Analyzing Suicidal Text Using Natural Language Processing

Cassandra Barton
Utah State University

Dr. Luis Gordillo
Utah State University

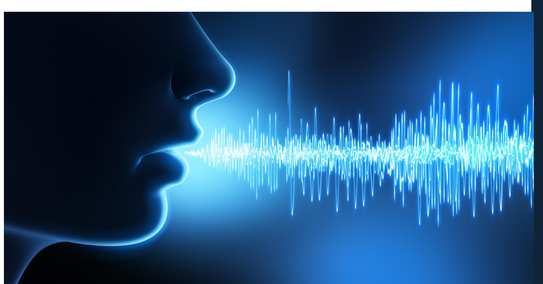
Introduction

I wanted to use mathematics to make a more direct personal impact in people's lives. Suicide has touched closed to home recently so I decided to put my math skills to the test. I, and millions of people like me, feel terrible for not seeing the signs that a loved one might commit suicide. Using Natural Language Processing, what I wanted to know was this: **Can we in some way anticipate suicidal events before they happen?**

Methods

I found the diary of a girl named Victoria. I used machine learning to classify each of her entries as "suicidal" and "non-suicidal" (see Figure 1) and separated them into two different text files.

I then used the "Term Frequency – Inverse Document Frequency" (TF-IDF) equation to find the most important *unique* words in each text file.



We can predict when **suicidal events** will occur using **Natural Language Processing**.

1.

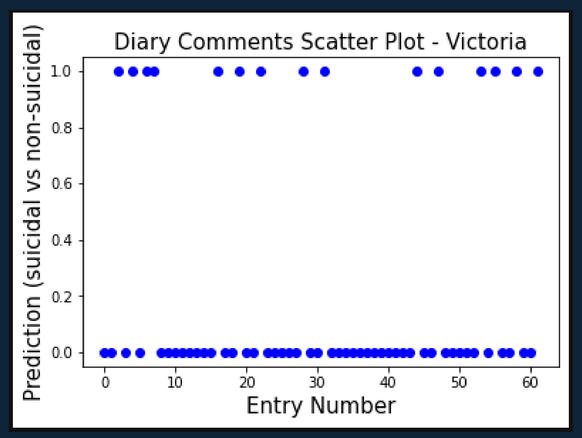


Figure 1 shows how often Victoria's suicidal diary entries occur.

2.

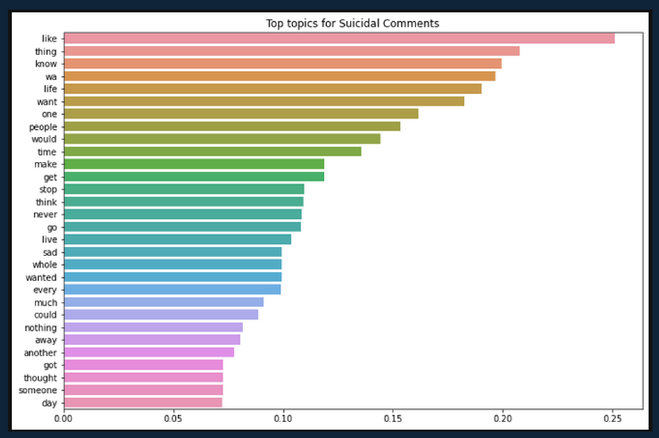


Figure 2 shows the top topics/words she uses in those suicidal entries.

Scan the QR code to download the full paper

STATE | UtahStateUniversity

TF-IDF Example

This is how TF-IDF works. Here is the equation:

$$w_{ij} = tf_{ij} \times \log\left(\frac{N}{df_i}\right)$$

1) tf_{ij} = number of times a word i appears in a document j.
2) N = total number of documents.
3) df_i = number of documents that contain i.

Suppose we have the following two documents:

Document 1

Term	Term Count
this	1
is	1
a	2
sample	1

Document 2

Term	Term Count
this	1
is	1
another	2
example	3

Figure 3 shows documents for TF-IDF example.

If we want to find out how important the word "example" is in each document, we do the following:

$$tf('example', d_1) = \frac{0}{5} = 0$$

$$tf('example', d_2) = \frac{3}{7} \approx .429$$

$$idf('example', D) = \log\left(\frac{2}{1}\right) = .301$$

$$tfidf('example', d_1) = 0 * 0.301 = 0$$

$$tfidf('example', d_2) = .43 * .3 \approx .129$$

For Document 1, the word does not have any meaning because it isn't present. Because it is not present in Document 1 but is present in Document 2, we give that word a score of .129.

Results

We see in Figure 2 that when Victoria was suicidal, she used the words "like", "thing", "know", "life", "want", etc. When she uses these words, it is an indication that we should reach out and make sure she is okay before it is too late. Just do it. They will be glad that you called.