

# INLS 613 - Text Mining Assignment 2

Due: Monday, February 24, 2020 by 11:55pm via Sakai

## 1 Objective

The goal of this homework is to give you exposure to the practice of training and testing a machine-learning model for predictive analysis of text. You will use a toolkit called LightSIDE. As in HW1, the task is to classify movie reviews into *positive* and *negative* sentiment. You will be training a Naive Bayes classifier to predict whether a movie review expresses a positive or negative opinion. The *primary* goal of the assignment is for you to learn to experiment with different feature representations and do error analysis, and to review some concepts we've covered in class.

## 2 Software Details and Data

LightSIDE is a text-mining toolkit built by Elijah Mayfield at Carnegie Mellon University. You are expected to learn how to use it as part of this exercise. The user's manual is a great place to start!<sup>1</sup> You can download and install LightSIDE on your own computers.

The training and test sets for this assignment can also be found inside the `/LightSIDE/data/hw` directory. These are smaller versions than the datasets used for Assignment #1.

## 3 LightSIDE Exercises

Complete the following exercises. Please provide your answers using complete paragraphs. Make sure you use a Naive Bayes classifier (the default classifier) and, with the exception of Exercise #5 below, make sure you use unigram features and select the "Skip stopwords in N-Grams" option.<sup>2</sup>

1. Generate a feature table using unigram features. LightSIDE provides several metrics that measure the degree of co-occurrence between a feature and a target class value (in our case, *positive* and *negative*). This and the next question focus on precision. Suppose you have the following contingency table:

	positive	negative
word $w$ occurs	$a$	$b$
word $w$ does not occur	$c$	$d$

The precision of term  $w$  with respect to the *positive* class is given by  $\frac{a}{(a+b)}$ , and the precision of term  $w$  with respect to the *negative* class is given by  $\frac{b}{(a+b)}$ .

Sort the feature table by descending order of precision with respect to the positive class. You can do this by selecting *positive* in the "Evaluations to Display" tab and then double-clicking on the header labeled "precision". This functionality is illustrated in Figure 1.a.

<sup>1</sup>[http://ankara.lti.cs.cmu.edu/side/LightSide\\_Researchers\\_Manual.pdf](http://ankara.lti.cs.cmu.edu/side/LightSide_Researchers_Manual.pdf)

<sup>2</sup>This option tells LightSIDE to remove stopwords from your unigram feature representation.

At the top of the list, you will find some terms you might expect. For example, “breath-taking” has perfect precision with respect to the *positive* class. There are, however, a few surprises. For example, “ultimately” has perfect precision with respect to the *positive* class. Choose a feature from the top of the list that you did not expect to be perfectly correlated with a particular class value and look at the instances in `train.csv` where the term appears. List the term, its precision value, and provide an explanation for why the term has a high co-occurrence with the target class value. Is the term associated with some language phenomenon that you did not anticipate, or is it a statistical anomaly. (20%)

2. Now, look at the middle of the list. Here, you will find terms that have a precision of 0.5 for a given class value. In other words, these are terms that occur an equal number of times in *positive* and *negative* reviews. Again, here you will find some terms you might expect. For example, “zombies” occurs an equal number of times in *positive* and *negative* reviews. There are, however, a few surprises. For example, “depressing” (an arguably negative term) also appears an equal number of times in *positive* and *negative* reviews. Choose a feature from the middle of the list (with a precision value of about 0.50) that you did not expect to be *uncorrelated* with a particular class value and look at the instances in `train.csv` where the term appears. List the term, its precision value, and try to provide an explanation for why the term has a low co-occurrence with the target class value that you expected it to have a high co-occurrence with. (20%)

3. Train a model on `train.csv` and then re-apply this model to `train.csv` (yes, the same file). How does the accuracy of the model on `train.csv` (trained on `train.csv` and tested on `train.csv`) compare to its performance on `test.csv` (trained on `train.csv` and tested on `test.csv`)? This functionality is illustrated in Figure 1.b.

You’ll notice that the model’s accuracy on `train.csv` is not perfect. In other words, the model fails to correctly predict some instances it used to estimate its own model parameters! Use the “predict labels” functionality in LightSIDE (Figure 1.c) to output the model’s predictions on `train.csv`. Select a false positive or false negative prediction, copy/paste it into your report, and provide an explanation for why you think the instance is particularly difficult. (20%)

4. LightSIDE allows you to set a threshold on the minimum number of training set instances that must contain a particular feature in order for that feature to make it into the feature representation (Figure 1.a).

Let’s call this threshold  $t$ . If we set  $t = 1$ , then every term in the training set makes it into the feature representation. If we set  $t = 2$ , then only terms that appear in *at least 2* training set instances make into the feature representation. If we set  $t = 5$ , then only terms that appear in *at least 5* training set instances make into the feature representation. You should convince yourself that greater values of  $t$  lead to fewer features.

Fill out the table below with the accuracy numbers from training models with  $t = 1, 2, 3, 4, 5$  and evaluating these models on the training set (second column) and on the test set (third column). Using LightSIDE, this will require you to construct five different *feature tables* in the ‘Extract Features’ tab and perform 10 train/test operations in the ‘Build Models’ tab.

How does the accuracy of the classifier change for these different values of this threshold on the training set and on the test set? Write a short paragraph explaining what is happening and why. (20%)

threshold	training set accuracy	test set accuracy
1	?	?
2	?	?
3	?	?
4	?	?
5	?	?

5. Explore different feature representations in order to improve the accuracy of your Naive Bayes classifier on test.csv. You can generate different feature representations by selecting different types of features from the “configuration plugin” pane (Figure 1.a) and by adjusting the threshold parameter mentioned in the previous question (Figure 1.a) . Note that LightSIDE can be slow to learn a model and apply a model when the feature representation is large. Provide a couple of paragraphs description of what you tried, what worked, and what did not work.

The student that achieves the best accuracy (on test.csv) will be given ONE bonus point towards his/her final grade and, of course, fame and glory. **(20%)**

## 4 Submission

Submit all your answers in the form of a report. Please submit Word and PDF formats only. As in HW1, include your best accuracy for Exercise #5 in your report.

Find "train.csv" under data/hw directory

This "rare threshold" tells LightSIDE to only keep features that appear in at least n instances

Select "pos" or "neg" to evaluate the co-occurrence of features with respect to the pos/neg class according to these metrics

For all questions except for #5, select this configuration: unigrams and stopwords removed

Click here to reverse the order of features based on the metric selected in "Evaluations to Display" (in this case, precision).

**(a) Feature Representation Interface**

Here, you can select any of the feature representations constructed in the "Extract Features" tab.

Clicking "train" will automatically train a model using the data imported in the "Extract Features" tab and will test the model on the "Supplied Test Set"

Evaluation outcomes from train/test experiment

In this assignment, you will always supply a test set. In some cases, train.csv and in other cases test.csv.

Metric	Value
Accuracy	0.802
Recall	0.6018

Act \ Pred	neg	pos
neg	88	56
pos	43	200

**(b) Model Building and Evaluation Interface**

Choose the model you want to apply. You will be able to select models trained in the "Build Models" tab.

Import the file you want to make predictions for.

You can use this button to export this prediction data to a csv file (that you can open in excel)

Use this display to compare the prediction and true values.

class	class_prediction	text
neg	neg	I do not know what today's movie goes exp...
neg	pos	The film producers are hoping that Camer...
neg	pos	At first sight I must say already watch the C...
neg	pos	Just listen to the Broadway cast album and t...
neg	pos	Brave cross-dressing title box finds success...
neg	neg	How dare you? Adam Ore without apparent...
pos	pos	The first version of the film is 122 minutes. S...
pos	pos	After some further thought about the film I...
pos	pos	I was a junior in high school when Fleish hit th...
pos	pos	And I do. Peter Falk has created a role that...
neg	neg	Okay... she's on the boat with the guy realiz...
pos	pos	Engaging entry from Europe about Czech fig...
neg	pos	Maybe this movie was actually intended to b...
neg	pos	Once again Biner is faced with the dilemma o...
pos	pos	Inevitably one of the most interesting films...
neg	neg	Not for those adrenaline maniacs etc: It's a g...
pos	pos	In watching this off and on for a few season...
neg	neg	Directed by a veteran Hollywood director he...
pos	pos	Having worked professionally with young grl...
neg	neg	There's something going on in this film direc...
pos	pos	What annoys me with so called science prog...
pos	pos	I saw the world premiere at the Toronto Inte...
neg	neg	I never saw Doctor Who before (at least not ...
neg	neg	====>Mogler (Aha!!!!!! I suppose that you...
neg	neg	Based on a Stephen King novel NEEEDUL THE...
neg	neg	House of the Damned (also known as Spectr...
neg	neg	He being from Australia and being the serie...
pos	pos	My wife and I find this movie to be a wonderf...
pos	pos	This movie sucked sooo bad I couldn't even ...
pos	pos	I enjoyed this show it was on in the UK but ...
pos	pos	Having discovered the Ring Trilogy I have be...
neg	neg	I want the 99 minutes of my life back that wa...
neg	neg	me and a couple friends form university - ab...
pos	pos	It came before the ten commandments land ...
pos	pos	I thought the movie was great if you didn't ...
pos	pos	I went into this film thinking I wasn't going to...

**(c) Prediction/Annotation Interface**

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Figure 1: LightSIDE Screen Shots