

Subjectivity and Sentiment Analysis: from Words to Discourse

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MAVIR November 2010



Foci

- Natural Language Processing
 - Understanding text and conversation by computer
 - Recognizing opinions
 - Public opinion (blogs, comments)
 - News coverage
 - Political speeches

Burgeoning Field

- Quite a large problem space
- Several terms reflecting varying goals and models
 - Sentiment Analysis
 - Opinion Mining
 - Opinion Extraction
 - Subjectivity Analysis
 - Appraisal Analysis
 - Affect Sensing
 - Emotion Detection
 - Identifying Perspective
 - *Etc.*



What is Subjectivity?

- The **linguistic** expression of somebody's opinions, sentiments, emotions, evaluations, beliefs, speculations (*private states*)

Private state: state that is not open to objective observation or verification Quirk, Greenbaum, Leech, Svartvik (1985).

Note that this particular use of subjectivity is adapted from literary theory E.G. Banfield 1982, Fludernik 1993; Wiebe PhD Dissertation 1990.

Examples of Subjective Expressions

- References to private states
 - She was enthusiastic about the plan
 - He was boiling with anger
- References to speech or writing events expressing private states
 - Leaders rounding condemned his verbal assault on Israel
- Expressive subjective elements
 - That would lead to disastrous consequences
 - What a freak show



Manually (human) Annotated News Data

Wilson PhD Dissertation 2008

I think people are happy because Chavez has fallen

direct subjective

span: think

source: <writer, I>

attitude:



attitude

span: think

type: positive arguing

intensity: medium

target:



target

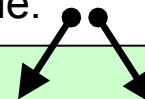
span: people are happy because
Chavez has fallen

direct subjective

span: are happy

source: <writer, I, People>

attitude:



attitude

span: are happy

type: pos sentiment

intensity: medium

target:



target

span: Chavez has fallen

inferred attitude

span: are happy because
Chavez has fallen

type: neg sentiment

intensity: medium

target:



target

span: Chavez

MPQA corpus: <http://www.cs.pitt.edu/mpqa>

Focus

- Our focus is linguistic disambiguation; how should language be interpreted?
 - *Is it subjective in the first place? If so, is it positive or negative? What is it about? Etc.*
- *Subjective language is highly ambiguous*



Interpretation

Lexicon of
keywords
out of context

continuum

Full contextual
Interpretation
of words in text
or dialogue

NLP methods/resources
building toward full
interpretations

“The dream”

Today: several tasks along the continuum



Interpretation

Lexicon of
keywords
out of context

continuum

Full contextual
Interpretation
of words in text
or dialogue



Brilliant
Difference
Hate
Interest
Love
...



Subjectivity Lexicons

- Most approaches to subjectivity and sentiment analysis exploit subjectivity lexicons.
 - Lists of keywords that have been gathered together because they have subjective uses



Automatically Identifying Subjective Words

- Much work in this area

E.g. Hatzivassiloglou & McKeown 1997; Wiebe 2000; Turney 2002; Kamps & Marx 2002; Wiebe, Riloff, Wilson 2003; Kim & Hovy 2005; Esuli & Sebastiani 2005;

Subjectivity Lexicon: <http://www.cs.pitt.edu/mpqa>

Entries from several sources (our work and others')



However...

- Consider the keyword “Interest”.
- It is in the subjectivity lexicon.
- *But, what about “interest rate”, for example?*



Dictionary Definitions *senses*

Interest, involvement -- (a sense of concern with and curiosity about someone or something; "an interest in music")

Interest -- (a fixed charge for borrowing money; usually a percentage of the amount borrowed; "how much interest do you pay on your mortgage?")



Dictionary Definitions *senses*

S Interest, involvement -- (a sense of concern with and curiosity about someone or something; "an interest in music")

O Interest -- (a fixed charge for borrowing money; usually a percentage of the amount borrowed; "how much interest do you pay on your mortgage?")

Senses

- Even in subjectivity lexicons, many senses of the keywords are objective ~50% in our study!
- Thus, many appearances of keywords in texts are *false hits*



Senses

- *His **alarm** grew as the election returns came in.* ✓
- *He set his **alarm** for 7am.* ✗
- *His **trust** grew as the candidate spoke.* ✓ ✗
- *His **trust** grew as interest rates increased.*








WordNet Miller 1995; Fellbaum 1998

Noun

- **S: (n) difference** (the quality of being unlike or dissimilar) *"there are many differences between jazz and rock"*
- **S: (n) deviation, divergence, departure, difference** (a variation that deviates from the standard or norm) *"the deviation from the mean"*
- **S: (n) dispute, difference, difference of opinion, conflict** (a disagreement or argument about something important) *"he had a dispute with his wife"; "there were irreconcilable differences"; "the familiar conflict between Republicans and Democrats"*
- **S: (n) difference** (a significant change) *"the difference in her is amazing"; "his support made a real difference"*
- **S: (n) remainder, difference** (the number that remains after subtraction; the number that when added to the subtrahend gives the minuend)



Examples

- “There are many **differences** between  African and Asian elephants.”
- “... dividing by the absolute value of the  **difference** from the mean...”
- “Their **differences** only grew as they spent more time together ...” 
- “Her support really made a **difference** in my life” 
- “The **difference** after subtracting X from  Y...”



Subjectivity Sense Labeling

- Automatically classifying senses as subjective or objective

Wiebe & Mihalcea 2006

Gyamfi, Wiebe, Mihalcea, Akkaya 2009

See also: Esuli & Sebastiani 2006, 2007

Andreevskaia & Bergler 2006a,b

Su & Markert 2008,2009



Interpretation

Lexicon of
keywords
out of context

continuum

Full contextual
Interpretation
of words in text
or dialog

Brilliant

sense#1 S

sense#2 S

...

Difference

sense#1 O

sense#2 O

sense#3 S

sense#4 S

sense#5 O

...

Now we will leave the lexicon and look at
disambiguation in the context of a text or
conversation



Contextual Subjectivity Analysis

S O?

**Subjectivity
Sentence
Classifier**

S O?

**“He spins a riveting plot which
grabs and holds the reader’s interest...”**

Do the sentences contain subjectivity?

“The notes do not pay interest.”

E.g. Riloff & Wiebe 2003
Yu & Hatzivassiloglou 2003

Contextual Subjectivity Analysis

S O?

**Subjectivity
Phrase
Classifier**

S O?

“He spins a **riveting plot which
grabs and holds the reader’s **interest...**”**

Is a phrase containing a keyword subjective?

“The notes do not pay **interest.”**

Wilson, Wiebe, Hoffmann 2005

Contextual Subjectivity Analysis

**Pos, Neg,
Neutral?**

**Sentiment
Phrase
Classifier**

**Pos, Neg,
Neutral?**

**“There are many differences between
African and Asian elephants.”**

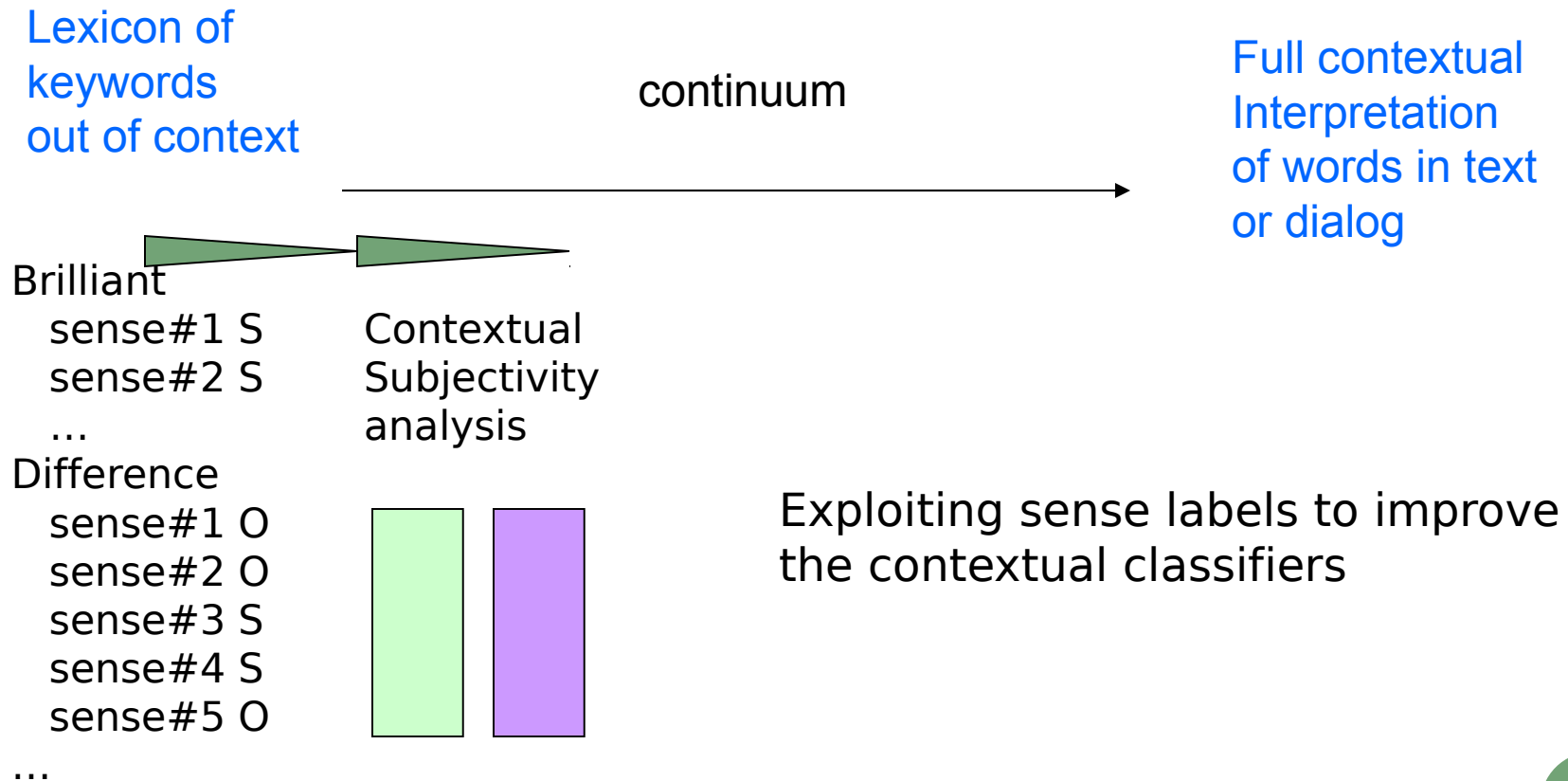
Is a phrase containing a keyword positive,
Negative, or neutral?

We'll return to this, topic after next.
But first...

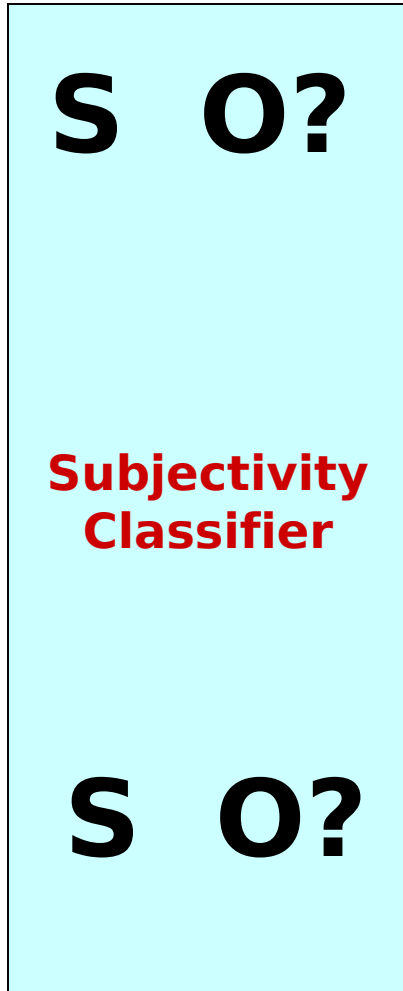
**“Their differences only grew as they spent
more time together ...”**

Wilson, Wiebe, Hoffmann 2005

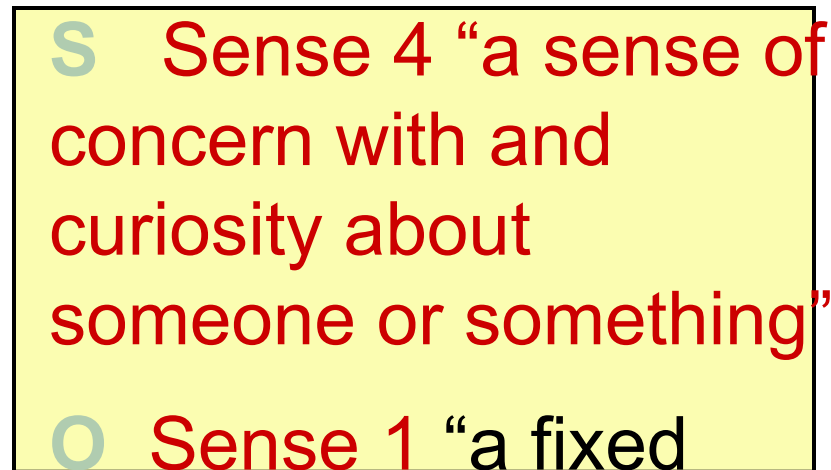
Interpretation



Subjectivity Tagging using WSD

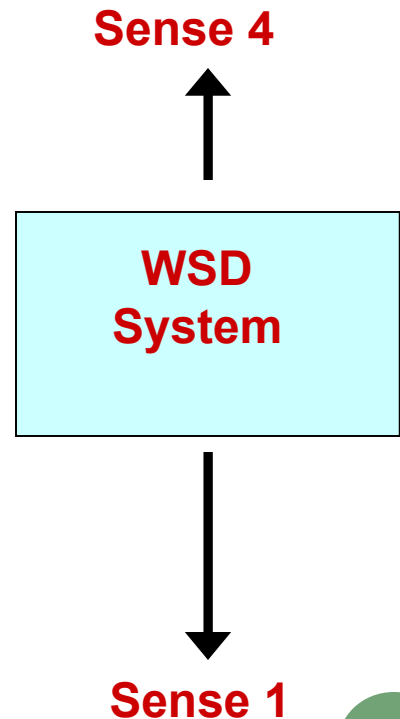


"He spins a riveting plot which grabs and holds the reader's **interest**..."

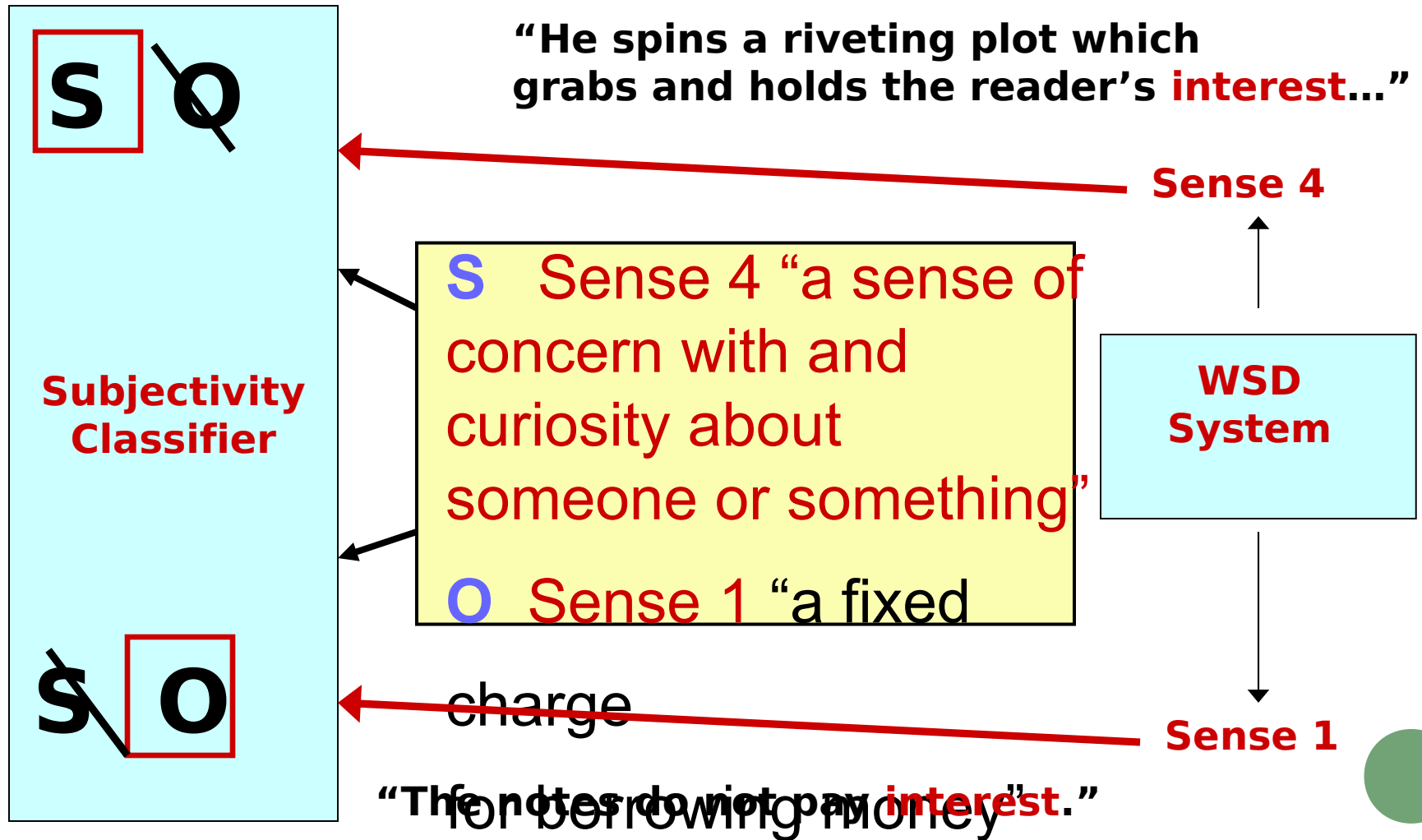


charge

"The notes do not pay **interest** for borrowing money."



Subjectivity Tagging using WSD



Examples

- “There are many differences between African and Asian elephants.” Sense#1 O
- “... dividing by the absolute value of the difference from the mean...” Sense#2 O
- “Their differences only grew as they spent more time together ...” Sense#3 S
- “Her support really made a difference in my life” Sense#4 S
- “The difference after subtracting X from Y...” Sense#5 O

- “There are many differences between African and Asian elephants.” Sense#1 O
- “... dividing by the absolute value of the difference from the mean...” Sense#2 O
- “Their differences only grew as they spent more time together ...” Sense#3 S
- “Her support really made a difference in my life” Sense#4 S
- “The difference after subtracting X from Y...” Sense#5 O
Is is one of these?

- “There are many differences between African and Asian elephants.” Sense#1 O
- “... dividing by the absolute value of the difference from the mean...” Sense#2 O
- “Their differences only grew as they spent more time together ...” Sense#3 S
- “Her support really made a difference in my life” Sense#4 S
- “The difference after subtracting X from Y...” Sense#5 O

Subjectivity Tagging using Subjectivity WSD

S O?

Subjectivity Classifier

S O?

“There are many **differences** between African and Asian elephants.”

Difference

sense#1 O

sense#2 O

sense#3 S

sense#4 S

sense#5 O

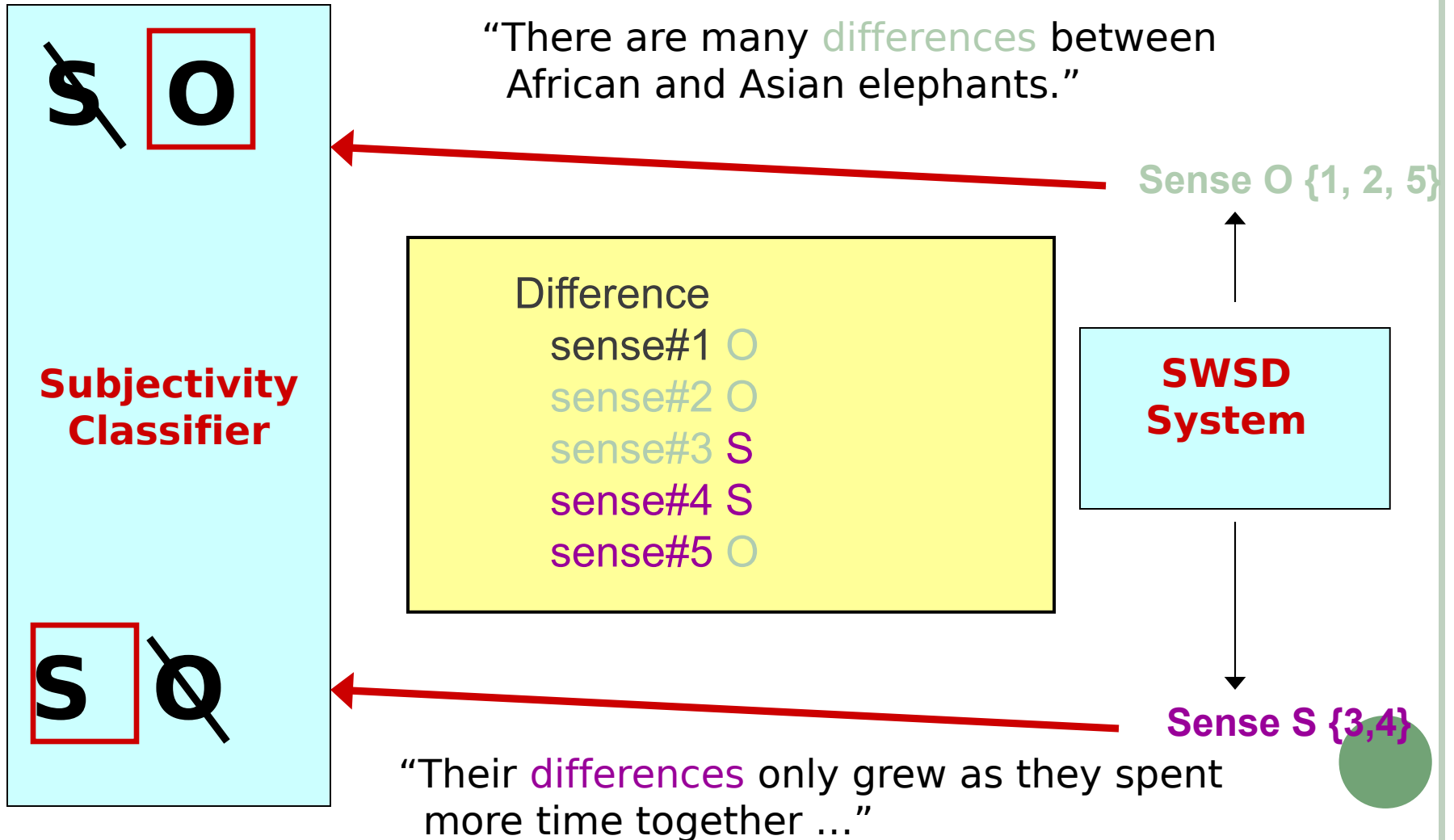
Sense O {1, 2, 5}

SWSD System

Sense S {3,4}

“Their **differences** only grew as they spent more time together ...”

Subjectivity Tagging using Subjectivity WSD



SWSD Akkaya, Wiebe, Mihalcea 2009 Akkaya, Conrad, Wiebe, Mihalcea 2010

- Compared system performance when
 - **WSD:** Using the full sense inventory
 - **SWSD:** Using only two senses, subj-sense and obj-sense
- SWSD Performance is well above baseline and the performance of full WSD
 - **SWSD is a feasible variant of WSD**
 - **Subjectivity provides a natural course-grained sense grouping**

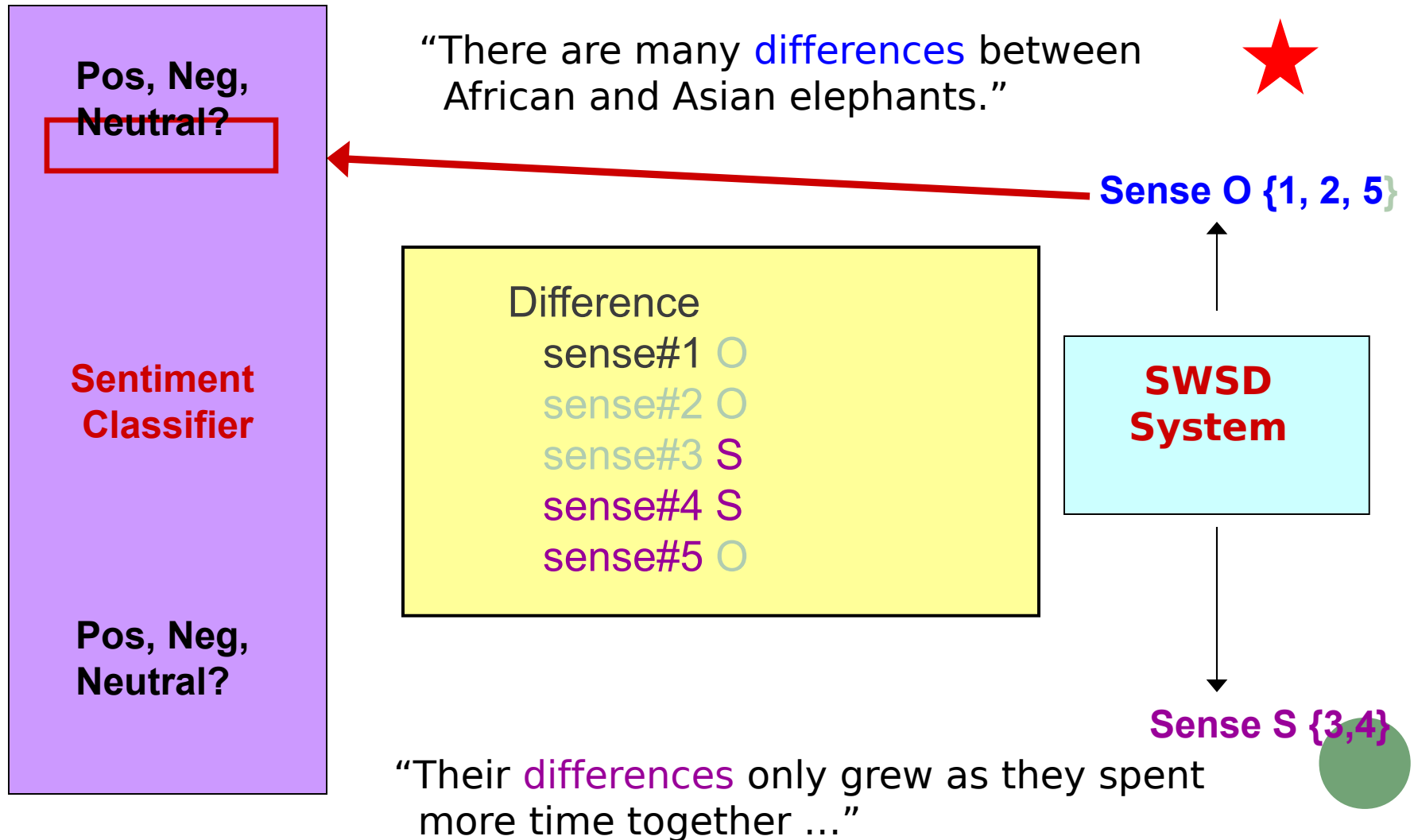


SWSD in Subjectivity Tagging

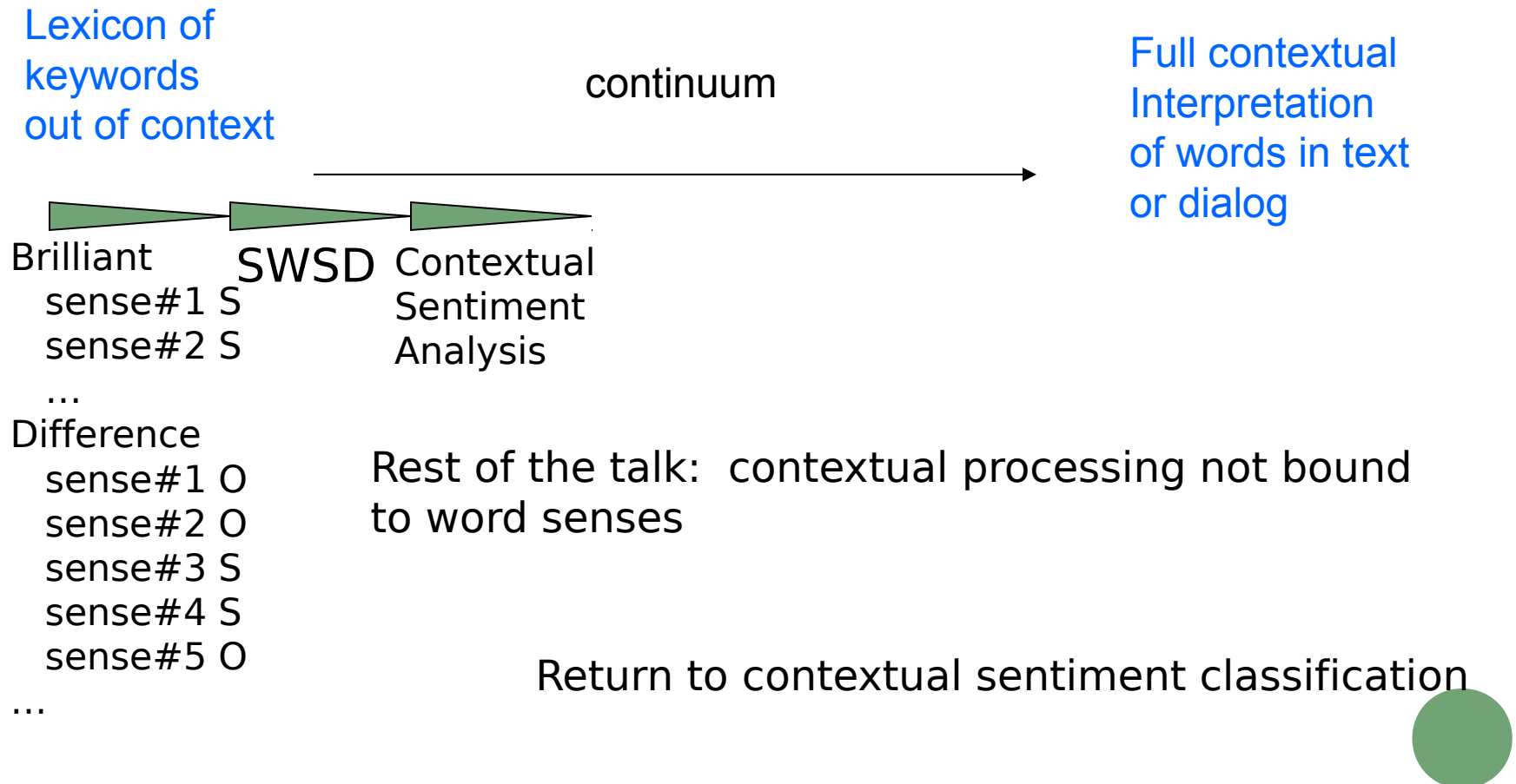
- SWSD exploited to improve performance of subjectivity analysis systems
- Both S/O and Pos/Neg/Neutral classifiers



Sentiment Analysis using SWSD



Interpretation



Sentiment Analysis Wilson, Wiebe, Hoffman 2005, 2009

- Automatically identifying positive and negative emotions, evaluations, and stances
 - Our approach: classify expressions containing a keyword as positive, negative, both, or neutral



Phrase-Level Sentiment Analysis

See also, E.G. Yi, Nasukawa, Bunescu, Niblack 2003;
Polanyi & Zaenen 2004; Popescu & Etzioni 2005;
Suzuki, Takamura, Okumura 2006; Moilanen &
Pulman 2007; Choi & Cardie 2008



Prior versus Contextual Polarity

- Many subjectivity lexicons contain polarity information
- Prior polarity: out of context, positive, negative, or neutral
- A word may appear in a phrase that expresses a different polarity in context
- Contextual polarity



MPQA (Human) Polarity Annotations

- Judge the contextual polarity of the sentiment that is **ultimately** being conveyed in the context of the text or conversation



Contextual Interpretation

They have not succeeded, and will never succeed, in breaking the will of this valiant people.



Contextual Interpretation

They have not **succeeded**, and will never succeed, in breaking the will of this valiant people.



Contextual Interpretation

They have **not succeeded**, and will never succeed, in breaking the will of this valiant people.



Contextual Polarity is Complex

They **have not succeeded, and will never succeed**,
in breaking the will of this valiant people.



Approach

- Step 1: Neutral or Polar?
- Step 2: Are the polar instances Positive or Negative?
- Combine a variety of evidence



Evidence

- Modifications and Conjunctions

- Cheers to Timothy Whitfield for the **wonderfully** **horrid** visuals

pos
wonderfully horrid



- Disdain **and** wrath

mod

- Hatzivassiloglou & McKeown 1997

disdain (neg) and **wrath**(neg)



- Subjectivity of the surrounding context; syntactic role in the sentence; etc.



Polarity Influencers

- Negation
 - Local not good
 - Longer-distance dependencies
 - Does not look very good (proposition)
 - No politically prudent Israeli could support either of them (subject)
 - Phrases with negations may intensify instead
 - Not only good, but amazing!



Polarity Influencers

- Modality
 - No reason at all to believe that the economy is good



Polarity Influencers

- Contextual Valence Shifters Polanyi & Zaenan 2004
 - General polarity shifter
 - Pose little threat
 - Contains little truth
 - Negative polarity shifters
 - Lack of understanding
 - Positive polarity shifters
 - Abate the damage

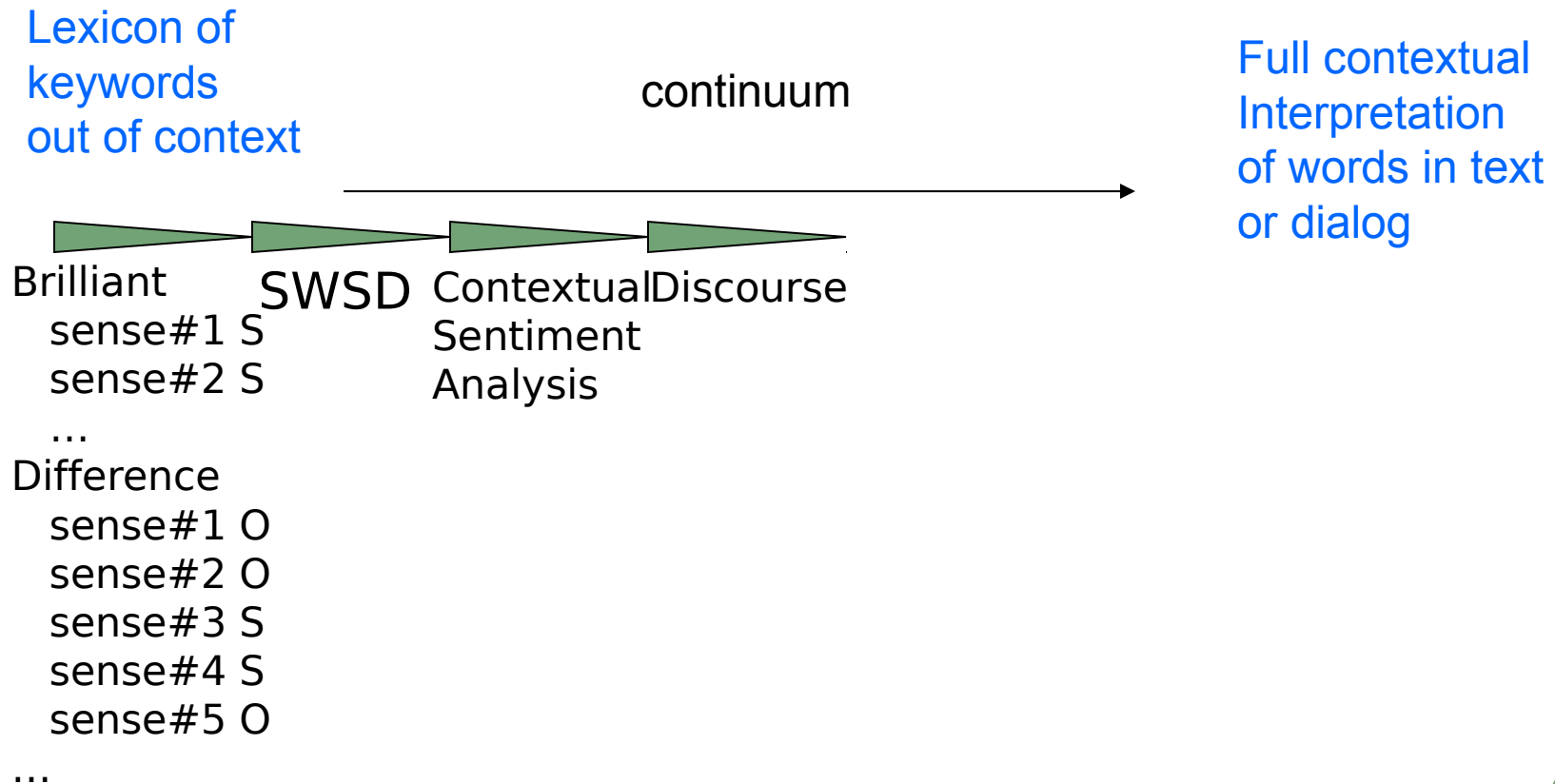


Approach

- Step 1: Neutral or Polar?
- Step 2: Are the polar instances Positive or Negative?
- Combine a variety of evidence
- Still much to do in the area of recognizing contextual polarity



Interpretation



Discourse-Level Treatment

- Interdependent interpretation of opinions
- More information about the overall stance

Somasundaran & Wiebe 2009; Somasundaran et al. 2009a,b; 2008a,b

See also: Bansal, Cardie, Lee 2008; Thomas, Pang, Lee 2006; Diermeier, Godbout, Yu, Kaufmann 2007; Malouf & Mullen 2008; Lin and Hauptmann 2006; Greene & Resnik 2009; Jiang & Argamon 2008; Klebanov, Diermeier, Beigman 2008; Polanyi & Zaenan 2006; Asher, Benamara, Matheiu 2008; Hirst, Riabinin, Graham 2010

Motivation: Interdependent Interpretation of Opinions

Example from the AMI Meeting corpus (Carletta et al., 2005)

- Scenario-based goal oriented meeting, where the participants have to design a new TV remote

D:... this kind of rubbery material, *it's* a **bit more bouncy**, like you said they get chucked around a lot. A **bit more durable** and *that* can also be **ergonomic** and *it* kind of feels a **bit different from all the other remote controls**.

Motivation: Interdependent Interpretation of Opinions

D:... this kind of rubbery material, ^{positiv_e} *it's* a **bit more bouncy**, like you said they
get chunked around a lot. A ^{positiv_e} **bit more durable** and *that* can also be
^{positiv_e} **ergonomic** and *it* kind of feels a **bit different from all the other remote**
controls. [?]

Motivation: Interdependent Interpretation of Opinions

D:... this kind of rubbery material, *it's* a **bit more bouncy**, like you said they get chunked around a lot. A **bit more durable** and *that* can also be **ergonomic** and *it* kind of feels **a bit different from all the other remote controls.**

The diagram illustrates the interpretation of opinions in the text. It uses green boxes labeled 'positiv' to highlight positive sentiment words: 'bouncy', 'durable', and 'ergonomic'. Blue lines connect pronouns to their referents: 'it's' to 'bouncy', 'that' to 'durable', and 'it' to 'different'. A brown box with a '?' is placed above 'different', indicating a question or uncertainty about the sentiment of that word.

Observation:

1. Speaker is talking about the same thing

Motivation: Interdependent Interpretation of Opinions

D:... this kind of rubbery material, it's a ^{positive} **bit more bouncy**, like you said they get ^{positive} **chucked** around a lot. A **bit more durable** and that can also be ^{positive} **ergonomic** and it kind of feels a **bit different from all the other remote controls.** [?]

Observation:

1. Speaker is talking about the same thing
2. Speaker is reinforcing his stance (pro-rubbery material)

Motivation: Interdependent Interpretation of Opinions

Discourse-level relations can help disambiguation of difficult cases

D:... this kind of rubbery material, it's a ^{positiv_e} **bit more bouncy**, like you said they get chunked around a lot. A ^{positiv_e} **bit more durable** and that can also be ^{positiv_e} **ergonomic** and it kind of feels a **bit different from all the other remote controls.**

Observation:

1. Speaker is talking about the same thing
2. Speaker is reinforcing his stance (pro-rubbery material)

Interpretation coherent with the discourse:

Being “a bit different from other remote controls” is positive

Motivation:

More information about the opinion stance

positive

negative

- Shapes **should be** curved, so round shapes **Nothing** square-like.

negative

- ... So we **shouldn't have too** square corners and that kind of thing.

Motivation:

More information about the opinion stance

positive

negative

- Shapes **should be** curved, so round shapes **Nothing** square-like.

negative

- ... So we **shouldn't have too** square corners and that kind of thing.

Prediction: Stance regarding the curved shape

QA System: Will the curved shape be accepted?

Motivation:

More information about the opinion stance

Direct opinion

positive

negative

- Shapes **should be** curved, so round shapes **Nothing** square-like.

negative

- ... So we **shouldn't have too** square corners and that kind of thing.

Motivation:

More information about the opinion stance

Direct opinion

positive

- Shapes **should be** curved, so round shapes **Nothing** square-like.

Opinions towards mutually exclusive option (alternative)

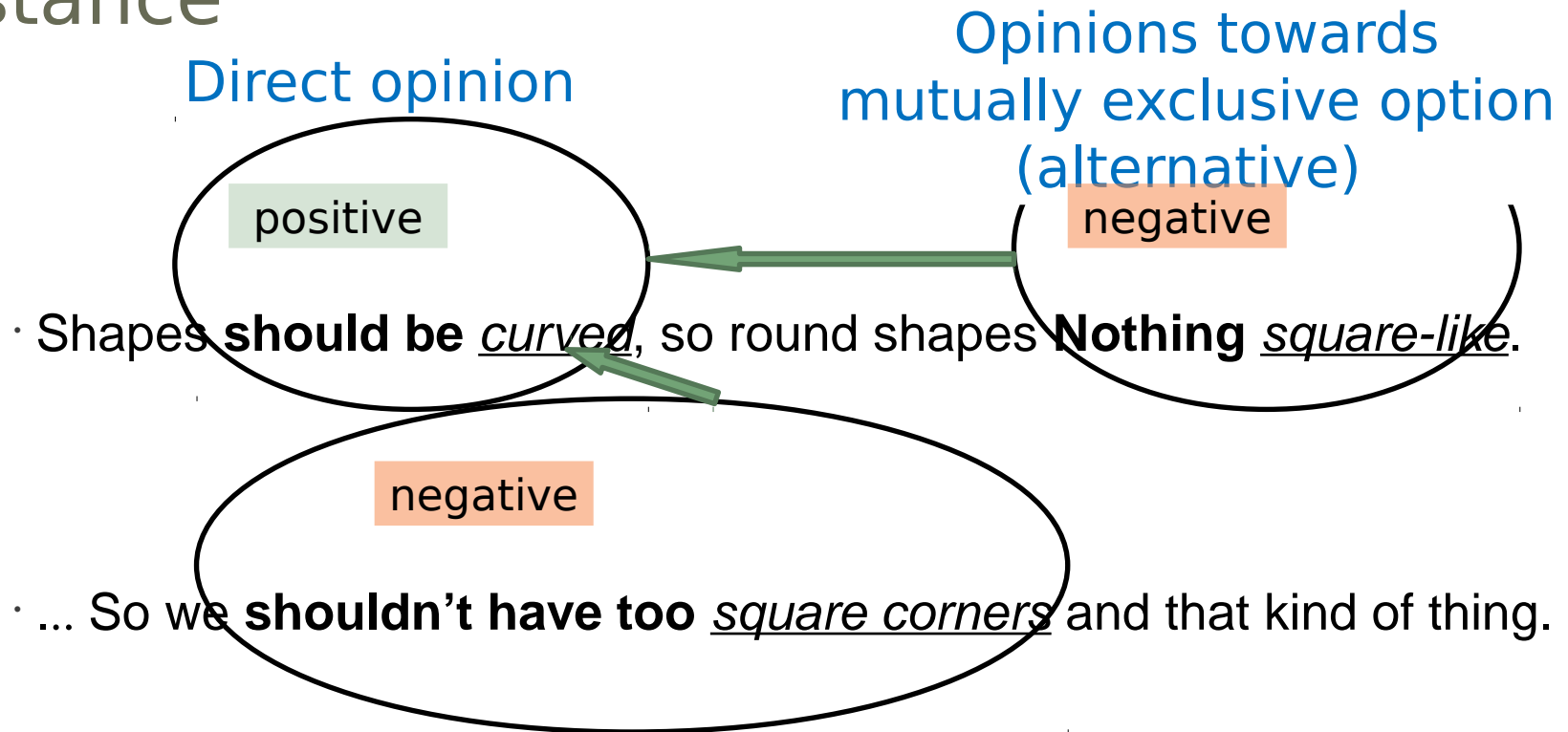
negative

negative

- ... So we **shouldn't have too** square corners and that kind of thing.

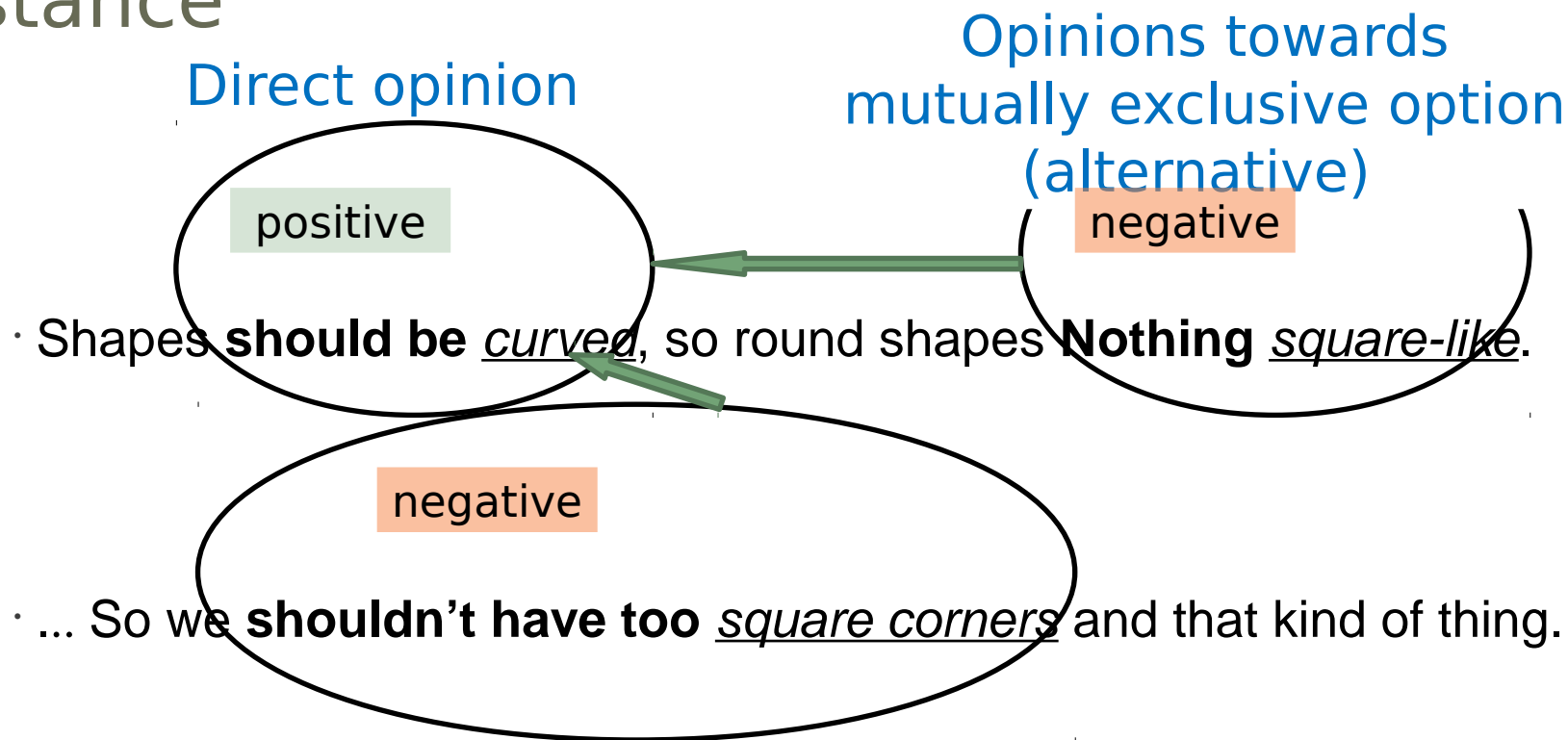
Motivation:

More information about the opinion stance



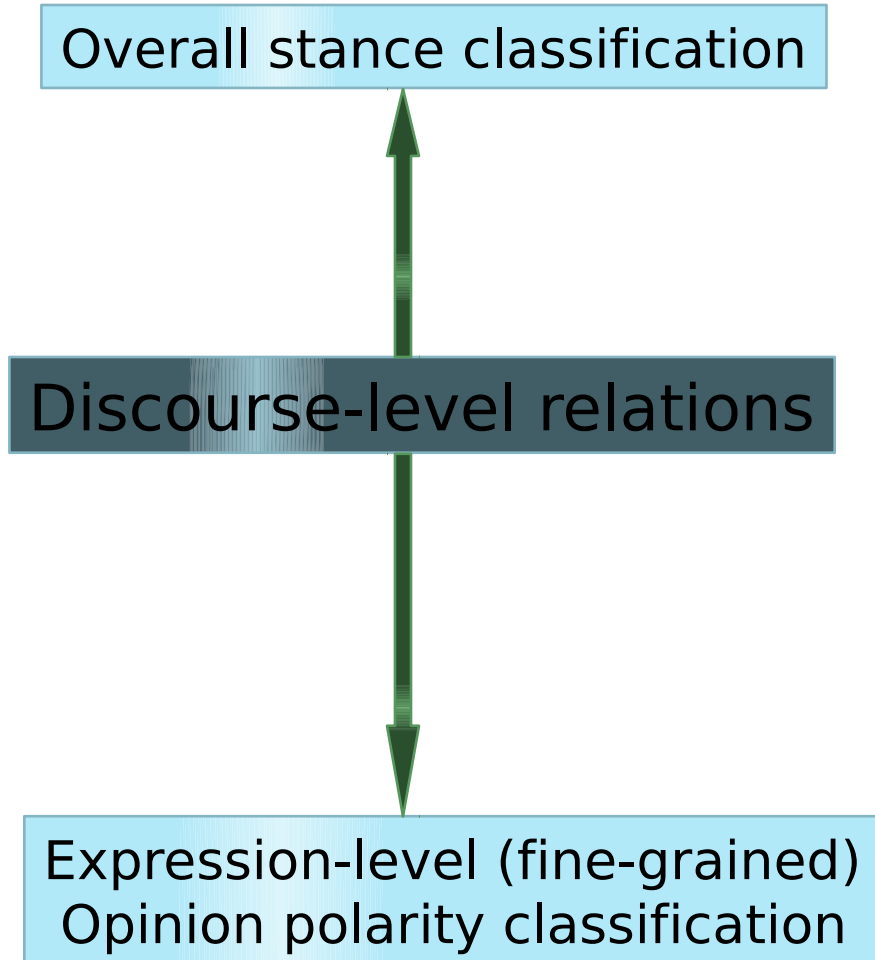
Motivation:

More information about the opinion stance

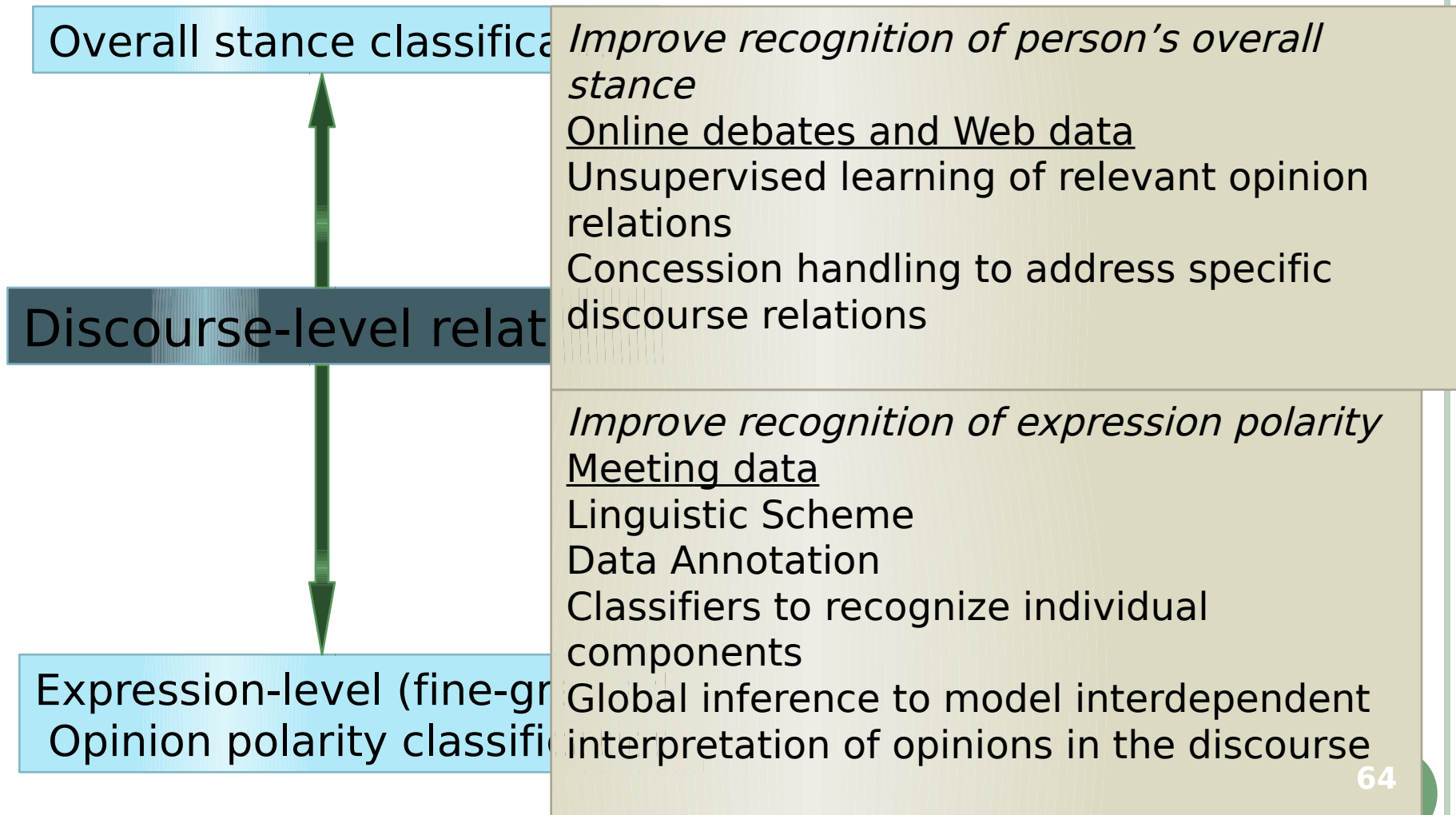


Discourse-level relations can provide
More opinion information regarding the
stance

This work



This work



Discourse-level relations

Opinion expressions are related in the discourse via

the relation between their **targets** [what the opinion is about] and whether / how the opinions **contribute to an overall stance**

Target relations

- This blue remote is **cool**. positive
- What's more, the rubbery material is **ergonomic**. positive
- I feel the red remote is **a better choice**. positive
- The blue remote will be **too expensive**. negative

Target relations

- This blue remote is **cool**.
samepositive
- What's more, the rubbery material is **ergonomic**.
positive
- I feel the red remote is **a better choice**.
positive
negative
- The blue remote will be **too expensive**.

Target relations

- This blue remote is **cool**.
samepositive
- What's more, the rubbery material is **ergonomic**.
positive
- I feel the red remote is **a better choice**.
alternativepositivenegative
- The blue remote will be **too expensive**.

Discourse-level relations

- This blue remote is **cool**.
positive
e
same
- What's more, the rubbery material is
positive
e
ergonomic.

- I feel the red remote is **a better choice**.
alternative
positive
e
negative
e
- The blue remote will be **too expensive**.

Discourse-level relations

- This blue remote is **cool**.

positive

reinforcing

same

- What's more, the rubbery material is **ergonomic**.

positive

- I feel the red remote is **a better choice**.
- The blue remote will be **too expensive**.

alternative

positive

negative

Discourse-level relations

- This blue remote is **cool**.

positive

reinforcing

same

- What's more, the rubbery material is **ergonomic**.

positive

- I feel the red remote is **a better choice**
- The blue remote will be **too expensive**.

alternative

positive

negative

Discourse-level relations

- This blue remote is **cool**.

same

positive

reinforcing

- What's more, the rubbery material is **ergonomic**.

positive

- I feel the red remote is **a better choice**
- The blue remote will be **too expensive**.

alternative

positive

reinforcing

negative

Discourse-level relations

- *The red remote is **inexpensive**,*
- *but the blue one is **cool***

alternative

positive

e

positive

e

non-reinforcing

- *The blue ~~remote~~ is **cool**,*
- *However, it is **expensive***

same

positive

e

negative

non-reinforcing

Discourse-level relations

- This blue remote is **cool**.

positive

reinforcing

same

- What's more, the rubbery material is **ergonomic**.

positive

<Pos, Pos, same>

- I feel the red remote is **a better choice**
- The blue remote will be **too expensive**.

alternative

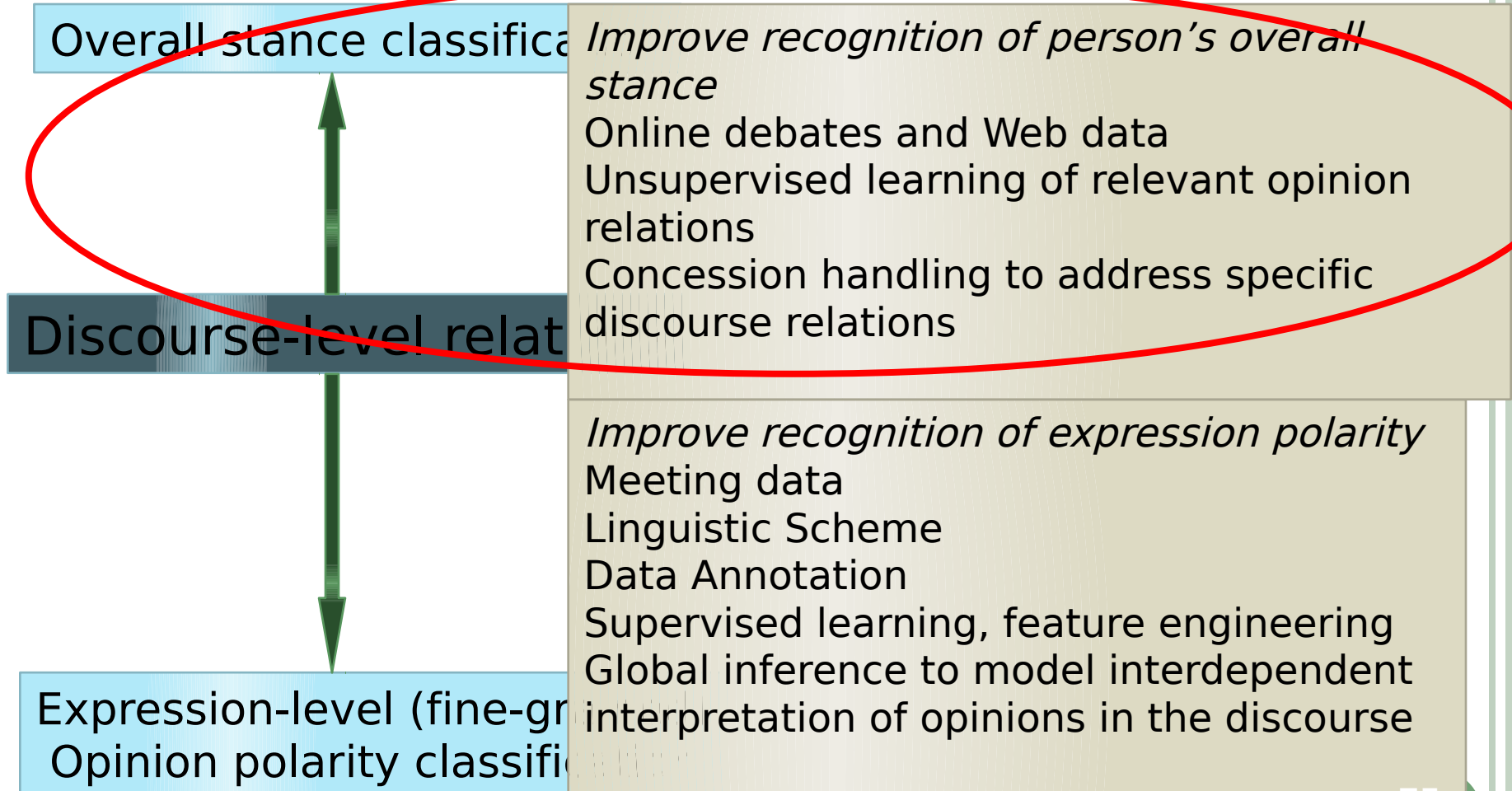
positive

reinforcing

negative

<Pos, Neg, alternative>

This work



Polarity Target Pairs

- Unsupervised
- Do not have target and discourse relations between opinions annotated
- The data are on-line debates, in which people largely reinforce their stances
- Our basic unit is the polarity-target pair (computed automatically)
- Mine web data for reinforcing relations

find via web mining that these support the same stance

- This blue remote is **cool**.
- What's more, the rubbery material is **ergonomic**.

Blue remote -- positive

reinforcing

rubbery material -- positive

Data

Debate: iPhone vs. Blackberry

iPhone of course. Blackberry is now for the senior businessmen market! The iPhone incarnate the 21st century whereas Blackberry symbolizes an outdated technology. The iPhone can reach a very diversified clientele ...

Data

Debate: iPhone vs. Blackberry

iPhone of course. Blackberry is now for the senior businessmen market! The iPhone incarnate the 21st century whereas Blackberry symbolizes an outdated technology. The iPhone can reach a very diversified clientele ...

Arguing why their stance is correct

Data

Debate: iPhone vs. Blackberry

iPhone of course. Blackberry is now for the senior businessmen market! The iPhone incarnate the 21st century whereas Blackberry symbolizes an outdated technology. The iPhone can reach a very diversified clientele ...

Alternatively, justifying why the opposite side is not good

Data

Debate: iPhone vs. Blackberry

Side
Classification:
pro-iPhone stance

iPhone of course. Blackberry is now for the senior businessmen market! The iPhone incarnate the 21st century whereas Blackberry symbolizes an outdated technology. The iPhone can reach a very diversified clientele ...

Multiple **positive** opinions toward the iPhone reinforce a pro-iPhone stance

Multiple **negative** opinions toward the alternative further reinforce the pro-iPhone stance

iPhone vs. Blackberry

Technology
Feb 01, 2007

Share



Watch



Flag

[Add an Argument](#)

23

iPhone : The next revolution of Apple

VOTE

[Add an Argument](#)

16

Blackberry : The eternal classic

VOTE



SOSO

Feb 01, 2007 02:32

4 convinced

Rebuttal



iPhone of course. Blackberry is now for the senior businessmen market! The iPhone incarnate the 21st century whereas Blackberry symbolises an outdated technology. The iPhone can reach a very diversified clientele : young, adult, active, rich, less rich population. The Blackberry have always targeted an elite. With the iPhone we are the elite and we can play spies as well as we can listen to cool music.



wlai

Feb 01, 2007 04:20

3 convinced

Rebuttal



It's the User Interface, stupid



coop

Feb 02, 2007 09:05

5 convinced

Rebuttal



Rebuttal to: SOSO

Yes, the iPhone is cool, but "reach(ing) the less rich population" is definitely NOT what Apple is going to do with this product. They never have until recently with the Mac Mini and the iPod Shuffle, but this iPhone is freakin' expensive. It is three times the price of the Blackberry Pearl, which is significantly smaller. I like my music, video and phone, but I don't want to carry a brick around in my pocket when I only need my phone. The Pearl does music and video nicely and fits in my pocket with little bulge (I'm female). If I want some serious tunes or video content, I'll whip out my 30Gb iPod for those times. The iPhone doesn't even give you 30Gb of space, so you'll never be able to carry all your music like a regular iPod, so you'll still need one. But the real iPhone killer is its attachment to Circular, the number one

Dual-topic,
Dual-sided
debates
regarding
Named Entities

iPhone vs. Blackberry

Technology
Feb 01, 2007

Topics:

1. iPhone
2. Blackberry

Share



Sides/ Stances:

1. Pro-iPhone
2. Pro-Blackberry

23

iPhone : The next revolution of Apple

the eternal classic

VOTE



SOSO

Feb 01, 2007 02:32

4 convinced

Side

Classification:

pro-iPhone stance

iPhone of course. Blackberry is a market! The iPhone incarnate the 21st century whereas Blackberry symbolises an outdated technology. The iPhone can reach a very diversified clientele : young, adult, active, rich, less rich population. The Blackberry have always targeted an elite. With the iPhone we are the elite and we can play spies as well as we can listen to cool music.



coop

Feb 02, 2007 09:05

5 convinced

Rebuttal

Side Classification:
pro-Blackberry
stance

Rebuttal to: SOSO

Yes, the iPhone is cool, but "reach(ing) the less rich population" is definitely NOT what Apple is going to do with this product. They never have until recently with the Mac Mini and the iPod Shuffle, but this iPhone is freakin' expensive. It is three times the price of the Blackberry Pearl, which is significantly smaller. I like my music, video and phone, but I don't want to carry a brick around in my pocket when I only need my phone. The Pearl does music and video nicely and fits in my pocket with little bulge (I'm female). If I want some serious tunes or video content, I'll whip out my 30Gb iPod for those times. The iPhone doesn't even give you 30Gb of space, so you'll never be able to carry all your music like a regular iPod, so you'll still need one. But

Side

Classification:

pro-iPhone stance



wlai

Feb 01, 2007 04:20

It's the User Interface, stupid

Web mining

Web mining

Stance-1
Pro-iPhone

iPhone vs. Blackberry

Stance-2
Pro-Blackberry

Web mining

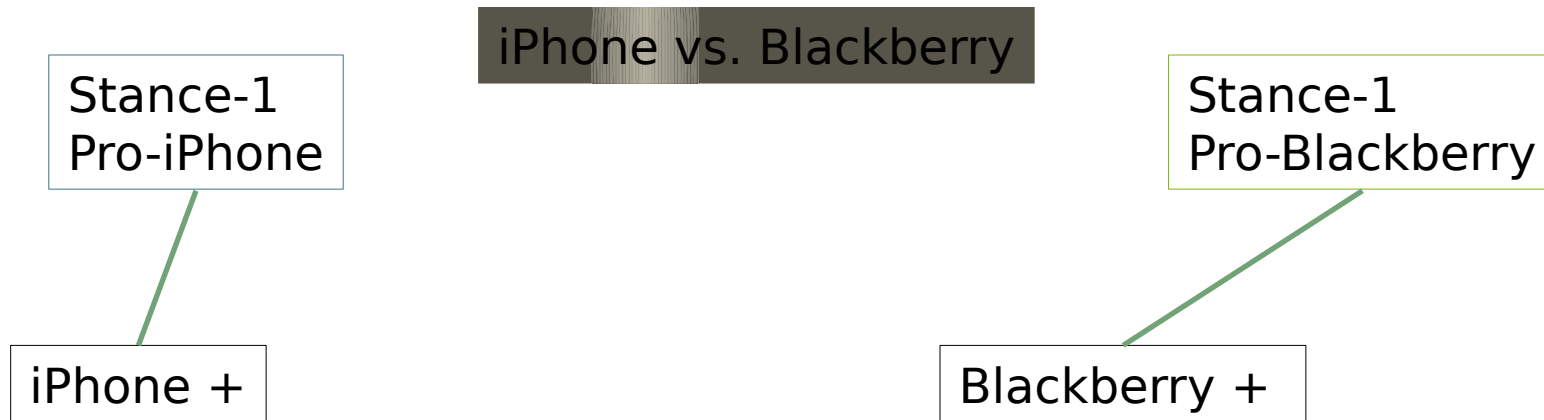
iPhone vs. Blackberry

Stance-1
Pro-iPhone

iPhone +

Stance-1
Pro-Blackberry

Web mining



Web mining

iPhone vs. Blackberry

Stance-1
Pro-iPhone

iPhone - Blackberry -

Stance-1
Pro-Blackberry

Blackberry +

Argue for a pro-iPhone stance via negative opinion towards the alternative target (Blackberry)

Web mining

iPhone vs. Blackberry

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iPhone - Blackberry -

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Stance-1
Pro-Blackberry

Blackberry -

iPhone -

Argue for a pro-blackberry stance via negative opinion towards the alternative target (iPhone)

Web mining

iPhone vs. Blackberry

Stance-1
Pro-iPhone

iPhone +

Blackberry -

Topic polarity pairs that
reinforce a pro-iPhone
stance

Stance-1
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Topic polarity pairs that
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Web mining

iPhone vs. Blackberry

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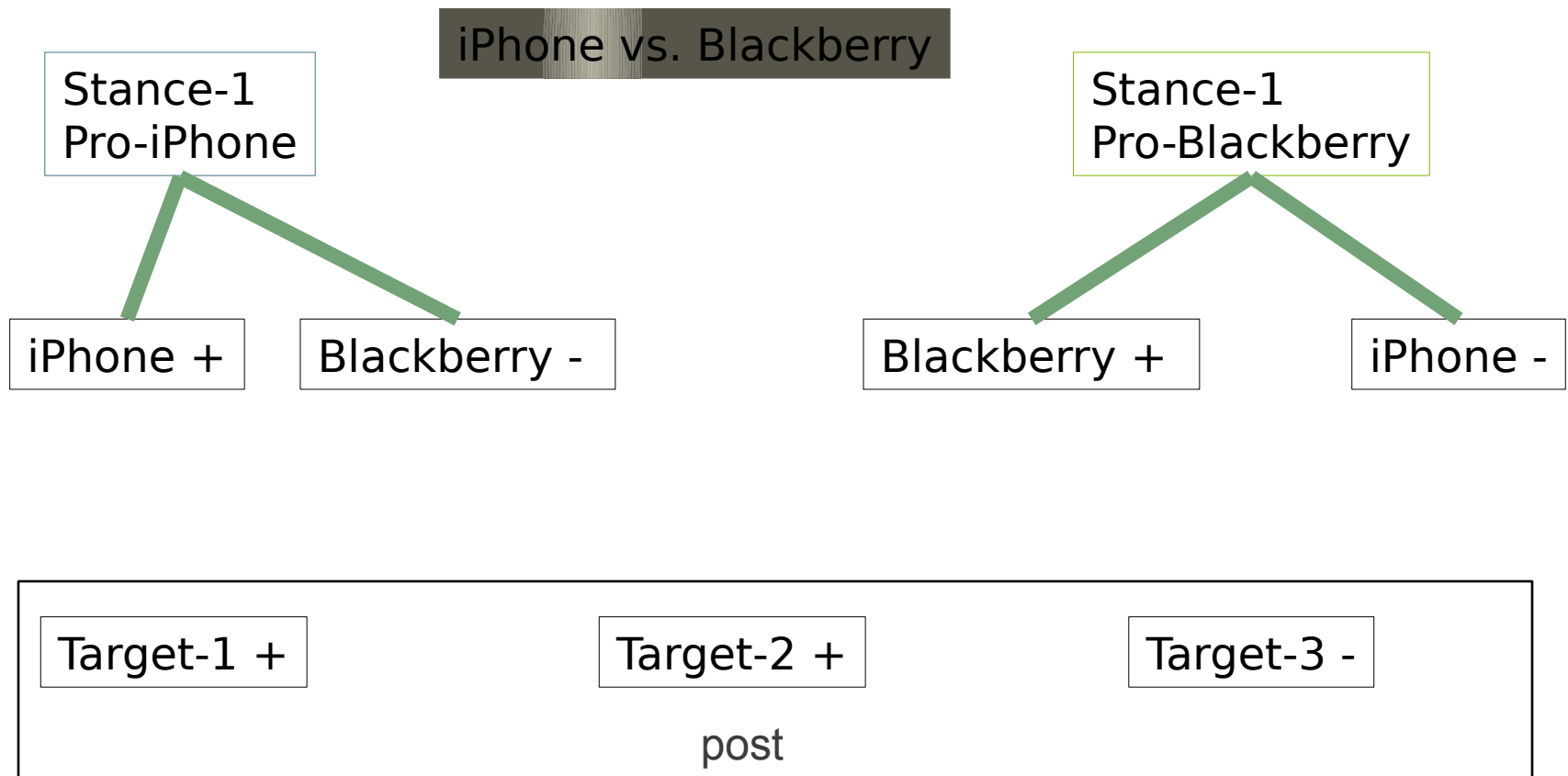
Target-1 +

Target-2 +

Target-3 -

post

Web mining



If these all mention the topic, the task is straightforward

Web mining

iPhone vs. Blackberry

Stance-1
Pro-iPhone

iPhone +

Blackberry -

Stance-1
Pro-Blackberry

Blackberry +

iPhone -

Pearl +

keyboard +

battery -

post

Debate topics are evoked in a variety of ways

Pro-blackberry

- The Pearl does music and video nicely ...
- First, you still can't beat the full QWERTY keyboard for quick, effortless typing.

Pro-iPhone

- Well, Apple has always been a well known company.
- Its MAC OS is also a unique thing.

Debate topics are evoked in a variety of ways

Pro-blackberry

- The Pearl does more and more nicely ...
Type of Blackberry
- First, you still can't beat the full QWERTY keyboard, Blackberry
quick, effortless typing.

Pro-iPhone

- Well, Apple has Maker of iPhone known company.
- Its MAC OS is also a unique thing.

Feature of iPhone

Debate topics are evoked in a variety of ways

Pro-blackberry

- The Pearl does music and video nicely ...
- First, you still can't beat the full QWERTY keyboard for quick, effortless typing.

Pro-iPhone

- Well, Apple has a Unique Aspects well known company.
- Its MAC OS is also a unique thing.

shared aspects

- iPhone and Blackberry, both
 - Have e-mail facilities
 - Can be used to take photos
 - Operate on batteries
 - Etc.

Both sides share aspects

shared aspects - example

- **Faster** keyboard input

People expressing positive opinions regarding keyboards (generally) prefer Blackberry

shared aspects

□ **Faster** keyboard input

Certain shared aspects may be perceived to be better in one side

- Keyboards in blackberry

Value for shared aspects depends on personal preferences

- Music

- Keyboards

People argue about what they value

shared aspects

- keyboard+

How likely is it to be used to reinforce a
pro-iPhone stance
pro-Blackberry stance

Web mining

iPhone vs. Blackberry

Stance-1
Pro-iPhone

iPhone +

Blackberry -

Stance-1
Pro-Blackberry

Blackberry +

iPhone -

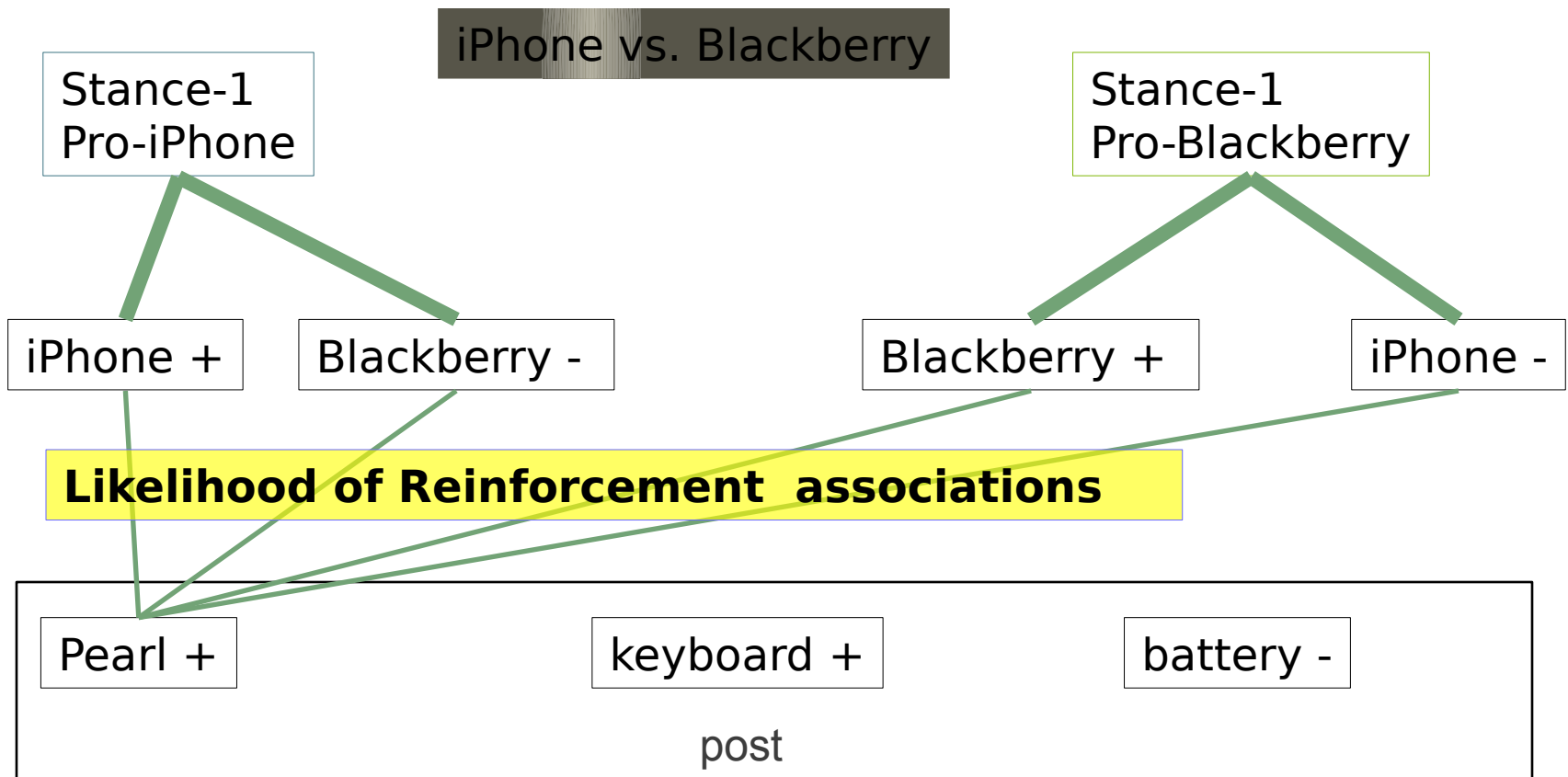
Pearl +

keyboard +

battery -

post

Web mining



Associations with topic-polarity

- For each opinion-target (target_j) calculate its association with each of the opinion-topics
 - $P(\text{topic1+} | \text{targetj+})$
 - $P(\text{topic1-} | \text{targetj+})$
 - $P(\text{topic2+} | \text{targetj+})$
 - $P(\text{topic2-} | \text{targetj+})$

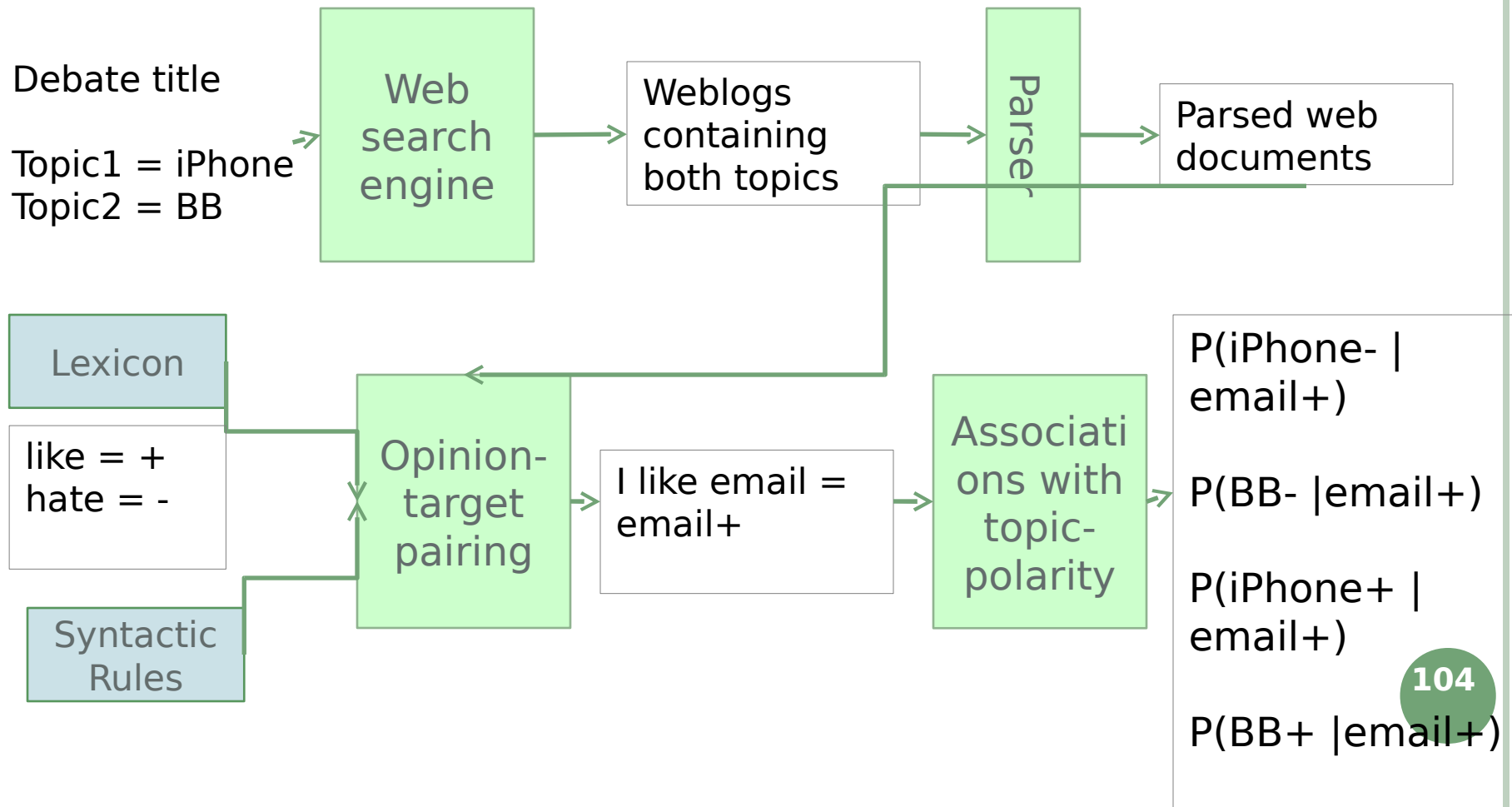
$P(\text{iPhone+} | \text{email+})$

$P(\text{iPhone-} | \text{email+})$

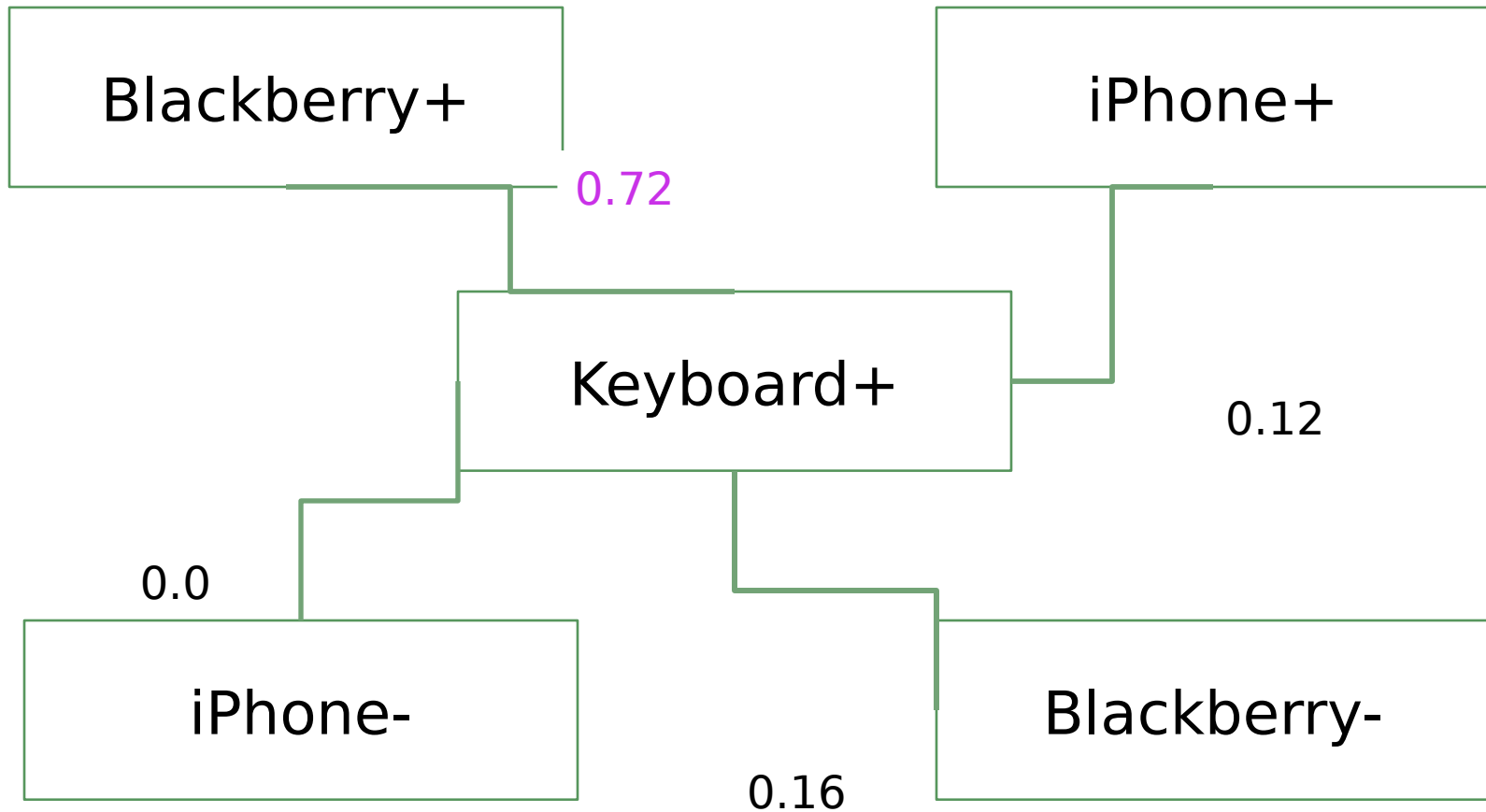
$P(\text{BB+} | \text{email+})$

$P(\text{BB-} | \text{email+})$

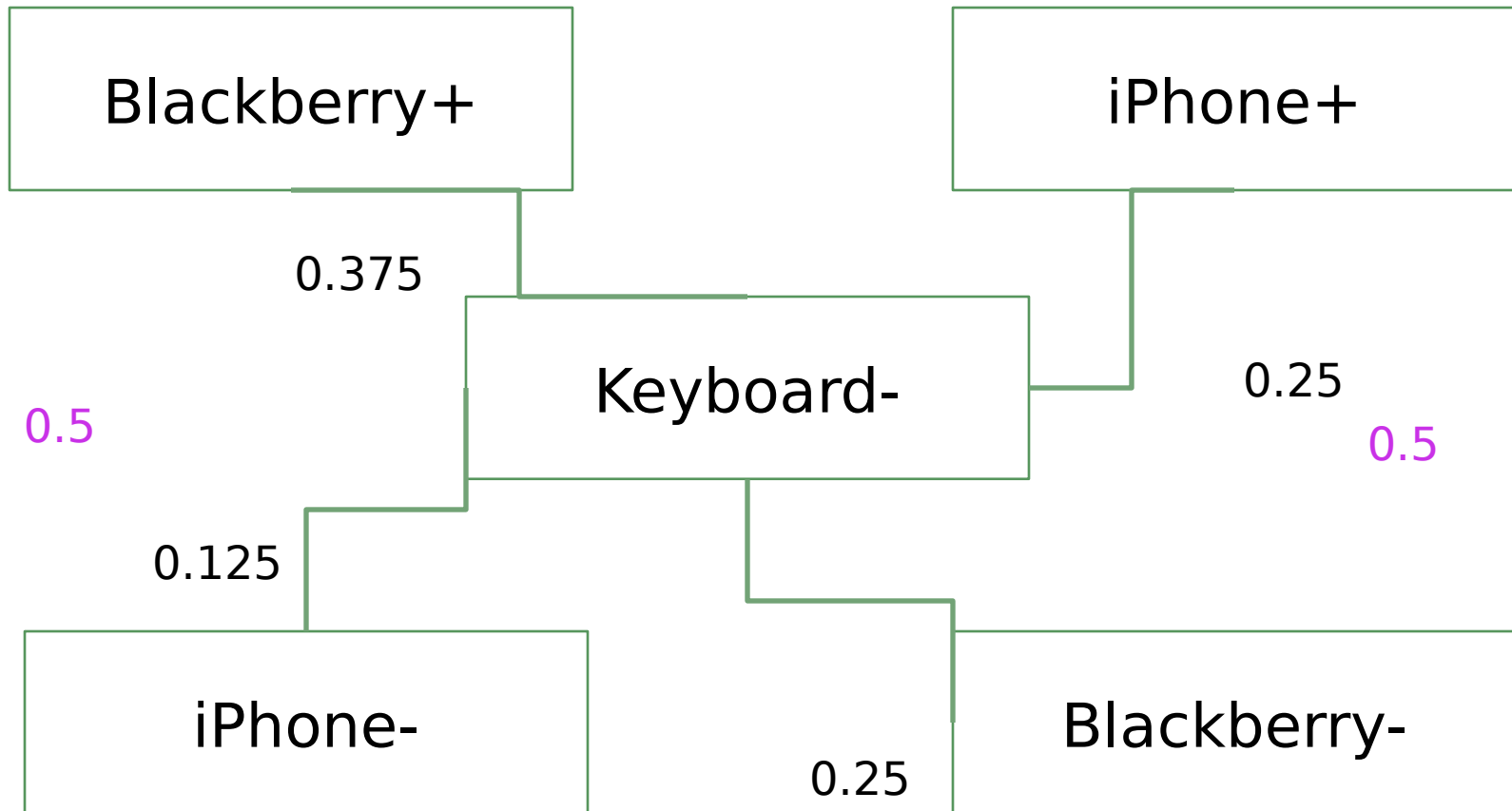
Methodology: Learning associations



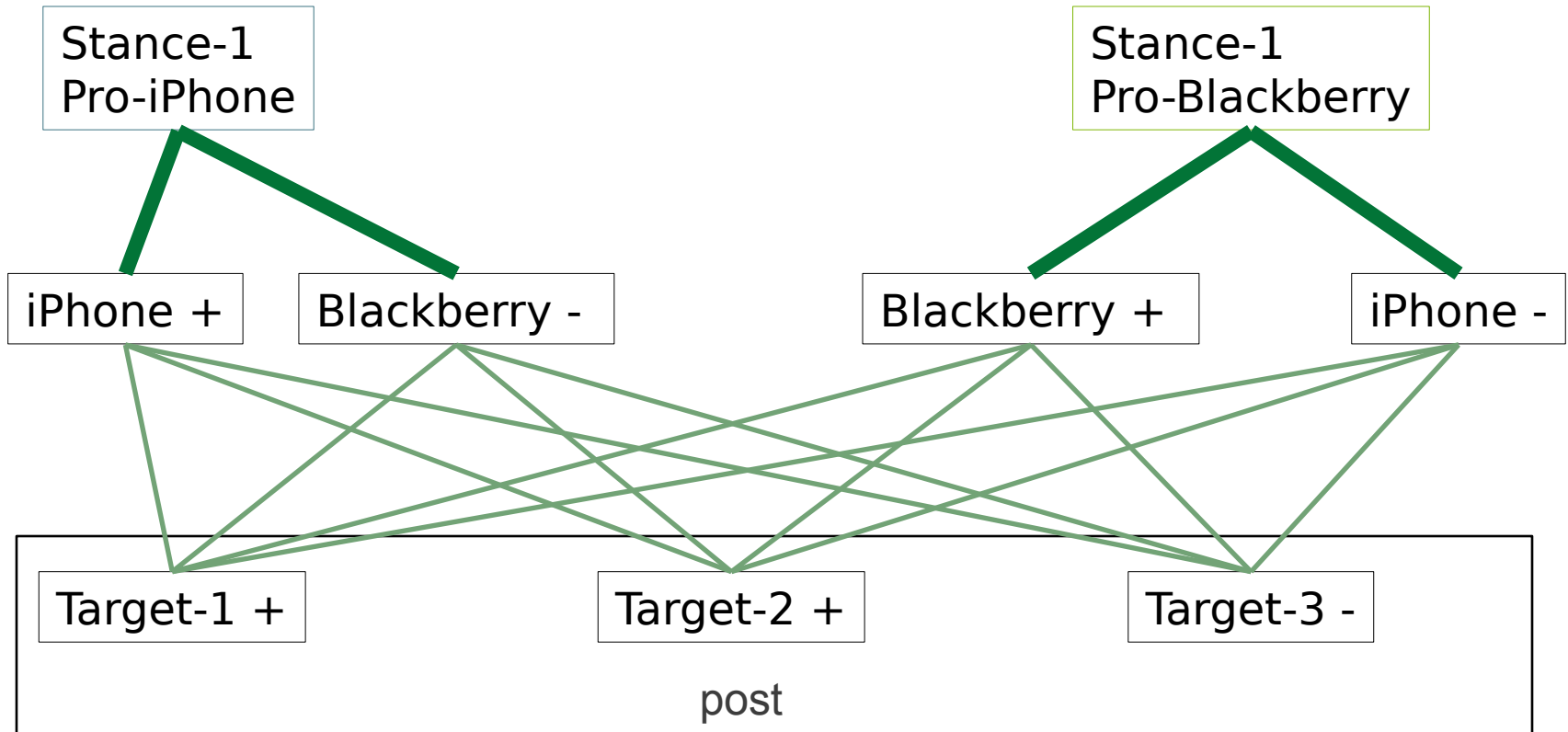
Associations learnt from web data

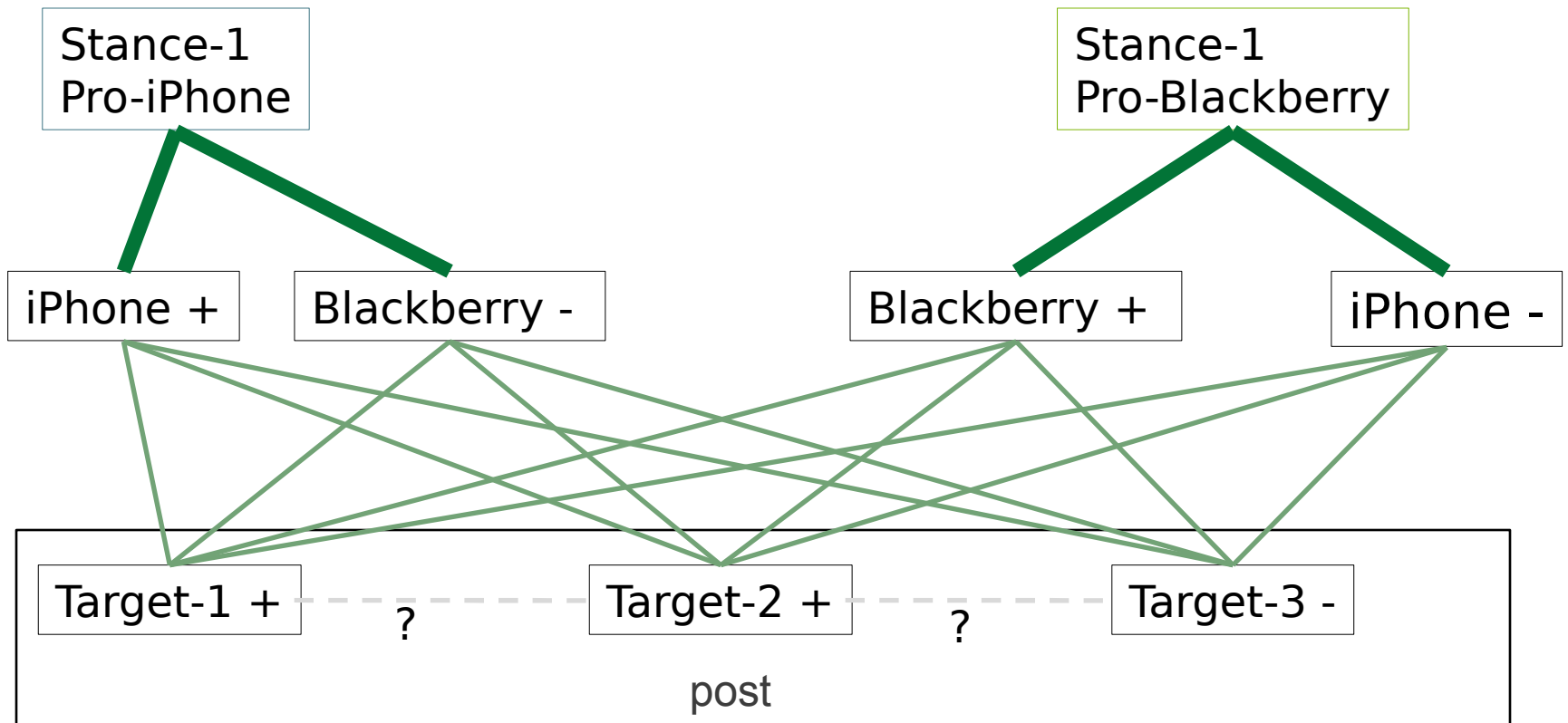


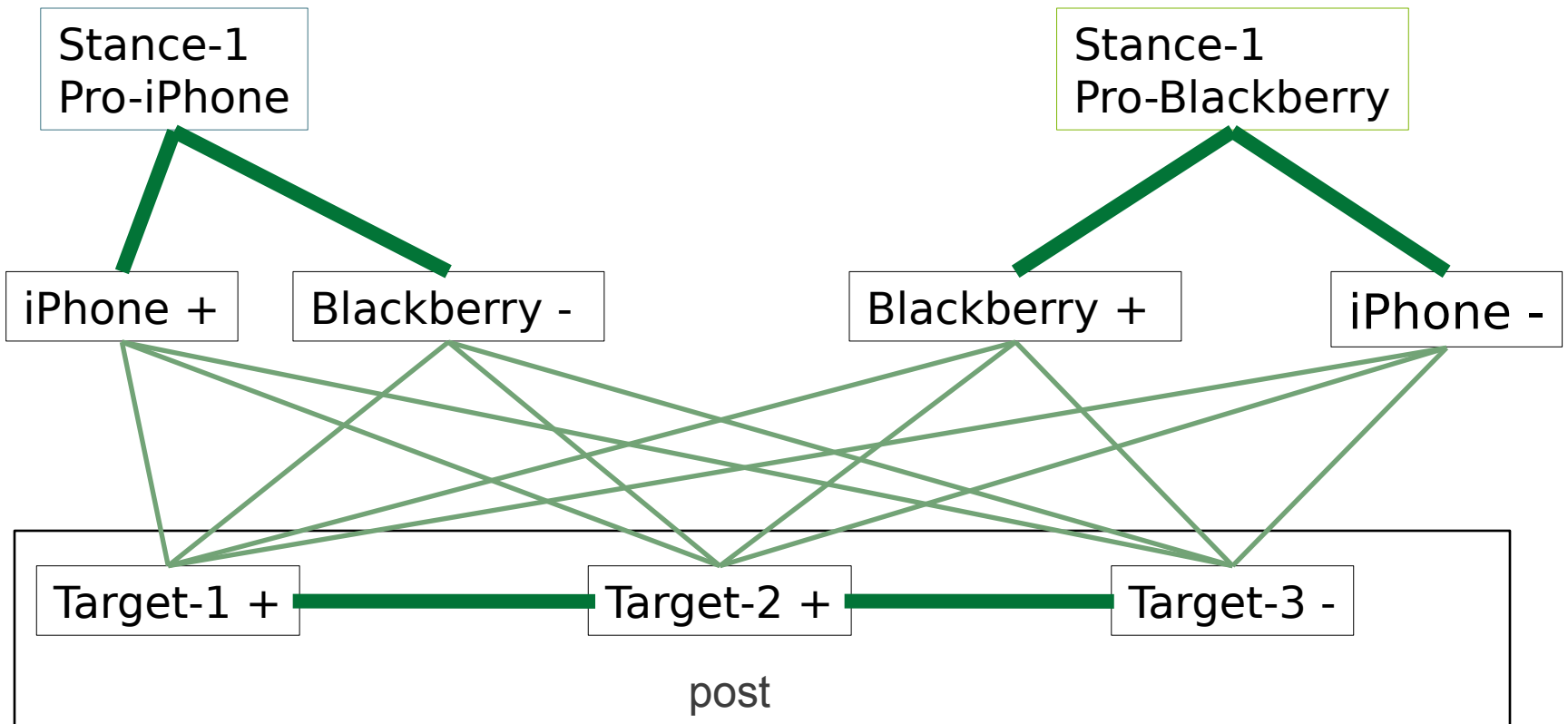
Associations learnt from web data



From the Web mining Phase

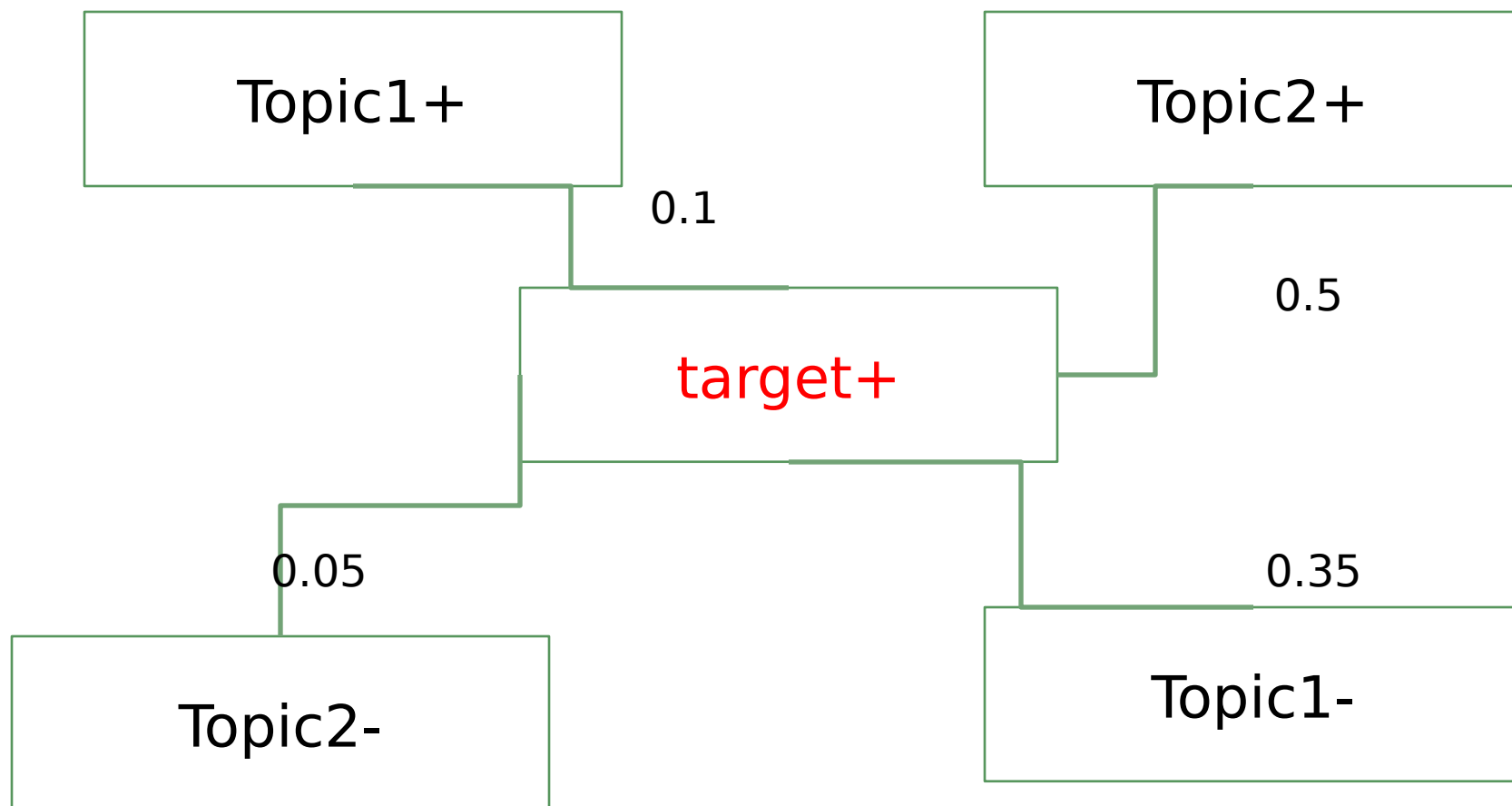






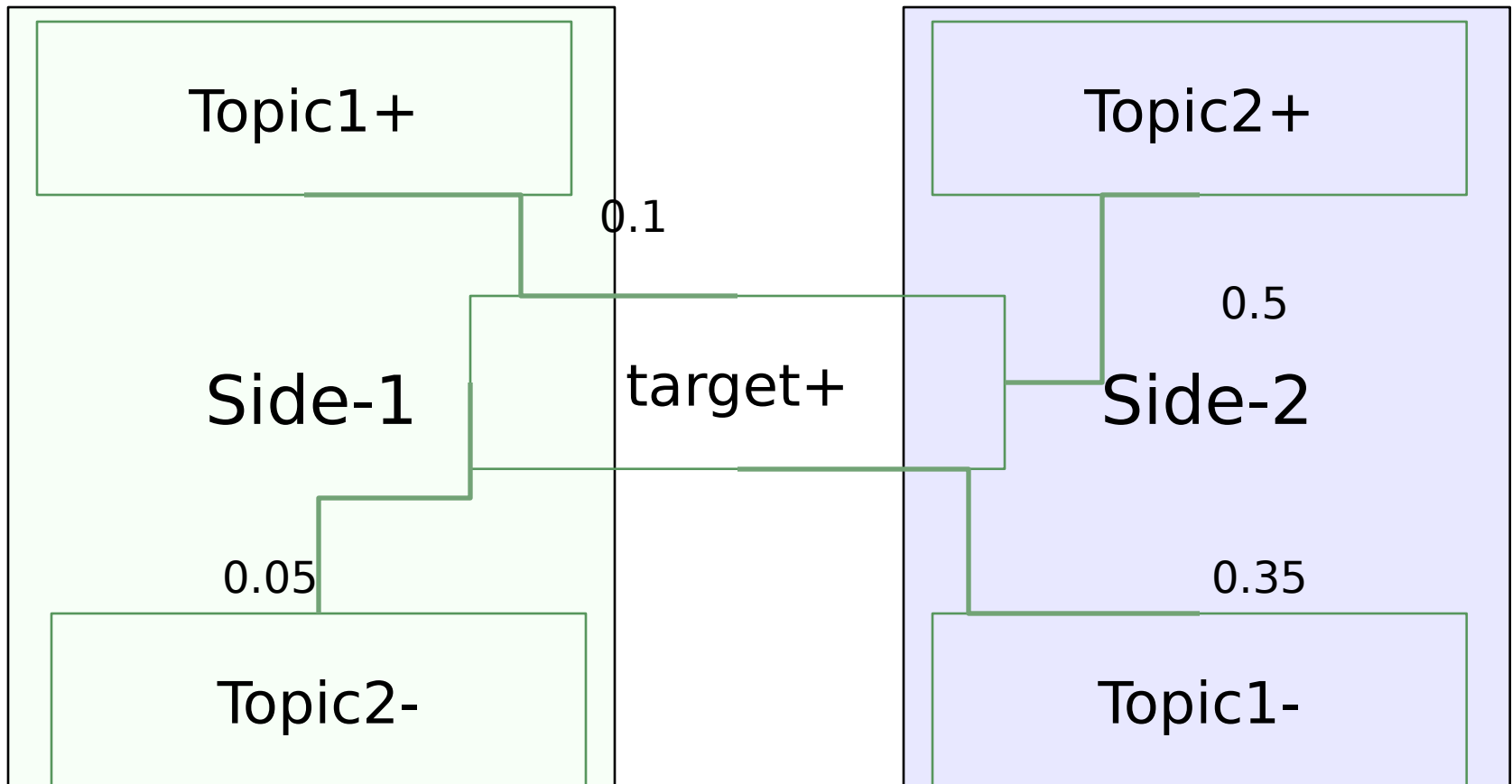
Assume reinforcement unless detected otherwise

Association Lookup



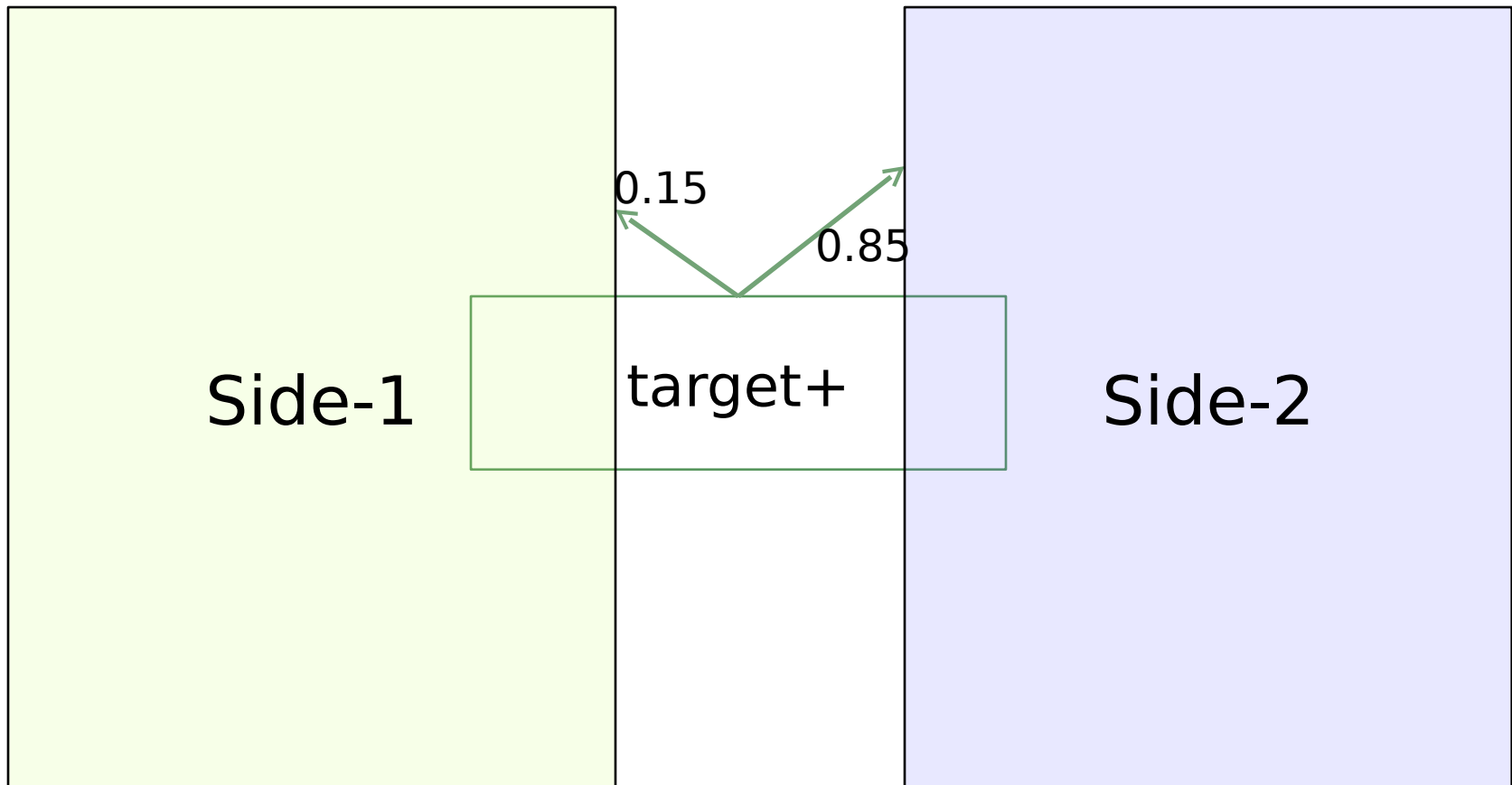
Association of **positive opinion towards a target** to positive or negative opinions regarding either of the topics

Association Lookup, Side Mapping



Side-1 = Topic1+ alternatively Topic2-
Side-2 = Topic2+ alternatively Topic1-

Association Lookup, Side Mapping



Association of positive opinion towards a target to both of the stances

Non-reinforcing opinions within the post

- While the iPhone looks nice and does play a decent amount of music, it can't compare in functionality to the BB.

Side Classification:
pro-Blackberry
stance

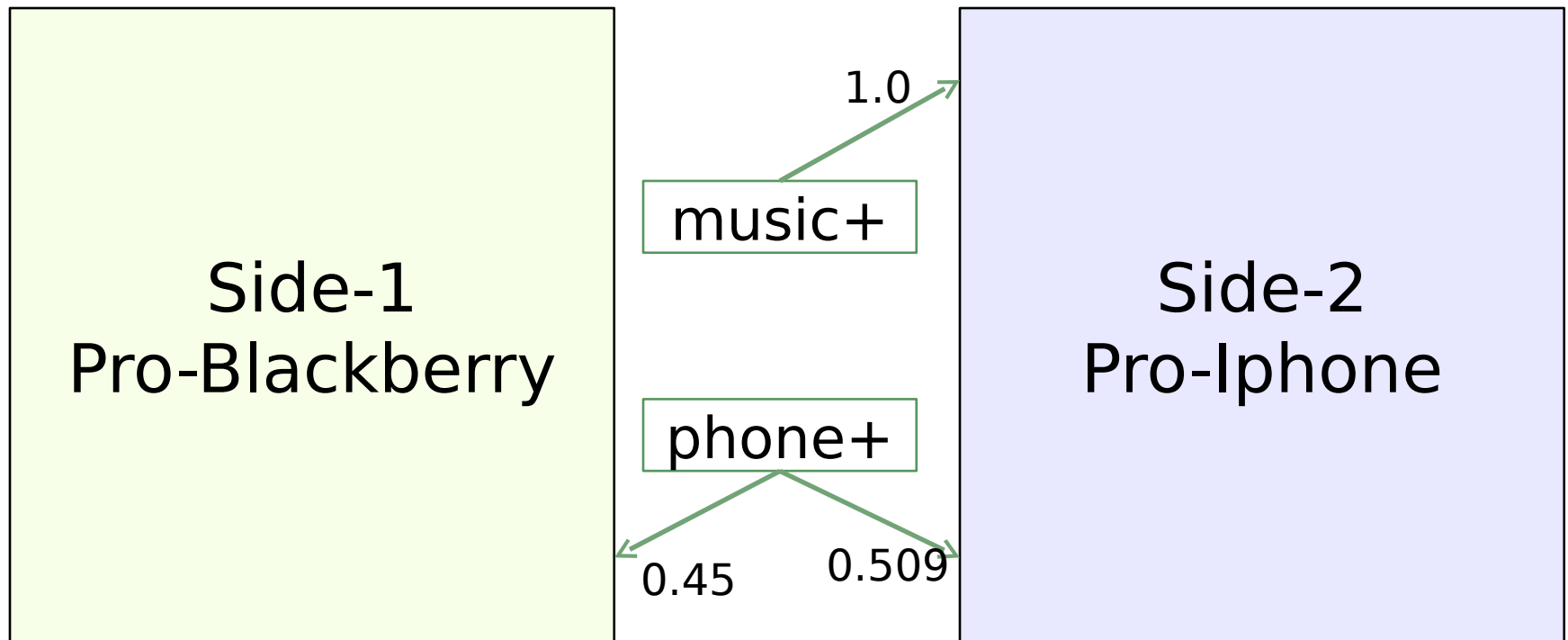
Concessionary opinions

Concession Handling

Detecting concessionary opinions

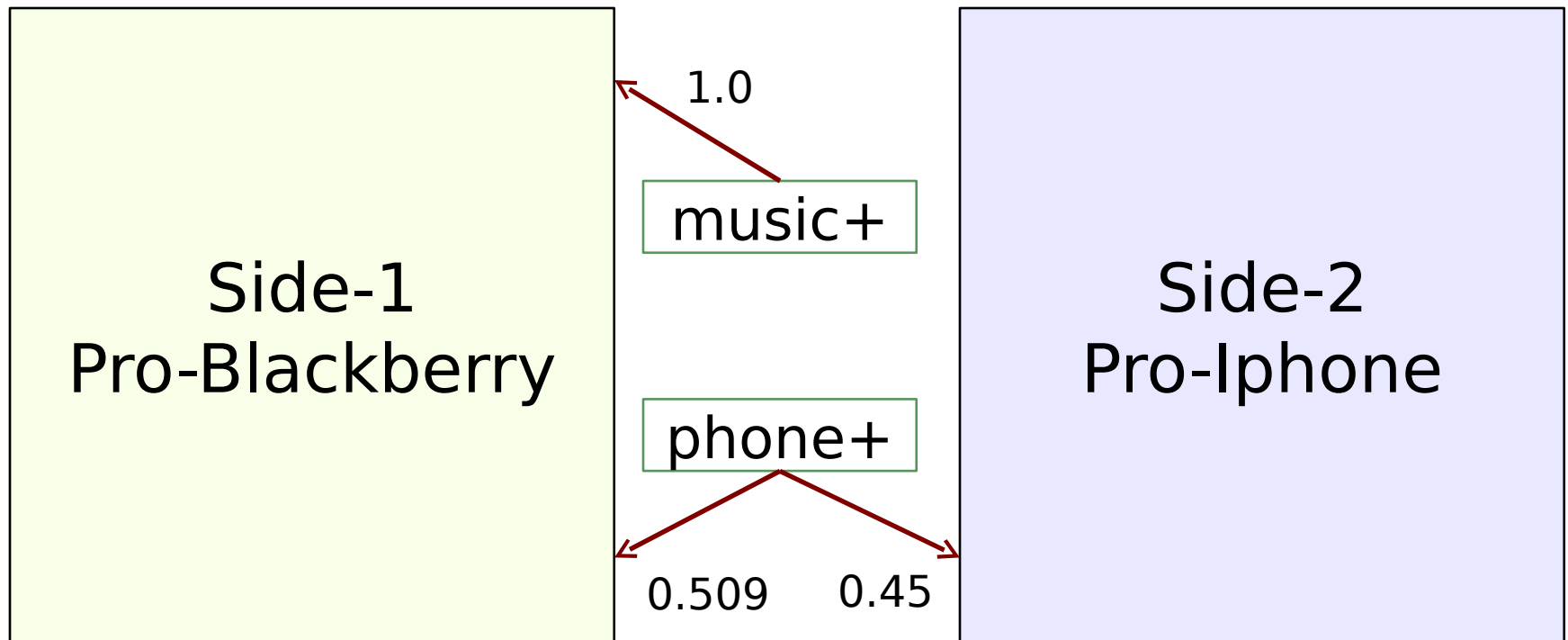
- Find Concession indicators
 - Discourse connectives from Penn Discourse Treebank (Prasad et al., 2007)
- Use simple rules to find the conceded part of the sentence
 - **While** the *iPhone* looks nice and does play a decent amount of music, *it can't compare in functionality* to the BB.
 - I like my *music*, and *phone*, **but** I don't want to *carry a brick around* in my pocket when I only need my phone.

Concession Handling



Original associations learnt from the web

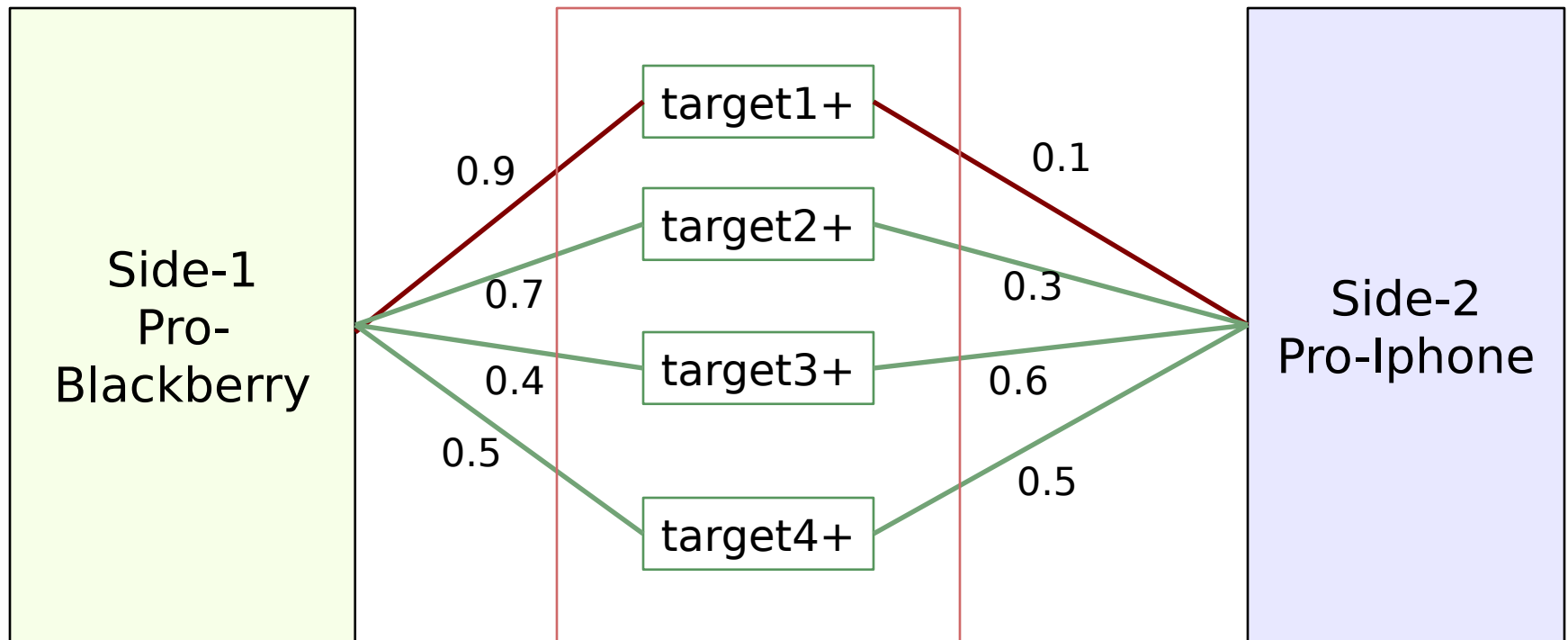
Concession Handling



Associations after concession handling

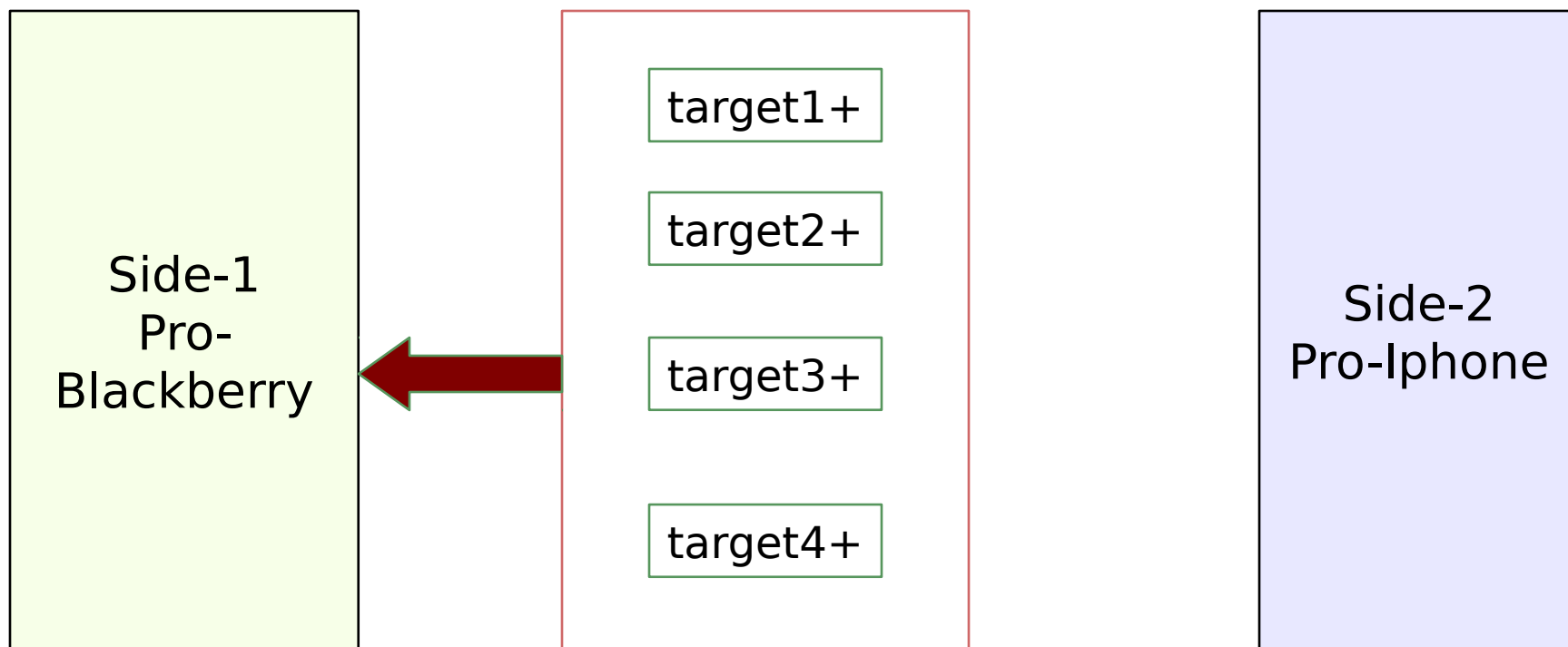
Conceded opinions are counted for the opposite side

Aggregation



Each opinion-target pair in the post has a bias toward one or the side

Aggregation



Each opinion-target pair in the post has a bias toward one or the other side.
Assign the side to the post which maximizes the association value of the post

Political and Ideological Debates

- Many websites
- Controversial issues such as gun control, healthcare, belief in God
- Topic is often a proposition or question
 - All health care should be free
 - Should marriage for same-sex couples be legal?
 - Does God really exist?
- More complex and challenging than our product debate data

Targets

- More often, targets are clauses or entire sentences rather than simple NPs
- The answer is greedy insurance companies that buy your Rep & Senator

Opinions and Targets

- Often, opinions affect more than their immediate targets
- The people are happy that Chavez has fallen (MPQA)
 - Positive toward Chavez falling and negative toward Chavez himself
- If there is a right to healthcare, you are stealing the provision of that right from someone else
 - Negative toward you and toward the right to healthcare
- Public education is beset by exploding costs, and deteriorating quality
 - Negative toward costs, quality and, ultimately, the state of public education

More variation

- The personal beliefs associated with a side are more variable
 - For example, in healthcare, some believe that socialism and universal healthcare are equated, while others do not
- In the product domains, in most cases there is some ground truth regarding the products and their features

Many open problems in subjectivity analysis

- Complex discourse structure
- Non-literal language
- Irony and sarcasm
- Inferences and world knowledge
- Good hard problems that should be around for a long time! *Leora Morgenstern, AAAI Spring Symposium on NAME*

Thank you