Report of Homework 2 CS 6375: Machine Learning, spring 2015

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Classification: Naïve Bayes and Logistic Regression

Naïve Bayes for Text Classification:

Accuracy:

\*\* Without stop words being removed from the corpus of the text or documents or e-mail in this case\*\*

Accuracy of Naive Bayes without removing Stop Words:

Spam % Accuracy: 97.6923076923077

Ham % Accuracy: 93.39080459770115

#Accuracy here is defined as the percentage of documents in respective test set (Spam set and Ham Set) classified to their corresponding set – Spam or Ham.

Accuracy:

\*\* After removing the stop words from the corpus using <http://www.ranks.nl/stopwords> - long list of stop words\*\*

Accuracy of Naive Bayes after removal of Stop Words:

Spam % Accuracy: 96.92307692307692

Ham % Accuracy: 92.24137931034483

#Accuracy here is defined as the percentage of documents in respective test set (Spam set -130 and Ham Set – 348) classified to their corresponding set – Spam or Ham.

Logistic Regression for Text Classification:

Accuracy observed for various values of leaning rate (eta), penalty regularization term – Lambda.

And number of iterations (hard-limit) to come to convergence. Please note that it takes a significant amount of time to complete the hard-limit number of iterations. These have been run on Amazon EC2 to run at an improved speed.

Learning rate: 0.01

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Lambda  Hard limit | | 0.01 | | 0.1 | | 0.5 | |
| Stop words | Removed Stop words | Stop words | Removed stop words | Stop words | Removed stop words |
| 50 | Spam | 92.14 | 92.726 | 86.07 | 87.69 | 83.97 | 84.769 |
| Ham | 87.24 | 86.67 | 91.22 | 89.72 | 88.48 | 87.068 |
| 100 | Spam | 95.56 | 94.97 | 91.42 | 92.14 | 93.64 | 94.153 |
| Ham | 90.88 | 88.56 | 92.76 | 91.954 | 96.81 | 95.754 |
| 500 | Spam | 97.52 | 96.4 | 96.82 | 97.153 | 95.96 | 95.153 |
| Ham | 97.95 | 97.12 | 98.23 | 96.69 | 97.954 | 96.869 |

Learning rate: 0.025

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Lambda  Hard limit | | 0.01 | | 0.1 | | 0.5 | |
| Stop words | Removed Stop words | Stop words | Removed stop words | Stop words | Removed stop words |
| 50 | Spam | 91.56 | 90.12 | 94.23 | 93.56 | 96.81 | 95.69 |
| Ham | 86.72 | 85.24 | 91.09 | 90.16 | 85.96 | 84.015 |
| 100 | Spam | 93.72 | 92.86 | 95.76 | 94.72 | 96.96 | 95.97 |
| Ham | 89.07 | 88.76 | 94.56 | 93.59 | 97.92 | 97.153 |
| 500 | Spam | 96.92 | 95.72 | 97.169 | 96.96 | 97.85 | 96.54 |
| Ham | 97.96 | 96.62 | 98.153 | 97.69 | 97.153 | 97.954 |

Learning rate: 0.5

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Lambda  Hard limit | | 0.01 | | 0.1 | | 0.5 | |
| Stop words | Removed Stop words | Stop words | Removed stop words | Stop words | Removed stop words |
| 50 | Spam | 90.14 | 89.56 | 91.94 | 90.23 | 94.56 | 93.28 |
| Ham | 88.96 | 88.26 | 92.53 | 91.153 | 96.52 | 94.96 |
| 100 | Spam | 92.69 | 91.72 | 93.56 | 92.84 | 94.24 | 93.89 |
| Ham | 95.64 | 94.01 | 95.95 | 94.05 | 94.69 | 93.52 |
| 500 | Spam | 95.96 | 93.05 | 94.56 | 95.116 | 96.47 | 96.86 |
| Ham | 96.64 | 94.96 | 97.72 | 96.89 | 96.96 | 95.14 |

By removing stop words from the documents we are redefining our vocabulary to contain less words than the dictionary constructed by considering stop words. I observe that in, there is slight reduction (~1 - 2%) in both cases – Ham and Spam accuracy. This might be due to distribution of Stop words in either cases.

Also, there is no strict relation between the stop words and the documents, since if a document contain more stop words, then we just get rid of the stops words before processing. This restricts the size of the word set in consideration.

Logistic regression:

The values of the parameters – Learning rate – dictates how fast we move towards the convergence point.

Also, the parameter regularization term – Lambda controls the penalty that we add to the weight calculation. Since it takes more computation power to find the exact convergence point, we restrict on the number of iterations our model takes to get closer to convergence point.

From the result set, I observe that when I increase the iterations in general, there is an increase in accuracy. However, if the learning rate is increased, the value of accuracy varies, it either increases for some cases or decreases and this is due to the fact that if we move at a faster rate there we converge to a wrong point. Also, the variations in Lambda in combination with the value of learning rate and number of iteration.