Project Report

1. Project description

(1) Area: social media analytics
(2) Topic: Twitter sentiment analysis
Our web app is designed for searching tweets and delivering sentiment analysis using key words as input.
(3) Business case:
Business popularity analysis; market prediction; targeted promotion…

2. Dataset

(1) For training experiment in Azure ML Studio, we used a labled dataset Sentiment140 which comprises approximately 1,600,000 automatically annotated tweets.
(a) Dataset Description
Each instance in the data set has 6 fields:

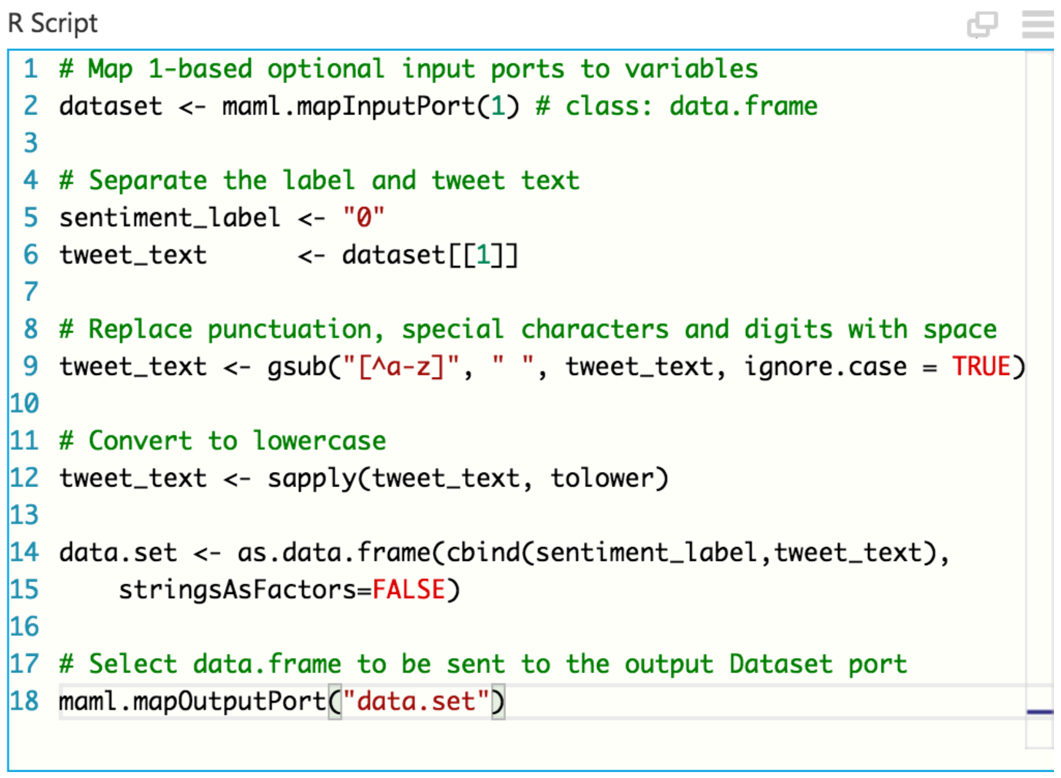
- sentiment_label - the polarity of the tweet (0 = negative, 2 = neutral, 4 = positive)
- tweet_text - the text of the tweet
- tweet_id - the id of the tweet
- time_stamp - the date of the tweet (UTC)

- target - the query (lyx). If there is no query, then this value is NO_QUERY.
- user_id - the user who posted the tweet

We used the first two fields – tweet_text, sentiment_lable – for training models in Azure Studio.

(b) Data Preprocessing and Cleaning

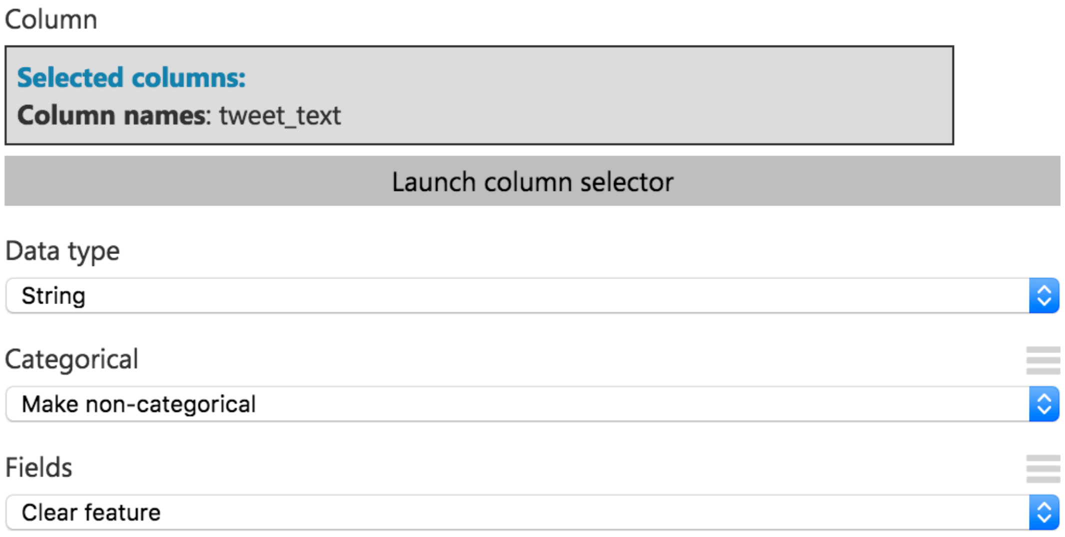
- We used the R code in **Execute R Script** module to remove punctuation marks, special characters and digits, and then performed case normalization.



R Script

```
# Map 1-based optional input ports to variables
dataset <- maml.mapInputPort(1) # class: data.frame

# Separate the label and tweet text
sentiment_label <- "0"
tweet_text      <- dataset[[1]]

# Replace punctuation, special characters and digits with space
tweet_text <- gsub("[^a-z]", " ", tweet_text, ignore.case = TRUE)

# Convert to lowercase
tweet_text <- sapply(tweet_text, tolower)

data.set <- as.data.frame(cbind(sentiment_label,tweet_text),
    stringsAsFactors=FALSE)

# Select data.frame to be sent to the output Dataset port
maml.mapOutputPort("data.set")
```

- W used the **Metadata Editor** module to change the: we marked the text column as non-categorical column and marked the text column as a non-feature. Because we want the learner to ignore the source text and not use it as a feature when training the model, but rather to use the extracted features that we build in the next step.



Column

Selected columns:
Column names: tweet_text

Data type: String

Categorical: Make non-categorical

Fields: Clear feature

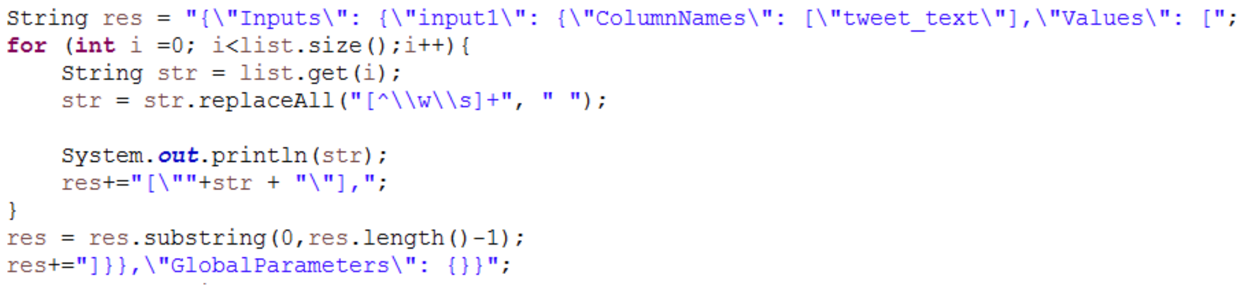
(2) For predictive experiment, we used the real-time twitter data source as the web service input.

We used twitter4j.jar to get real-time tweets and old tweets within 7 days by keyword. Also, we can get a several days' tweets by setting since date and until date.

Firstly, we got authentication by inputting OAuth access code and Token code

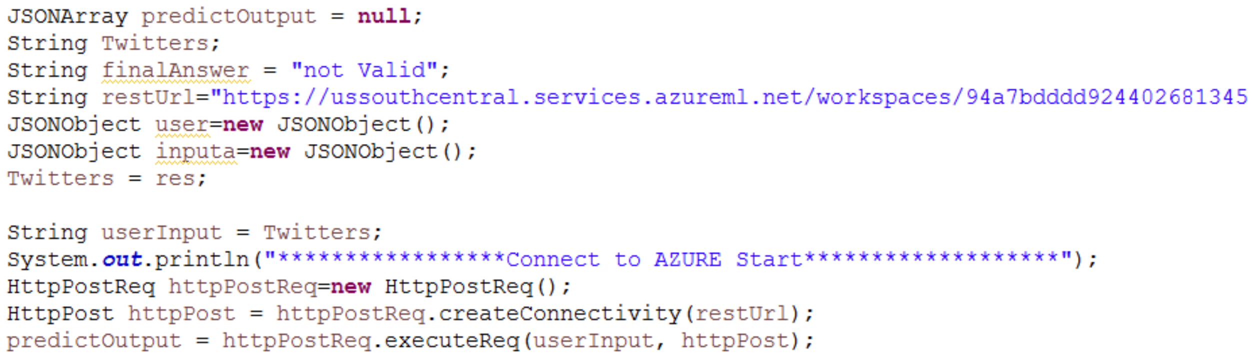
```
ConfigurationBuilder cb = new ConfigurationBuilder();
ModelAndView mv = new ModelAndView();
System.out.println("321");
cb.setDebugEnabled(true)
  .setOAuthConsumerKey("eUL89IkTvO54eMTeNmUzXr2EK")
  .setOAuthConsumerSecret("7tSH8eSvufxjwtqy9RLRgClDIHOx0Bpot0fh46qoXe5zIdtdc3")
  .setOAuthAccessToken("2692099357-tSArR3QAD6ML1Io27URWLFpQ23NAtkkcdus8q64")
  .setOAuthAccessTokenSecret("psoNY7VqcKVom6hiidmKdJWNnQGAXnLau40Zd1ZTo2siI");
TwitterFactory tf = new TwitterFactory(cb.build());
Twitter twitter = tf.getInstance();
```

After authentication, we can use getTweets() method to get today’s tweets, and store them as web service input format.



```
String res = "{\"Inputs\": {\"input1\": {\"ColumnNames\": [\"tweet_text\"],\"Values\": [";
for (int i =0; i<list.size();i++){
    String str = list.get(i);
    str = str.replaceAll("[^\\w\\s]+", " ");

    System.out.println(str);
    res+="[\""+str + "\"],";
}
res = res.substring(0,res.length()-1);
res+="]}},\"GlobalParameters\": {}}";
```

The web service API used like following



```
JSONArray predictOutput = null;
String Twitters;
String finalAnswer = "not Valid";
String restUrl="https://ussouthcentral.services.azureml.net/workspaces/94a7bdddd924402681345
JSONObject user=new JSONObject();
JSONObject inputa=new JSONObject();
Twitters = res;

String userInput = Twitters;
System.out.println("*****************Connect to AZURE Start*******************");
HttpPostReq httpPostReq=new HttpPostReq();
HttpPost httpPost = httpPostReq.createConnectivity(restUrl);
predictOutput = httpPostReq.executeReq(userInput, httpPost);
```

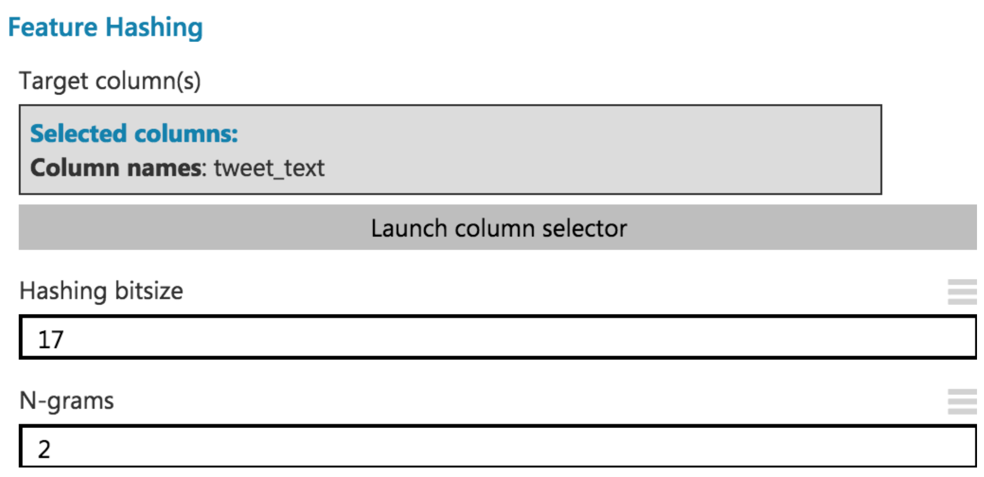
3. Azure Studio – Model & Web service

(1) Compare Different Models.

(a) Two-class Support Vector Machines (SVMs)

SVMs are supervised learning models that analyze data and recognize patterns. They are good for large feature sets.

We used the **Feature Hashing** module to represent variable-length tweet_text as equal-length numeric feature vectors.



Feature Hashing

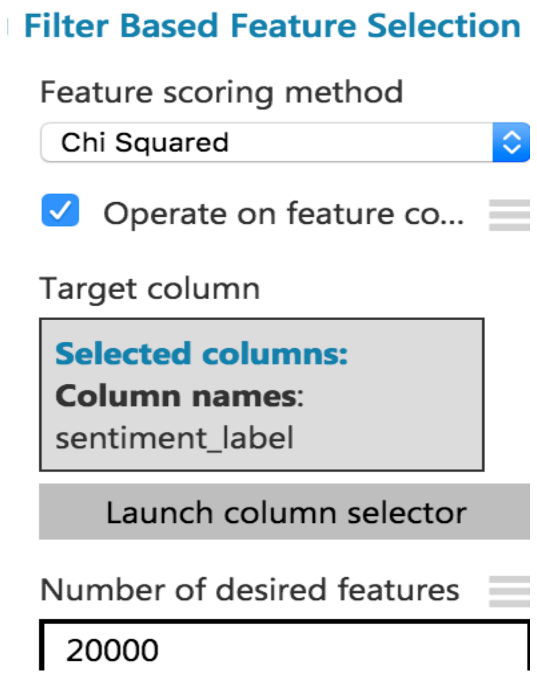
Target column(s)

Selected columns:
Column names: tweet_text

Hashing bitsize: 17

N-grams: 2

Then we used the **Filter Based Feature Selection** module to select a compact feature subset from the exhaustive list of extracted hashing features. The aim is to reduce the computational complexity without affecting classification accuracy.



Filter Based Feature Selection

Feature scoring method: Chi Squared

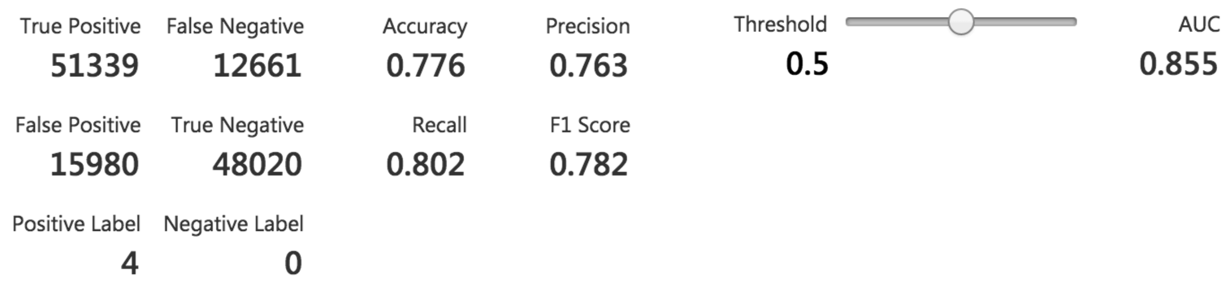
✓ Operate on feature co...

Target column

Selected columns:
Column names: sentiment_label

Number of desired features: 20000

Below is the performance metrics with threshold set as 0.5.

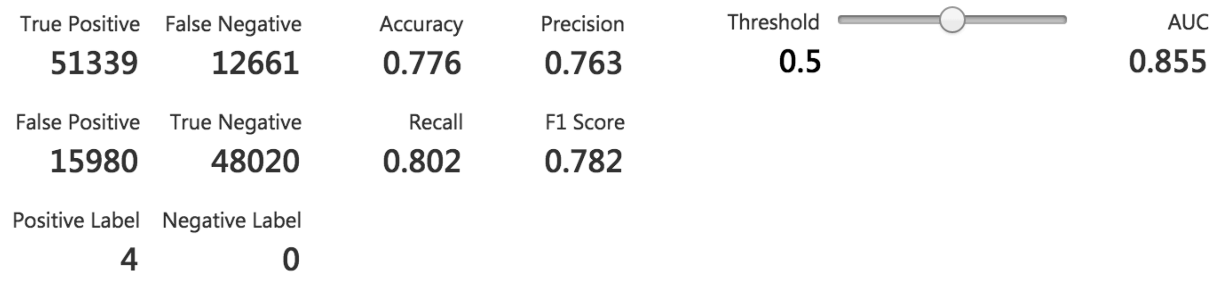


True Positive	False Negative	Accuracy	Precision	Threshold	AUC
51339	12661	0.776	0.763	0.5	0.855
False Positive	**True Negative**	**Recall**	**F1 Score**		
15980	48020	0.802	0.782		
Positive Label	**Negative Label**				
4	0				

(b) Two-Class Logistic Regression

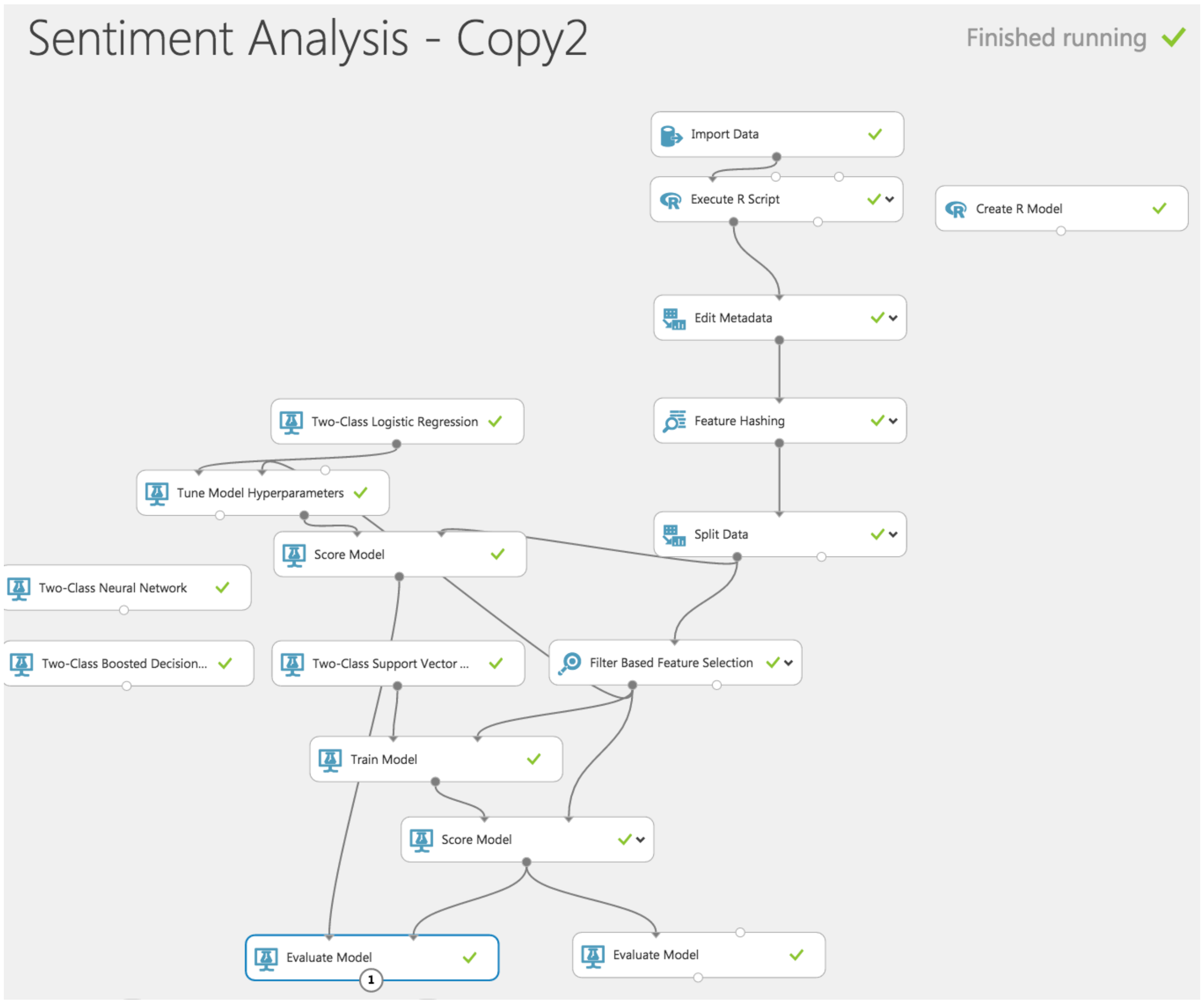
We also tried this module for training model. It predicts the probability of occurrence of an event by fitting data to a logistic function.

Below is the performance metrics with threshold set as 0.5.



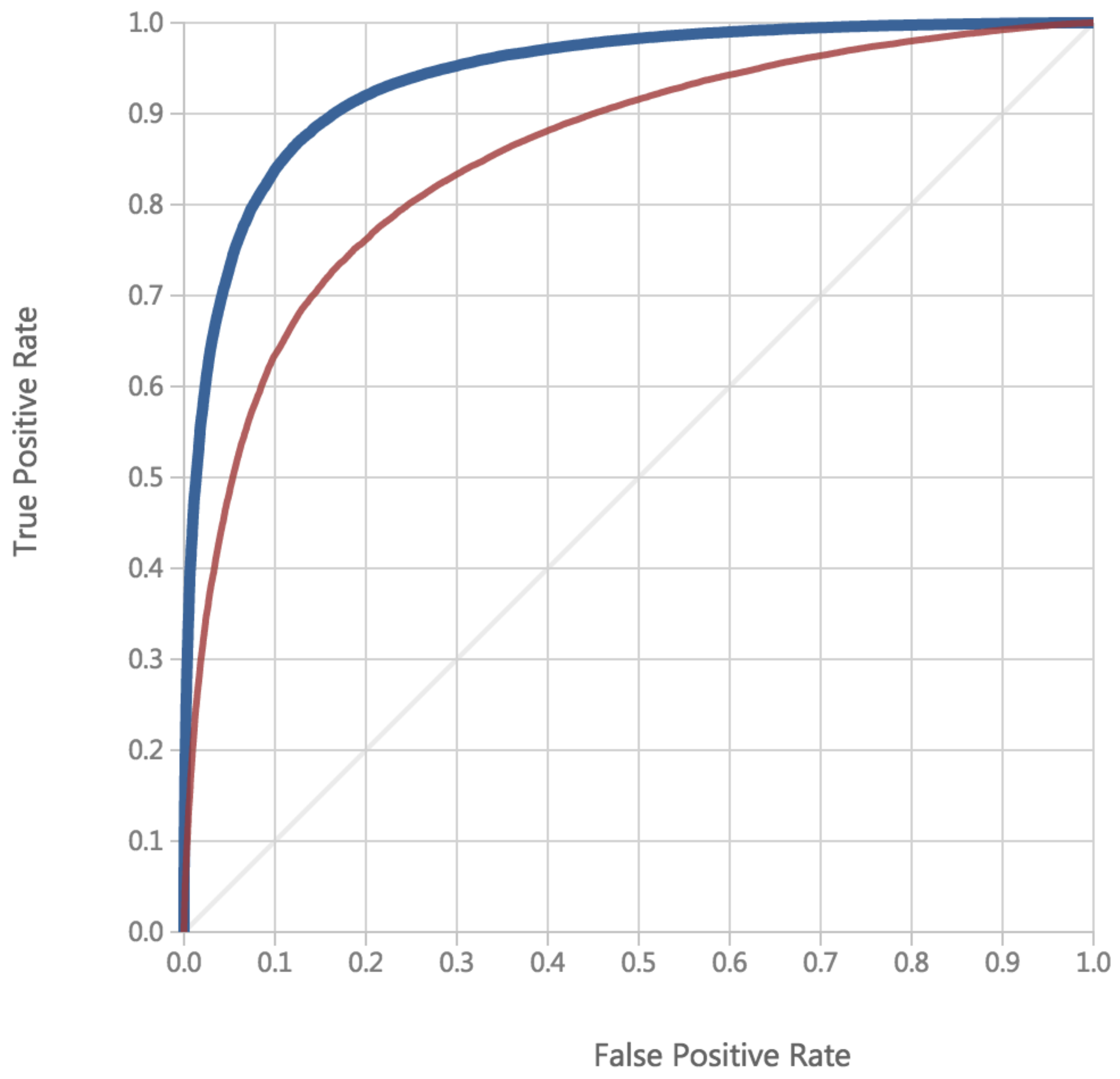
True Positive	False Negative	Accuracy	Precision	Threshold	AUC
51339	12661	0.776	0.763	0.5	0.855
False Positive	**True Negative**	**Recall**	**F1 Score**		
15980	48020	0.802	0.782		
Positive Label	**Negative Label**				
4	0				

It worked not as good as the SVMs.

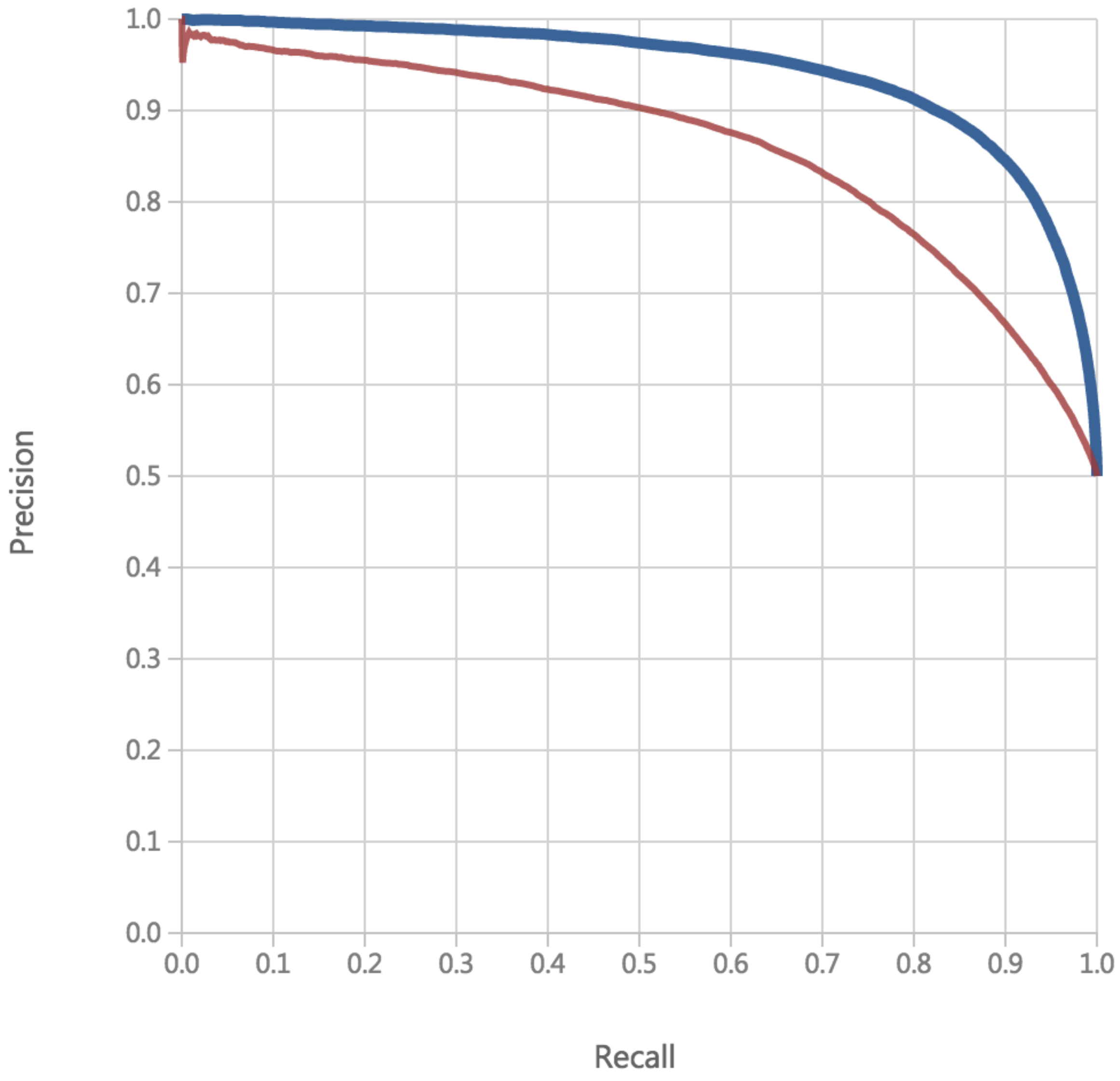


Below is the visualized evaluation when we compared these two models.

ROC:

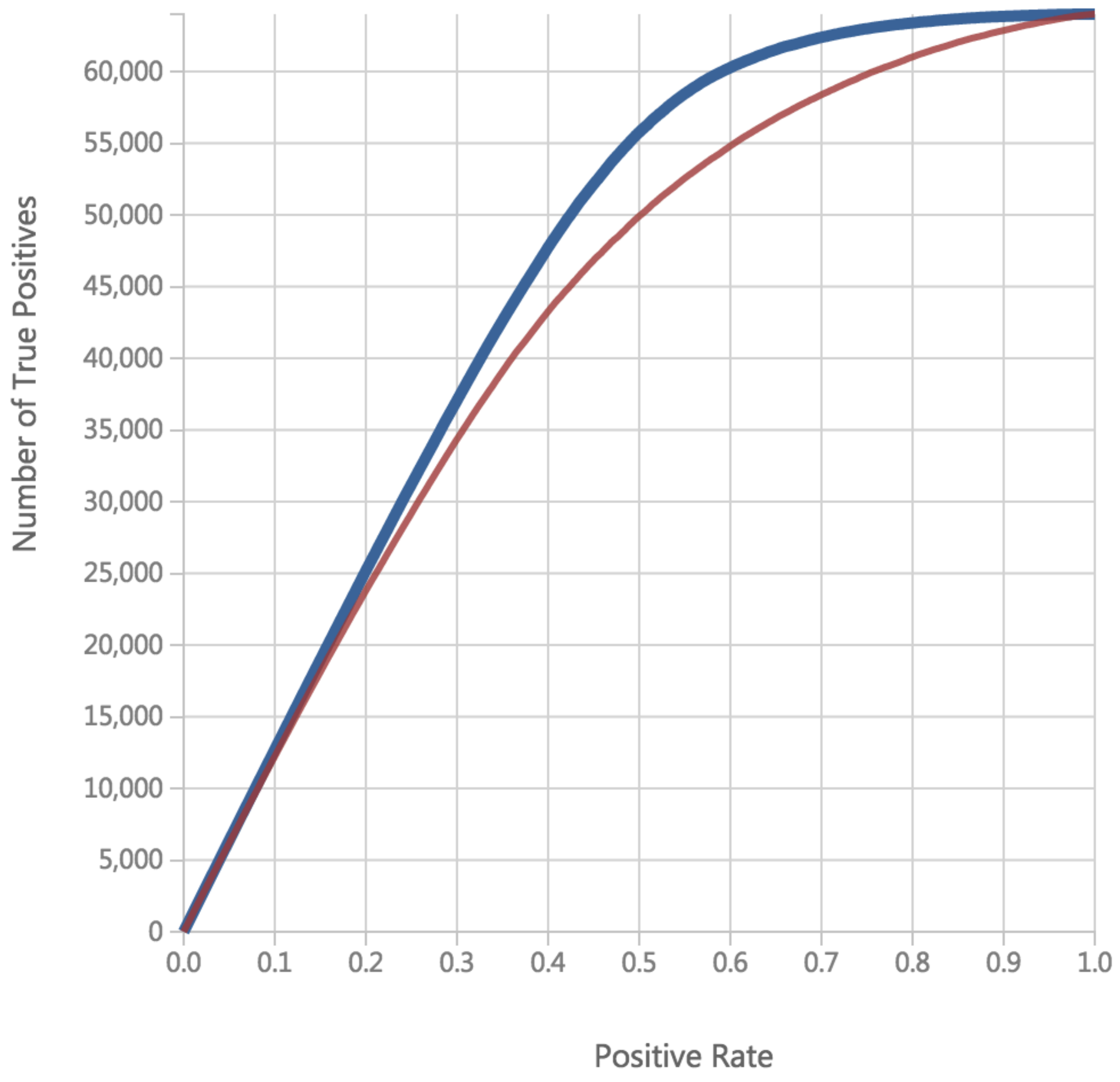


Precision-recall:

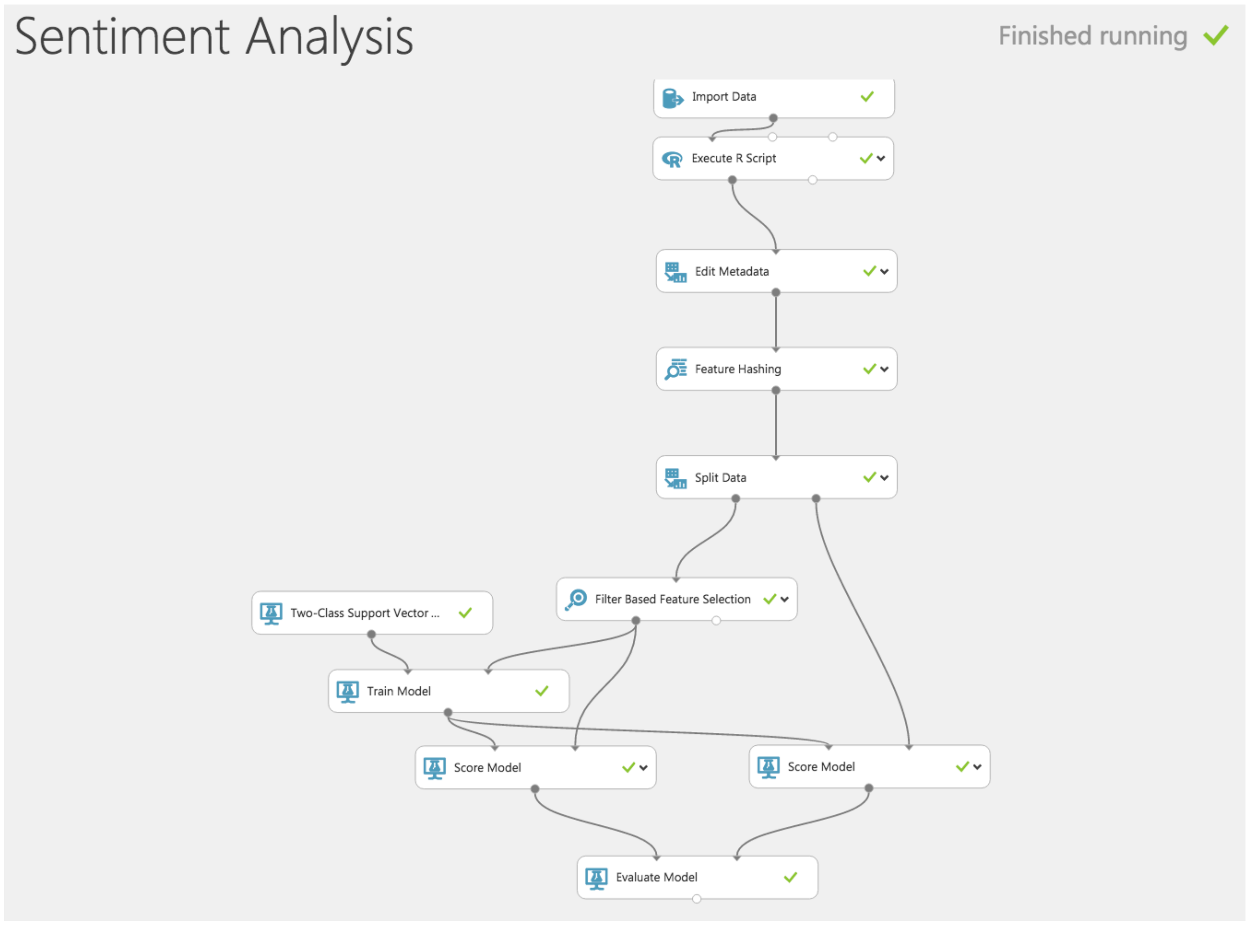


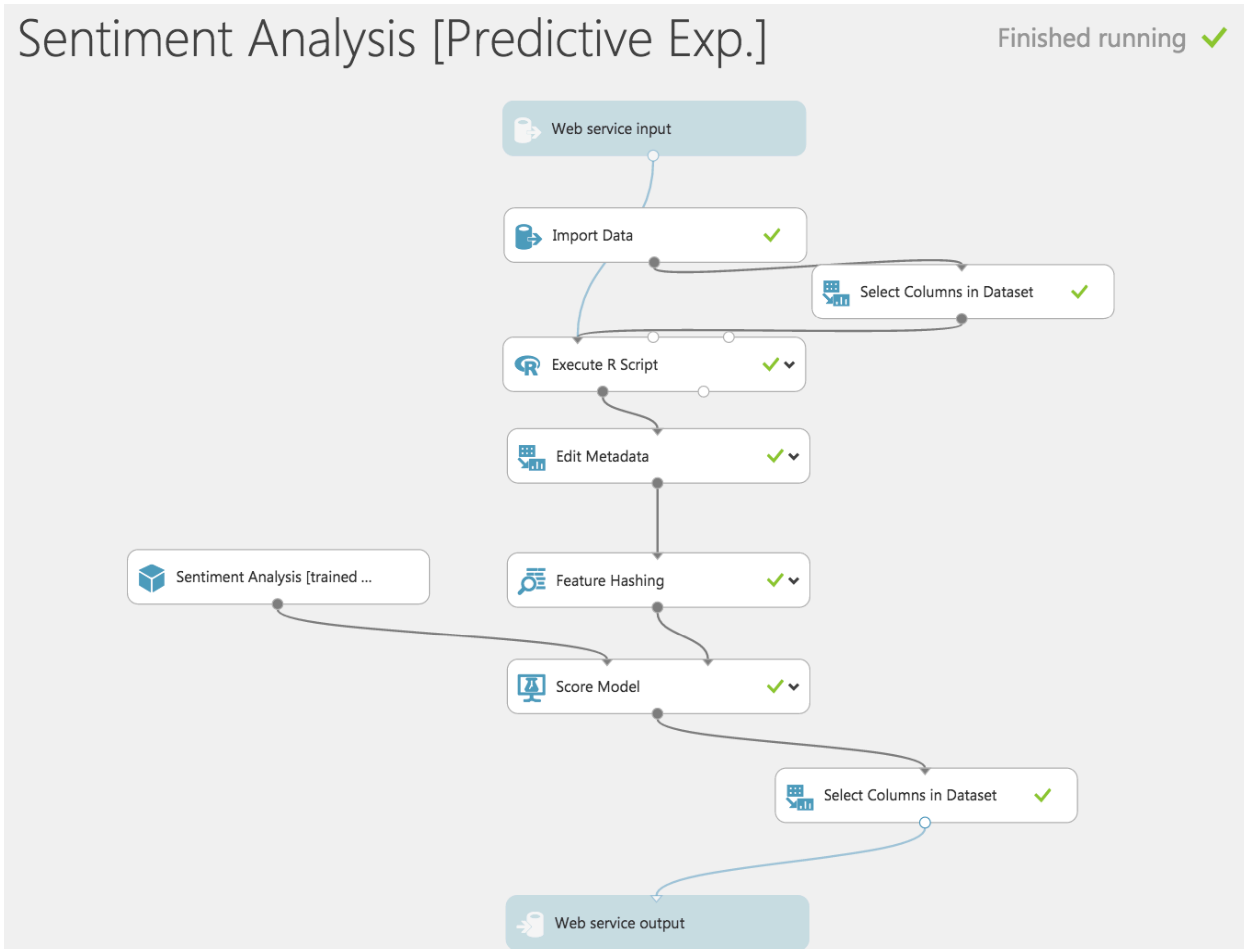
Precision
Recall
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Lift:



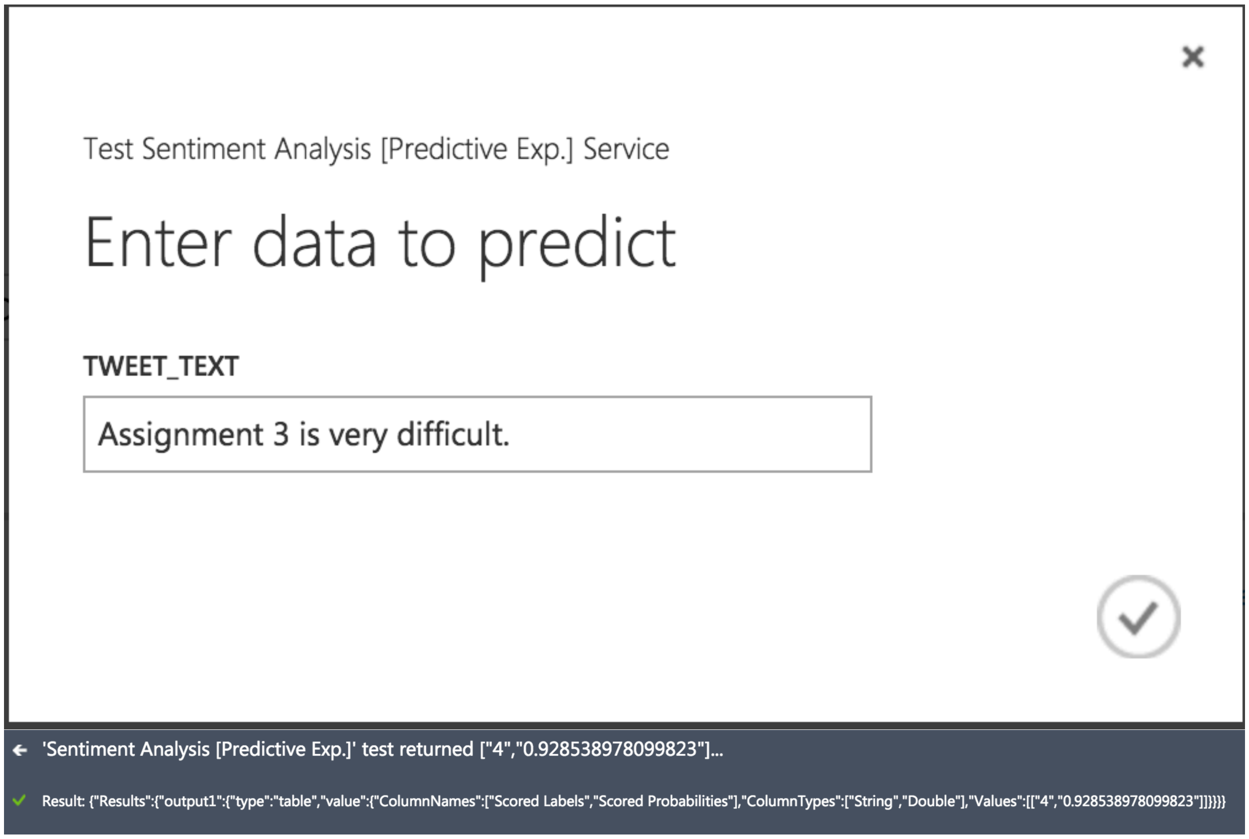
(2) In the experiment for deploying web service, we used the two-class vector machine model.


Sentiment Analysis
Finished running
Import Data
Execute R Script
Edit Metadata
Feature Hashing
Split Data
Two-Class Support Vector ...
Filter Based Feature Selection
Train Model
Score Model
Score Model
Evaluate Model


Sentiment Analysis [Predictive Exp.]
Finished running
Web service input
Import Data
Select Columns in Dataset
Execute R Script
Edit Metadata
Sentiment Analysis [trained ...
Feature Hashing
Score Model
Select Columns in Dataset
Web service output

(3) Web Service/API Testing

(a)Use web service in Azure Studio



Test Sentiment Analysis [Predictive Exp.] Service

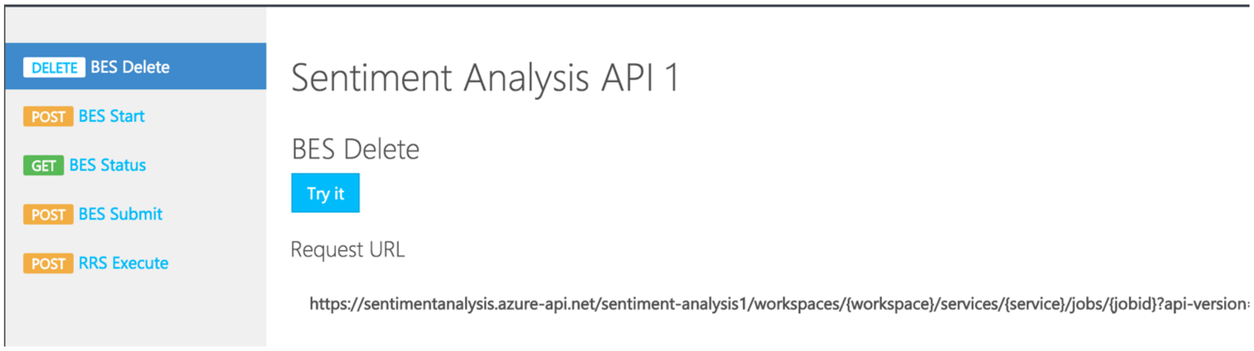
Enter data to predict

TWEET_TEXT

Assignment 3 is very difficult.

```
'Sentiment Analysis [Predictive Exp.]' test returned ["4","0.928538978099823"]...
Result: {"Results":{"output1":{"type":"table","value":{"ColumnNames":["Scored Labels","Scored Probabilities"],"ColumnTypes":["String","Double"],"Values":[["4","0.928538978099823"]]}}}}
```

(b)Test API in Azure Portal



Sentiment Analysis API 1

BES Delete

Try it

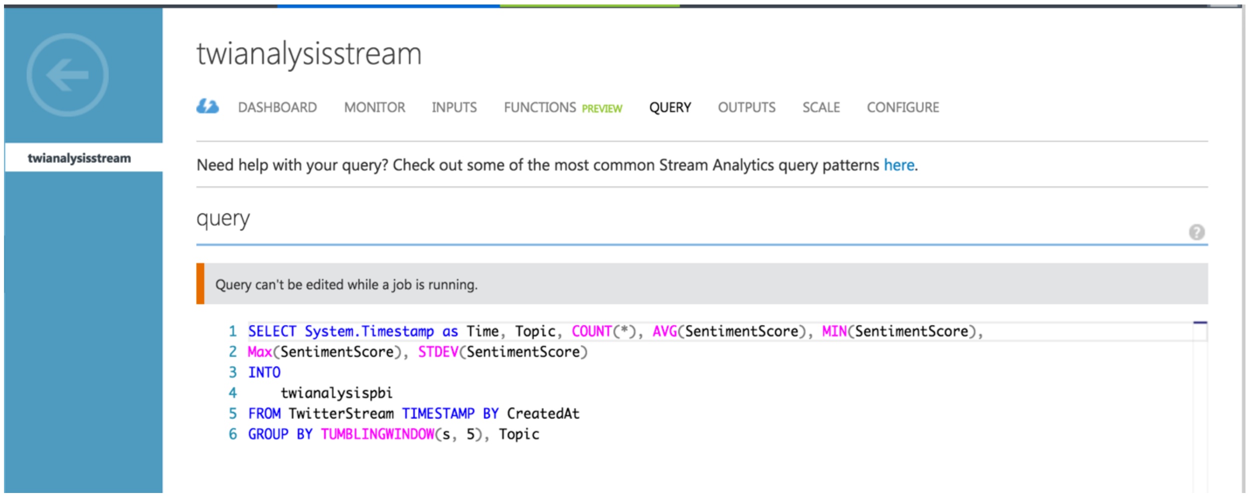
Request URL

https://sentimentanalysis.azure-api.net/sentiment-analysis1/workspaces/{workspace}/services/{service}/jobs/{jobid}?api-version

4. Azure portal - Stream Analytics

We also built a sentiment analysis solution for social media analytics by bringing real-time Twitter events into Event Hubs. We used Stream Analytics query to analyze

the tweets data and then used a dashboard to provide insights in real time using Power BI.
First, we created an Event Hub input and a Consumer Group in the Azure Portal.
Then, we run a client application that taps into Twitter data via Twitter's Streaming APIs to collect Tweet events about a parameterized set of topics. The 3rd party open source tool Sentiment140 is used to assign a sentiment value to each tweet (0: negative, 2: neutral, 4: positive) and then Tweet events are pushed to Event Hub. To use this client, we generated our Twitter account and OAuth access token.
At last, we set up a Stream Analytics job to analyze these events in real time.



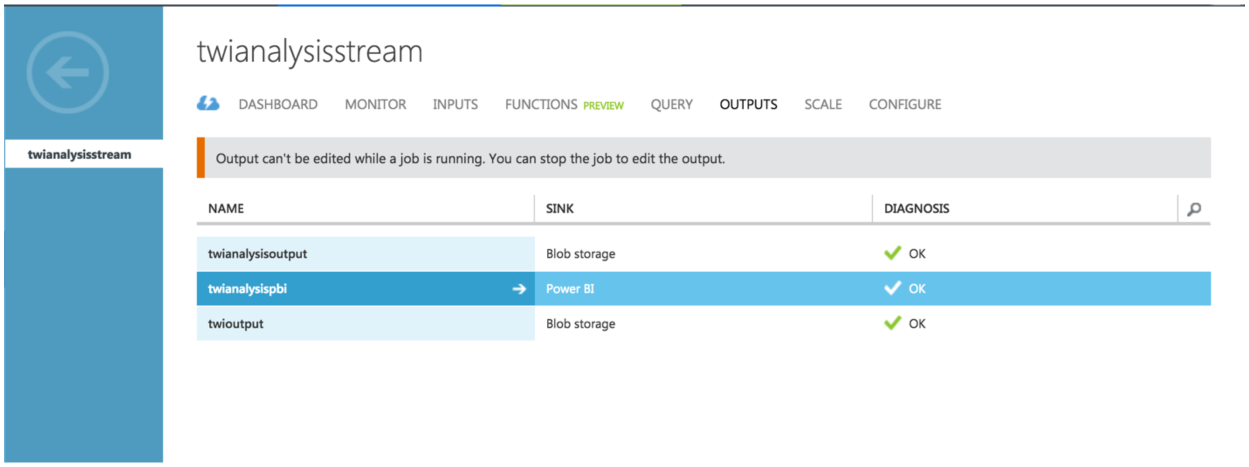
twianalysisstream

Need help with your query? Check out some of the most common Stream Analytics query patterns here.

query

Query can't be edited while a job is running.

```
SELECT System.Timestamp as Time, Topic, COUNT(*), AVG(SentimentScore), MIN(SentimentScore),
Max(SentimentScore), STDEV(SentimentScore)
INTO
    twianalysispbi
FROM TwitterStream TIMESTAMP BY CreatedAt
GROUP BY TUMBLINGWINDOW(s, 5), Topic
```

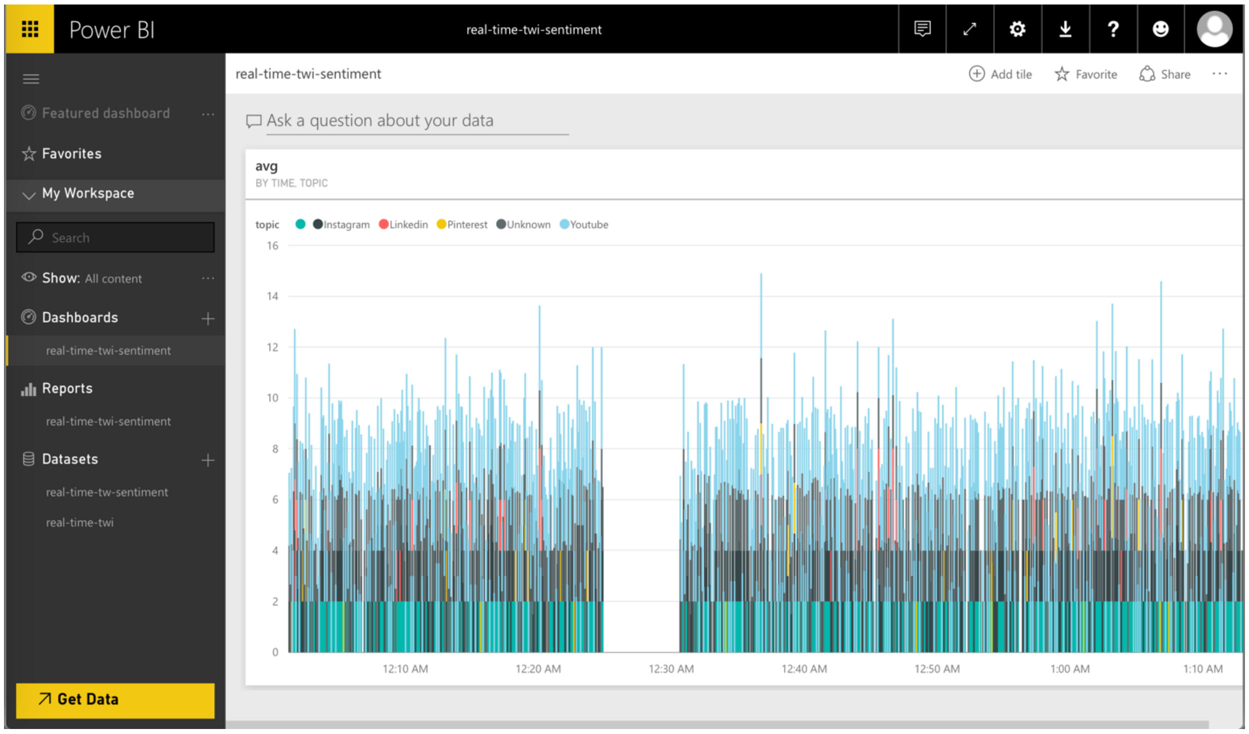

twianalysisstream

DASHBOARD MONITOR INPUTS FUNCTIONS PREVIEW QUERY OUTPUTS SCALE CONFIGURE

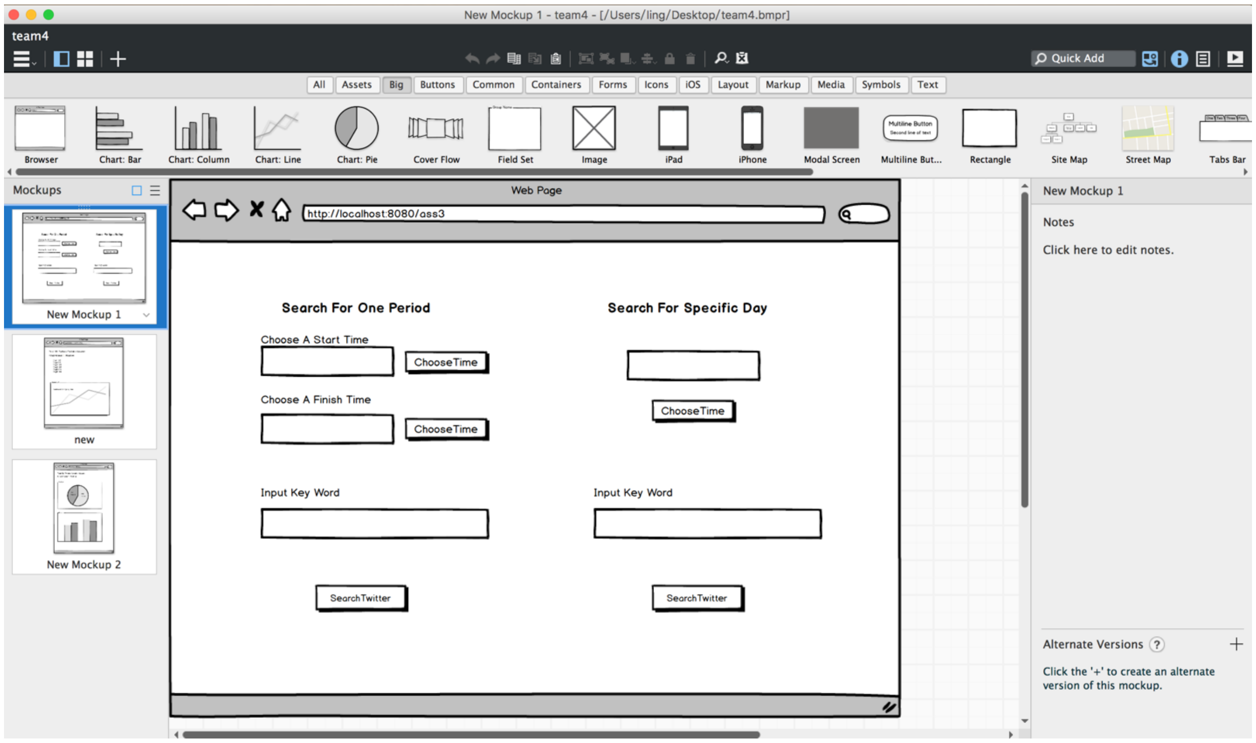
Output can't be edited while a job is running. You can stop the job to edit the output.

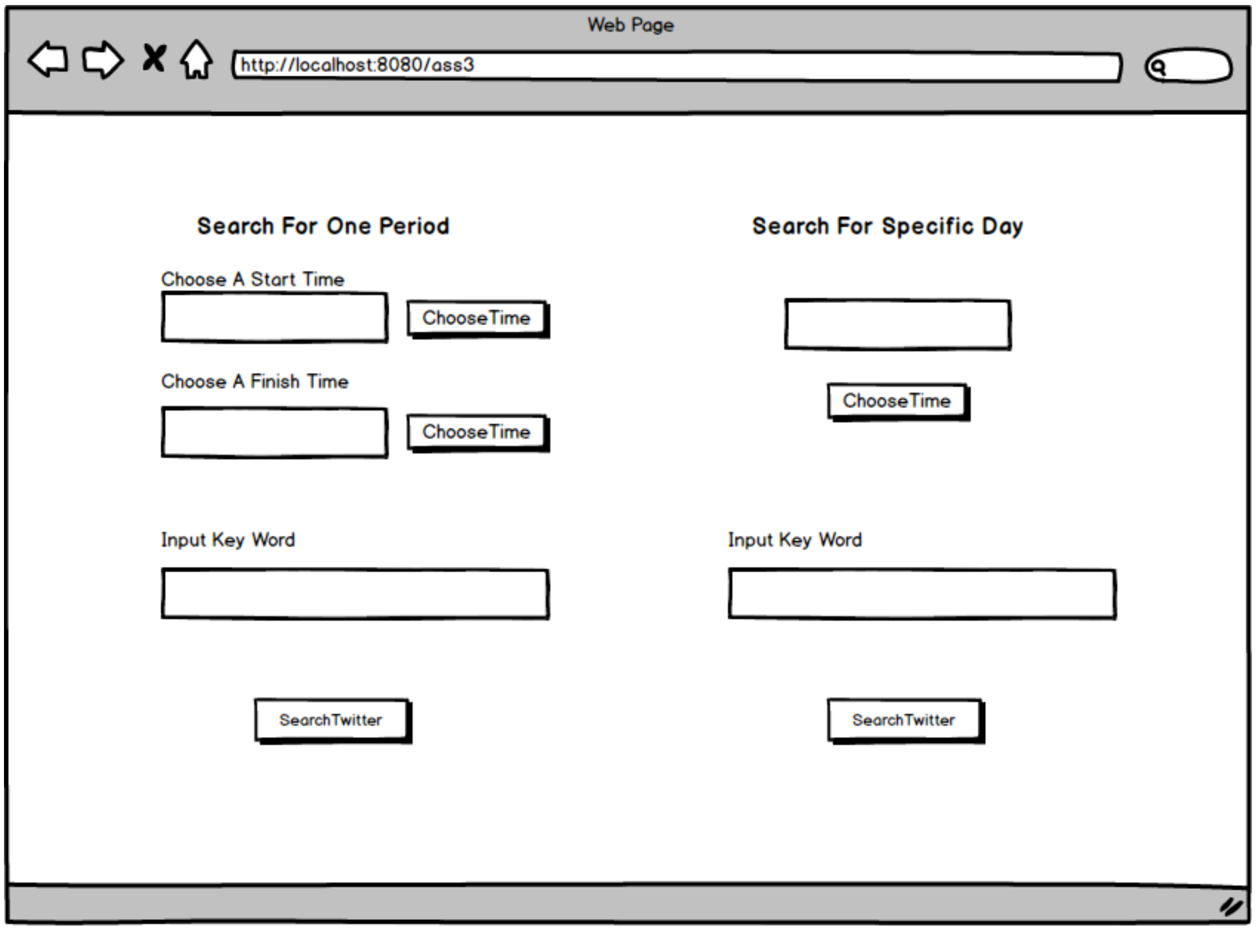
NAME	SINK	DIAGNOSIS
twianalysisoutput	Blob storage	✓ OK
twianalysispbi	Power BI	✓ OK
twioutput	Blob storage	✓ OK

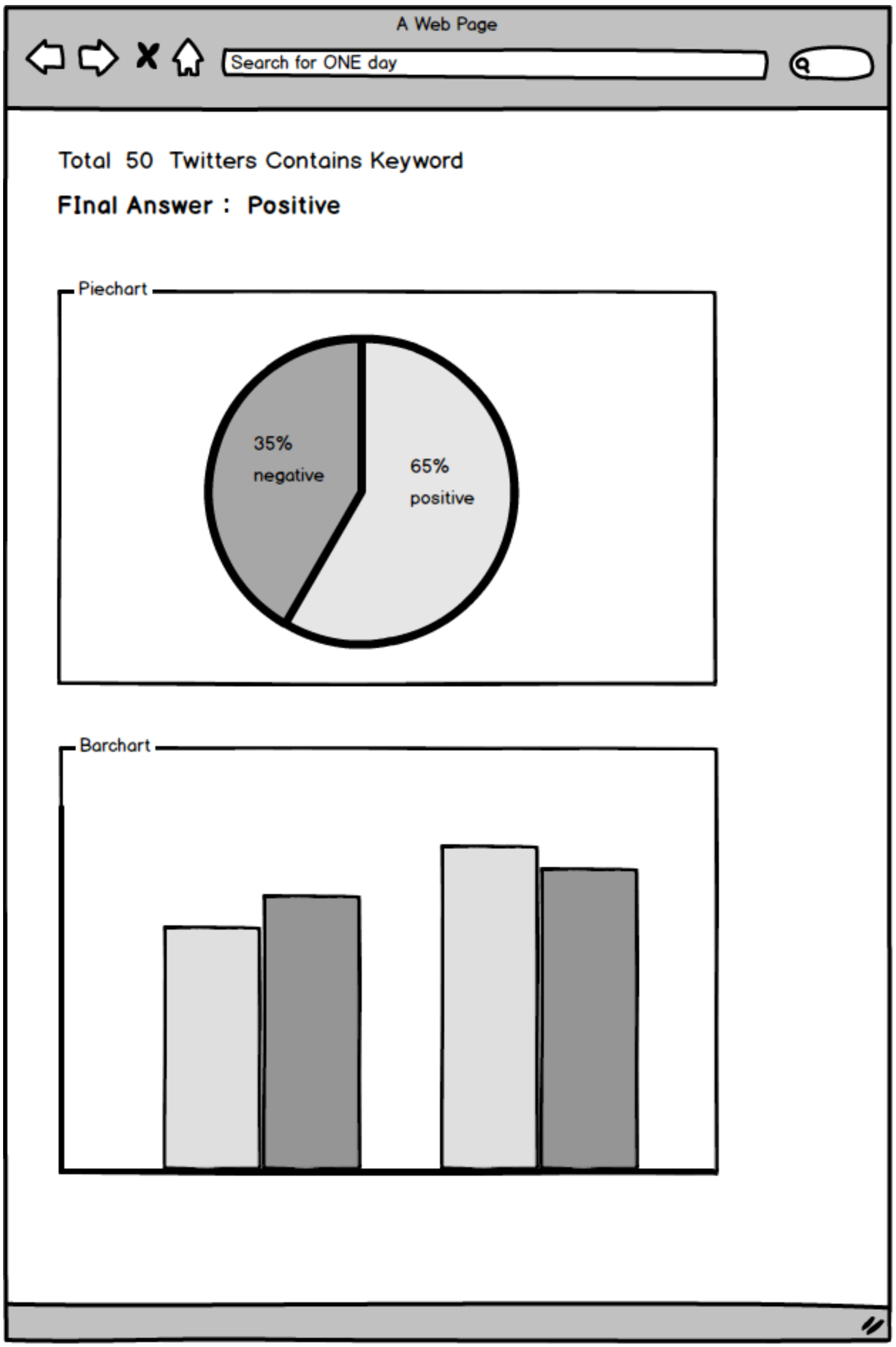
Once the job is running and processing the real-time Twitter stream, we can view the output for sentiment analysis and extend our application to include a customized dashboard over the output using Power BI.



5. Balsamiq Mockup

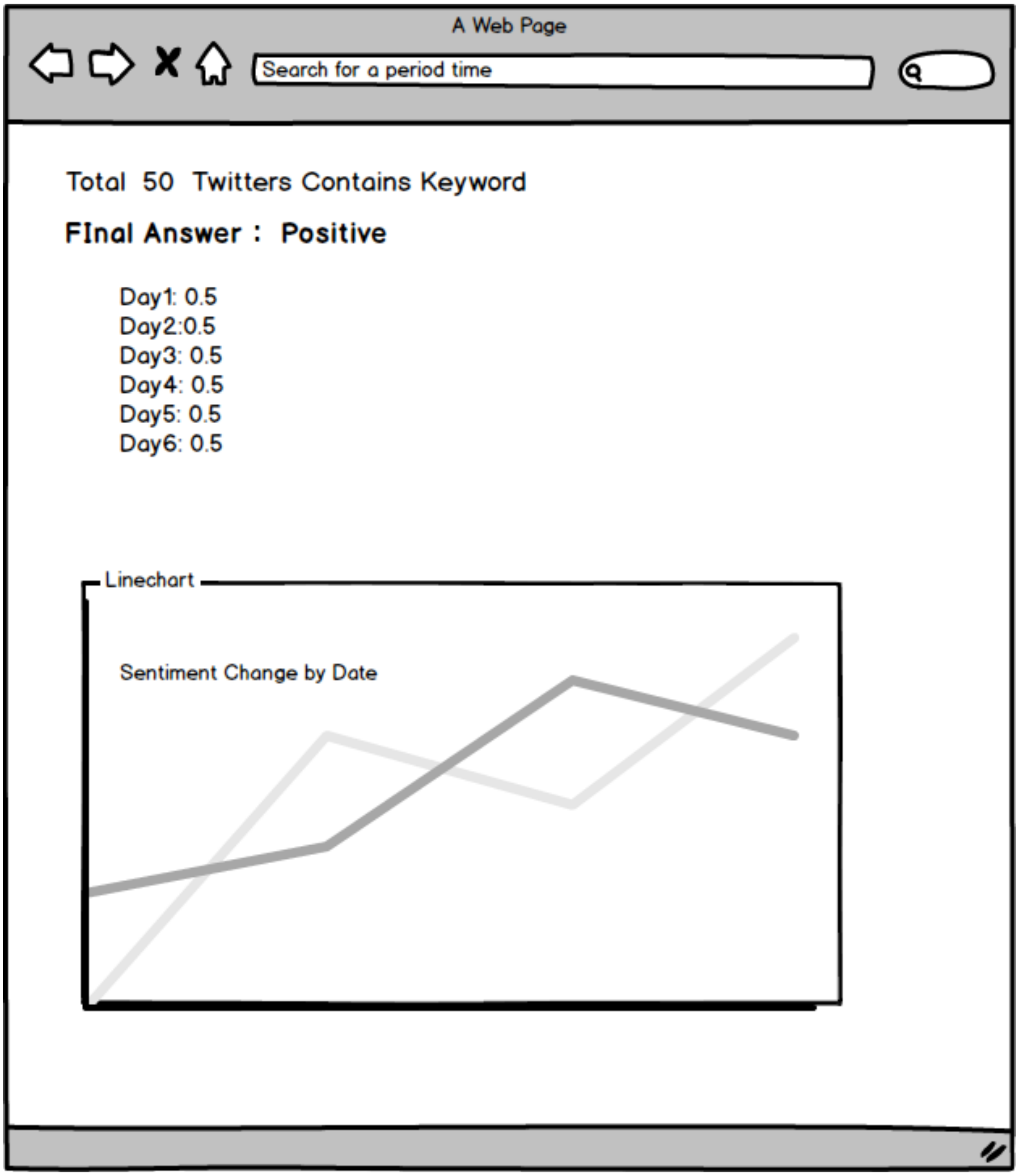

New Mockup 1 - team4 - [/Users/ling/Desktop/team4.bmpr]
team4
Quick Add
All
Assets
Big
Buttons
Common
Containers
Forms
Icons
iOS
Layout
Markup
Media
Symbols
Text
Browser
Chart: Bar
Chart: Column
Chart: Line
Chart: Pie
Cover Flow
Field Set
Image
iPad
iPhone
Modal Screen
Multiline But...
Rectangle
Site Map
Street Map
Tabs Bar
Mockups
New Mockup 1
new
New Mockup 2
Web Page
http://localhost:8080/ass3
Search For One Period
Choose A Start Time
ChooseTime
Choose A Finish Time
ChooseTime
Input Key Word
SearchTwitter
Search For Specific Day
ChooseTime
Input Key Word
SearchTwitter
New Mockup 1
Notes
Click here to edit notes.
Alternate Versions
Click the '+' to create an alternate version of this mockup.


Web Page
http://localhost:8080/ass3
Search For One Period
Choose A Start Time
ChooseTime
Choose A Finish Time
ChooseTime
Input Key Word
SearchTwitter
Search For Specific Day
ChooseTime
Input Key Word
SearchTwitter



Total 50 Twitters Contains Keyword

FInal Answer : Positive



Total 50 Twitters Contains Keyword

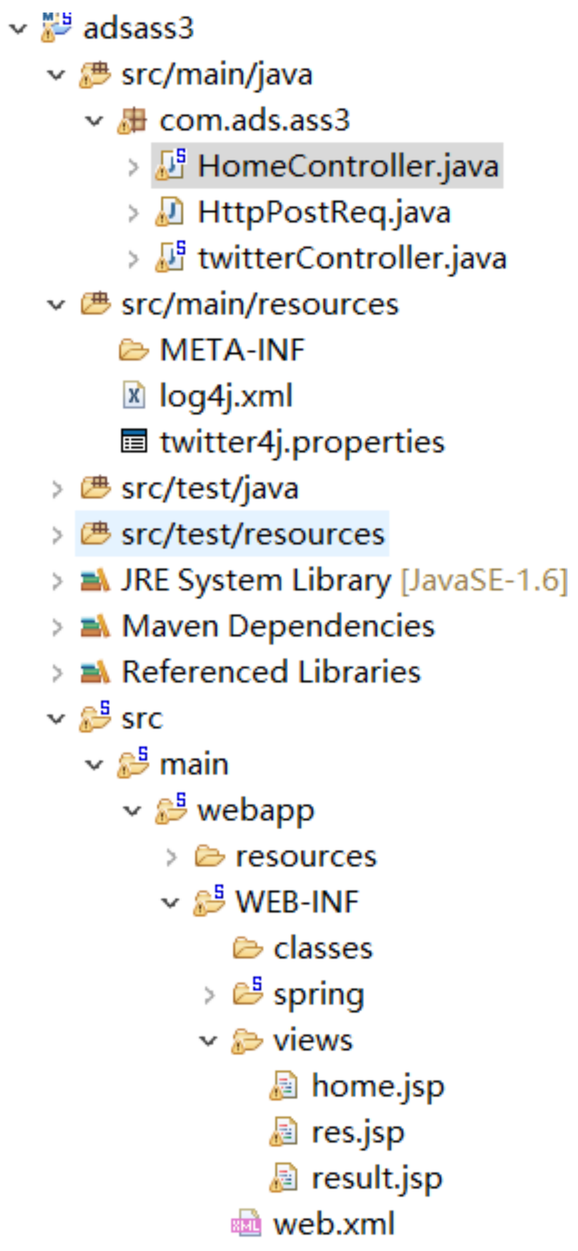
FInal Answer : Positive

Day1: 0.5
Day2:0.5
Day3: 0.5
Day4: 0.5
Day5: 0.5
Day6: 0.5

6. Web application

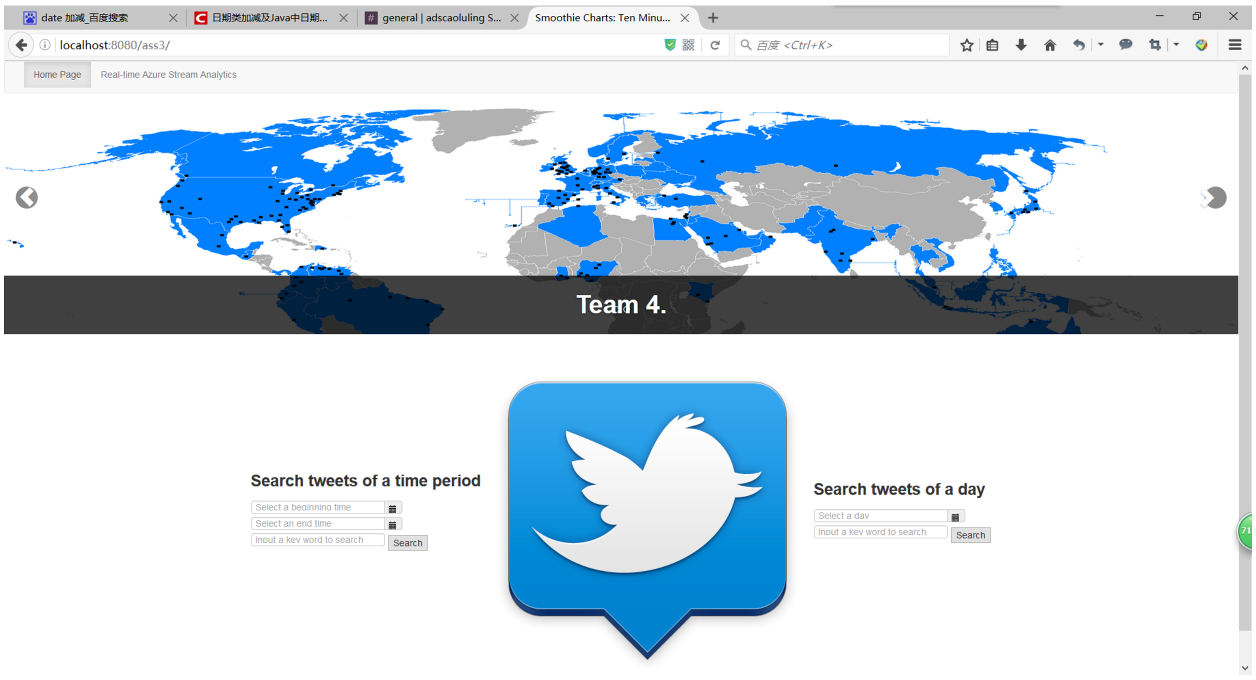
We generated our web application based on Spring MVC and boostrap, there are two main function in our website, the first one is analyzing tweets according to keyword in a period of time and generating graph, the second is analyzing one day’s tweets by sentimental algorithm and generating graph in details.

To make our web application more friendly, it has three jsp page with bootstrap and javascript, and three Controller to take charge of first function, API and second one respectively.



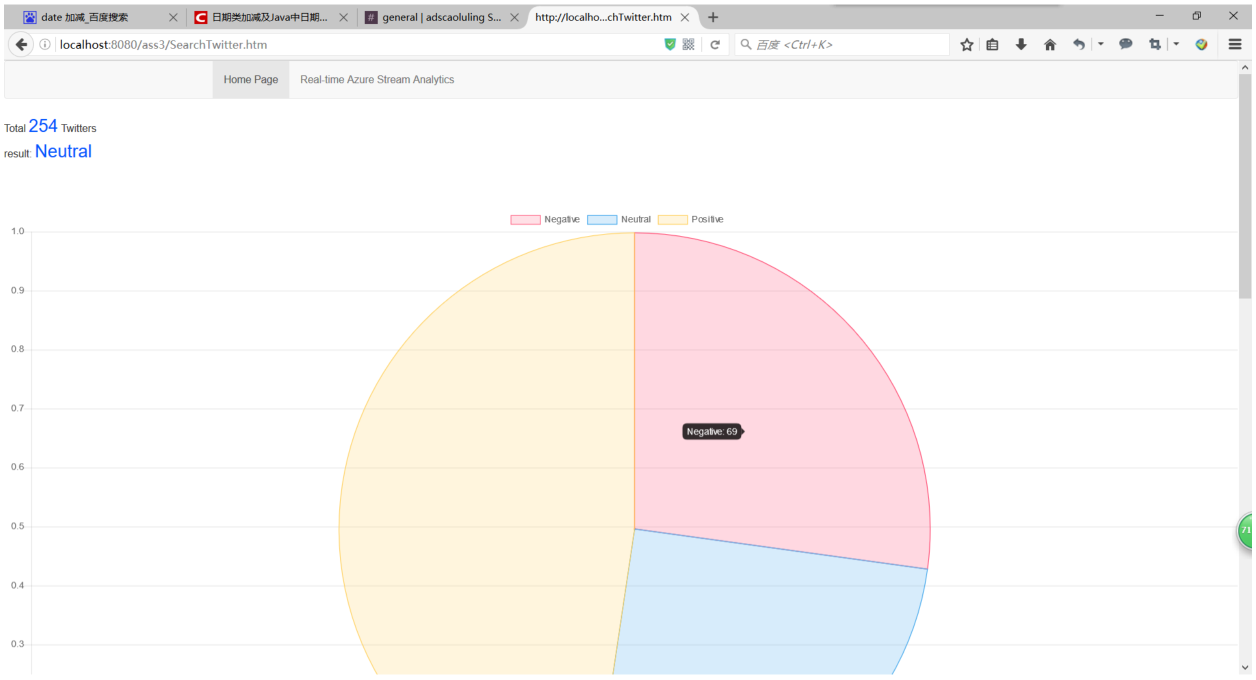
```
adsass3
  src/main/java
    com.ads.ass3
      HomeController.java
      HttpPostReq.java
      twitterController.java
  src/main/resources
    META-INF
    log4j.xml
    twitter4j.properties
  src/test/java
  src/test/resources
  JRE System Library [JavaSE-1.6]
  Maven Dependencies
  Referenced Libraries
  src
    main
      webapp
        resources
        WEB-INF
          classes
          spring
          views
            home.jsp
            res.jsp
            result.jsp
          web.xml
```

This is our home page



One the left can search tweets based on time period, one the right can search tweets in details

The right hand function:

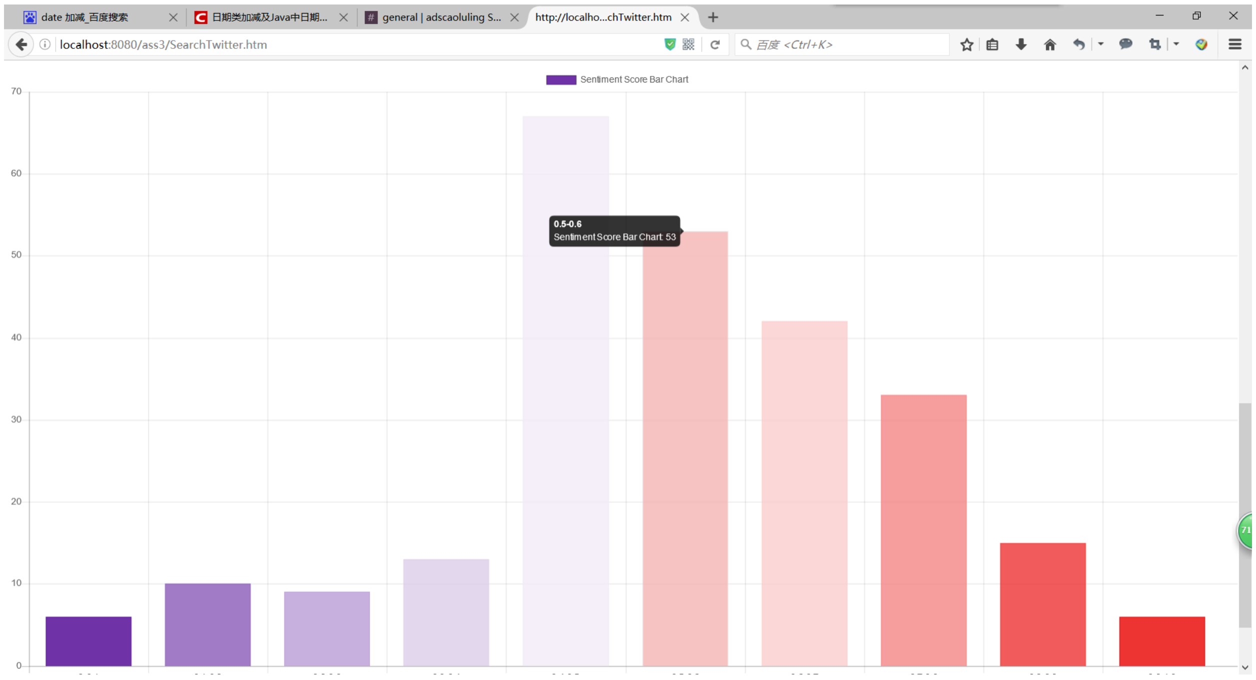


localhost:8080/ass3/SearchTwitter.htm
Home Page
Real-time Azure Stream Analytics
Negative
Neutral
Positive
Negative: 69
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3

Total 254 Twitters

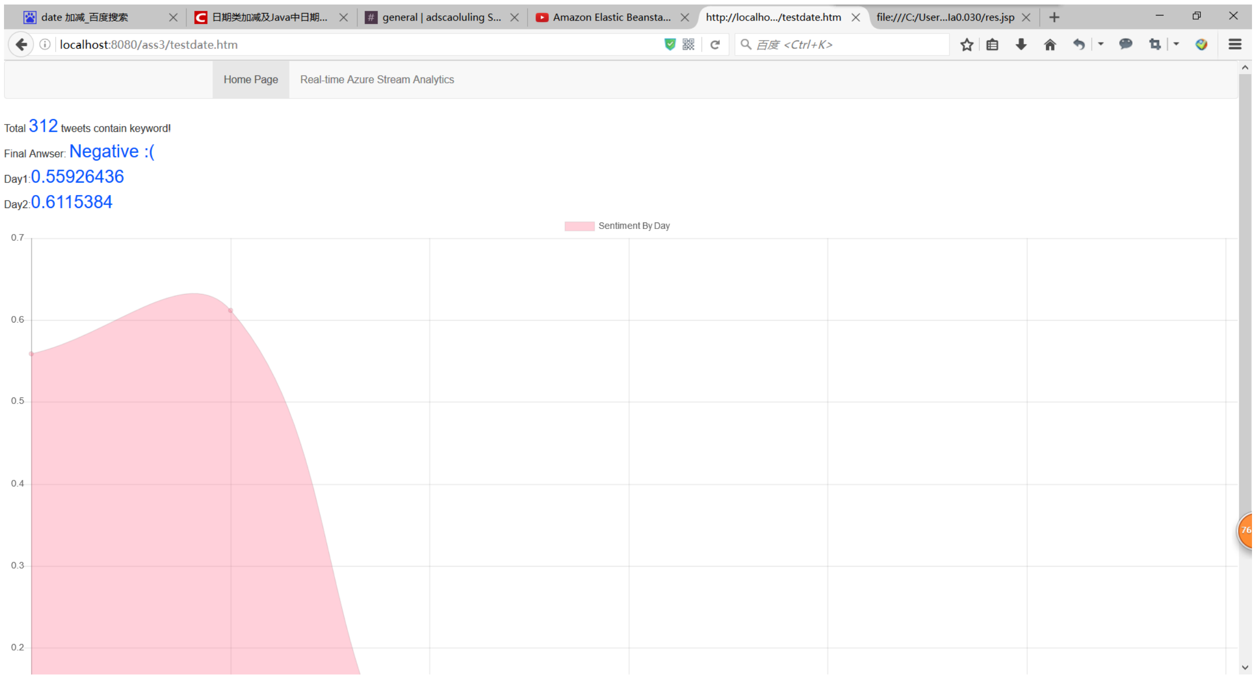
result: Neutral

This graph shows the percentage of people's feeling.



This graph shows the distribution of people's feeling

This is the left hand function page, the information of total tweets, final answer and details of date are shown.


date 加减_百度搜索
日期类加减及Java中日期...
general | adscaoluling S...
Amazon Elastic Beansta...
http://localho.../testdate.htm
file:///C:/User...la0.030/res.jsp
localhost:8080/ass3/testdate.htm
Home Page
Real-time Azure Stream Analytics

Total 312 tweets contain keyword!

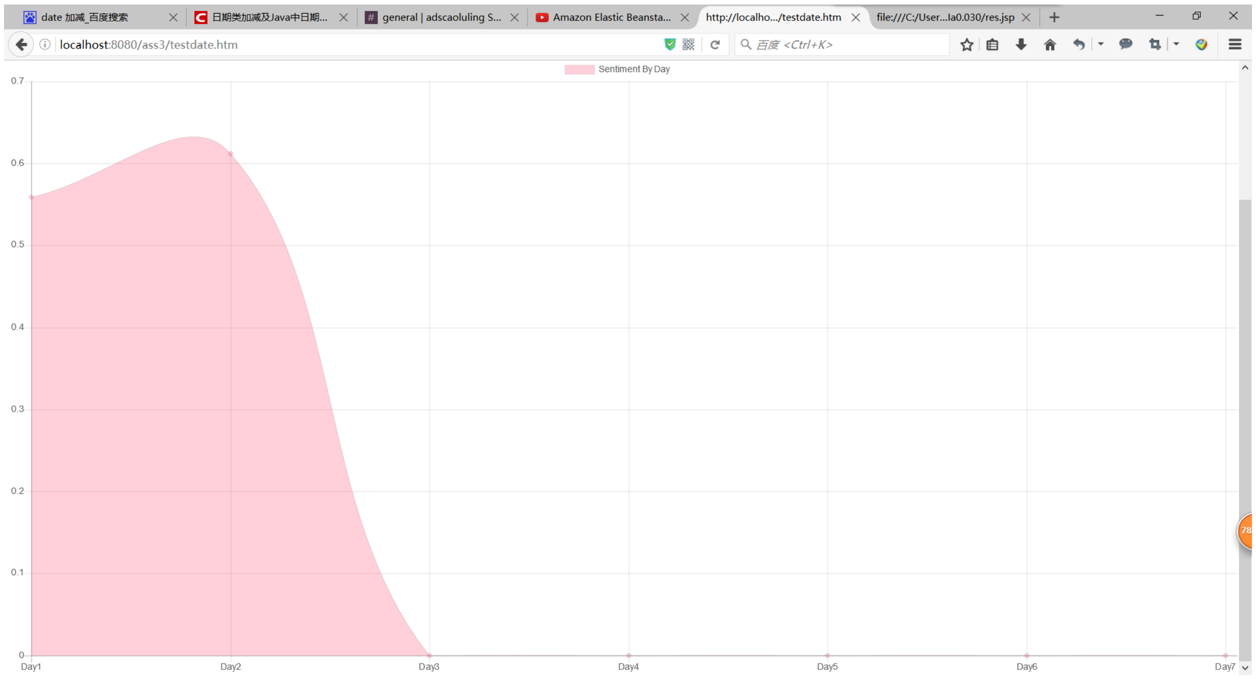
Final Anwser: Negative :(

Day1 0.55926436

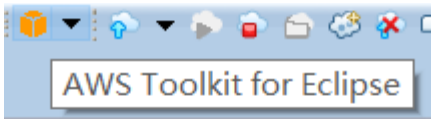
Day2 0.6115384

Sentiment By Day
0.7
0.6
0.5
0.4
0.3
0.2

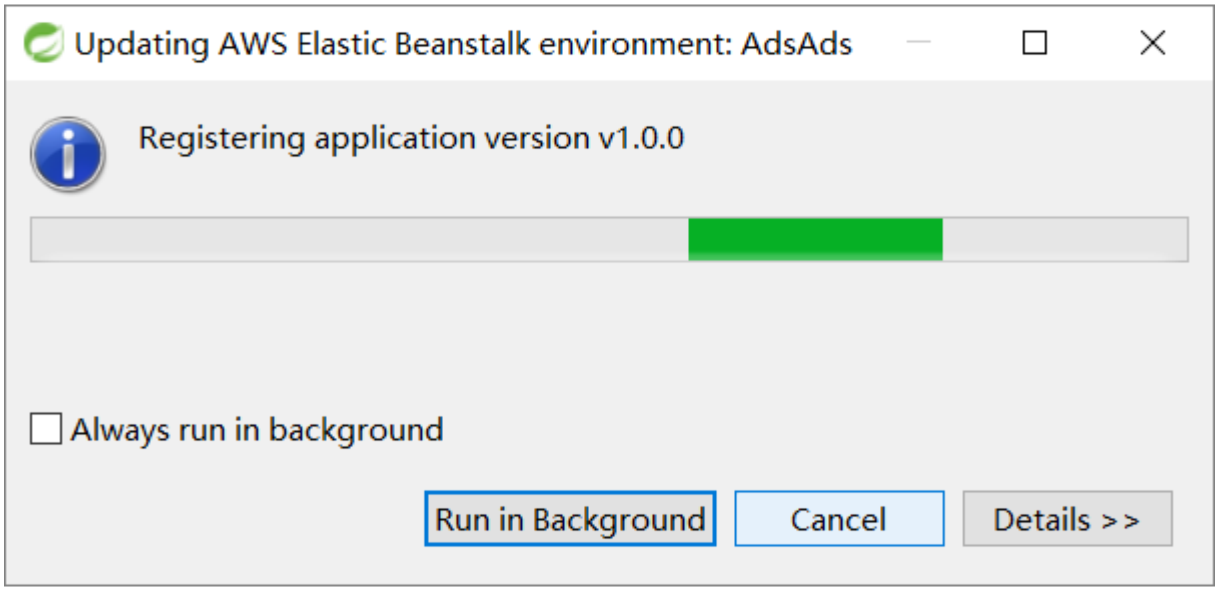
This is the whole graph of trend, x-axis is date, y-axis is score, 0 to 0.45 is negative, 0.46 to 0.55 is neutral, 0.56 and higher is positive.



To allow our web application to access by anywhere, we decided to use AWS ToolKit for Eclipse to put our app into AWS Elastic Beanstalk.



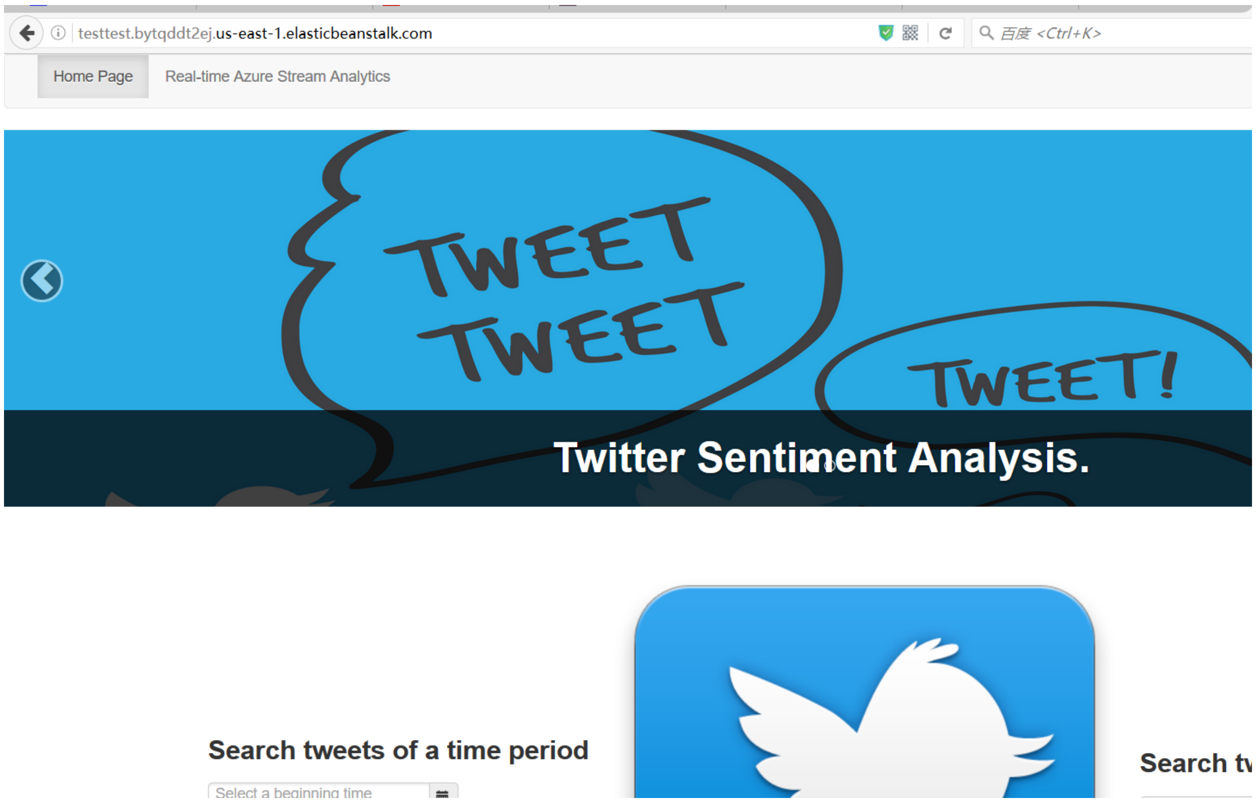
Uploading:



Updating AWS Elastic Beanstalk environment: AdsAds

Registering application version v1.0.0

After a few minutes, we can access our web by url:
http://adsa3final.kmftggpm5e.us-east-1.elasticbeanstalk.com/



testtest.bytqddt2ej.us-east-1.elasticbeanstalk.com

百度 <Ctrl+K>
Home Page
Real-time Azure Stream Analytics
TWEET TWEET
TWEET!
Twitter Sentiment Analysis.
Search tweets of a time period
Select a beginning time
Search tw