面向网络评论的观点信息抽取研究

刘康

中国科学院自动化研究所模式识别国家重点实验室

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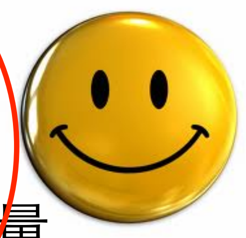
Opinion Mining

- 主观信息抽取
  - Unstructured → Structured
  - “*我今年入手诺基亚5800，把玩不到24小时，目前感觉5800屏幕很好，操作也很方便，通话质量也不错，但是外形有些偏女性化，不适合男生。这些都是小问题，最主要的问题是电池不耐用，只能坚持一天，反正我觉得对不起这个价格。*”

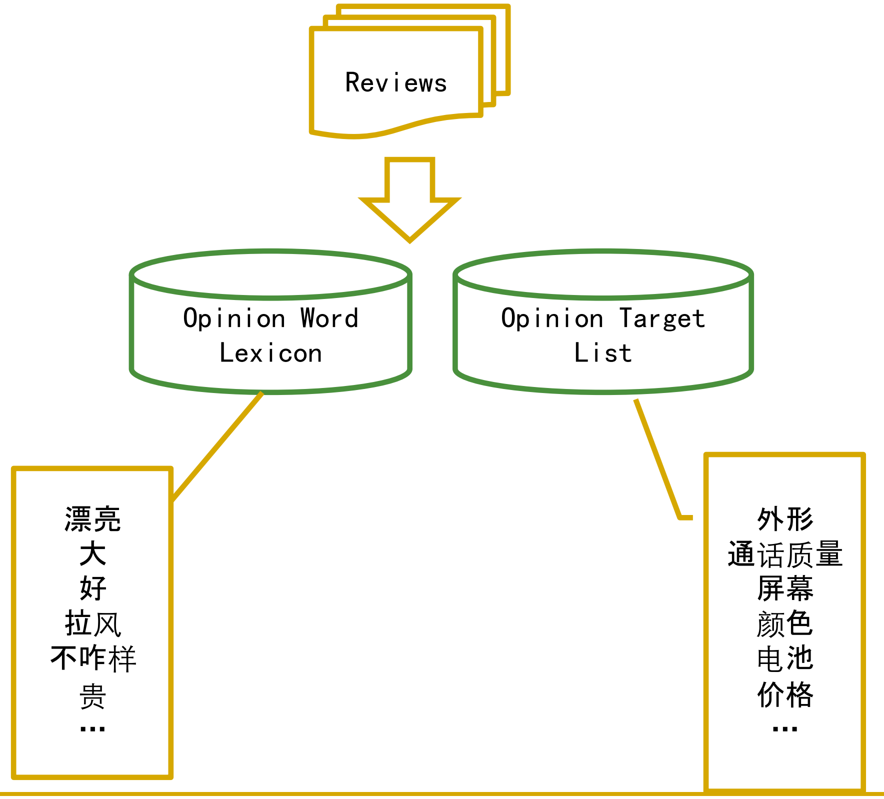
- 外形
- 电池

- 屏幕
- 操作
- 通话质量



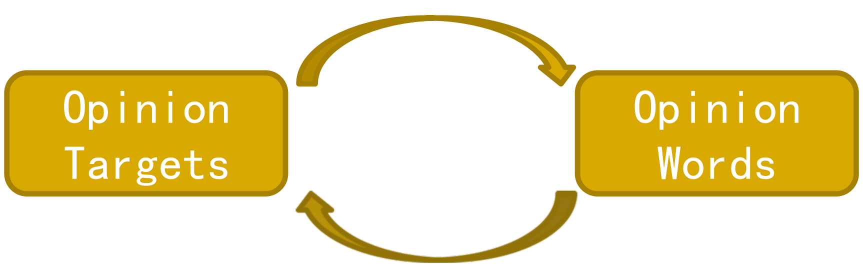
任务

- 观点评价对象和评价词抽取

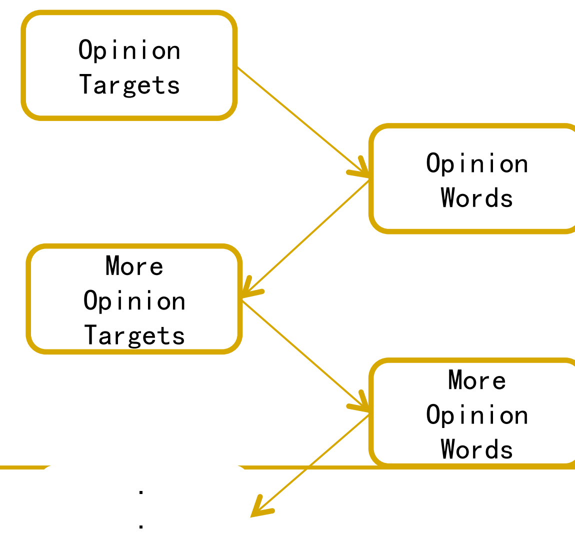


已有工作

- 非监督方法（Hu AAAI 2004, Popescu EMNLP 2005, Qiu CL 2010, Zhang COLING 2010）
  - 评价对象：名词、名词短语
  - 评价词：形容词、动词等
  - 假设：评价词与评价对象之间具有评价关系
    - 如果一个词是一个评价对象，则与之具有评价关系的词很可能就是一个评价词；反之亦然。
    - Good Screen, Bad Design
  - Bootstrapping 框架



Double Propagation



评价关系识别

- 近邻开窗(Hu 2004, Wang 2008)

这款 手机的外观 很 漂亮

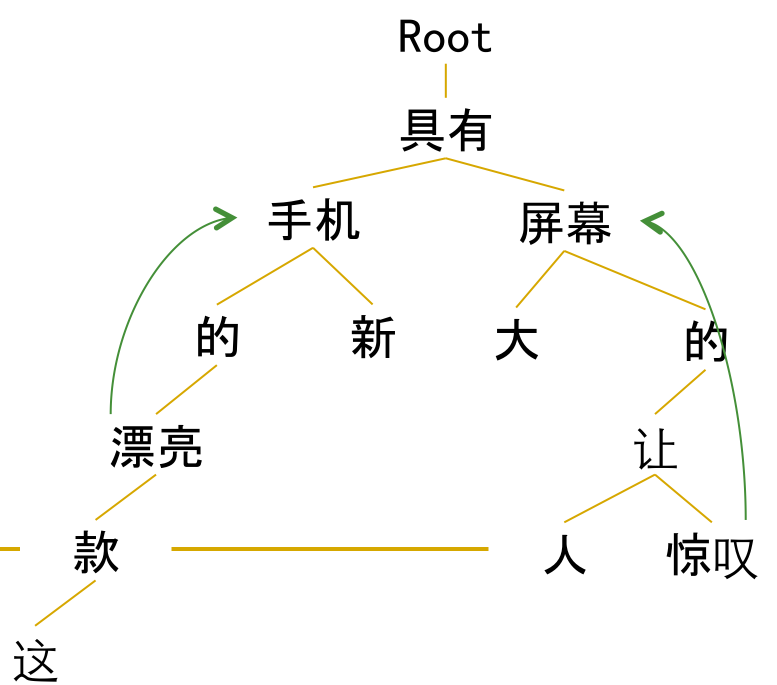
这 款 漂亮 的 新 手机 具有 让人 惊叹 的 大 屏幕

这 家 小店 位于 小巷 的 深处 ，尽管 位置 不 好 找 ，但是 仍然 很 赞

评价关系识别(续)

- 句法模板：Popescu (EMNLP 2005), Qiu (IJCAI 2009)
  - 利用评价对象和评价词之间的依存句法关系

这 款 漂亮 的 新 手机 具有 让人 惊叹 的 大 屏幕



Typed dependencies

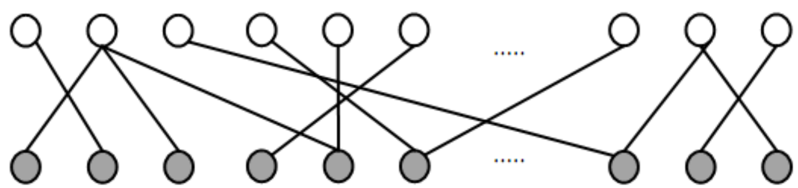
det(款-2, 这-1)
nsubj(漂亮-3, 款-2)
dep(的-4, 漂亮-3)
rcmod(手机-6, 的-4)
amod(手机-6, 新-5)
nsubj(具有-7, 手机-6)
root(ROOT-0, 具有-7)
dep(的-11, 让-8)
dobj(让-8, 人-9)
dep(让-8, 惊叹-10)
rcmod(屏幕-13, 的-11)
amod(屏幕-13, 大-12)
dobj(具有-7, 屏幕-13)

问题

- 评价关系识别
  - 句法方法：
    - 现有人工设定句法模板，覆盖度不高、精度差
      - 如何自动学习句法模板，如何考虑句法模板的置信度？
    - 网络文本通常是不规范文本，句法分析性能差
      - 是否可以不用句法分析器?
- 已有抽取框架仅仅利用评价对象和评价词之间的评价关系
  - 忽略评价对象和评价词本身的语义信息
    - Bad Feeling, Good Thing
- Bootstrapping抽取框架具有误差传递问题
  - 如何避免误差传递?

问题1：避免误差传递

- 基于Ranking的抽取框架
  - 评价对象（TC）：名词、名词短语
  - 评价词（OC）：形容词、动词

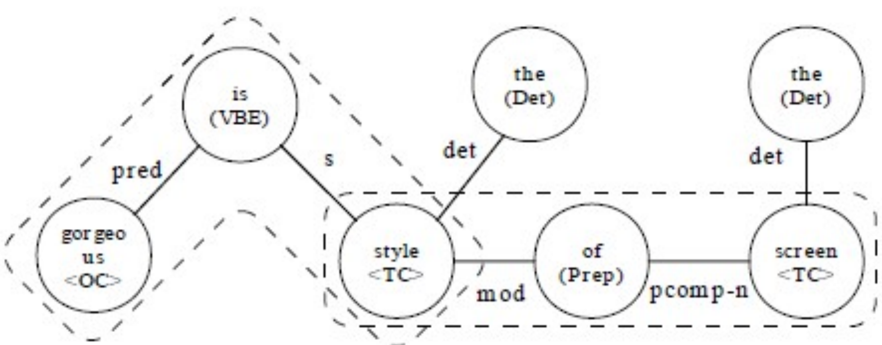


  - Ranking：Random Walking，PageRank，……

问题2：评价关系识别（利用句法信息 ACL2013）

- 自动学习句法模板
  - 种子词（评价词）：
    - good, bad, colorful, gorgeous……
  - 与种子词最近的名词（名词短语）间的最短依存路径
  - 滤除低频模板

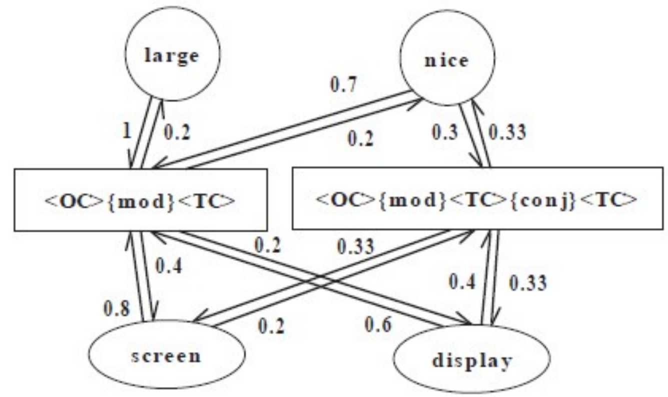
The style of the screen is gorgeous



<OC>{pred}(VBE){s}<TC>

评价关系识别：利用句法信息(续)

- 构建 Sentiment Graph
  - 三类节点
    - TC：评价对象候选
    - OC：评价词候选
    - P：抽取所使用的模板
  - 假设
    - 如果一个词是一个评价对象，则与之具有评价关系的OC评价词的置信度则很高；反之亦然。
    - 如果一个词是一个评价对象，另一个词是评价词，则抽取出他们的模板则应该具有很高的置信度；同时高置信度的模板抽取出的OC和TC也应高具有高置信度。



Ranking

- Random Walking Algorithm

$$\mathbf{c}_p^{t+1} = \mathbf{M}_{oc\_p}^T \times \mathbf{c}_{oc}^t + \mathbf{M}_{tc\_p}^T \times \mathbf{c}_{tc}^t$$

$$\mathbf{c}_{oc}^{t+1} = (1-\lambda)\mathbf{M}_{p\_oc}^T \times \mathbf{c}_p^t + \lambda \mathbf{c}_{oc}^0$$

$$\mathbf{c}_{tc}^{t+1} = \mathbf{M}_{p\_tc}^T \times \mathbf{c}_p^t$$

$$\mathbf{M}_{oc\_p}(v_o, v_p) = w(v_o, v_p)$$

$\mathbf{M}_{tc\_p}$, $\mathbf{M}_{p\_oc}$, $\mathbf{M}_{p\_tc}$

$$w(v_a, v_b) = freq(v_a, v_b)/freq(v_a)$$

实验

- 数据集
  - Customer Review Dataset (CRD)
  - COAE 2008
  - Collect a larger dataset: LARGE

Dataset	Domain	#Sentences	#OW	#OT
Large (English)	Hotel	10,000	434	1,015
	MP3	10,000	559	1,158
COAE08 (Chinese)	Camera	2,075	351	892
	Car	4,783	622	1,179

Data set	Number of reviews	Number of sentences
D1	45	597
D2	34	346
D3	41	546
D4	95	1,716
D5	99	740

- 评价指标
  - P, R and F1

实验结果： CRD

Methods	D1			D2			D3			D4			D5			Avg.
	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F	F
Hu	0.75	0.82	0.78	0.71	0.79	0.75	0.72	0.76	0.74	0.69	0.82	0.75	0.74	0.80	0.77	0.76
DP	**0.87**	0.81	**0.84**	**0.90**	0.81	**0.85**	**0.90**	0.86	**0.88**	0.81	0.84	0.82	**0.92**	0.86	**0.89**	**0.86**
Zhang	0.83	0.84	0.83	0.86	0.85	**0.85**	0.86	**0.88**	0.87	0.80	0.85	0.82	0.86	0.86	0.86	0.85
Ours-Stage1	0.79	**0.85**	0.82	0.82	**0.87**	0.84	0.83	0.87	0.85	0.78	**0.88**	0.83	0.82	**0.88**	0.85	0.84
Ours-Full	0.86	0.82	**0.84**	0.88	0.83	**0.85**	0.89	0.86	0.87	**0.83**	0.86	**0.84**	0.89	0.85	0.87	**0.86**

Table 2: Results of opinion target extraction on the *Customer Review Dataset*.

Methods	D1			D2			D3			D4			D5			Avg.
	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F	F
Hu	0.57	**0.75**	0.65	0.51	0.76	0.61	0.57	0.73	0.64	0.54	0.62	0.58	0.62	0.67	0.64	0.62
DP	**0.64**	0.73	0.68	0.57	0.79	0.66	0.65	0.70	0.67	0.61	0.65	0.63	0.70	**0.68**	**0.69**	0.67
Ours-Stage1	0.61	**0.75**	0.67	0.55	**0.80**	0.65	0.63	**0.75**	**0.68**	0.60	**0.69**	0.64	0.68	0.70	**0.69**	0.67
Ours-Full	**0.64**	0.74	**0.69**	**0.59**	0.79	**0.68**	**0.66**	0.71	**0.68**	**0.65**	0.67	**0.66**	**0.72**	0.67	**0.69**	**0.68**

Table 3: Results of opinion word extraction on the *Customer Review Dataset*.

实验结果：Large and COAE2008

Methods	MP3			Hotel			Camera			Car			Avg.
	P	R	F	P	R	F	P	R	F	P	R	F	F
Hu	0.53	0.55	0.54	0.55	0.57	0.56	0.63	0.65	0.64	0.62	0.58	0.60	0.58
DP	0.66	0.57	0.61	0.66	0.60	0.63	0.71	0.70	0.70	0.72	0.65	0.68	0.66
Zhang	0.65	0.62	0.63	0.64	0.66	0.65	0.71	0.78	0.74	0.69	0.68	0.68	0.68
Ours-Stage1	0.62	0.68	0.65	0.63	0.71	0.67	0.69	0.80	0.74	0.66	0.71	0.68	0.69
Ours-Full	**0.73**	**0.71**	**0.72**	**0.75**	**0.73**	**0.74**	**0.78**	**0.81**	**0.79**	**0.76**	**0.73**	**0.74**	**0.75**

Table 4: Results of opinion targets extraction on *Large* and *COAE08*.

Methods	MP3			Hotel			Camera			Car			Avg.
	P	R	F	P	R	F	P	R	F	P	R	F	F
Hu	0.48	0.65	0.55	0.51	0.68	0.58	0.72	0.74	0.73	0.70	0.71	0.70	0.64
DP	0.58	0.62	0.60	0.60	0.66	0.63	0.80	0.73	0.76	0.79	0.71	0.75	0.68
Ours-Stage1	0.59	**0.69**	0.64	0.61	**0.71**	0.66	0.79	**0.78**	0.78	0.77	**0.77**	0.77	0.71
Ours-Full	**0.64**	0.67	**0.65**	**0.67**	0.69	**0.68**	**0.82**	**0.78**	**0.80**	**0.80**	0.76	**0.78**	**0.73**

Table 5: Results of opinion words extraction on *Large* and *COAE08*.

问题2：评价关系识别（不利用句法信息 EMNLP 2012）

- Word alignment

C: 救援 人员 在 倒塌的 房屋 里 寻找 生还者

E: Rescue workers search for survivors in collapsed houses

- Monolingual word alignment

E: The phone has a colorful and even amazing screen

E: The phone has a colorful and even amazing screen

IBM对齐模型

- IBM model （IBM-1, IBM-2, IBM-3）

$$P_{IBM-1}(A|S) \propto \prod_{j=1}^{n} t(w_j | w_{a_j})$$

词之间的共现关系

$$P_{IBM-2}(A|S) \propto \prod_{j=1}^{n} t(w_j | w_{a_j}) d(j | a_j, n)$$

词之间的位置关系

$$P_{IBM-3}(A|S) \propto \prod_{i=1}^{n} n(\phi_i | w_i) \prod_{j=1}^{n} t(w_j | w_{a_j}) d(j | a_j, n)$$

一个词的一对多关系

E: The phone has a colorful and even amazing screen

E: The phone has a colorful and even amazing screen

模型约束

- 名词或名词短语(形容词)只能与形容词(名词或名词短语)或NULL对齐
- 其他词只能和自己对齐

E: NULL The phone has a colorful and even amazing screen

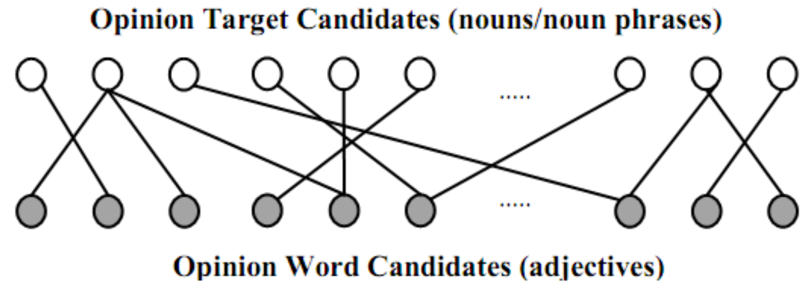
E: NULL The phone has a colorful and even amazing screen

- 例子

	battery life	sound	software
wonderful	0.000	0.042	0.000
poor	0.032	0.000	0.026
long	0.025	0.000	0.000

Ranking

- Random Walk with Restart



$$C^{t+1} = (1-\lambda) \times M^T \times M \times C^t + \lambda \times S$$

$Association(w_N, w_A)$

$$M = \begin{bmatrix} & \cdots & m \\ \vdots & \ddots & \vdots \\ & \cdots & \end{bmatrix}$$

$Importance(c)$

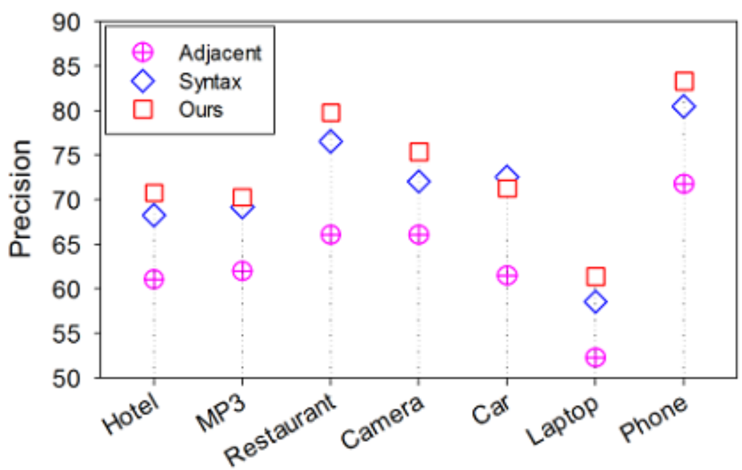
$$S = \begin{bmatrix} \\ s \\ \\ \end{bmatrix}$$

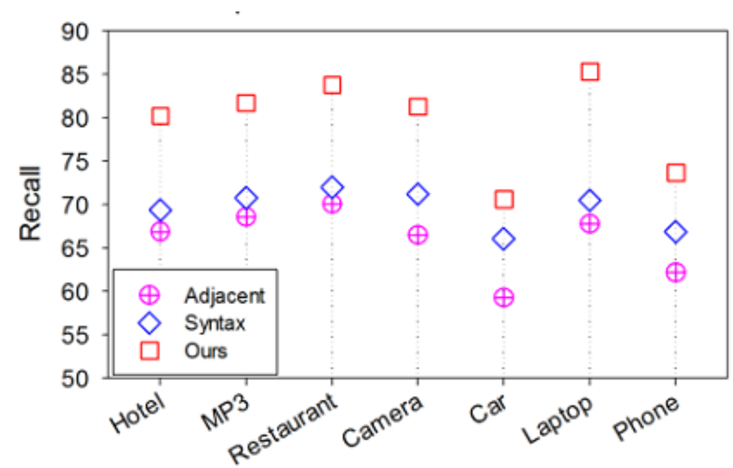
$$C = \lambda \times (I - (1-\lambda) \times M^T \times M)^{-1} \times S$$

实验结果

- Compared Methods
  - Adjacent: Adjacent rule
  - Syntax: Syntactic patterns
  - Ours: WAM

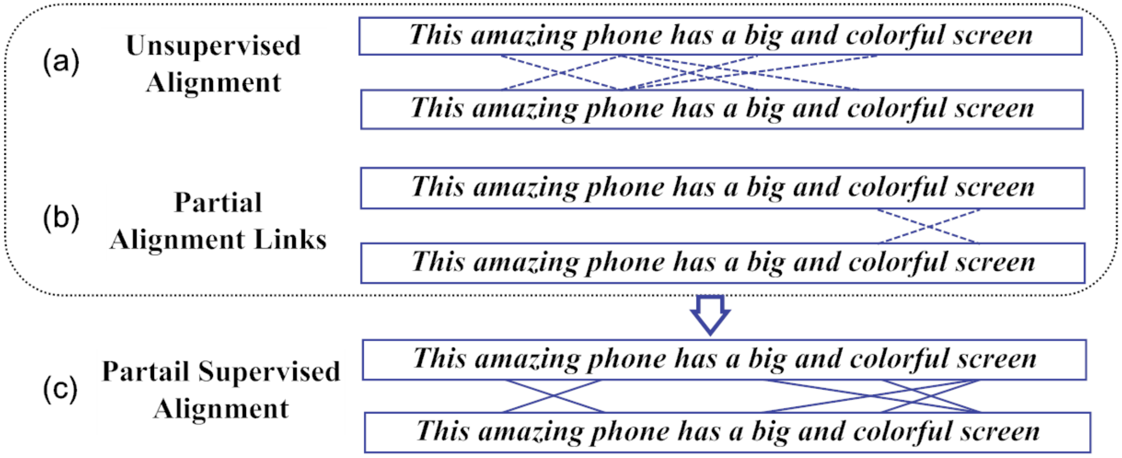
\+ Our Graph-based Algorithm





句法信息与词对齐模型相结合IJCAI2013

- 句法信息一点都没有用吗
  - WAM：训练过程完全无监督，容易产生错误
  - 需要对其进行约束



部分监督的单语对齐模型(Qin Gao, Workshop on SMT, ACL 2010)

- Given the partial alignment $\hat{A} = \{(i, a_i) | i \in [1, n], a_i \in [1, n]\}$

$$A^* = \underset{A}{argmax}\, P(A|S, \hat{A})$$

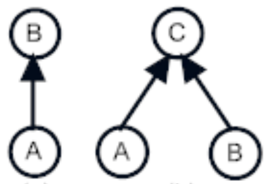
- Three steps
  - Train a simple alignment model to generate an initial alignments for IBM-3
  - Update the alignments to make it consistent to the partial alignments links
  - Optimize the alignment under the constraints iteratively

Algorithm 1 Constrained Hill-Climbing

Calculate the seed alignment a_0 using HMM model
while $ic(a_0) > 0$ **do**
    if $\{a : ic(a) < ic(a_0)\} = \emptyset$ **then**
        break
    end if
    $a_0 := \arg\max_{a \in nb(a_0), ic(a) < ic(a_0)} Pr(f|e, a)$
end while
$M_{ij} := -1$ if $(i, j) \notin \alpha_I^J$ or $(i, 0) \in \alpha_I^J$
loop
    $S_{jj'} := -1$ if $(j, a_{j'}) \notin \alpha_I^J$ or $(j', a_j) \notin \alpha_I^J$
    $M_{i_1 j_1} = \arg\max M_{ij}$; $S_{j_1 j_1'} = \arg\max S_{ij}$
    if $M_{i_1 j_1} \leq 1$ and $S_{j_1 j_1'} \leq 1$ **then**
        Break
    end if
    if $M_{i_1 j_1} > S_{j_1 j_1'}$ **then**
        Update $M_{i_1 *}, M_{j_1 *}, M_{* i_1}, M_{* j_1}$
        and $S_{i_1 *}, S_{j_1 *}, S_{* i_1}, S_{* j_1}$, set $a_0 := M_{i_1 j_1}(a_0)$
    else
        Update $M_{j_1 *}, M_{j_1' *}, M_{* j_1}, M_{* j_1'}$
        and $S_{j_1' *}, S_{j_1 *}, S_{* j_1'}, S_{* j_1}$, set $a_0 := S_{j_1 j_1'}(a_0)$
    end if
end loop
Return a_0

部分对齐信息：句法模板

- 高质量的句法模板



(a) (b)

Pattern1: $A \xrightarrow{R1} B \quad A \in \{O\},\ B \in \{T\}$

Pattern2: $A \xrightarrow{R1} C \xleftarrow{R2} B \quad A \in \{O\},\ B \in \{T\},$
$C \in \{\text{any words}\}$

Pattern#1: $<OC> \xrightarrow{mod} <TC>$
Example: This phone has an *amazing design*
Pattern#2: $<TC> \xrightarrow{obj} <OC>$
Example: I *like* this *phone* very much
Pattern#3: $<OC> \xrightarrow{pnmod} <TC>$
Example: the *buttons easier* to use
Pattern#4: $<OC> \xrightarrow{mod} (NN) \xleftarrow{subj} <TC>$
Example: *IPhone* is a *revolutionary* smart phone
Pattern#5: $<OC> \xrightarrow{pred} (VBE) \xleftarrow{subj} <TC>$
Example: The *quality* of LCD is *good*

实验结果

Methods	Camera			Car			Laptop			Phone		
	P	R	F	P	R	F	P	R	F	P	R	F
Hu	0.63	0.65	0.64	0.62	0.58	0.60	0.51	0.67	0.58	0.69	0.60	0.64
DP	0.71	0.70	0.70	0.72	0.65	0.68	0.58	0.69	0.63	0.78	0.66	0.72
Zhang	0.71	0.78	0.74	0.69	0.68	0.68	0.57	0.80	0.67	0.80	0.71	0.75
Liu	0.75	0.81	0.78	0.71	**0.71**	0.71	0.61	**0.85**	0.71	0.83	0.74	0.78
Ours	**0.77**	**0.82**	**0.79**	**0.74**	**0.71**	**0.72**	**0.66**	**0.85**	**0.74**	**0.85**	**0.75**	**0.80**

Table 1: Experimental Results on *COAE 2008*

Methods	Hotel			MP3			Restaurant		
	P	R	F	P	R	F	P	R	F
Hu	0.60	0.65	0.62	0.61	0.68	0.64	0.64	0.69	0.66
DP	0.67	0.69	0.68	0.69	0.70	0.69	0.74	0.72	0.73
Zhang	0.67	0.76	0.71	0.67	0.77	0.72	0.75	0.79	0.77
Liu	0.71	0.80	0.75	0.70	0.82	0.76	0.80	0.84	0.82
Ours	**0.76**	**0.83**	**0.79**	**0.74**	**0.84**	**0.79**	**0.85**	**0.85**	**0.85**

Table 2: Experimental Results on *Large*

Methods	D1			D2			D3			D4			D5		
	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F
Hu	0.75	0.82	0.78	0.71	0.79	0.75	0.72	0.76	0.74	0.69	0.82	0.75	0.74	0.80	0.77
DP	**0.87**	0.81	0.84	**0.90**	0.81	0.85	**0.90**	0.86	0.88	**0.81**	0.84	0.82	**0.92**	0.86	**0.89**
Zhang	0.83	0.84	0.83	0.86	**0.85**	0.85	0.86	0.88	0.87	0.80	**0.85**	0.82	0.86	0.86	0.86
Liu	0.84	**0.85**	0.84	0.87	**0.85**	**0.86**	0.88	0.89	0.88	**0.81**	**0.85**	**0.83**	0.89	**0.87**	0.88
Ours	0.86	0.84	**0.85**	0.88	0.83	0.85	0.89	**0.90**	**0.89**	**0.81**	0.83	0.82	0.91	**0.87**	**0.89**

Table 3: Experimental Results on *Customer Review Dataset*

WAM在不同数据规模下是否都有效？ACL2013

- Varying data size
  - 500→1,000,000

数据量大的时候，精准的opinion relation识别结果没有作用

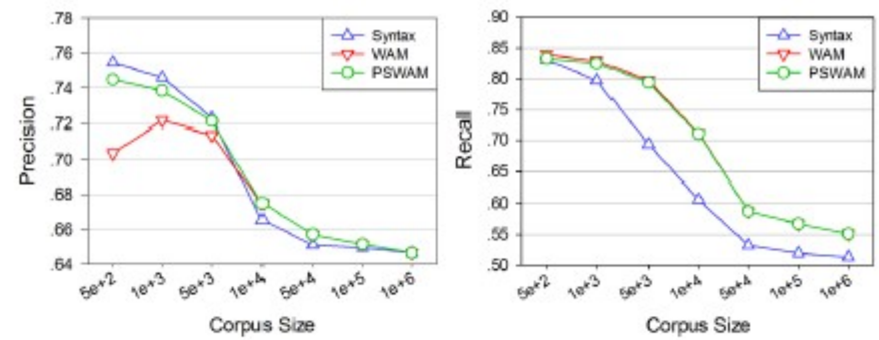


Figure 4: Experimental results on Hotel

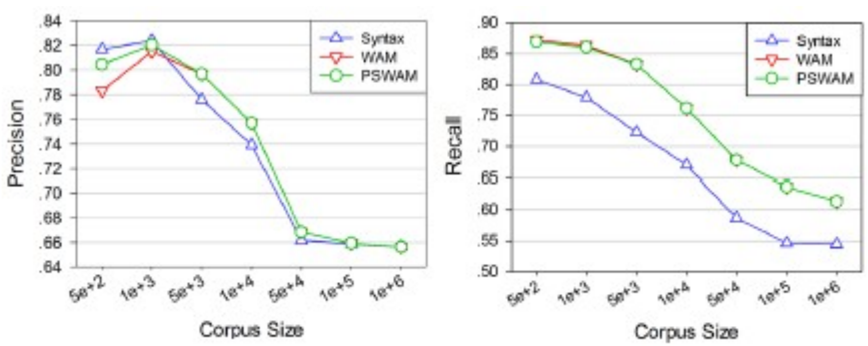


Figure 3: Experimental results on Restaurant

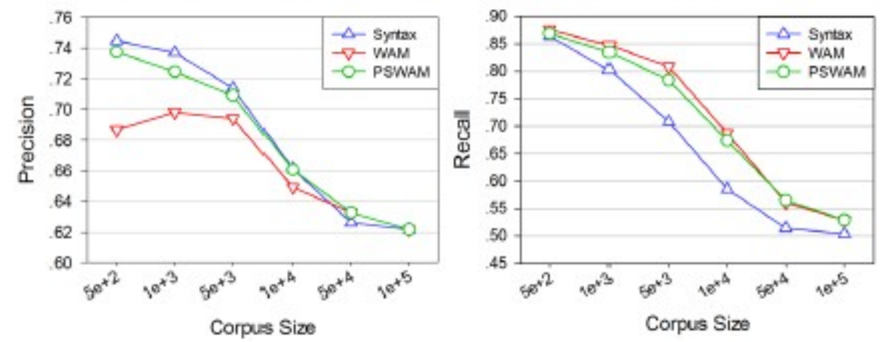
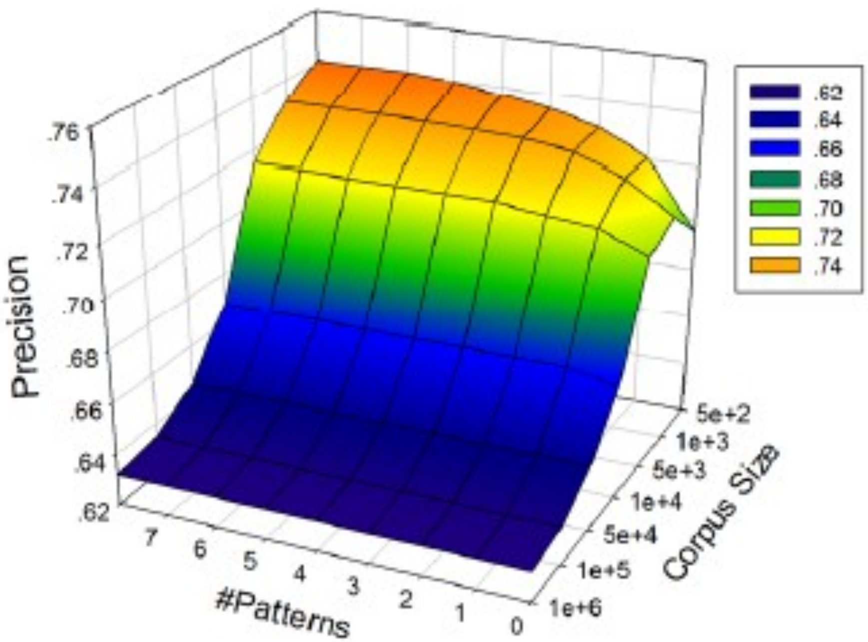
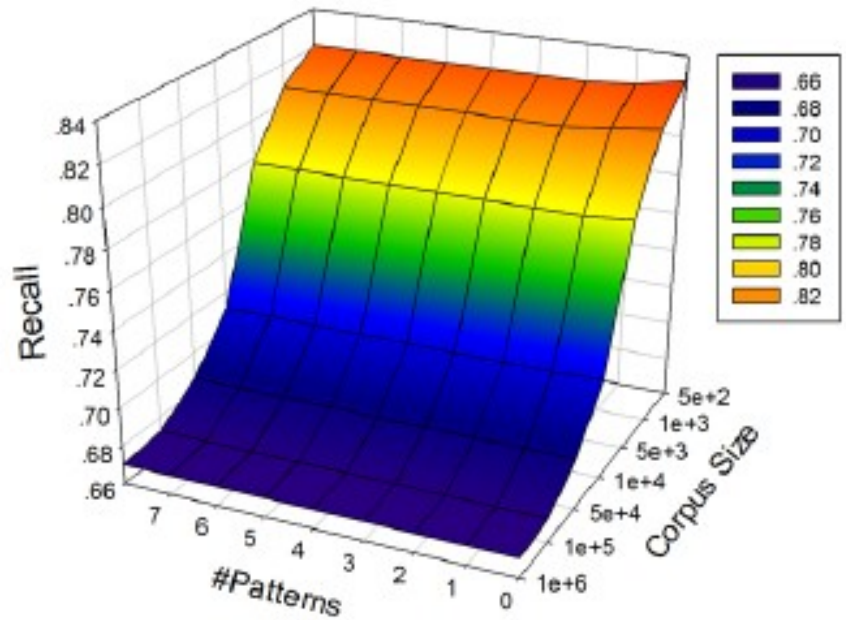


Figure 5: Experimental results on MP3

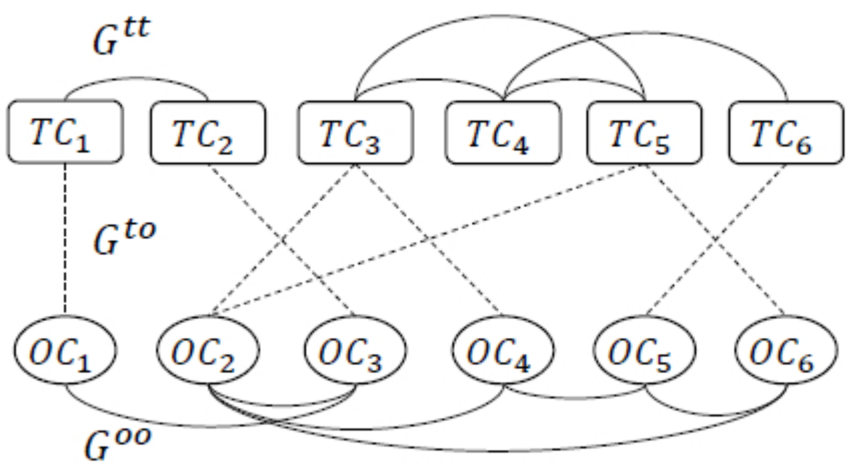
WAM在不同数据规模下是否都有效？（续）

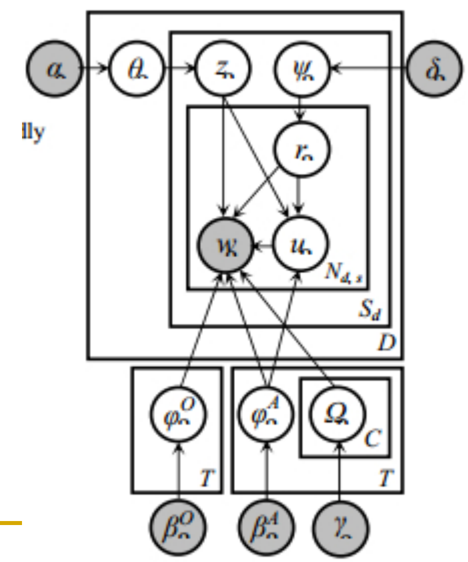




问题3：考虑候选本身的语义信息 ACL2014

- 假设
  - 如果一个词是一个评价对象，则与之具有评价关系的OC评价词的置信度则很高；反之亦然。
  - 如果一个词是一个评价对象（评价词），则与之具有相同语义关系的词也应该是评价对象（评价词）；反之亦然。
    - LCD vs. LED, beautiful vs. colorful





Ranking

- Co-ranking Algorithm

$$
\begin{aligned}
C_t = {} & (1 - \lambda - \mu) \times \hat{M}_{to} \times C_o \\
& + \lambda \times M_{tt} \times C_t + \mu \times I_t \\
C_o = {} & (1 - \lambda - \mu) \times \hat{M}_{to}^T \times C_t \\
& + \lambda \times M_{oo} \times C_o + \mu \times I_o
\end{aligned}
$$

评价对象抽取结果

Methods	D1			D2			D3			D4			D5			Avg.
	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F	F
Hu	0.75	0.82	0.78	0.71	0.79	0.75	0.72	0.76	0.74	0.69	0.82	0.75	0.74	0.80	0.77	0.758
DP	**0.87**	0.81	0.84	**0.90**	0.81	0.85	**0.90**	0.86	0.88	**0.81**	0.84	0.82	**0.92**	0.86	0.89	0.856
Zhang	0.83	0.84	0.83	0.86	0.85	0.85	0.86	0.88	0.87	0.80	0.85	0.82	0.86	0.86	0.86	0.846
SAS	0.80	0.79	0.79	0.82	0.76	0.79	0.79	0.74	0.76	0.77	0.78	0.77	0.80	0.76	0.78	0.778
Liu	0.84	0.85	0.84	0.87	0.85	0.86	0.88	0.89	0.88	**0.81**	0.85	**0.83**	0.89	0.87	0.88	0.858
Hai	0.77	**0.87**	0.83	0.79	**0.86**	0.82	0.79	0.89	0.84	0.72	0.88	0.79	0.74	0.88	0.81	0.818
CR	0.84	0.86	0.85	0.87	0.85	0.86	0.87	**0.90**	0.88	**0.81**	0.87	**0.83**	0.89	0.88	0.89	0.862
CR_WP	0.86	0.86	**0.86**	0.88	**0.86**	**0.87**	0.89	**0.90**	**0.89**	**0.81**	0.87	**0.83**	0.91	**0.89**	**0.90**	**0.870**

Table 2: Results of Opinion Targets Extraction on *Customer Review Dataset*

Methods	Camera			Car			Laptop			Phone			Mp3			Hotel			Avg.
	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F	F
Hu	0.63	0.65	0.64	0.62	0.58	0.60	0.51	0.67	0.58	0.69	0.60	0.64	0.61	0.68	0.64	0.60	0.65	0.62	0.587
DP	0.71	0.70	0.70	0.72	0.65	0.68	0.58	0.69	0.63	0.78	0.66	0.72	0.69	0.70	0.69	0.67	0.69	0.68	0.683
Zhang	0.71	0.78	0.74	0.69	0.68	0.68	0.57	0.80	0.67	0.80	0.71	0.75	0.67	0.77	0.72	0.67	0.76	0.71	0.712
SAS	0.72	0.72	0.72	0.71	0.64	0.67	0.59	0.72	0.65	0.78	0.69	0.73	0.69	0.75	0.72	0.69	0.74	0.71	0.700
Liu	0.75	0.81	0.78	0.71	0.71	0.71	0.61	0.85	0.71	0.83	0.74	0.78	0.70	0.82	0.76	0.71	0.80	0.75	0.749
Hai	0.68	**0.84**	0.76	0.69	**0.75**	0.72	0.58	**0.86**	0.72	0.75	0.76	0.76	0.65	0.83	0.74	0.62	0.82	0.75	0.742
CR	0.75	0.83	0.79	0.72	0.74	0.73	0.60	0.85	0.70	0.83	**0.77**	**0.80**	0.70	**0.84**	0.76	0.71	**0.83**	0.77	0.758
CR_WP	**0.78**	**0.84**	**0.81**	**0.74**	**0.75**	**0.74**	**0.64**	0.85	**0.73**	**0.84**	0.76	**0.80**	**0.74**	**0.84**	**0.79**	**0.74**	0.82	**0.78**	**0.773**

Table 3: Results of Opinion Targets Extraction on *COAE 2008* and *Large*

评价词抽取结果

Methods	D1			D2			D3			D4			D5			Avg.
	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F	F
Hu	0.57	0.75	0.65	0.51	0.76	0.61	0.57	0.73	0.64	0.54	0.62	0.58	0.62	0.67	0.64	0.624
DP	0.64	0.73	0.68	0.57	0.79	0.66	0.65	0.70	0.67	0.61	0.65	0.63	0.70	0.68	0.69	0.666
SAS	0.64	0.68	0.66	0.55	0.70	0.62	0.62	0.65	0.63	0.60	0.61	0.60	0.68	0.63	0.65	0.632
Hai	0.62	**0.77**	0.69	0.52	**0.80**	0.64	0.60	0.74	0.67	0.56	**0.69**	0.62	0.66	**0.70**	0.68	0.660
CR	0.62	0.75	0.68	0.57	0.79	0.67	0.64	**0.75**	0.69	0.63	**0.69**	0.66	0.68	0.69	0.69	0.678
CR_WP	**0.65**	0.75	**0.70**	**0.59**	**0.80**	**0.68**	**0.65**	0.74	**0.70**	**0.66**	0.68	**0.67**	**0.71**	**0.70**	**0.70**	**0.690**

Table 4: Results of Opinion Words Extraction on *Customer Review Dataset*

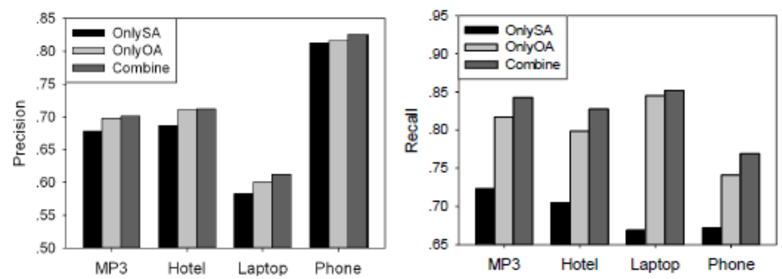
Methods	Camera			Car			Laptop			Phone			Mp3			Hotel			Avg.
	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F	P	R	F	F
Hu	0.72	0.74	0.73	0.70	0.71	0.70	0.66	0.70	0.68	0.70	0.70	0.70	0.48	0.67	0.56	0.52	0.69	0.59	0.660
DP	0.80	0.73	0.76	0.79	0.71	0.75	0.75	0.69	0.72	0.78	0.68	0.73	0.60	0.65	0.62	0.61	0.66	0.63	0.702
SAS	0.73	0.70	0.71	0.75	0.68	0.71	0.72	0.68	0.69	0.71	0.66	0.68	0.64	0.62	0.63	0.66	0.61	0.63	0.675
Hai	0.76	0.74	0.75	0.72	**0.74**	0.73	0.69	**0.72**	0.70	0.72	0.70	0.71	0.61	**0.69**	0.64	0.59	0.68	0.64	0.690
CR	**0.80**	**0.75**	**0.77**	0.77	**0.74**	0.75	0.73	0.71	0.72	0.75	0.71	0.73	0.63	**0.69**	0.64	0.63	0.68	0.66	0.710
CR_WP	**0.80**	**0.75**	**0.77**	**0.80**	**0.74**	**0.77**	**0.77**	0.71	**0.74**	**0.78**	**0.72**	**0.75**	**0.66**	0.68	**0.67**	**0.67**	**0.69**	**0.68**	**0.730**

Table 5: Results of Opinion Words Extraction on *COAE 2008* and *Large*

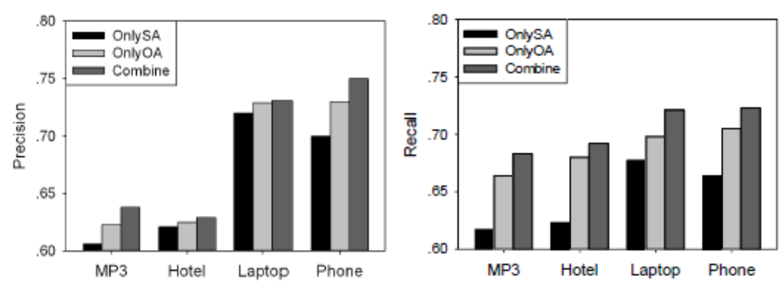
Semantic Relation vs. Opinion Relation

- Compared Methods
  - OnlySA: semantic relations
  - OnlyOA: opinion relations
  - Combine: both relations

+ Graph-based Ranking Algorithm



(a) Opinion Target Extraction Results



(b) Opinion Word Extraction Results

总结

- Bootstrapping抽取框架具有误差传递问题
  - 如何避免误差传递?
    - Ranking-based Framework
- 评价关系识别
  - 如何自动学习句法模板，如何考虑句法模板的置信度？
    - 在图中加入模板节点，考虑模板置信度
  - 是否可以不用句法分析器?
    - WAM替代句法分析器
    - PSWAM将句法信息与WAM相结合
    - 讨论了大规模数据下WAM是否更加有效
- 已有抽取框架仅仅利用评价对象和评价词之间的评价关系
  - 忽略评价对象和评价词本身的语义信息
    - 利用主题模型挖掘词间语义关系
    - 利用Co-ranking算法融入各种语义关系

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Q&A

谢谢