Project for CS421 – University of Illinois at Chicago

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SETUP:

1. Kindly download the Stanford Core NLP package from http://nlp.stanford.edu/software/stanford-corenlp-full-2018-02-27.zip.
   Run the server on default port 9000 using the following command
   java -mx4g -cp "*" edu.stanford.nlp.pipeline.StanfordCoreNLPServer 9000

2. In the *execution* folder execute the following command
   bash run.sh
   After the script finishes running, please find the results in the output folder.

TECHNIQUES:

1. For **Length**, we separated the sentences using nltk's sentence tokenizer. Then the sentence was split with "," with respect to constraint of minimum 5 words (we had checked for various length and 4 was the best fit).

2. For **Spelling Mistakes**, we counted the number of words that do not appear in the enchant dictionary of "en_US" and "en_UK". Also, since we observed that enchant outputs some correct spelled words as incorrect, we used GloVe to be doubly sure about the spell check of the words in the training corpus. For example, if there are certain words that were marked incorrect by enchant and correct by GloVe, then they were stored in the separate list so as to compare these words with the words that occur later in the essays of test corpus. If yes (i.e they occur in the test corpus), then they won't be considered as incorrect. This helped us to prevent from the detection of incorrect spelling mistakes. Few other words like e.g. Mrs., Mr. ,etc. are correct and shouldn't be marked as errors, thus we have separately handled the cases where if either of such words occur, they are left untouched. *Using GloVe ensures correct spelling mistakes to be encountered and not incorrect ones.*
   We also gathered all possible lists of ProperNouns such as Countries, Cities, Brands, Companies, Languages, Nationalities, Days and Months.

3. For **Subject Verb** agreement, we used the parse tree given by Stanford Core NLP. Parse Tree helped us to map a list of all violating rules after traversing the tree to the pairs of incorrect POS tags in each sentence. We then traversed the parse tree to find the head noun and its corresponding verb to check if they disagree with the rules mentioned for subject and verb agreement.*The most important feature of using a ParseTree for this part is that it not only find the set of subject and the verb that are adjacent to each other (and violates the rule) but also those that are separated by many POS tags and violates the subject-verb agreement policy. This increases the chances of finding errors that are hard to catch otherwise.*

4. For **Verb agreement**, we used POS tagging technique to create bigrams and trigrams of only those words that matches the Verb list (verb list includes POS tags like “VB”, “VBZhas", “VBZis", “MD", “VBD", “VBG", “VBN” and “VBP"). The resulted chunks of bigrams and trigrams are checked against the rules (hand crafted verb disagreement criteria). If either of the two (bigrams or trigrams) matches any rule defined for verb disagreement then, that accounts for an error. Also, we have checked for the verb tense agreement by creating chunks of the sentences with each chunk having a verb associated with it. We created set of rules that check for the chunks that have occurrences of improper tense.

5. For **Sentence Formation error**, parse trees were exploited. Parse tree was seen for many examples to find pattern of errors in the sentence. It was found that trees where FRAG was child of non "S" or "SBAR" node, it was an error. Also "SBAR" where its parent was not NP, VP and S was seen as an error. So the parse tree was recursively traversed to find such FRAG and SBAR to get the errors.

6. For **Text Coherence,** we collected all pronouns and possessive objective and eliminated the ones that are not third person. Then, for every singular third person pronoun and possessives, we checked if there exists a male or female antecedents. If not, it was counted as an error. And finally, for plural third person pronouns and possessives we checked for one case of checking an antecedent where if there is no plural antecedent, or no singular antecedent with compatible number then it was counted as an error.

7. For **Topic Coherence,** we used an electronic dictionary called “WordNet” . We created the ‘synsets’ of each token in the essay and the words in corresponding topic. For each ‘synset’ for an essay word and a topic word, a similarity score is

calculated. Then for that particular pair of words, maximum similarity score (depends on maximum similarity in the meaning of the words) is calculated and added to the total score for that essay. In this way, we get the maximum score for the essay that have achieved the objective of addressing the actual topic of the essay. Once the similarity score for each essay is retrieved, the score is assigned on the basis of different thresholds.

Pattern of Errors

subject-verb disagreement rules such as [‘NNP', ‘VBP’], [‘NNP', ‘VB’], [‘NN', ‘VB’] etc. These sets of POS tags indicate that none of the two words having those tags are semantically correct if they are in the same sentence and thus accounts for an error.

verb rules include bigrams and trigrams such as [“VBD, VBG", “MD, VBZis”, “MD, VBZhas", “MD, VB, VBD”] etc. Presence of any such rules denotes the occurrences of incorrectly framed sentences with the improper usage of verbs. Verb Tense agreement includes certain pattern of errors such as [”MD,VB,VB”, "VBP,VB", “VBZ,VBG,VBZ”].

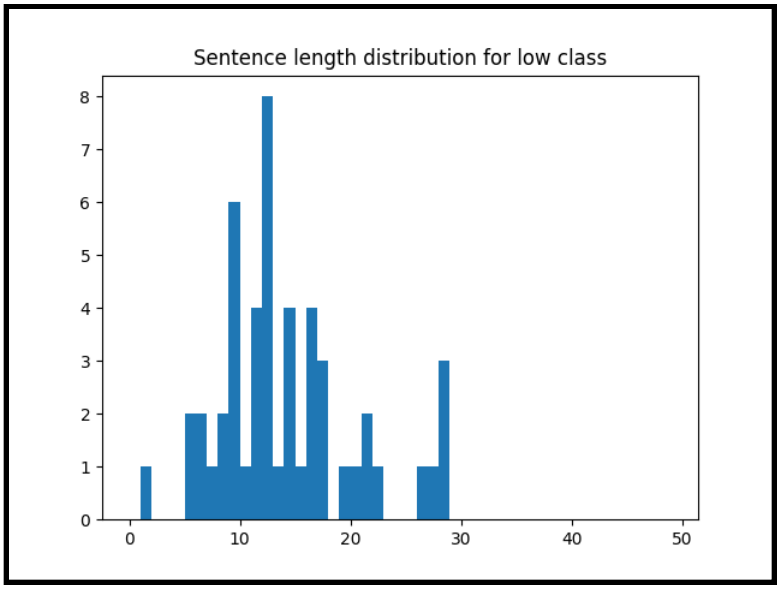
Sentence Formation error, patterns as follow were observed:
If ‘FRAG’ has non (“S" or "SBAR") parent
If "SBAR" has non (NP, VP or S) parent

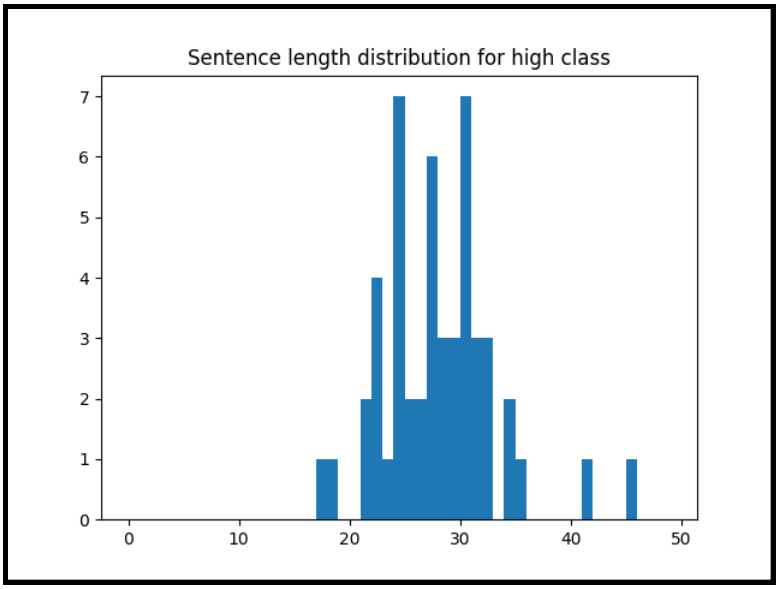
You can find the complete set of rules in score.py file.

Please find below the logic for finding scores from number of errors :

Calculation of the sub scores:

a. Number of sentences and length





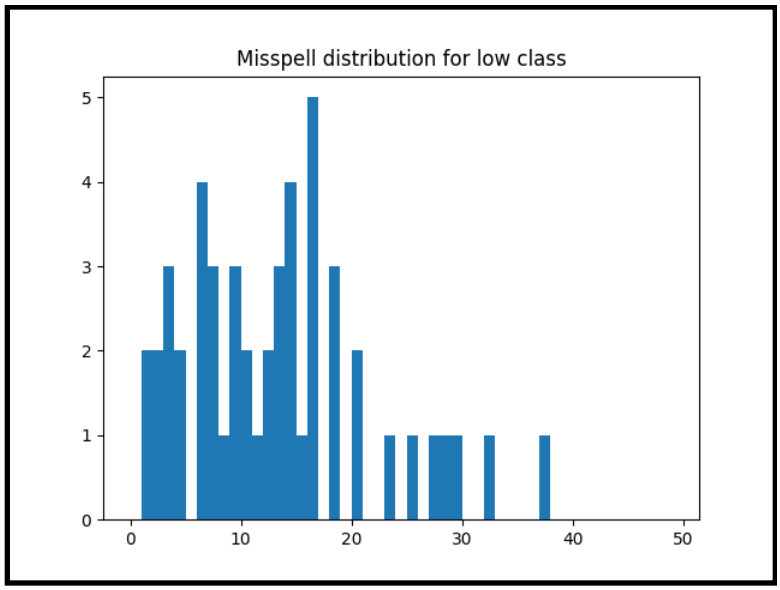
Histogram Distribution For The Length Of The Essays

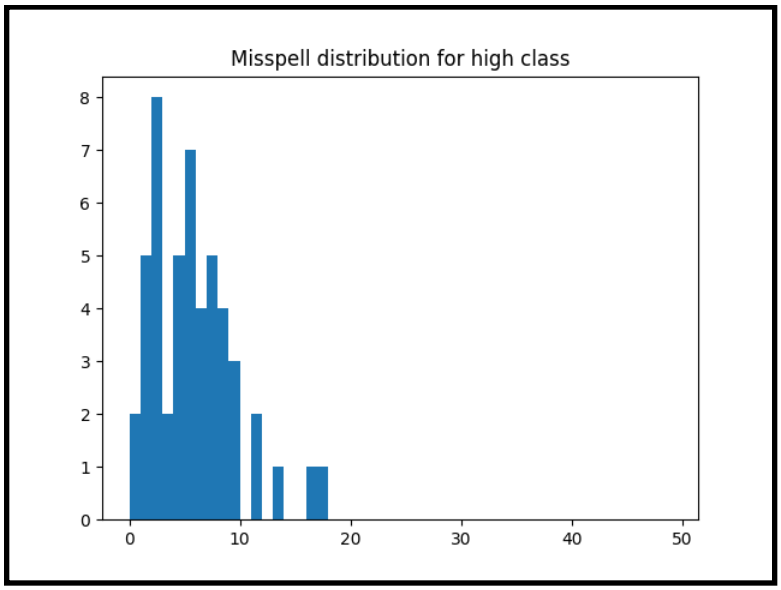
- The X-axis of the above histograms represents the possible length of the essays and the Y-axis represents the number of essays with a particular length.
- From the above distribution of the low and high essay types, following range of scores were inferred to score each essay on the basis of the appropriate length requirements.

Length (No of Sentences)	0 - 5	6 - 12	13 - 18	19 - 22	≥ 23
Score	1	2	3	4	5

Score Distribution Table For The Length Of The Essays

b. Spelling Mistakes





Histogram Distribution For the Spelling Mistakes In The Essays

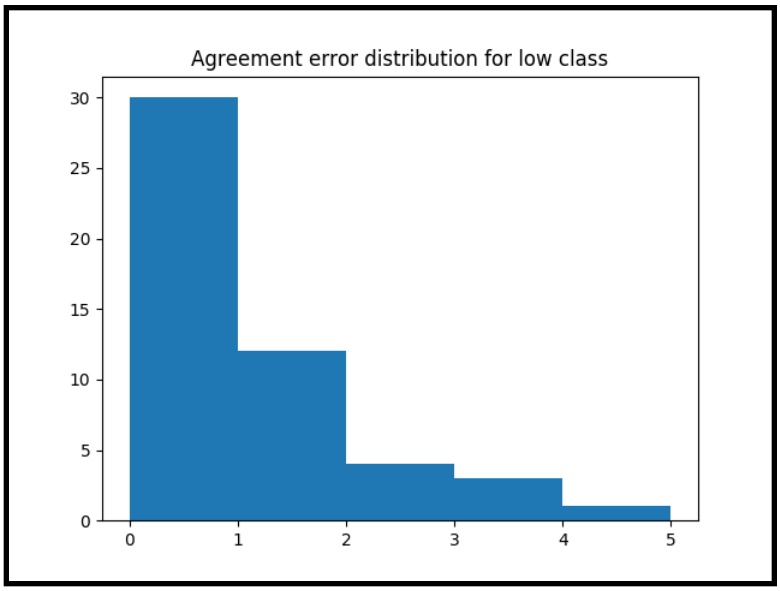
- The X-axis of the above histograms represents the possible number of spelling errors in the essays and the Y-axis represents the number of essays for a particular number of spelling mistakes.
- From the above distribution of the low and high essay types, following range of scores were inferred to score each essay on the basis of the occurrences of spelling mistakes in each essay.

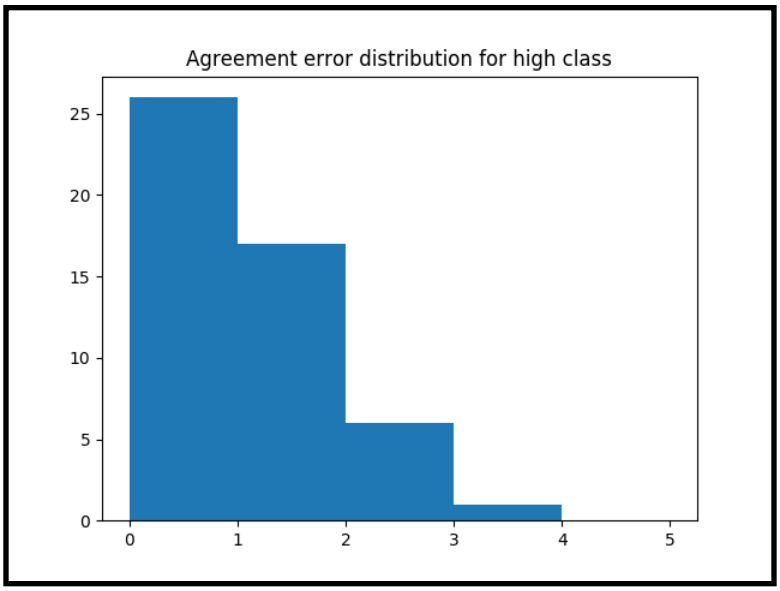
No of Spelling mistakes	0 - 5	6 - 10	11 - 15	16 - 20	≥ 21
Score	0	1	2	3	4

Score Distribution Table For The Spelling Mistakes In The Essays

c. Syntax and Grammar

c - i. Subject - Verb Agreement





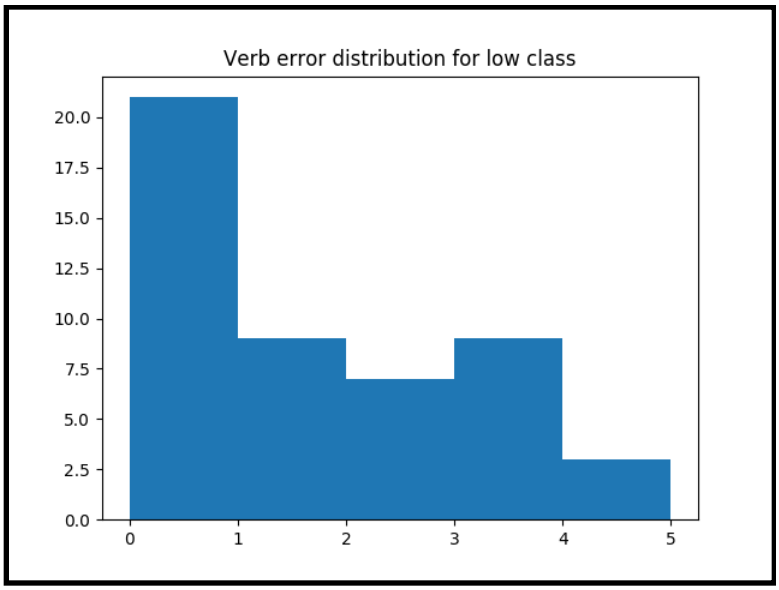
Histogram Distribution For The Subject - Verb Agreement Errors In The Essays

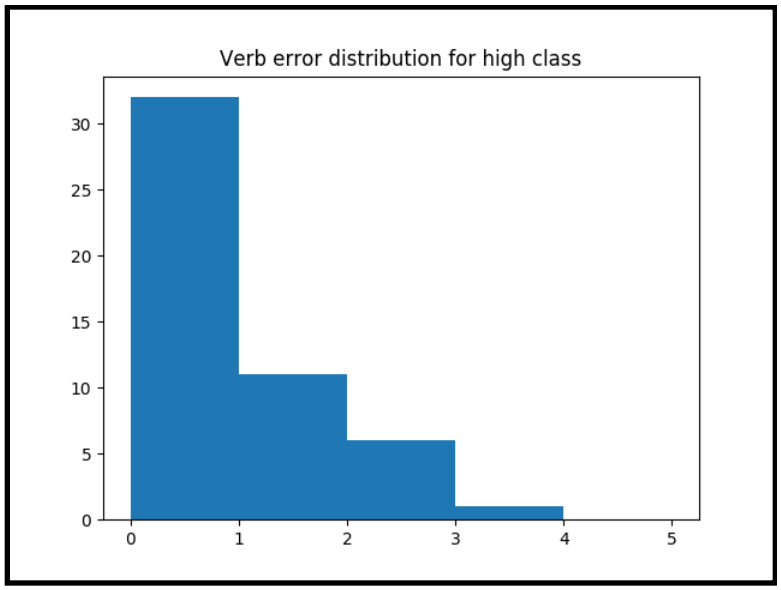
- The X-axis of the above histograms represents the possible number of subject - verb agreement errors in the essays and the Y-axis represents the number of essays for a particular number of agreement errors.
- From the above distribution of the low and high essay types, following range of scores were inferred to score each essay on the basis of the occurrences of subject - verb agreement errors in each essay.

No of Agreement Errors	1	2	3	4	>4
Score	5	4	3	2	1

Score Distribution Table For The Subject - Verb agreement Errors In The Essays

c - ii. Verbs





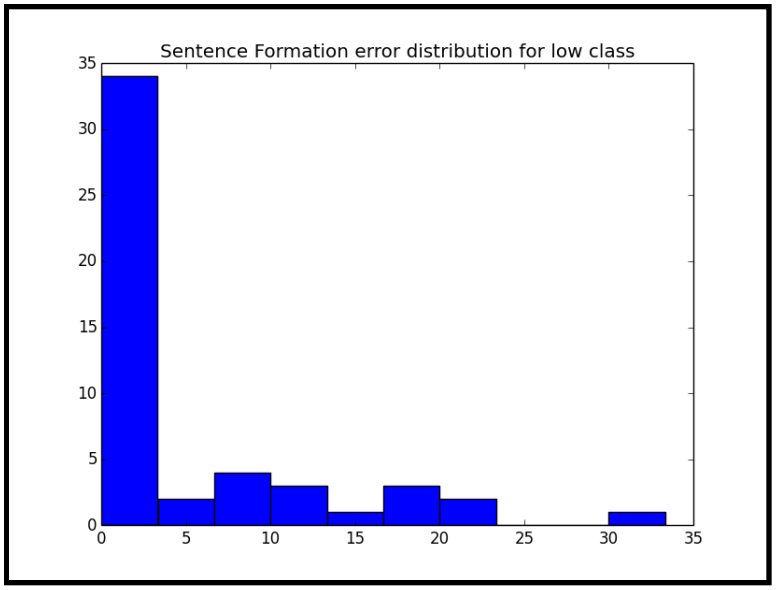
Histogram Distribution For The Verb Agreement Errors In The Essays

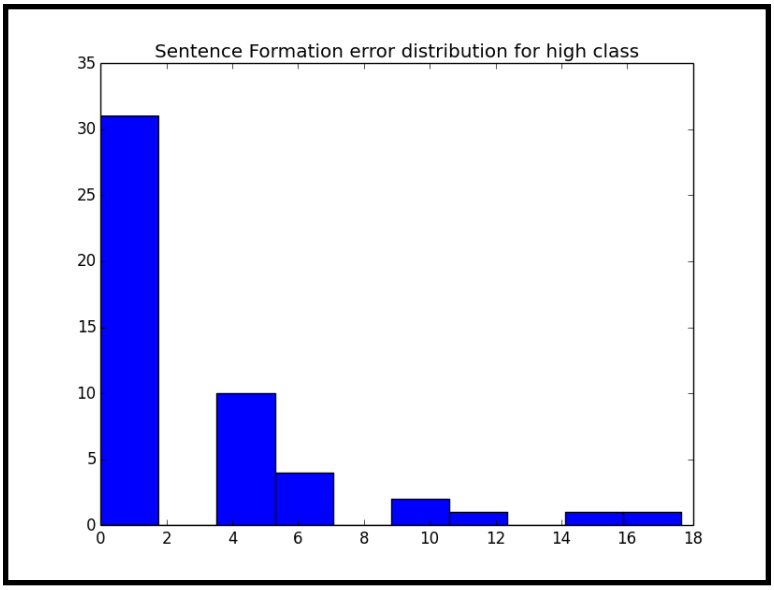
- The X-axis of the above histograms represents the possible number of verb errors in the essays and the Y-axis represents the number of essays for a particular number of verb errors.
- From the above distribution of the low and high essay types, following range of scores were inferred to score each essay on the basis of the occurrences of verb errors (including auxillary verbs, verb tenses) in each essay.

No of Verb Errors	1	2	3	4	>4
Score	5	4	3	2	1

Score Distribution Table For The Verb Errors In The Essays

c - iii. Sentence Formation



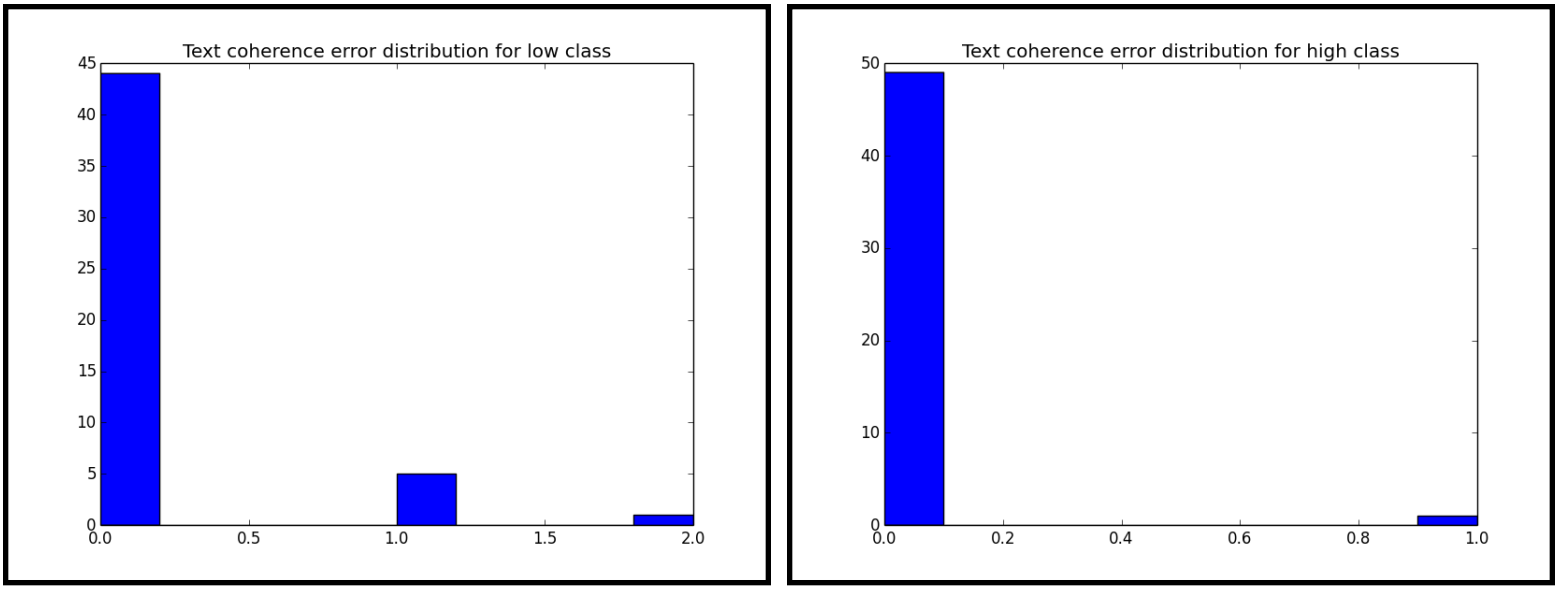


- The X-axis of the above histograms represents the Sentence Formation Errors Percentance in the essays and the Y-axis represents the number of essays for a particular number of Sentence Formation errors.
- From the above distribution of the low and high essay types, following range of scores were inferred to score each essay on the basis of the occurrences of Sentence Formation errors in each essay.

No of Sentence Formation Errors (in %)	0 - 5	5 - 10	10 -12	12 - 18	> 18
Score	5	4	3	2	1

Histogram Distribution For The Sentence Formation Errors In The Essays

d - i. Text Coherence - Essay Coherence via Pronouns



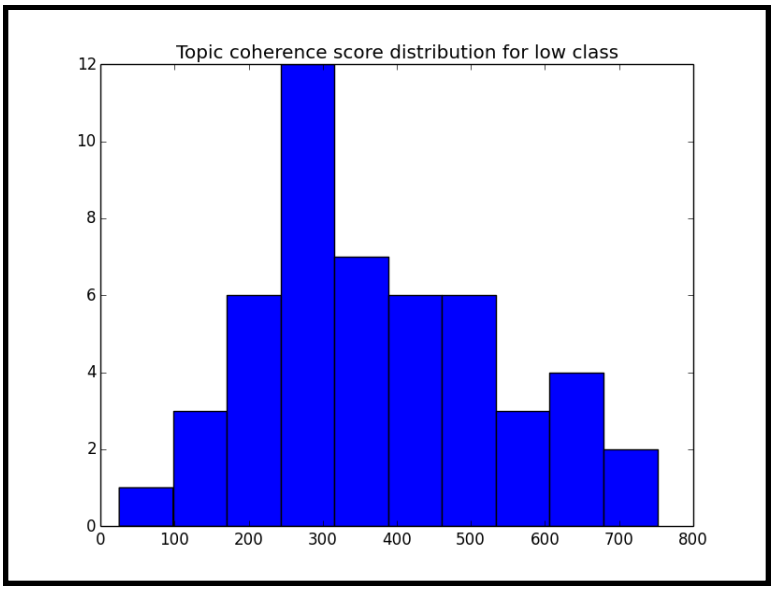
Histogram Distribution For The Text Coherence Errors In The Essays

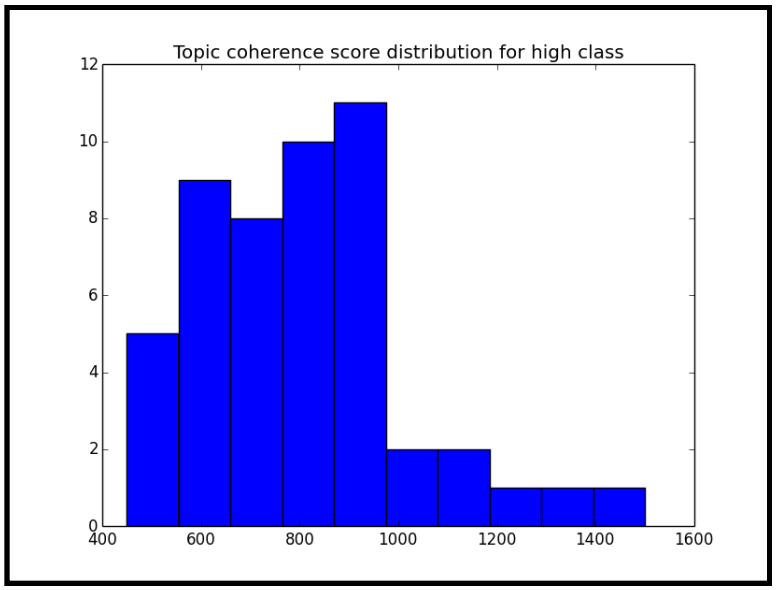
- The X-axis of the above histograms represents the number of Text Coherence Errors in the essays and the Y-axis represents the number of essays for a particular number of Sentence Formation errors.
- From the above distribution of the low and high essay types, following range of scores were inferred to score each essay on the basis of the occurrences of Text Coherence errors in each essay.

No of Text Coherence errors	0	-	1	-	2
Score	5	4	3	2	1

Score Distribution Table For The Text Coherence Errors In The Essays

d - ii. Topic Coherence





Histogram Distribution For The Topic Coherence Errors In The Essays

- The X-axis of the above histograms represents the Maximum Similarity score of words vs topic in the essays and the Y-axis represents the number of essays for a particular number of Sentence Formation errors.
- From the above distribution of the low and high essay types, following range of scores were inferred to score each essay on the basis of the occurrences of Topic Coherence similarity value in each essay.

MaxSimilarity score of words vs topic	>900	600 - 900	500 - 600	300 - 500	< 300
Score	5	4	3	2	1

Score Distribution Table For The Topic Coherence Errors In The Essays