ml-guide.html
- Cross validation and train-test splitting in Spark: https://spark.apache.org/docs/latest/ml-tuning.html