Linguistically Regularized LSTM for Sentiment Classification

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目录
Contents

1 Background

Shortcoming of previous models

1.depend on expensive phrase-level annotation
2.do not full employ linguistic resources

2 Model

Linguistically Resource

- **sentiment word**
- **negation word**
- **intensity word**

Regularizer

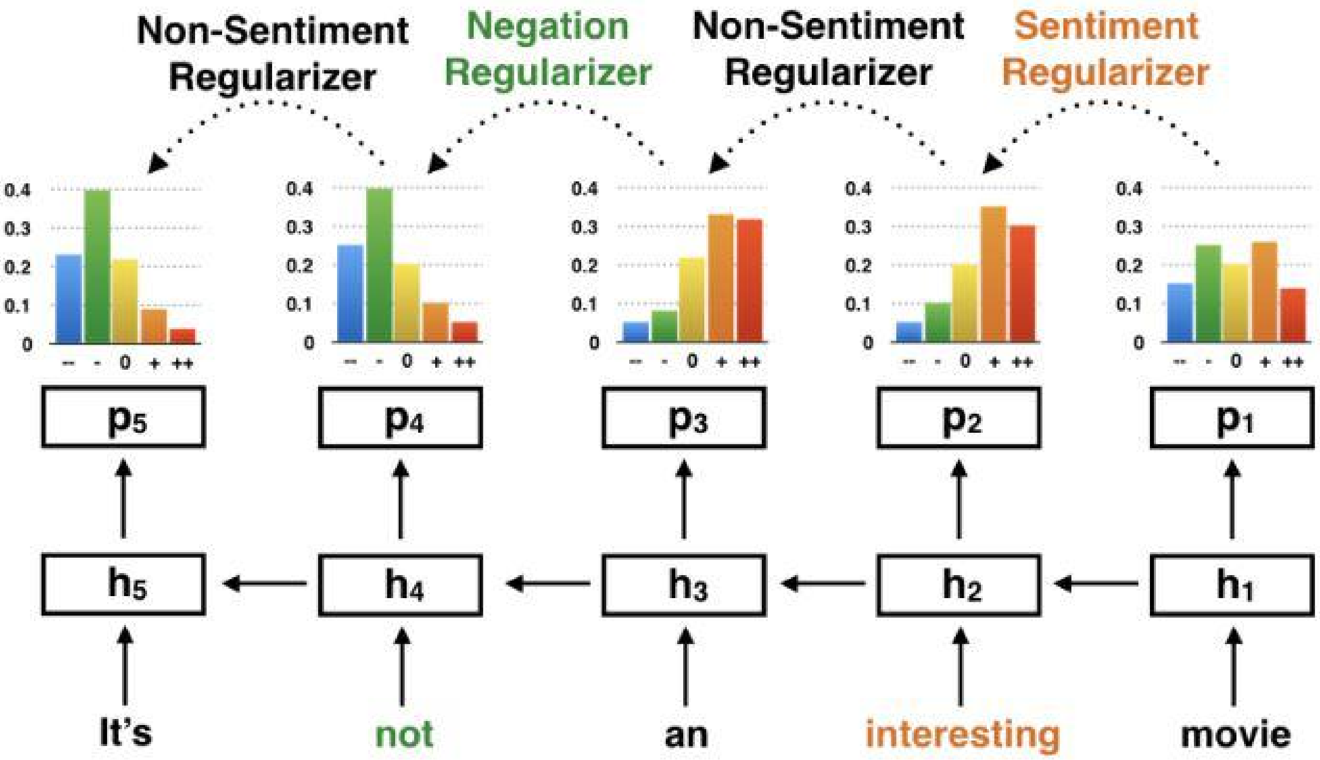
1.Non-Sentiment Regularizer eg. movie | a movie

2.Sentiment Regularizer eg. movie | interesting movie

3.Negation Regularizer eg. interesting movie | not interesting movie

4.Intensity Regularizer eg.interseting movie | very interesting movie

Model


Non-Sentiment Regularizer
Negation Regularizer
Non-Sentiment Regularizer
Sentiment Regularizer
0.4
0.3
0.2
0.1
0
-- - 0 + ++
p5
p4
p3
p2
p1
h5
h4
h3
h2
h1
It's
not
an
interesting
movie

Sentiment Regularizer

1. $$p_{t-1}^{(SR)} = p_{t-1} + s_{c(x_t)}$$

2. $$L_t^{(SR)} = max(0, D_{KL}(p_t || p_{t-1}^{(SR)}) - M)$$

3. $$D_{KL}(p||q) = \frac{1}{2}\sum_{l=1}^{C} p(l)\log q(l) + q(l)\log p(l)$$

4. $$\mathcal{L}(\theta) = -\sum_i \hat{y}_i \log y_i + \alpha \sum_i \sum_t L_{t,i} + \beta||\theta||^2$$

Negation Regularizer

1. $$p_{t-1}^{(NR)} = softmax(T_{x_j} \times p_{t-1})$$

2. $$p_{t+1}^{(NR)} = softmax(T_{x_j} \times p_{t+1})$$

3. $$L_t^{(NR)} = min \begin{cases} max(0, D_{KL}(p_t || p_{t-1}^{(NR)}) - M) \\ max(0, D_{KL}(p_t || p_{t+1}^{(NR)}) - M) \end{cases}$$

Bidirectional LSTM

1. $$\overrightarrow{p}_{t-1}^{(R)} = softmax(T_{x_j} \times \overrightarrow{p}_{t-1})$$

2. $$\overleftarrow{p}_{t+1}^{(R)} = softmax(T_{x_j} \times \overleftarrow{p}_{t+1})$$

3. $$L_t^{(R)} = min \begin{cases} max(0, D_{KL}(\overrightarrow{p}_t || \overrightarrow{p}_{t-1}^{(R)}) - M) \\ max(0, D_{KL}(\overleftarrow{p}_t || \overleftarrow{p}_{t+1}^{(R)}) - M) \end{cases}$$

3 Experiment

Dataset

Dataset	MR	SST
# sentences in total	10,662	11,885
#sen containing sentiment word	10,446	11,211
#sen containing negation word	1,644	1,832
#sen containing intensity word	2,687	2,472

Data

1.sentiment lexicon:MPQA and SST

2.

Negation word	no, nothing, never, neither, not, seldom, scarcely, etc.
Intensity word	terribly, greatly, absolutely, too, very, completely, etc.

Experience

Method	MR	SST Phrase-level	SST Sent.-level
RNN	77.7*	44.8#	43.2*
RNTN	75.9#	45.7*	43.4#
LSTM	77.4#	46.4*	45.6#
Bi-LSTM	79.3#	49.1*	46.5#
Tree-LSTM	80.7#	51.0*	48.1#
CNN	81.5*	48.0*	46.9#
CNN-Tensor	-	51.2*	50.6*
DAN	-	-	47.7*
NCSL	82.9	51.1*	47.1#
LR-Bi-LSTM	82.1	50.6	48.6
LR-LSTM	81.5	50.2	48.2

Experience

Method	MR	SST
LR-Bi-LSTM	82.1	48.6
LR-Bi-LSTM (-NSR)	80.8	46.9
LR-Bi-LSTM (-SR)	$\boxed{80.6}$	46.9
LR-Bi-LSTM (-NR)	81.2	47.6
LR-Bi-LSTM (-IR)	81.7	47.9
LR-LSTM	81.5	48.2
LR-LSTM (-NSR)	80.2	46.4
LR-LSTM (-SR)	$\boxed{80.2}$	46.6
LR-LSTM (-NR)	80.8	47.4
LR-LSTM (-IR)	81.2	47.4

4 Conclusion

Conclusion

1 通过损失函数将语言学规则引入现有的句子级情感分析的LSTM模型

2 使用tree-LSTM

Thank you for your listening