Streaming Architecture for Predictive Modeling

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#whoami

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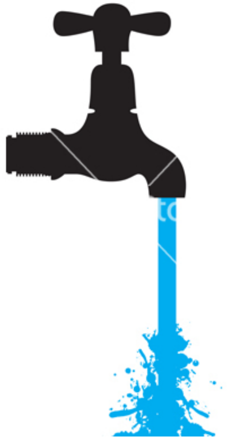
  - Fellow @ Insight Data Engineering
  - BS + MS in Systems Engineering @UVA

- Github Repo:
  - https://github.com/keiraqz/SparkModeling

Batch vs. Streaming

- Batch
  - Run a process in a scheduled way
  - Good for computation on huge amount of historical data
  - Complex analysis, hard to compute in real time

- Streaming
  - Continuous
  - “Life as it happens”: process data as it comes in
    - Traffic information
    - Heart beat monitoring
    - Capital One: double swipe



Task and Dataset

- Task: Predict Phishing website
  - e.g. Your password for x website is expiring, update at: http://abc.com/update
  - Predict if a website URL is a phishing website

- Phishing Websites Data Set
  - From UCI: https://archive.ics.uci.edu/ml/datasets/Phishing+Websites#
  - Extracted features + Labeled data points

Feature Selection

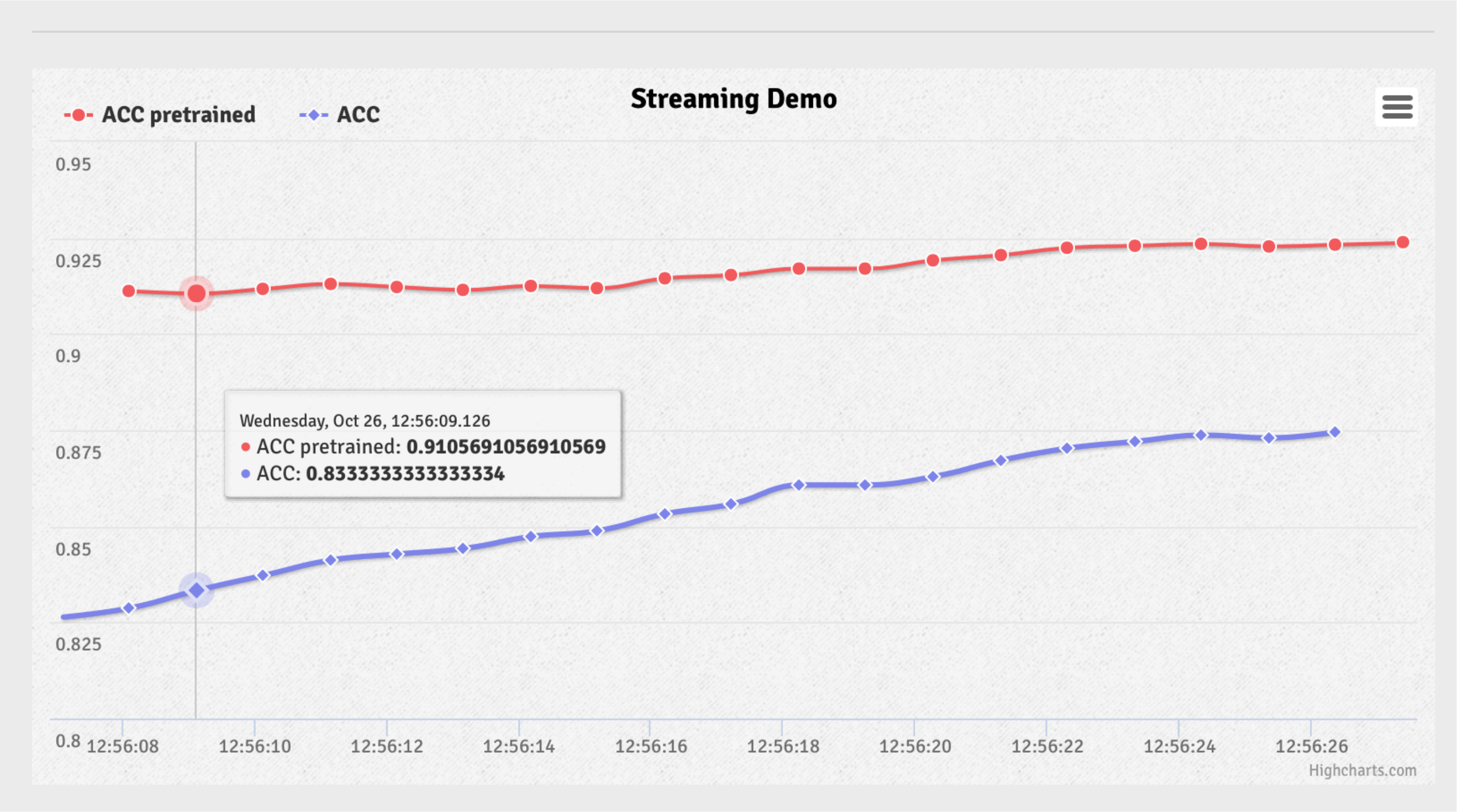
- Description provided in the dataset
- Some examples
  - Using URL Shortening Services “TinyURL”:
    - bit.ly/19DXSk4
  - Age of Domain:
    - minimum age of the legitimate domain is 6 months
  - Adding Prefix or Suffix Separated by (-) to the Domain:
    - http://www.confirme-paypal.com/

Train and Predict

	Pre-trained Model	Online Model Updating	Online Prediction
Method 1	YES	NO	YES
Method 2	NO	YES	YES
Method 3	YES	YES	YES

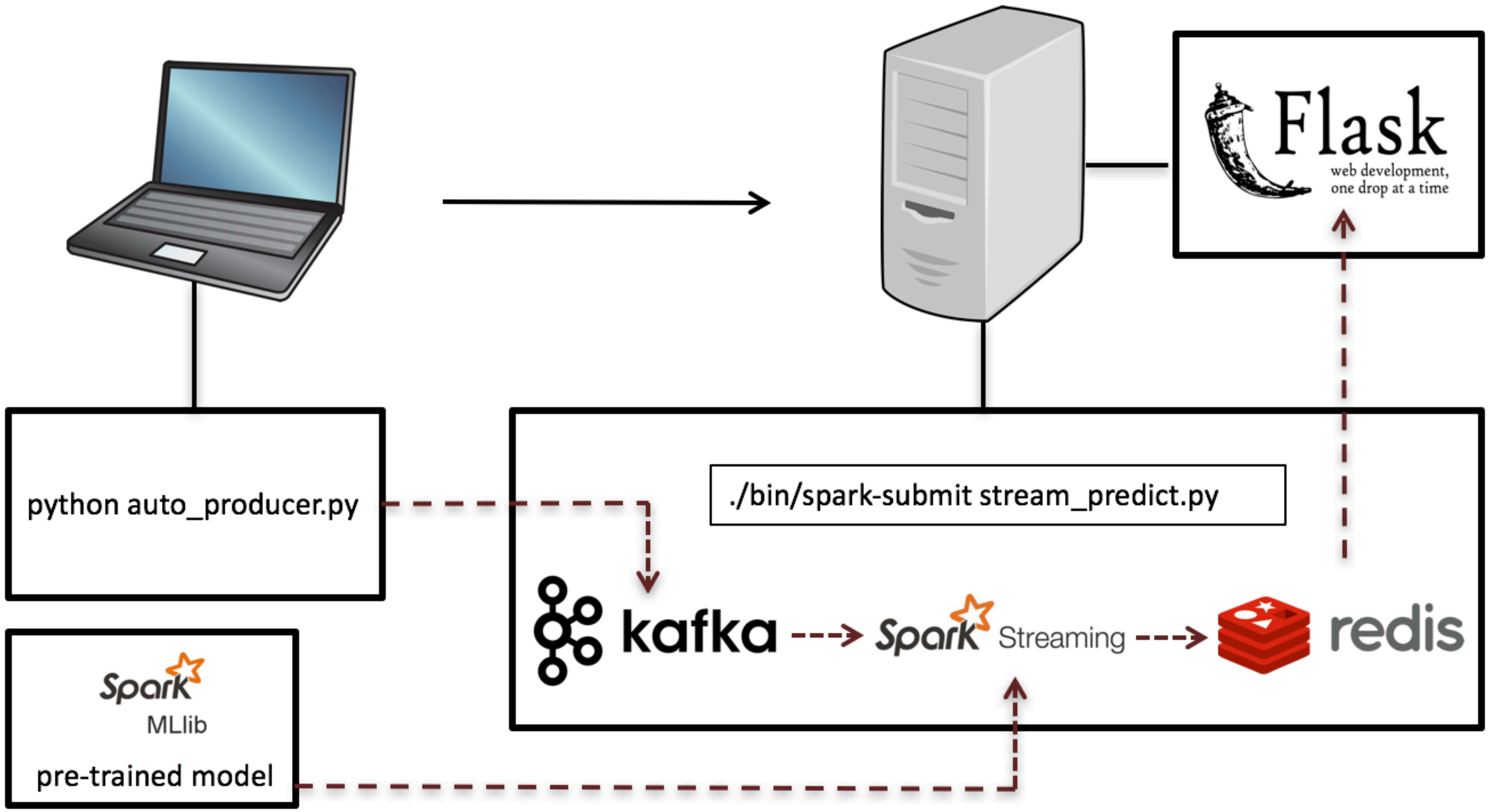
Demo: Method 2 & Method 3

Online updating with and without a pre-trained model



Wednesday, Oct 26, 12:56:09.126
- ACC pretrained: **0.9105691056910569**
- ACC: **0.8333333333333334**

Backend



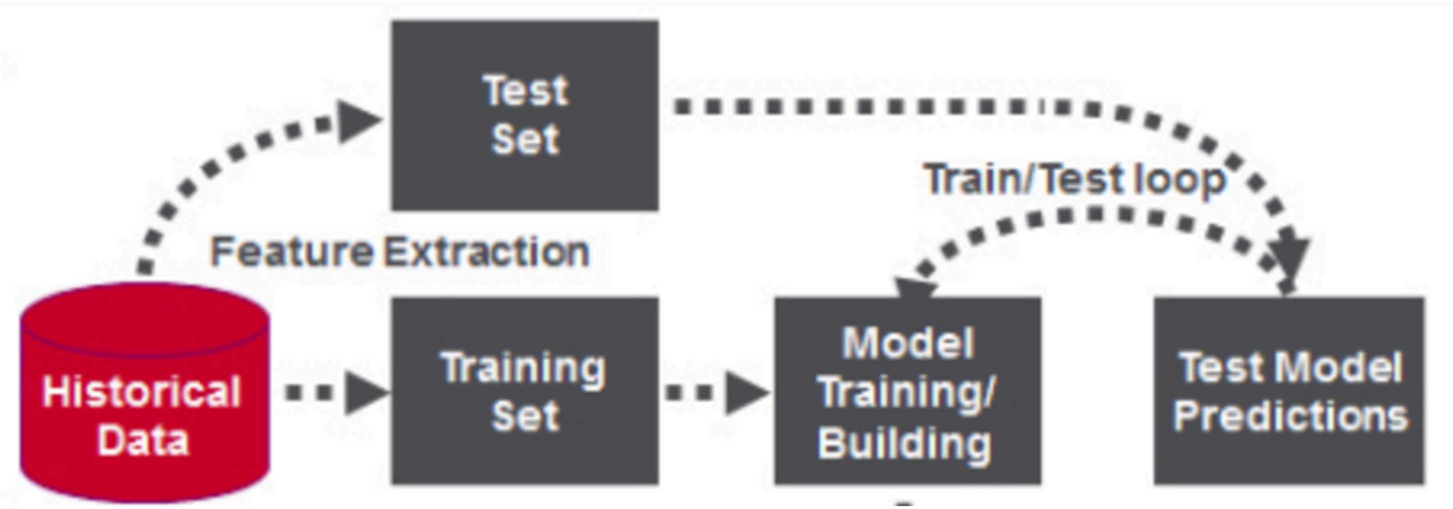
python auto_producer.py

./bin/spark-submit stream_predict.py

pre-trained model

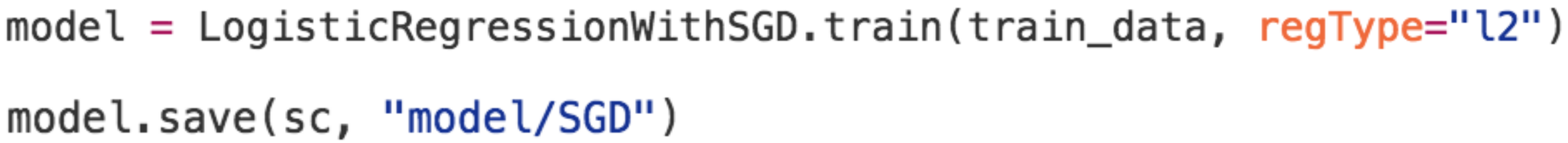
Train on Historical Data

- Classification problem
- Logistic Regression with Stochastic Gradient Descent



Code Snippet #1

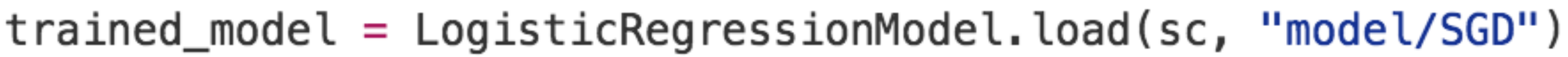
- Spark 2.0 feature: Save model to file



```
model = LogisticRegressionWithSGD.train(train_data, regType="l2")

model.save(sc, "model/SGD")
```

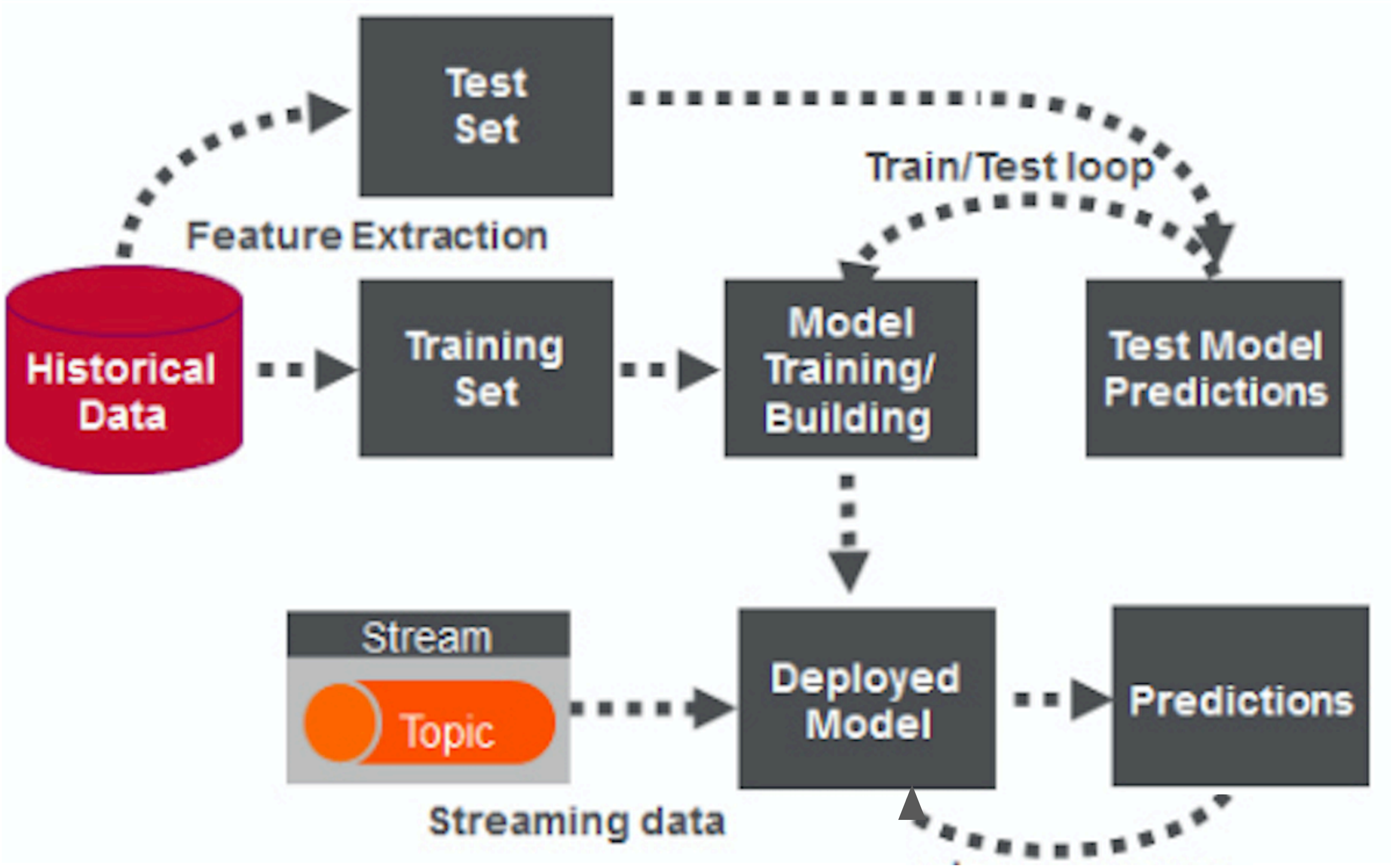
- Load model file



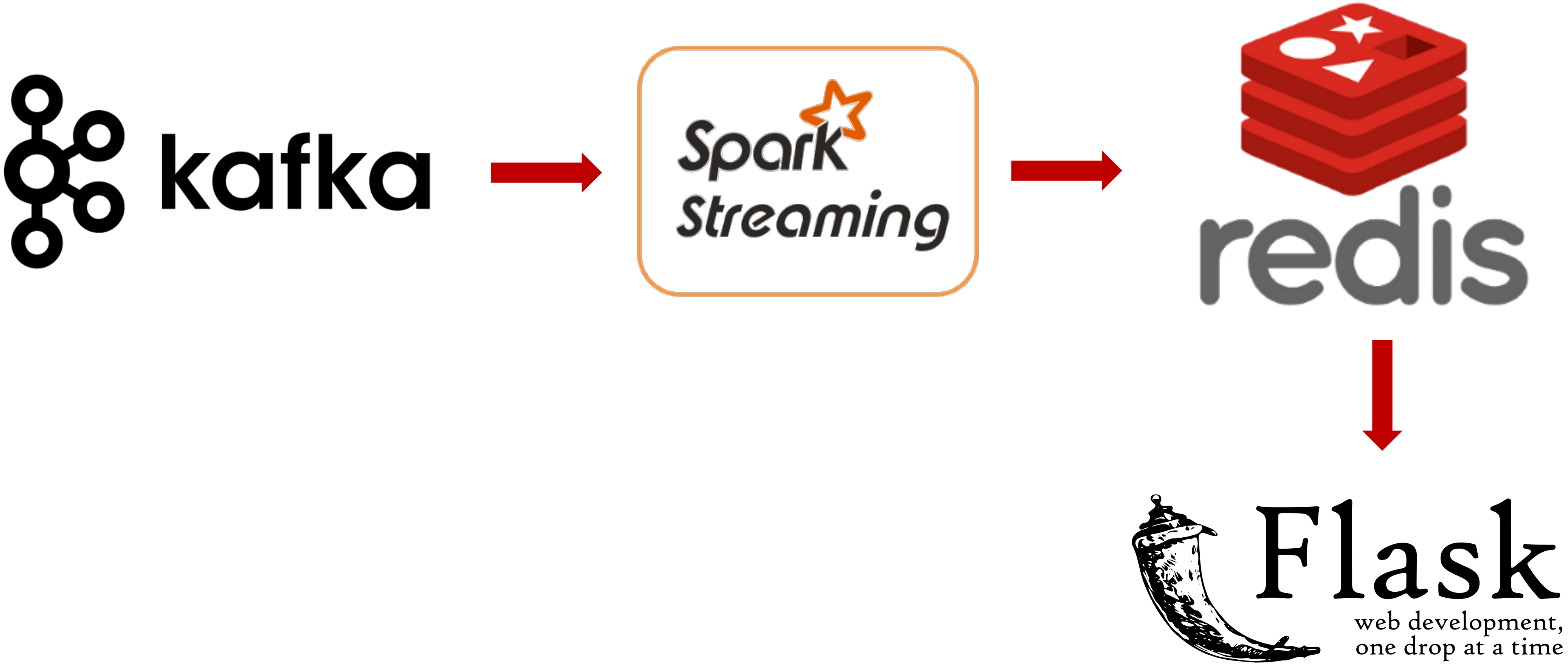
```
trained_model = LogisticRegressionModel.load(sc, "model/SGD")
```

Predict & Update

- Streaming Logistic Regression Model with Stochastic Gradient Descent

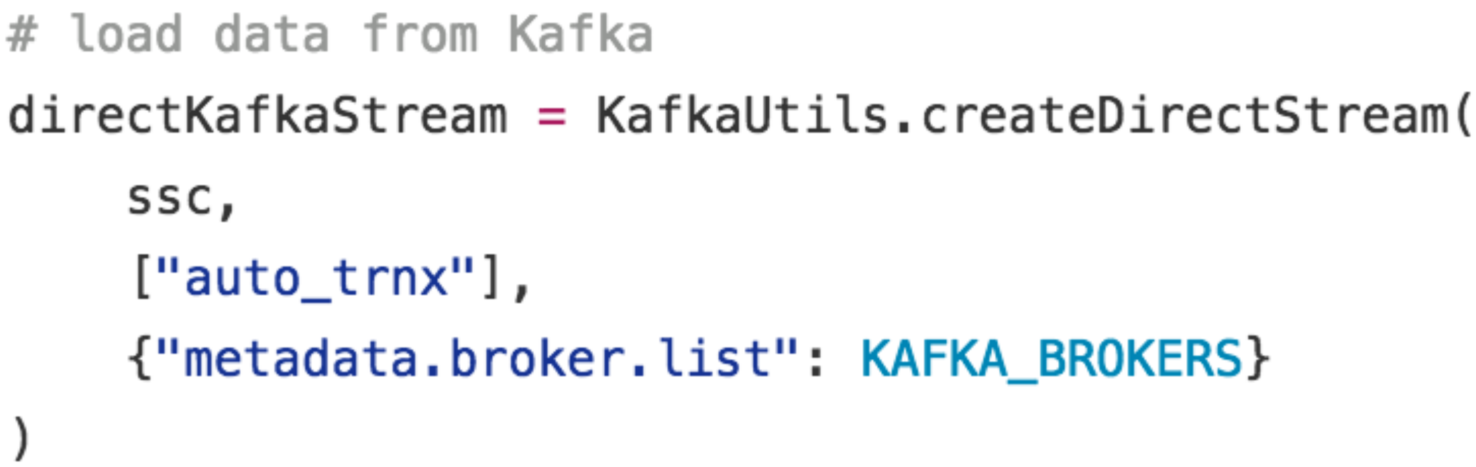


Build the Streaming Pipeline



Code Snippet #2

- Kafka -> Spark Streaming: Spark Streaming Kafka connector



```
# load data from Kafka
directKafkaStream = KafkaUtils.createDirectStream(
    ssc,
    ["auto_trnx"],
    {"metadata.broker.list": KAFKA_BROKERS}
)
```

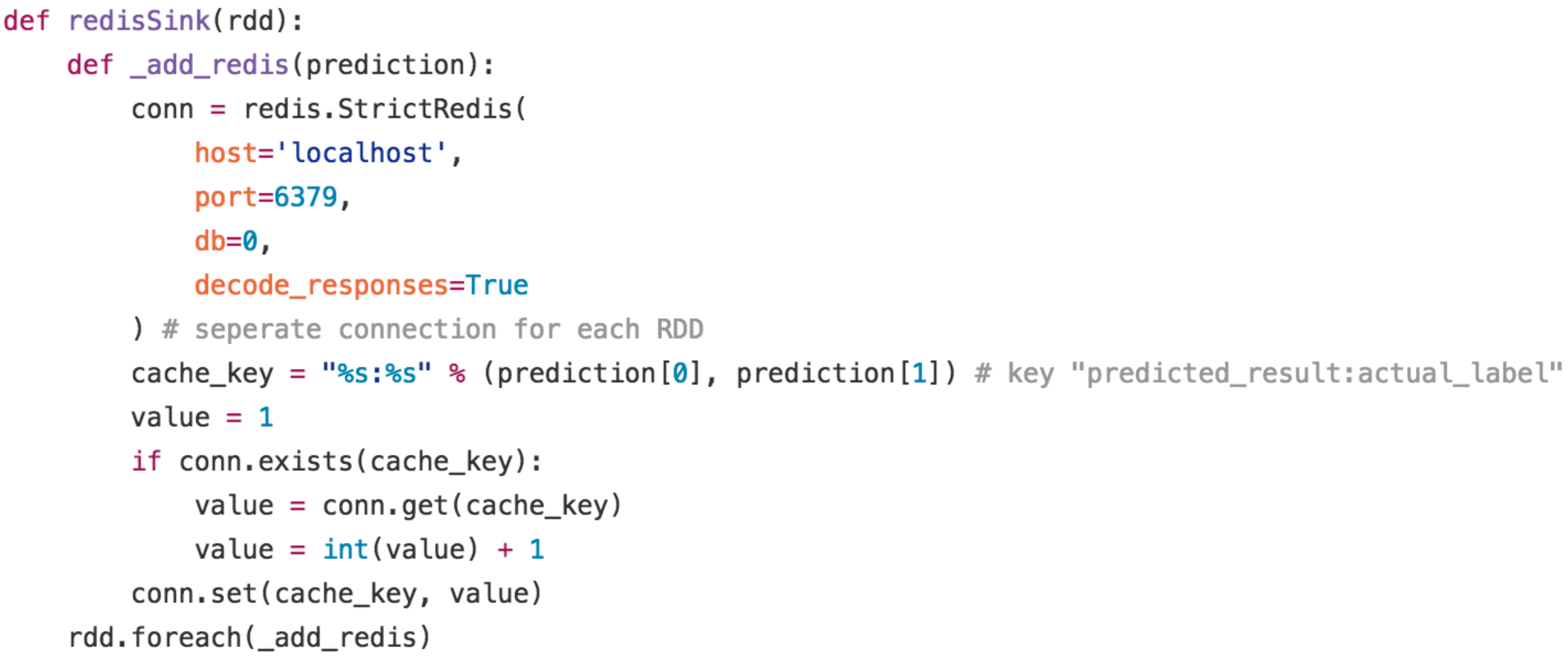
- **Dependency**: spark-streaming-kafka-0-8_2.11-2.0.1.jar
  - Use the right version
  - Make sure you add the jar and its dependencies to your project

Parallelism in Spark

- Parallelism in Data Receiving
  - For example, split Kafka input DStream based on topics
  - One Kafka Input stream for one topic to receive data in parallel
    - numStreams = 5
    - kafkaStreams = [KafkaUtils.createStream(...) **for** _ **in** range (numStreams)]
- Parallelism in Data Processing
  - conf = SparkConf().setMaster("local[2]")
    - Meaning - 2 threads: “minimal” parallelism
  - Spark Cluster: YARN, Mesos, Standalone

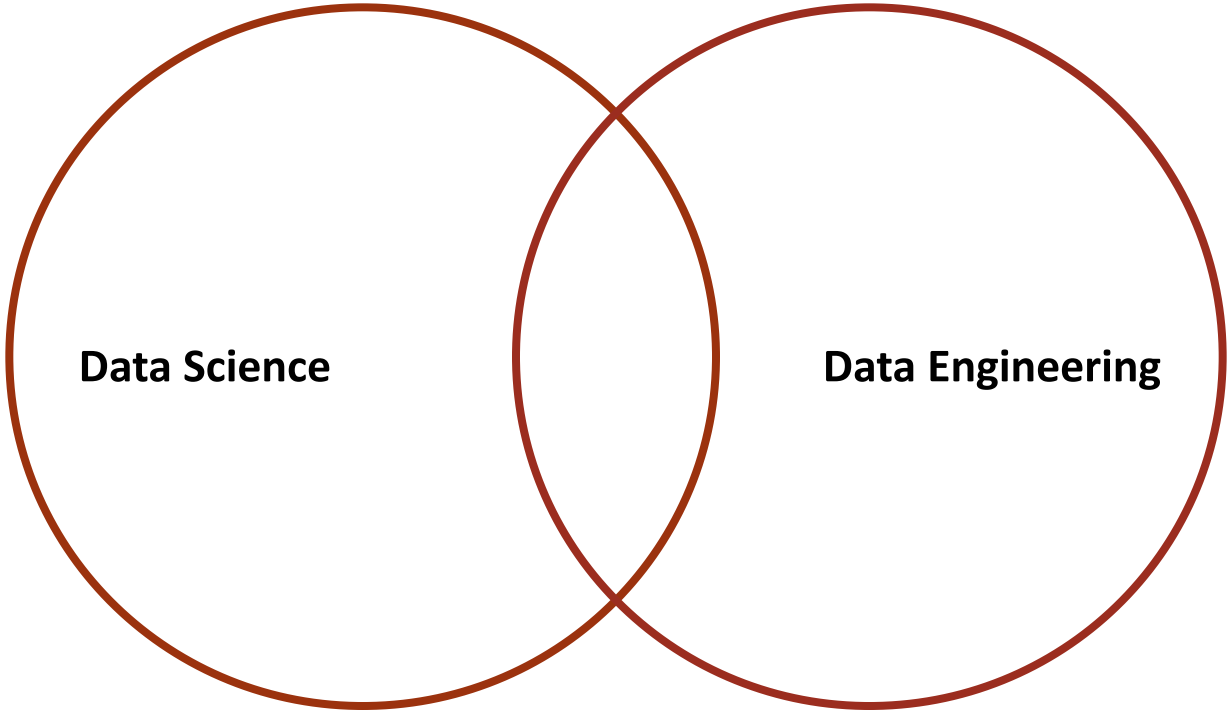
Code Snippet #3

- Spark Streaming -> Redis: Python Redis connector (pip install redis)



```
def redisSink(rdd):
    def _add_redis(prediction):
        conn = redis.StrictRedis(
            host='localhost',
            port=6379,
            db=0,
            decode_responses=True
        ) # seperate connection for each RDD
        cache_key = "%s:%s" % (prediction[0], prediction[1]) # key "predicted_result:actual_label"
        value = 1
        if conn.exists(cache_key):
            value = conn.get(cache_key)
            value = int(value) + 1
        conn.set(cache_key, value)
    rdd.foreach(_add_redis)
```

Summary



- Find the right features
- Get labeled data
    - Manual labeling

- Spark Programming
    - Spark connector or Python connector
    - Use MLlib

- Tuning Spark
    - # of drivers
    - # of executors
    - Memory
    - level of parallelism

Questions?