

Cracking An Unsolved Civil War Cipher

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Civil War-era Military Document:

- Sender: F.J. Porter to Union General G. B. McClellan
- ~150 years old
- Possession: Lehigh University Library
- Status: Yet to be decrypted, original codebook unknown
- Previous work: Program by Professor Lopresti which output all possible decryptions of the letter.

Purpose of Research:

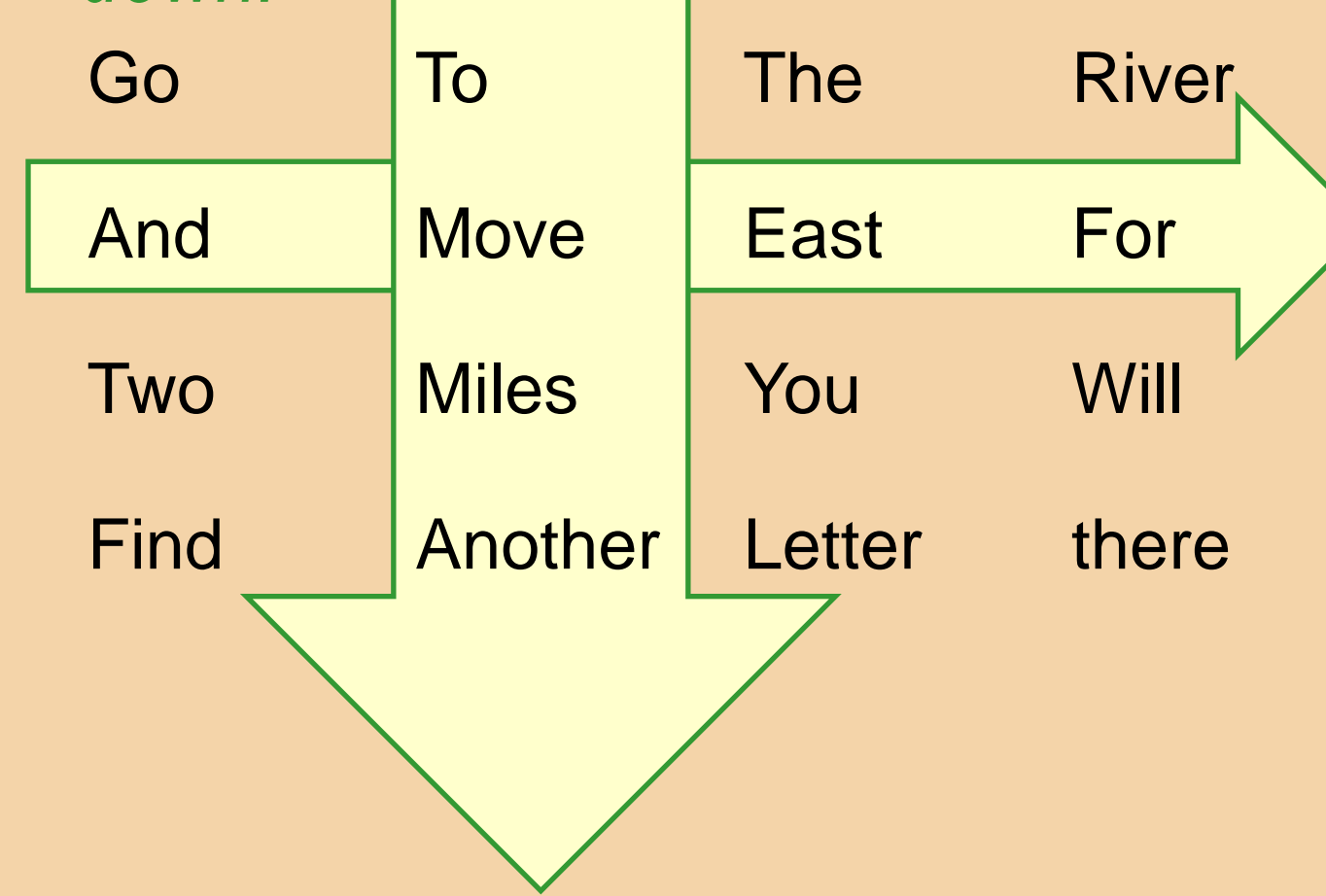
The goal of our project is to write a program that can grade texts based on their resemblance to proper English. This could be used to narrow down the possible decryptions of the civil war message output by Professor Lopresti's program.

Background

What is an encryption scheme?

The letter is broken up into a matrix and each word is a different element in the matrix. It is encrypted by transposing multiple columns or rows in the matrix in a specific manner. The order and manner in which they are shifted is the encryption scheme. The civil war message is encrypted with what is called the Stager cipher, which randomizes full words of a text using specific column/row routings. The diagrams to the right illustrate this method with the phrase: "Go to the river and move east for two miles. You will find another letter there." The encryption scheme is:

Third row, shift one element right.
Second column, shift one element down:



The encrypted message is then:

Go Another The River
for To Move East
Two And You Will
Find Miles Letter there

Technical Approach (Solution):

Develop a method to narrow down all the possible encryption schemes by using two primary programs that grade a body of text:

1. Bigrams Program:

- Take a large text corpus as input
- Tag all words as their appropriate parts of speech
- Calculates and outputs the parts of speech bigrams statistics

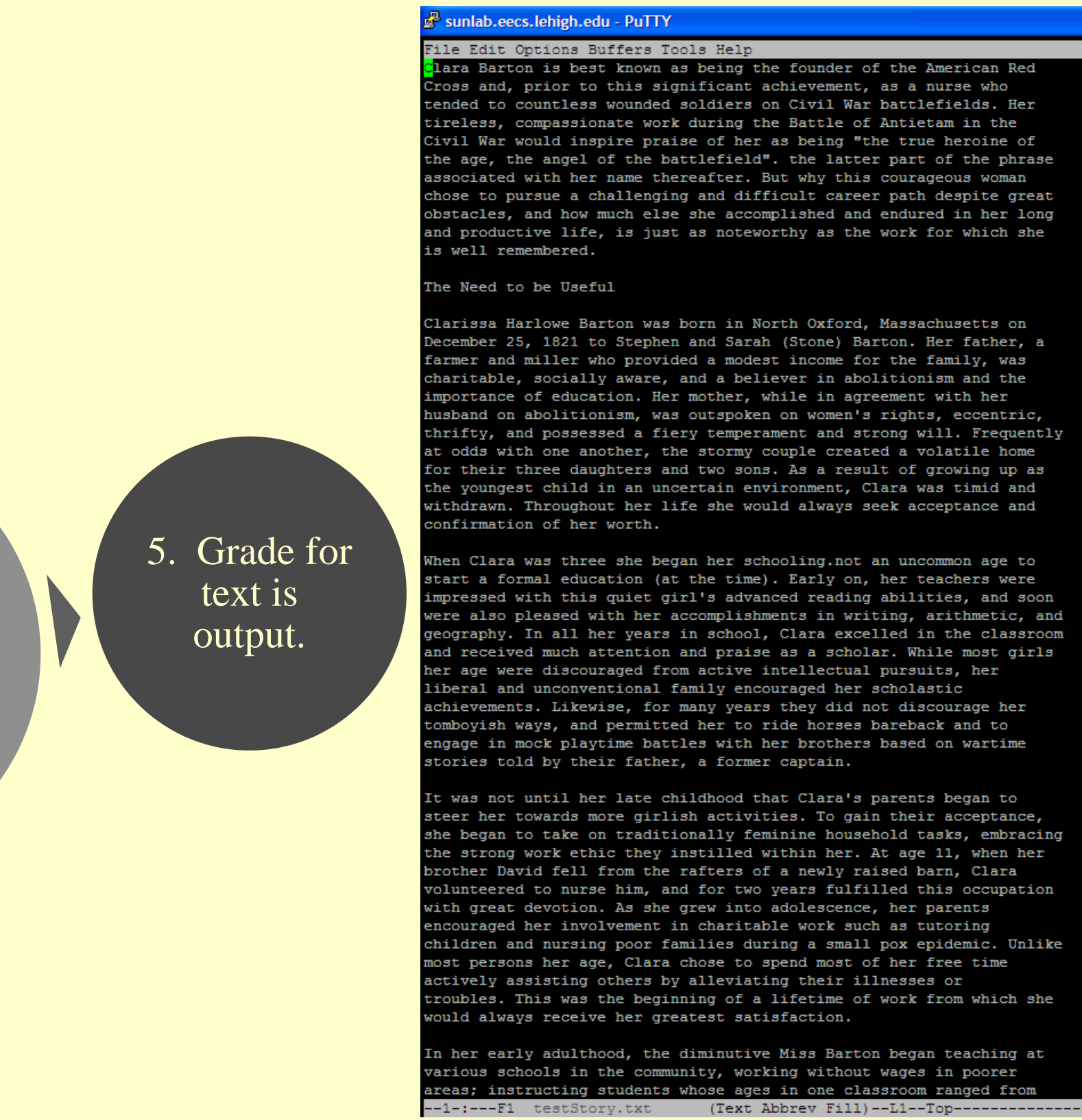
2. Natural Language Grading Program:

- Takes the parts of speech bigram statistics as the input
- Also takes a text to be tested as input
- Calculates and outputs a grade based on the bigram statistics

(the grade is indicative of the text's resemblance to formal English)

**Parts of speech tagger is courtesy of Stanford University. Software: Stanford Log-linear Part-of-Speech Tagger www.nlp.stanford.edu/software/tagger.shtml

Visual Representation:



Implementation

```
Clara exuberantly assisted the Union army by gathering and purchasing provisions for the soldiers, and
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Clara exuberantly assisted the Union army by gathering and purchasing provisions for the soldiers, and
Natural Language Grading Program reads in hash table and string of text being graded.
(example string shown above)

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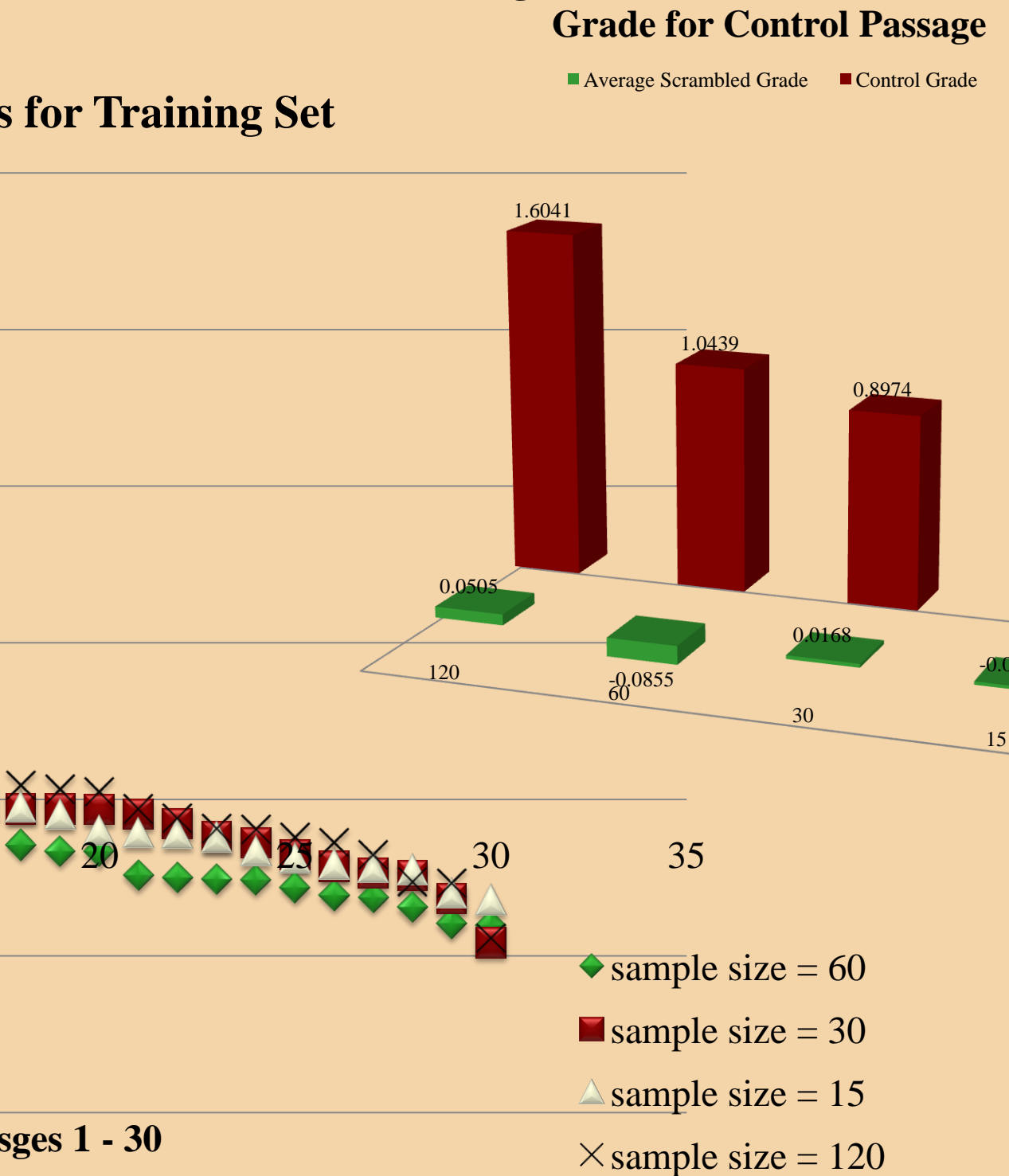
Bigrams Program that reads in large body of text.

Outputs a hash table with the bigram parts of speech frequencies.

Natural Language Grading Program calculates a grade based on the frequencies stating how correctly the sentence is written. (After testing, the grade for a proper sentence is anything above 0.4.)

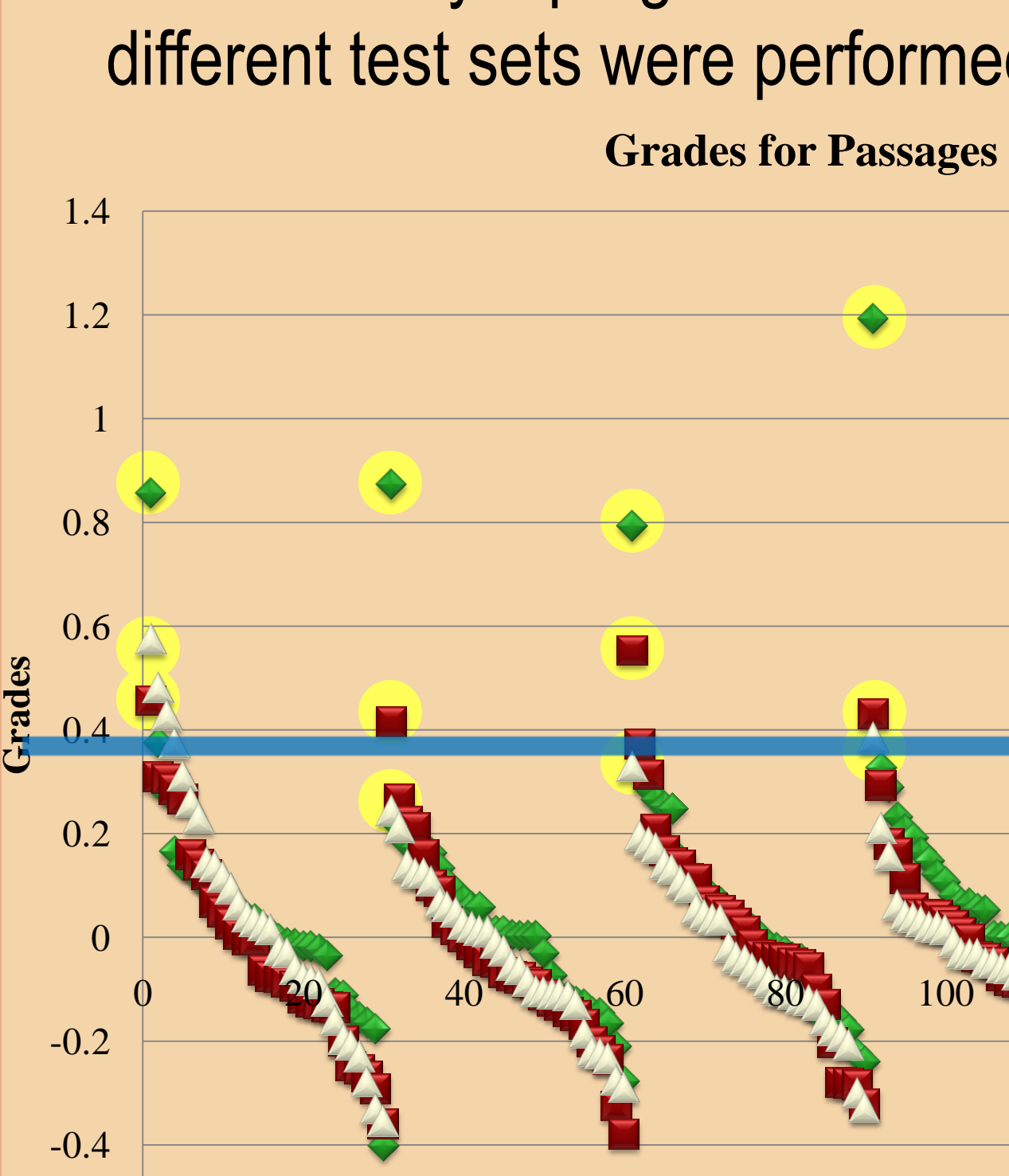
Training Set

15, 30, 60 and 120 word passages that could be found in the original bulk text were tested and given grades. 1 out of the 15, 30, 60 and 120 word samples were not scrambled and the rest of the passages were scrambled by a program that randomized the order of the words.



Testing Set

15, 30, and 60 word passages that could not be found in the original bulk text were tested and given grades. 1 out of the 15, 30, and 60 word samples were not scrambled and the rest of the passages were scrambled by a program that randomized the order of the words. 4 different test sets were performed.



The next step would be to use the Natural Language Grading Program to narrow down the possible encryption schemes. To corroborate our solution a decryption of the letter from Queens University produced a score output by our NLG program of 0.4554, which is above our 0.4 threshold, demonstrating our program's effectiveness. Since the parameters of the cipher are still unknown for this proposed solution, there is further work to be done. However, there may be other Civil War military documents yet to be decrypted that could utilize our software to narrow down their possible encryption schemes.

Technical Requirements

Development Platform: Windows
Development Environment: Eclipse
Software: Stanford Log-linear Part-of-Speech Tagger www.nlp.stanford.edu/software/tagger.shtml
Languages: Java and Tcl/Tk

Acknowledgements:

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