MLeap + Combust.ML

Deploy Your Spark Pipelines Directly To Production

Github: https://github.com/combust-ml/mleap

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Combust.ML

SPARK SUMMIT
EUROPE 2016

Opening Demo

How much should I rent my house for on AirBnb?

```
http://combust.ml/airbnb
```

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

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.

Outdated Research <> Engineering Dynamics

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

Hadoop and HDFS helped bridge the data gap.

Spark has bridged the language gap, by providing a common set of APIs to easly process data and train models

MLeap and Combust.ML extend Spark functionality by allowing researchers and engineers to deploy pipelines as a service

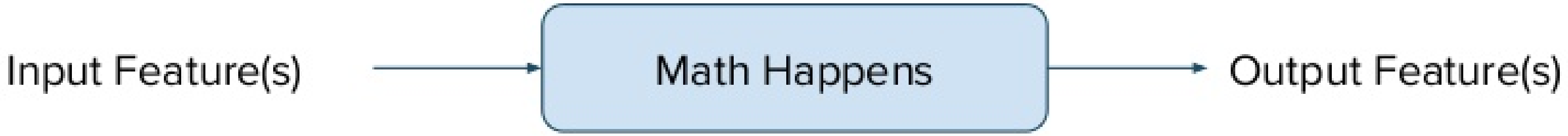
Existing Solutions: You won’t believe how many companies are still deploying algorithms in a SQL environment! And these are billion dollar operations.

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

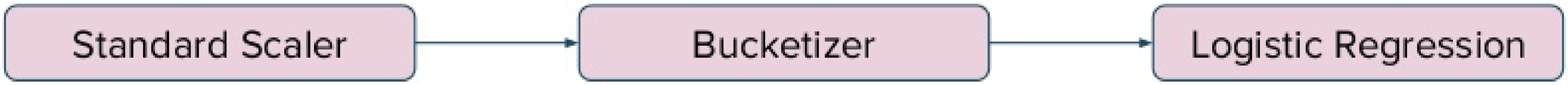
Lesson Learned: Push code down to where the data is, not the other way around!

Overview of Pipelines and Transformers

A Transformer generates a new feature or a vector of features based on an input or a vector of inputs. Some transformers need to be trained, while others are basic algebraic functions.

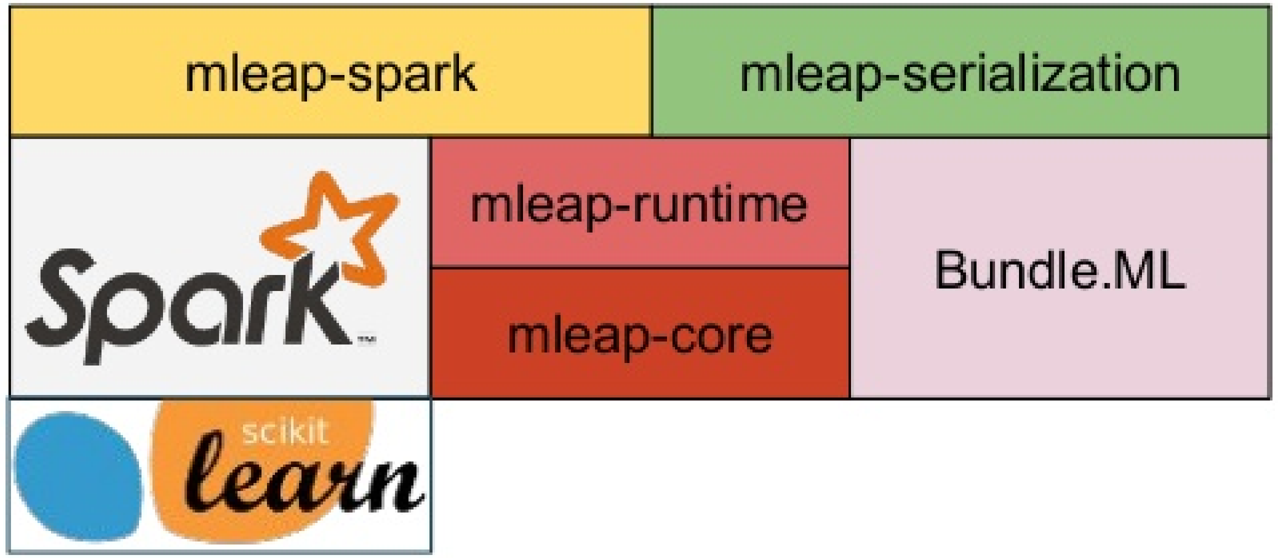


Pipelines piece together a series of transformers and generally start with feature transformers and end with a model transformer (your algorithm).



MLeap Components

- mleap-core - feature builders, regression models, classification models, clustering models, ANN
- mleap-runtime - provides DataFrame-like "LeapFrame" and MLeap transformers
- mleap-spark - serialize to Bundle.ML, execute MLeap transformers on Spark dataframes
- bundle-ml - common serialization format for Spark, MLeap, Scikit-Learn, TensorFlow
- mleap-scikit - MLeap <> Scikit-Learn transformers integration



mleap-spark

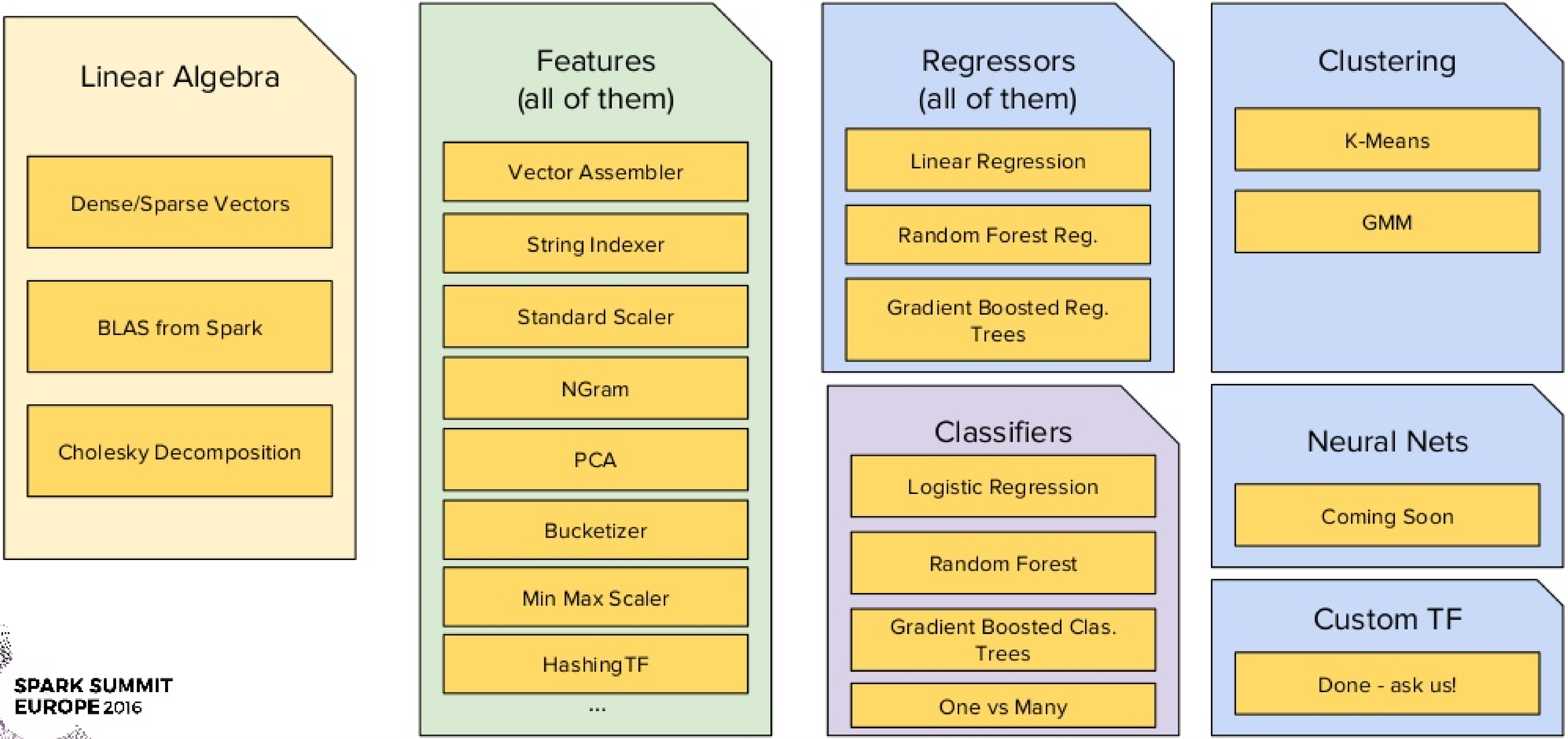
mleap-serialization

mleap-runtime

mleap-core

Bundle.ML

MLeap Core Components



Linear Algebra

- Dense/Sparse Vectors
- BLAS from Spark
- Cholesky Decomposition

Features (all of them)

- Vector Assembler
- String Indexer
- Standard Scaler
- NGram
- PCA
- Bucketizer
- Min Max Scaler
- HashingTF
- ...

Regressors (all of them)

- Linear Regression
- Random Forest Reg.
- Gradient Boosted Reg. Trees

Classifiers

- Logistic Regression
- Random Forest
- Gradient Boosted Clas. Trees
- One vs Many

Clustering

- K-Means
- GMM

Neural Nets

- Coming Soon

Custom TF

- Done - ask us!

MLeap Runtime

Power and functionality of Spark Transformers without the dependency on the Spark context. Deploy anywhere!

- Provides a LeapFrame, which stores data for transformations by MLeap transformers, which mirror the transform functionality of Spark transformers
- MLeap transformers correspond one-to-one with Spark transformers
- No dependencies on Spark
- Can implement custom transformers and serialization with a few classes worth of code

MLeap TransformBuilder

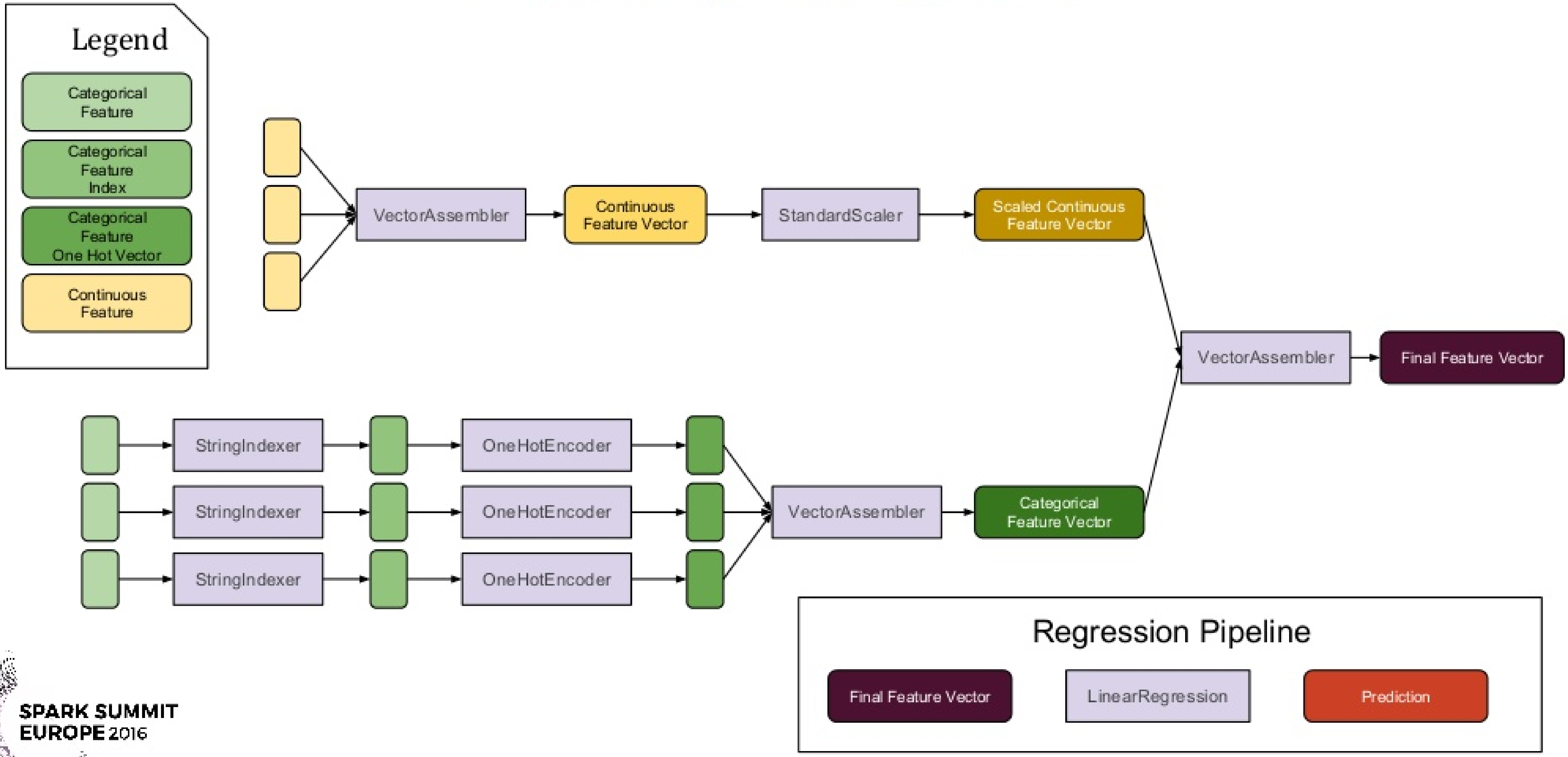
A **TransformBuilder** is used by **Mleap Transformer**s to transform an arbitrary context. The context can be:

1. **A LeapFrame**, this will immediately transform the LeapFrame using a transformer pipeline

2. **A Spark DataFrame**, this will convert Mleap UDFs from Mleap Transformers to Spark UDFs used to transform the Spark DataFrame

3. **A TransformCompiler**, this is a planned feature to allow compilation of your pipeline for ultra-fast execution on our model servers and **C libraries**

Demo Pipeline Upclose



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Serialize to Bundle.ML

The goal of MLeap and Bundle.ML is to let you serialize and deserialize your entire pipeline and not just the algorithm portion.

- Provides common serialization for both Spark and MLeap transformers
- 100% protobuf/JSON based for easy reading, compact data, and portability
- Store as a zip file for easy transport
- Scikit-Learn Support (In Development): Scikit and Spark share a common set of transformers and models already, and are both focused on transformer-based pipelines. The goal is to build a common serialization format between the two.

MLeap Spark

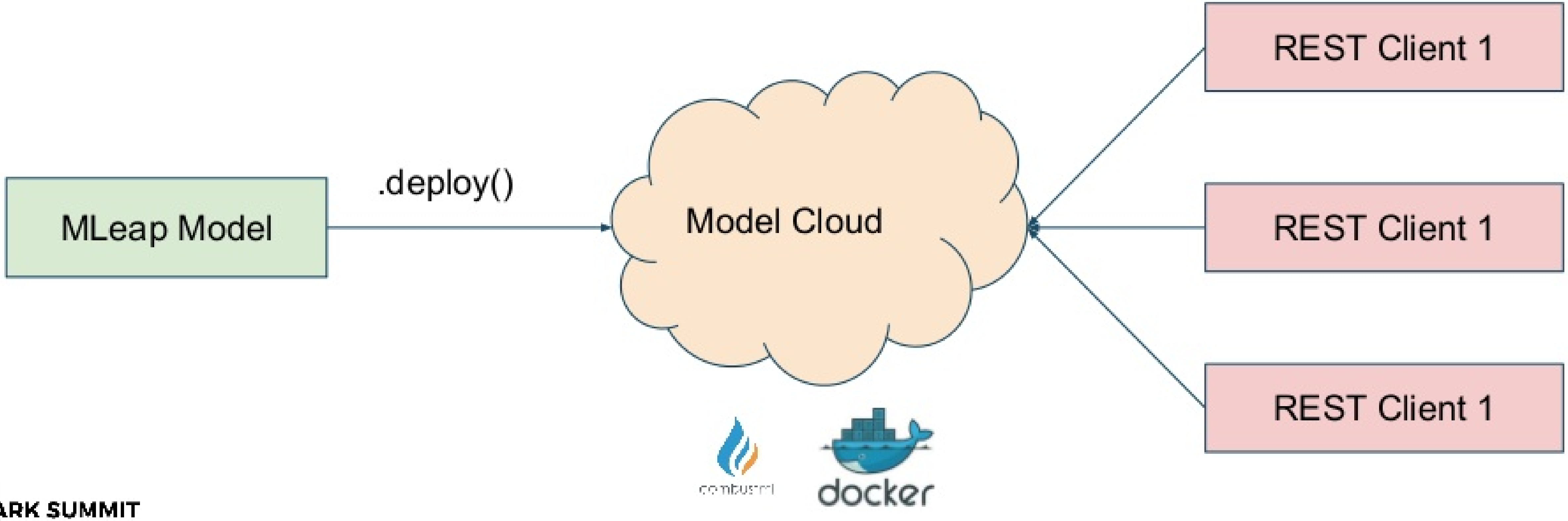
MLeap-Spark provides serialization of spark ml piplines to/from Bundle.ML

- Provides several extensions and modifications to Spark transformers
  - SVM - Support Vector Machine estimator/model (uses MLlib)
  - OneHotEncoder - Custom implementation to get around Spark's reliance on metadata
  - OneVsRest - Custom implementation to allow output of probabilities

- Allows execution of Mleap Transformers on Spark DataFrames

Combust Model Cloud

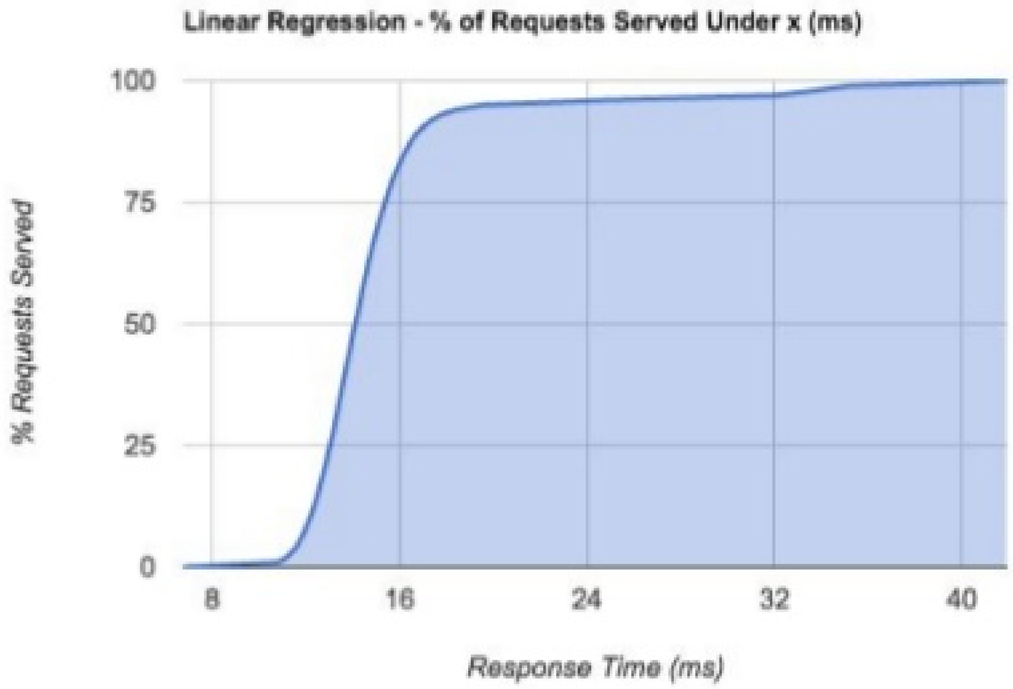
Provides **RESTful** endpoints to your **MLeap models**. Highly-optimized for throughput. **14ms** average response time for the example pipeline, can be optimized even further for serialization of LeapFrames across the network.



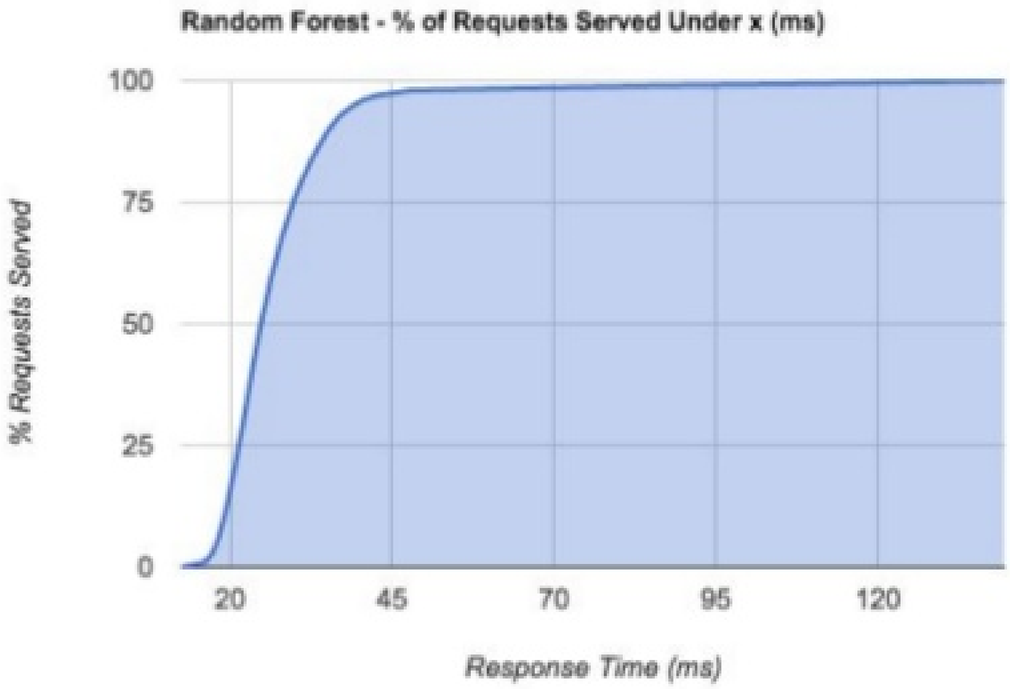
Benchmarks: Combust.ml Model Server

MacBook Pro, Uncompiled Models, JSON Serialization, Airbnb Models

Linear Regression (14ms)



Random Forest Regression (24ms)



combuts.ml Overview

combust.ml is built on (soon-to-be) **open-sourced** API servers, optimized for executing MLeap pipelines from Spark, Scikit-Learn transformers

1. Public hosting for trying combust services, deploy limited number of models, no support for custom transformers
2. Private hosting allows for automatic model scaling, custom transformers, non-public REST servers, compile models to C libraries, scaling with mesos on AWS or private data center
3. Training platform for non-technical audiences

Train **Store** **Deploy**

Future of MLeap

- Complete set of Spark/Scikit-Learn Transformers
- Unify core model libraries with Spark
- Python interface for PySpark users (export Spark pipelines)

THANK YOU.

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