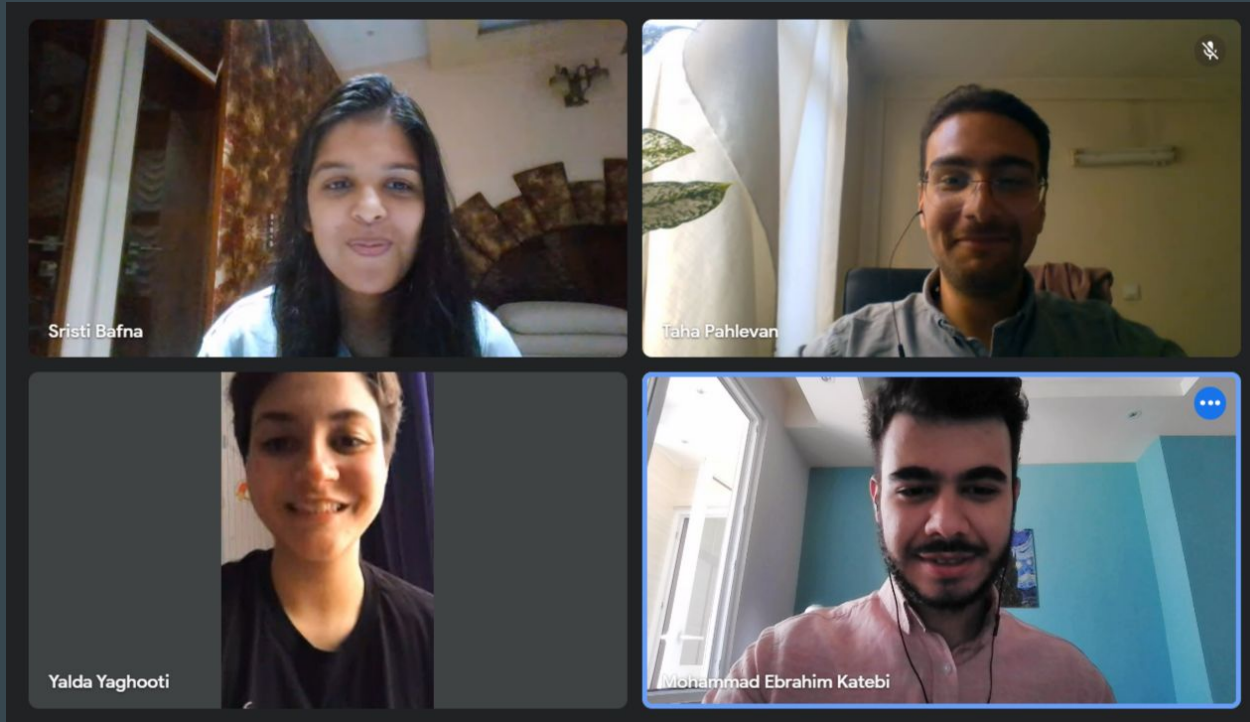


Identifying Drivers of Suicidal Ideation-Attempt Transition Using an Interpretable Deep Learning Classification Model

Pod name: Panoplosaurus_talempong

Members: Sristi Bafna, Mohammad Ebrahim Katebi, Taha Pahlevan, Yalda Yaghooti

Who are we



MYSTical Watchers

What is the Three-Step Theory of Suicide?

Klonsky - 2015

- a) Suicidal ideation is caused by the combination of unbearable pain (usually psychological) and hopelessness,
- b) Suicidal ideation is strong when one's pain exceeds or overwhelms one's connectedness (to valued people, communities, or sources of purpose and meaning), and
- c) Transition from strong suicidal ideation to potentially lethal suicide attempts is facilitated by dispositional, acquired and practical contributors to capability for suicide.

Thus, the 3ST is a concise theory that explains suicide in terms of just four variables: pain, hopelessness, connectedness, and suicide capability.

Hypothesis and Novelty

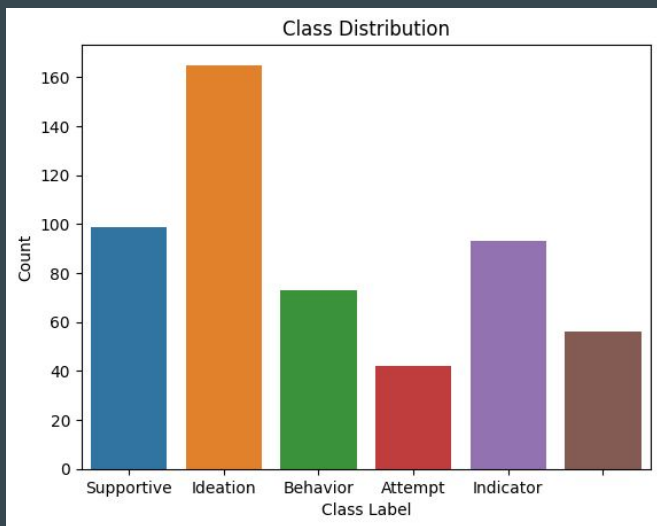
Deep Learning models use indicators of pain, hopelessness, connectedness and capability variables proposed by the Three-Step Theory of Suicide to identify the likelihood of a person of transitioning from suicidal ideation to attempt

We introduce **novelty** through the following aspects:

1. Leveraging DL to study the transition from suicidal ideation to suicidal attempt
2. Work with a dataset annotated by professional psychologists
3. Perform real-world data augmentation

Dataset

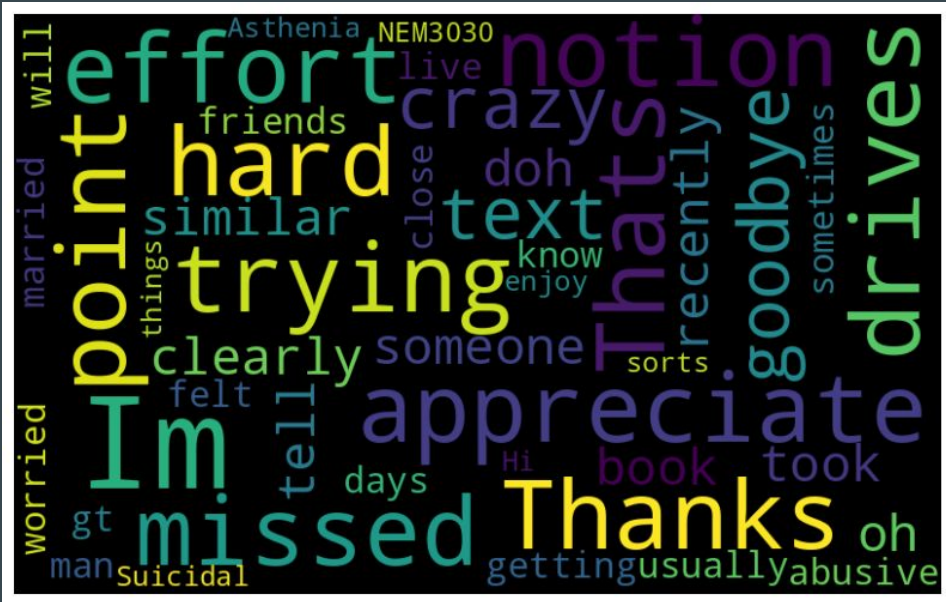
Kaggle dataset ([thedevastator/suicidal-behaviors-and-attempts](https://www.kaggle.com/thedevastator/suicidal-behaviors-and-attempts)) of 500 Reddit posts



A	B	C
User	Post	Label
user-0	['Its not a viable option, and youll be leaving your wife behind. Youd	Supportive
user-1	['It can be hard to appreciate the notion that you could meet someo	Ideation
user-2	['Hi, so last night i was sitting on the ledge of my window contempla	Behavior
user-3	['I tried to kill my self once and failed badly cause in the moment i w	Attempt
user-4	['Hi NEM3030. What sorts of things do you enjoy doing?', 'Personally	Ideation
user-5	['Since I dont know what DBT is, would you mind explaining it to me	Supportive
user-6	['No matter what you ever think, there will be people who care. Whi	Supportive
user-7	['Dont see it as failing at killing yourself, theres a reason why you live	Ideation
user-8	['The reason I have faith in our species ability to spread and survive i	Supportive
user-9	['A book is usually what I do when Im getting down, but it doesnt wc	Ideation
user-10	['Dont do it man. Seriously this is making me sad. I dont know you I	Indicator
user-11	['Whats up? Tell me. Im here for you. ', 'Wow. I cant imagine how he	Supportive
user-12	['I wish I could give a shit about what would make it to the front pag	Behavior
user-13	['I have one question for you: whatre your interests? Specifics, pleas	Ideation
user-14	['You are not alone, my dear. You have two parents who, from what	Ideation
user-15	['No you are not bothering anyone. View it like this: if you were both	Behavior
user-16	['oh, doh.I had someone tell me similar recently, so took it seriously.	Ideation
user-17	['Im interested, since youve pretty much described my life. Im a guy,	Behavior
user-18	['No need for thanks it just makes me happy that it maybe helped sc	Attempt

Examining the 'Ideation' Data

[There are many things that can help. If you got nothing you got nothing to lose. Life is hard. It is a riddle. Some people are happy, some are not. Some are doing what they love some don't. Steve Jobs did what he loved, but he is dead. You on the other side is alive. He gave the advice that you should do what you love. That advice you haven't been following. He said that you should live each day as it were your last. 10 years ago I was contemplating suicide for some of the same reasons. I decided to move home to my parents. They helped. Then I did lots of things. I read self-help books, took mushrooms, stopped drinking, bought a GPS, bought a vaporizer, started using a memorizer app called Anki, started using a text-to-speech app, started using an app for registering what I ate (MyFitnessPal), started with something called TRE which helps with dealing with trauma. All that shit made a difference. Why am I saying this? Because the little things help. Fuck society, fuck their expectations.



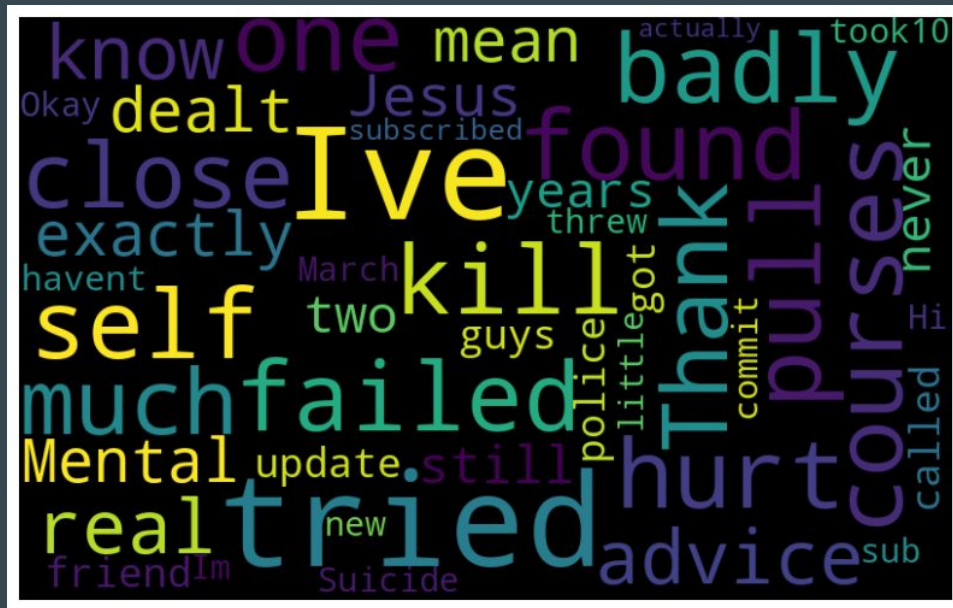
Example Post

Word Cloud for Ideation Data

Examining the 'Attempt' Data

['In some respects I can relate. Im a guy, but the only thing Ive ever really wanted in life was to find love. Every day I come home wishing I had someone special to greet, to cuddle with, all of that. I tried to kill myself once I despaired so badly of ever finding love. I still havent found it, but I have changed dramatically, and I can say with absolute certainty that Im closer now than ever before. I increased my odds ENORMOUSLY. Do you want Love? I think you do. Heres the good news. You CAN achieve your goal, you can have the joking and flirting and all the other wonderful things that come from love. But how? Youre going to have to fight for it - focus on making YOURSELF better (not more attractive to the opposite sex).

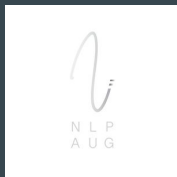
Example Post



Word Cloud for Attempt Data

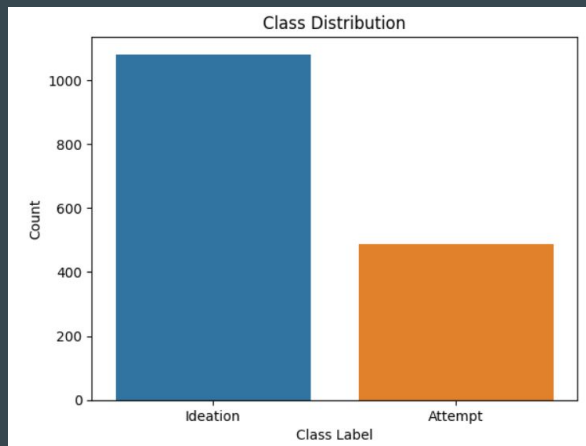
Data Augmentation

- ❖ Our Dataset is tiny! 42 Attempt Labels: Random chance accuracy after training
- ❖ Label forging: [Indicator,Ideation] - [Behavior,Attempt] (columbia suicide severity rating scale (c-ssrs))



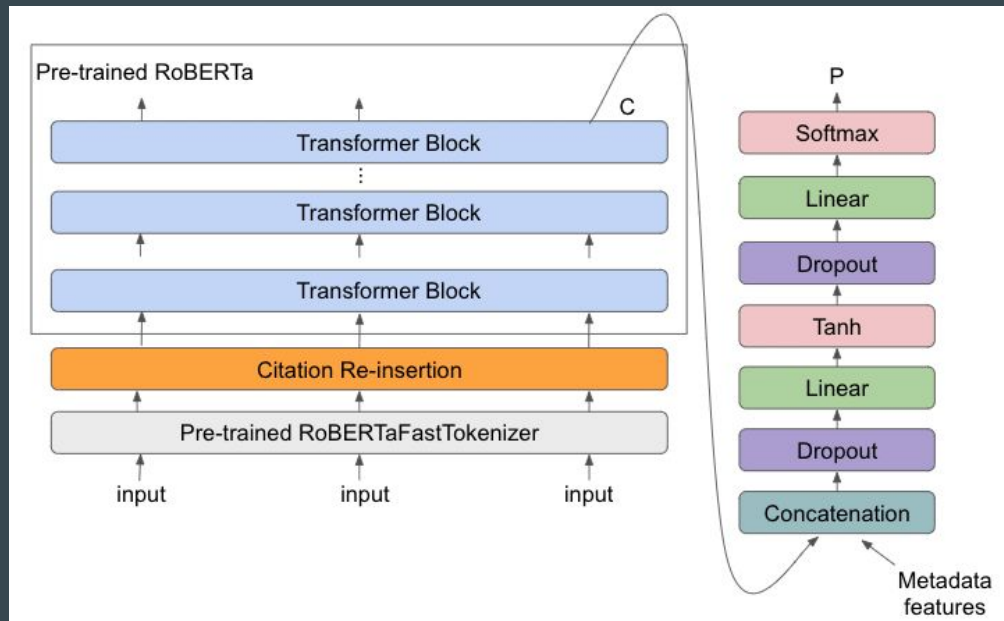
nlpaug: Data augmentation for NLP

```
1 aug = naf.Sequential([
2     naw.SpellingAug(aug_min=0, aug_max=1024, aug_p=0.04),
3     naw.SynonymAug(aug_src='wordnet', aug_min=0, aug_max=1024, aug_p=0.04),
4     naw.RandomWordAug(action='delete', aug_min=0, aug_max=1024, aug_p=0.04),
5     naw.RandomWordAug(action='swap', aug_min=0, aug_max=1024, aug_p=0.04)
6 ])
```



Model

Roberta For Sequence Classification



Fine Tuning

[816/816 13:10, Epoch 6/6]

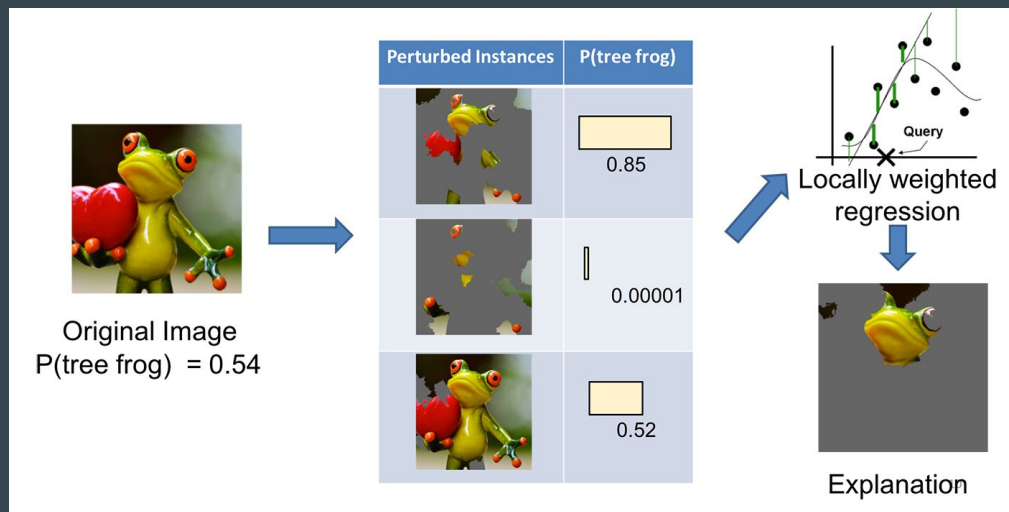
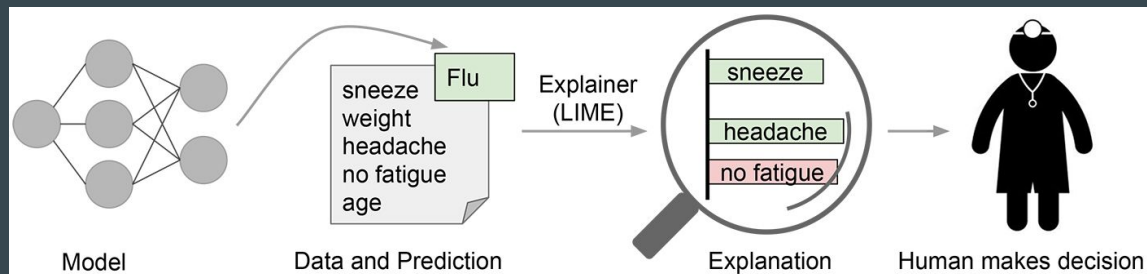
Epoch	Training Loss	Validation Loss	Accuracy
1	No log	0.578532	0.708155
2	No log	0.492833	0.789700
3	No log	0.589570	0.854077
4	0.471900	0.227647	0.961373
5	0.471900	0.103102	0.987124
6	0.471900	0.121198	0.982833

```
{'eval_loss': 0.33324599266052246,  
'eval_accuracy': 0.9527896995708155,  
'eval_runtime': 7.6914,  
'eval_samples_per_second': 30.294,  
'eval_steps_per_second': 3.9,  
'epoch': 6.0}
```



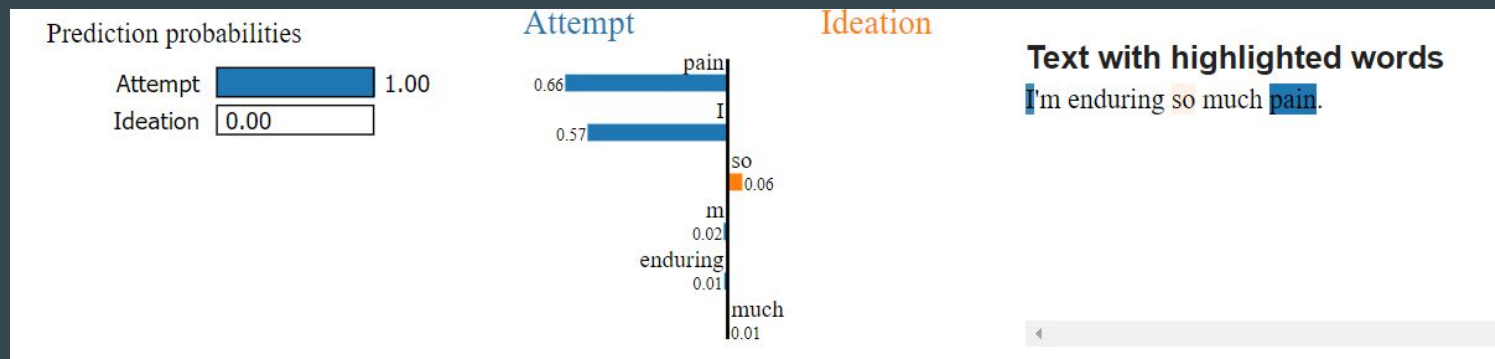
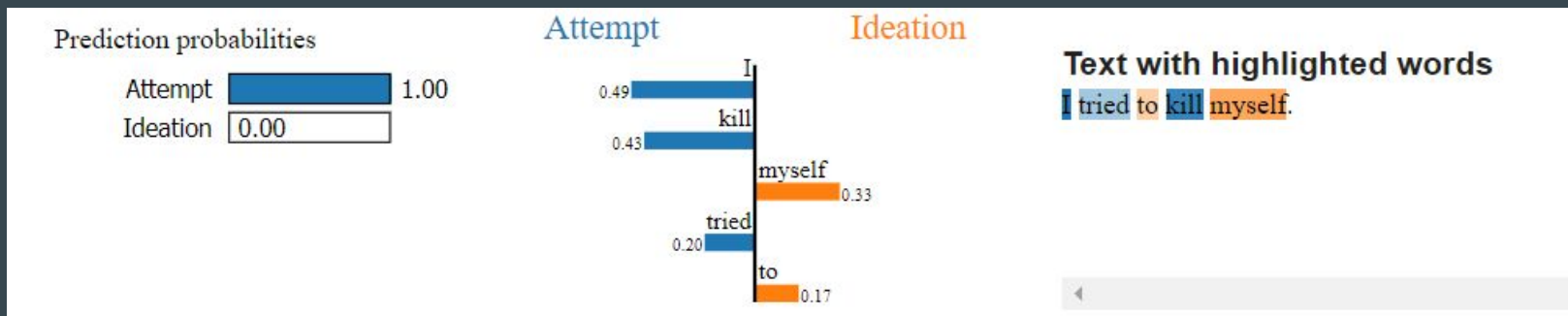
Mekatebi/NMA_DL_2023_Project

Model Interpretation - Local Interpretable Model-Agnostic Explanations (LIME)



<https://github.com/marcotcr/lime>

Model Interpretation - Local Interpretable Model-Agnostic Explanations (LIME)



Not possible on the whole dataset! (RAM, Compute)

Model Interpretation - Transformers Interpret

Legend: ■ Negative □ Neutral ■ Positive

True Label	Predicted Label	Attribution Label	Attribution Score	Word Importance
0	Attempt (1.00)	Attempt	2.41	#s I just look 10 more . Okay I threw up a little bit but now I feel weird and bloated . Its not so much that I want to die but Im scared and I dont see a way out . I dont see the light at the end of the tunnel anymore . Its just black . I feel like my life is hopeless so why prolong the suffering . Is there anyone out there ? #/s

Transformers
Interpret



<https://github.com/cdpierse/transformers-interpret>

Model interpretation using SHAP

Provides an explanation for a machine learning model's prediction by computing the contribution of each feature to the prediction

Some interesting top keywords: Therapy, unbearable, religion, god, souls, depression, anxiety, gun, crime, guilt, courage, family, friend, passion

I tried therapy . I hated it . Im not much of a talk er and being forced to keep a conversation going with a stranger for an hour was torture . I dont really have any hobbies

Im in the SAME situation . no family (parents passed , foster child , no friends etc .) Ill tell people this from time to time and they really dont get it

Family always seems to be a difficult one . You cannot choose your family but you can choose what interactions you have with them

Now that Im close to death Im scared of rotting in hell . Rot ting because suicide is seen as the worst sin in every religion out there . Thank you for listening

Limitations

1. Class imbalance
 - a. Problem - 5 labels for a dataset with just 500 posts (including posts without labels)
 - b. Our solution - Manually worked with adjusting weights in the loss function
2. Lack of Data Availability
 - a. Problem -
 - i. Models like BERT and RoBERTa need a lot of data to perform well
 - ii. Only dataset annotated by trained professionals - Data usually self-labelled/taken from specific subreddits
 - b. Our solution - Performed data augmentation to create new posts, making the data size larger.
3. Computationally expensive interpretation methods (especially LIME)
4. No statistical test for accepting or rejecting the 3ST model
5. Lack of demographic data in the dataset

References

1. Klonsky, E. D., & May, A. M. (2015). The Three-Step Theory (3ST): a new theory of suicide rooted in the “Ideation-to-Action” framework. *International Journal of Cognitive Therapy*, 8(2), 114–129.
<https://doi.org/10.1521/ijct.2015.8.2.114>
2. Klonsky, E. D., May, A. M., & Saffer, B. Y. (2016). Suicide, suicide attempts, and suicidal ideation. *Annual Review of Clinical Psychology*, 12(1), 307–330. <https://doi.org/10.1146/annurev-clinpsy-021815-093204>
3. May, A. M., & Klonsky, E. D. (2016). What distinguishes suicide attempters from suicide ideators? A Meta-Analysis of Potential factors. *Clinical Psychology-science and Practice*, 23(1), 5–20. <https://doi.org/10.1111/cpsp.12136>
4. Klonsky, E. D., Dixon-Luinenburg, T., & May, A. M. (2021). The critical distinction between suicidal ideation and suicide attempts. *World Psychiatry*, 20(3), 439–441. <https://doi.org/10.1002/wps.20909>
5. <https://www.statcan.gc.ca/en/data-science/network/explainable-learning>