**Aspect Sentiment classification and Analysis:**

**Book Review Data:** [**http://www.cs.jhu.edu/~mdredze/datasets/sentiment/index2.html**](http://www.cs.jhu.edu/~mdredze/datasets/sentiment/index2.html)

The goal of this project is to identify and extract sentence Aspects from Book Review text and use 3 classification methods to identify sentence polarity (positive, negative and neutral). Each classification method will be evaluated against the Book Review Rating to determine Precision, Recall, Accuracy and F-Score.

**Key Aspects words:** myth, hero, magical, god, science, mystery, fantasy, tale, folk, mirth and goddess.

**Classification Method1: Naïve Bayes Classification Method:**

For the each pre-selected Book Review Aspect, find the Aspect in the review text.

Build a vocabulary of total sentence words, total positive, total neutral and total negative sentence words. Positive, neutral and negative sentences are identified by the user rating.

**Ratings (1-2): Negative, Rating (3): Neutral and Ratings: (4-5) Positive.**

The sentence word frequency is used in this model. If word “good” occurs 3 times in a sentence it gets a count of 3.

Train the classifier on the first 80% of data and test on the last 20%.

The Naïve Bayes model uses the following equation to train the classifier.

**ClassNB(j) = argmax P(C(j)) \* SUM of Products P(w(i),C(j))/C(j)**

P(C(j)): **Prior Class Probability**. The total number of words in a class over all words in the training set

P(w(i),C(j)): Probability word(i) in class(j) over all words in class(j)

The model uses Laplace smoothing which requires 1 to be added to the numerator and the length of the entire vocabulary to be added to the denominator.

**P(w(i),C(j)) = (w(i),C(j)) + 1 / Sum C(j) + | vocabulary |**

Train the classifier and assign a positive, neutral or negative class to each Aspect sentence identified.

The test set is used to evaluate the strength of the model against the observations or review rating using various measures (Precision, Recall, Accuracy and F-score).

**Classification Method2 Alternate version: Boolean Multinomial Naïve Bayes Classification Method:**

For the each pre-selected Book Review Aspect, find the Aspect in the review text.

Build a vocabulary of total sentence words, total positive, total neutral and total negative sentence words. Positive, neutral and negative sentences are identified by the user rating.

**Ratings (1-2): Negative, Rating (3): Neutral and Ratings: (4-5) Positive.**

In this case, for Aspect sentence identified, use only a binary representation of the word.

If “good” occurs 3 times one in sentence, good is assigned a value of 1.

The idea is that the sentiment will not change if a positive, neutral or negative word is used more than once.

The same Naïve Bayes model is used to train and test the classifier.

**Classification Method3: Bag of Words**

For the each pre-selected Book Review Aspect, find the Aspect in the review text.

Calculate the target sentence sentiment Score using the bag of words method and identify polarity. Sentence sentiment scores less than 0 are negative, scores greater than zero positive.

Sentiment Scores will be calculated based on words from: AFINN and Harvard dictionaries.

For each positive or negative aspect sentence display the Review Rating, the Sentiment Score and Aspect Sentence. Display average the aspect rating, the overall sentiment score, the total number of classified positive and negative sentences along with classified percentage.

Use the SYNSET of the Aspect words to find positive and negative percentages.

Finally evaluate the strength of the model using Precision, Recall, Accuracy and F-Score against the user ratings.

**Measures used:**

**Accuracy in the context of Classification:** The total number of correctly predicted over all records

**Precision in the context of Classification:** The percent of correct predictions in a Class (Expectation) over all predictions in that Class: Correct and Incorrect. Precision is a measure of the exactness of a model. A low Precision indicates many false Positives.

**Recall in the context of Classification:** The number of correct predictions in a Class or Expectation over all items actually in that Class (Observation). Recall is a measure of the completeness of a model. A low Recall indicates many False Negatives.

**F-Score** **in the context of Classification**: F-score balances Precision and Recall giving equal weight to both. It can be a better measure of the strength of a model.

**Observation for Book Reviews:** Rating

Ratings from 1-2 are negative, Ratings equal to 3 are neutral, Ratings from 4-5 are positive.

Summary Statistics for the 3 models

**Naive Bayes Boolean MN Bag of Words**

Positive Precision: 0.858 0.858 0.902

Neutral Precision: 0.000 0.000

Negative Precision: 0.000 0.000 0.114

Positive Recall: 1.000 1.000 0.853

Neutral Recall: 0.000 0.000

Negative Recall: 0.000 0.000 0.170

Accuracy: 0.858 0.858 0.784

F-score: 0.924 0.924 1.020

Naive Bayes and Boolean Naive Bayes are the most Accurate classifiers: **0.858**

Bag of Words Model is third with an Accuracy of **0.784**

Bag of words model has a better F-score with **1.020**

Naive Bays and Multinomial Naive Bayes are tied with an F-Score of  **0.924**

The statistical methods (Naïve Bayes) are slightly better classifiers.