Depression Screening with Text Messages

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Motivation

2 in 5 graduate students suffer from depression⁴.

Despite being the most treatable mental health disorder, it takes 11 years on average to get treated³.

Suicide is the 2nd leading cause of death for US adults under 30. Globally depression is the leading cause of disability, costing $1 trillion³.

Given texting popularity, text messages could be used to passively screen for depression but only a third of people are willing to share this modality³.

Data

<table>
<thead>
<tr>
<th>PHQ-9 score</th>
<th>Interpretation²</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>Not Depressed</td>
<td>NA</td>
</tr>
<tr>
<td>5-9</td>
<td>Mildly Symptomatic</td>
<td>Monitor</td>
</tr>
<tr>
<td>10-14</td>
<td>Mild Depression</td>
<td>Support</td>
</tr>
<tr>
<td>15-19</td>
<td>Moderate Depression</td>
<td>Treatment</td>
</tr>
<tr>
<td>20+</td>
<td>Severe Depression</td>
<td>Treatment</td>
</tr>
</tbody>
</table>

Moodable⁴/EMU data: retrospectively-harvested crowd-sourced Smartphone & social media data. PHQ-9 was deployed to obtain a depression label. 151 participants sent texts within the last year⁶.

Screening with Text Messages

Machine learning methods selected from 245 content features involving:
- Word category frequencies
- POS tag frequencies
- Sentiment
- Volume

Logistic regression models only used 10 features from two weeks of texts, achieving an F1 = 0.81 with three principal components⁵.

Generating Text Messages

Goal: create a corpus of public texts from PHQ-9 labeled participants.

Generative Adversarial Networks (GANs) generate realistic data by using a generator and a discriminator engaged in a minimax game. GANs must be modified to generate sequences of discrete tokens as 1. words are not differentiable leading to no policy updates and 2. sequences are only scored when complete so rewards are sparse.

Evolution of Text Generation Models

We deploy SeqGAN to determine the impact of text quantity on generation quality measured by negative log-likelihood (NLL). SeqGAN 1. trains a stochastic parameterized policy with a policy gradient and 2. estimates rewards using a Monte Carlo search with a roll-out policy.

Future Work in Generating Texts

- Compare the screening ability of real texts with texts generated by GANs built on texts from single and multiple participants.
- Further anonymize generated texts by replacing named entities.
- Evaluate the appropriateness of popular metrics for this task.

References


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- Prof. Agui, Dogrusucu, Penicin, Harris, and Ball, Gao, Flannery, Resom, Assan, and Wu

SeqGAN can still be effective when trained on around 2000 texts, though most of the participants have under 200 texts. We only need 20 epochs to train.