

# Emotion Analysis in Suicide Notes: An Application for Forensic Text Analysis

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# Outline

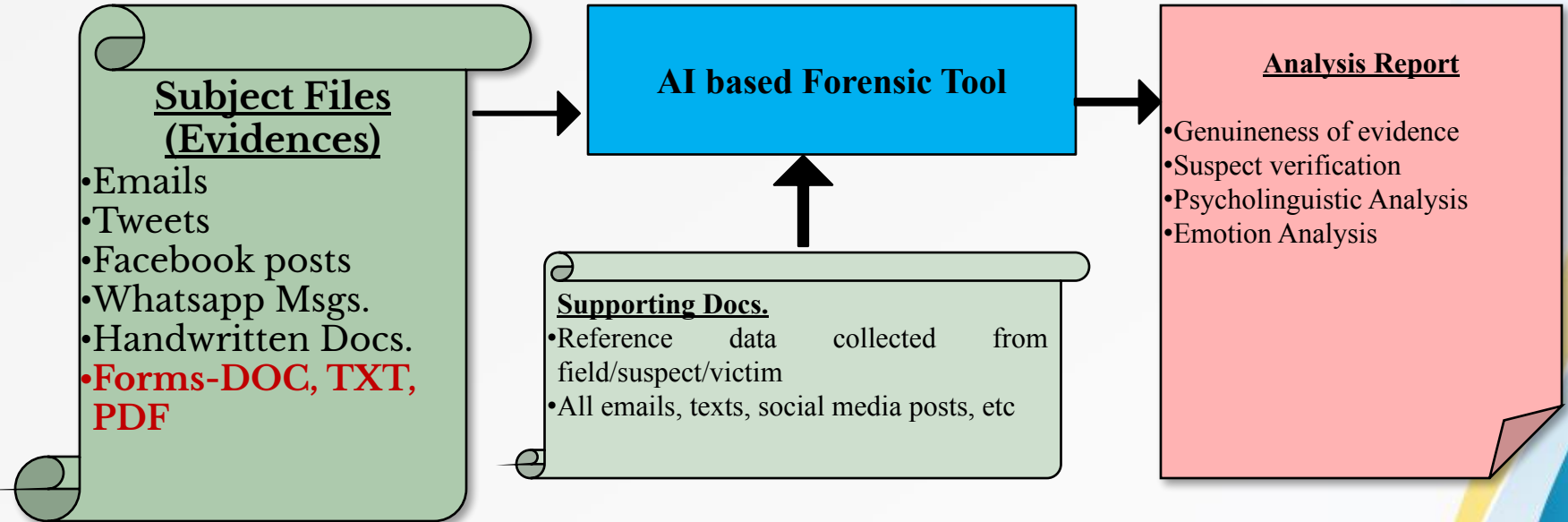
## Emotional Analysis from Suicidal Notes

- Problem Definition & Background
- Data Collection
- Model Architecture
  - Emphasis on Word Attention mechanism
- Preliminary analysis using in-house Emotional Analyzer

# Why the need for Emotion Analysis in Forensic Text(s)?

- Emotional Analysis in Forensic texts is important to study the psychological behaviors of humans
- Studying the psychological perspectives of
  - the victims (in case of who committed suicide?)
  - criminals (in case of FIRs, ransom notes, etc)

# AI assisted Tools for Forensic Text Analysis



# An Example

## Virginia Woolf:

*"Dearest, I feel certain that I'm going mad again. ... I begin to hear voices, and I can't concentrate. So I am doing what seems to be the best thing to do. ... I can't go on spoiling your life any longer. I don't think two people could have been happier than we have been. V."*

## Output of Emotion Analysis:

***Dearest, I feel certain that I'm going mad again*** □ Fear, Sorrow, Hopelessness

***I begin to hear voices, and I can't concentrate*** □ Anger, Sorrow

***So I am doing what seems to be the best thing to do*** □ Fear, Information

***I can't go on spoiling your life any longer*** □ Guilt, Hopelessness, Sorrow

***I don't think two people could have been happier than we have been*** □ Pride, Thankfulness

***Emotion shows the state of the mind of the person***

# Datasets: Suicidal Notes

- **Challenges in Collection of Suicide Notes**

- ❖ Scarcity of suicidal notes (especially in digitized forms)
- ❖ Mostly In hand-written textual forms

- **Datasets**

- ❖ Suicidal notes from different web sources
- ❖ From a book '**...Or Not to Be: A Collection of Suicide Notes**' by Marc Etkind

# Dataset-I: From different web sources

- **110 suicide notes**

- ~50 notes from anonymous identities
- rest of some famous personalities (e.g. Adolf Hitler, Kevin Carter, Virginia Woolf, etc)

- **Some Statistics about the dataset**

- No. of Unique Notes: 110
- Total No. of words: 19586
- Total No. of sentences: 893
- Average words per line: 21.93
- Smallest Note: 2 Words by Hart Crane ('Goodbye, everybody!')
- Longest Note: 1941 Words by a 16-year High School Student

## Few Samples (from known personalities)

- **Adolf Hitler:** "I myself and my wife - in order to escape the disgrace of deposition or capitulation - choose death. It is our wish to be burnt immediately on the spot where I have carried out the greatest part of my daily work in the course of a twelve years' service to my people."
- **Sylvia Path:** "Please Call Dr. Horder."
- **Virginia Woolf:** "Dearest, I feel certain that I'm going mad again. ... I begin to hear voices, and I can't concentrate. So I am doing what seems to be the best thing to do. ... I can't go on spoiling your life any longer. I don't think two people could have been happier than we have been. V."
- **Kevin Carter:** I am depressed . . . without phone . . . money for rent . . . money for child support . . . money for debts . . . money!!! ... I am haunted by the vivid memories of killings and corpses and anger and pain ... of starving or wounded children, of trigger-happy madmen, often police, of killer executioners...! have gone to join Ken if I am that lucky.



# Few Samples (Anonymous victims)

- I know what I am doing. Annette found out. Ask Cara. I love you all. -Bill
- The survival of the fittest. Adios Unfit.
- So that's it. That's me. Leaving the world to be a better place.
- I have no family and no friends, very little food, no viable job and very poor future prospects. I have therefore decided that there is no further point in continuing my life. It is my intention to drive to a secluded area, near my home, feed the car exhaust into the car, take some sleeping pills and use the remaining gas in the car to end my life.
- I must end it. There's no hope left. I'll be at peace.
- Dear World, I am leaving you because I am bored. I feel I have lived long enough. I am leaving you with your worries in this sweet cesspool – good luck.

No. of Words vs Age Intervals

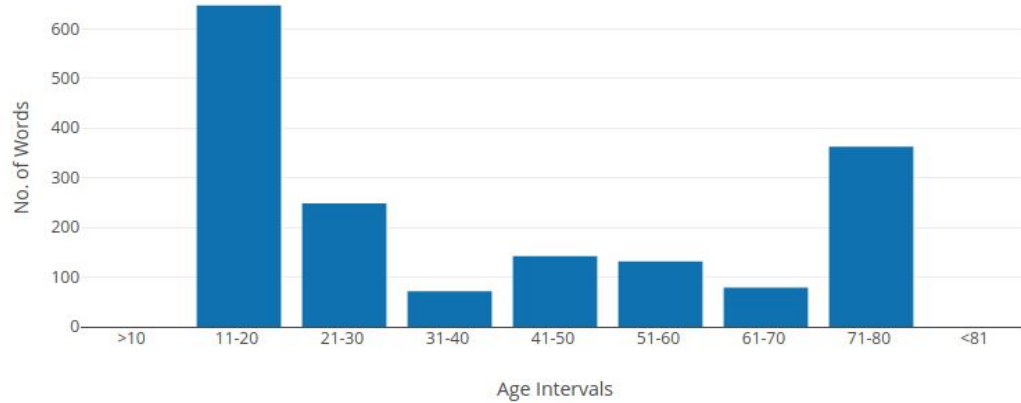
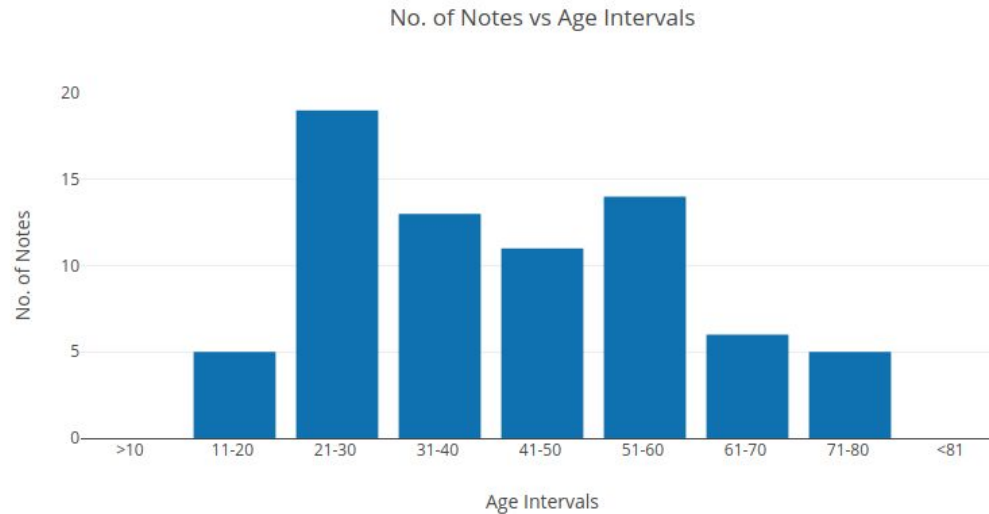


Fig 1. Average No. of Words vs Age Intervals

Fig 2. No. of Notes vs Age Intervals



# Dataset-II:

(From a book '**...Or Not to Be: A Collection of Suicide Notes**' by Marc Etkind)

## Approximately 140 suicide notes

- Notes relating to various categories such as: Love and Hate, Disgrace, Suicides committed in public, across Hollywood, etc.

## Statistics of the dataset

- No. of Unique Notes: ~140
- Total No. of words: ~12833
- Total No. of sentences: ~920
- Average words per line: 14.07
- Smallest Note: \$36

(From an anonymous jumper from Golden Gate Bridge, when found had \$36 in his mouth)

# Some samples

*I would like my sister Frances to have the piano that you have in your apartment. Do this or I will haunt you. Goodbye Sweets, Be seeing you soon. Love. Joe.*

A man to his ex-girlfriend

14 / MARC ETKIND

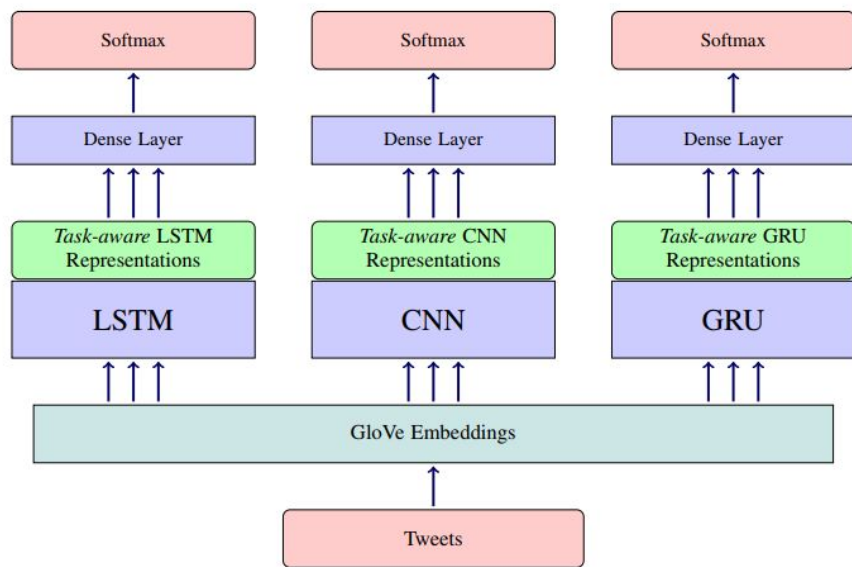
*Sorry about this. There's a corpse in here. Please inform police.*  
Before hanging himself, a workman chalked this on the wall of a home he was repairing.

*Kids, if there are any errors in this letter, I did not proof it carefully.*  
A teacher to the end, the superintendent of the Cleveland public schools left this postscript to his note. His body was found in his school office with a self-inflicted bullet wound.

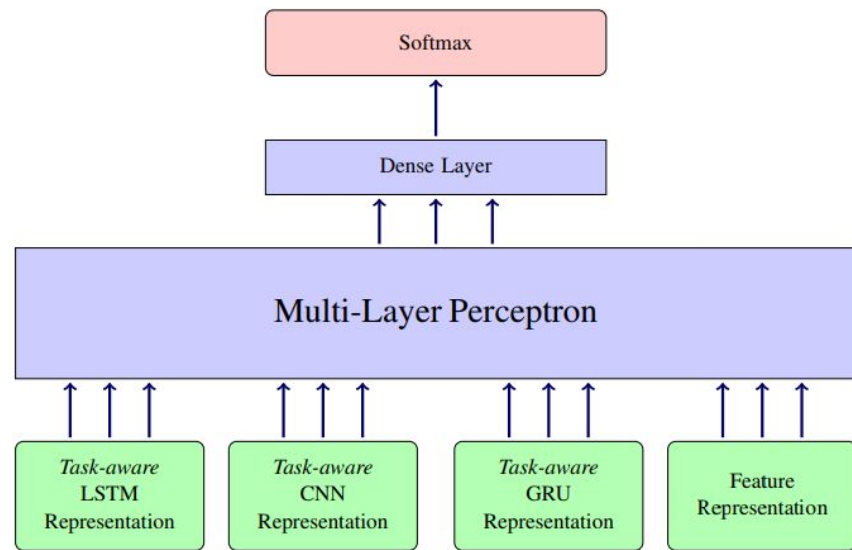
*Bow wow and good-bye, Pepper*  
From a man to his dog

# Deep Ensemble Models: Architecture

- Ensemble learning framework built on top of learned representations of three deep learning models and a hand-crafted feature vector
  - The idea is to exploit the richness of different feature representations to solve a task
  - Separately trained all three DL models
  - Extracted task-aware intermediate layer representations from these CNN, LSTM and GRU models



(a) Individual deep learning models

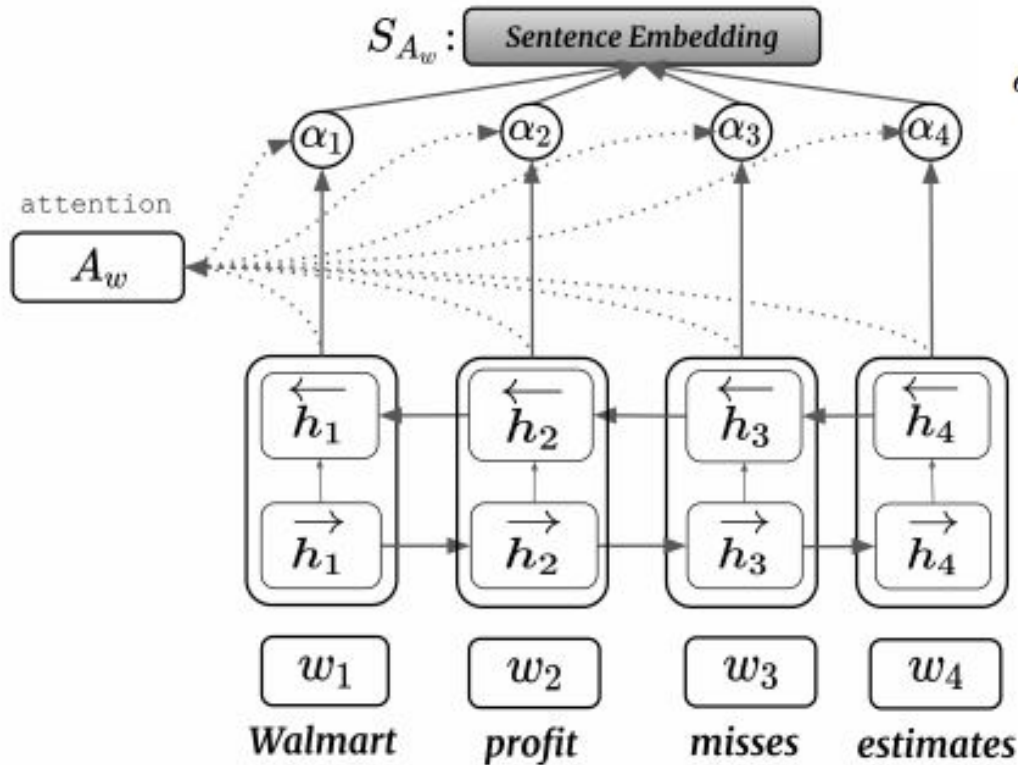


(b) Ensemble model

# Word-Level Attention

- Intent is to derive sentence-meaning from the words
- **Attention model** enables the sentence vector to have more attention on “important” words
- **Attention Vector** calculates weights corresponding to each word vector using its own shallow neural network
- **Sentence vector** is formed by calculating the weighted sum of every word vector

# Word Level Attention - Architecture



$$e_t = a(h_t), \alpha_t = \frac{\exp(e_t)}{\sum_{k=1}^T \exp(e_k)}, c = \sum_{t=1}^T \alpha_t h_t$$

- $a$  is a learnable function depending on  $h$
- $\alpha$ : attention weights (probability vector)
- $c$ : weighted average of the state sequence  $h$

# Attention Visualization (in the order: CNN, GRU, LSTM)

thanks for giving me the opportunity

thanks for giving me the opportunity

thanks for giving me the opportunity

thank you for being a positive influence on my life and making it a little better

thank you for being a positive influence on my life and making it a little better

thank you for being a positive influence on my life and making it a little better



# About Dataset

❖ Collected dataset spans across 250 suicide notes

➤ Containing 15 emotion classes

- *Abuse, Anger, Blame, Fear, Forgiveness, Guilt, Happiness/Peacefulness, Hopefulness, Hopelessness, Information, Instruction, Love, Pride, Sorrow, Thankfulness*

TOTAL Instances: 2360; Train Instances: 1887; Test Instances: 473

All integers denotes sentences		Abuse	Anger	Blame	Fear	Forgiveness	Guilt	Happiness	Hopefulness	Hopelessness	Information	Instruction	Love	Pride	Sorrow	Thankfulness
		A(D1)	Train	Test												
		10	61	38	18	20	61	26	130	66	927	176	70	12	242	30
		2	15	9	5	5	15	6	33	17	232	44	18	3	61	8

# Experiments and Results

All integers denotes percentage

	CNN	GRU	LSTM	Ensemble (MLP)	Ensemble (Majority O/P)
	A	A	A	A	A
Train Accuracy	99	99	99	99	99
Test Accuracy	53	59	55	62	61
Precision	50	58	54	59	59
Recall	53	59	55	61	62
F1-score	50	58	54	59	59

## Results Analysis: Inter-Model Effectiveness Comparisons (1/2)

- ❖ **#Emotion** depicted by < ✓ **modell1**>
- ❖ **#Emotion** depicted by < ✗ **model2**>

### ✓ **GRU** : ✗ **Ens (Avg. O/P)**

- my neck sweating **#Information** **#Abuse**
- look after my dogs **#Instruction** **#Anger**
- you destroyed my life **#Blame** **#Anger**

### ✓ **Ens (Avg. O/P)** : ✗ **GRU**

- i feel dead inside **#Sorrow** **#Abuse**
- please forgive me all for taking my own life so early **#Forgiveness** **#Abuse**
- they begin to tell me that nobody wants me there **#Information** **#Anger**

# Results Analysis: Inter-Model Effectiveness Comparisons (2/2)

- ❖ **# Emotion** depicted by < ✓ **model1**>
- ❖ **# Emotion** depicted by < ✗ **model2**>

## ✓ **GRU** : ✗ **Ens (MLP)**

- i am eager and keen to have a good time **#Hopefulness** **#Anger**
- i hate myself and i hate living **#Sorrow** **#Abuse**
- dear world i am leaving you because i am bored **#Information** **#Abuse**

## ✓ **Ens (MLP)** : ✗ **GRU**

- leaving the world to be a better place **#Hopefulness** **#Anger**
- we have made many discoveries **#Information** **#Anger**
- please forgive me all for taking my own life so early **#Forgiveness** **#Anger**

# Results from Ensemble models capable of capturing 15-emotions

## *A sample Note*

```
Dearest, I feel certain
that I'm going mad again.
... I begin to hear voices,
and I can't concentrate.
So I am doing what seems
to be the best thing to
do. ... I can't go on
spoilng your life any
longer. I don't think two
people could have been
happier than we have| been.
```

## *Predictions*

```
Sentence 16: I want to say that everybody knows it.
```

```
Predictions by
      ENSEMBLE Weighted Voting: Information
      ENSEMBLE MLP: Information
```

```
Sentence 17: If anybody could have saved me it would have been you.
```

```
Predictions by
      ENSEMBLE Weighted Voting: Hopefulness
      ENSEMBLE MLP: Hopefulness
```

```
Sentence 18: Everything has gone from me but the certainty of your goodness.
```

```
Predictions by
      ENSEMBLE Weighted Voting: Blame
      ENSEMBLE MLP: Blame
```

```
Sentence 19: I can't go on spoiling you life any longer.
```

```
Predictions by
      ENSEMBLE Weighted Voting: Pride
      ENSEMBLE MLP: Pride
```

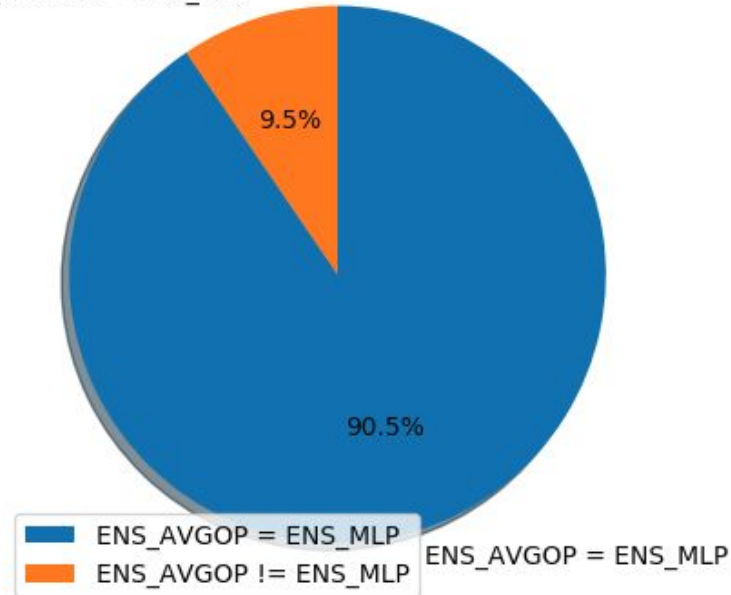
```
Sentence 20: I don't think two people could have been happier than we have been.
```

```
Predictions by
      ENSEMBLE Weighted Voting: Hopelessness
      ENSEMBLE MLP: Sorrow
```

# Results from Ensemble models capable of capturing 15-emotions

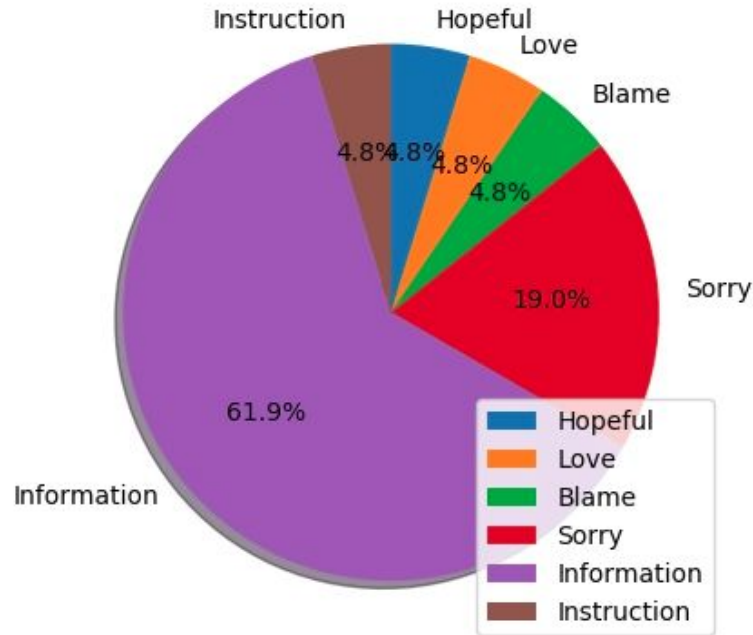
Predicted outputs Comparison of Ensemble (Voted) and Ensemble (MLP)

ENS\_AVGOP != ENS\_MLP

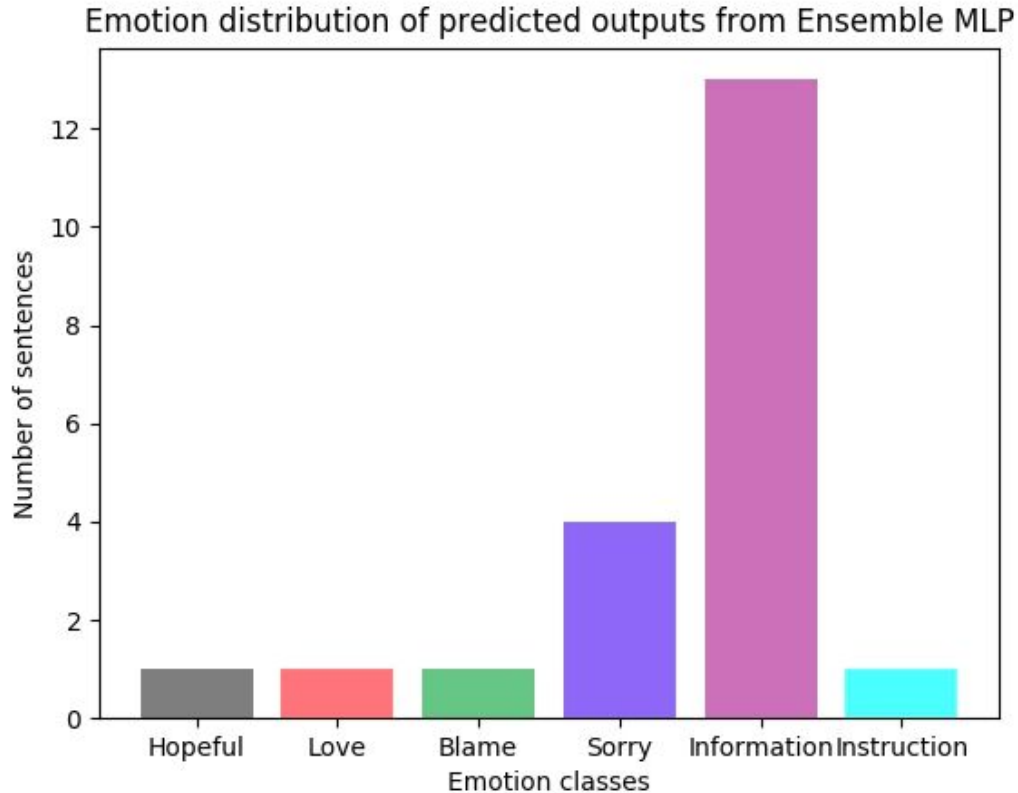


# Results from Ensemble models capable of capturing 15-emotions

Emotion distribution of predicted outputs from Ensemble MLP



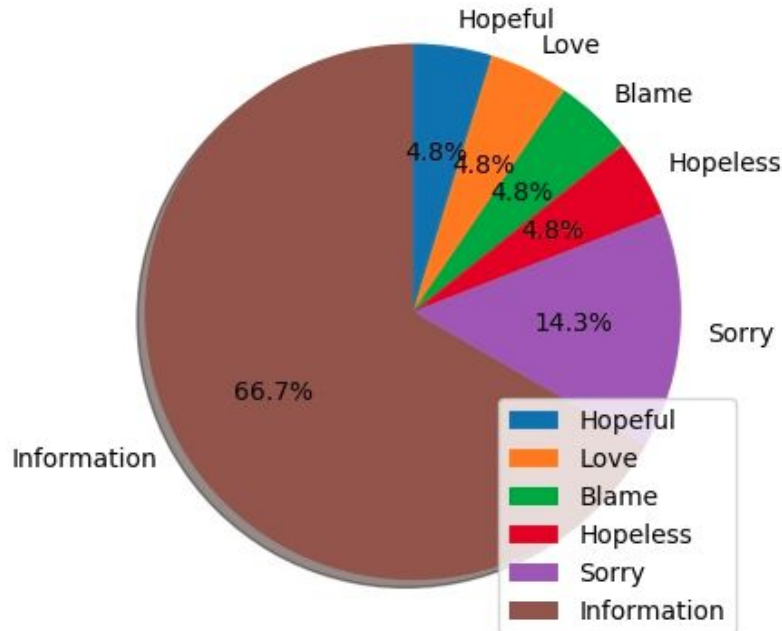
# Results from Ensemble models capable of capturing 15-emotions





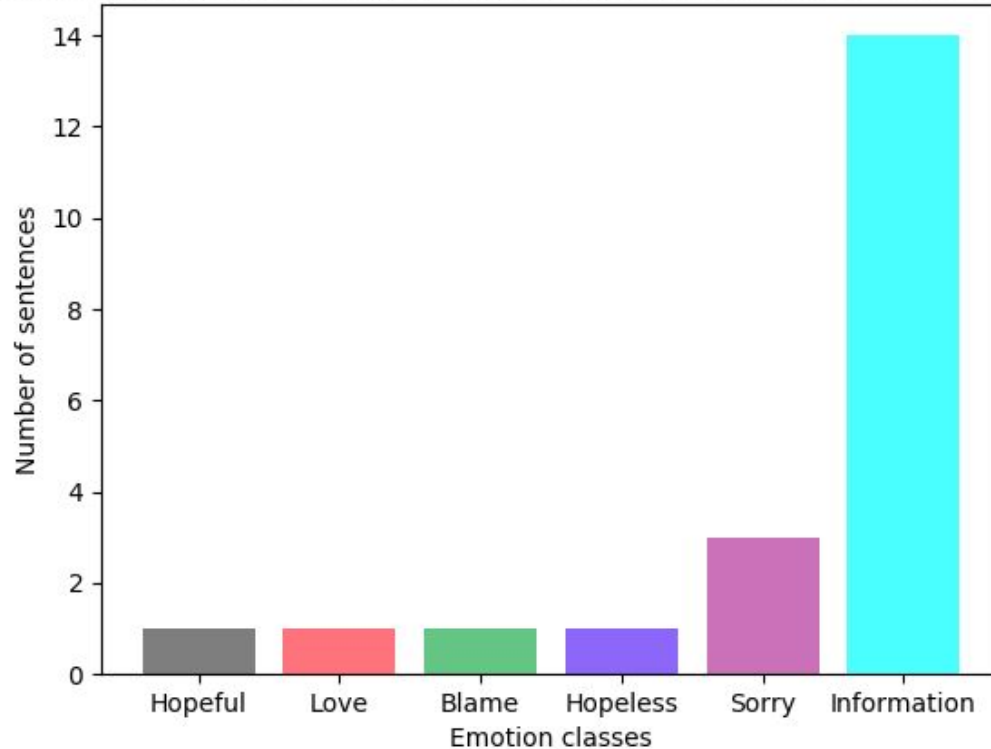
# Results from Ensemble models capable of capturing 15-emotions

Emotion distribution of predicted outputs from Ensemble Voted Classifier



# Results from Ensemble models capable of capturing 15-emotions

Emotion distribution of predicted outputs from Ensemble Voted Classifier



# References

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Any Questions?

Thank You.