

## Applying AI in Children's Reading Skill Development

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**ABSTRACT:** The paper is discussing an ongoing developing app, which serves two purposes. One is used to promote beginner readers' interests in a close reading of children's classics, such as "Anne with Green Gables." At the same time, this app can promote children's interests in programming in python. We utilized different visualization for word frequency of the literature to promote children's interest and text analysis with word clouds, bar charts, print able CSV files with word frequency, definition, and synonyms. Children can upload their drawing of figures from the novel to produce a word cloud. Besides, we will use this literature as a starting point to demonstrate to children how AI technology can aid text analytics and how to program to achieve this purpose.

**KEYWORDS:** Education; Deep Learning, Natural Language Processing, literature anthology, storytelling; reading literacy; early literacy

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### I. INTRODUCTION

Reading skills is essential in early children's development. Reading can help children in many ways, including gaining knowledge, enhance personal development and self-concept, experience pleasure, boost confidence to share with family and friends [6] [9]. Children's classic literacy can serve many purposes for children's academic development, such as reading comprehension, writing skills, speech, and foreign language. [5] states that "parental literacy activities involvement and parental literacy expectations contribute more to children's literacy knowledge enhancement."

The proposed app utilizes AI, such as natural language processing, data visualization on children's classic literature to produce both aesthetic appealing word clouds and "spatially grouped color-coding word cloud" improve children's literature/reading comprehension and facilitate children's interest in children's classic literacy. Parent can use this app to check readability and reading levels, and random print out the word list for children's speech and story-telling activities.

Bartram et al. state that "Communicating the right affect, a feeling, experience or emotion, is critical in creating engaging visual communication." [3] Word clouds serve not only as *an aesthetic* tool for textual information, as [1] pointed out that "Word clouds continue to be a popular tool for summarizing textual information, despite their well-documented deficiencies for analytical tasks. Much of their popularity rests on their playful visual appeal". However, based on the finding of Hearst et al., word cloud can also serve as a useful tool for understanding the underlying topics by adopting "white space separator and/or spatially grouped color coding." Besides, the results of [3] [7] show that we can manipulate color and palette properties to achieve affective expressiveness even in the small sets of colors used for data encoding in information visualization. Our app can produce both aesthetic appealing word clouds and a "spatially grouped color-coding word cloud."

### II. IMPLEMENTATION

In this project, we have been using open-source modules and libraries in python, including pathlib, imageio, wordcloud, text blob, nltk, pandas, CSV, and PIL, and NumPy. We first read the novel "Anne of the Green Gable" from <https://www.gutenberg.org/ebooks/45> in the text format by pathlib into the program.

For the text visualization part in the word cloud, using mask images can generate random word cloud images. In this application, we utilize four mask images from [2], one from [https://amueller.github.io/word\\_cloud/auto\\_examples/masked.html](https://amueller.github.io/word_cloud/auto_examples/masked.html), and one from 6-year-old drawing based on her imagination of Dianna's character in "Anne of Green Gables." Each word cloud displays the top 100 most frequent words from chapter 1, which excludes the stop word from <https://gist.github.com/sebleier/554280>. These top 100 words offer reading more context meaning regarding chapter 1. Also, a bar chart was displayed.

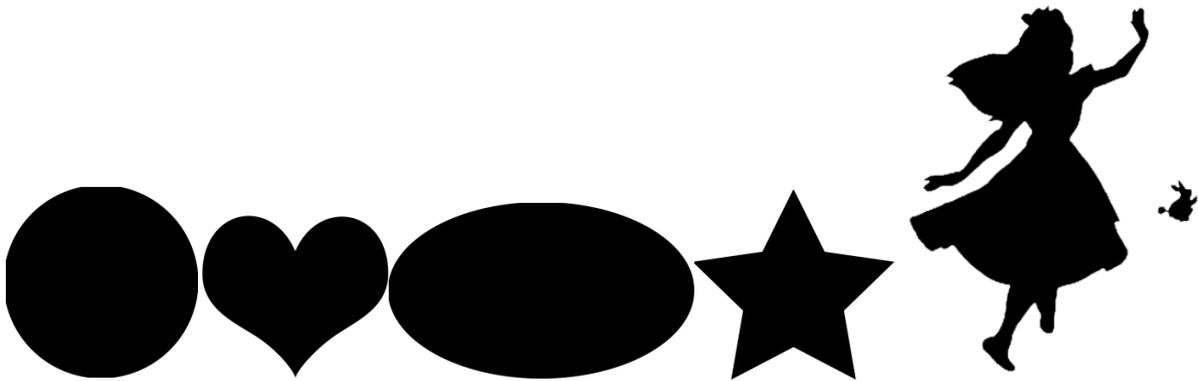


Figure 1. Mask Images.

An image-based coloring scheme also is adopted in this application (figure 3) from [https://amueller.github.io/word\\_cloud/auto\\_examples/colored.html#sphx-glr-auto-examples-colored-py](https://amueller.github.io/word_cloud/auto_examples/colored.html#sphx-glr-auto-examples-colored-py). We use Image Color Generator to generate the color of the word based on the average of the color of the source image in the same region as the word.

The app writes to the CSV file the word, count, definition, and synonym. To achieve this, we use a loop iterating through all words of chapter 1. We also eliminate the stop words from <https://gist.github.com/sebleier/554280>. Also, "said" is removed in our program along with stop words. The list of definitions of all words is returned from the WordNet database [8].

### III. RESULT

This application can obtain various word cloud text visualizations, including figures 2-5. Figure 2 represents the top 100 frequency words with various shape input with five mask images shown in figure 1. Even these word clouds are not essential tools for literature study; they fascinate kids aged 6 to 10 in the experiment. After seeing this and listened to the first chapter, they tend to come back to appreciate these words cloud to identify character, settings, and themes. They even utilize these word clouds as a tool to start their story writing.

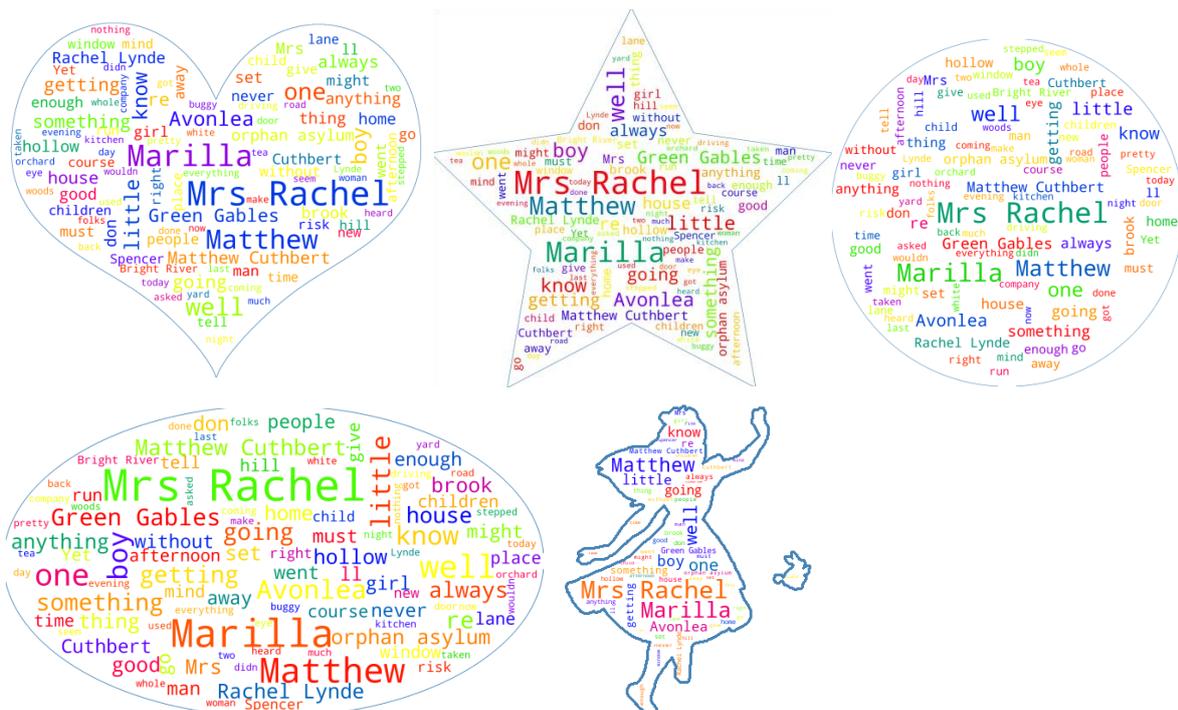


Figure 2. Word Cloud images generated based on image masks in Figure 1.

In figure 3, we generated the first-word cloud image by using the same mechanics as figure 2. The second-word cloud image shows that the word color is the average color of the third image as a mask image in the same position.

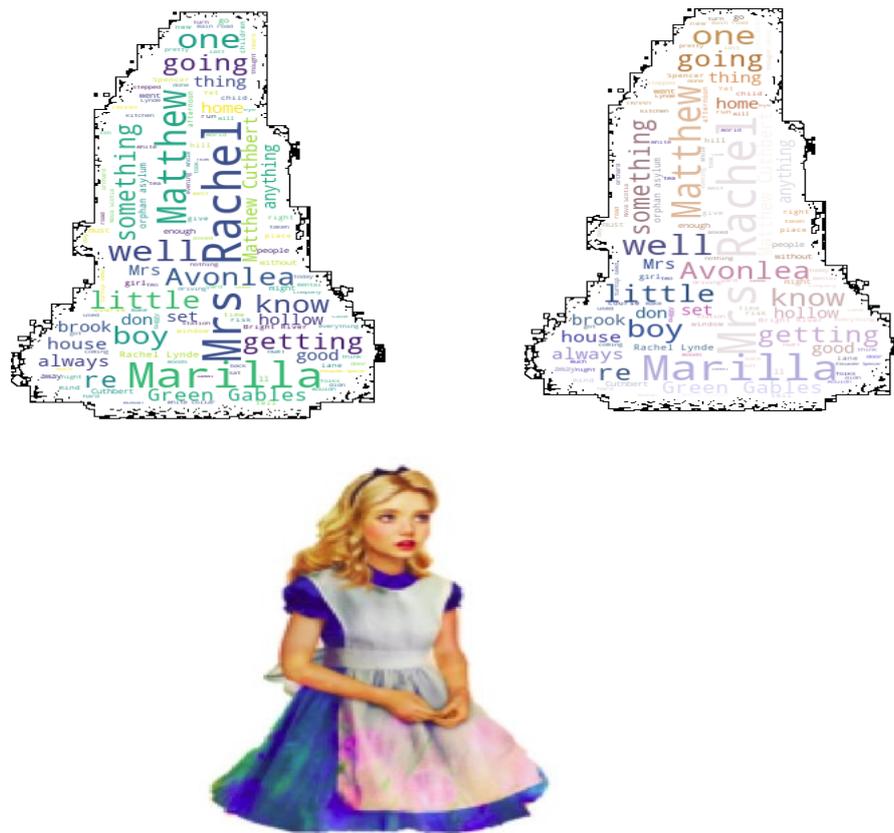


Figure 3. word cloud based on an image-based coloring scheme.

This app allows children to input the drawing of their imaginary image of characters to be image masks. Figure 4 demonstrates the result of word cloud by using Dianna as an image mask with word color to reflect the image's average color.



Figure 4. Word cloud based on an image-based coloring scheme using a 6-year-old drawing as an image mask.

Figure 5 demonstrates the bar chart based on the rank of the frequency of words. Users can change the app's parameter to determine the number of words shown on the bar chart.

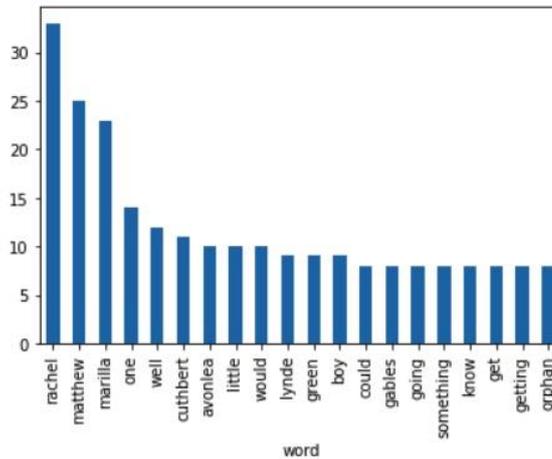


Figure 5 Bar chart of top 20 frequent words.

Our app generates a .csv file to reflect the unique words in chapter 1. We deleted the Stop words. It shows that there is a total of 774-words. Most long and big words only have the frequency of one. The file includes the definition and Synonyms of each of these words. These serve as handy tools for children to study vocabulary and better understand the text. Figure 6 shows the screenshot of part of printable word table.

ID	word	frequency	definition	
1	mrs	36	[a form of address for a married woman', 'a form of address for a man']	{'Mrs', 'Mr.', 'Mrs.', 'Mr.', 'Mister'}
2	rachel	33	[(Old Testament) the second wife of Jacob and mother of Joseph and Benjamin]	{'Rachel'}
3	matthew	25	[(New Testament) disciple of Jesus; traditionally considered to be the author of the first Gospel', 'one of the Gospels in the New Testament; includes the Sermon on the Mount']	{'Gospel_According_to_Matthew', 'Matthew', 'St_Matthew', 'Levi', 'St_Matthew_the_Apostle', 'Saint_Matthew_the_Apostle', 'Saint_Matthew'}
4	marilla	23	[]	set()
5	one	14	['the smallest whole number or a numeral representing this number', 'a single person or thing', 'used of a single unit or thing; not two or more', 'having the indivisible character of a unit', 'of the same kind or quality', 'used informally as an intensifier', 'indefinite in time or position', 'being a single entity made by combining separate components', 'eminent beyond or above comparison']	{'peerless', 'I', 'one', 'matchless', 'one_and_only', '1', 'unity', 'unrivalled', 'unmatched', 'unrivaled', 'ace', 'unmatchable', 'single', 'ane', 'unitary', 'I', 'nonpareil'}
6	well	12	[a deep hole or shaft dug or drilled to obtain water or oil or gas or brine', 'a cavity or vessel used to contain liquid', 'an abundant source', 'an open shaft through the floors of a building (as for a stairway)', 'an enclosed compartment in a ship or plane for holding something as e.g. fish or a plane's landing gear or for protecting something as e.g. a ship's pumps', 'come up, as of a liquid', 'in good health especially after having suffered illness or injury', 'resulting favorably', 'wise or advantageous and hence advisable', '(often used as a combining form) in a good or proper or satisfactory manner or to a high standard (good' is a nonstandard dialectal variant for `well')', 'thoroughly or completely; fully; often used as a combining form; ; ; ; ;', 'indicating high probability; in all likelihood', '(used for emphasis or as an intensifier) entirely or fully', 'to a suitable or appropriate extent or degree', 'favorably; with approval', 'to a great extent or degree', 'with great or especially intimate knowledge', 'with prudence or propriety', 'with skill or in a pleasing manner', 'in a manner affording benefit or advantage', 'in financial comfort', 'without unusual distress or resentment; with good humor']	{'well', 'considerably', 'comfortably', 'swell', 'good', 'intimately', 'advantageously', 'wellspring', 'substantially', 'fountainhead', 'easily'}
7	cuthbert	11	[]	set()
8	avonlea	10	[]	set()
9	little	10	[a small amount or duration', 'limited or below average in number or quantity or magnitude or extent', '(quantifier used with mass nouns) small in quantity or degree; not much or almost none or (with 'a') at least some', '(of children and animals) young, immature', '(informal) small and of little importance', '(of a voice) faint', 'low in stature; not tall'. 'lowercase'. 'small in a way that arouses feelings (of tenderness or its opposite	{'petty', 'lilliputian', 'piddling', 'picayune', 'niggling', 'short', 'footling', 'small', 'little', 'trivial', 'minuscule', 'slight', 'fiddling', 'piffing'}

736	wiser	1	['having or prompted by wisdom or discernment', 'marked by the exercise of good judgment or common sense in practical matters', 'evidencing the possession of inside information', 'improperly forward or bold']	{'overbold', 'wise', 'heady', 'knowing', 'judicious', 'impudent', 'fresh', 'smart', 'wise_to', 'sassy', 'saucy', 'impertinent'}
737	steadier	1	['not subject to change or variation especially in behavior', 'not liable to fluctuate or especially to fall', 'securely in position; not shaky', 'marked by firm determination or resolution; not shakable', 'relating to a person who does something regularly', 'not easily excited or upset']	{'unshakable', 'steady', 'firm', 'unfluctuating', 'steadfast', 'unbendable', 'regular', 'stiff', 'unfaltering', 'unwavering'}
738	doubtful	1	['open to doubt or suspicion; ; ; - Karen Horney', 'fraught with uncertainty or doubt', 'unsettled in mind or opinion']	{'in_question', 'dubious', 'tentative', 'dubitable', 'doubtful'}
739	seems	1	['give a certain impression or have a certain outward aspect', 'seem to be true, probable, or apparent', 'appear to exist', 'appear to one's own mind or opinion']	{'appear', 'look', 'seem'}
740	uncanny	1	['suggesting the operation of supernatural influences; ; - John Galsworthy; ; - Henry Kingsley', 'surpassing the ordinary or normal; - George Will']	{'unearthly', 'uncanny', 'eldritch', 'preternatural', 'weird'}
741	somehow	1	['in some unspecified way or manner; or by some unspecified means', 'for some unspecified reason']	{'somehow', 'in_some_way', 'in_some_manner', 'someways', 'somehow'}
742	grown	1	['pass into a condition gradually, take on a specific property or attribute; become', 'become larger, greater, or bigger; expand or gain', 'increase in size by natural process', 'cause to grow or develop', 'develop and reach maturity; undergo maturation', 'come into existence; take on form or shape', 'cultivate by growing, often involving improvements by means of agricultural techniques', 'come to have or undergo a change of (physical features and attributes)', 'grow emotionally or mature', 'become attached by or as if by the process of growth', '(of animals) fully developed']	{'arise', 'mature', 'turn', 'fully_grown', 'uprise', 'acquire', 'rise', 'raise', 'originate', 'grownup', 'big', 'farm', 'maturate', 'develop', 'grow', 'get', 'grown', 'full-grown', 'spring_up', 'produce', 'adult'}
743	believe	1	['accept as true; take to be true', 'judge or regard; look upon; judge', 'be confident about something', 'follow a credo; have a faith; be a believer', 'credit with veracity']	{'think', 'consider', 'conceive', 'believe', 'trust'}
744	looks	1	['the feelings expressed on a person's face', 'the act of directing the eyes toward something and perceiving it visually', 'physical appearance', 'the general atmosphere of a place or situation and the effect that it has on people', 'perceive with attention; direct one's gaze towards', 'give a certain impression or have a certain outward aspect', 'have a certain outward or facial expression', 'search or seek', 'be oriented in a certain direction, often with respect to another reference point; be opposite to', 'take charge of or deal with', 'convey by one's expression', 'look forward to the probable occurrence of', 'accord in appearance with', 'have faith or confidence in']	{'flavor', 'depend', 'search', 'wait', 'seem', 'look', 'see', 'attend', 'calculate', 'looking', 'facial_expression', 'await', 'feel', 'expression', 'tone', 'take_care', 'feeling', 'expect', 'spirit', 'bet', 'appear', 'face', 'reckon', 'looking_at', 'flavour', 'front', 'smell', 'count', 'aspect'}

Figure 6 Screenshot of printable word table with definition and synonyms

#### IV. CONCLUSION AND FUTURE WORK

This paper described a developing app to help young readers improve their reading skills in children's classics. This app can produce various aesthetic word cloud images to raise the young reader's interest. Besides, user can paint their image based on their imagination of characters in the literature to feed the app to produce their word cloud. A vocabulary table generated from the app includes the definition, and synonyms are an excellent tool for young readers. We are expanding the app's functionality to show the reading level and readability of the text, train the model by deep learning technique to write poems within the literature context, have conversations with users to aid users for literature anthology, and apply more interaction with the users. The app can also write stories based on randomly selected words, including settings, characters, from context to company the kids to write a story.

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