Reading Between the Lines: Sentiment Visualization for Poetry

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ABSTRACT

Poetry has been around for thousands of years, yet it always lived in a fluid state of development. Given the current technological development applied to literature studies, the classification of emotional states from poetry has not been receiving enough attention in the NLP world given its flexible connection to traditional grammatical structure. This paper discusses Reading Between the Lines, a sentiment visualization project specifically designed for poetry. The project intends provide assistance to build alternative view for readers when interpret the expression of emotions in poetic works.

KEYWORDS

Data Visualization; Visual Analytics; Computation; Literature Interpretation; Natural Language Processing, Sentiment Lexicon.

CCS CONCEPTS

Human-centered computing, Data Visualization, Vis. application domains, Visual analytics

1. INTRODUCTION

Poetry is one of the most subjective and expressive forms of literature. As a verbal art form, it predates written text, often involved with emotions, history, culture, religion, and personal expression. Often the best poems are written from the heart, raw, emotional, and to the point. Poem favors brevity, yet the best poems also capture a great amount of detail, making them incredibly powerful to their readers. This makes poetry often difficult to fully understand due to its unique literature structure.

Figure 0: Reading Between the Lines Project Cover

Reading Between the Lines (Figure 0) explores ways poetry can be interpreted computationally via NLP analysis, as well as if visualization can be used as a tool to provide insights to help the readers deconstruct the poet's choice of words behind their creation, or provide a new perspective for the poet on what they have written.

2. RELATED WORKS

Sentiment analysis in Natural Language Processing is the application of text analysis and computational linguistics techniques to systematically extract, quantify, and identify affective states and subjective information in a text sample. The standard categories of classifications include valence, arousal, dominance, concreteness, etc (Peters, M.E. et al, 2018).

Using NLP or Deep learning in the context of poetry has grown in popularity over the past few years. Relevant recent works include Deep-speare, an AI algorithm trained to write sonnets from Shakespeare's works (Lau, J.H., et al, 2018), or Emily, a poetry search classification and reduced-representation visualization interface (Madnani, N., 2005), as well as many others that compares poetry with other categories of formal and informal written including song lyrics and public speech (Singhi, A. and Brown, D.G., 2014). While existing research has been primarily focusing on using NLP and sentiment analysis for creative authorship or metadata classification purposes (Greene, E., et al, 2011), rarely any past projects have used this method for explorative purposes, or as a tool intended to assist human interpretation of poetry. Reading Between the Lines is a one-of-its-kind intractable visualization demo aimed to assist users with understanding and interpreting poetry via sentiment guidance.

3. METHODS& TOOLS

D3.js

The visual aspect of the project is primarily built using the open-source JavaScript library D3.js, which creates custom interactive data visualizations in

HTML via primarily SVGs. A few visualizations were driven by additional plug-ins such as the D3-Cloud-Plugin and D3-Force-Labels. Additionally, CSS framework like Bootstrap and Javascript libraries like jQuery was used to assist visual styling.

The Poetry Foundation Database
A collection of pre-processed and annotated poetry datasets were used for exploration and visualization purpose in this project. Original sources of the poetry datasets were from The Poetry Foundation website.

NRC-VAD Lexicon
The NRC Valence, Arousal, and Dominance (VAD) Lexicon, which includes a list of more than 20,000 English words and their valence, arousal, and dominance scores, was used to analyze the sentiment of poetry in this project. For a given word and a dimension (V/A/D), the scores range from 0 (lowest V/A/D) to 1 (highest V/A/D). Valence is the positive-negative or pleasure--displeasure dimension; arousal is the excited--calm or active-passive dimension; and dominance is the powerful--weak dimension. The preliminary analysis involves extracting pre-annotated keywords from the poems, and additional aggregation such as linear regression and data-binning was done to further build upon a multi-aspect analysis of each poem.

3. VISUALIZATION DESIGN & RESULT

Presented in a vertical layout, Reading Between the Lines walks through the ways poetry has developed through the centuries, how emotions are expressed through poetic diction and how the NRC-VAD Lexicon can be used to extract valence, arousal, and dominance scores for poems. It visualizes different sentiment patterns under different contexts such as time periods and categories, as well as the expression of emotions in individual poems. The user can explore a full database of poetry via different interactions, and even create a downloadable visual analysis for a poem of their creation.

Figure 1: Visual Lexicon Library

Visual Lexicon Library
The Visual Lexicon Library (Figure 1) is a randomly sampled collection of the lexicon, ordered across a horizontal 0 to 1 spectrum based on their respective VAD scores. Vertical spread of selected words enables the users to better understand the distribution of words in the library for better understanding of latter visualization results. Enabling the user to be able to explore words based on their VAD scores, as well as to trace transitions of words across the attributes allows for a better understanding of the dynamicity of the library acting as the ground truth for analysis.

Renaissance / Modern Poetry Comparison Graph

Figure 2: Renaissance / Modern Poetry Comparison Graph

Comparing the poetry from an era of cultural revival and poetic evolution to modern literature (Figure 2) creations is driven by the intention to build associations between users' existing understanding of poetry in the traditional context to poetry under modern or futuristic conditions. The violin comparison graph vertically maps the distribution of average poem sentiment classified into the two time periods. Though modern poetry appears to have a more varied pattern in sentiment characteristics, the mean and standard deviation for all three attributes across two time periods has been relatively consistent. From this, assumptions can be made, such as that modern poetry may be more personalized than earlier (Renaissance) poetry with specific rhythmic guidelines, given changes like increasing poetry written in the free verse form and disappearance of formal and traditional English literature. However, the main goal is to show that poetry has not fallen short for emotional expression over the past decades, and understanding its embedded sentiment is as equally important as it was to readers from the past.

Thematic Correlation Radar Diagram
People express different emotions when speaking and writing about specific subjects based on a combination of a common definition and subjective experience. Does this apply to poetry as well? The collection of 36 chosen themes analyzed from the original poetry database displayed in radar diagram format is able to allow the users to explore differences

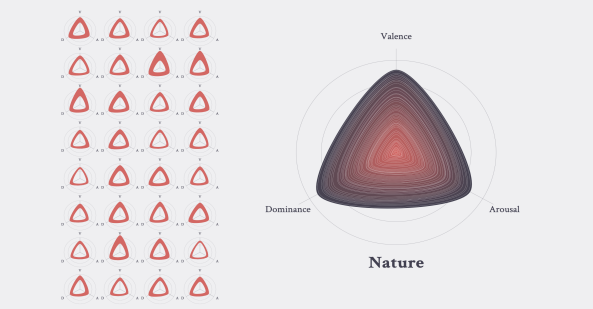

Figure 3: Thematic Correlation Radar Diagram

between poems of different thematic contexts. Each mini-radar diagram presents the min and max VAD scores of the poem classifier in each category while selecting on them reveals a more detailed version of the diagram scaled to emphasize the VAD scores of individual poems within each theme (Figure 3).

Thematic Cluster

The drop-down toggled cluster visualization is a simplified, alternative way to represent poetry sentiment data based on thematic context. Length and VAD scores of poems are displayed from a hierarchical perspective. This also acts as a segue to the Poetic Vocabulary Analysis.

Poetic Vocabulary Analysis

This section explores the way different poets utilize words within the poetry, and how their choices affect the overall perceived sentiment in their work. A full-length poem is parsed into an array of words and highlighted when the algorithm recognizes the word matching one existing in the lexicon library (Figure 4). The user's selection of VAD attribute changes the scale of how words are highlighted, as well as the tooltip information display when hovering above them. Through prospecting through the highlight is distributed throughout the poem analysis, the user would be able to explore how the poet's sentimental flow, as well as a clear perception of the accuracy of

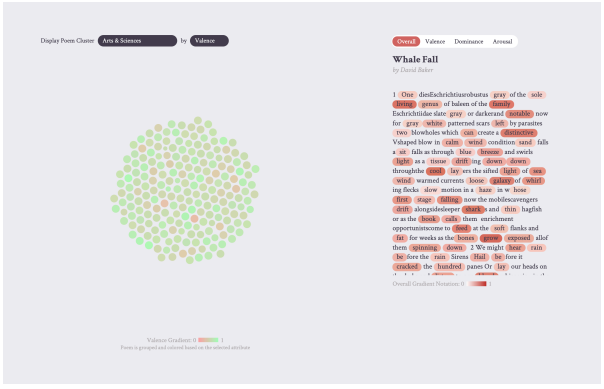

Figure 4: Thematic Cluster Connected to Poetic Vocabulary Analysis

the analysis based on the percentage of words detected and highlighted by the lexicon.

Custom Poetry Analyzer

This (Figure 5) is an additional tool to the main visualization where the user may apply the sentiment analysis techniques covered above to text samples outside of the data, including new inventions. The analyzer returns a static visual output of the input poetry consisting of a word-by-word highlight overview, distribution of the three sentiment distribution, as well as a word cloud highlighting high frequency words appearing in the poem.

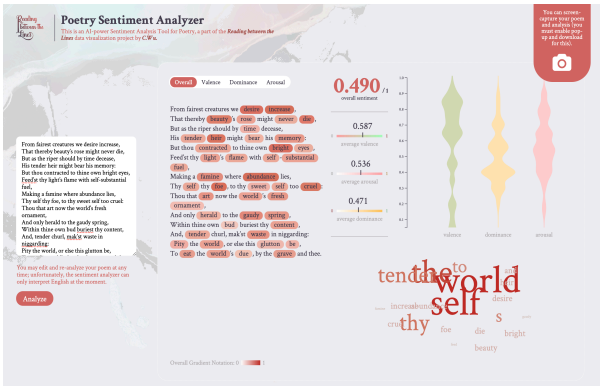

Figure 5: Custom Poetry Analysis

4. DISCUSSION & FUTURE WORK

AI-driven analysis and modeling of poetry still has many challenges for research in digital literature studies, language and linguistics. Questions can still be asked regarding how emotional expressions can be extracted from poetry, such as Given the subject matter, how does poetry vary from traditional formal and informal text? Can we quantify expression in poetry through methods like isolating high frequency word and their emotional connotation, or do we need more insights from robust NLP / Sentiment Analysis to understand the intention behind the poets' work? And how do we leverage human perception with computation result to illuminate engagement with poetic creations

Though only 20,000-30,000 words are used by an individual commonly, there are about a total of 170,000 words in current use in the English language; hence, the lexicon is by far not fully capable to fully interpret the collective sentiment of all poetry. There are alternative solutions such as employing sophisticated neural networks in aid of enhancing classification, however, rather than using robust sentiment analysis models trained via text of other genre at the cost of increased computation labor and reduced transparency, deconstructing and visualizing sentiment using lexicon is has its own advantages,

such as solving the common explainability issue with NLP analysis by revealing the full analysis methodology to the readers, and allowing them to combine their judgement with the lexicon's interpretation result.

Despite clear limitation with the basic sentiment analysis techniques used to drive the visualization, this project presents an opportunity for poets and readers to be able to deconstruct poetic creations into digestible subdata and perceive them from interesting, new perspectives.

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