Affect Analysis of Textual Input Utterance in Japanese and its Application in Human-Computer Interaction

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Originality

- Developed a new approach to emotions in language: Emotemes
- Applied an old theory to a new task: Theory of kinesics in analysis of emoticons
- Made one step further in implementation of emotional intelligence in machines: Contextual appropriateness of emotions

Presentation Outline

1. Introduction
2. Tools for Affect Analysis of Textual Input
   - ML-Ask: A System for Affect Analysis of Utterances in Japanese
   - CAO: A System for Analysis of Emoticons
3. Application of Emotive Information in Human-Computer Interaction
   - Method of Automatic Evaluation of Conversational Agents
   - Method of Verifying Contextual Appropriateness of Emotion
4. Concluding Remarks and Further Work

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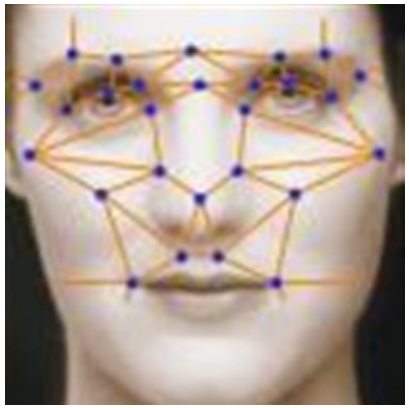
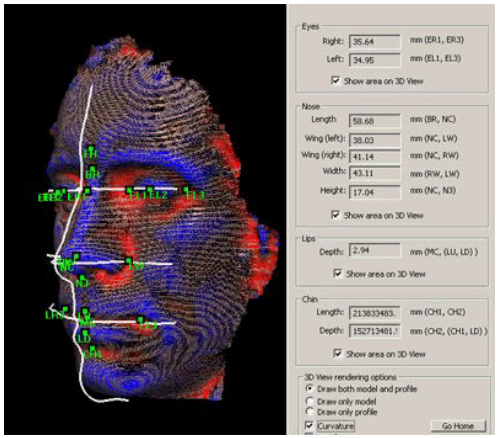
Introduction

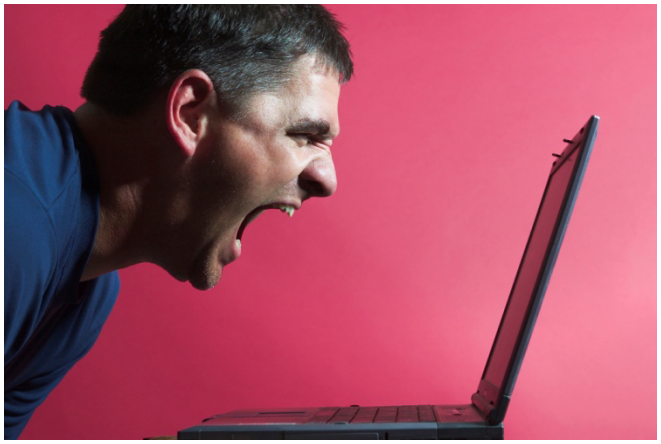
Introduction

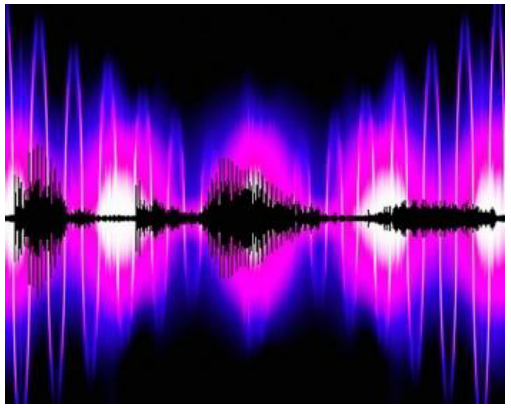
Emotion recognition

- Facial expressions
- Voice
- Gestures
- Language









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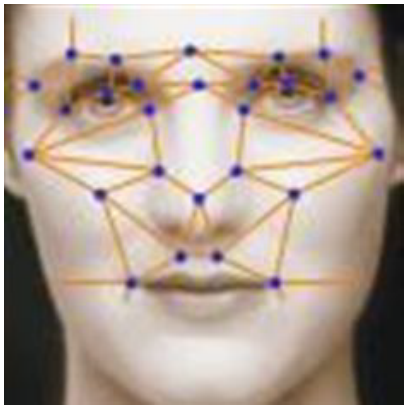

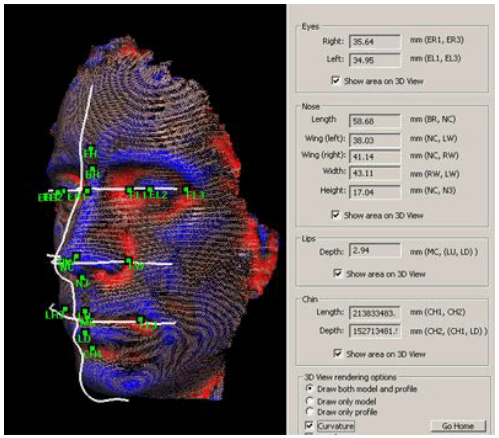

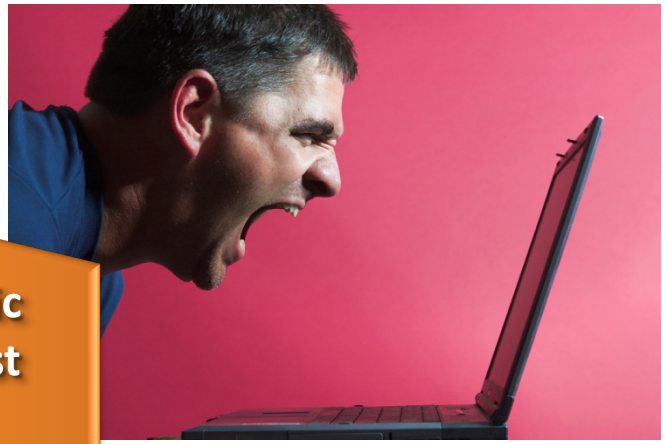

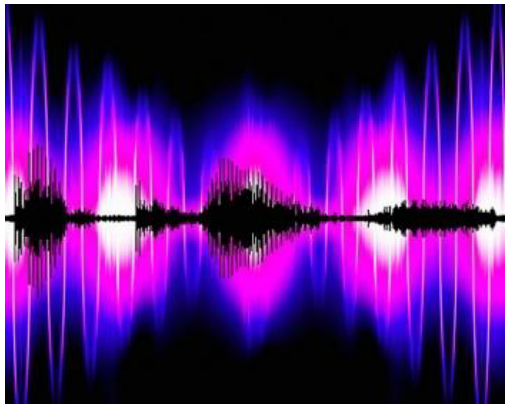

The semantic and pragmatic diversity of emotions is best conveyed in language*.

*) Robert C. Solomon. *The Passions: Emotions and the Meaning of Life*, Hackett Publishing, 1993.; Schrauf, Robert W. and Julia Sanchez (2004). *The preponderance of negative emotion words across generations and across cultures.* Journal of Multilingual and Multicultural Development, 25(2-3), 266-284.

Tools for Affect Analysis of Textual Input

ML-Ask: A System for Affect Analysis of Utterances in Japanese

ML-Ask

- Some problems with today affect analysis systems (for Japanese)
  - ① No standards for emotion type classification
  - ② Simplified classification (+/- , happiness/sadness)
  - ③ **How to tell if the utterance is emotive?**
  - ④ **No evaluations on large corpora**

① **compare:**

- Endo, D., Saito, S. and Yamamoto, K. *Kakariuke kankei wo riyo shita kanjoseikihyogen no chushutsu.*(*Extracting expressions evoking emotions using dependency structure*), Proceedings of The Twelve Annual Meeting of The Association for Natural Language Processing. 2006
- Tsuchiya, Seiji, Yoshimura, Eriko, Watabe, Hirokazu and Kawaoka, Tsukasa. *The Method of the Emotion Judgment Based on an Association Mechanism.* Journal of Natural Language Processing, Vol.14, No.3, The Association for Natural Language Processing. 2007
- Ryoko Tokuhisa, Kentaro Inui, Yuji Matsumoto. *Emotion Classification Using Massive Examples Extracted from the Web*, In Proc. of Coling 2008,pp.881-888,2008.

②

- Peter D. Turney. 2002. Thumbs Up or Thumbs Down? Semantic Orientation Applied to Unsupervised Classification of Reviews. In *Proceedings of ACL'02, pp. 417-424*
- Jorge Teixeira, Vasco Vinhas, Eugenio Oliveira and Luis Reis. A New Approach to Emotion Assessment Based on Biometric Data. In Proceedings of WI-IAT'08, pages 459-500, 2008.

③

- Ryoko Tokuhisa, Kentaro Inui, Yuji Matsumoto. *Emotion Classification Using Massive Examples Extracted from the Web*, In Proc. of Coling 2008,pp.881-888,2008.

④

- Junko Minato, David B. Bracewell, Fuji Ren and Shingo Kuroiwa. 2006. Statistical Analysis of a Japanese Emotion Corpus for Natural Language Processing. *LNCS 4114.*

ML-Ask

- Usual approach to affect analysis:
  - A database of emotive words *
  - Processing (Matching input with databases, machine learning, Web mining, word statistics, etc.)
  - Example: 太郎は楽しい人です “John is a nice person.”
    Emotive expression: “nice”
    emotion: liking, fondness

    …but that’s just a *declarative sentence*.
    In a real conversation:

    いや～でも、太郎って楽しいやつだよな！
    “Oh, but John is such a nice person !”

*) For example: WordNet Affect in English: Strapparava, C., Valitutti, A.: *An Affective Extension of WordNet*, Proceedings of LREC’04, pp.1083-1086.(2004)
In Japanese: manually build: Seiji Tsuchiya, Eriko Yoshimura, Hirokazu Watabe and Tsukasa Kawaoka, Proposal of Method to Judge Speaker's Emotion Based on Association Mechanism, KES2007, Vol.1, pp.847-857, 2007; enriched with Web minig: Ryoko Tokuhisa, Kentaro Inui, and Yuji Matsumoto. Emotion classification using massive examples extracted from the Web. In Proceedings of the 22nd International Conference on Computational Linguistics (COLING-2008), pp881-888, Aug. 2008

ML-Ask

- My approach to affect analysis:

In language there are:

1. Emotive/evaluative expressions*
2. Emotiveness indicators. “Emotemes” – Japanese emotive morphemes**

いや～でも、太郎って楽しいやつだよな！
いや～でも、太郎って最低のやつだよな！

*) A. Nakamura, *Kanjō hyōgen jiten* (Dictionary of Emotive Expressions), Tokyodo Publishing, Tokyo (1993)

**) M. Ptaszyński, *Moeru gengo - Intānetto kei-jiban no ue no nihongo kaiwa ni okeru kanjōhyōgen no kōzō to kigōrontekikinō no bunseki – “2channeru„ denshikeijiban o rei toshite* –(Boisterous language. Analysis of structures and semiotic functions of emotive expressions in conversation on Japanese Internet bulletin board forum - 2channel -), UAM, Poznań (2006)

Michal Ptaszynski, Pawel Dybala, Rafal Rzepka and Kenji Araki. *Effective Analysis of Emotiveness in Utterances based on Features of Lexical and Non-Lexical Layer of Speech.* In Proceedings of NLP2008, pp 171-174, 2008.

Michal Ptaszynski, Pawel Dybala, Rafal Rzepka and Kenji Araki. *Affecting Corpora:Experiments with Automatic Affect Annotation System - A Case Study of the 2channel Forum* -, The Conference of the Pacific Association for Computational Linguistics (PACLING-09), September 1-4, 2009, Hokkaido University, Sapporo, Japan

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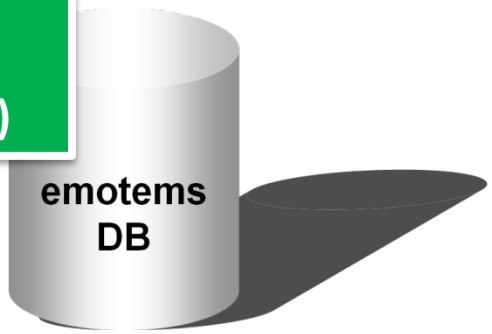
ML-Ask

Gathered manually (907 items)



exclamatives

すげぇ *sugee* (great!)
うおぉ *wooo* (whoa!)

mimetics (*gitaigo*)

ワクワク *wakuwaku* (heart pounding)
ﾄﾞｷﾄﾞｷ *dokidoki* (go pit-a-pat)

vulgarities

–やがる *–yagaru* (fu**ing do sth)
くそ *kuso* (shit)
馬鹿 *baka* (stupid)

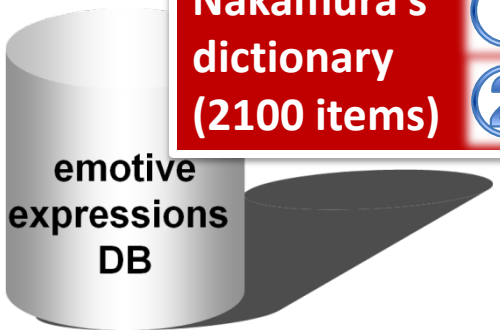
hypocorystics

–ちゃん *–chan* (name suffix)

textual representations of voice modulation and body language (emoticons)

“!”, “??”, “…”, (T_T), (-д-;), __|￣|○

Nakamura’s dictionary (2100 items) ① ②



nouns

愛情 *aijou* (love)
安心 *anshin* (relief)
恐怖 *kyofu* (fear)

verbs

喜ぶ *yorokobu* (be glad)
悲しむ *kanashimu* (feel sad)
むかつく *mukatsuku* (get angry)

phrases / idioms

虫酸が走る *mushizu ga hashiru* (give *one* the creeps)
心が解ける *kokoro ga tokeru* (*one’s* heart is melting in relief)
歓天喜地 *kantenkichi* (delight larger than Haven and Earth)

adjectives

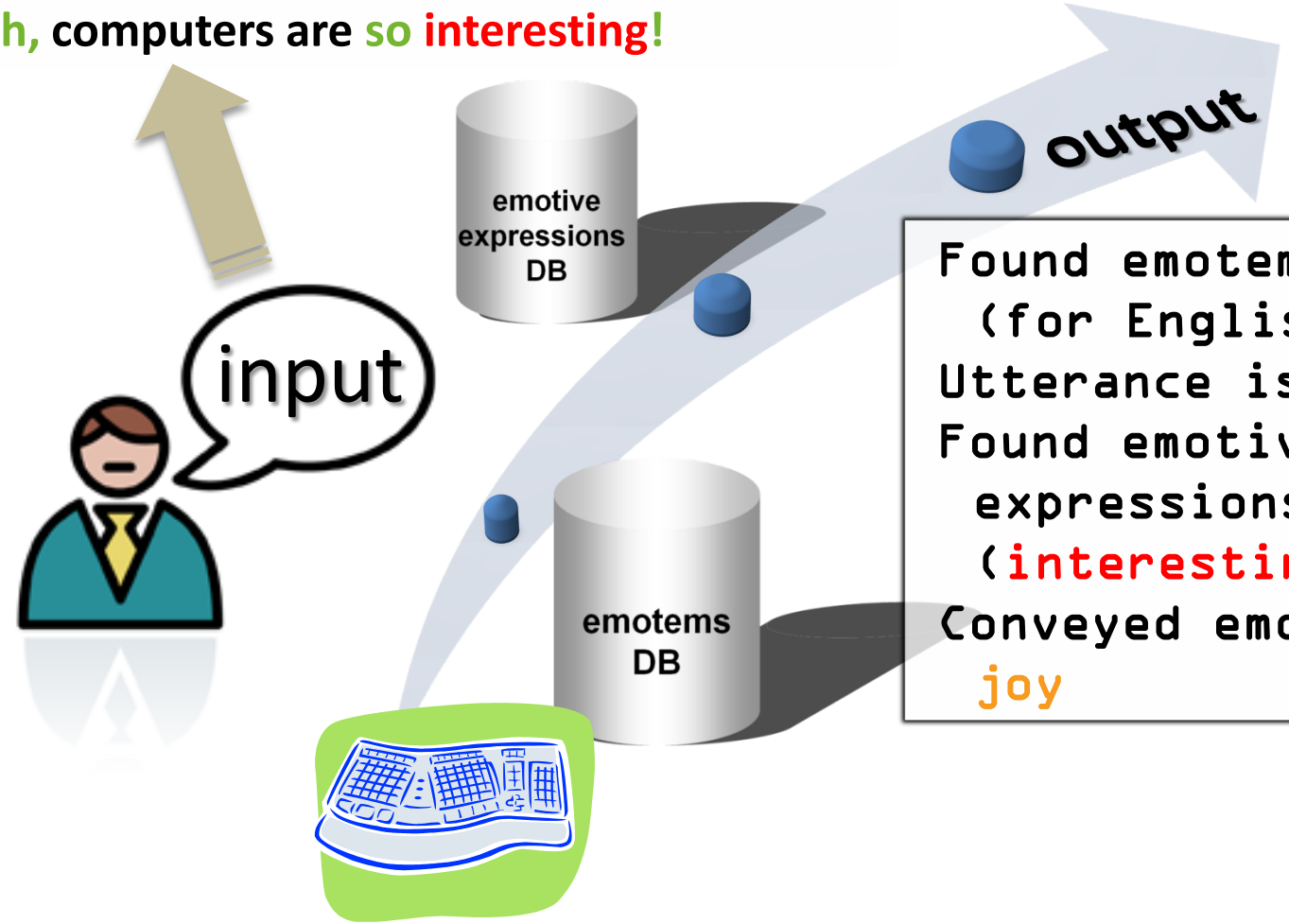
嬉しい *ureshii* (happy)
悔しい *kuyashii* (mortifying)
怖い *kowai* (scary)

10-type emotion classification:

1. Joy, delight
2. Anger
3. Sorrow, sadness, gloom
4. Fear
5. Shame, shyness, bashfulness
6. Liking, fondness
7. Dislike, detestation
8. Excitement
9. Relief
10. Surprise, amazement

ML-Ask

コンピュータは面白いですね!
Konpyuuta wa omoshiroi desu ne!
Oh, computers are so interesting!



Evaluation of ML-Ask

- Emotive / not-emotive
  - questionnaire (layperson): 80 sentences (40 emotive, 40 non-emotive)
    ML-Ask annotated correctly 72 from 80 utterances (90% of agreements)
  - The system‘s agreement with annotators was indicated as very strong (kappa=.8).
  - Error description:
    In 2 cases the system wrongly annotated utterances as "emotive“
    in 6 cases it was the opposite.

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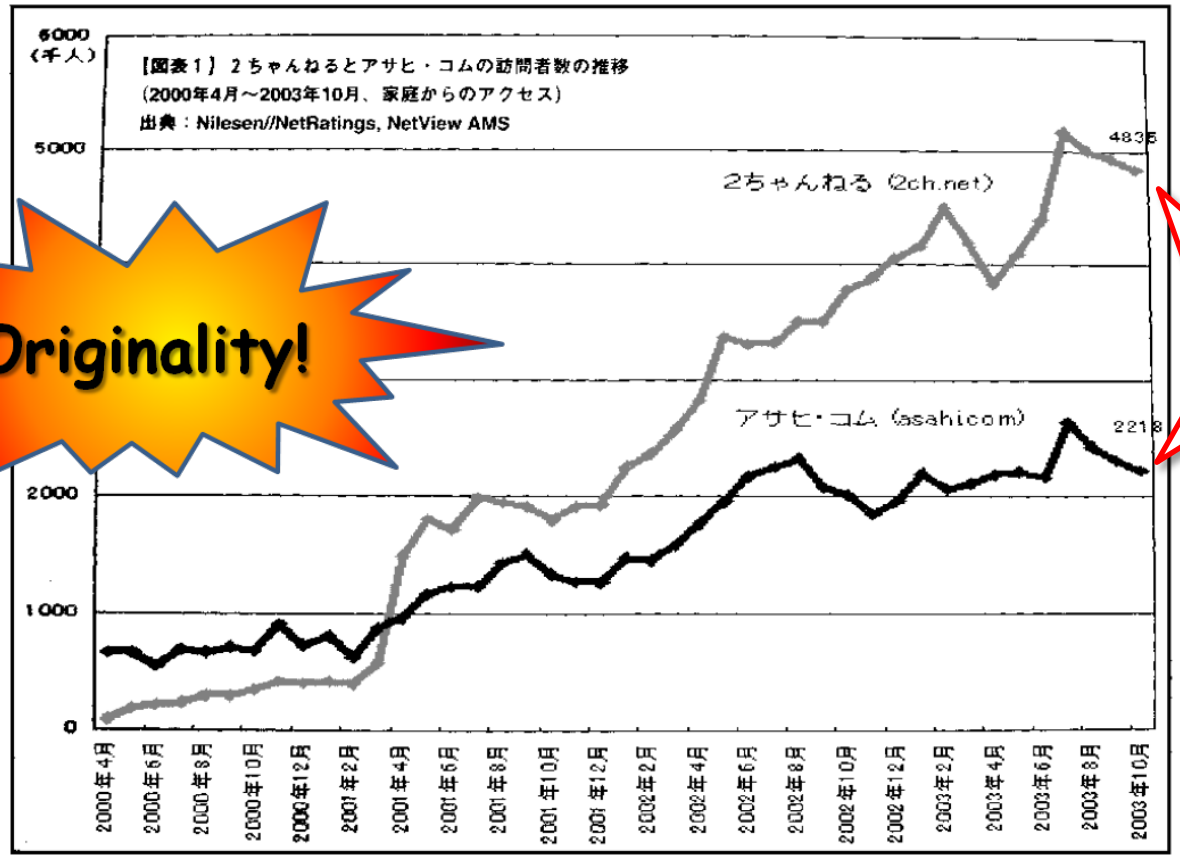
    in 6 cases it was the opposite.

ML-Ask proved its reliability in identifying emotive utterances. ③

Originality!

Experiment on a large corpus ④

- 2channel BBS forum (http://www.2ch.net/)
  - Special feature: lots of expressive contents
- ROBUST!!!



Originality!

For 2003.10 number of comments on *2channel* was TWO TIMES as on asahi.com !

Nakazawa Shin'ichi (2004) "2channeru koushiki gaido 2004", Tokyo, Koamagajin

Experiment on a large corpus

- Processing all is… difficult
- Lets take only a part of it:
  - *Densha otoko* **電車男** (Train m
  - 177,553 characters
  - in 1,840 utterances
  - divided into 6 parts/chapters.

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  - Manual affect annotation (Ptaszynski 2006)**
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- …Its annotated!
  - Manual affect annotation (Ptaszynski 2006)**
  - 2 annotators
  - I annotated the corpus using ML-Ask and compared the results.

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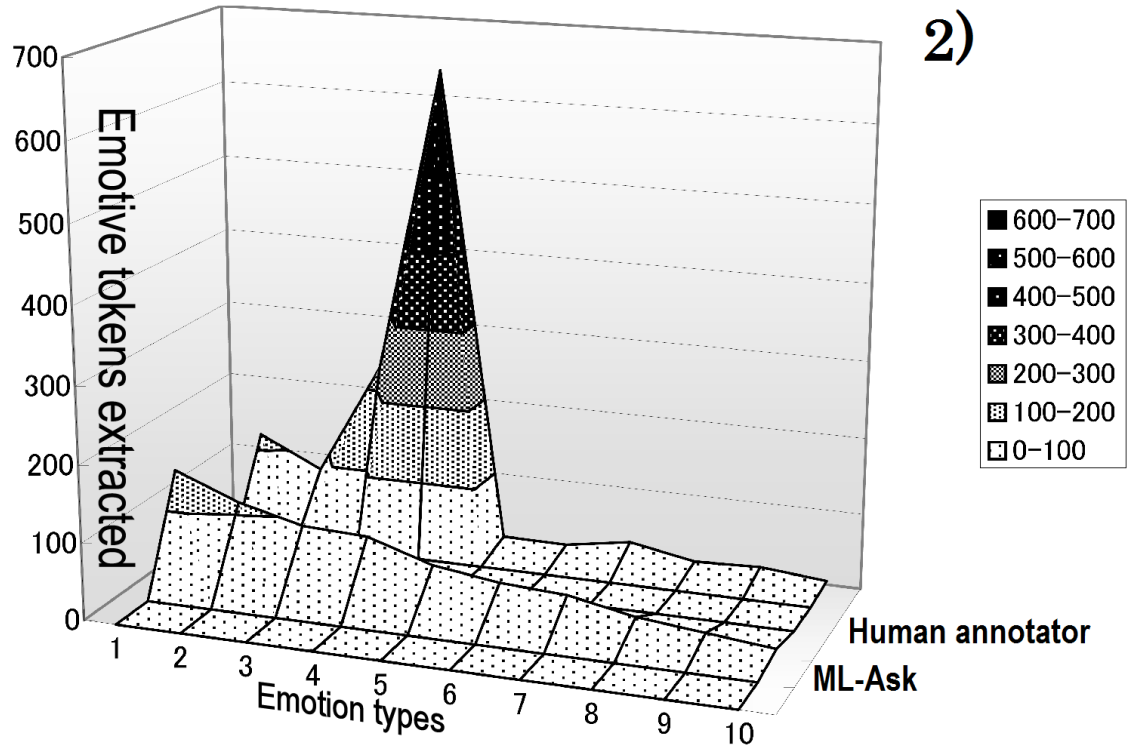
Results

- Emotion type annotation tendencies
  - Similar: 8/10 types (joy, anger, gloom, fear, shame/shyness, fondness, relief and surprise)
  - Problematic: 2/10 types (dislike, excitement)



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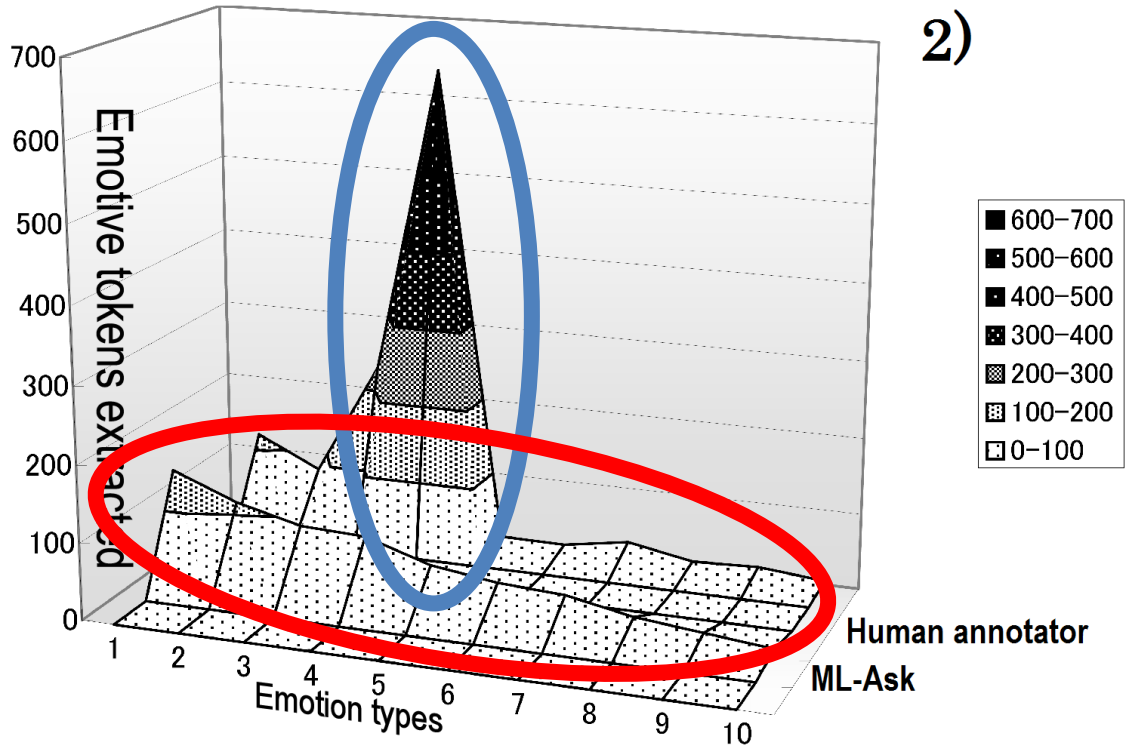

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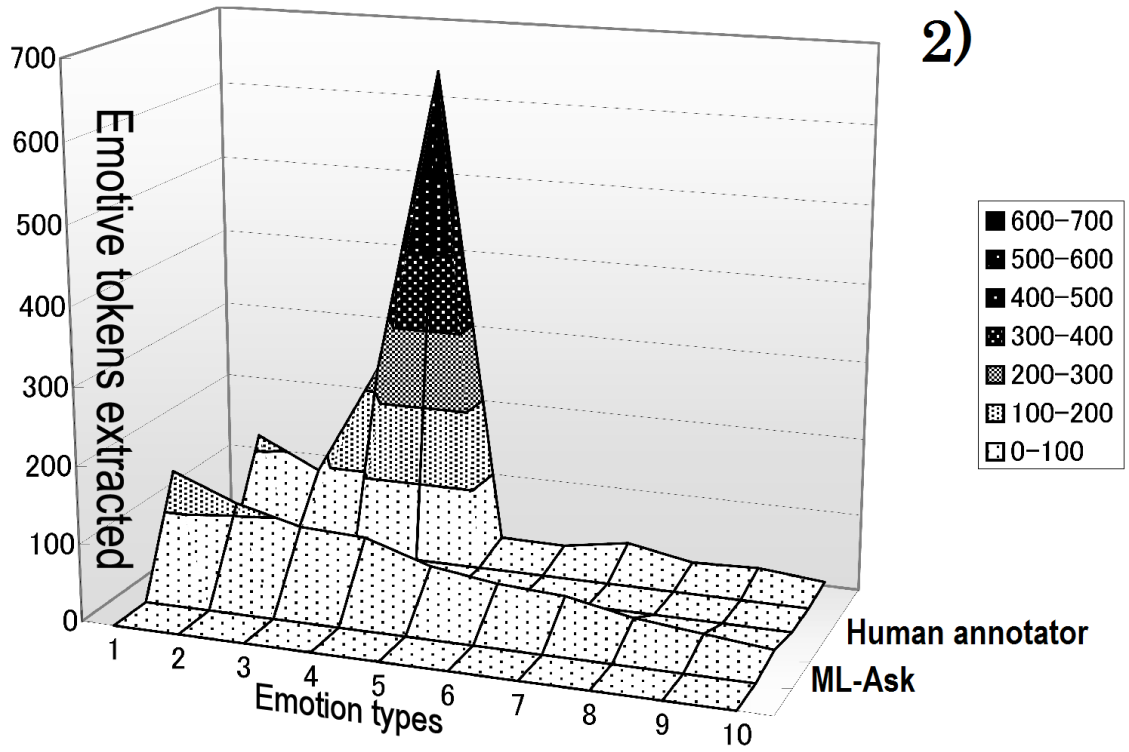

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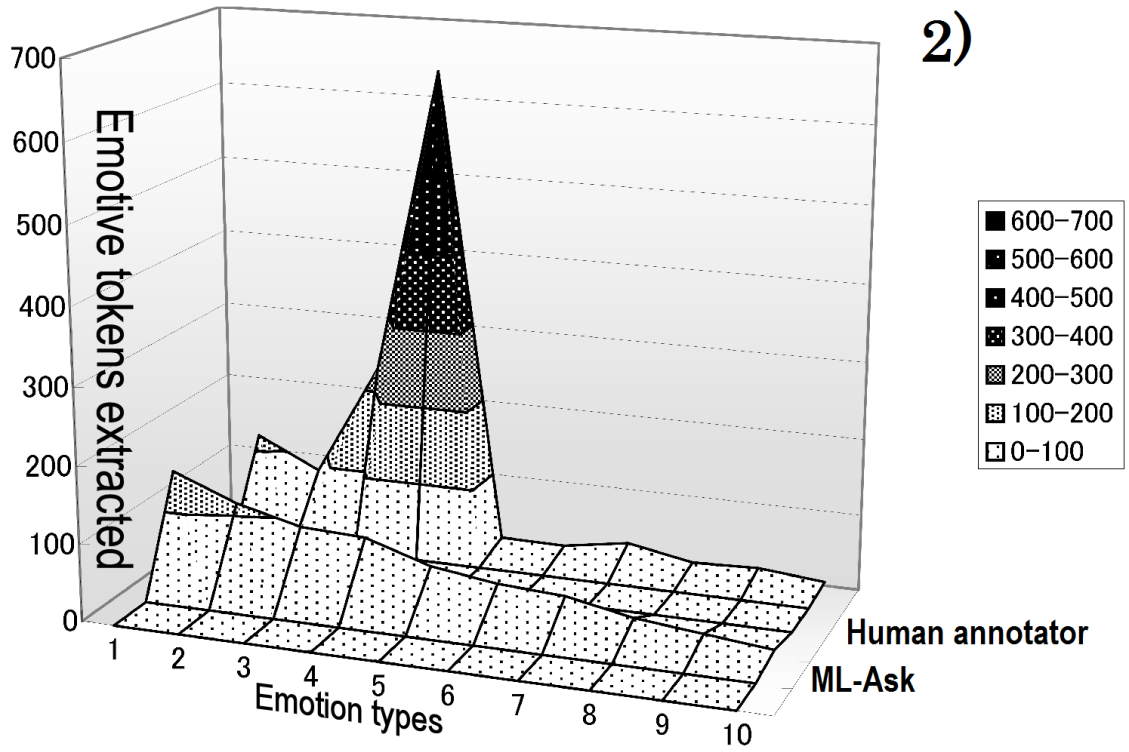
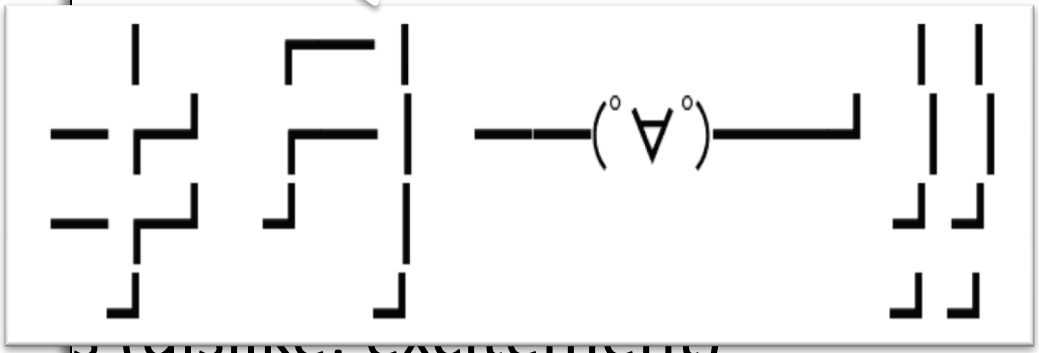
WHY?

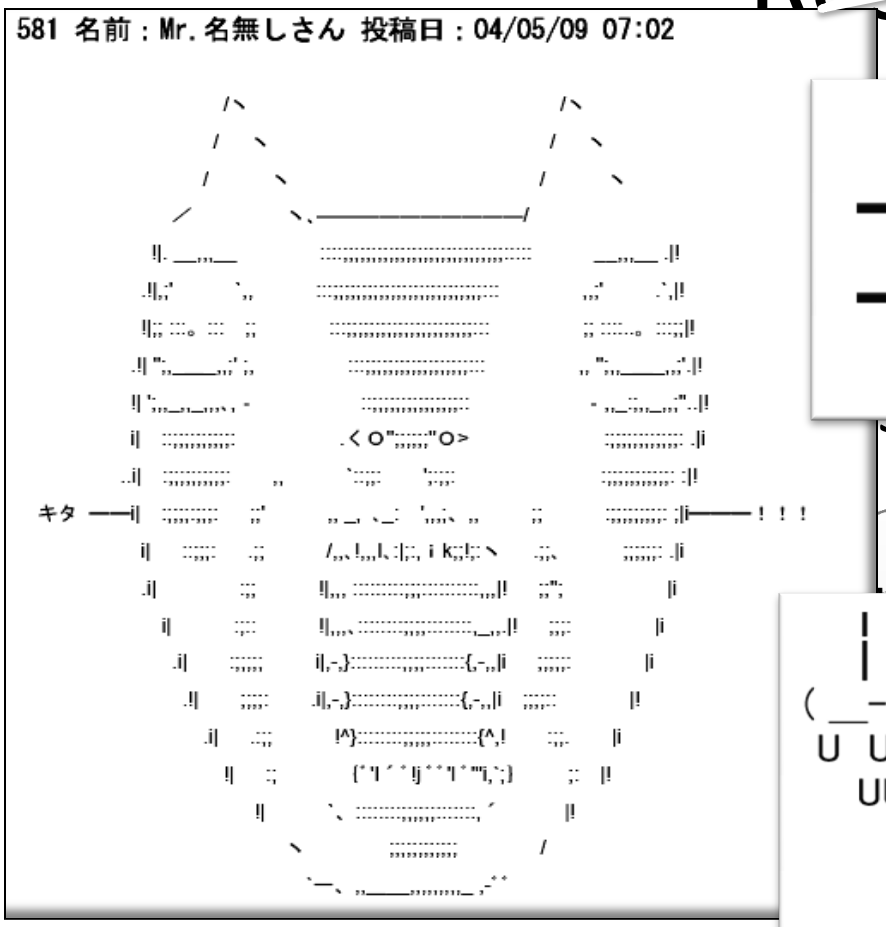
To express these two emotions in particular, *2channel* users mostly use slang (ASCII, unusual emoticons, etc. – difficult to process mechanically!).



Results

Excitement





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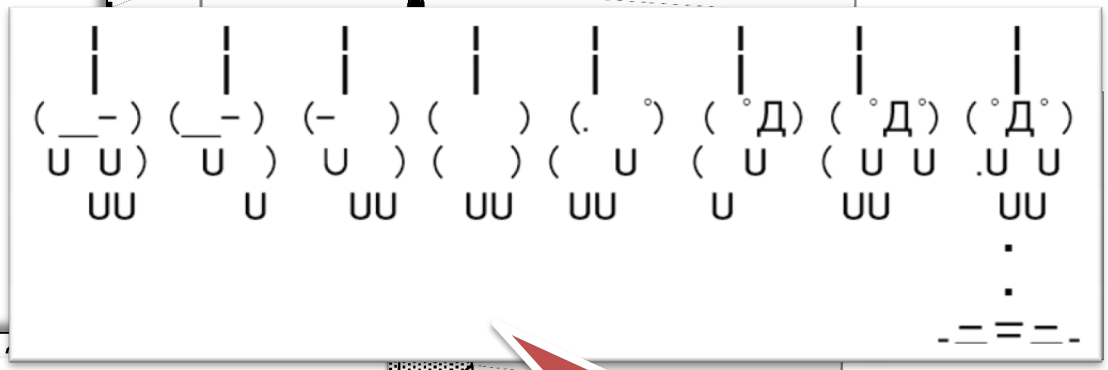
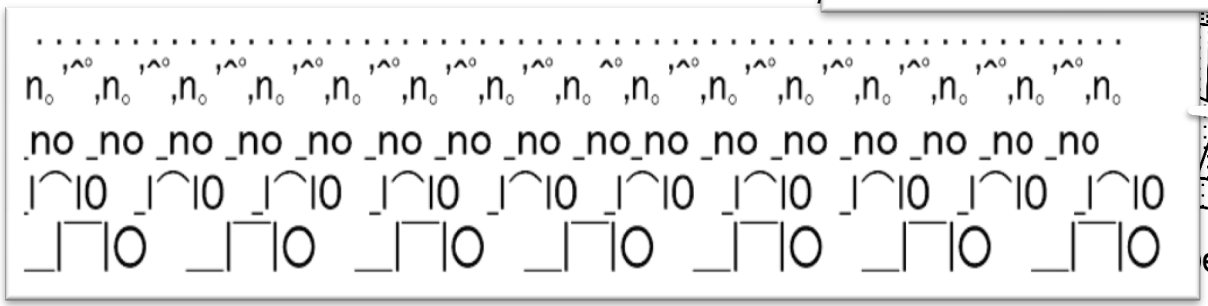
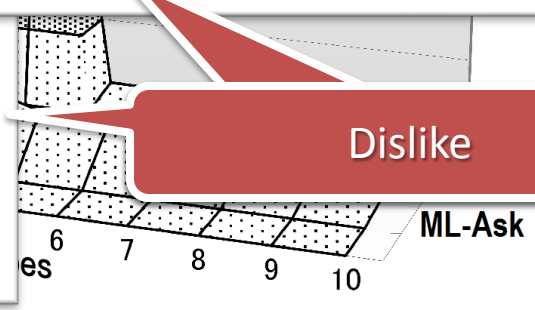




Dislike



Results

- After excluding these two emotion types:
- 90% of agreements with human annotators
- with a good strength of agreement coefficient (Kappa = .681)
- Results were very statistically significant (P value = .0035).

Conclusions

- I presented ML-Ask, a system for automatic annotation of corpora with emotive information.
  - Emotive / non-emotive – high accuracy
- I performed an annotation experiment on a large corpus (discussions from a popular Japanese forum *2channel*).
- ML-Ask was successful in providing information on tendencies of emotive utterances.
- Need to deal with emoticons

Future Work

- Updating the emotive expressions lexicon
- Statistically disambiguate emotive affiliations of emotemes (e.g. an exclamation mark would be used with ”excitement”, rather than with ”gloom”)
- Experiments including large scale annotations of other natural dialogue corpora

CAO: A System for Analysis of Emoticons

Emoticons - Definition

Emoticons:

- Emoticons are representations of body language in online communication (more-less).

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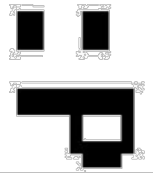

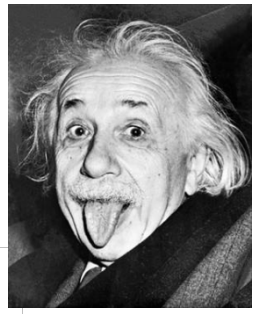

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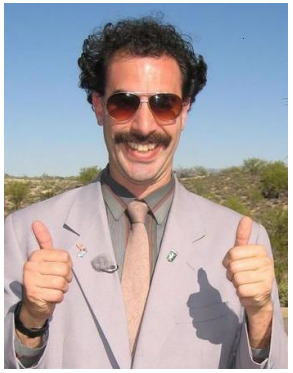

Therefore…

Emoticons - Definition

Emoticons:

- Are an important in part of communication [1,2] in online communities (blogs, forums, BBS, e-mails, chat-rooms, etc.)

1. Suzuki, N. and Tsuda, K. 2006. Automatic emoticon generation method for web community, WBC2006, pp. 331-334.
2. Derks, D., Bos, A.E.R., von Grumbkow, J. 2007. Emoticons and social interaction on the Internet: the importance of social context, Computers in Human Behavior, 23, pp. 842-849.

Emoticons - Definition

Emoticons:

- Can be roughly divided into:
  - 1-line Western (text-base or pictures)
  - 1-line Eastern
  - Multiline Eastern

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  - 1-line Eastern
  - [illegible]line Eastern

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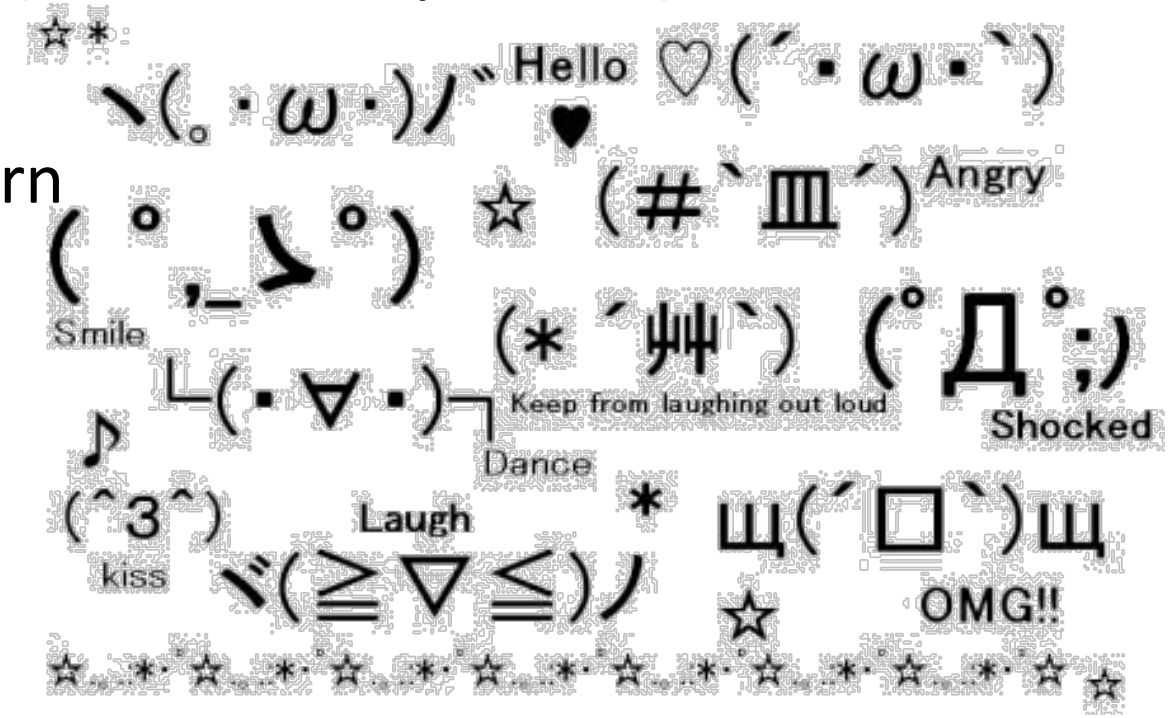

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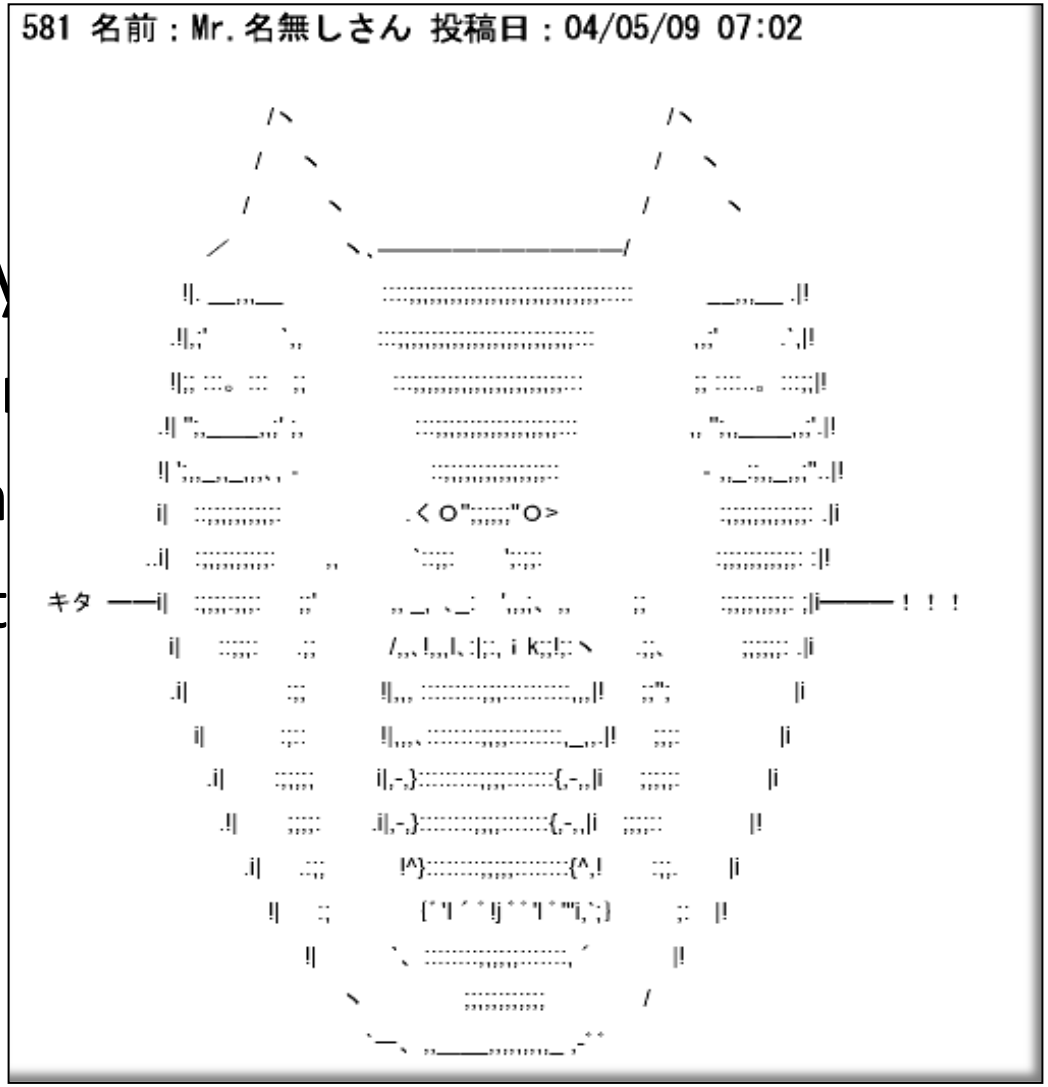

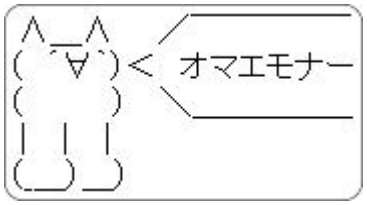

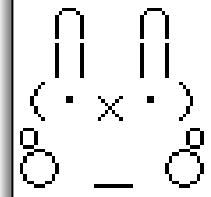

Emoticons - Definition

Emoticons:

- Can be roughly divided into:
  - 1-line Western (text-base or pictures)
  - 1-line Eastern
  - Multiline Eastern

I focused on these, because…

Emoticons - Definition

Emoticons:

- Can be roughly divided into:
  - 1-line Western
  - 1-line Eastern
  - Multiline Eastern

← **There already is some research + I was a little more ambitious**

← **This is a task for image processing**

Emoticons - Definition

Emoticons:

- Can be roughly divided into:
  - 1-line Western
  - 1-line Eastern
  - Multili[illegible] Eastern

← There already is some research + I was a little more ambitious

← This is a task for image processing

Only a little research done here

Emoticons - Definition

Some examples:

\(*^o^*)/

･ﾟ･(ﾉД`;)･ﾟ･

(;^_^A

(°.　°)

(^_-)y--~

(==╦==Д==╦==)

(｡･_･｡)人(｡･_･｡)

(＊￣―￣)

Since emoticons are representations of body language…

Emoticons - Definition

Originality!

Some examples:

\(*^o^*)/

·°·(ノД`;)·°

(;^_^A

(°.　°)

(^_-)y--~

(==╦==Д==╦

(。･_･。)人(。･_･。)

(*￣―￣)

s are

s of

...

A structural approach to body language could be applicable here as well!

Emoticons - Definition

- **Theory of kinesics:**
- Non-verbal behavior is used in everyday communication systematically and can be described structurally.
- A minimal part = a kineme, the smallest meaningful set of body movements, e.g. raising eyebrows, etc.

Birdwhistell (1952, 1970)

Birdwhistell, R. L. 1952. Introduction to kinesics: an annotation system for analysis of body motion and gesture, University of Kentucky Press.
Birdwhistell, R. L. 1970. Kinesics and Context, University of Pennsylvania Press, Philadelphia.

Emoticons - Definition

- **Theory of kinesics:**
- Non-verbal behavior is
  communication system
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- A minimal part = a kine
  meaningful set of body
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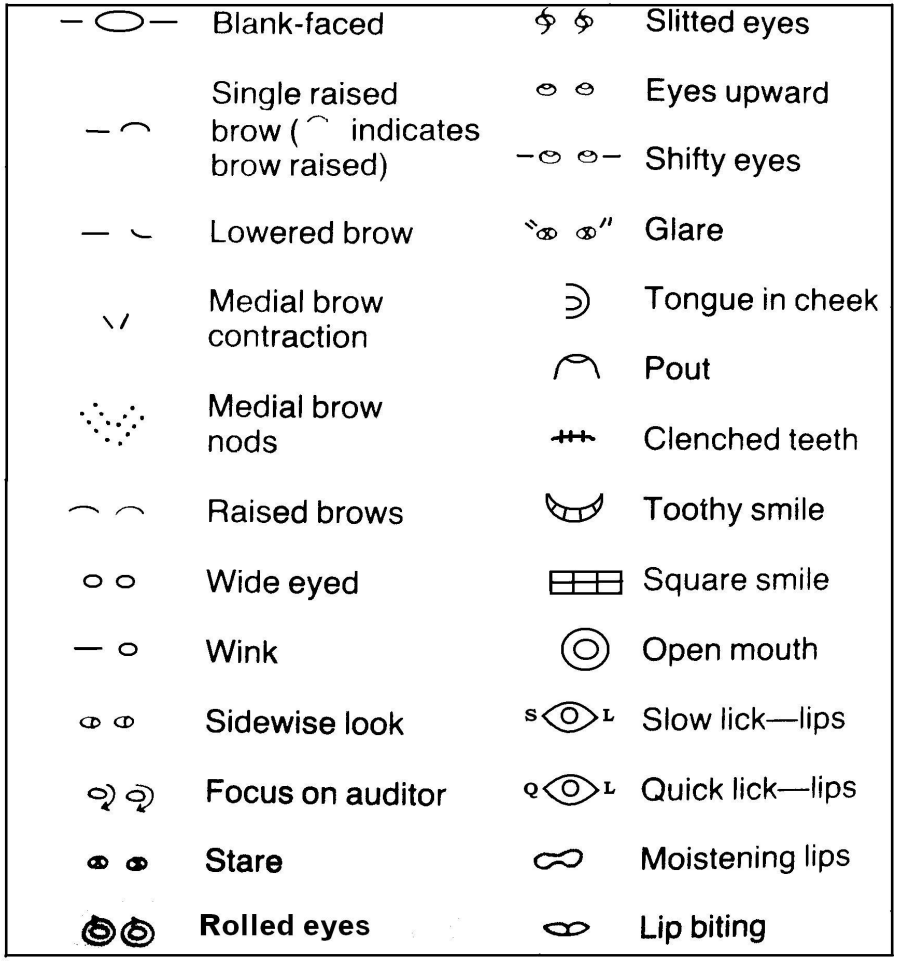
B



Birdwhistell, R. L. 1952. Introduction to kinesics: a
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Emoticons - Definition

Some examples:

\(*^o^*)/

·゜·(ノД`;)·゜·

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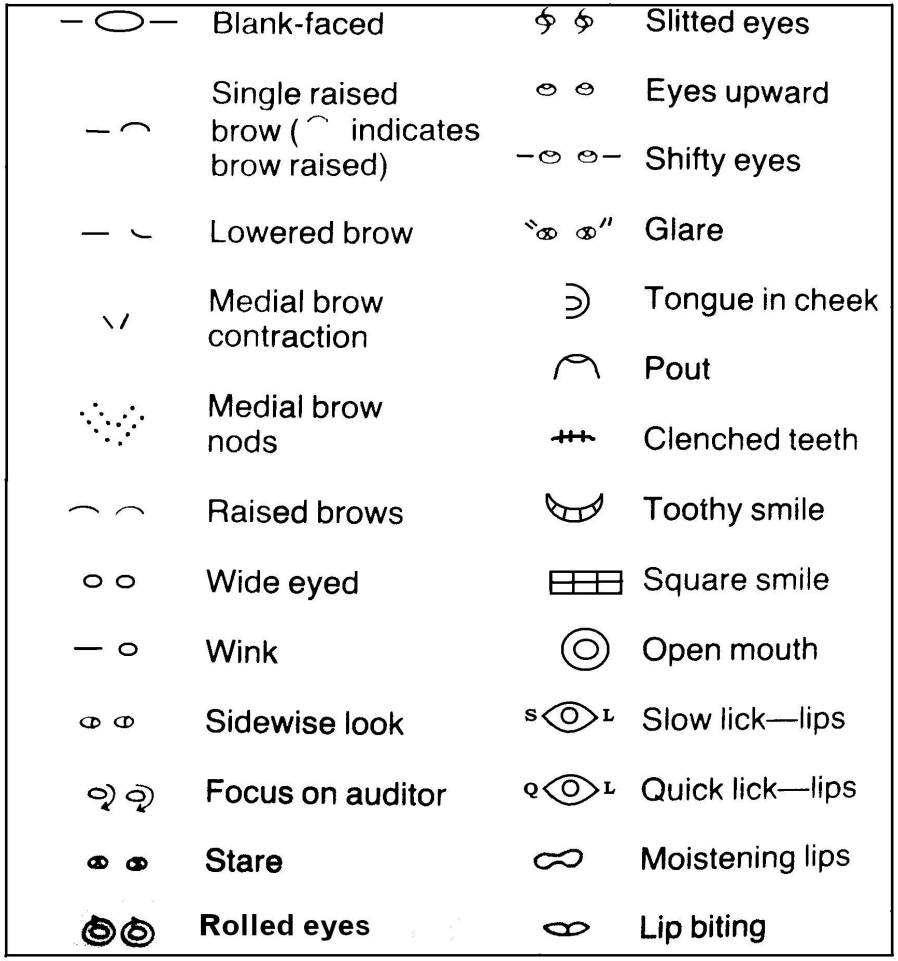
(==╦==Д==╦==)

(。・_・。)人(。・_・。)

(*　　　　　　　　　　　　　　)



Emoticons - Definition

Some examples:

\(*^o^*)/

·゜·(/Д`;)·゜·

(;^_^A

(°.　°)

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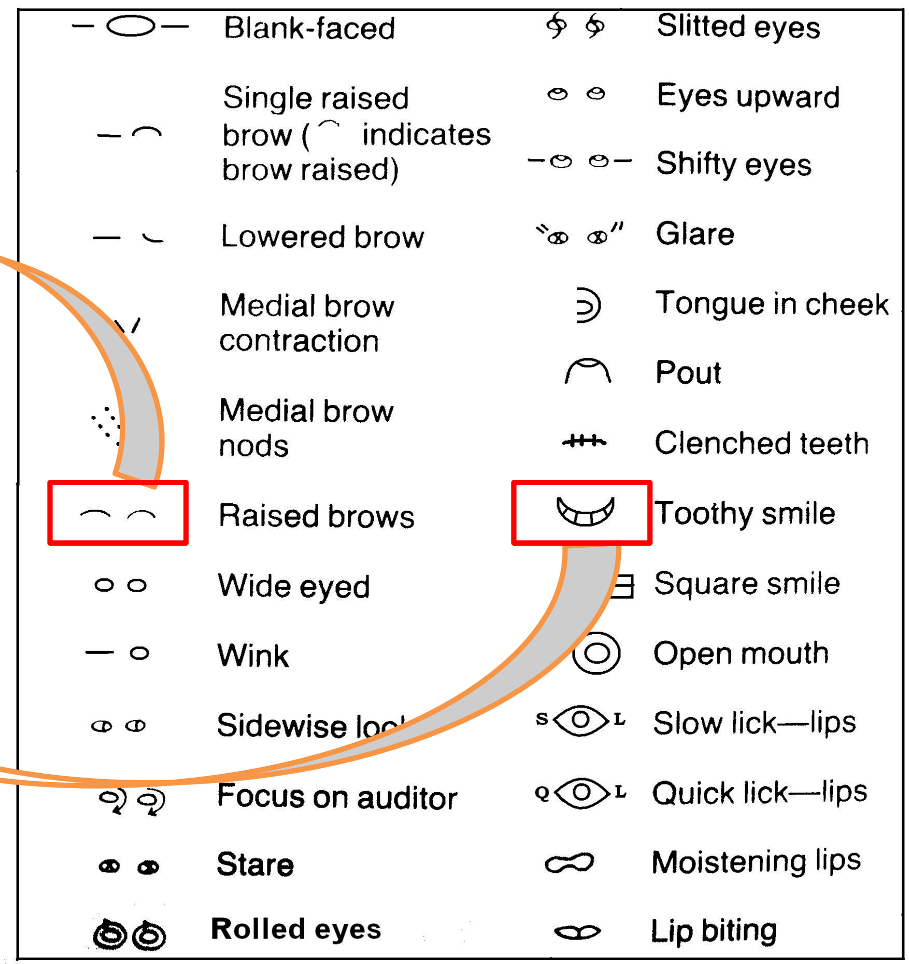
(==╦==Д==╦==)

(｡･_･｡)人(｡･_･｡)

(*￣_￣)



Emoticons - Definition

\(*^o^*)/

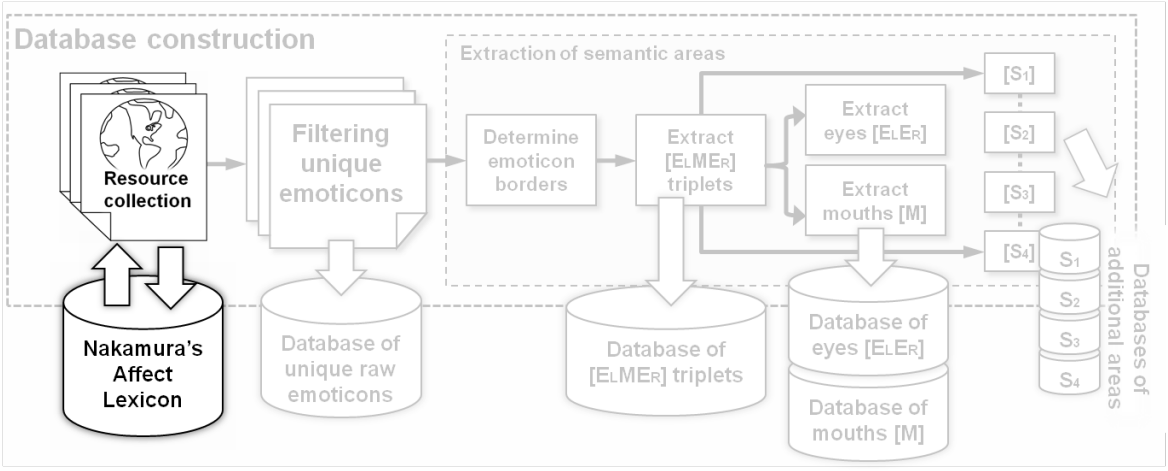
- Additional area: \
- Bracket: (
- Additional area: *
- Face: ^o^ — Eyes: ^ ^
- Additional area: * — Mouth: o
- Bracket:)
- Additional area: /

Assumption:
Emoticons could be analyzed by dividing them to areas (kinemes)!

Database Construction

- Visited 7 online emoticon dictionaries:

1. *Face-mark Party,* 2. *Kaomo-jiya,*
3. *Kao-moji-toshokan,* 4. *Kaomoji-café,*
5. *Kaomoji Paradise,* 6. *Kaomojisyo and*
7. *Kaomoji Station.*



http://www.facemark.jp/facemark.htm,
http://kaomojiya.com/,
http://www.kaomoji.com/kao/text/,
http://kaomoji-cafe.jp/, http://rsmz.net/kaopara/,
http://matsucon.net/material/dic/,
http://kaosute.net/jisyo/kanjou.shtml

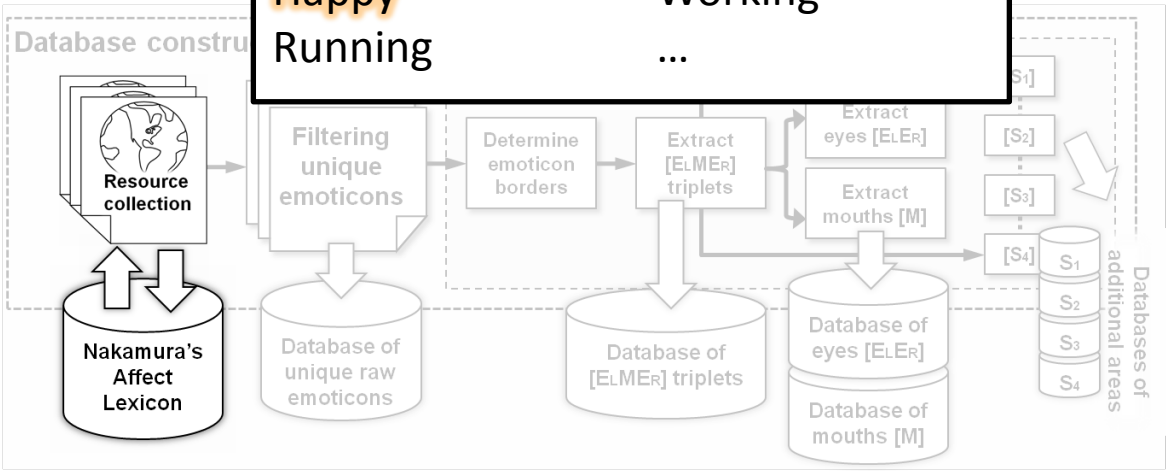
Database Construction

- Used an affect analysis system to select and categorize only emotion-related labels.

Emoticon Dictionary

Emoticon labels:

Hobbies	Screaming
Greetings	Joyful
Angry	Crying
Happy	Working
Running	…



Ptaszynski, M., Dybala, P., Rzepka, R. and Araki, K. 2009. Affecting Corpora: Experiments with Automatic Affect Annota-tion System - A Case Study of the 2channel Forum, In *Proceedings PACLING-09, pp. 223-228.*

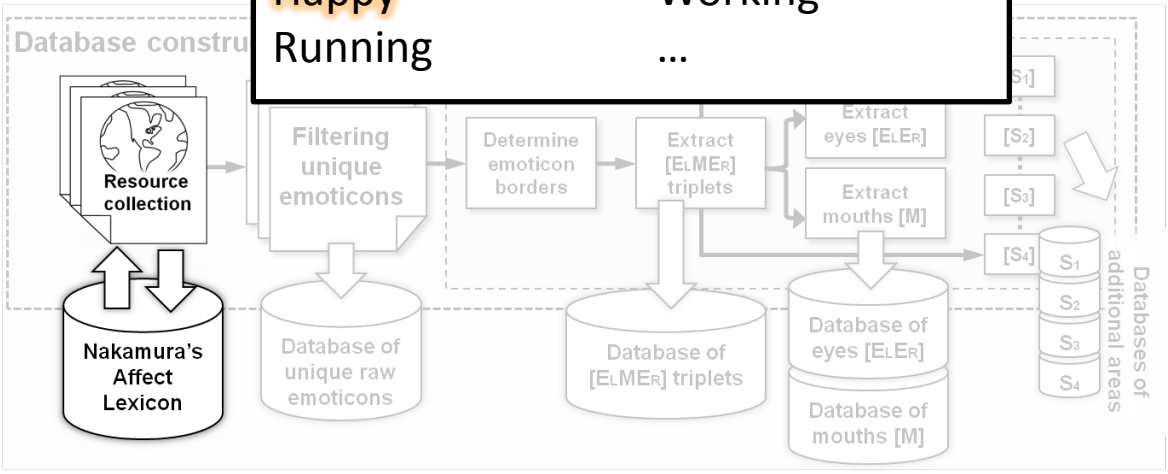
Database Construction

- Used an affect analysis system to select and categorize only emotion-related labels.
- Extract emoticons only from labels related to emotions

Emoticon Dictionary

Emoticon labels:

Hobbies	Screaming
Greetings	Joyful
Angry	Crying
Happy	Working
Running	…



\(*^o^*)/

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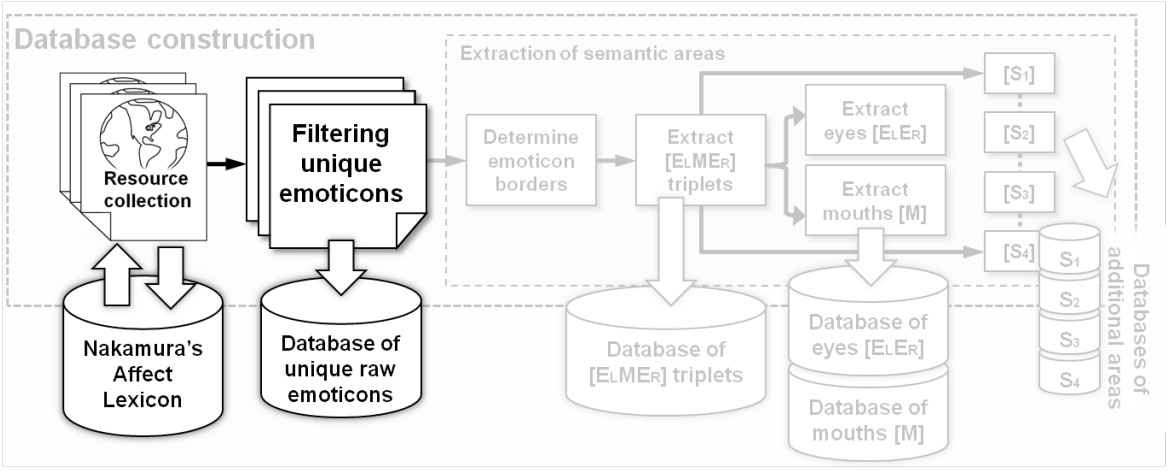
Database Construction

- Obtained 10,137 unique emoticons classified with emotion types.

joy, delight	liking, fondness	anger	surprise, amazement	sadness, gloom	excite-cite-ment	dis-like	shame, shyness	fear	relief	Over-all	Emoticons
3128	1988	1238	1227	1203	1124	704	526	179	99	**11416**	All extracted
1972	1972	1221	1196	1169	1120	698	511	179	99	**10137**	Unique
63%	99%	99%	97%	97%	99%	99%	97%	100%	100%	**89%**	Ratio

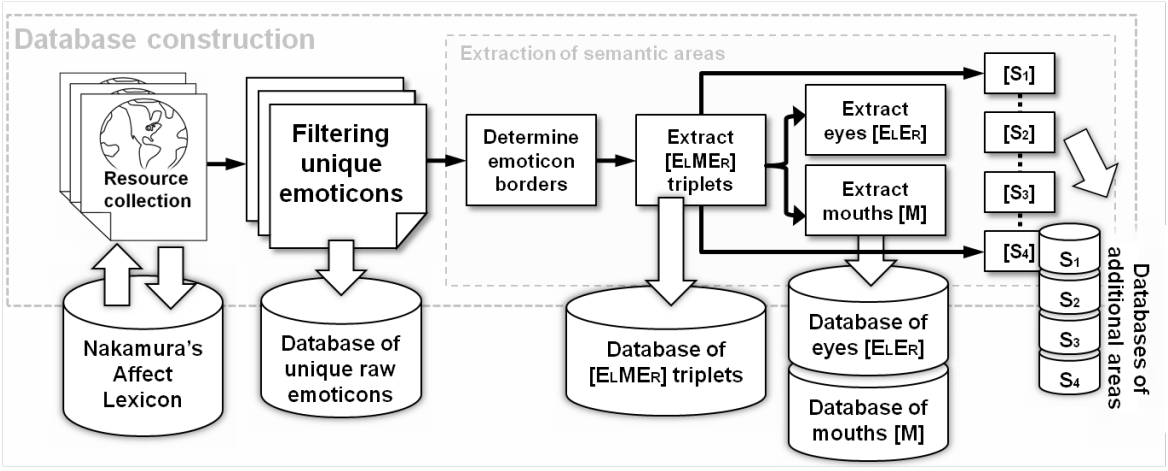
\(*^o^*)/



Database Construction

- Automatically divide emoticons into:
  - Eyes [E]: ^ ^
  - Mouths [M]: o
  - Additional areas (inside emoticon) [S]: * *
  - Additional areas (outside emoticon) [S]: \ /

\(*^o^*)/



Database Construction

- We have a set of databases!
  - Raw emoticons
  - Triplets (E-M-E)
  - Eyes (E-E)
  - Mouths (M)
  - Additional (S)

\(*^o^*)/

joy, delight	liking, fondness	anger	surprise, amazement	sadness, gloom	excite-cite-ment	dis-like	shame, shyness	fear	relief	Over-all	Emoticons
3128	1988	1238	1227	1203	1124	704	526	179	99	**11416**	All extracted
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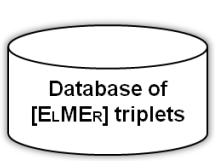
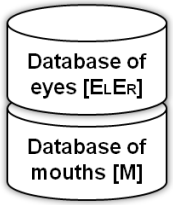
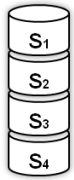
63%	99%	99%	97%	97%	99%	99%	97%	100%	100%	**89%**	Ratio

areas	$E_L M E_R$	S_1	B_1	S_2	E_L E_R	M	S_3	B_2	S_4
joy, delight	1298	1469	--	653	349	336	671	--	2449
anger	741	525	--	321	188	239	330	--	1014
sadness,	702	350	--	303	291	170	358	--	730
fear	124	72	--	67	52	62	74	--	133
shame, shyness	315	169	--	121	110	85	123	--	343
liking, fondness	1079	1092	--	802	305	239	805	--	1633
dislike	527	337	--	209	161	179	201	--	562
excitement	670	700	--	268	243	164	324	--	1049
relief	81	50	--	11	38	26	27	--	64
surprise, amazement	648	405	--	231	183	154	279	--	860
overall	**6185**	**5169**	**--**	**2986**	**1920**	**1654**	**3192**	**--**	**8837**

Already annotated with emotion types!





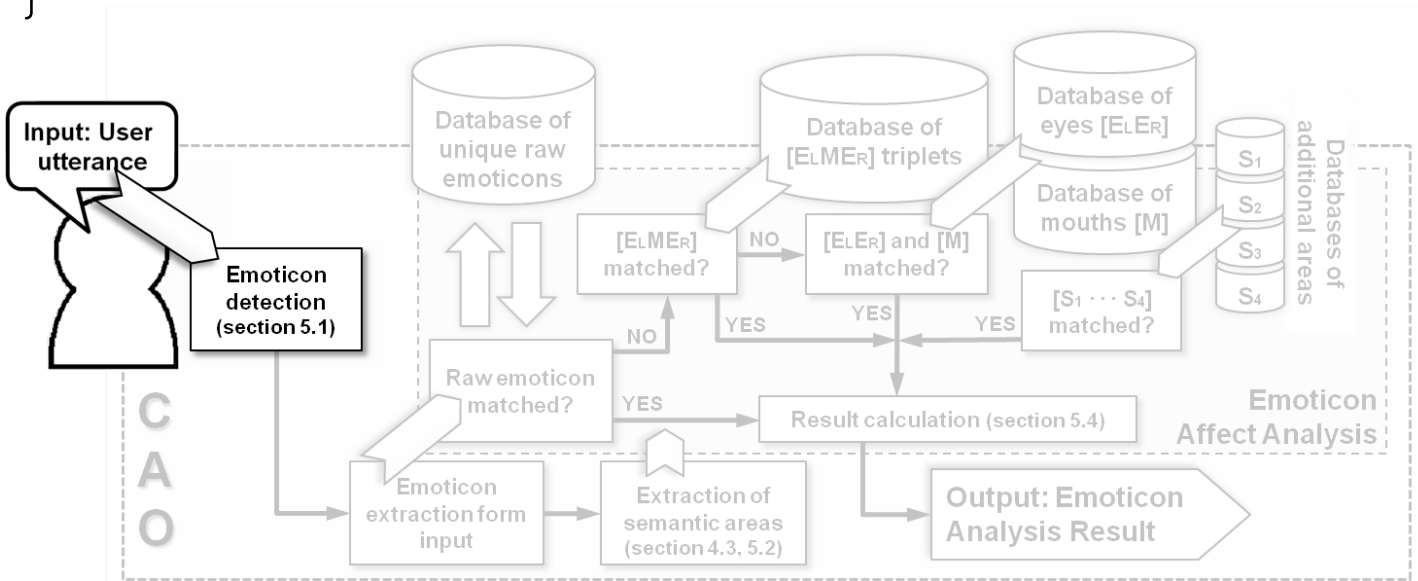


CAO – Emoticon Analysis System

- Constructed CAO system for emoticon analysis with these databases.

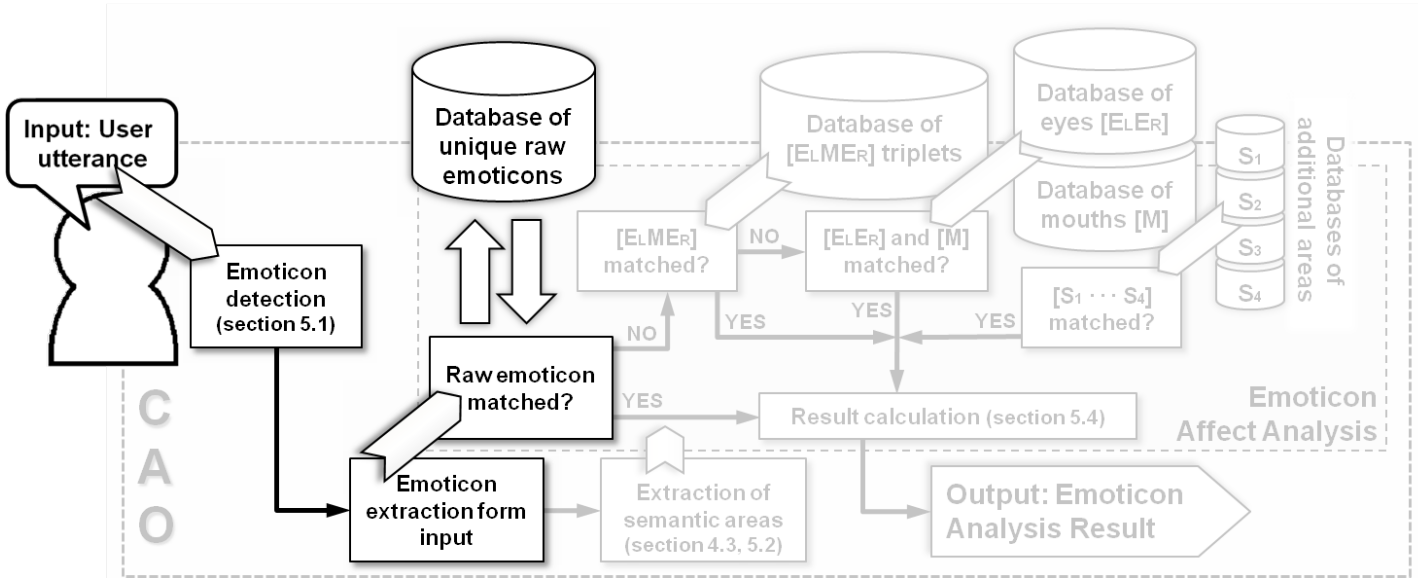
CAO – Emoticon Analysis System

- Emoticon detection in (any) input
  - Use 455 characters most frequently (>10 times) appearing in emoticons ($x_1, x_2, \ldots x_{455}$)
  - `If (any three x appear in a row) { there is an emoticon in input }`



CAO – Emoticon Analysis System

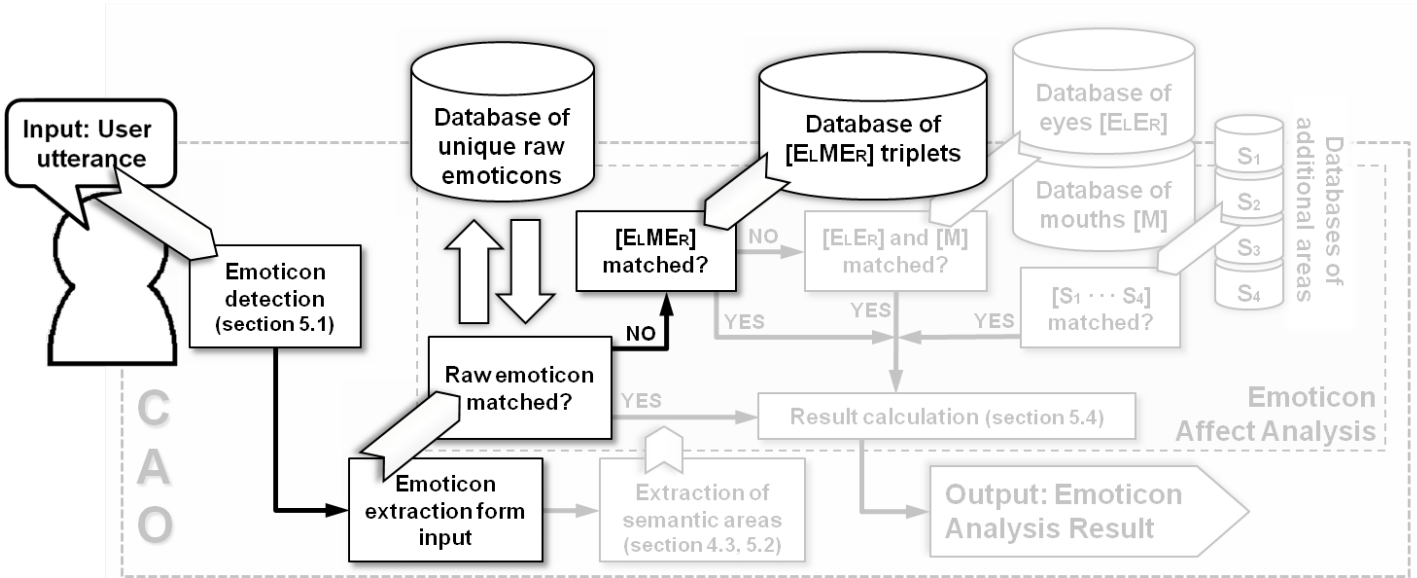
- Emoticon extraction from input (+ affect analysis)
  - Three steps:
    1. Looking for a “raw” emoticon (+checking emotion labels)



CAO – Emoticon Analysis System

- Emoticon extraction from input (+ affect analysis)
  - Three steps:
    1. Looking for a “raw” emoticon (+checking emotion labels)
    2. Looking for a triplet (+checking emotion labels)

If no “raw” emoticon

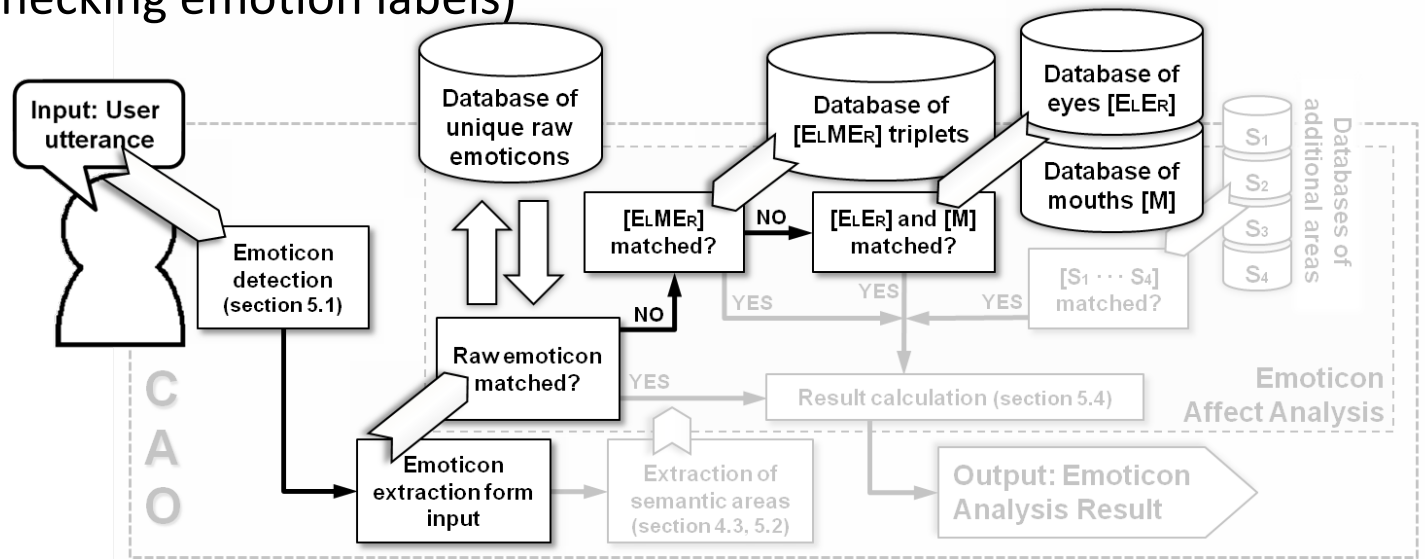


CAO – Emoticon Analysis System

- Emoticon extraction from input (+ affect analysis)
  - Three steps:
    1. Looking for a “raw” emoticon (+checking emotion labels)
    2. Looking for a triplet (+checking emotion labels)
    3. Checking all combinations of triplets (eyes x mouth*) (+checking emotion labels)

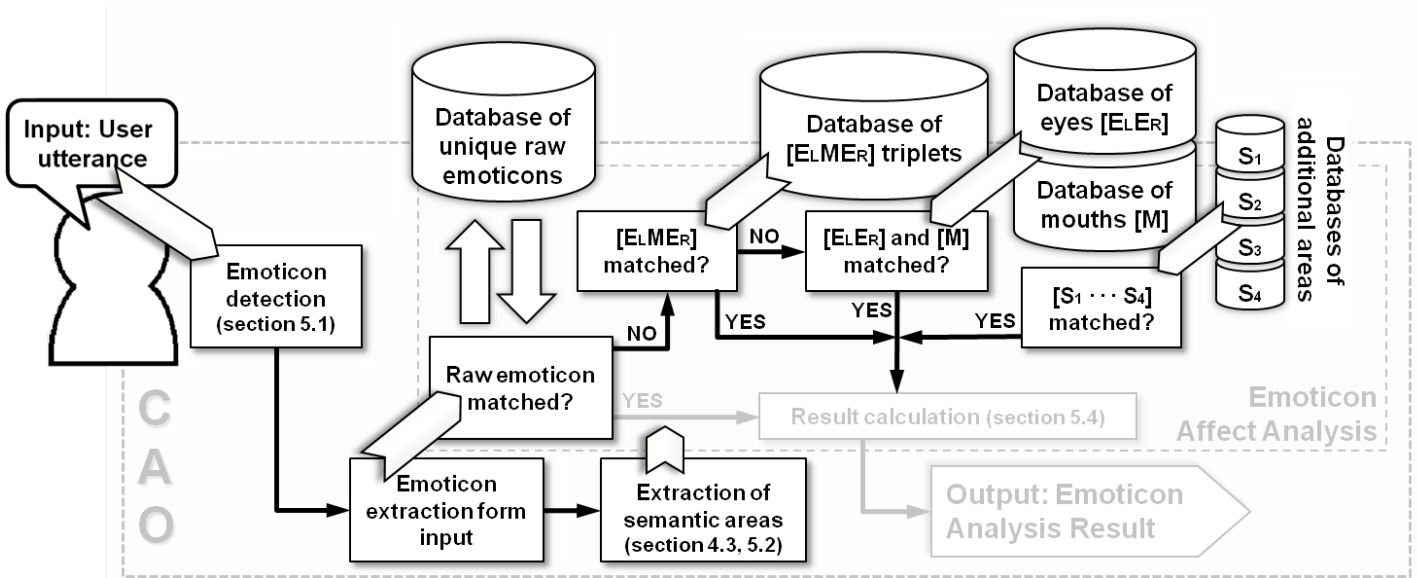
If no triplet

*)Eyes=1,920
Mouths=1,654
All combinations:
ExM=3,175,680



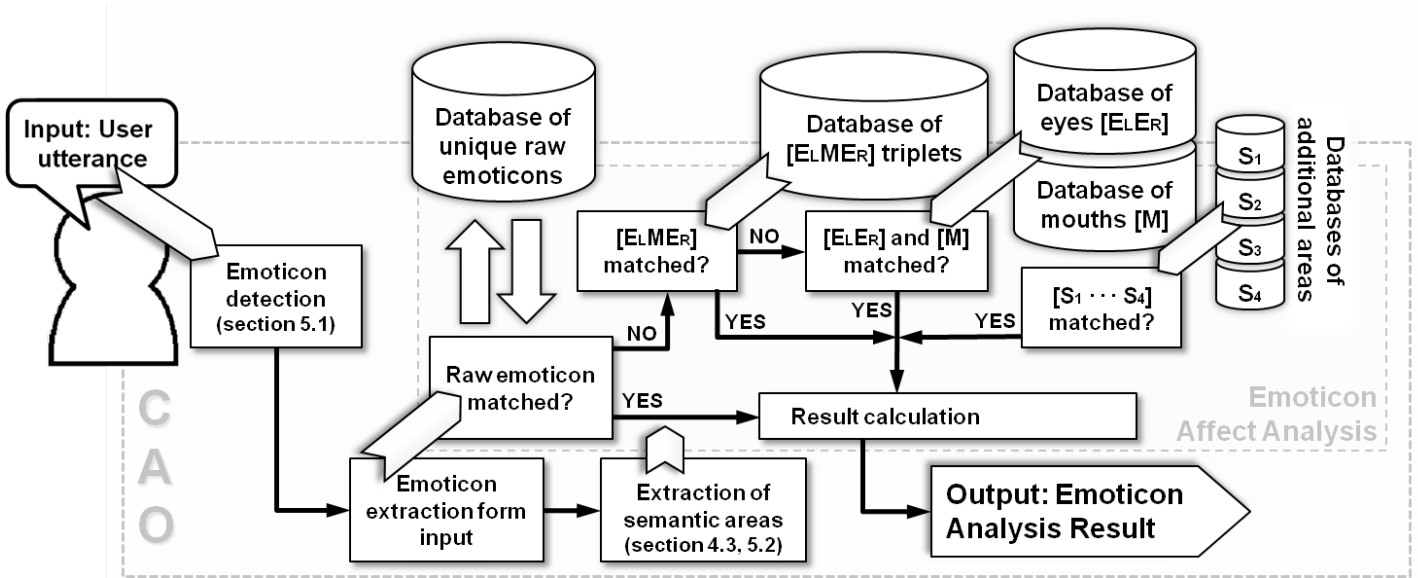
CAO – Emoticon Analysis System

- Emoticon extraction from input
  - Finally:
    - Extract additional areas (+checking emotion labels)



CAO – Emoticon Analysis System

- Emoticon extraction from input
  - Finally:
    - Extract additional areas (+checking emotion labels)
  - Summarize scores (to determine emotion types statistically most probable for this emoticon)



Evaluation of CAO

- Test set
  - A large corpus of blogs from: Ameba Blog*
  - Over 350 million sentences in Japanese
  - Many text-base emoticons on Ameba, less pictures （顔文字＞絵文字）

*) ameblo.jp

Evaluation of CAO

- Randomly extracted 1000 middle-sized* sentences as the test set
  - 418 of those sentences included text-base emoticons.
    - annotate emoticons from the sentences (different samples than in sentences)
      Question: What emotion could be expressed with this emoticon?
    - Answers (emotion type, random order): *a) System's; b) Similar**; c) Completely different; d) Other (from the seven remaining);*

Test Set Gold standard

*)20-50 characters in Japanese **) From the same affect space in two-dimensional model of affect

Evaluation of CAO

- Results

Detection			
		System	
		Emoticon	No emoticon
Users	Emoticon	394	24
	No emoticon	0	582
No. of agreements=976 (97.6%), Kappa=0.95			

In 24/418 cases there were no 3 usual chars in a row

Evaluation of CAO

- Results

Extraction		
R	P	F-score
94.3%	100%	97.1%
$(\frac{394}{418})$	$(\frac{394}{394})$	$2\frac{P*R}{P+R}$

Errors only for the undetected emoticons

Evaluation of CAO

- Results
- Emotion Estimation on Separate Emoticons
  - Emotion types: 93.54%

Accuracy in determining probable emotion types a certain emoticon could be used to express

Conclusions

- Presented a prototype system for automatic affect analysis of Eastern type emoticons, CAO.
- Inspired by Theory of Kinesics
- Gathered database of +10,000 emoticons and (almost) automatically expanded it to +3 mln.

Conclusions

- CAO is capable of:
  - Detecting emoticons in any input
  - Extracting emoticons form input
  - Dividing emoticons into semantic areas (eyes, mouths, etc.)
  - Estimating potential emotion types expressed by emoticons.
- CAO got almost ideal results in all tasks.

Future Work (CAO)

Possible applications:

- Affect analysis/annotation of corpora
- Emotion detecting in online communication
  - Support for Internet messengers, blog services, forums, etc.
- Sentiment analysis (when looking only at valence)
- Detecting irony*

*) Carvalho, P., Sarmento, L., Silva, M. J., and de Oliveira, E. 2009. Clues for detecting irony in user-generated contents: oh..!! it's "so easy" ;-). In Proceeding of the 1st international CIKM Workshop on Topic-Sentiment Analysis For Mass Opinion (Hong Kong, China, November 06 - 06, 2009)

Application of Emotive Information in Human-Computer Interaction

How to improve HCI?

- Development
  - Make evaluation methods more efficient
  - …
- Performance
  - Make Appearance more natural
  - Make machine more aware of user behavior

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  - Make evaluation methods more efficient
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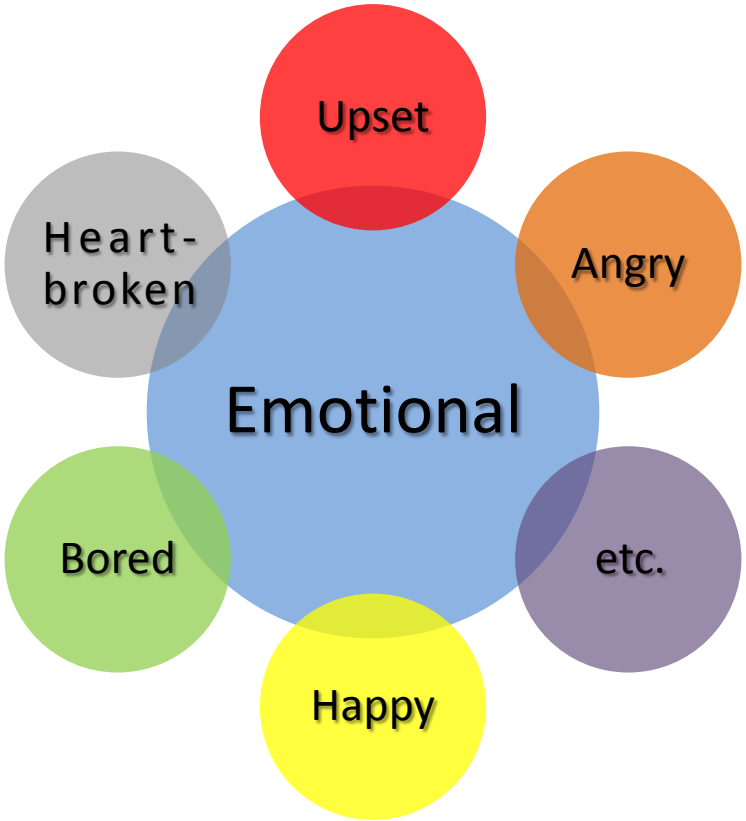
Method of Verifying Contextual Appropriateness of Emotion

Method of Verifying Contextual Appropriateness of Emotion

When do we need to talk?



What do we expect?

Emotion Management

- Sympathy / Empathy
- Consolation
- Cheer
- Praise
- Counsel
- etc.

Method of Verifying Contextual Appropriateness of Emotion

When do we need to talk?

What do we expect?

A conversational agent with emotional intelligence could help people manage their emotions!

Method of Verifying Contextual Appropriateness of Emotion

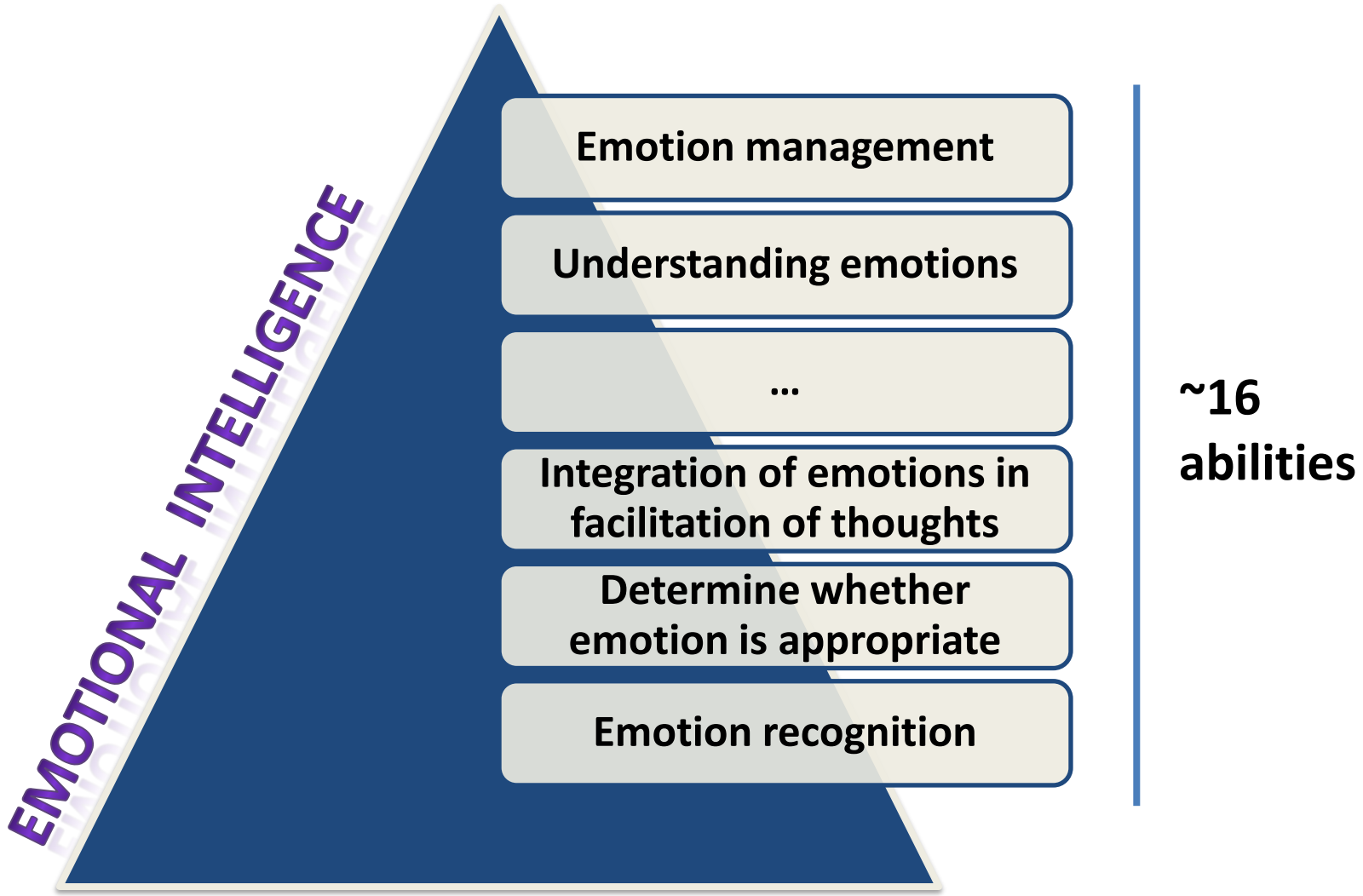
Emotional Intelligence

1990. Peter Salovey & John D. Mayer – **Emotional Intelligence** [1]

The ability to recognize emotions, to discriminate among them and to use it to guide one's thinking and actions.

1. Salovey, P. & Mayer, J.D. (1990) "Emotional intelligence" Imagination, Cognition, and Personality, 9, 185-211

Method of Verifying Contextual Appropriateness of Emotion



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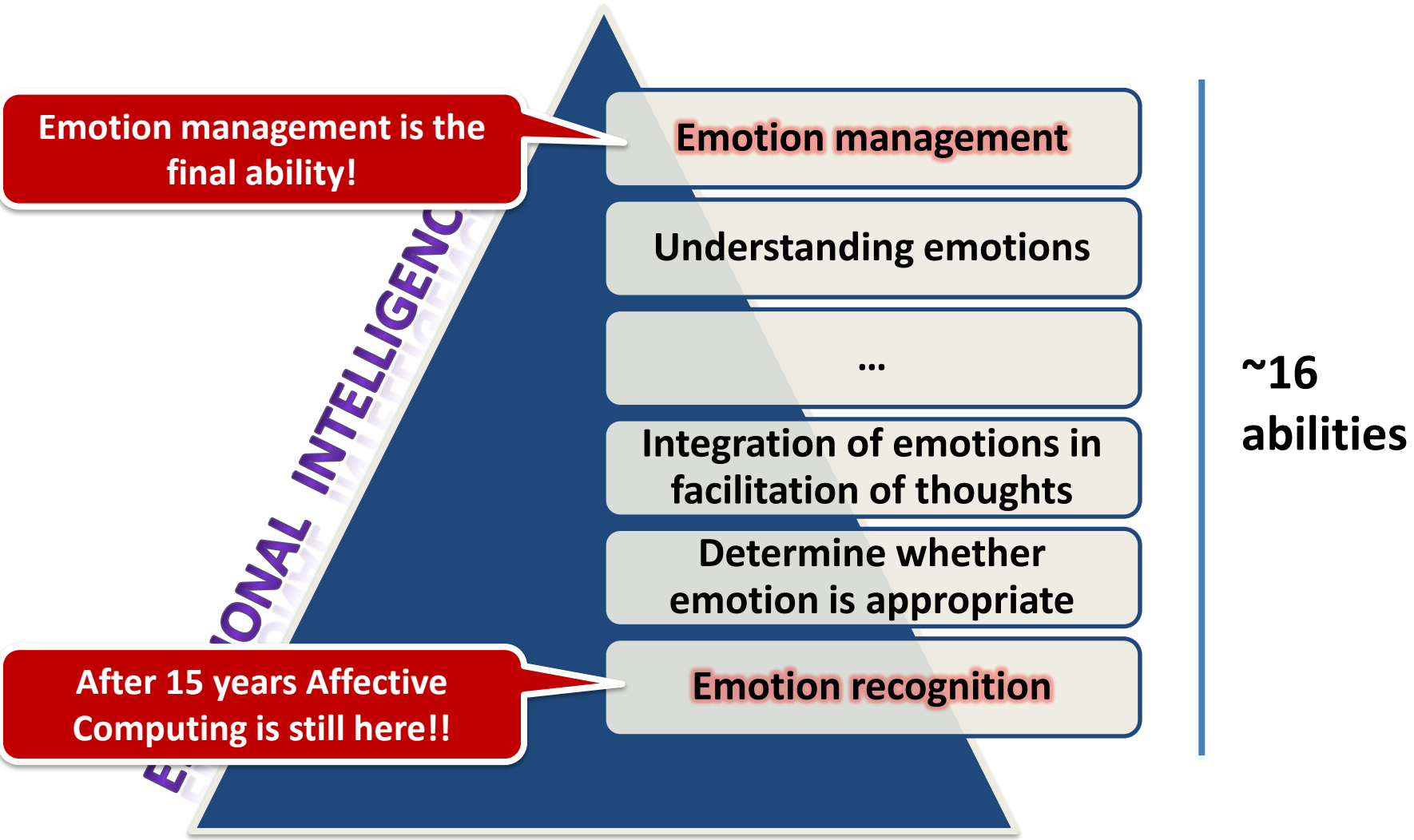

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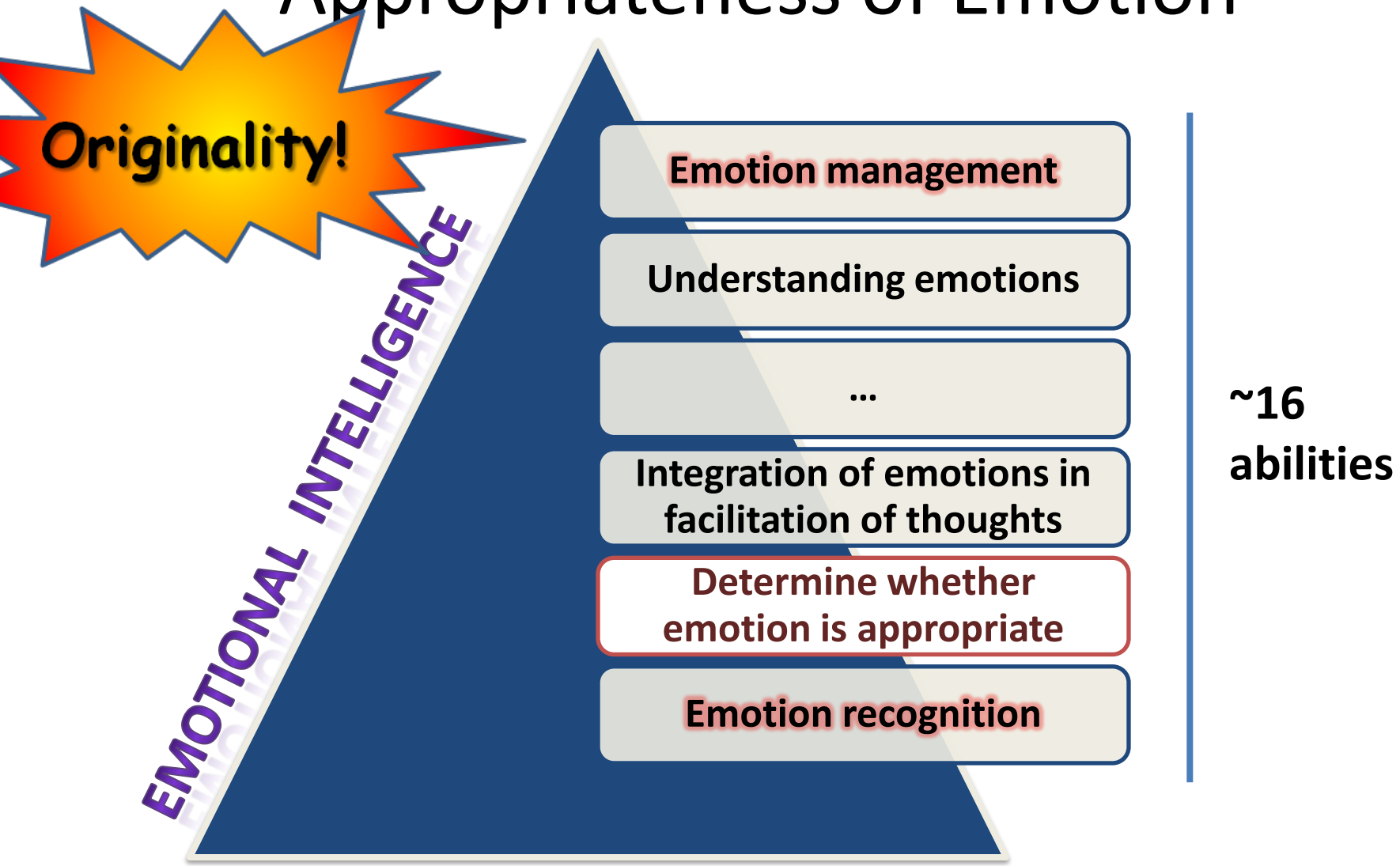


Contextual Appropriateness of Emotions

ML-Ask and CAO provide information on the expression of emotion in utterance.

- うれしい！
  “Oh, I’m so happy! (^o^)” [joy, happiness]

- 悲しいよ…
  “Oh, I’m so depressed… ･ﾟ･(ノД`;)･ﾟ･” [depression]

Contextual Appropriateness of Emotions

- 試験に合格してうれしい！ [joy, happiness]
  “Oh, I’m so happy (because) I passed the exam!”

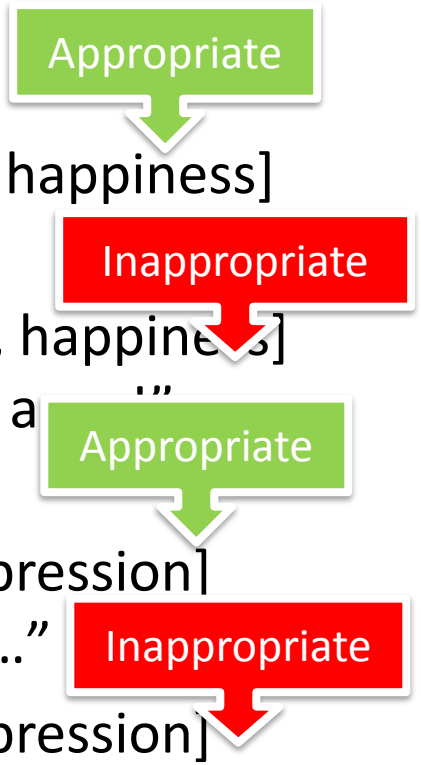
- 彼女に振られて悲しい… [depression]
  “Oh, I’m is so depressed (because) my girlfriend left…”

Contextual Appropriateness of Emotions

- 試験に合格してうれしい！ [joy, happiness]
  “Oh, I’m so happy (because) I passed the exam!”
- あの野郎が車に引かれたと聞いてすっきり！ [joy, happiness]
  “Oh, I’m so happy (because) that bastard was hit by a car!”

- 彼女に振られて悲しい… [depression]
  “Oh, I’m is so depressed (because) my girlfriend left…”
- バレンタイン・デーが来るから悲しいね… [depression]
  “Oh, I’m so depressed (because) the Valentine’s Day is coming…”

Contextual Appropriateness of Emotions



- 試験に合格してうれしい！ [joy, happiness]
  “Oh, I’m so happy (because) I passed the exam!”
- あの野郎が車に引かれたと聞いてすっきり！ [joy, happiness]
  “Oh, I’m so happy (because) that bastard was hit by a [illegible]”
- 彼女に振られて悲しい… [depression]
  “Oh, I’m is so depressed (because) my girlfriend left…”
- バレンタイン・デーが来るから悲しいね… [depression]
  “Oh, I’m so depressed (because) the Valentine’s Day is coming…”

Contextual Appropriateness of Emotions

[Expression of emotion] [causal form] [**cause of emotion**]

cause of emotion = context of expression of emotion
makes the expression either Appropriate or Inappropriate

Contextual Appropriateness of Emotions

– "Oh, I'm so happy (because) I passed the exam!" [joy, happiness],
試験に合格してうれしい！

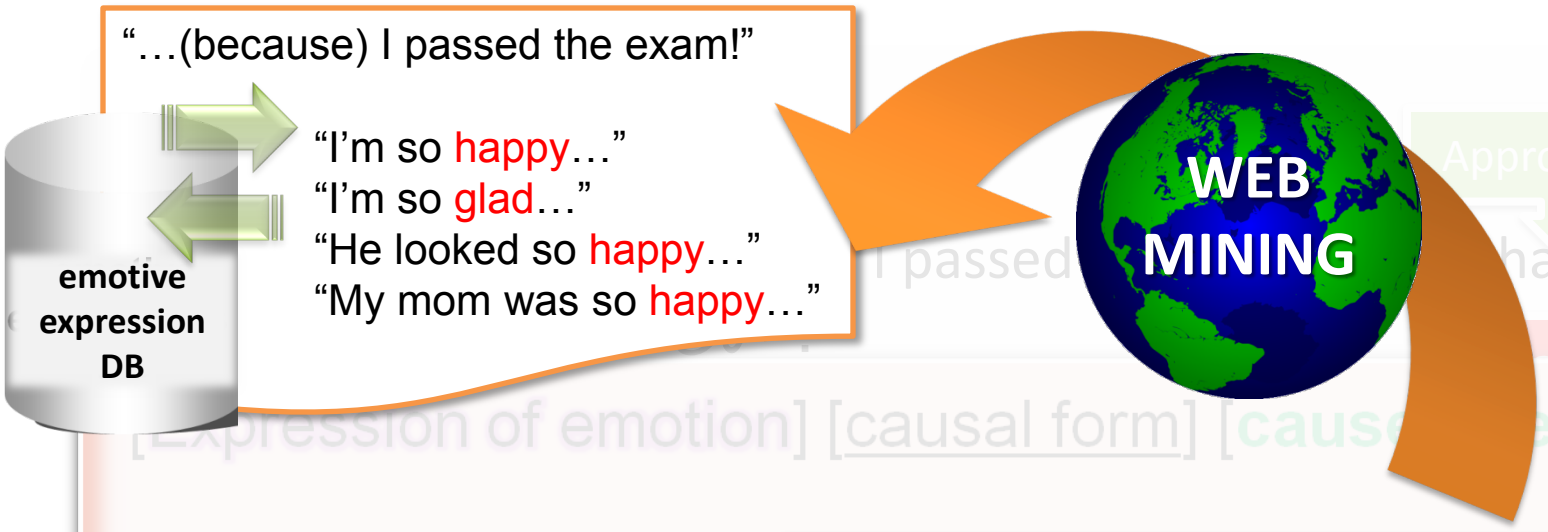
[Expression of emotion] [causal form] [cause of emotion]

cause of emotion = context of expression of emotion
makes the expression either Appropriate or Inappropriate

Original utterance	*Aa, pasokon ga kowarete shimatta…* (Oh no, the PC has broken…)
longest n-gram (here: hexagram)	*Aa* [interjection] *pasokon* [noun] *ga* [particle] *kowareru* [verb] *te* [verb connector] *shimau* [perfect form]
pentagram	*pasokon ga koware te shimau*
tetragram	*Aa, pasokon ga kowareru*
trigrams	*pasokon ga kowareru* / *koware te shimau*

– Oh, I'm so depressed (because) the Valentine's Day is Inappropriate
バレンタインデーが来るのが悲しいな… [depression]

Contextual Appropriateness of Emotions

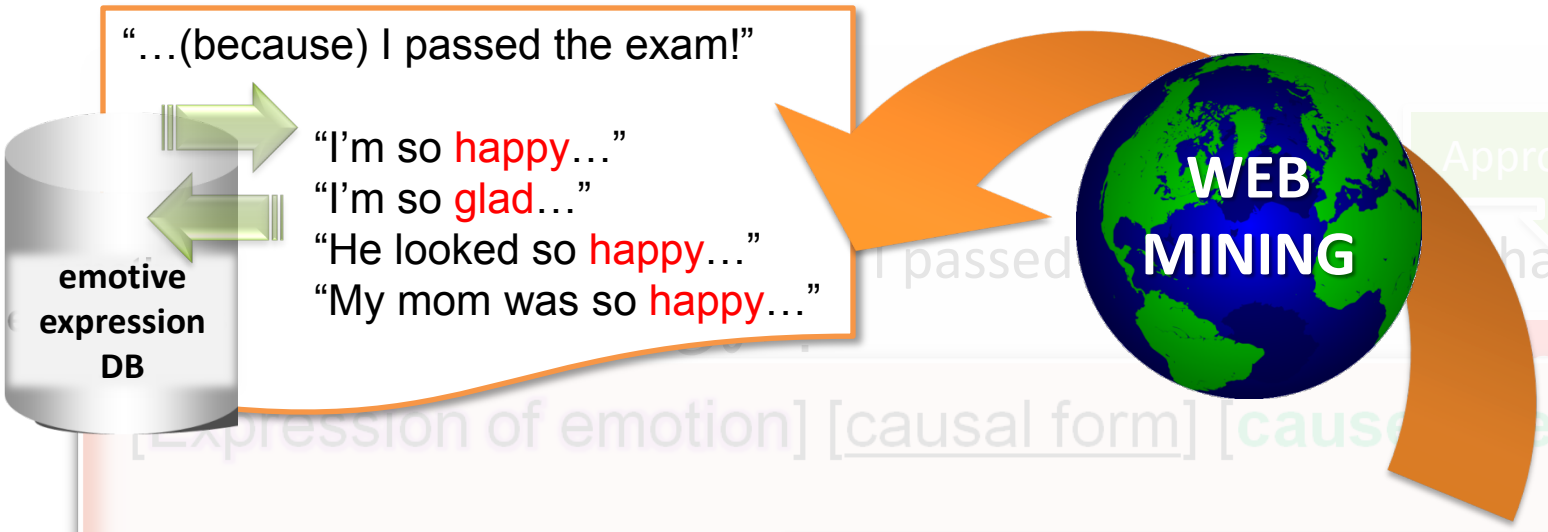


context of expression of emotion

Original n-gram	*pasokon ga koware te shimau*
n-gram phrase adjusting (morpheme modification) / *-te* /	*pasokon ga koware te shima- tte*
/ *-to* /	*pasokon ga koware te shimau to*
/ *-node* /	*pasokon ga koware te shimau node*
/ *-kara* /	*pasokon ga koware te shimau kara*
…	…

morphemes of causality:
-te, -to, -node, -kara, -tara

Contextual Appropriateness of Emotions



context of expression of emotion

Take 50% of results

Sentence: *Aa, pasokon ga kowarete shimatta…* (Oh no, the PC has broken…)

Extracted emotion type	Type extracted / all extracted types	Ratio
[fear]	28/133	0.210526315789474
[sorrow, sadness]	26/133	0.195488721804511
[dislike, detestation]	16/133	0.120300751879699
[liking, fondness]	14/133	0.105263157894737
[relief]	12/133	0.090225563909774
[excitement]	11/133	0.082706766917293
[joy, delight]	10/133	0.075187969924812
[surprise, amazement]	9/133	0.067669172932330
[anger]	5/133	0.037593984962406
[shame, shyness, bashfulness]	2/133	0.015037593984962

List of emotions appearing most often = appropriate /natural/ for this context

Originality!

al Appropriateness of Emotions

"…(because) I passed the exam!"

emotive expression DB

"I'm so happy…"
"I'm so glad…"
"He looked so happy…"
"My mom was so happy…"

context of expression of emotion

List of emotions appearing most often = appropriate /natural/ for this context

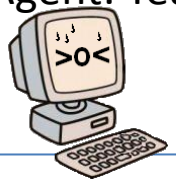
Confront expression from the sentence with the list

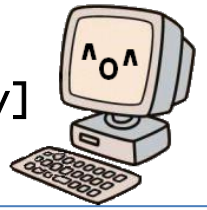
"I'm so happy (because) I passed the exam!"

Contextual Appropriateness of Emotions

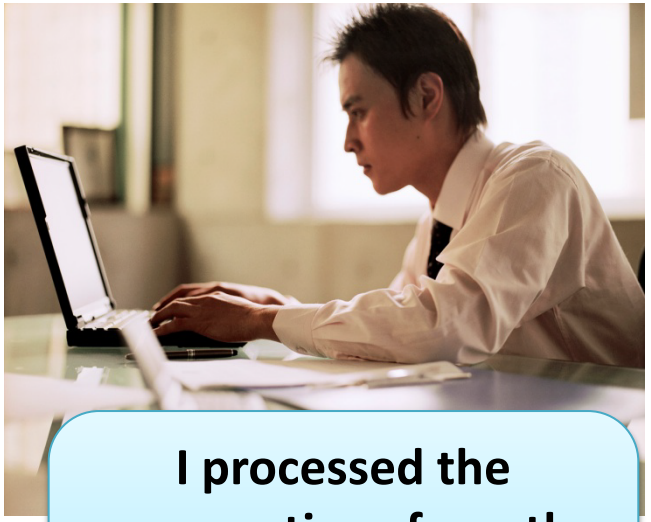
	Negative	Positive
Appropriate	User: I hate him for making a fool of me in front of everyone. **ML-Ask:dislike;** **Web mining:anger, dislike** Agent: Yeah, you have a reason to be angry. **[empathy]**	User: I'm so happy I passed the exam! **ML-Ask:joy;** **Web mining:joy, excitement** Agent: Yeah! That's great! **[sympathy]**
Inappropriate	User: I'm so depressed because St. Valentines day is coming. **ML-Ask:dislike, depression;** **Web mining:excitement, joy** Agent: You should be happy! **[consolation]**	User: I'd be happy if that bastard was hit by a car! **ML-Ask:joy;** **Web mining:fear, sadness** Agent: Are you sure this is what you really feel? **[counsel]**

…or 4 situations, when using 2D Affect Model





Evaluation experiment



- 13 user-participants
- 2 conversational agents
  - Modalin: modality[1]
  - Pundalin: modality + puns[2]
- 10-turn conversation
- 26 conversations (6 had no specified emotions) -> 20 conversation sets
- affect analysis, verification

I processed the conversations from the previous experiment with this method.

1) Shinsuke Higuchi, Rafal Rzepka and Kenji Araki. *A Casual Conversation System Using Modality and Word Associations Retrieved from the Web*. In Proceedings of the EMNLP 2008, pages 382-390, 2008.
2) Pawel Dybala, Michal Ptaszynski, Shinsuke Higuchi, Rafal Rzepka and Kenji Araki. *Humor Prevails! – Implementing a Joke Generator into a Conversational System*, LNAI 5360:214-225, Springer-Verlag, 2008.

Evaluation experiment

- Results of verification procedure – evaluated by a questionnaire
- Questionnaire:
  - Are the emotions positive / negative?
  - What were the emotion types?
  - Were the emotions appropriate for the situation?
- 20 sets / Every set evaluated by 10 people (≠users)
- Overall 200 different evaluations

Results

- Calculated number of people who agreed with the system per case.
- Majority rule
  (at least half of the people per case agreed)
- Evaluated items:

A) Affect analysis / types (ML-Ask + CAO)

B) Affect analysis / valence (ML-Ask + CAO)

C) Appropriateness verification of emotion types

D) Appropriateness verification of emotion valence

Results

A) Affect analysis / types (ML-Ask + CAO)

B) Affect analysis / valence (ML-Ask + CAO)

- A) = 89%
- B) = 93%

C) Appropriateness verification of emotion types

D) Appropriateness verification of emotion valence

- C) = 70%
- D) = 80%

Conclusions

Computing contextual appropriateness of emotions is a feasible task.

Presented method uses:

Affect analysis system
to recognize user's emotions…

Web mining technique
to verify their contextual appropriateness

Conclusions

- Agent equipped with our system can determine what communication strategy is the most desirable

- Applications
  - Personal conversational agent (free counselor for stress management, 24h/7/365)
  - Toy-companion for kids (as a part of education & safety application)

Contextual Appropriateness of Emotions

- Idea of Contextual Appropriateness of Emotions implies:
  - Expressed emotion (both + and -) can be appropriate or inappropriate for its context.
- If an emotion is appropriate:
  - Everything's fine (familiarization with user)
- If an emotion is not appropriate:
  - Alarm ("something is not right!")
- Future Work:
  - Understanding the character of the alarm
    (A symptom of depression? Dangerous thoughts? Irony?)

Michal Ptaszynski, Pawel Dybala, Wenhan Shi, Rafal Rzepka and Kenji Araki: "Towards Context Aware Emotional Intelligence in Machines: Computing Contextual Appropriateness of Affective States", In Proceedings of Twenty-first International Joint Conference on Artificial Intelligence (IJCAI-09), Pasadena, California, USA, 2009, pp. 1469-1474

Summary

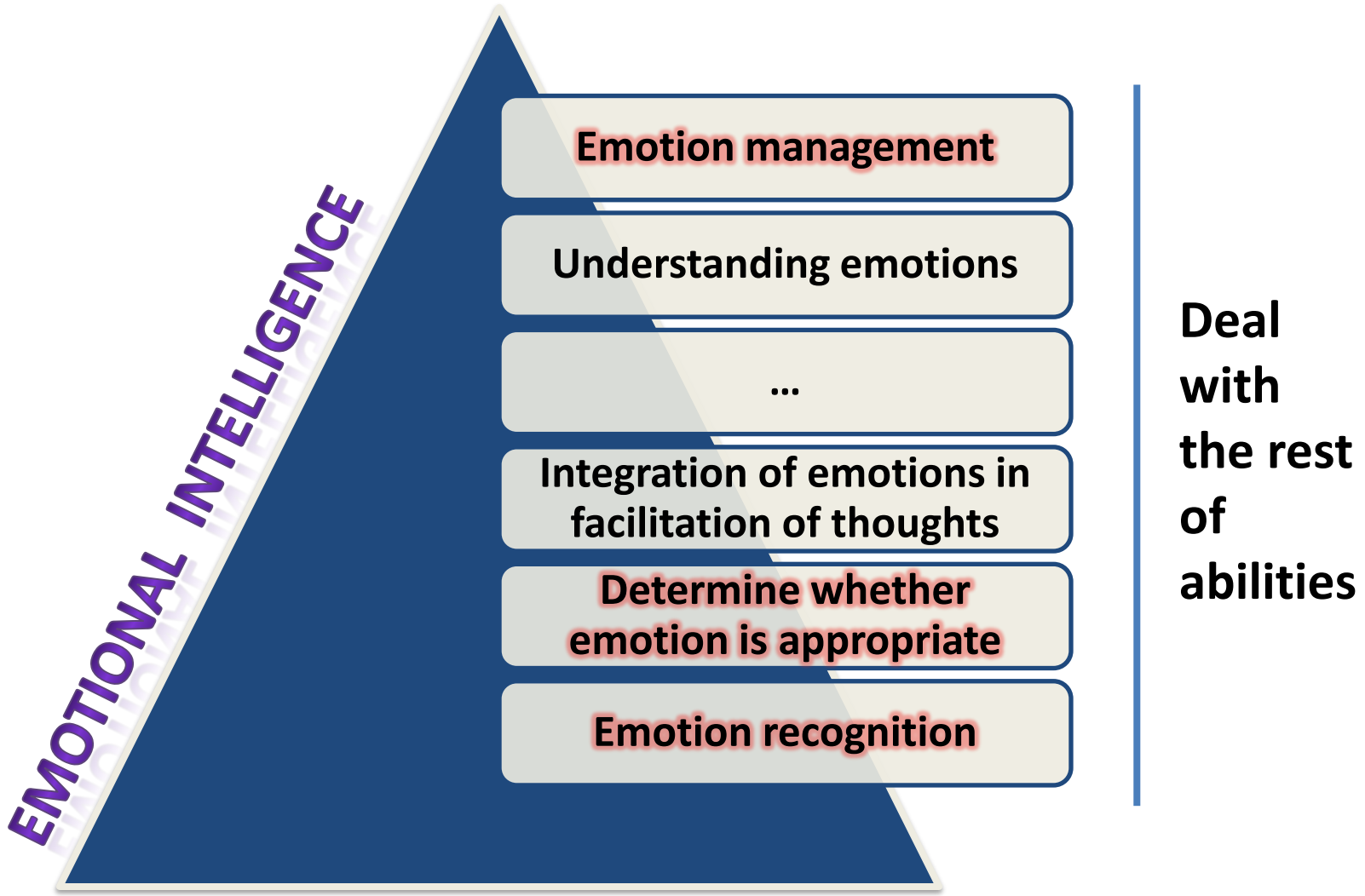
Summary

- Developed a new approach to emotions in language: Emotemes
  → ML-Ask (emotive/non-emotive)
- Applied an old theory to a new task: Theory of kinesics in analysis of emoticons
  → CAO (near ideal results)
- Made one step further in implementation of emotional intelligence in machines:
  → Contextual appropriateness of emotions

Future Work

- Improve ML-Ask
  - Enlarge databases
  - Disambiguate emotive type affiliation of emotemes
- Improve Web mining
  - Mine only specified areas (blogs, forums)
  - Make standalone system (use on a large corpus)
- Experiments on different corpora
  - natural conversations, forums, chat-room logs
- Implementation in conversational agent
  - specify the conversational strategies for each case

Future Work


EMOTIONAL INTELLIGENCE
Emotion management
Understanding emotions
…
Integration of emotions in facilitation of thoughts
Determine whether emotion is appropriate
Emotion recognition
Deal with the rest of abilities

Thank you for your kind attention.