Learning Latent Opinions for Aspect-level Sentiment Classification

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Aspect-level Sentiment Classification

Review

The food is usually good but it certainly isn't a relaxing place to go.

Sentiment

food: positive
place: negative

The food is **usually good** but it **certainly isn't a relaxing** place to go.

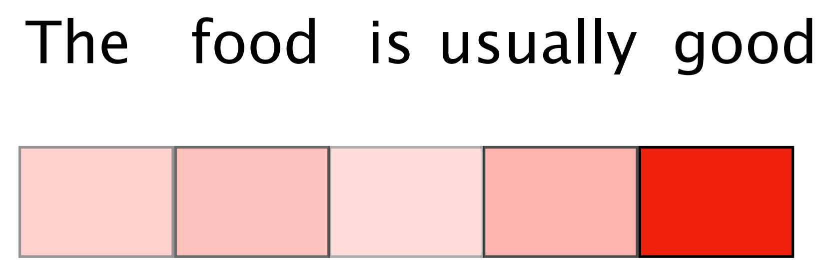
positive *negative*

Problem: requires additional annotations.

Latent Variable: Attention

Review: $w_0, w_{1,}..., w_n$

$p(z=k)$
$0 \leq k \leq n$



* Rely on LSTM to capture contextual information implicitly

Explicitly capture the structural dependencies

between target and opinion

between opinion words

The food is usually good but it certainly isn't a relaxing place to go.

positive *negative*

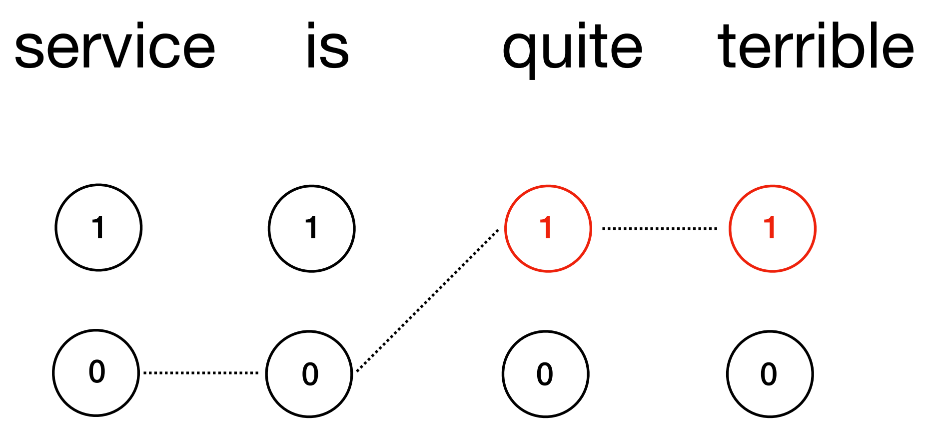
Observations:

* may be multiple targets which may hold different sentiments
* opinions are usually coherent and short span
* target and its opinion usually closely related in terms of syntactic structure

Segmentation Attention

$p(z_i) \quad z_i \in \{0,1\}$

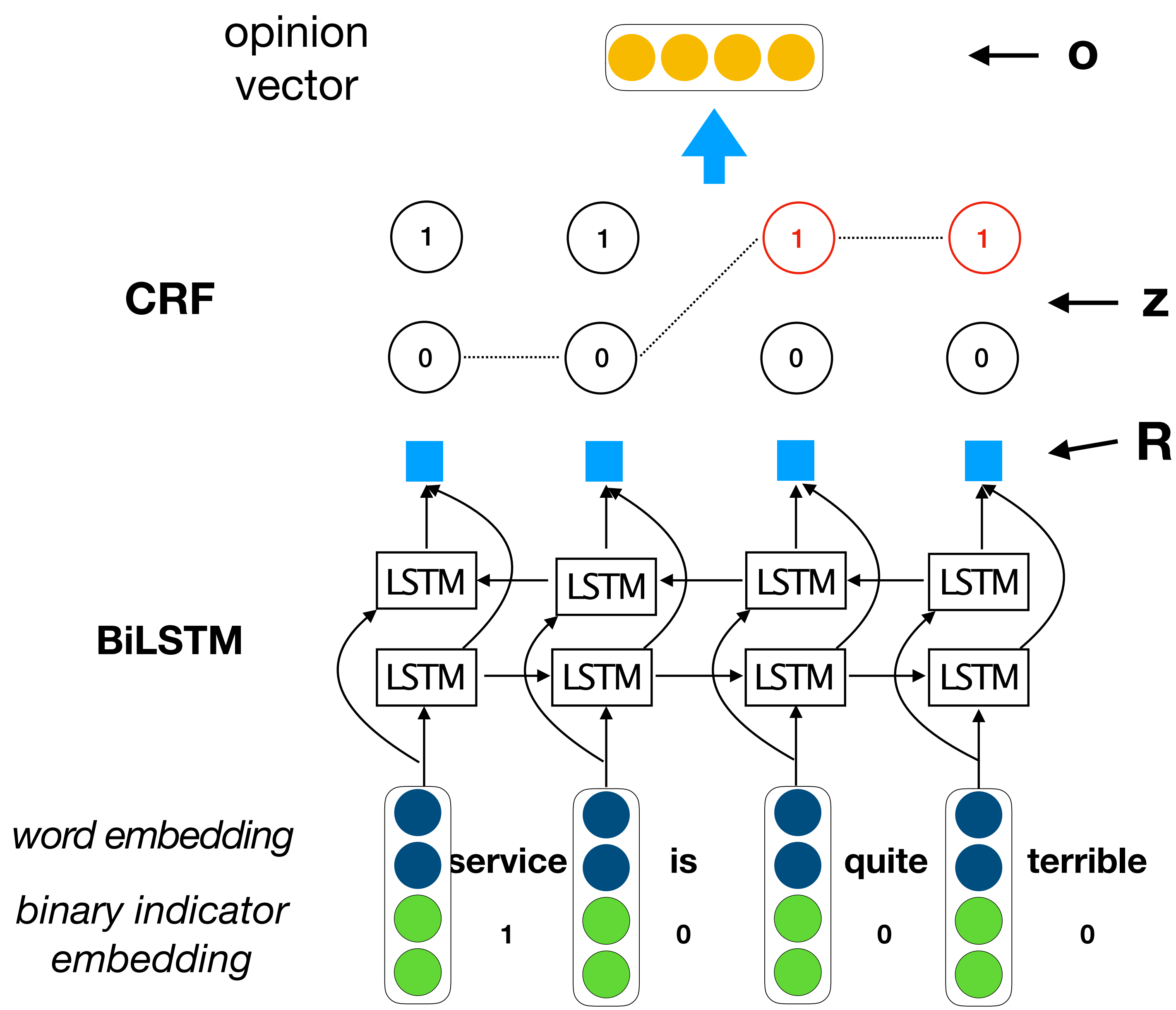
Whether it's a part of the opinion



Add first order assumption

Conditional Random Field

Model



Feature Function (g)

$$\mathbf{z} = [z_1, ..., z_n]$$

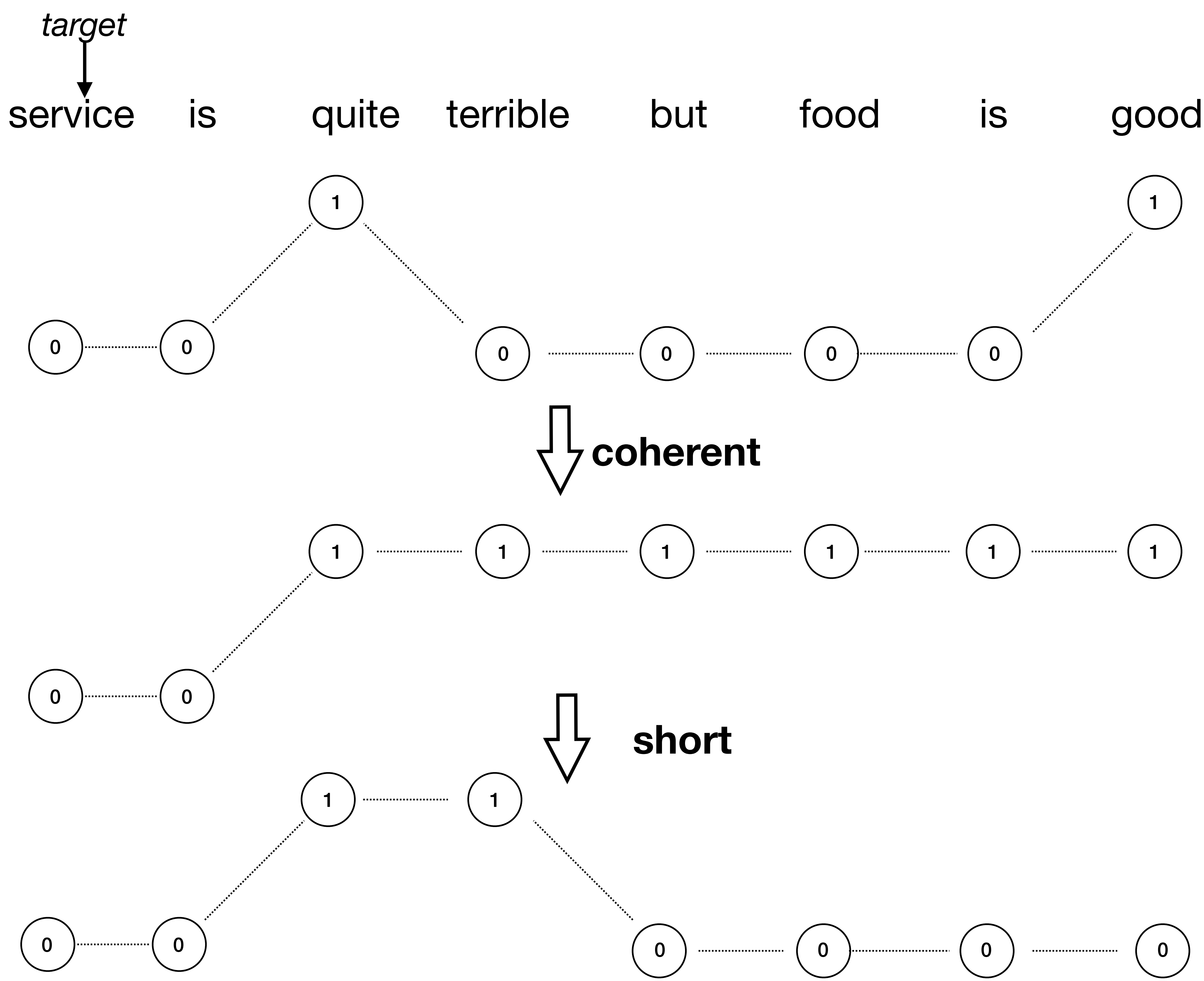
$$\mathbf{o} = \sum_{\mathbf{z}} p(\mathbf{z}) g(\mathbf{R}, \mathbf{z})$$

$$g(\mathbf{R}, \mathbf{z}) = \sum_{i=1}^{n} \mathbb{1}(z_i = 1)\mathbf{r_i}$$

$$\mathbf{o} = \sum_{i} p(z_i = 1)\mathbf{r_i}$$

marginal probability

Regularizer



Regularizer

1. punish the state transitions

$$\Omega_1(\mathbf{z}) = \sum_i \sum_{j \neq i} \max(0, \mathbf{W}^e_{ij} - \mathbf{W}^e_{ii})$$

2. punish the long opinions

$$\Omega_2(\mathbf{z}) = \sum_{i=1}^{n} p(z_i = 1)$$

Object Function

$$\mathcal{L} = \frac{1}{N} \left[\sum_{i=0}^{N} -y_i \log p(y_i) + \lambda_1 \Omega_1(\mathbf{z}) + \lambda_2 \Omega_2(\mathbf{z}) \right]$$

Results: SemEval 2014 task 4

Method	Laptop	Restaurant	Twitter
SVM	70.5	80.2	63.4
AdaRNN	-	-	66.3
AT-LSTM	68.9	77.2	-
MemNet	70.3	78.2	68.5
RAM	74.5	80.2	69.4
A-Softmax	68.8	76.9	66.0
SA-Softmax	69.0	77.1	66.2
SA-Softmax-P	69.1	77.8	66.5
A-LSTM	72.7	78.4	68.2
SA-LSTM	74.5	79.8	**69.9**
SA-LSTM-P	**75.1**	**81.6**	69.0

* A- standard Attention
* SA- Segmentation Attention
* P- with regularizers

Conclusions

* LSTM helps
* SA- is more beneficial than A-
* P- helps, especially with LSTM
* State-of-the-art performance
* not significant in Twitter (one target)

Results: SemEval 2016 task 5

Method	Restaurant						Hotel
	English	Spanish	French	Turkish	Russia	Dutch	Arabic
XRCE	88.1	-	78.8	-	-	-	-
IIT-TUDA	86.7	83.6	72.2	84.3	73.6	77.0	81.7
LSTM	81.4	75.7	69.8	73.6	73.9	73.6	80.5
HP-LSTM	85.3	81.8	75.4	79.2	77.4	84.8	82.9
A-LSTM	86.5	86.5	81.8	**86.2**	81.3	85.6	86.5
SA-LSTM	88.1	83.8	81.9	78.6	81.1	86.1	86.7
SA-LSTM-P	**88.7**	**88.0**	**82.4**	83.7	**82.8**	**87.3**	**86.9**

Conclusions

* SA helps, better with P (regularizer)
* Language insensitivity
* Significant improvement, especially for low resource language

Latent Opinions

**** Explicitly extract latent opinions using Viterbi***

**** provide causal explanations of how model works internally***

Method	Laptop		Restaurant	
	Precision	Recall	Precision	Recall
A-Softmax	50.2	44.6	59.7	36.9
SA-Softmax	36.2	68.1	38.5	64.7
SA-Softmax-P	65.5	55.2	42.2	58.3
A-LSTM	48.4	47.9	56.5	53.7
SA-LSTM	25.5	75.4	21.2	78.3
SA-LSTM-P	49.1	58.7	39.4	59.9

Conclusions

* LSTM and SA helps recall opinions

* Regularizer helps balance P and R

* unsupervised extraction of opinions at word-level

* annotations provided by Wang et al. 2016

Latent Opinions

1.	It also has lots of other ***Korean dishes*** (+) that are affordable and just as yummy .	*multiple opinions*
2.	They have ***wheat crusted pizza*** (+) made with really fresh and yummy ingredients .	*coherent span*
3.	The ***room*** is a gorgeous (+) , bi level space and the long bar perfect for a ***drink*** (+) .	*same sentiment, different opinion*
4.	The ***appetizers*** are ok (+) , but the ***service*** is slow (-) .	*different sentiment, different opinion*

Error Analysis

1. attention error

assign sentiment to intensity words like “really”, “sure”

2. representation error

Negation opinion

+

the ***filet mignon*** was not very good

-

You will not be disappointed by any of the choices in the ***menu*** .

Thanks

Code available on Github: https://github.com/berlino/SA-Sent