CSC411 - Project #3

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Part 1

Question   Describe the datasets. You will be predicting whether the review is positive or negative from keywords that appear in the review. Is that feasible? Give 3 examples of specific keywords that may be useful, together with statistics on how often they appear in positive and negative reviews.

Answer   It is feasible. The word "best" appears in 489 positive reviews and 365 negative reviews. The word "horrendous" appears in 3 positive reviews and 9 negative reviews. The word "awful" appears in 19 positive reviews and 103 negative reviews. Therefore, "best" could be useful to identify positive review, while "horrendous" and "awful" could be used to identify negative review. (There are 1000 positive reviews and 1000 negative reviews in total.)

Part 2

Question Implement the Naive Bayes algorithm for predicting whether the review is positive or negative. Tune the parameter m using the validation set, and report how you did it and what was the result. Report the performance on the training and the test sets that you obtain. Note that compting products of many small numbers leads to underflow. Use the fact that $a_1 a_2 \cdots a_n = exp(log a_1 + log a_2 + \cdots log a_n)$. In your report, explain how you used that fact.

Answer In order to predict the review, we use the formula:

$$P(class|a_1, \cdots, a_n) = \frac{P(a_1, \cdots, a_n|class)P(class)}{P(a_1, \cdots, a_n)}$$

If $P(positive|a_1, \cdots, a_n) \geq P(negative|a_1, \cdots, a_n)$, we predict the review to be positive. Otherwise, we predict the review to be negative. Because $P(a_1, \cdots, a_n)$ is the same for $P(positive|a_1, \cdots, a_n)$ and $P(negative|a_1, \cdots, a_n)$, we only need to compare $P(a_1, \cdots, a_n|positive)P(positive)$ and $P(a_1, \cdots, a_n|negative)P(negative)$.

$$P(a_1, \cdots, a_n|class)P(class) = P(a_1|class)P(a_2|class) \cdots P(a_n|class)P(class)$$
$$= exp(log(P(a_1|class)) + \cdots + log(P(a_n|class)) + log(P(class)))$$

Based on the formula above, we only need to compare $log(P(a_1|positive)) + \cdots + log(P(a_n|positive)) + log(P(positive))$ and $log(P(a_1|negative)) + \cdots + log(P(a_n|negative)) + log(P(negative))$. Therefore, we implemented our part 2 python program based on the comparison.

Part 3

Question   List the 10 words that most strongly predict that the review is positive, and the 10 words that most strongly predict that the review is negative. State how you obtained those in terms of the the conditional probabilities used in the Naive Bayes algorithm.

Answer

$$P(class|a_i) = \frac{P(a_i|class)P(class)}{P(a_i)}$$

$$P(class|a_i) = exp(log(P(a_i|class)) + log(P(class)) - log(P(a_i)))$$

We use the formula above to compute and compare $P(positive|a_i)$ for all words in positive reviews and $P(negative|a_i)$ for all words in negative reviews.

The top 10 words that predicts positive are:

'ziembicki', 'unites', 'ulu', 'torrance', 'toiling', 'tiegs', 'swope', 'salability', 'rothchild', 'rollergirl'

The top 10 words that predicts negative are:

'zaltar', 'workout', 'unmercifully', 'szwarc', 'stuffing', 'slunk', 'salkinds', 'refugees', 'popeye', 'omega-hedron'

Part 4

Question

Answer

Part 5

Question

Answer

Part 6

Question

Answer

Part 7

Question

Answer

Part 8

Question

Answer