MLeap: Release Spark ML Pipelines

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SPARK SUMMIT 2016
DATA SCIENCE AND ENGINEERING AT SCALE

Opening Demo

How much should I rent my house for on AirBnb?

`http://spark-summit.combust.ml`

Yes, open your cell phone and go here :)

Problem Statement: Deploying machine learning algorithms to a production environment is a lot more difficult than it has to be and is a common source of friction at data-driven organizations

Action		Reaction
- Data scientists write data pipelines to construct research datasets	⟷	- Engineers re-write the data pipelines for a production-ready system
- Engineers write scalable libraries for computing features and algorithms	⟷	- Data scientists largely don't use those libraries and maintain/re-write their own copy of the code
- Data scientists largely focus on linear/logistic regressions due to engineering constraints	⟷	- Talented engineers get largely tired of coding up linear regressions and updating coefficients

Everyone wants to do better! The winning technology will be the one that enables Engineers and Data Scientists to collaborate and work across a single platform.

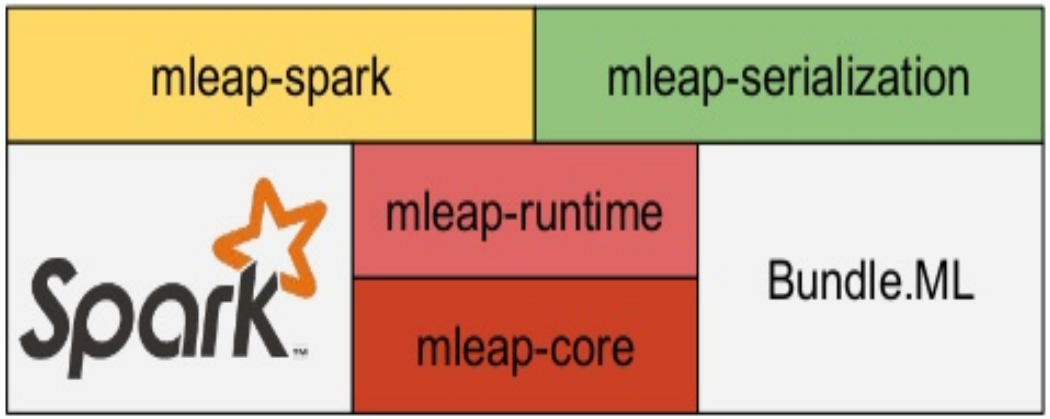
Existing Solutions: You won't believe how many companies are still deploying algorithms in a SQL environment! And these are billion dollar operations.

	Hard-Coded Models (SQL, Java, Ruby)	PMML	Emerging Solutions (yHat, DataRobot)	Enterprise Solutions (Microsoft, IBM, SAS)	MLeap
Quick to Implement	✗	✓	✗	✗	✓
Open Sourced	✗	✓	✗	✗	✓
Committed to Spark/Hadoop	✗	⊖	⊖	✓	✓
API Server Infrastructure	✗	⊖	✓	✗	✓

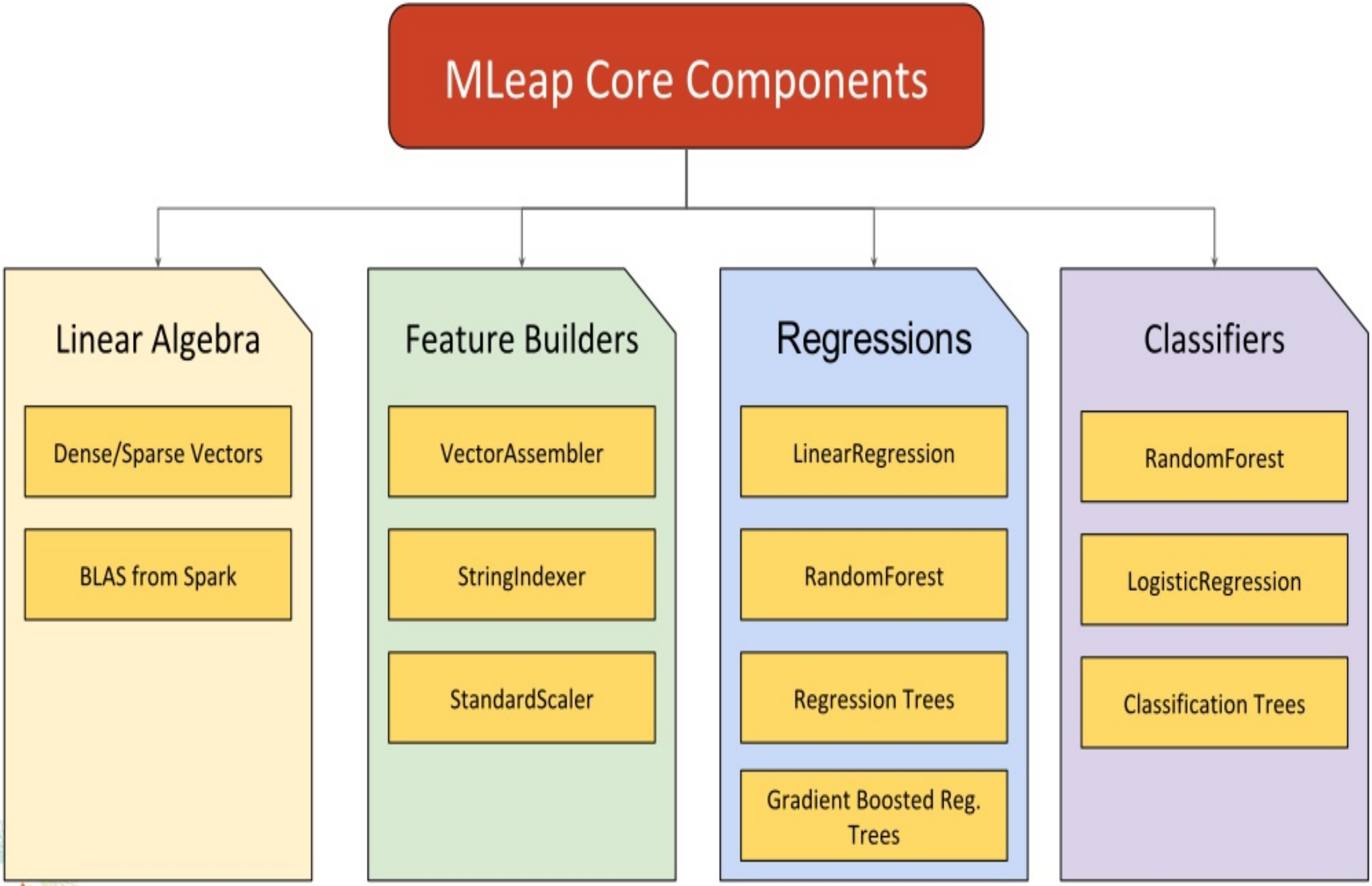
Lesson Learned: Push code down to where the data is, not the other way around!

MLeap Components

- core - provides linear algebra system, regression models, and feature builders
- runtime - provides DataFrame-like "LeapFrame" and transformers for it
- spark - provides easy conversion from Spark transformers to MLeap transformers
- serialization - common serialization format for Spark and MLeap (Bundle.ML)



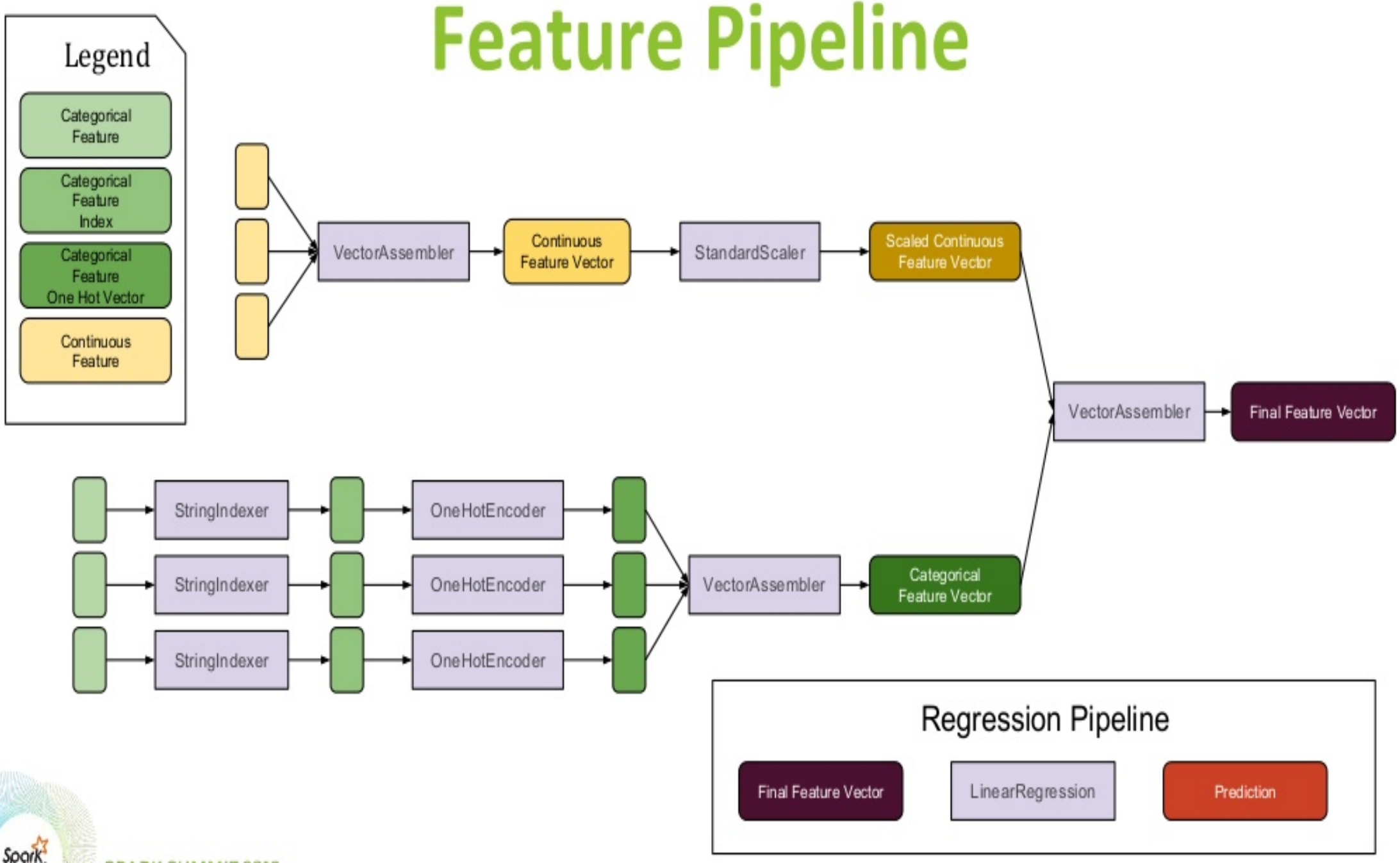
New features: expanded serialization formats to include both json and protobuf for large models (i.e. random forests with thousands of features)


MLeap Core Components
Linear Algebra
Dense/Sparse Vectors
BLAS from Spark
Feature Builders
VectorAssembler
StringIndexer
StandardScaler
Regressions
LinearRegression
RandomForest
Regression Trees
Gradient Boosted Reg. Trees
Classifiers
RandomForest
LogisticRegression
Classification Trees

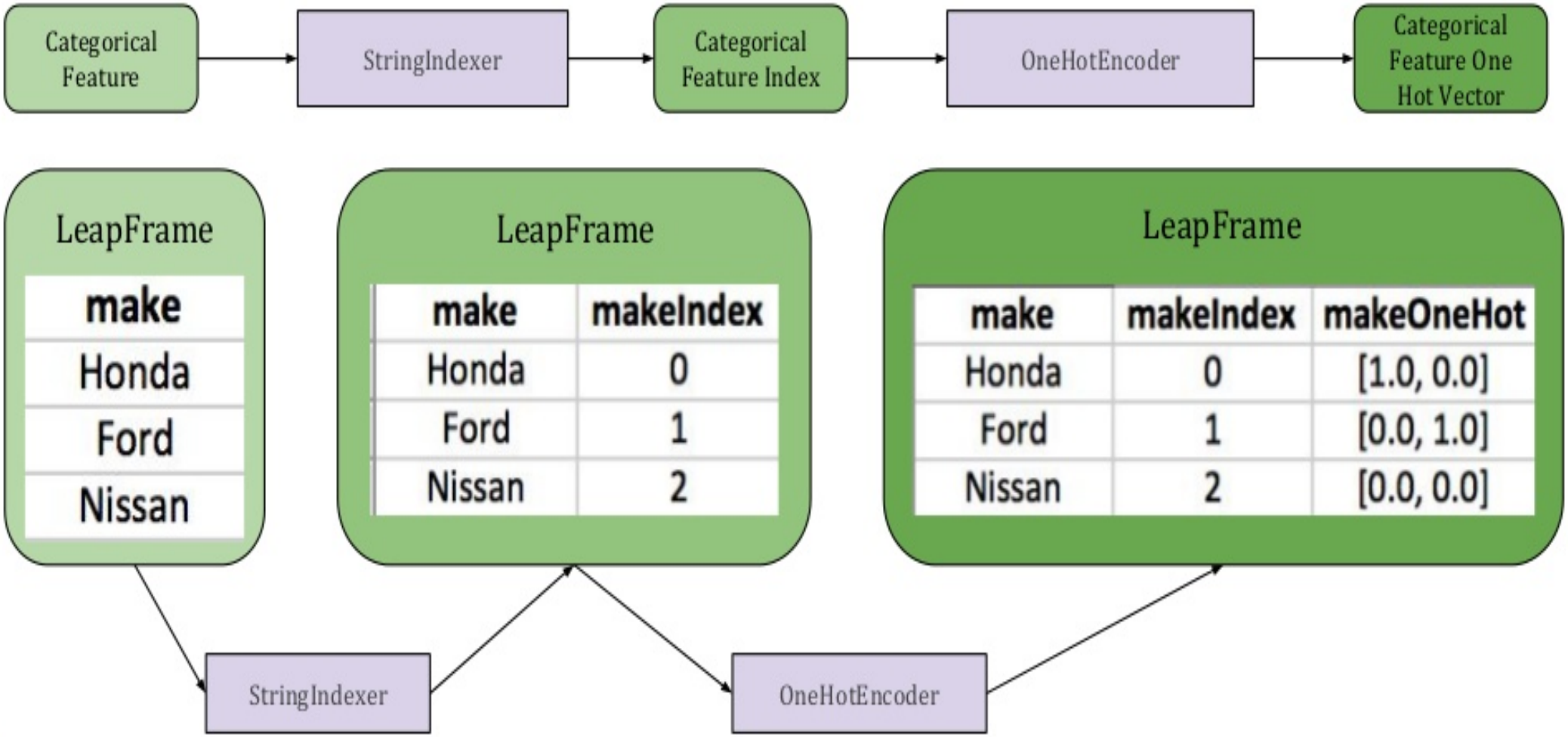
MLeap Runtime

- Provides LeapFrame, which stores data for transformations by MLeap transformers
- MLeap transformers use mleap-core building blocks to transform LeapFrame
- MLeap transformers correspond one-to-one with Spark transformers
- No dependencies on Spark


Feature Pipeline



Categorical Pipeline



MLeap Serialization (Bundle.ML)

- Provides common serialization for both Spark and MLeap
- 100% protobuf/JSON based for easy reading, compact data, and portability
- No dependencies on Parquet *
- Can be written to zip files, file system, HDFS, anywhere with an FS-like structure

String Indexer Model

```
{
  "type": "com.truecar.mleap.runtime.transformer.StringIndexerModel",
  "inputCol": "make",
  "outputCol": "makeIndex",
  "indexer": {
    "strings": ["Ford", "Nissan", "Honda"]
  }
}
```

Linear Regression Model

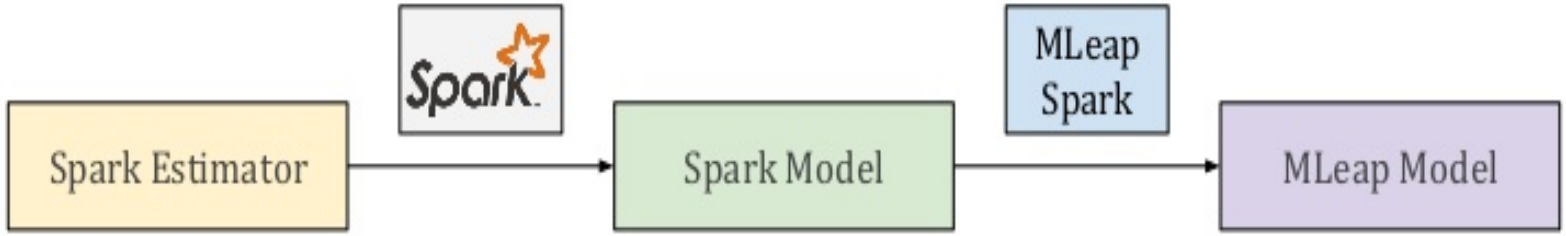
```
{
  "type": "com.truecar.mleap.runtime.transformer.LinearRegressionModel",
  "featuresCol": "features",
  "predictionCol": "listOverMsrpPrediction",
  "model": {
    "weights": [-0.060649238549871816, -0.008726825316488376, ...],
    "intercept": 0.360124036840183
  }
}
```

Linear Regression Model (Code)

```
case class LinearRegression(coefficients: Vector,
                            intercept: Double) extends Serializable {
  def apply(features: Vector): Double = {
    features.toBreeze.dot(coefficients.toBreeze) + intercept
  }
}
```

MLeap Spark

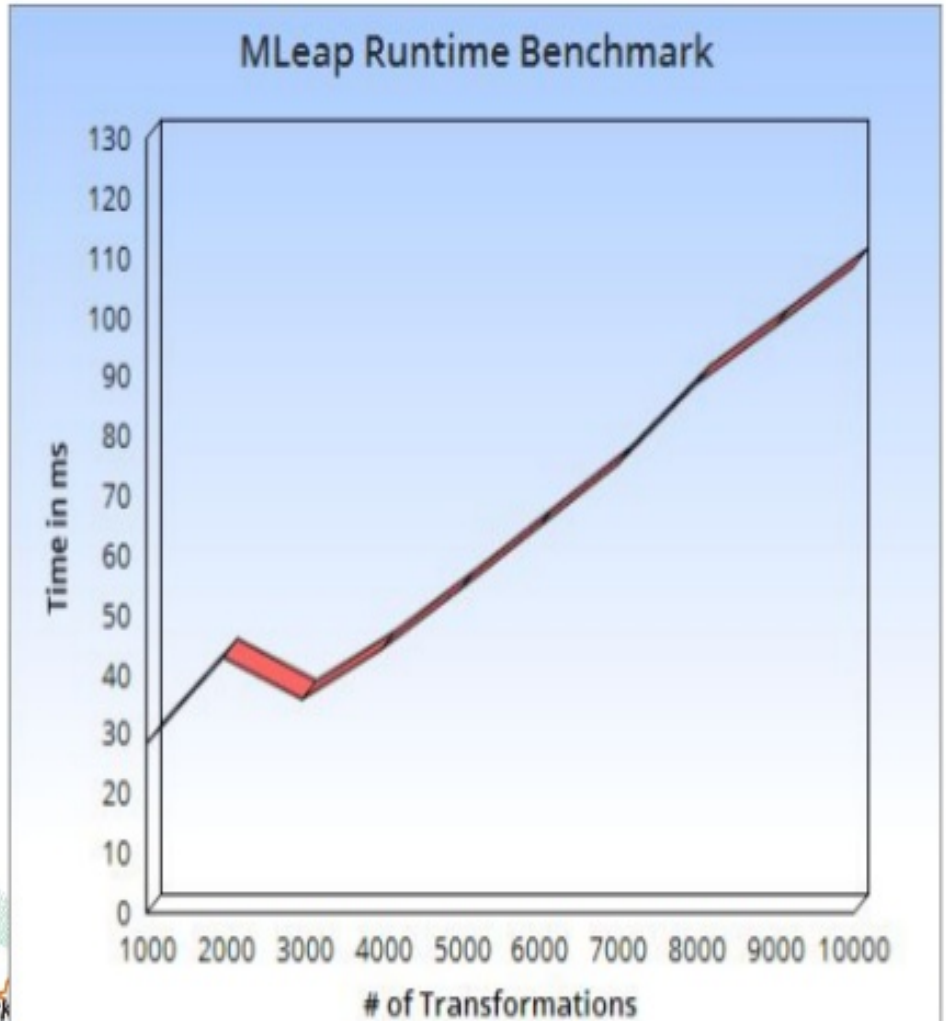
- Train an ML pipeline with Spark then export it to MLeap



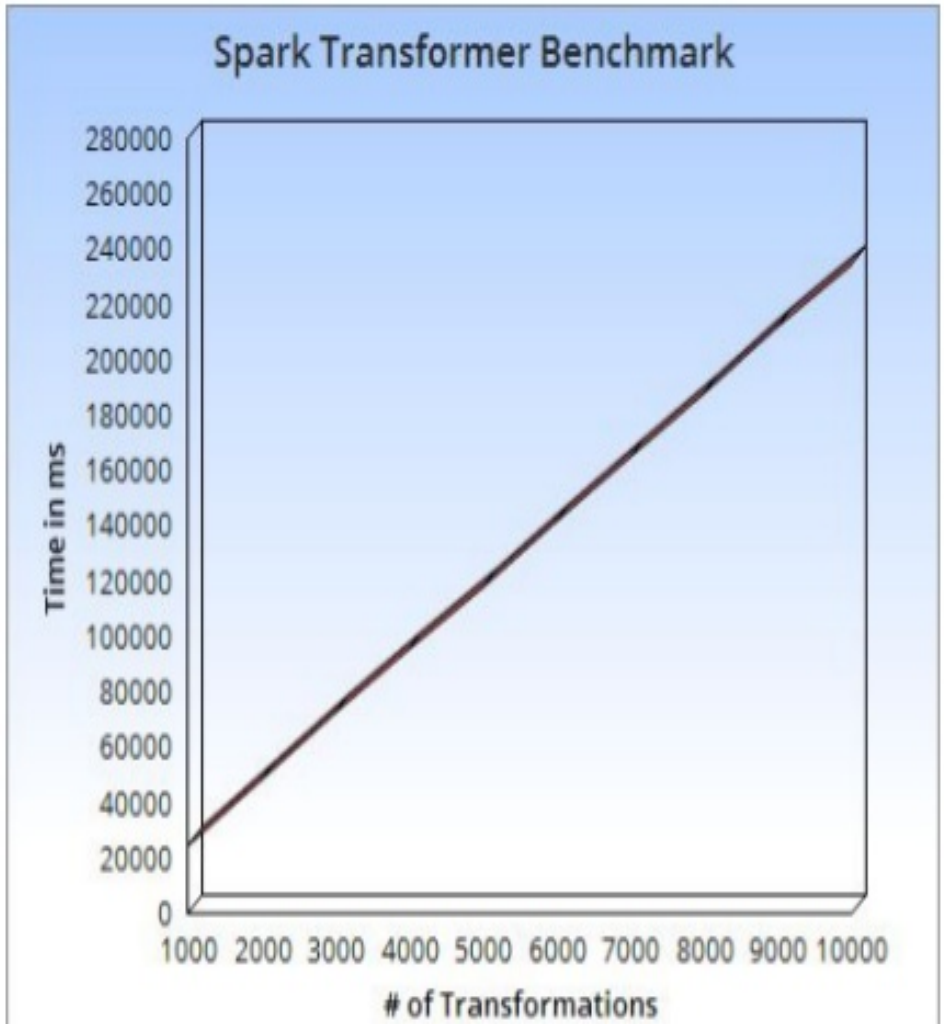
- Execute an MLeap pipeline against a Spark DataFrame

Benchmarks

MLeap: **0.011ms**/transform



Spark: **23.4ms**/transform



MLeap Demo

- Train a sample Airbnb listing price model using linear regression and random forest against some AirBnb training data
- Deploy both models to a local API server
- Get real-time results
- IN UNDER 5 MINUTES!

Future of MLeap

- Unify linear algebra and core libraries with Spark
- Python/R interface (6 months)
- Deploy easily to embedded systems and outside of JVM (1 year)
- Full support for all Spark transformers

Combust.ML Overview

- Provides a scalable scala-based API server, tuned specifically for MLeap models
- Public interface to drop-in data and deploy restful services
- Feedback loops for verifying model accuracy
- Feature vector definitions for researchers and engineers

Thank Yous

Spark Saturday - Capital One, D.C.

Roaring Elephant Podcast, Netherlands

Hadoop Summit - Dublin, IR

Spark Summit West - New York, NY

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THANK YOU.

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