

Sentiment Analysis

this movie was great! would watch again +

the movie was gross and overwrought, but I liked it +

this movie was not really very enjoyable —

- ▶ Bag-of-words doesn't seem sufficient (discourse structure, negation)
- ▶ There are some ways around this: extract bigram feature for “*not X*” for all X following the *not*

Sentiment with Bag-of-words Models

	Features	# of features	frequency or presence?	NB	ME	SVM
(1)	unigrams	16165	freq.	78.7	N/A	72.8
(2)	unigrams	”	pres.	81.0	80.4	82.9
(3)	unigrams+bigrams	32330	pres.	80.6	80.8	82.7
(4)	bigrams	16165	pres.	77.3	77.4	77.1
(5)	unigrams+POS	16695	pres.	81.5	80.4	81.9
(6)	adjectives	2633	pres.	77.0	77.7	75.1
(7)	top 2633 unigrams	2633	pres.	80.3	81.0	81.4
(8)	unigrams+position	22430	pres.	81.0	80.1	81.6

- Simple feature sets can do pretty well!

Sentiment with Bag-of-words Models

- ▶ 10 years later — revisited basic BoW classifiers vs. other methods

Method	RT-s	MPQA
MNB-uni	77.9	85.3
MNB-bi	79.0	86.3
SVM-uni	76.2	86.1
SVM-bi	77.7	<u>86.7</u>
NBSVM-uni	78.1	85.3
NBSVM-bi	<u>79.4</u>	86.3
RAE	76.8	85.7
RAE-pretrain	<u>77.7</u>	<u>86.4</u>
Voting-w/Rev.	63.1	81.7
Rule	62.9	81.8
BoF-noDic.	75.7	81.8
BoF-w/Rev.	76.4	84.1
Tree-CRF	77.3	86.1

Before neural nets had taken off — results weren't that great

Kim (2014) CNNs **81.5 89.5**

Sentiment with Bag-of-words Models

- ▶ Stanford Sentiment Treebank (SST) binary classification
- ▶ Best systems now: large pretrained networks
- ▶ 90 -> 97 over the last 2 years

Model	Accuracy	Paper / Source	Code
XLNet-Large (ensemble) (Yang et al., 2019)	96.8	XLNet: Generalized Autoregressive Pretraining for Language Understanding	Official
MT-DNN-ensemble (Liu et al., 2019)	96.5	Improving Multi-Task Deep Neural Networks via Knowledge Distillation for Natural Language Understanding	Official
Snorkel MeTaL(ensemble) (Ratner et al., 2018)	96.2	Training Complex Models with Multi-Task Weak Supervision	Official
MT-DNN (Liu et al., 2019)	95.6	Multi-Task Deep Neural Networks for Natural Language Understanding	Official
Bidirectional Encoder Representations from Transformers (Devlin et al., 2018)	94.9	BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding	Official
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Neural Semantic Encoder (Munkhdalai and Yu, 2017)	89.7	Neural Semantic Encoders	
BLSTM-2DCNN (Zhou et al., 2017)	89.5	Text Classification Improved by Integrating Bidirectional LSTM with Two-dimensional Max Pooling	