

Opinion Mining and Sentiment Analysis

Hsin-Hsi Chen

Department of Computer Science and Information Engineering

National Taiwan University

Taipei, Taiwan

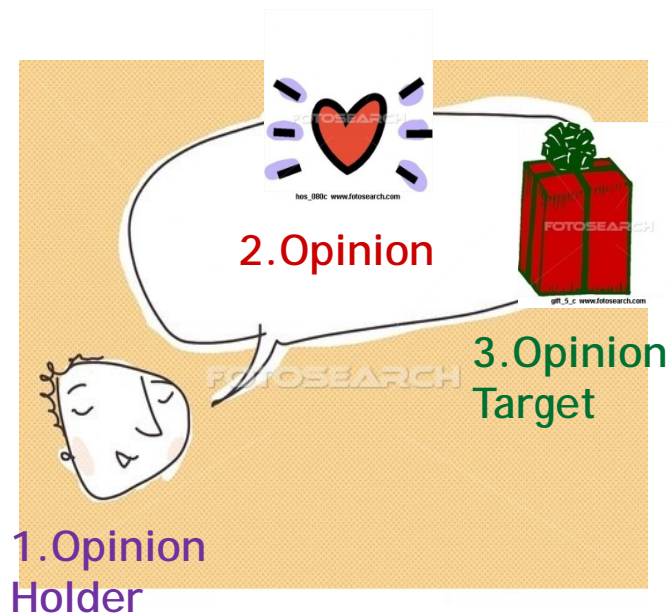
E-mail: hhchen@ntu.edu.tw

Outlines

- Opinion vs. Emotion
- Why opinion mining and emotion analysis
- What are the challenging issues
- Some surveys
- Evaluation issues
- Summary

What is an opinion?

- Opinion is a subjective information.
- Opinion usually contains an **opinion holder**, an **attitude**, and a **target**, but not obligatory.



I like this gift.

EMOTION

Yes...

I like this gift. (maybe happy)

I don't like to eat stinky Tofu. (disgusted)

But...

George suggested that Mary should save more money.
(just a suggestion, could be impartial, not emotional)

He loves her but doesn't want to clean her room.
(emotion? Maybe complicated)

So we conclude:

Opinions and emotions are not certainly related, but they are both under the research domain of sentiment analysis.

Why opinion processing is important?

- Documents discussing public affairs, common themes, interesting products, and other topics are reported and distributed on the Web.
 - review sites, forum, discussion groups, blogs, news, ...
- Watching specific information sources and summarizing the newly discovered opinions are important
 - for governments to improve their services,
 - for companies to market their products, and
 - for customers to purchase their objects.

Opinion Mining is Useful

- Buyer's best guide
- Marketing
- Public poll
- Advertisement



User Reviews [\(Review this title\)](#)

358 out of 648 people found the following review useful.

Transcendent and amazing experience, 16 December 2009

★★★★★★★★★★

Author: [thekrikke](#) from Belgium

The King of the World has returned! Mr. James Cameron's youngest "Avatar" is a mind-blowing adventure and the most impressive and intricate work of art, I've ever seen.

Trip Advisor

“Very nice small hotel with good location and friendly stuff ”



Slavagv6 1 contribution
Moscow

Mar 3, 2010 | Trip type: Family NEW

Save Review

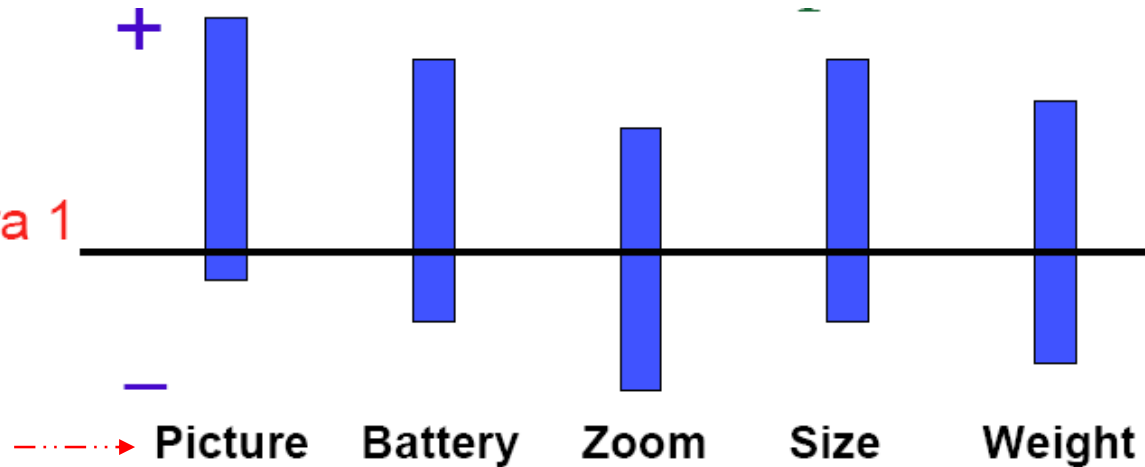
We've been only 4 days in Geneva, the weather was not so nice so we spent quite a lot of our time in our room. The service was good, so as all stuf very helpful and professional. Good location few steps from the citi center and old toun. Free wi-fi. So we can't say anyting bad about East-West and would... more

Product Review

- Summary of reviews of

Digital camera 1

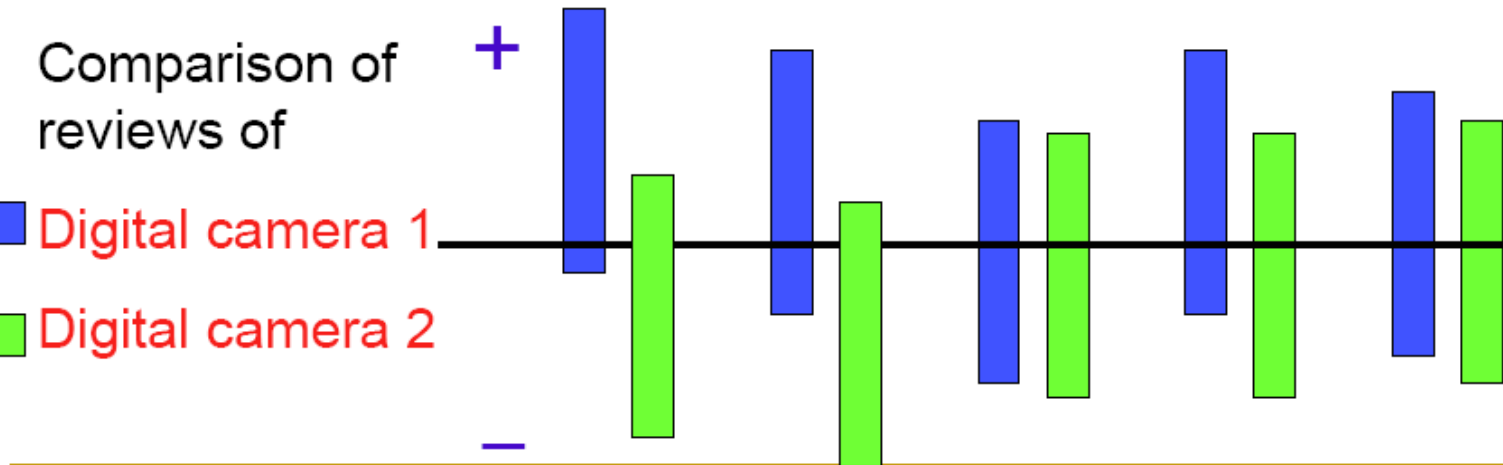
attributes



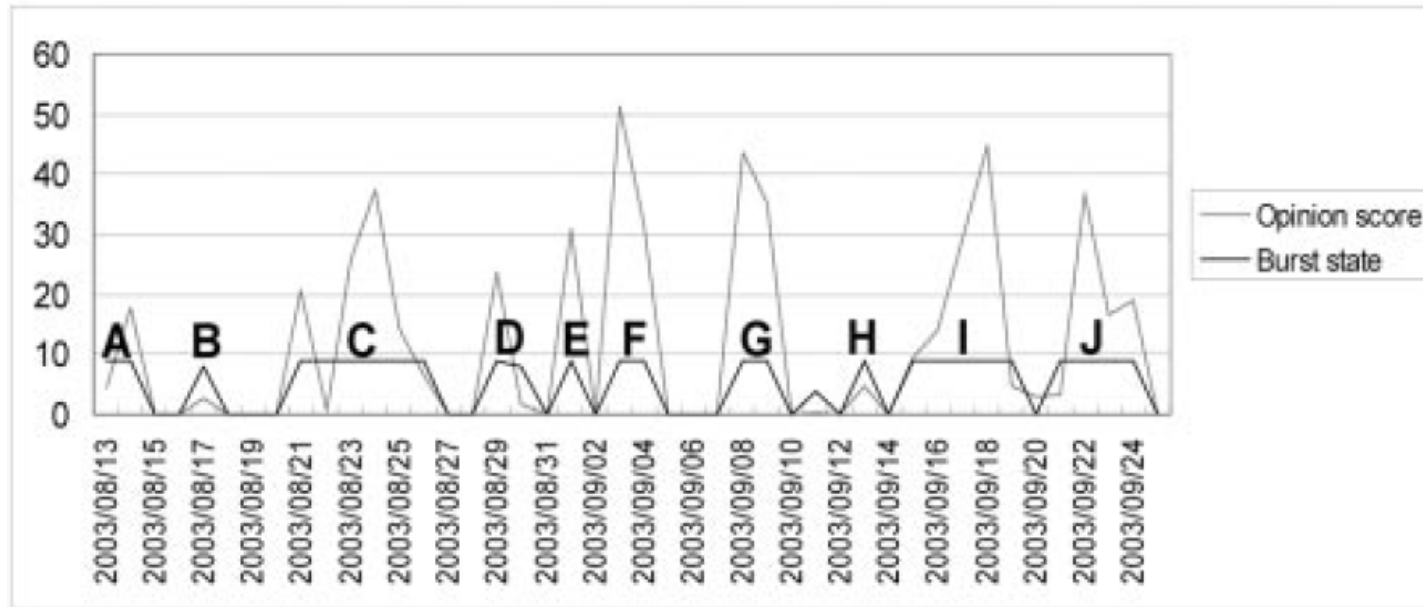
- Comparison of reviews of

Digital camera 1

Digital camera 2



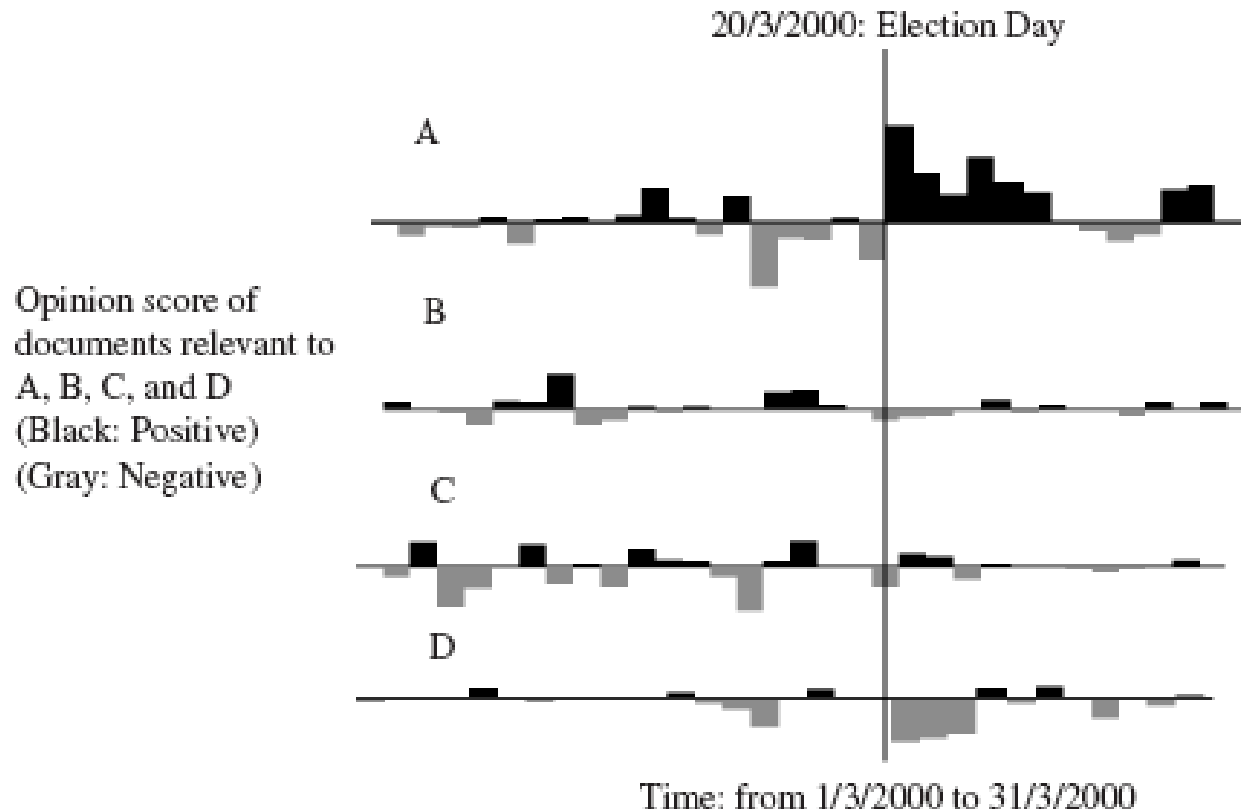
Tracking Target : TSMC; Tracking Period : 2003/8/17-2003/9/30



- A TSMC and UMC expect revenue to rise in Q4.
- B Hedging through Morgan Taiwan stock index futures, foreign investors earn in both spot and futures markets.
- C Nasdaq hit record high of last 16 months, benefiting the market for long-term tradings.
- D IDM capacity is expected to grow low. Deluged with urgent analogic and IC orders, TSMC and UMC's low end plants receive orders over 10%.
- E Foreign capital keeps investing in TSMC and UMC.
- F Win-win to TSMC and ASE due to professional labor division.
- G 0.18 um communication chip orders acquired by Chartered, Q3 capacity utilization exceeds 60%.
- H IBM wins another foundry order of power IC from Intersil.
- I 3C electronics orders flooded in. TSMC and ASE capacity utilization approaches 95% in Q4.
- J Morris Chang: Semiconductor industry booming next year, and killer apps contribute.

Opinion Tracking

Tracking Target : Persons; **Tracking Period** : 2000/3/1-2000/3/31



Opinionated Applications

- Sentiment word mining
- Opinionated sentence extraction
- Opinionated document extraction
- Opinion summarization
- Opinion tracking
- Opinionated question answering
- Multi-lingual/Cross-lingual opinionated issues

Challenging Issues

Opinion Holder

- Named entity extraction
- Co-reference resolution
- Nested expressions

Opinion

- Opinion extraction
- Polarity judgment
- Multi-perspective

Opinion Target

- Topic detection
- Vague boundaries
- Abstract concept

OPINION MINING

Granularity

- Word
- Sentence
- Document
- Multi-document

Relevancy

- Independent from sentiment
- Topic extraction

Language

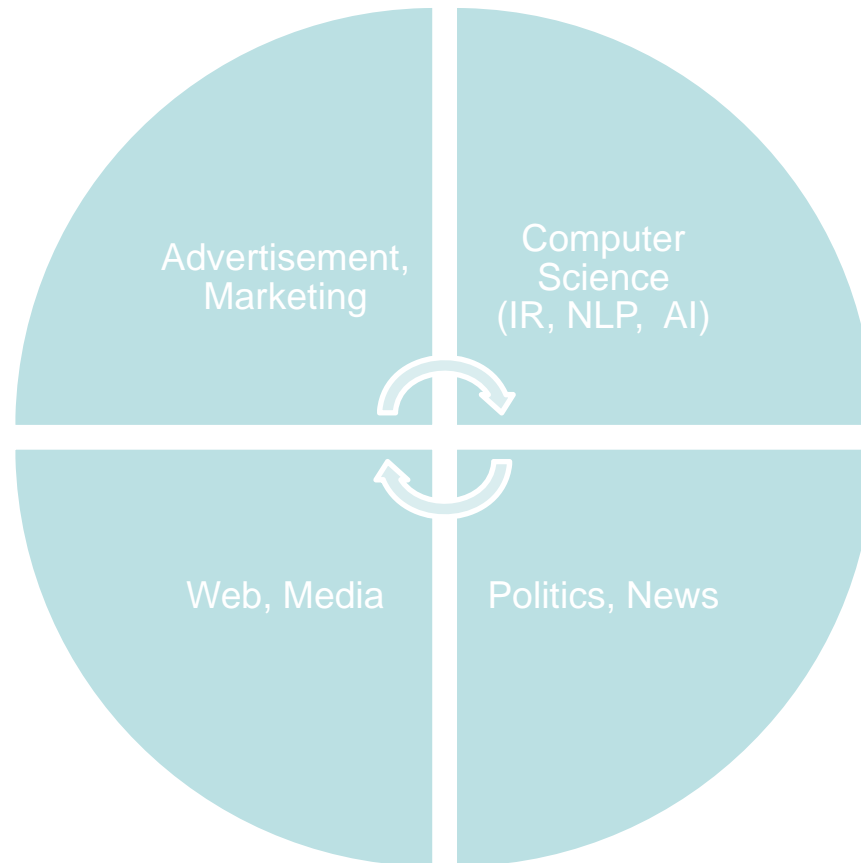
- Monolingual
- Multilingual

Methodology

- Bag of units
- Structural

RELATED WORK

Pang and Lee, 2002, Thumbs up? Sentiment classification using machine learning techniques. EMNLP, 79-86



Related Work

- **[Political Science]** L.W. Martin, 2008, **A robust transformation procedure for interpreting political text**. *Political Analysis*, 16(1):93–100.
- **[Marketing]** Y. Chen and J. Xie, 2008, **Online consumer review: Word-of-mouth as a new element of marketing communication mix**. *Management Science*, 54(3):477–491.
- **[Marketing]** comScore/the Kelsey group, 2007, **Online consumer-generated reviews have significant impact on offline purchase behavior**. Press Release.
- **[Web Ethics]** T. Hoffman, 2008, **Online reputation management is hot—but is it ethical?** *Computerworld*.

Related Work

- **[Advertisement]** X. Jin, et al., 2007, **Sensitive webpage classification for content advertising**. In Proceedings of the International Workshop on Data Mining and Audience Intelligence for Advertising, pages 28-33.
- **[Law]** J.G. Conrad and F. Schilder, 2007, **Opinion mining in legal blogs**. In Proceedings of the International Conference on Artificial Intelligence and Law (ICAIL), pages 231–236.
- **[Trust]** A. Kale, et al., 2007, **Modeling trust and influence in the blogosphere using link polarity**. In Proceedings of the International Conference on Weblogs and Social Media (ICWSM).
- **[National Security]** A. Abbasi and H. Chen, 2007, **Affect intensity analysis of dark web forums**. In Proceedings of Intelligence and Security Informatics (ISI), pages 282–288.
- **[Government]** C. Cardie, et al., 2006, **Using natural language processing to improve eRulemaking: project highlight**. In Proceedings of Digital Government Research, pages 177-178.

Related Work

- Researches from the **word level**, to **document level**, then to **sentence level**, and to **multi-document level**.
 - Wiebe and Wilson (2003): extract subjective nouns.
 - Kim and Hovy (2004): Sentiment classifier for English words.
 - Dave (2003): Classifier on product reviews.
 - Wilson (2005): polarities of phrase-level units.
 - Jindal and Liu (2006): comparative sentences.
 - Kagi and Kitsuregawa (2007): create opinion dictionaries.

Related Work

- Researches on different **genres** of articles, e.g., reviews, news and blogs.
- Reviews and Blog articles were researched at the document level.
 - Hu and Liu (2004): opinion summarization of products.
 - Bai *et al.* (2005): movie reviews.
 - Ghose and Ipeirotis (2007): rank reviews from end users' and manufacturers' aspects.
 - Godbole (2007): news and blog articles.
 - Mei *et al.* (2007): blog articles.
 - Kawai (2007): news articles.
 - Cesarano *et al.* (2007): news articles in OASYS.

Related Work

- Researches on finding **opinion holders, opinions, opinion targets**
 - Choi *et al.* (2005): opinion holder, named entity extraction methods.
 - Breck *et al.* (2007): opinion holder, CRF.
 - Ruifeng *et al.* (2008): opinion target, linguistic knowledge.

Related Work

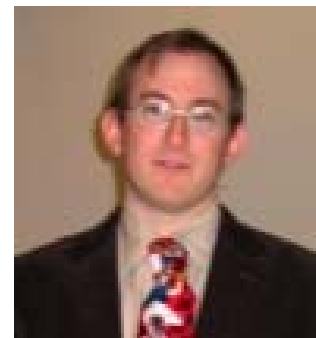
- Useful **resources**
 - English Corpus: MPQA.
 - English Resource: SentiWordnet
 - Chinese Resource: NTUSD
 - Evaluation Forum: NTCIR-MOAT/TREC
- **Approaches**: Machine learning vs. linguistic rules
- Incorporating syntactic relations
 - Pang and Lee (2002): machine learning methods may not be good in this research questions.
 - Riloff and Wiebe (2003): linguistic cues.
 - Wiebe *et al.* (2002): MPQA.
 - Andrea and Fabrizio (2006): SentiWordnet.
 - Qiu *et al.* (2008)

NTCIR Opinion Analysis Task

Slides selected from Yohei Seki's
talk at PACLIC (2009, 12, 3)

International Collaboration

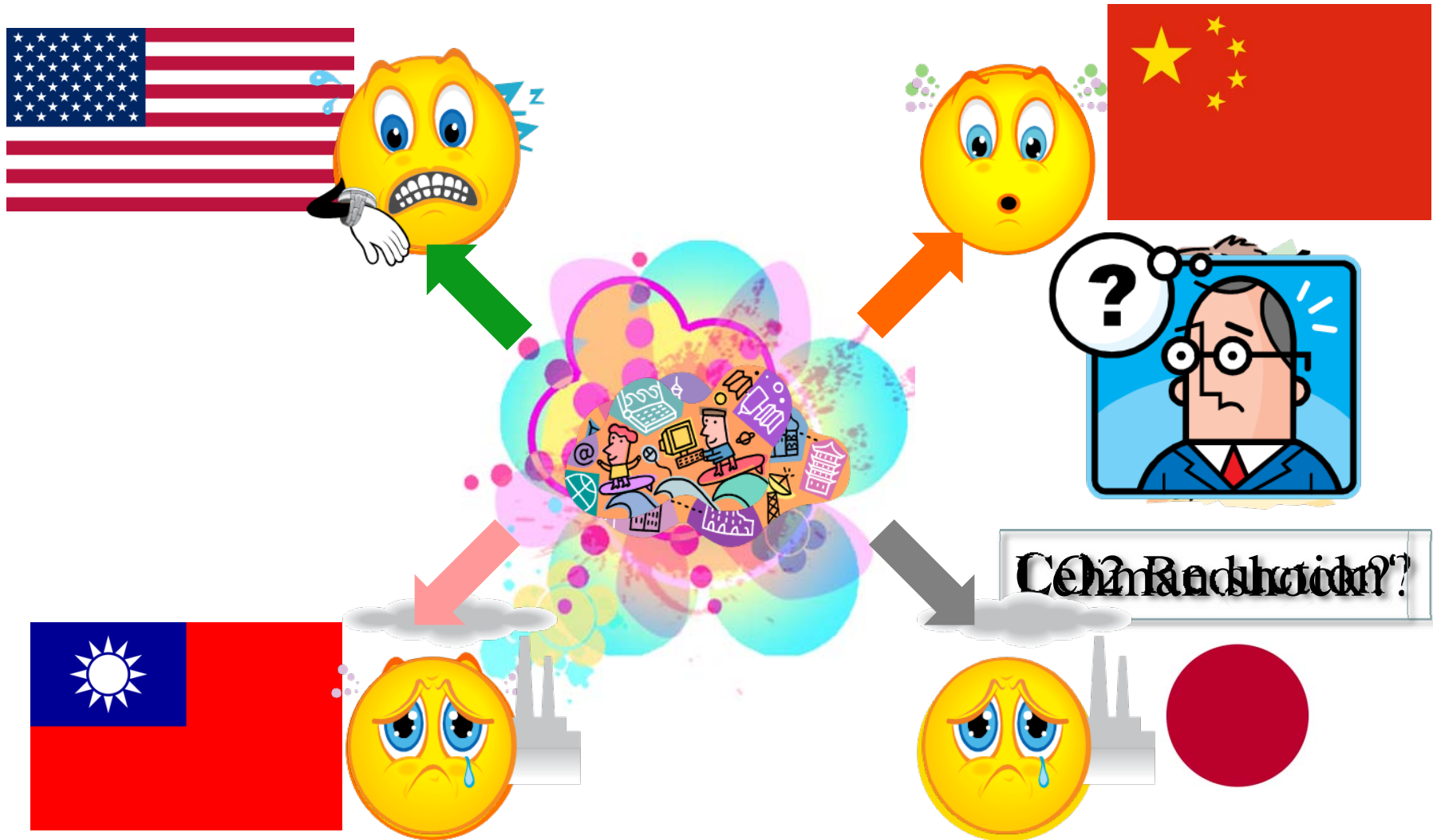
- Hsin-Hsi Chen and Lun-Wei Ku (National Taiwan University)
- Le Sun (Institute of Software, Chinese Academy of Sciences)
- Noriko Kando (National Institute of Informatics)
- Yohei Seki (Toyohashi University of Technology)
- David Kirk Evans (Amazon Japan)



Multilingual Opinion Analysis

- Application: to summarize the opinions from different cultures/areas/languages.
- Challenge: to clarify the effective features/approaches for different languages

Toward Multilingual Online Opinion Mining/Sentiment Analysis



MOAT

- Multilingual Opinion Analysis Task held at NTCIR-6, -7, and -8 (2006-current)
- Languages
 - English, Chinese, and Japanese
- Subtasks:
 - Opinion detection, polarity judgment, holder, target, and relevance judgment, etc.

Dataset (Test Collection)

- NTCIR-6 (2006-2007)
Sentence Level Annotation in Newspapers

Language	Japanese			English			Chinese		
	Sum	Train	Test	Sum	Train	Test	Sum	Train	Test
# of Docs.	490	68	422	438	19	419	843	143	700
# of Sents.	15,279	2,754	12,525	8,356	786	7,570	11,907	2,660	9,247
# of Topics	30	4	26	28	1	27	32	4	28

- NTCIR-7 (2007-2008)
Sentence- and *Opinion Expression*- Level Annotation

Language	Japanese			English			Traditional Chinese			Simplified Chinese		
	Sum	Train	Test	Sum	Train	Test	Sum	Train	Test	Sum	Train	Test
# of Docs.	287	38	249	167	25	142	246	58	188	271	19	252
# of Sents.	7,163	1,278	5,885	4,711	399	4,312	6,174	1,509	4,655	5,301	242	4,877
# of Opinion Exps	7,569	1,348	6,221	4,733	404	4,329	6,176	1,509	4,657	7,523	570	6,953
# of Topics	22	4	18	17	3	14	17	3	14	16	2	14

Subtasks in MOAT

- Basic opinion frame
 - <Opinion holder> holds (positive, negative, or neutral) <(attitudinal) opinion> toward <opinion target>.
- Five subtasks are designed structurally:

Subtask	Value	Annotation Unit	From
Opinionated Sentence	YES, NO	Sentence	NTCIR-6
Relevant Sentence	YES, NO		
Opinionated Polarities	POS, NEG, NEU	Opinion Expression	
Opinion Holders	String, multiple		
Opinion Targets	String, multiple		NTCIR-7

Opinionated Sentence Judgment

- Three formal types of opinion are defined based on Wiebe et al. (2005)
 - Explicit mentions of opinion
 - **Psychologists** *argue* that teenagers are not old ...
 - Speech events expressing opinion
 - **Ito** *said* the government must concentrate now ...
 - Expressive subjective elements
 - Japan must seem to be a country full of antiquated rules.
(Opinion holder: **author**)

Relevant Opinionated Sentence Judgment

- Relevant opinion extraction is useful (irrelevant opinion is harmful) for opinion information access such as public opinion survey / reputation analysis.
 - Example topic: *Bali Island Terrorist Bombing*
 - Relevant opinion: The similarity of targets between the nightclub and the Marriott is the reason that **officials believe Jemaah was involved in Tuesday's attack.**
 - Irrelevant opinion: “**I'm concerned about our homeland,**” Bush told reporters on the South Lawn of the White House before leaving for a political fund-raising trip here.

Polarity Classification

- In one sentence, several polarities (positive/negative/neutral) are sometimes mixed.
 - Bush said that **whoever was responsible for the attacks was engaged in “cold-blooded murder”** and added that **the government was “doing everything we can to capture whoever that might be.”**
- Opinion expressions (sub-sentence segmented units) are prepared for the participants in the polarity classification subtask.

Opinion Holder Identification

- Opinion holder:
agent who expresses opinions
- Why is opinion holder identification research so useful?
 - News articles or blogs contain many opinions from different opinion holders.
 - By grouping opinion holders, we can distinguish between opinions that reflect different source perspectives.



Opinion Target Identification

- Opinion target:
The object/person/matter which opinion holder holds attitudes toward.
- Why is opinion target identification research so useful?
 - To aggregate and summarize opinions toward correct opinion targets (e.g., opinion toward Bush/terror).
 - Opinion/attitude types (criticism, evaluation, emotion) are strongly associated with target semantic role.

Annotation tool in NTCIR

Topic ID: N01
Doc ID: NYT_ENG_20050113.0226
[Download TSV](#) [Download XML](#) [Download Results\(zip\)](#) [Download STN](#)

Sentence ID: 0002
Public and private comments by central bankers and other officials here have been noticeably more relaxed since the beginning of January, when the dollar reversed its relentless decline against the euro --
even though economists caution that underlying trends have not changed.

opinionated:yes no
 relevant:yes no NOTHNIG
 answer:yes no NOTHNIG
 polarity:POS NEU NEG NOTHING

anaphora:yes no author
holder: central bankers and other officials@1

anaphora:yes no unknown
target: decline

Title : Euro
Question : What negative prospects were discussed about the Euro when it was introduced in January of 2002?
Polarity : Negative
Opinion type : perspective controversy
Keyword : Euro introduction
Period : 2002-01

Edit Document
[0000] EUROPE ASKS, WHAT EURO CRISIS?
[0001] Europeans, many of whom worked themselves into a tizzy about the swooning dollar and the stamped rebounded in recent weeks.
[0002] **Public and private comments by central bankers and other officials here have been noticeably reversed its relentless decline against the euro -- even though economists caution that underlying tr**
[0003] The European Central Bank on Thursday left its benchmark interest rate unchanged at 2 percent, and i about growth prospects and inflation.
[0004] "The environment has changed a little," Trichet said at a news conference in Frankfurt.
[0005] He noted that the recent decline in oil prices had eased inflationary pressure and removed another hurc
[0006] "While short-term inflationary pressures persist, they have recently diminished somewhat," Trichet decl
[0007] He added, "The conditions remain in place for economic growth to proceed."
[0008] The European Central Bank has tried to avoid being buffeted by the daily swings in the currency mark daily records against the dollar.
[0009] European exporters complain that this has depressed their sales in the United States.
[0010] On Thursday, Trichet reiterated that sharp currency moves were unwelcome and undesirable for grow
[0011] But his otherwise relaxed tone suggested that for now, the euro was a manageable problem.
[0012] ... Kramer, a s
... "axed."
... on rather t
... ted State:
... say the p
... economy t
... with robus
... German
... en made G
... arency on th
[0022] For the first time in years, economists are starting to speak of Germany as a potential engine of growth
[0023] Retail sales picked up here over the Christmas holiday, and surveys of German business confidence tu
[0024] The recovery of the dollar has also shifted many Europeans' gaze from the United States to Asia.
[0025] While last month European leaders were calling on the United States to tackle its trade and budget def
[0026] "There is a need for emerging Asia to go progressively in the direction of perhaps progressive and ord
... he's chief economist. Other Ising
... by the American treasury s
... s to confront the deficit o
... side.
... much more than anyone in

Select values

annotate holders/targets with anaphora

Split sentences into opinion expression units

Cross-lingual Opinion Analysis Task



- Provide *English opinion question*, and extract answer opinions from *Japanese, (traditional/simplified) Chinese, and English document collections*.
- Clarify language dependent and language independent opinion features.
- Improve *language adaptation technologies* from the participants.

Corpora for Emotion Analysis

SemEval-2007 Task 14: Affective Text

- Affective Text
 - Classification of emotions and valence (i.e. positive/negative polarity) in news headlines
 - An exploration of the connection between emotions and lexical semantics
- Applications
 - Sentiment Analysis
 - Computer Assisted Creativity
 - Verbal Expressivity in Human Computer Interaction

Corpus

- News headlines drawn from major newspapers such as New York Times, CNN, and BBC News, as well as from the Google News search engine.
 - a development data set consisting of 250 annotated headlines
 - a test data set with 1,000 annotated headlines

Data Annotation

- Provided a set of predefined six emotion labels (i.e. Anger, Disgust, Fear, Joy, Sadness, Surprise), classify the titles with the appropriate emotion label and/or with a valence indication (positive/negative)
- a Web-based annotation interface displayed one headline at a time, together with six slide bars for emotions and one slide bar for valence

Inter-Annotator Agreement

- The test data set was independently labeled by six annotators.

EMOTIONS	
Anger	49.55
Disgust	44.51
Fear	63.81
Joy	59.91
Sadness	68.19
Surprise	36.07
VALENCE	
Valence	78.01

(Strapparava and Mihalcea, 2007)

Issues

- Scale
 - Only 1,250 headlines were annotated
- Annotators
 - Only 6 annotators participated
- Inter-Annotator Agreement
 - Range from 36.07 to 68.19

Public Available Emotion Corpora

- Are there large scale data sets without cost of annotation available?
 - Blog Corpus collaboratively contributed by bloggers
 - News corpus annotated by readers collaboratively

Blog Data Set for Writer Emotion Analysis

Blogosphere

- A growing dataset **collaboratively contributed by bloggers**
 - Over 130 millions of blogs exists
 - Over 1 millions of articles are created everyday

statistics are from the Technorati, 2008

- People (**bloggers**) share daily experiences, opinions, or emotions with articles (**posts**) using the blog platform
 - 1. Simple publishing interface**
 - 2. Time-lined Distributions**
 - 3. Non-verbal emotional expressions**

Blog Post Sample

Tom so crazy but I'm so happy

今天跟你約吃飯 不知為什麼特別緊張 😬

(I had a meal with you today. Don't know why I was so nervous.)

也許因為一陣子沒見吧

(Maybe it's because we hadn't seen each other for a long time.)

謝謝你請我吃飯 還送我禮物 📺

(Thank you for treating me and giving me a present.)

雖然一直叫你不要送我東西

(Although I told you not to give me anything.)

但收到的時候還是很開心 😊

(But I was very happy receiving it.)

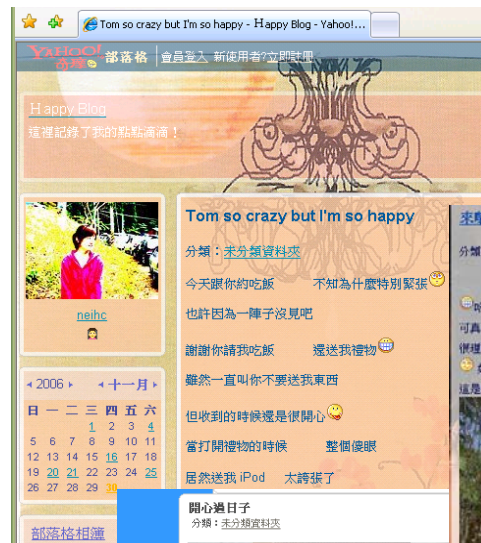
當打開禮物的時候 整個傻眼

(When I opened the gift, I was astonished.)

居然送我 iPod 太誇張了

(You gave me an iPod. It's so unbelievable.)

Tom so crazy but I'm so happy 😄



這是有次 我們和朋友一起叫了早餐 在BALI 因為朋友住對面 以為我們沒睡 幫我們叫了兩份 我也以為他們還在睡 也幫他們叫了兩份 結果 一共來了八份 😊 大家都笑了 原來 大家都很為對方著想 都是很疼彼此的朋友 於是 四個人就開開心心吃了一頓超豐盛的早餐 😊 很多時候 能為別人多想一點 也讓開心的 🍷

Non-verbal emotional expressions

- Yahoo! Kimo Emotion Icon Set ([Emoticon](#))

符號	文字	意涵	符號	文字	意涵	符號	文字	意涵	符號	文字	意涵
	:)	微笑		:O	驚訝		0:)	天使		(:|	呵欠
	:(	難過		X-(	生氣		:-B	戴眼鏡		=P~	流口水
	;)	眨眼		:>	得意		=;	再見		:-?	考慮
	:D	開懷		B-)	耍帥		I-)	睡著			偷笑
	::)	眨眨眼		:-S	擔心		8-)	環顧		=D>	鼓掌
	:-/	疑惑		>:)	邪惡		:-&	不舒服		[-o<	祈禱
	:x	愛意		:((	大哭		:-S	安靜		:-<	嘆氣
	:>	害羞		:))	大笑		[-(	不說了		>:P	呸
	:p	吐舌頭		:|	呆住		:o)	小丑		@};-	花
	:*	親親		/:)	皺眉		@-)	神智不清		:@)	豬頭

Blog Dataset Overview



Dataset	# of articles	# of tagged articles	% of tagged articles	Average length of untagged articles	Average length of tagged articles
*07-09 ('06)	3,169,679	485,499	15.32%	614 characters	374 characters
*10-12 ('06)	4,116,066	669,224	16.26%	618 characters	383 characters
*01-03 ('07)	4,186,287	646,312	15.44%	646 characters	407 characters
*04-06 ('07)	5,312,966	779,637	14.67%	635 characters	416 characters
*Training	16,784,998	2,580,672	15.37%	630 characters	397 characters
+July ('07) +Testing	2,007,920	277,449	13.82%	631 characters	428 characters
All	18,792,918	2,858,121	15.21%	630 characters	400 characters











































- People use emoticons to replace certain portions of their text contents to make their articles more succinct

Category Distributions



Category	# of articles (posts)	# of tagged posts	% of tagged posts	Avg. length of untagged posts	Avg. length of tagged posts
(unassigned)	3,782,071 (20.1%)	619,504	16.38%	430 chars	<i>271 chars</i>
Moms and Babies	334,525 (1.8%)	117,630	35.16%	591 chars	366 chars
Financial	381,425 (2.0%)	12,856	<i>3.37%</i>	1,003 chars	648 chars
Club	249,036 (1.3%)	30,862	12.39%	938 chars	494 chars
Audio-Visual	1,220,827 (6.5%)	66,990	<i>5.49%</i>	516 chars	557 chars
Sports	<i>219,211 (1.2%)</i>	22,538	10.28%	667 chars	553 chars
Travel	558,475 (3.0%)	141,900	25.41%	620 chars	585 chars
Political	<i>195,709 (1.0%)</i>	16,200	8.28%	1,172 chars	813 chars
Image Creation	502,406 (2.7%)	69,698	13.87%	<i>326 chars</i>	356 chars
Art Review	357,520 (1.9%)	30,898	8.64%	1,072 chars	661 chars
Hobbies	1,509,630 (8.0%)	200,526	13.28%	679 chars	403 chars
Life Style	1,181,203 (6.3%)	124,292	10.52%	926 chars	548 chars
Creative Writing	7,048,902 (37.5%)	1,207,427	17.13%	588 chars	386 chars
Consumer Electronics	244,733 (1.3%)	23,529	9.61%	1,033 chars	862 chars
Pets	231,536 (1.2%)	84,479	36.49%	441 chars	385 chars
Personal Growth	631,935 (3.4%)	78,789	12.47%	955 chars	538 chars
Science	<i>143,774 (0.8%)</i>	<i>10,003</i>	<i>6.96%</i>	1,228 chars	725 chars
Total	18,792,918 (100%)	2,858,121	15.21%	630 chars	400 chars

Emoticon Distributions

Icon	Description	Frequency	Icon	Description	Frequency	Icon	Description	Frequency
	Happy	457,657 (4.5%)		Worried	249,420 (2.4%)		Clown	23,609 (0.2%)
	Sad	237,650 (2.3%)		Devilish	141,293 (1.4%)		Dizzy	205,684 (2.0%)
	Winking	242,403 (2.4%)		Crying	715,967 (7.0%)		Yawning	82,900 (0.8%)
	Grinning	703,194 (6.9%)		Laughing	1,045,545 (10.2%)		Drooling	136,213 (1.3%)
	Blinking	259,808 (2.5%)		Straight face	63,173 (0.6%)		Pondering	214,800 (2.1%)
	Confused	266,015 (2.6%)		Cocky	94,818 (0.9%)		Giggling	174,585 (1.7%)
	Love-struck	700,975 (6.9%)		Angelic	51,509 (0.5%)		Applause	436,138 (4.3%)
	Blushing	280,062 (2.7%)		Nerdy	77,711 (0.8%)		Praying	315,330 (3.1%)
	Tongue	397,710 (3.9%)		Ignoring	43,291 (0.4%)		Disappointed	96,557 (0.9%)
	Kissing	195,103 (1.9%)		Sleeping	65,402 (0.6%)		Obnoxious	115,329 (1.1%)
	Surprising	365,183 (3.6%)		Rolling eyes	87,183 (0.9%)		Rose	631,044 (6.2%)
	Angry	326,470 (3.2%)		Sick	113,951 (1.1%)		Pig head	103,669 (1.0%)
	Smug	120,708 (1.2%)		Hush	35,908 (0.4%)			
	Cool	171,481 (1.7%)		Arrogant	185,955 (1.8%)	Total		10,231,403 (100%)

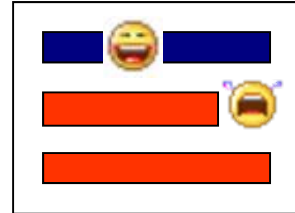
Arousal-Valence Model

- Emotion Category

To classify 😄 😱 ,baseline: 50%

To classify 😄 😱 😍 😡 ,baseline: 25%

To classify 😄 😱 😍 😊 😬 😞 ... ,baseline: <25%



Arousal
(Energetic)

Arousal (energetic)

(negative)

(negative)

Valence
(positive)

Valence
(Positive)

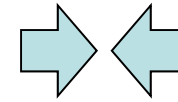
(silent)

(silent)

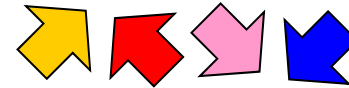


Emotion Classifier Setup

Bipolarity Classification:



Arousal-Valence Space Classification:



Setup Option	Value	Description
Model	S	SVM
	C	CRF
# of categories	2	positive polarity, negative polarity
	4	positive-energetic, positive-silent, negative-energetic, negative-silent
# of features	T#	# of lexical words used
# of seasons	1	one season, July-September, '06
	2	half a year, July-December, '06
	4	one year, July, '06 – June, 07

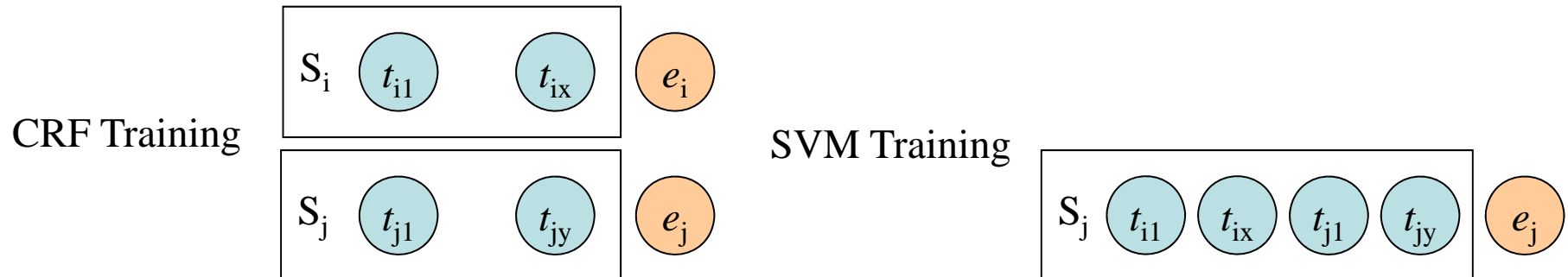
Instance Extraction

- A large-scale classifier
 - A sentence that contains only one emoticon are used
 - Extract tagged-sentence pairs (that can be evaluated by both SVM and CRF)

$$S_i \quad : \quad t_{i1}t_{i2} \dots t_{i|S_i|} \quad \rightarrow \quad e_i$$

$$S_j \quad : \quad t_{j1}t_{j2} \dots t_{j|S_j|} \quad \rightarrow \quad e_j$$

- Evaluate on the second sentence



Bipolarity Classification

Training Volume	1 season			2 seasons			4 seasons		
Exp. Setup	P	R	F	P	R	F	P	R	F
SVM-C2-T100	76.55%	44.56%	56.33%	76.68%	44.64%	56.43%	76.54%	44.56%	56.33%
SVM-C2-T200	75.59%	63.31%	68.91%	75.93%	63.60%	69.22%	75.81%	63.50%	69.11%
SVM-C2-T300	75.45%	72.63%	74.01%	75.94%	73.11%	74.50%	75.94%	73.11%	74.50%
SVM-C2-T400	75.41%	78.47%	76.91%	75.69%	78.76%	77.20%	75.74%	78.82%	77.25%
SVM-C2-T500	75.71%	80.91%	78.22%	75.78%	80.99%	78.30%	75.73%	80.93%	78.24%
SVM-C2-T600	75.85%	82.21%	78.90%	76.19%	82.59%	79.26%	75.90%	82.27%	78.96%
CRF-C2-T100	77.37%	45.04%	56.93%	77.09%	44.88%	56.73%	77.24%	44.97%	56.84%
CRF-C2-T200	76.69%	64.23%	69.91%	76.96%	64.46%	70.15%	76.99%	64.48%	70.18%
CRF-C2-T300	76.88%	74.01%	75.42%	76.93%	74.06%	75.47%	77.05%	74.18%	75.59%
CRF-C2-T400	76.82%	79.94%	78.35%	76.92%	80.04%	78.45%	77.00%	80.13%	78.53%
CRF-C2-T500	76.99%	82.28%	79.55%	77.07%	82.36%	79.63%	77.41%	82.73%	79.98%
CRF-C2-T600	76.66%	83.10%	79.75%	77.05%	83.52%	80.16%	77.56%	84.07%	80.68%

Training: 6,094,645, Testing: 680,420

Arousal-Valence Space Classification

Training Volume	1 season			2 seasons			4 seasons		
Exp. Setup	P	R	F	P	R	F	P	R	F
SVM-C4-T100	42.34%	24.65%	31.16%	41.56%	24.20%	30.59%	41.33%	24.06%	30.41%
SVM-C4-T200	41.20%	34.51%	37.56%	41.42%	34.69%	37.76%	41.63%	34.87%	37.95%
SVM-C4-T300	40.37%	38.86%	39.60%	42.70%	41.10%	41.88%	42.54%	40.95%	41.73%
SVM-C4-T400	40.62%	42.27%	41.43%	42.48%	44.20%	43.32%	43.06%	44.80%	43.91%
SVM-C4-T500	40.63%	43.43%	41.98%	42.68%	45.61%	44.09%	43.20%	46.17%	44.64%
SVM-C4-T600	40.78%	44.20%	42.42%	42.92%	46.53%	44.65%	43.19%	46.82%	44.93%
CRF-C4-T100	56.82%	33.08%	41.81%	57.06%	33.22%	41.99%	57.08%	33.23%	42.00%
CRF-C4-T200	55.00%	46.07%	50.14%	55.09%	46.14%	50.22%	55.14%	46.18%	50.27%
CRF-C4-T300	54.41%	52.38%	53.38%	54.48%	52.45%	53.45%	54.62%	52.58%	53.58%
CRF-C4-T400	53.81%	56.00%	54.88%	54.26%	56.46%	55.34%	54.56%	56.77%	55.64%
CRF-C4-T500	54.16%	57.88%	55.95%	54.25%	57.98%	56.06%	54.79%	58.56%	56.61%
CRF-C4-T600	54.15%	58.70%	56.33%	54.44%	59.01%	56.63%	54.55%	59.13%	56.74%

Training: 6,094,645, Testing: 680,420

News Data Set for Reader Emotion Analysis

Yahoo! Taiwan News

<http://tw.news.yahoo.com>

Yahoo!奇摩首頁 | 信箱 | 拍賣

服務說明

YAHOO! 奇摩 新聞

會員登入
新使用者? 立即註冊

新聞 網頁

新聞首頁 政治 社會 地方 國際 財經 科技 運動 健康 教育 藝文 影劇 旅遊 生活

資訊3C 科學發展 自然環境 照片故事 專輯 民調中心 軟體與環保

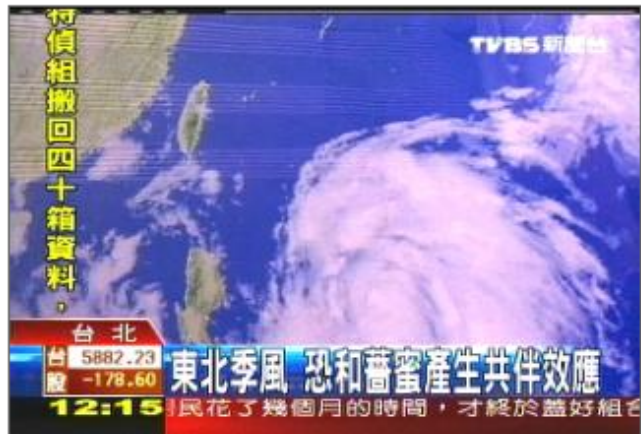
2008/10/23(星期四) 農曆(戊子)九月廿五日

新聞首頁 > 科技 > 科學發展 > TVBS

✉ 寄給朋友 | 友善列印 | 字級設定:

蕃蜜秋颱／秋颱蕃蜜 最快今海警、明晨陸警

TVBS 更新日期:2008/09/26 12:20 雷凱雯



9月想趁著週末出門走走，卻幾乎每個禮拜都遇上颱風，就連最後這周末，也突然碰上個愛插花的中颱蕃蜜；氣象局表

廣告

精采多樣的生活
盡在HP光潮

YAHOO! 生活+ 奇摩

美食大推薦

- 香酥多汁脆皮雞排
- 300元以下吃到飽



Yahoo! Taiwan News

休假日注定泡湯，但眼看災區重建工作還沒完成，薈蜜來勢洶洶，雨量恐怕不小的週末，真的得趕緊加快防颱準備工作。

這篇新聞讓你覺得？



新奇



1



溫馨



2



誇張



3



難過



4



實用



5



高興



6



無聊



7



生氣



8

送出

135人

推薦此新聞

推薦

• 若您願意推薦這則新聞，請點選左側的「推薦」按鈕，但推薦新聞需要收集更多網友意見，目前系統尚無法提供相關新聞。

↓ 儲存至「分享書籤」 | 傳訊給朋友

更多：科學發展 < 科技 < 新聞首頁

科學發展最多瀏覽

• 頭髮培養幹細胞 重症新希望 (自由)



- 戀愛新配方 <MiniTour> 兩人成行
- 哈日自由行3800 > 獨家送玩樂情懷誌
- 奧捷音樂會買1送1 > 再抽Gucc精品



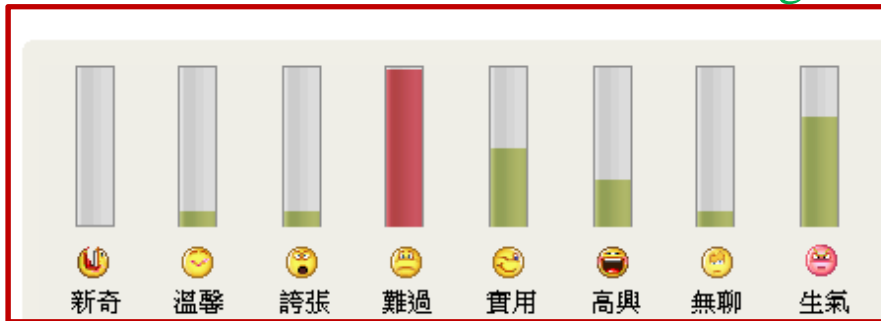
- 歡樂金門趣 > 體驗台海戰地全新風情
- 可樂全球線上訂房獨享現金2%回饋
- 金廈小三通 <機票船票接駁> 3710起

1. Awesome
2. Heartwarming
3. Surprising
4. Sad
5. Useful
6. Happy
7. Boring
8. Angry

Yahoo! Taiwan News

休假日注定泡湯，但眼看災區重建工作還沒完成，薈蜜來勢洶洶，雨量恐怕不小的週末，真的得趕緊加快防颱準備工作。

Emotion Distribution after Voting



共有 4214 人投票

[» 瀏覽更多態度投票結果](#)

135人
推薦此新聞

推薦

• 若您願意推薦這則新聞，請點選左側的「推薦」按鈕，但推薦新聞需要收集更多網友意見，目前系統尚無法提供相關新聞。

可樂旅遊

- 戀愛新配方 <MiniTour> 兩人成行
- 哈日自由行3800 > 獨家送玩樂情懷誌
- 奧捷音樂會買1送1 > 再抽Gucc精品

歡樂金門趣 > 體驗台海戰地全新風情

- 可樂全球線上訂房獨享現金2%回饋
- 金廈小三通 <機票船票接駁> 3710起

1. Awesome
2. Heartwarming
3. Surprising
4. Sad
5. Useful
6. Happy
7. Boring
8. Angry

Corpus

- Yahoo! Taiwan News articles
- January 24 – August 7, 2007
- Training: 25,975 articles
- Test: 11,441 articles

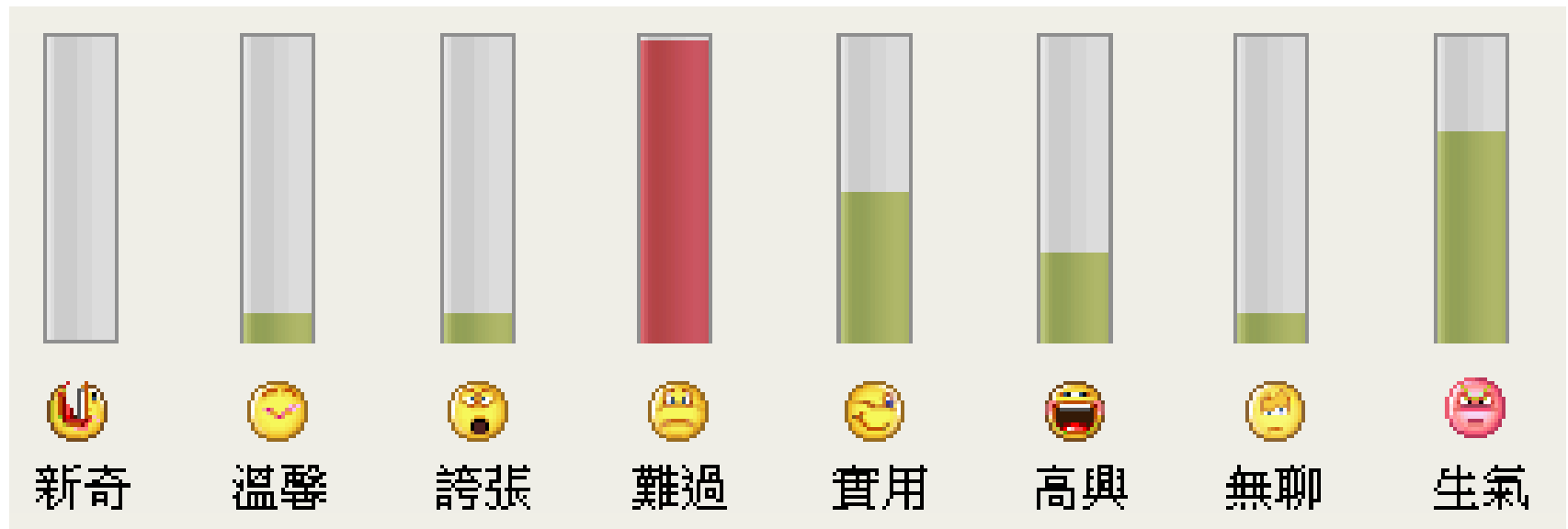
Emotion Classification from the Reader's Perspective

Research Objective

- Classify news articles into emotion categories

Research Objective

- Classify news articles into emotion categories



Awesome

Heartwarming

Surprising

Sad

Useful

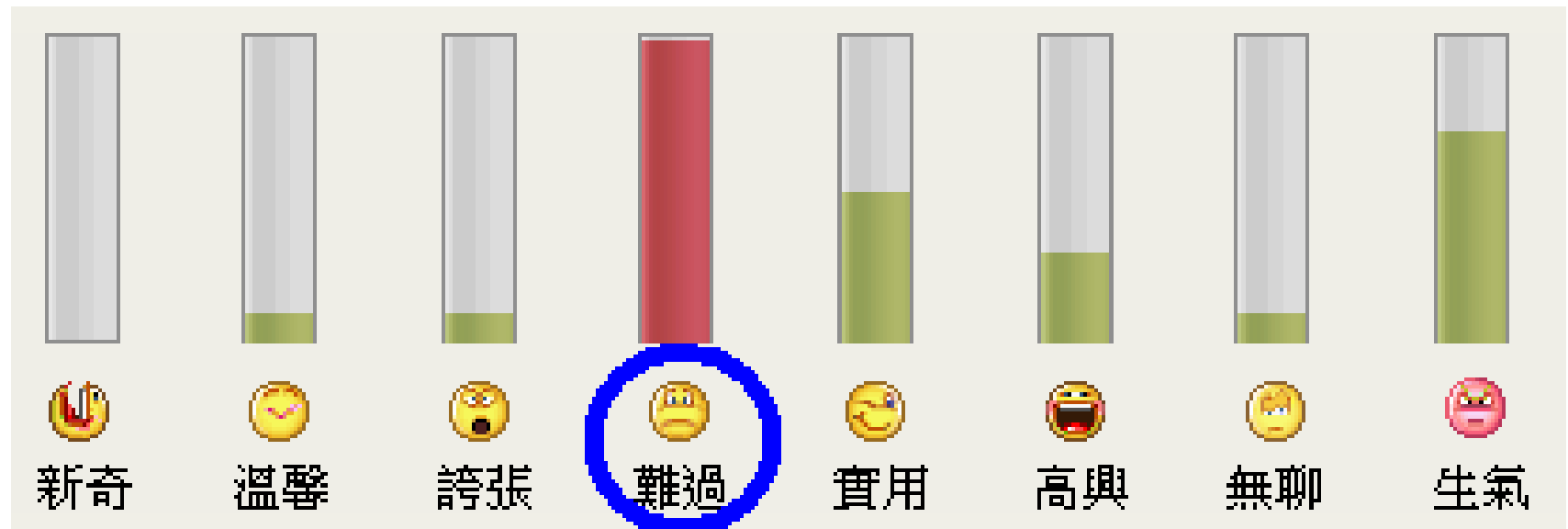
Happy

Boring

Angry

Research Objective

- Classify news articles into emotion categories



Awesome

Heartwarming

Surprising

Sad

Useful

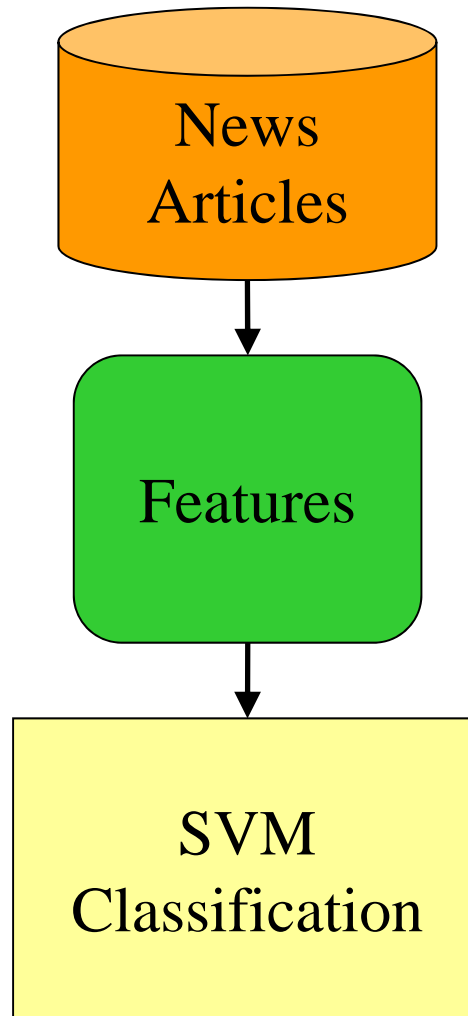
Happy

Boring

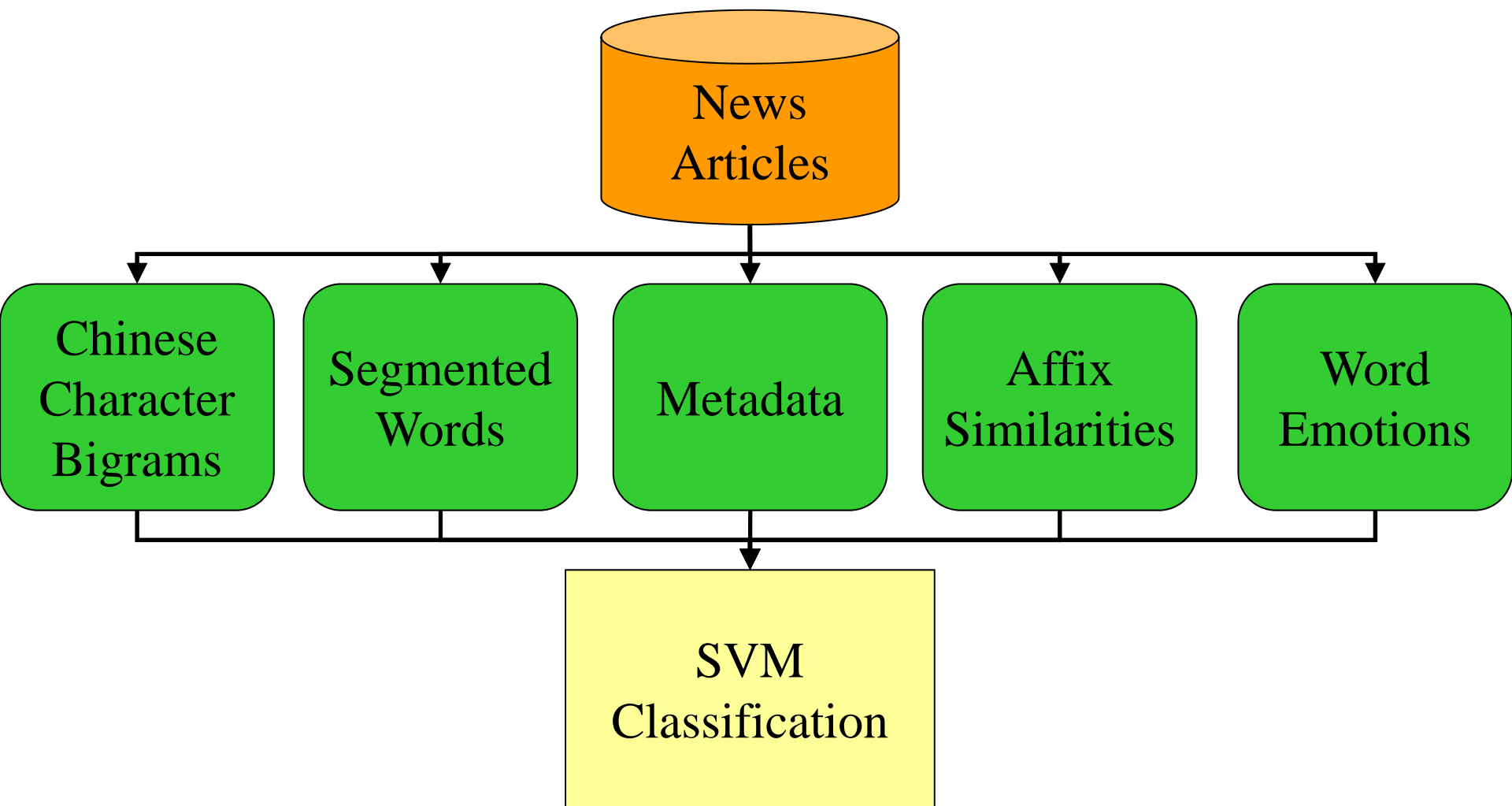
Angry

Approach

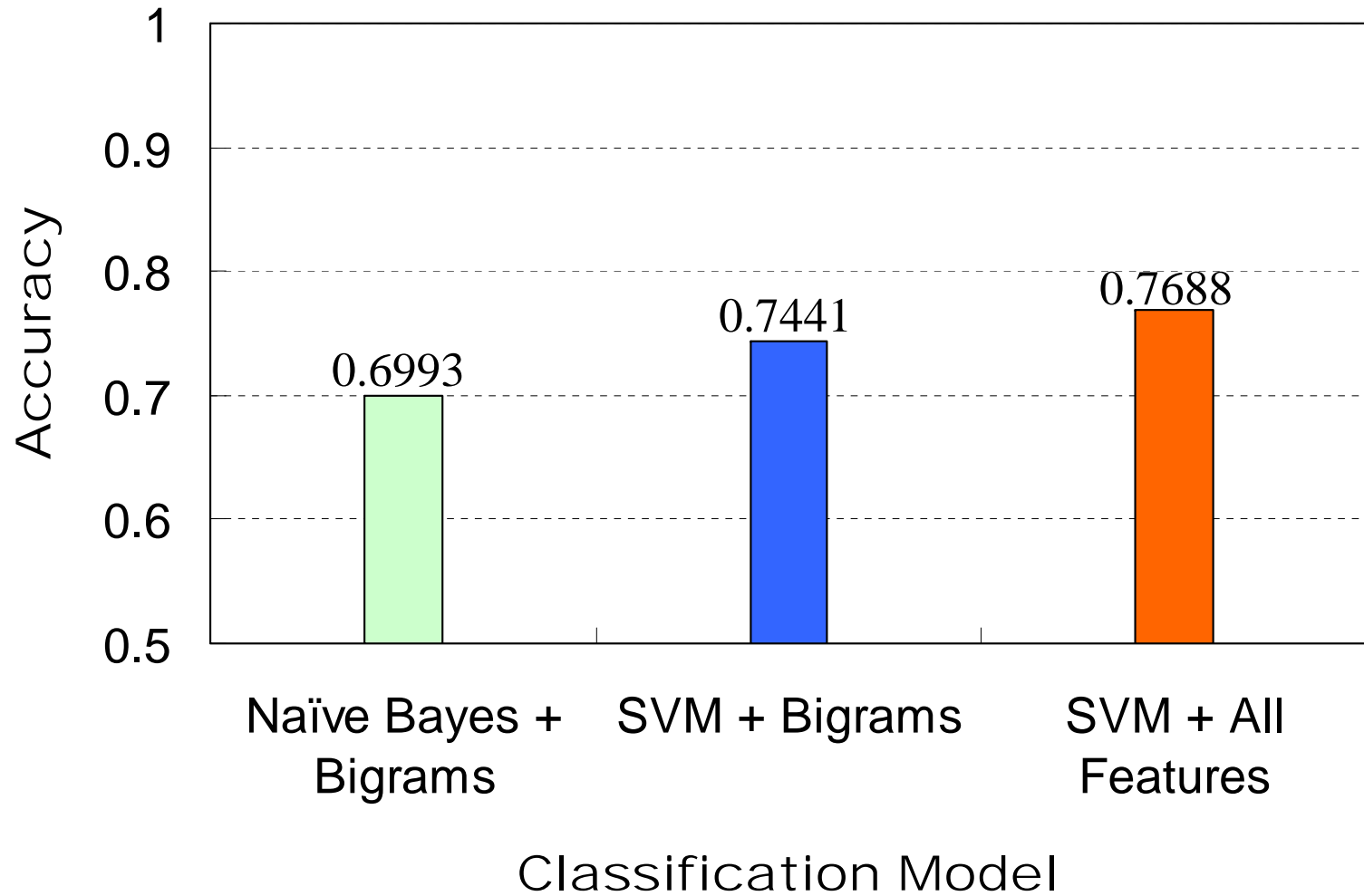
Approach



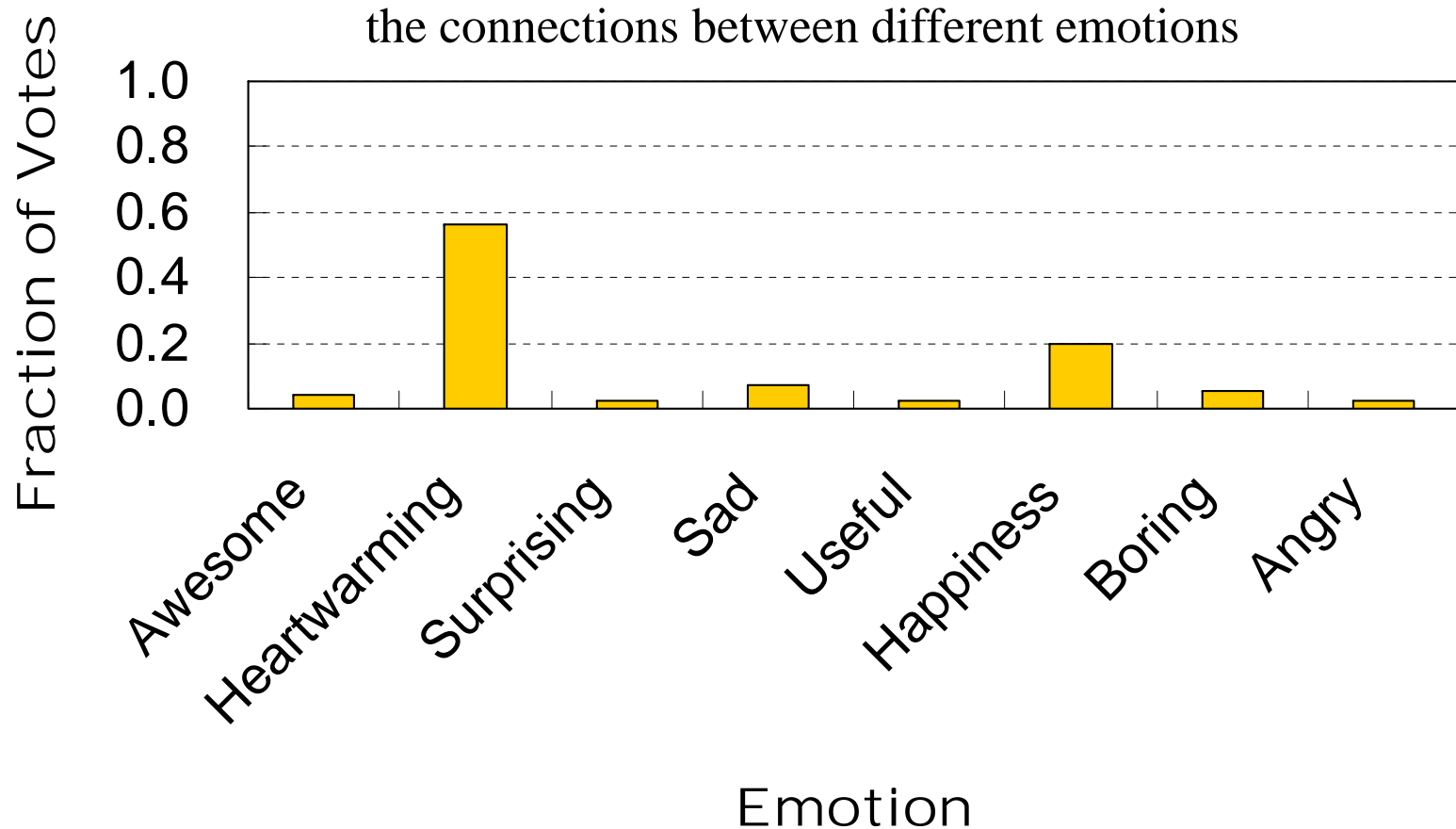
Approach



Results



Emotion Patterns



if most people feel heartwarming after reading a news article, then many other people are going to feel happy.

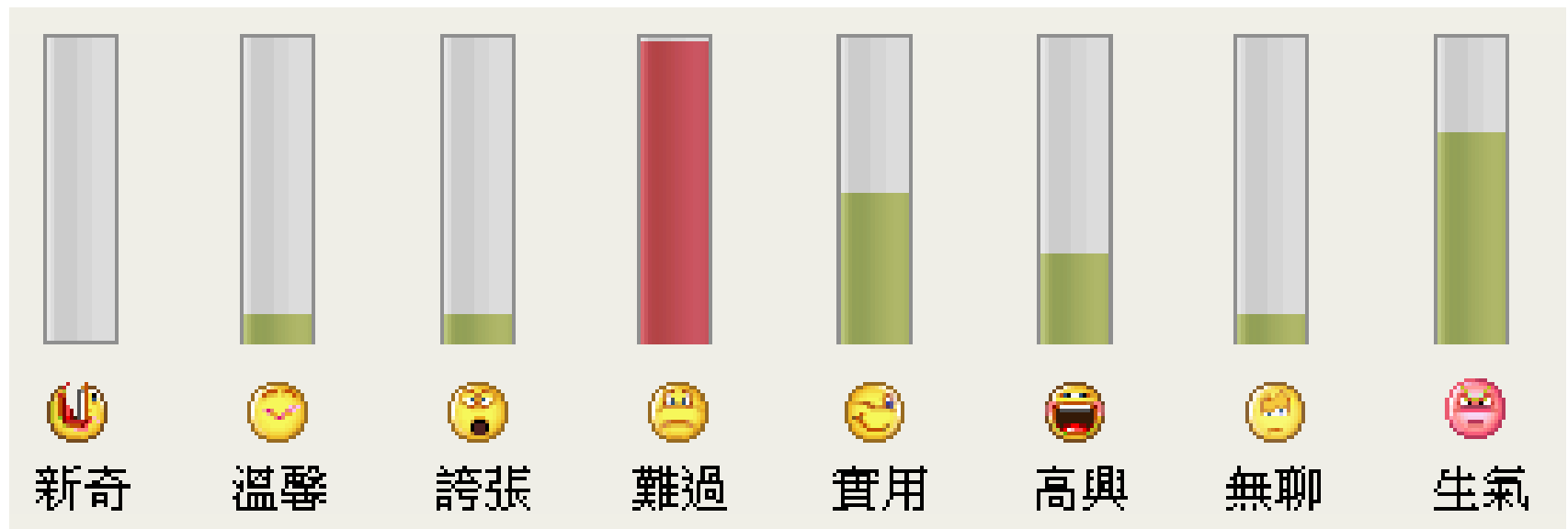
Summary

- Higher classification accuracy
- Corpora in other languages
 - Korean (Yahoo!)
 - Japanese (Yahoo!)
 - English (SemEval 2007 Affective Text Task)
- Emotion ranking

Ranking Reader Emotions
Using Pairwise Loss Minimization and
Emotional Distribution Regression

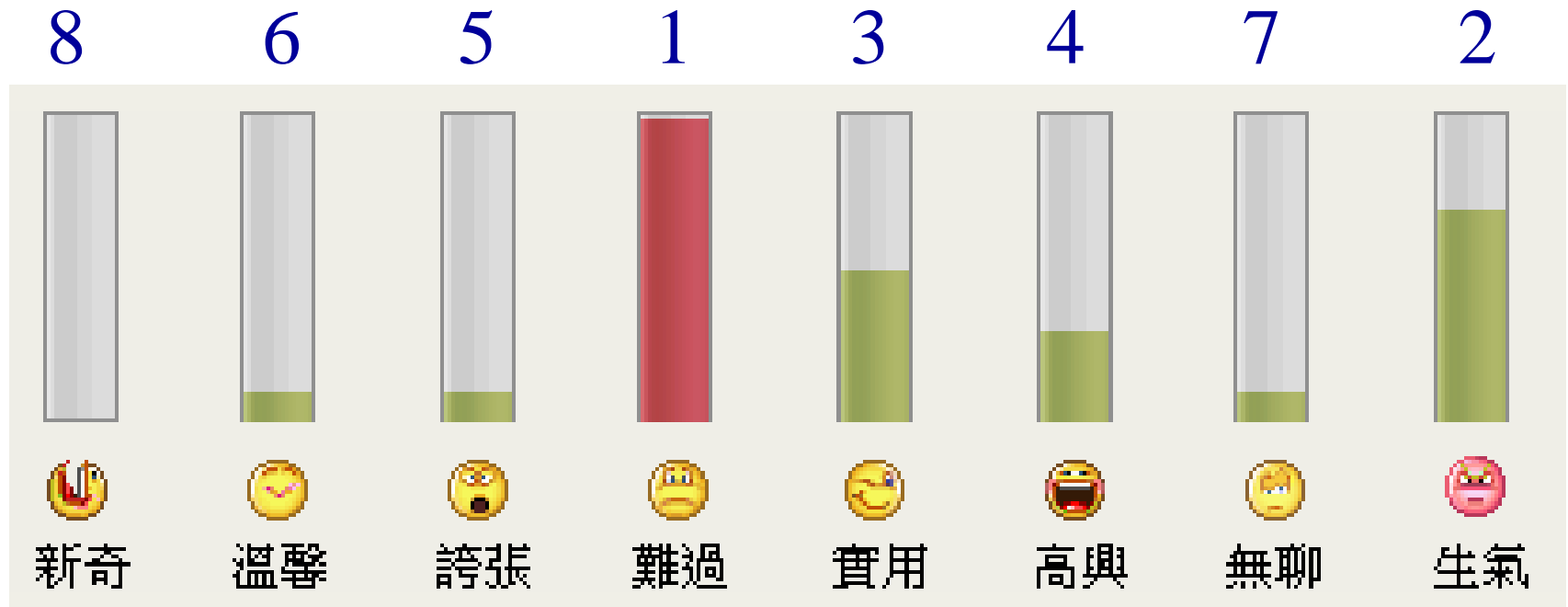
Research Objective

- Predict order of reader emotions



Research Objective

- Predict order of reader emotions



Research Objective

- Writer-emotion analysis
 - ➔ Single emotion
- Reader-emotion analysis
 - ➔ List of emotions

Pairwise Ranking Approach

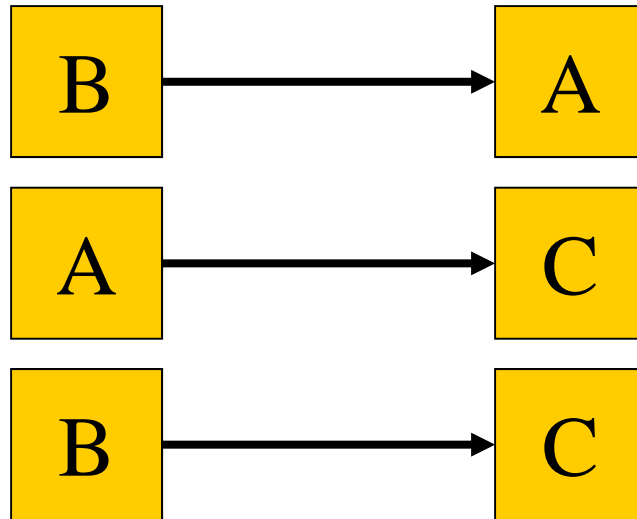
- Predict pairwise order of emotions
 - All of the pairwise ranking functions are applied to the unseen document, which generates the relative orders of every pair of emotions.
 - Use SVM to predict pairwise order
- Combine into a ranked list

Pairwise Ranking Example

- Ranking three emotions A, B, C

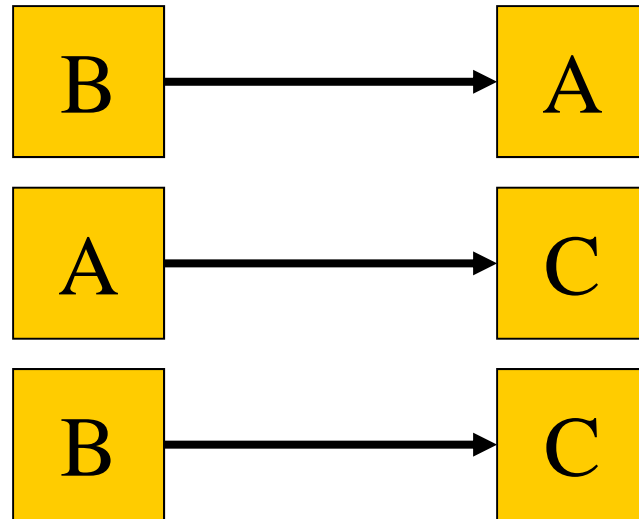
Pairwise Ranking Example

- Ranking three emotions A, B, C
- Prediction:



Pairwise Ranking Example

- Ranking three emotions A, B, C
- Prediction:



- Ranked List: B, A, C

Regression Approach

- Use regression to predict voting percentage
 - E.g., Support Vector Regression (SVR)
- Rank emotions by voting percentage
- Prediction Result:

0%

2%

4%

37%

19%

10%

1%

27%



新奇



溫馨



誇張



難過



實用



高興

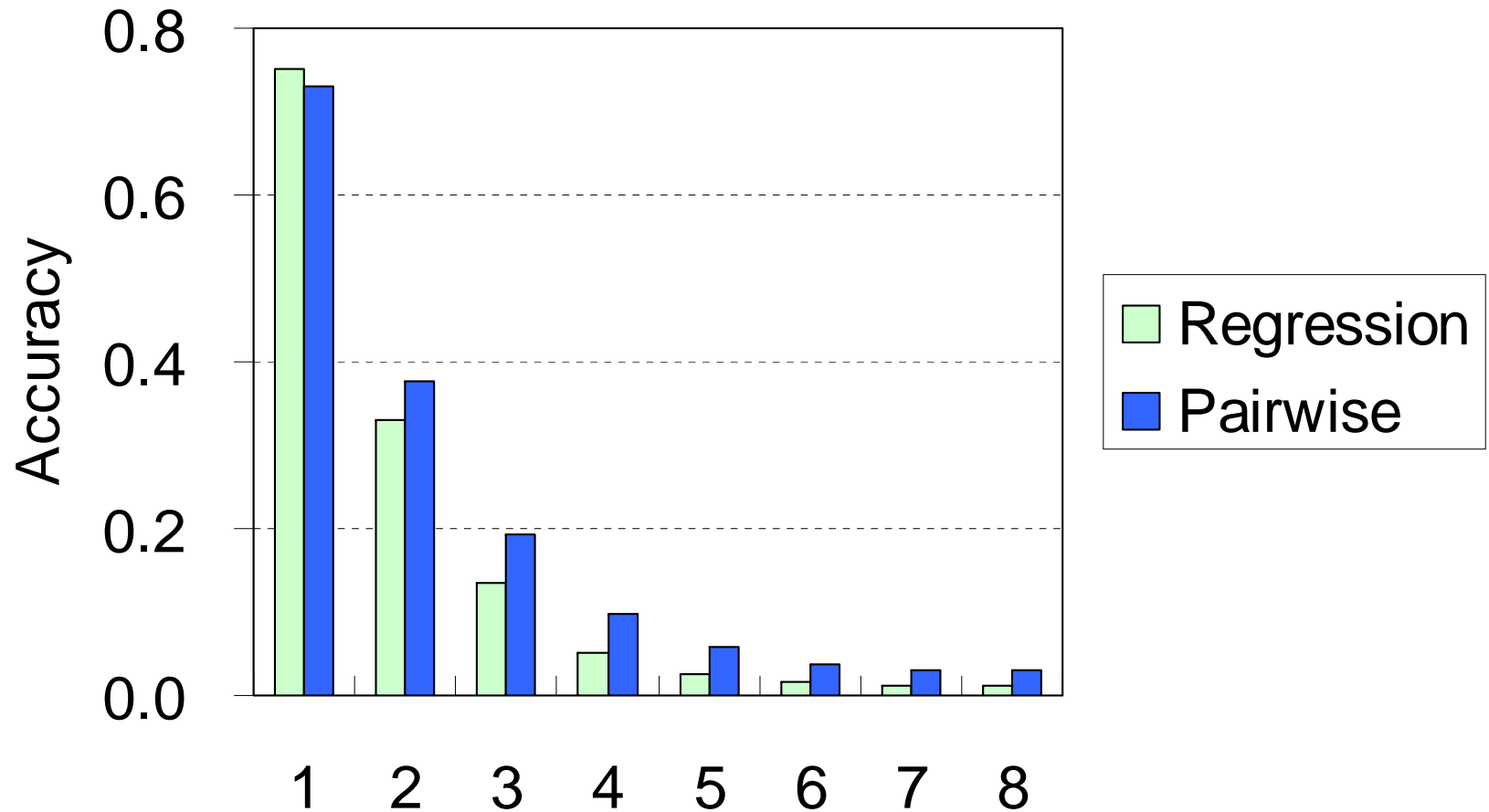


無聊



生氣

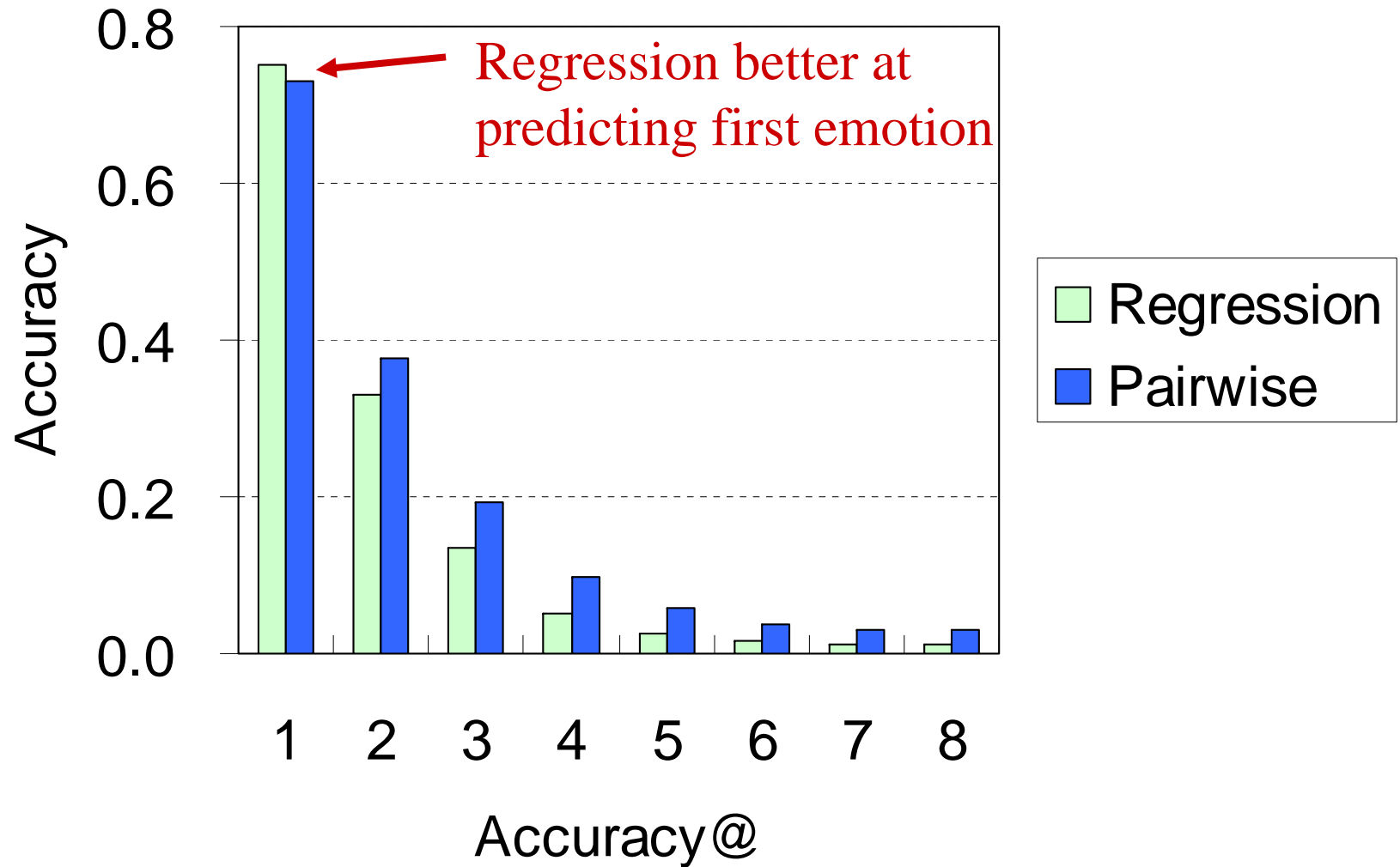
Results



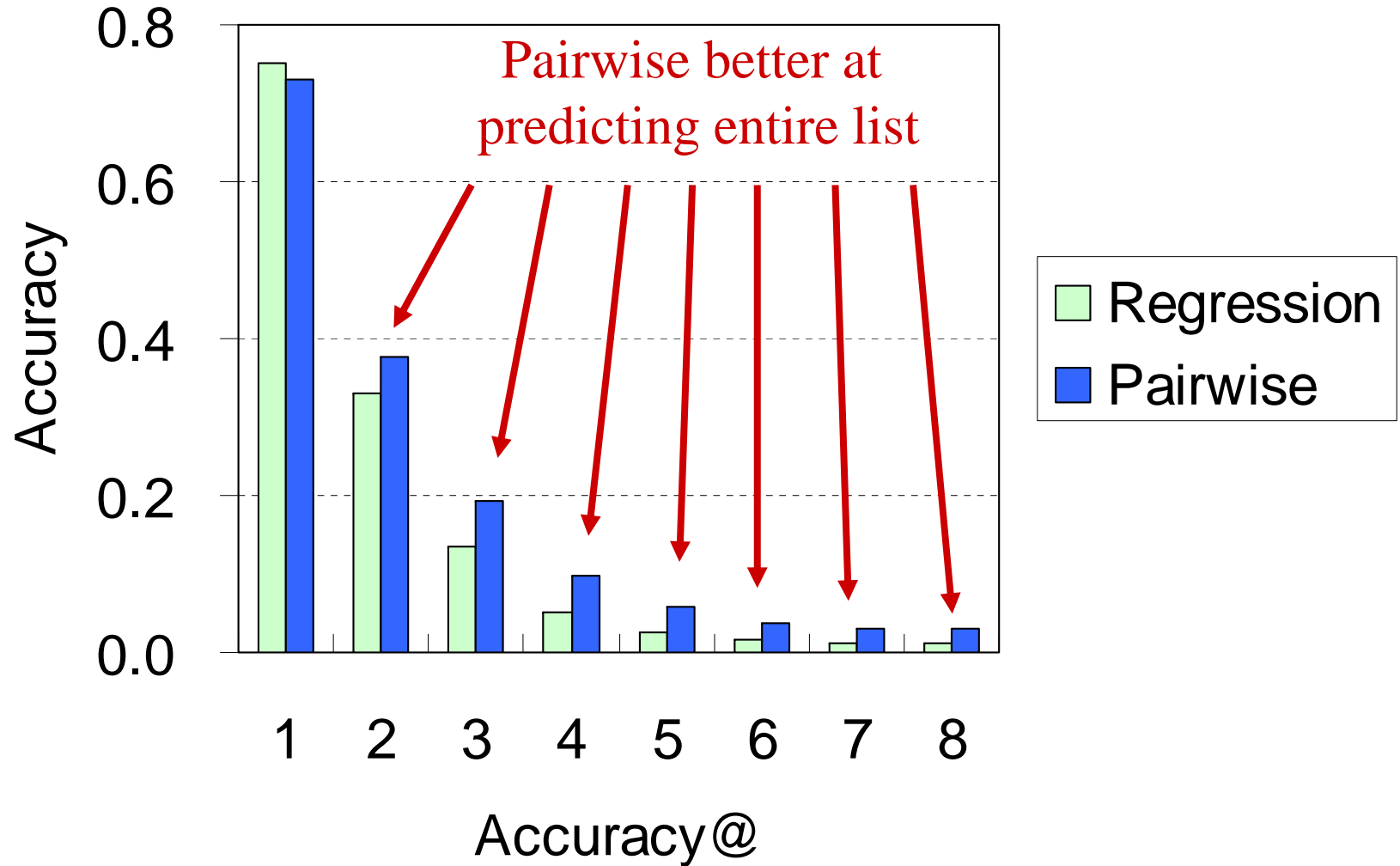
Accuracy@

ACC@k: a predicted ranked list is correct if the list's first k items are identical to the true ranked list's first k items.

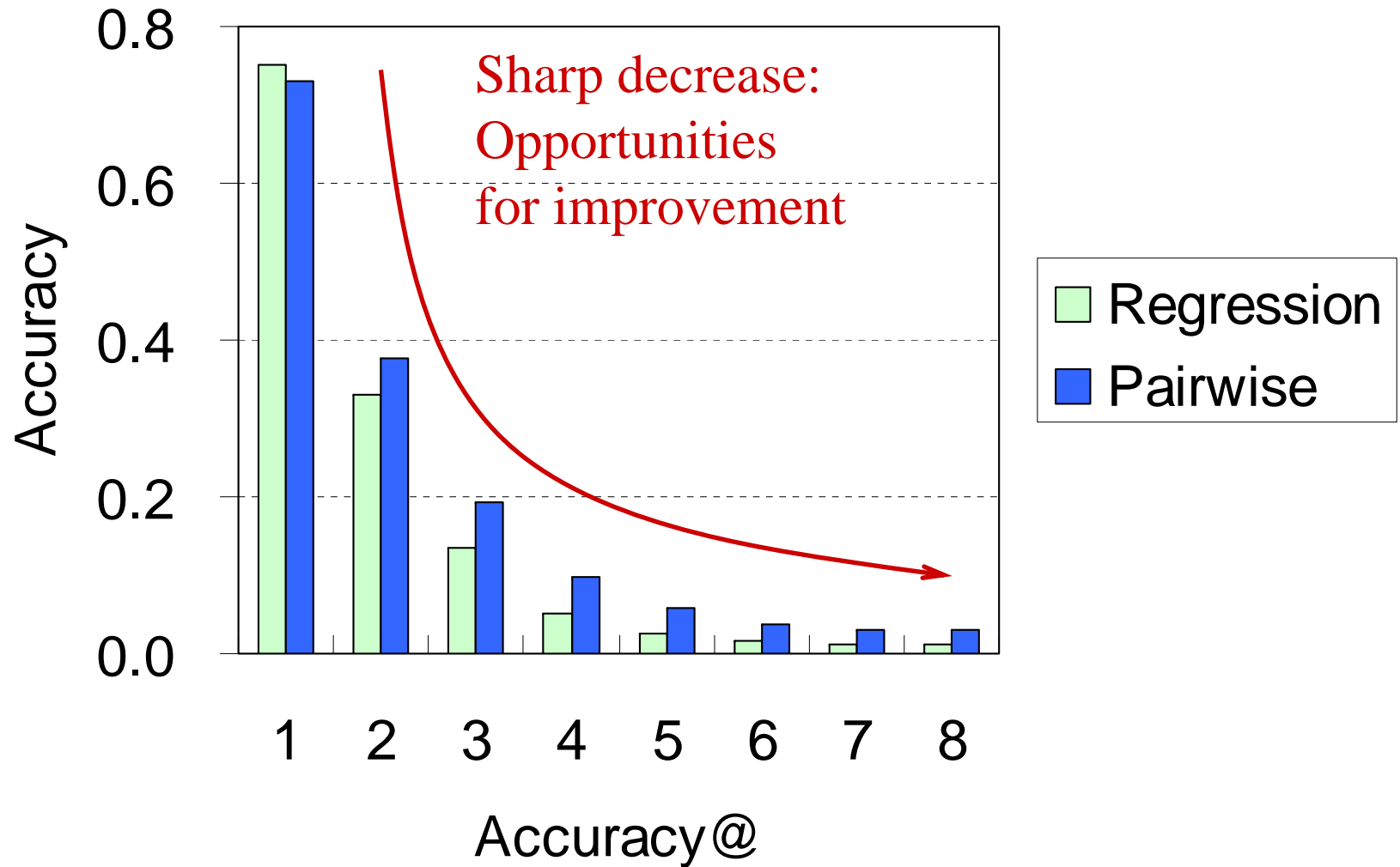
Results



Results



Results



Summary

- Achieve higher ranking accuracy
 - New features
 - New ranking algorithm
- Corpus in other languages (e.g., Korean)
- Integration into information retrieval

References for Opinion Mining

- Lun-Wei Ku, Li-Ying Lee, Dong-Ho Wu, and Hsin-Hsi Chen (2005). “Major Topic Detection and Its Application to Opinion Summarization.” *Proceedings of 28th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, August 15-19, 2005, Salvador, Brazil, 627-628.
- Yohei Seki, David Kirk Evans, Lun-Wei Ku, Hsin-Hsi Chen, Noriko Kando, and Chin-Yew Lin (2007). “Overview of Opinion Analysis Pilot Task at NTCIR-6.” *Proceedings of the 6th NTCIR Workshop Meeting on Evaluation of Information Access Technologies: Information Retrieval, Question Answering and Cross-Lingual Information Access*, May 15-18, 2007, Tokyo, Japan, 265-278.
- Lun-Wei Ku, Yong-Sheng Lo and Hsin-Hsi Chen (2007). “Test Collection Selection and Gold Standard Generation for a Multiply-Annotated Opinion Corpus.” *Proceedings of 45th Annual Meeting of Association for Computational Linguistics*, poster, June 23rd-30th, 2007, Prague, Czech Republic, 89-92.

References for Opinion Mining

- David Kirk Evans, Lun-Wei Ku, Yohei Seki, Hsin-Hsi Chen and Noriko Kando (2007). “Opinion Analysis across Languages: An Overview of and Observations from the NTCIR6 Opinion Analysis Pilot Task.” *Proceedings of the 7th International Workshop on Fuzzy Logic and Applications, WILF 2007*, Camogli, Italy, July 7-10, 2007, Masulli, Francesco; Mitra, Sushmita; Pasi, Gabriella (Eds.), LNAI , Vol. 4578, 456-563.
- Lun-Wei Ku and Hsin-Hsi Chen (2007). “Mining Opinions from the Web: Beyond Relevance Retrieval.” *Journal of American Society for Information Science and Technology*, Special Issue on Mining Web Resources for Enhancing Information Retrieval, 58(12), 1838-1850.
- Yohei Seki, David Kirk Evans, Lun-Wei Ku, Le Sun, Hsin-Hsi Chen and Noriko Kando (2008). “Overview of Multilingual Opinion Analysis Task at NTCIR-7.” *Proceedings of the 7th NTCIR Workshop Meeting on Evaluation of Information Access Technologies: Information Retrieval, Question Answering, and Cross-Lingual Information Access*, December 16-19, 2008, Tokyo, Japan, 185-203.

References for Opinion Mining

- Lun-Wei Ku, Ting-Hao Huang and Hsin-Hsi Chen (2009). “Using Morphological and Syntactic Structures for Chinese Opinion Analysis.” *Proceedings of Conference on Empirical Methods in Natural Language Processing (EMNLP 2009)*, August 6-7, 2009, Singapore, 1260-1269.
- Lun-Wei Ku, Hsiu-Wei Ho and Hsin-Hsi Chen (2009). “Opinion Mining and Relationship Discovery Using CopeOpi Opinion Analysis System.” *Journal of the American Society for Information Science and Technology*, 60(7), 1486–1503.
- Lun-Wei Ku, Ting-Hao Huang, and Hsin-Hsi Chen (2010). “Construction of Chinese Opinion Treebank.” *Proceedings of the Seventh International Conference on Language Resources and Evaluation*, May 17-23, 2010, Malta.

References for Emotion Analysis

- Changhua Yang, Kevin Hsin-Yih Lin and Hsin-Hsi Chen (2007). “Building Emotion Lexicon from Weblog Corpora.” *Proceedings of 45th Annual Meeting of Association for Computational Linguistics*, poster, June 23rd-30th, 2007, Prague, Czech Republic, 133-136.
- Kevin Hsin-Yih Lin, Changhua Yang and Hsin-Hsi Chen (2007). “What Emotions Do News Articles Trigger in Their Readers?” *Proceedings of 30th Annual International ACM SIGIR Conference*, poster, 23-27 July, 2007, Amsterdam, Netherland, 733-734.
- Changhua Yang, Kevin Hsin-Yih Lin, and Hsin-Hsi Chen (2007). “Emotion Classification Using Web Blog Corpora.” *Proceedings of 2007 IEEE/WIC/ACM International Conference on Web Intelligence*, November 2-5, 2007, Silicon Valley, 275-278.
- Changhua Yang, Kevin Hsin-Yih Lin and Hsin-Hsi Chen (2008). “Sentiment Analysis in Weblog Using Contextual Information: A Machine Learning Approach.” *International Journal of Computer Processing of Languages*, 21:4, 331–345.

References for Emotion Analysis

- Kevin Hsin-Yih Lin and Hsin-Hsi Chen (2008). “Ranking Reader Emotions Using Pairwise Loss Minimization and Emotional Distribution Regression.” *Proceedings of EMNLP 2008: Conference on Empirical Methods in Natural Language Processing*, October 25-27, 2008, Honolulu, Hawaii, 136-144.
- Kevin Hsin-Yih Lin, Changhua Yang, and Hsin-Hsi Chen (2008). “Emotion Classification of Online News Articles from the Reader’s Perspective.” *Proceedings of the 2008 IEEE/WIC/ACM International Conference on Web Intelligence*, December 9-12, 2008, Sydney, Australia, 220-226.
- Changhua Yang, Kevin Lin, and Hsin-Hsi Chen (2009). “Writer Meets Reader: Emotion Analysis of Social Media from both the Writer’s and Reader’s Perspectives.” *Proceedings of the 2009 IEEE/WIC/ACM International Conference on Web Intelligence (WI 2009)*, 15-18 September, 2009, Milan, Italy, 287-290.

Thanks, Merci, Danke, Grazie,
謝謝, 谢谢