Coooollll: A Deep Learning System for Twitter Sentiment Classification

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Twitter sentiment classification

- Input: A tweet
- Output: Sentiment polarity of the tweet
  - Positive / Negative / Neutral
Feature representation is crucial

• **NRC-Canada (Top system in SemEval 2013)**
  – Designing effective features
    • Sentiment lexicons
    • Linguistic rules

  – Enhance the feature representation from massive data for Twitter sentiment classification?
Our System

• **Coooolll**: A deep learning system for Twitter sentiment classification

![Diagram](image)

- **Training Data**
- **Massive Tweets**
- **Embedding Learning**
  - **SSWE Feature**
  - **NRC-Canada Feature**

- **Feature Representation**
  - Dimension 1
  - Dimension 2
  - ... (up to dimension N)
  - All-cap emoticon
  - Elongated

- **Learning Algorithm**
- **Sentiment Classifier**
Word Representation (Embedding)

• Word Embedding

\[
\text{linguistic} = \begin{pmatrix}
1.045 \\
0.912 \\
-0.894 \\
-1.053 \\
0.459
\end{pmatrix}
\]

• Word embedding is important
  – Compositionality
  – [Yessenalina11; Socher13]
Not Enough for Sentiment Analysis

• Existing embedding learning algorithms typically use the syntactic contexts of words.

The words with similar contexts but opposite sentiment polarity are mapped into close vectors.
SSWE Unified

• Intuition
  – Use both the syntactic contexts of words and the sentiment polarity of sentences to learn the sentiment-specific word embedding

  – Solution
  • A hybrid loss function by capturing both information
SSWE Unified

Loss Function

\[ \alpha \cdot \text{loss}_{cw}(t, t^r) + (1 - \alpha) \cdot \text{loss}_{us}(t, t^r) \]

Syntactic Loss

\[ \max(0, 1 - f^{cw}(t) + f^{cw}(t^r)) \]

Sentiment Loss

\[ \max(0, 1 - \delta_s(t)f^u_1(t) + \delta_s(t)f^u_1(t^r)) \]

Text: *it is so coool* :)
Embedding Training

• Data
  – Tweets contains positive/negative emoticons
    
    | Positive | :) | :) | :-) | :D | =) |
    |----------|----|----|-----|----|-----|
    | Negative | :( | :( | :-( |    |     |

  – 5M positive, 5M negative tweets from April, 2013

• Back-propagation + AdaGrad [Duchi 2011]
  – Embedding length = 50
  – Window size = 3
  – Learning rate = 0.1

Hu et al., 2013
Twitter Sentiment Classification

Input

Embedding Layer

Layer $f$

Layer $f'$

concatenate

$\text{average}$ $\text{max}$ $\text{min}$

$\text{concatenate}$

$+$

NRC-Canada Feature

$\text{Training Data}$ $\rightarrow$ $\text{Learning Algorithm}$ $\rightarrow$ $\text{Sentiment Classifier}$
Experiment

- **Results**

  - *Coooolll* is ranked 2\textsuperscript{nd} on Twitter2014 test set.
Detailed Results on Twitter2014

• Positive / Negative / Neutral classification

Average: 60.41
Top: 70.96
Detailed Results on Twitter2014

- Positive / Negative classification

![Bar chart showing comparison of NRC, SSWE, and Cooolll for positive/negative classification]
Results on Twitter 2013

• Comparison with Different Embeddings

Results of POS/NEG classification on SemEval 2013. Detailed in our ACL 2014 paper.
Summary

• We introduce a deep learning system for Twitter sentiment classification.

• We verify the effectiveness of the sentiment-specific word embedding for Twitter sentiment classification.

• We publish the sentiment-specific word embedding at http://ir.hit.edu.cn/~dytang.
Thanks