



Thwarting in Sentiment Analysis

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Problem Overview

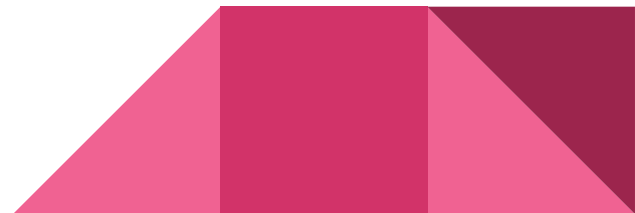
“I love the **sleek design**.
The **lens** is **impressive**.
The **pictures** look **good**
but, somehow this
camera disappoints me.
I do not recommend it.”



Aspect Level	
Design	Sleek
Lens	Impressive
Pictures	Good
Camera	Disappointing



Document Level
NOT RECOMMENDED



Related Work

- Although there is a lot of work in sentiment analysis, there is comparatively little direct research on thwarting
 - Thwarting is very rare (~1-2% of most datasets)
 - Persistent but minimal impact on sentiment analysis overall
 - Thwarting is difficult to detect
 - Generally requires domain knowledge
 - Generally requires hand annotation to identify
 - Expensive
 - Tedious



Methodology

Dataset Overview

- 50,000 Movie Reviews from IMDB
 - 50% Positive, 50% Negative
- Hand-annotated subset
 - 48% positive, 52% negative
 - 10 thwarted, 40 non-thwarted



Valence-Arousal-Dominance (VAD)

- Valence - “Pleasantness”
 - Tracks best to overall sentiment
- Arousal - Intensity
- Dominance - Degree of control
- 0-1 scale
- Words mapped as vectors
 - “Stupendous” [.7, .6, .3]
 - “Criminal” [.2, .6, .4]
 - “Forbidden” [.3, .8, .7]



Models

Rules-based

Read Document
into Memory

Preprocess Document

Text-Level Processing

Lowercase
POS-based Lemmatization
Pseudoword Replacement
POS-based Clause Identification
Negation Flagging

Clause-Level Processing

Pseudoword Removal
Stopword Removal
Punctuation Removal
Punctuation Removal
Non-Polar Token Removal
NaN Handling
Negation Application
for non mean-imputed tokens
VAD Dimension Averages
Single-Metric VAD Collation

Split Document
into 4-1 ratio

Last 1/5
of Document
is less than
3 clauses

Compute Average
Sentiment across first
4/5ths (A1)

Compute Average
Sentiment across
last 1/5th (A2)

Compute Weighted Average
Sentiment across
last 1/5th (A2)

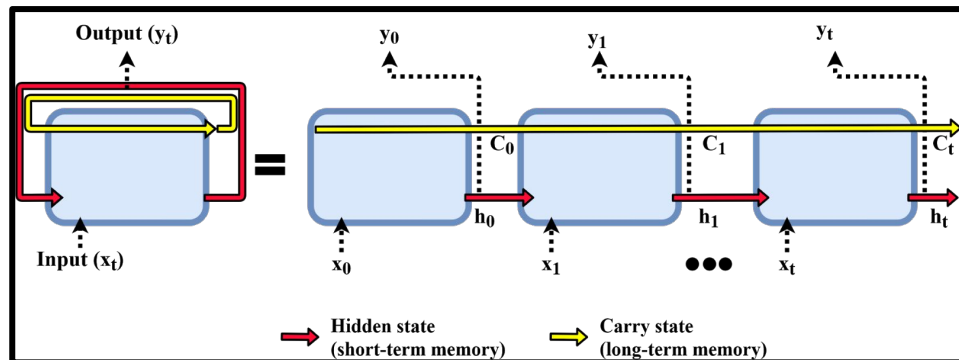
Binarize Average Sentiment for both Section Individually (S1, S2)

Return
S2

S1 \neq S2
AND
 $|A1 - A2| > 0.2$

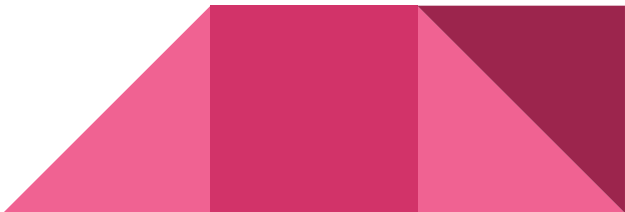
Return
S1

LSTM



Sample Input

The actors are terrible and the directing is lackluster. Although I dislike comedy, the movie was surprisingly enjoyable



Sample Input (Cont.)

C_{i1} : terrible -> 0.061

C_{i2} : lackluster -> 0.25

C_{i3} : dislike comedy -> 0.537

C_{i4} : movie surprisingly enjoyable -> 0.8796666

$D_i = [0.061, 0.25, 0.537, 0.8796666]$



Sample Output

Rules-based Model:

- Sentiment Prediction: False
- Thwarting Prediction: True

LSTM Model:

- Sentiment Prediction: 1

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=====
===== RULE-BASED MODEL RESULTS =====
=====
Confusion matrix for predicting overall sentiment on ALL evaluation documents
[[0. 0.]
 [0. 1.]]
Confusion matrix for predicting overall sentiment on ONLY thwarted evaluation documents
[[0. 0.]
 [0. 1.]]
Confusion matrix for predicting the existence of thwarting on ALL evaluation documents
[[0. 0.]
 [0. 1.]]
```

```
=====
===== LSTM MODEL RESULTS =====
=====
Confusion matrix for predicting overall sentiment on ALL evaluation documents
[[0. 0.]
 [0. 1.]]
Confusion matrix for predicting overall sentiment on ONLY thwarted evaluation documents
[[0. 0.]
 [0. 1.]]
```

Future Work

- Train LSTM on a larger dataset of thwarted reviews
- Divide longer documents into sub-sections before averaging
 - Reduce input vector size
- Try using rule-based method as an initial filtering for hand annotation





Thank you!

Resources

- [1] Ramteke Ankit, Malu Akshat, Bhattacharyya Pushpak; Nath, Saketha. 2013. *Detecting Turnarounds in Sentiment Analysis: Thwarting* <https://aclanthology.org/P13-2149.pdf>
- [2] Mohammad Saif. 2011. NCR Valence, Arousal, and Dominance (NCR-VAD) Lexicon. <https://saifmohammad.com/WebPages/nrc-vad.html>
- [3] LAKSHMIPATHI N. 2020. *Sentiment Analysis of IMDB Movie Reviews*. <https://www.kaggle.com/code/lakshmi25npathi/sentiment-analysis-of-imdb-movie-reviews>
- [4] Spacy en_core_web_sm pipeline, <https://spacy.io/models/en>
- [5] Pennington Jeffrey, Socher Richard, Manning Christopher. 2014. *GloVe: Global Vectors for Word Representation*. <https://nlp.stanford.edu/projects/glove/>
- [6] Pang Bo, Lee Lillian, Vaithyanathan Shivakumar. 2002. *Thumbs Up? Sentiment Classification using Machine Learning Techniques*. https://ncf.instructure.com/courses/6788/assignments/53643?module_item_id=154725
- [7] Wankhade Mayur, Rao Annavarapu Chandra Sekhara, Kulkarni Chaitanya. 2022. *A survey on sentiment analysis methods, applications, and challenges* <https://link.springer.com/article/10.1007/s10462-022-10144-1>
- [8] Panda Saimita, Gupta Saumya, Kumari Swati, Yadav Parul. 2020. *Sentiment Analysis Techniques and Approaches* <https://www.ijert.org/research/sentiment-analysis-techniques-and-approaches-IJERTV9IS060350.pdf>

