Simplifying End-to-End Big Data AI

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Intel Fellow

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Agenda

- Big Data AI
- Building Big Data AI applications
- Summary

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Why Big Data AI?

Transformation of Big Data

- Storing and processing more data
- Analyzing (querying) more data
- Real-time analysis
- Modelling and prediction (ML/DL)

AI is everywhere

- Moving from experimentation to production
- Applying to large-scale, distributed Big Data
- End-to-end AI pipeline

End-to-End AI Pipeline

Growing Demand for End-to-End Big Data AI Pipeline

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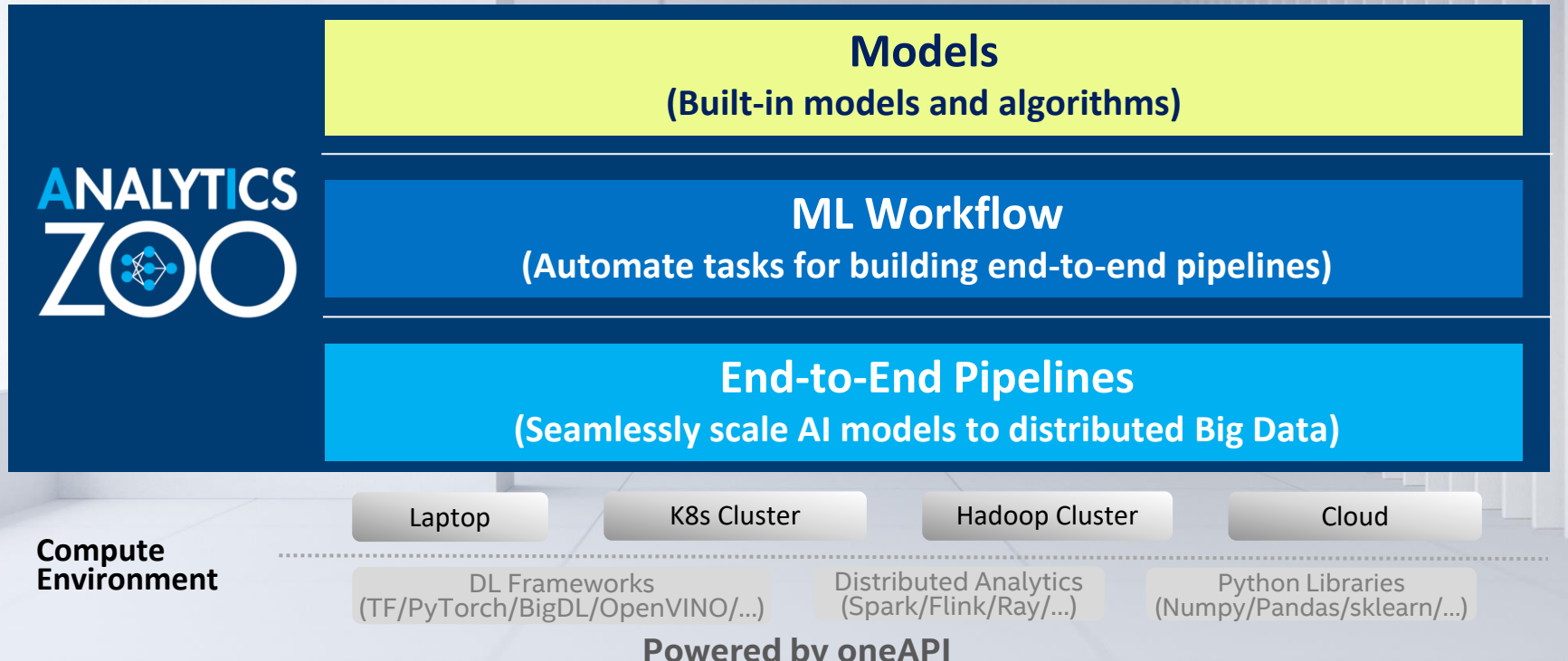
Analytics Zoo: Software Platform for Big Data AI



https://github.com/intel-analytics/analytics-zoo

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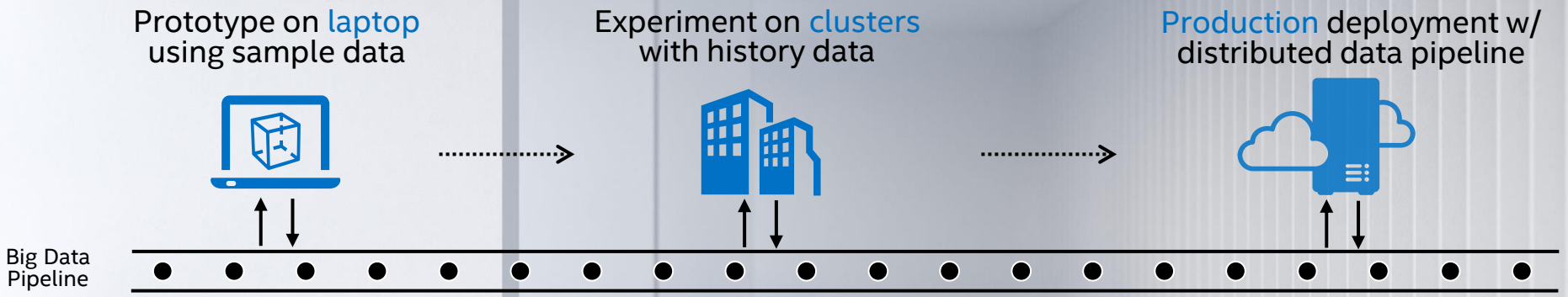
Analytics Zoo: End-to-End Big Data AI

Seamless Scaling from Laptop to Distributed Big Data



- Easily prototype end-to-end pipelines that apply AI models to big data
- "Zero" code change from laptop to distributed cluster
- Seamlessly deployed on production Hadoop/K8s clusters
- Automate the process of applying machine learning to big data

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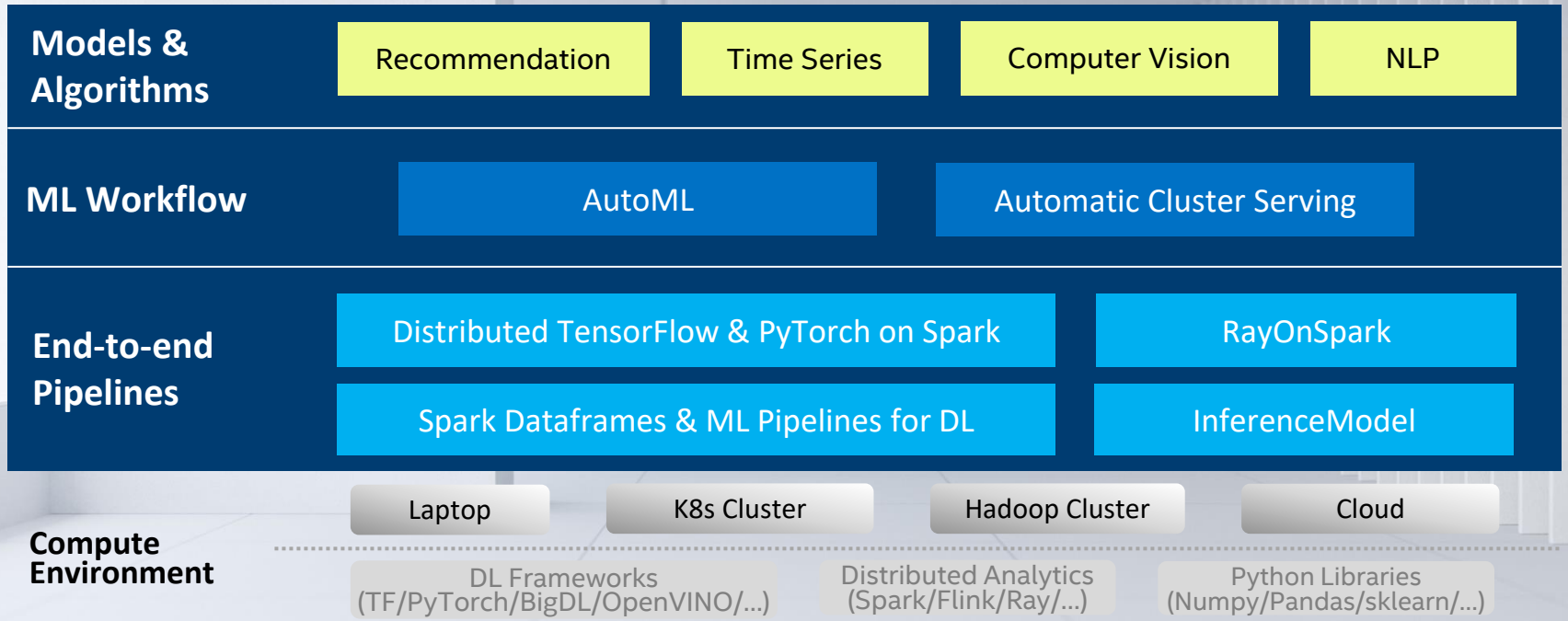
Analytics Zoo: Software Platform for Big Data AI



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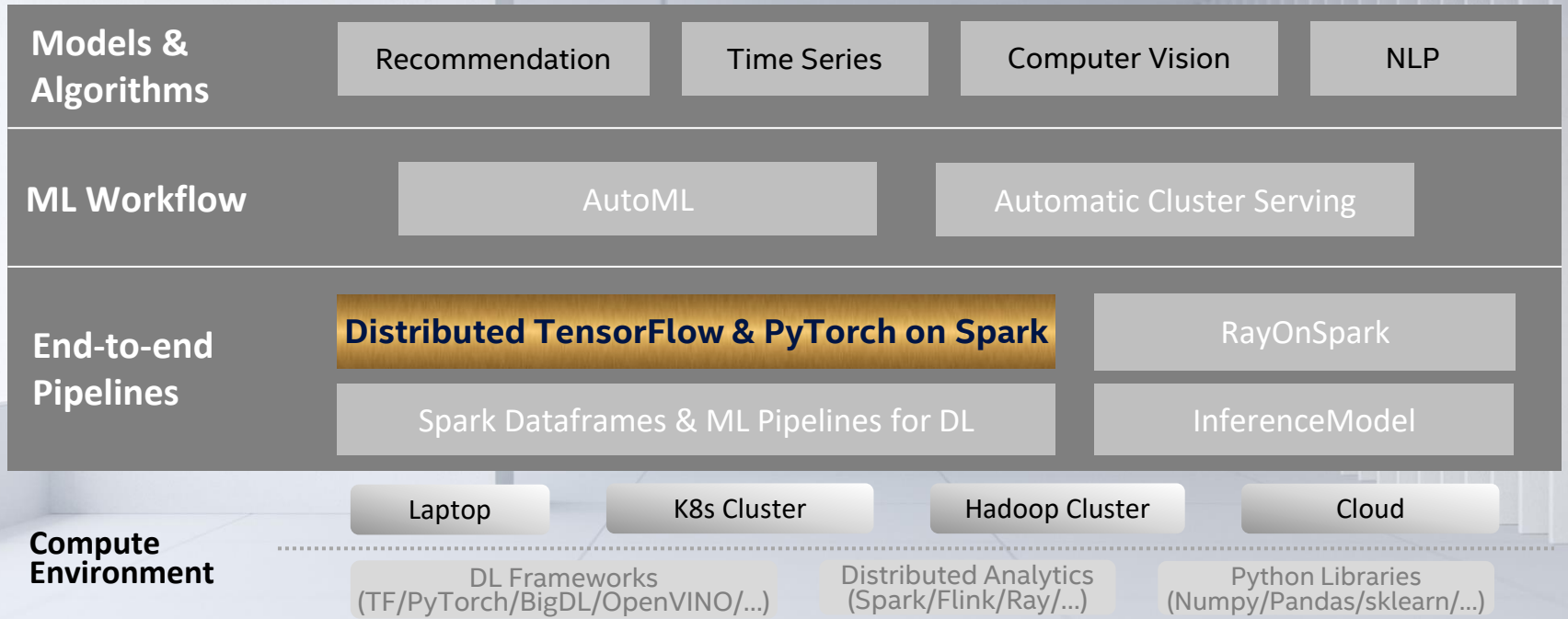
Analytics Zoo: Software Platform for Big Data AI



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https://github.com/intel-analytics/analytics-zoo

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Distributed TensorFlow/PyTorch on Spark

Write TensorFlow/PyTorch inline with Spark code

```
#spark dataframe
train_df = spark.read.parquet(…).select(…)

#tensorflow code
from tensorflow import keras
...
model = keras.models.Model(inputs=[user, item], outputs=predictions)
model.compile(…)

#distributed training on Spark
from zoo.orca.learn.tf.estimator import Estimator
est = Estimator.from_keras(keras_model=model, …)
est.fit(data=train_df,
        feature_cols=['user', 'item'],
        label_cols=['label'],
        …)
```

Analytics Zoo API in blue

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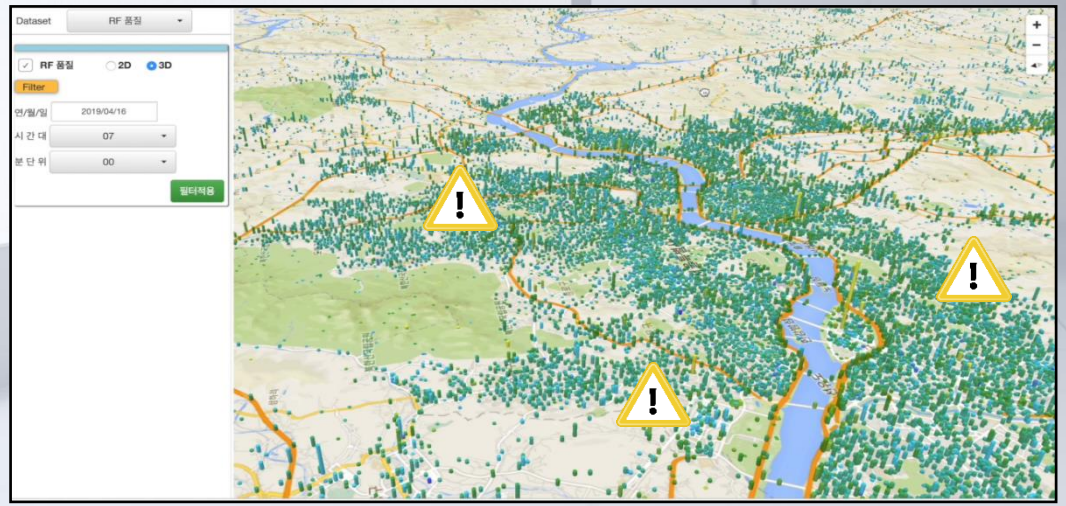
Time-Series Network Quality Prediction in SK Telecom

Distributed TensorFlow/PyTorch on Spark

- Predict Network Quality Indicators (CQI, RSRP, RSRQ, SINR, …)* for anomaly detection and real-time management



** CQI : Channel Quality Indicator*
** RSRP : Reference Signal Received Power*
** RSRQ : Reference Signal Received Quality*
** SINR :Signal to Interference Noise Ratio*

* "Vectorized Deep Learning Acceleration from Preprocessing to Inference and Training on Apache Spark in SK Telecom", Spark + AI Summit 2020
* https://networkbuilders.intel.com/solutionslibrary/sk-telecom-intel-build-ai-pipeline-to-improve-network-quality

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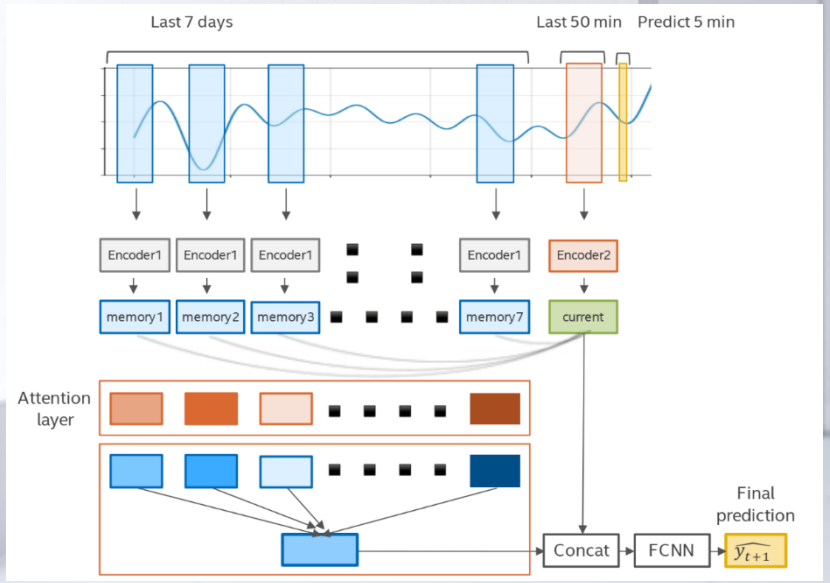
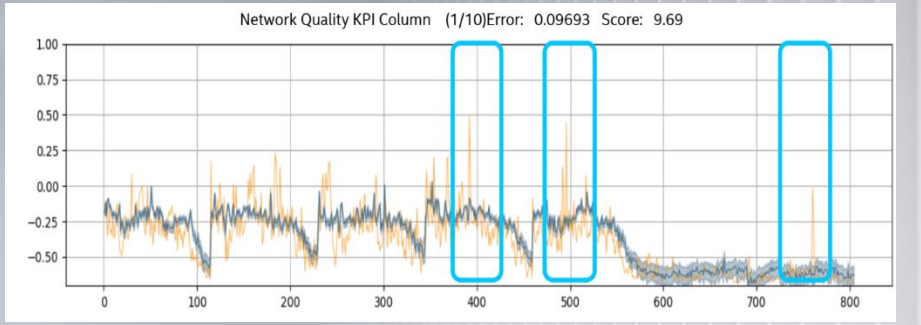
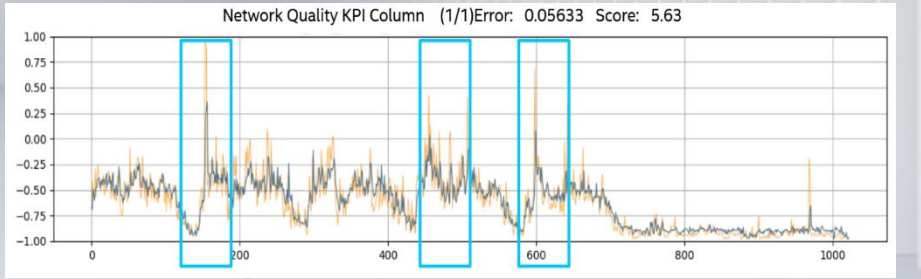
Model: Memory Augmented Network



seq2seq



Mem-network



Improved predictions for sudden change!

https://networkbuilders.intel.com/solutionslibrary/sk-telecom-intel-build-ai-pipeline-to-improve-network-quality

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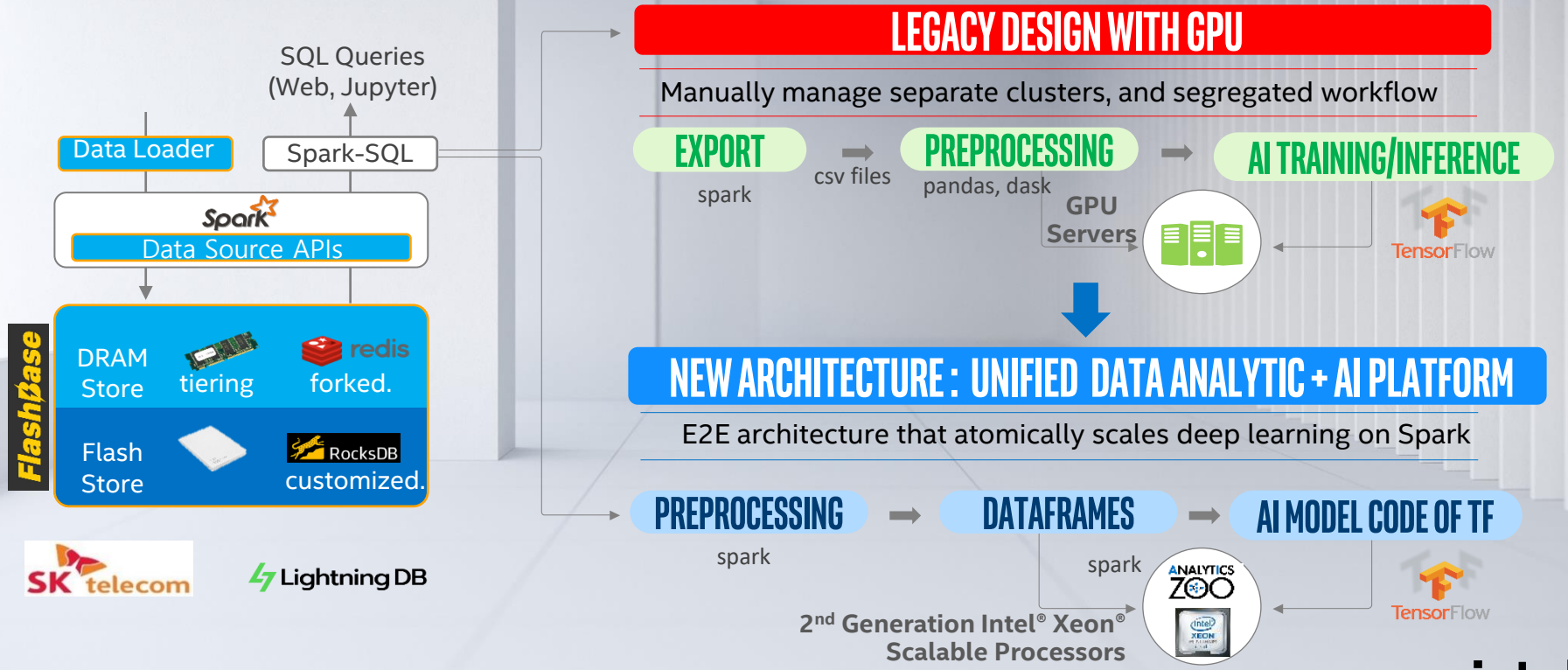
Architecture: Migrating to Analytics Zoo

Distributed TensorFlow/PyTorch on Spark



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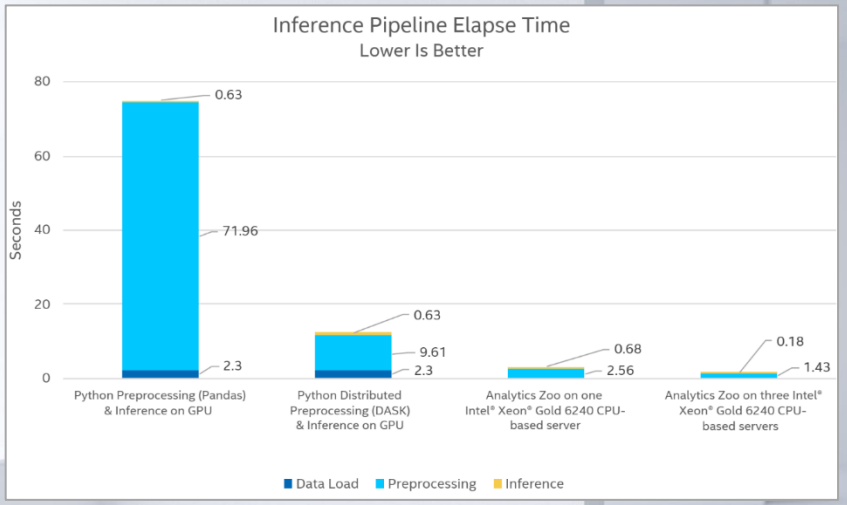
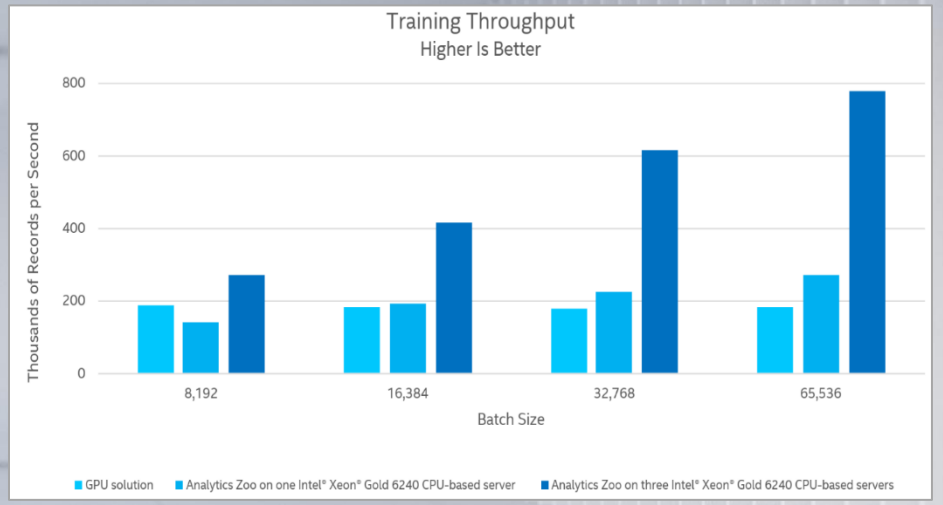
Inference and Training Speed-up with Analytics Zoo





Up-to 6x speedup for end-to-end inference running Analytics Zoo on Xeon in SK Telecom*

Up-to 4x speedup for end-to-end training running Analytics Zoo on Xeon in SK Telecom*

* https://networkbuilders.intel.com/solutionslibrary/sk-telecom-intel-build-ai-pipeline-to-improve-network-quality

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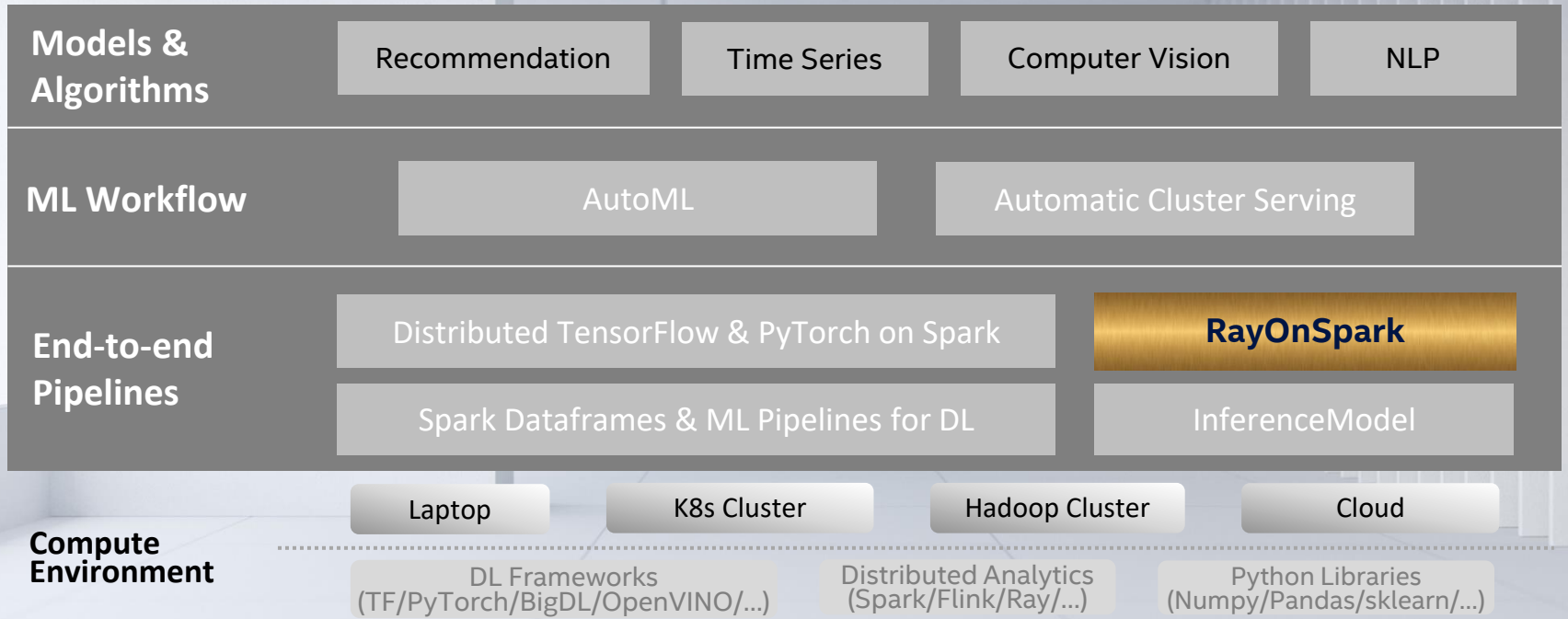
Analytics Zoo: Software Platform for Big Data AI



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https://github.com/intel-analytics/analytics-zoo

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RayOnSpark

Run Ray Programs Directly on Big Data Platform

```
from zoo.orca import init_orca_context, stop_orca_context

init_orca_context(cluster_mode="yarn", …, init_ray_on_spark=True)

#Ray code
@ray.remote
class TestRay():
    def hostname(self):
        import socket
        return socket.gethostname()

actors = [TestRay.remote() for i in range(0, 100)]
print([ray.get(actor.hostname.remote()) for actor in actors])

stop_orca_context()
```

https://medium.com/riselab/rayonspark-running-emerging-ai-applications-on-big-data-clusters-with-ray-and-analytics-zoo-923e0136ed6a

Analytics Zoo API in blue

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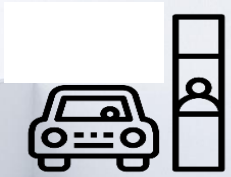
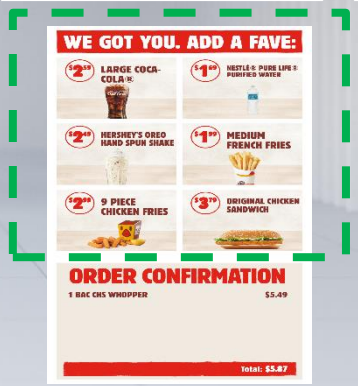
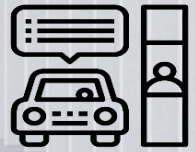
Fast Food Recommendation in Burger King

End-to-End Training Pipeline w/ RayOnSpark

Guest arrives ODMB → Checks Menu Board → Cashier enters order → Checks Menu Board → Guest completes order







* https://medium.com/riselab/context-aware-fast-food-recommendation-at-burger-king-with-rayonspark-2e7a6009dd2d
* *"Context-aware Fast Food Recommendation with Ray on Apache Spark at Burger King", Data + AI Summit Europe 2020*

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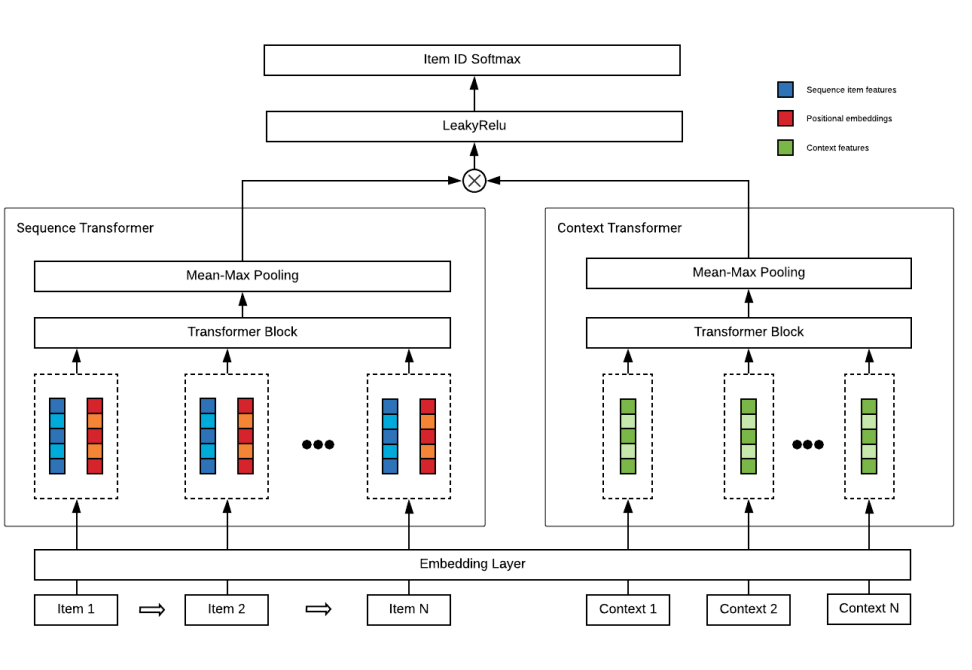
Model: Transformer Cross Transformer (TxT) Model



Model Components

- **Sequence Transformer**
  - Taking item order sequence as input
- **Context Transformer**
  - Taking multiple context features as input
- **Latent Cross Joint Training**
  - Element-wise product for both transformer outputs

* https://medium.com/riselab/context-aware-fast-food-recommendation-at-burger-king-with-rayonspark-2e7a6009dd2d
* *"Context-aware Fast Food Recommendation with Ray on Apache Spark at Burger King", Data + AI Summit Europe 2020*

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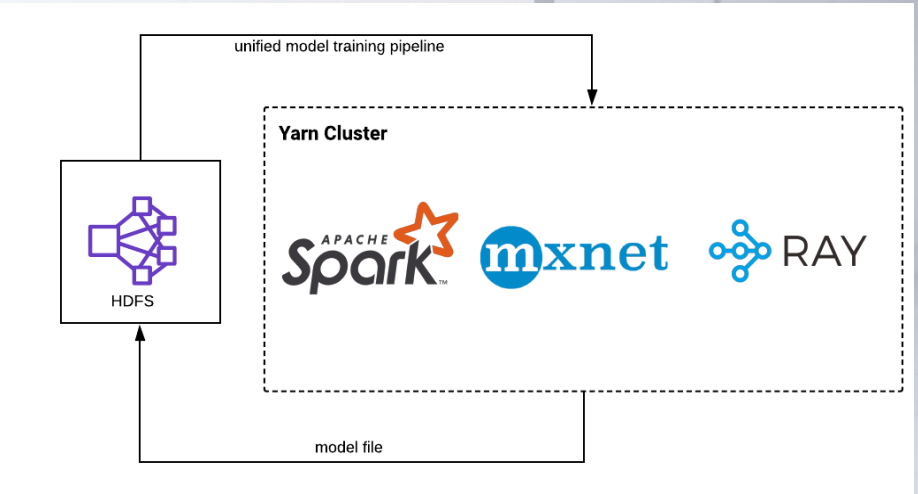
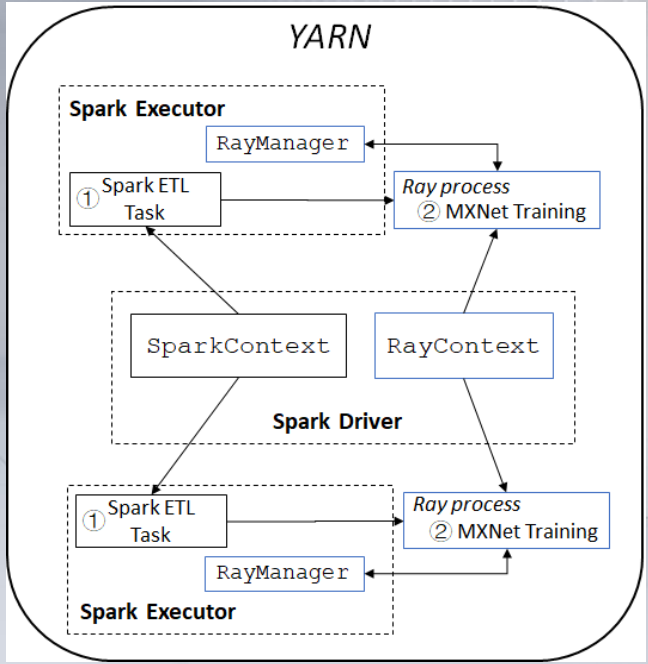
Architecture: Unified Data Processing and Training

End-to-End Pipeline w/ RayOnSpark





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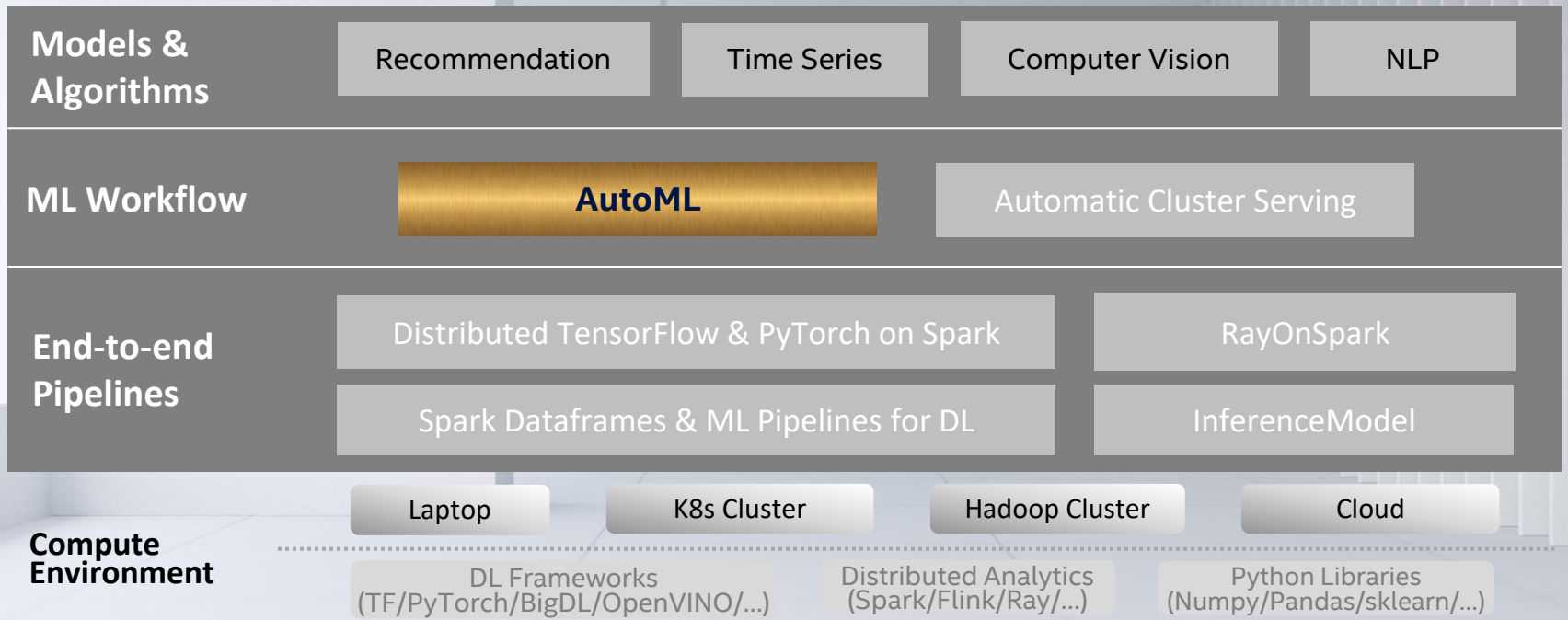
Analytics Zoo: Software Platform for Big Data AI



https://github.com/intel-analytics/analytics-zoo

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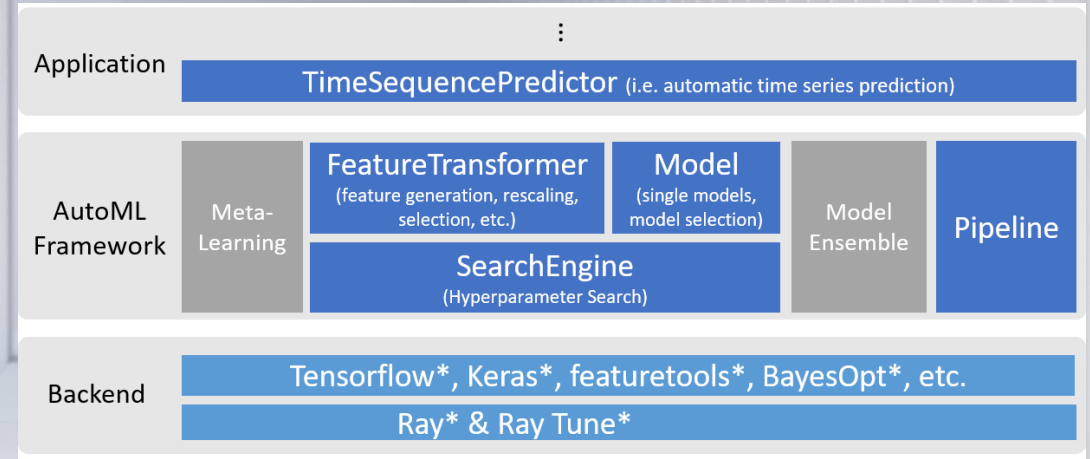
Scalable AutoML for Time Series Prediction

Automated feature generation, model selection and hyper parameter tuning

```
tsp = TimeSequencePredictor( \
            dt_col="datetime",
            target_col="value")

pipeline = tsp.fit(train_df,
             val_df, metric="mse",
             recipe=RandomRecipe())

pipeline.predict(test_df)
```



https://medium.com/riselab/scalable-automl-for-time-series-prediction-using-ray-and-analytics-zoo-b79a6fd08139

Analytics Zoo API in blue

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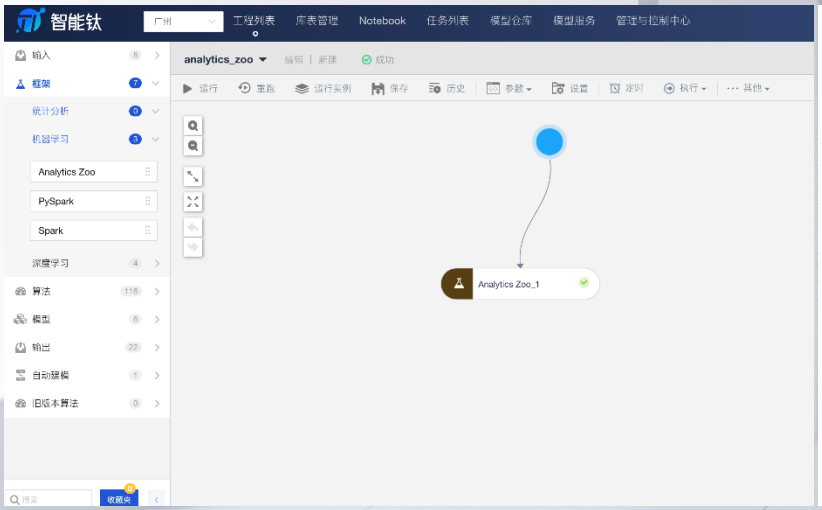
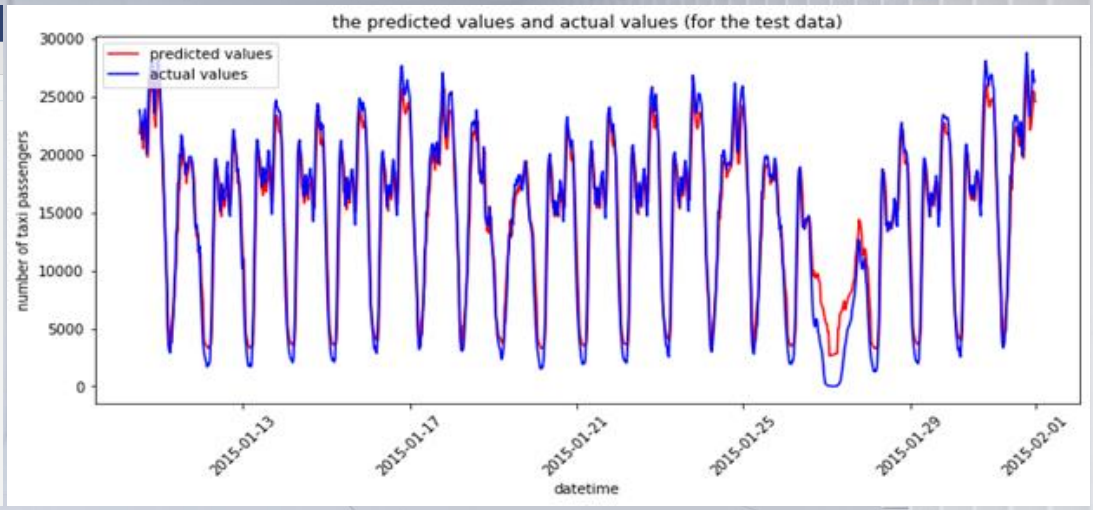
TI-One ML Platform in Tencent Cloud

Scalable AutoML for Time Series Prediction



Using Analytics Zoo in Tencent Cloud TI-One ML Platform



Predicting NYC Taxi Passengers Using AutoML

https://software.intel.com/content/www/us/en/develop/articles/tencent-cloud-leverages-analytics-zoo-to-improve-performance-of-ti-one-ml-platform.html

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Summary

INDUSTRY INFLECTIONS ARE FUELING THE GROWTH OF DATA

5G Network Transformation, Artificial Intelligence, Intelligent Edge, Cloudification

AI & ANALYTICS ARE THE DEFINING WORKLOADS OF THE NEXT DECADE

with growing demand for end-to-end AI pipeline

UNMATCHED PORTFOLIO BREADTH AND ECOSYSTEM SUPPORT

Intel delivers a silicon & software foundation designed for the diverse range of use cases from the cloud to the edge

ANALYTICS ZOO OPEN-SOURCE SOFTWARE PLATFORM FOR BIG DATA AI

Simplifies End-to-End Big Data AI pipeline solutions development

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Reference

Analytics Zoo: Software Platform for Big Data AI

- E2E Big Data & AI pipeline (distributed TF/PyTorch/OpenVINO/Ray on Spark)
- Advanced AI workflow (AutoML, Time-Series, Cluster Serving, etc.)

Github

- Project repo: https://github.com/intel-analytics/analytics-zoo

  Documentation: https://analytics-zoo.readthedocs.io/
- Use cases: https://analytics-zoo.readthedocs.io/en/latest/doc/Application/powered-by.html

Technical paper/tutorials

- CVPR 2020 tutorial: https://jason-dai.github.io/cvpr2018/
- ACM SoCC 2019 paper: https://arxiv.org/abs/1804.05839
- AAAI 2019 tutorial: https://jason-dai.github.io/aaai2019/
- CVPR 2018 tutorial: https://jason-dai.github.io/cvpr2018/


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