

What we can learn from negotiation texts

Marina Sokolova and Stan Szpakowicz
SITE, University of Ottawa

ICS PAS, December 2005



Plan of the talk

- Research agenda
- Electronic Negotiations (*E-nego*)
- *E-nego* text data
- Classification of negotiation outcomes
- Prediction of negotiation outcomes



Research agenda

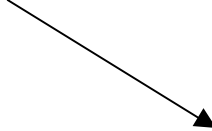
Text Analysis



Feature Selection



Text Classification



Interpretation of Results

Research agenda – continued

Hello Joe, I am a representative of ... Jane
Hello Jane, it is my pleasure ... Joe
...
I accept your offer. Best wishes, Joe 1

Jane – name, offer - nego,
pleasure - others

accept your offer → success
You should change → failure

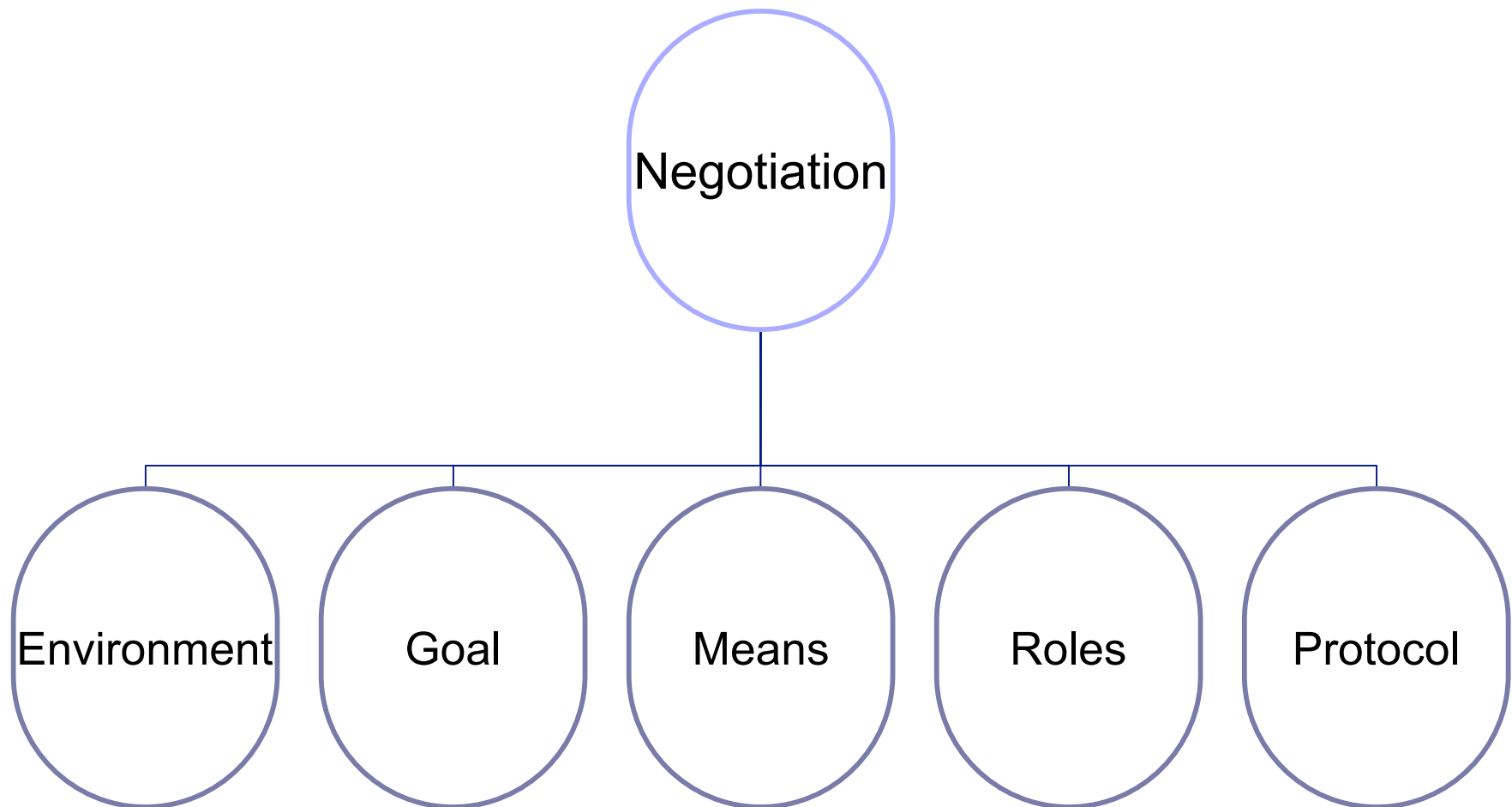
accept – 1, offer – 1
1 0 0 0 1 ... ?

Electronic Negotiations

- **Negotiation** - a process whereby two or more parties attempt to settle what each shall give and take, or perform and receive, in a transaction between them.
- In **electronic negotiations** participants negotiate by electronic means, such as email or *negotiation support systems*.



The key elements of a negotiation



E-nego – Examples of Application

- Law
- Business
- Economy
- Research and training



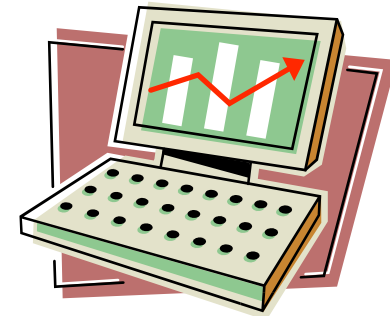
E-nego - Characteristics

■ The Negotiation Process:

- purposeful***,
- dynamic,
- multi-dimensional,
- irreversible.

■ Electronic Communication:

- characteristics of spoken *and* written language,
- business*** and personal,
- formal and informal.





Negotiation Strategies

1. **unilateral concession**, when one negotiator accepts demands and offers of the other;
2. **individual gain**, when one negotiator is interested only in maximizing her gains without considering the needs of the other party;

(continued)



Negotiation Strategies – continued

3. **competition**, which usually is connected with *distributive bargaining* when each party aims to obtain a higher share of benefits than the other;
4. **co-operation**, which is usually connected with *integrative bargaining* when the goal is to achieve the best possible deal for both parties.



The Inspire case study

Environment	<i>(Presumably) Business</i>
Means	<i>Electronic, a negotiation support system</i>
Goal	<i>To make a purchase</i>
Roles	<i>Buyer and seller</i>
Protocol	<i>Imposed by Inspire</i>



Nature of the Data: Formal Offers

A buyer's typical
starting offer

Price	\$3.47
Delivery	20 days
Payment	60 days
Returns	full price

A seller's typical
starting offer

Price	\$4.37
Delivery	60 days
Payment	Upon delivery
Returns	10%

A sample from a negotiation

(Buyer) Hi Joe, I'm Lisa and I represent Cypress Cycles in this negotiation. *After extensive deliberation we have prepared an offer to purchase sprockets and gear assemblies. We think it is a fairly good offer and hope you find it acceptable.*

(Seller) Hi Lisa, I am Joe, the representative of Itex Manufacturing and I am very delighted to get in touch with you. First of all, thank you very much for the possibility to negotiate with you and your company. *Despite your really interesting offer, it is not possible for me and my company to accept it under all circumstances. For that reason I would like to make the following proposal to you. I am very interested in what you are thinking about, so I am looking forward to hearing from you. Bye, Joe.*



Language Patterns - Roles

Roles in communication - sets of rights, obligations, and normative expectations attached to social positions.



BSN – buyers in successful negotiations

BUN – buyers in unsuccessful negotiations

SSN – sellers in successful negotiations

SUN – sellers in unsuccessful negotiations



The Inspire text data

2557 electronic negotiations

9 messages per negotiation (average)

1,514,623 word tokens

27,055 word types

1427 **successful** negotiations

1130 **unsuccessful** negotiations

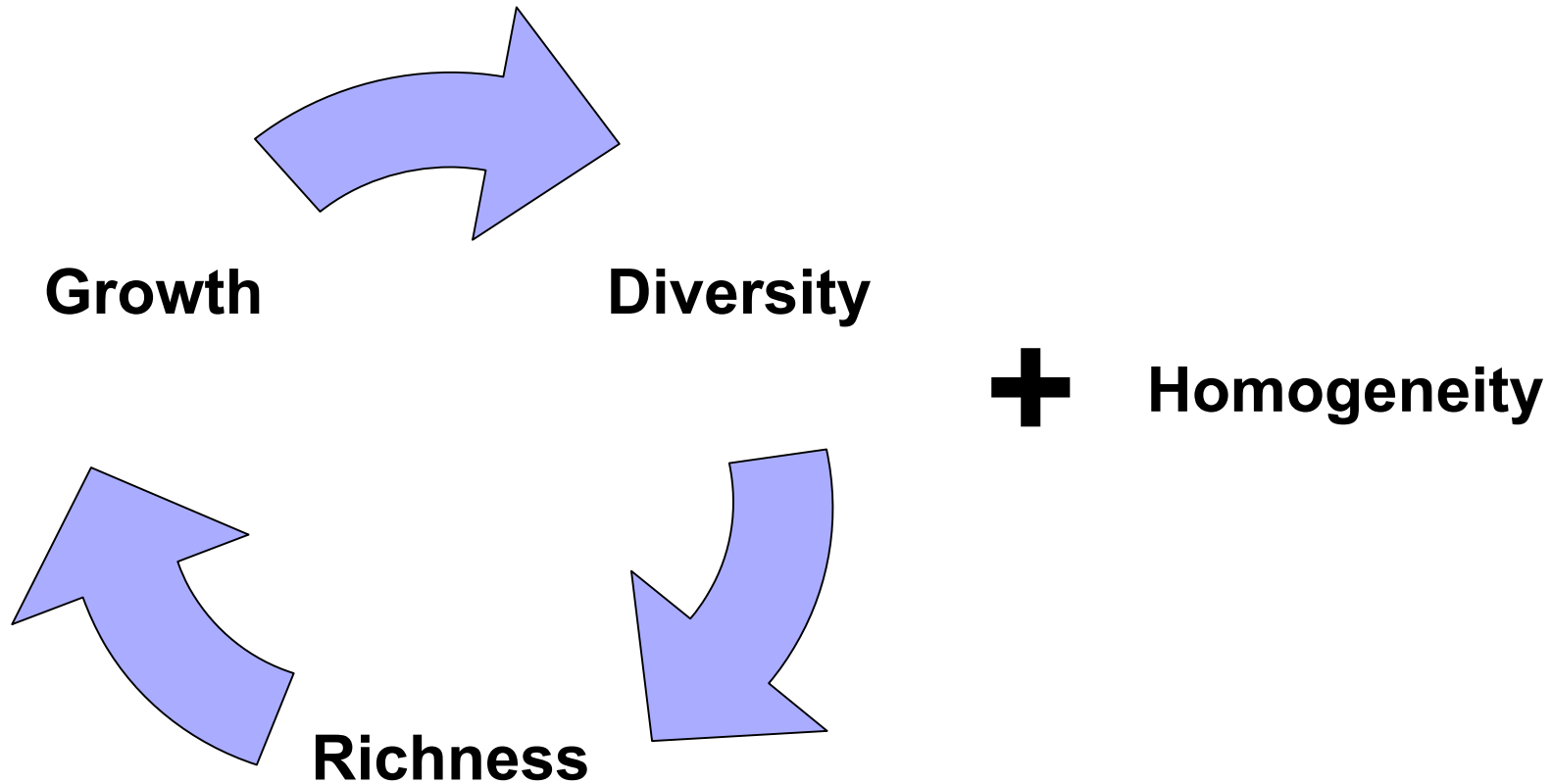
Ten most common words

Inspire	Dialogues	Brown	WSJ
to	I	the	the
I	you	of	of
you	and	and	to
the	the	to	a
a	to	a	and
and	ah	in	in
your	a	that	that
offer	it	is	for
we	in	was	one
is	know	He	is





Vocabulary Characteristics





Corpus analysis

Language with **unrestricted** growth

$$P(N) = V(1, N) / N$$

Corpus homogeneity

$$S(N) = V(2, N) / N$$

Closed domain

Similarity with the *Dialogues* corpus

$$\rho = 1 - 6 \sum d^2 / N(N^2 - 1)$$



Results of Corpus Analysis

- Language with unrestricted growth
- *Homogenous corpus*
- *Closed domain*
- Similarity with the *Dialogues* corpus



The Kneser-Ney N -gram model

$$P_{KN}(w_1 \dots w_n) = \max \{c(w_1 \dots w_{n-1}) - D, 0\} \\ + DN_{1+}(w_1 \dots w_{n-1})P_{KN}(w_n|w_2 \dots w_{n-1})$$

$c(w_1 \dots w_n)$ – the number of occurrences of the N -gram,

$$D = n_1/(n_1+n_2),$$

N_{1+} - the number of different $(N-1)$ -grams preceding w_n

The Inspire data – cross-entropy

<i>test set</i> \ <i>training set</i>	<i>Inspire</i>	<i>BSN</i>	<i>BUN</i>	<i>SSN</i>	<i>SUN</i>
<i>the same class</i>	5.69	6.42	6.61	6.57	6.57
<i>the opposite class</i>	N/A	6.33	6.64	6.48	6.55



Learning Language Traits from Corpora

- **Separate** successful and unsuccessful negotiations.
- **Build** N-grams.
- **Rank** N-grams.
- **Define** cut-off points.
- **Find** N-grams containing words from the same category that are
 - **frequent** in successful negotiations,
 - **rare** or **absent** in unsuccessful negotiations.



Representative Trigrams

<i>Successful negotiations</i>	<i>Unsuccessful negotiations</i>
I can accept that we have you can accept agree with you it is not I have made we can have	if we can will have to you will accept you will agree you are not I have not I have already



Indicative Words

Words are indicative of a corpus if they are frequent in it and rare in the other corpus:

$$LL(w) =$$

$$2 * (a * \log(\frac{a * (a+b)}{c}) + b * \log(\frac{b * (a+b)}{d}))$$

a, b - the numbers of occurrences of a word in corpora

c, d - the sizes of corpora in tokens

Indications of Argumentation (Buyers vs Sellers, the same outcomes)

Meaning	Pattern	BSN	SSN	BUN	SUN
Possibility	<i>I/we can Verb</i>	-	+	-	+
Requirement	<i>I/we must Verb</i>	+	-	+	-
Logical necessity	<i>it will Verb</i>	=	=	+	-

Verb ≠ be

- We can give
- it will wait
- ~~it will be~~

Indication of a Reaction to a Move

Pattern	BSN	SSN	BUN	SUN
the latest <i>Noun PersPron</i>	+	-	+	-
<i>PosPron</i> latest <i>Noun</i>	+	-	+	-

- the latest offer I
- your latest price

(*M. Sokolova, V. Nastase, S. Szpakowicz, ICON'04*)



Influence Strategies and Language

- substantiation, argument, persuasion;
- appeal, threat;
- agreement, refusal;
- questions, answers, exchange of offers.



Strategies and Parts-of-Speech


➤ Logical **necessity**

- *modals* — can, have to
- *not-negations* — cannot, shouldn't

➤ **Appeal**

- *personal pronouns* — I, we
- *no-negations* — never, none
- *not-negations* — not, don't
- *superlative adjectives* — latest, best

(continued)



Strategies and Parts-of-Speech – continued

- **Intention** with respect to the subject of discussion
 - *positive volition verbs* — hope, want;
 - *negative volition verbs* — decline, refuse;

- **Intention** with respect to continuation of negotiations
 - *mental verbs* — know, consider;
 - *adjectives* — new, last.



Statistical Difference

Modals	significant	-
Volition verbs	insignificant	+
Mental verbs	insignificant	+
Negations	insignificant	-

▪ means that more samples are in unsuccessful data than in successful data

⊕ means that more samples are in successful data than in unsuccessful data

(continued)



Statistical Difference – continued

<i>You PrimModal</i>	significant	-
<i>I/we PrimModal</i>	significant	+
<i>Be Not</i>	significant	-



Classification problems

- Given the text of a negotiation, is it **successful** or **unsuccessful**?
- Given the messages of a participant, is she **a buyer** or **a seller**?
- Multi-classification – a combination of these two problems.



Feature Selection

- **Process-based:**
 - Negotiation-related words
 - Strategy-related words
- **Corpus-based:**
 - Most frequent words
 - Indicative words



Negotiation-related Features

Word categories	Word types
nouns	offer, delivery, price ...
action verbs	send, return, pay ...
adjectives	recent, unacceptable ...
mental verbs	think, know
business	thanks, hope ...

(M. Shah, M. Sokolova, S. Szpakowicz, ICON'04)



Strategy-related Features

Word categories	Word types
personal pronouns	I, we, you ...
negations	no, none, nothing ...
modal verbs	can, should, might ...
mental verbs	consider, think ...
volition verbs	accept, promise ...
adjectives	last, next, final, latest

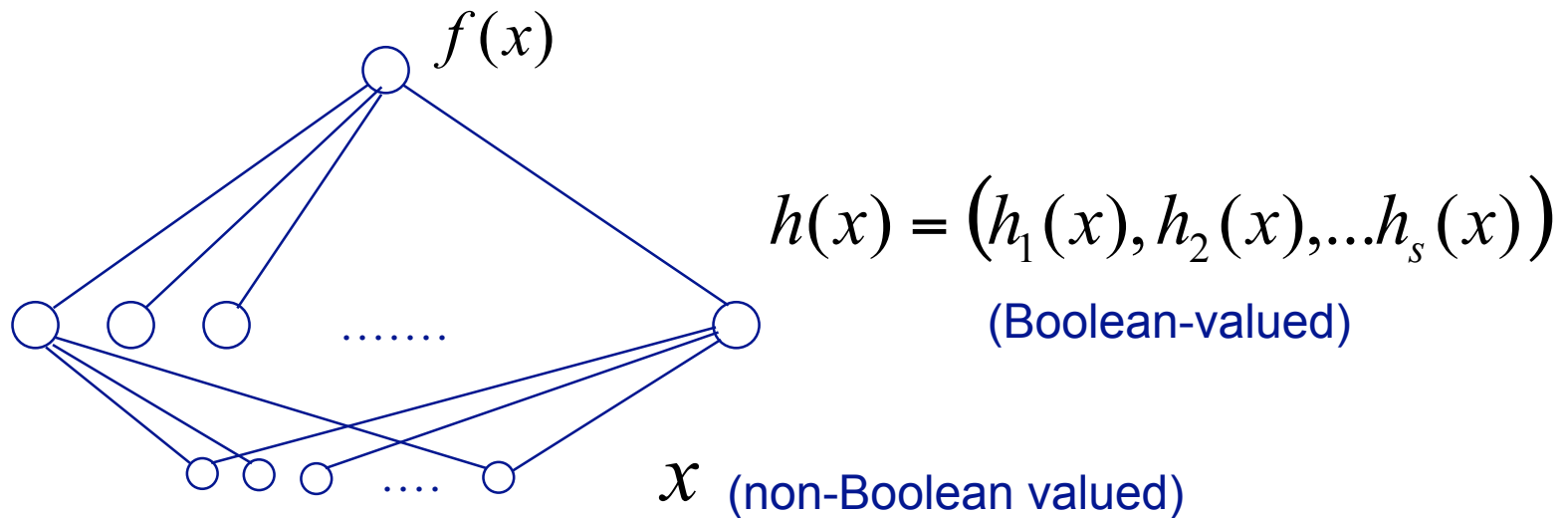
(M. Sokolova & S. Szpakowicz, AI'05)



Experimental Setting

- We **represent** the text of a negotiation as bags of
 - negotiation-related words,
 - words found by BestFirst,
 - words found by InfoGain,
 - casual talk words.
- Classifiers:
 - Support Vector Machine (*SVM*),
 - Decision Tree Induction (*C5.0*),
 - Naïve Bayes (*NB*),
 - Decision List Machine (*DLM*).

The Decision List Machine (DLM)



- Map x onto Boolean-valued feature vector $h(x)$
- Build a decision list $f(x)$ of a small number of these features

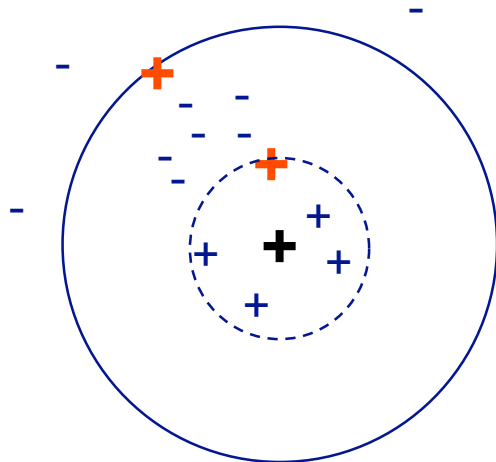
(M. Marchand & M. Sokolova, *JMLR*, 6, 2005)

DLM with Data-Dependent Balls

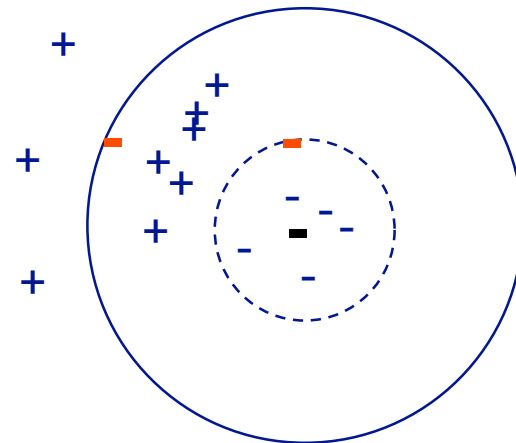
- Choose a metric $d(x, x')$
- For each training example x_i of class y_i and for any radius ρ , $h_{i,\rho}$ is a ball centered on x_i :

$$h_{i,\rho}(x) = \begin{cases} y_i & \text{if } d(x, x_i) \leq \rho \\ 1 - y_i & \text{otherwise} \end{cases}$$

Positive center



Negative center



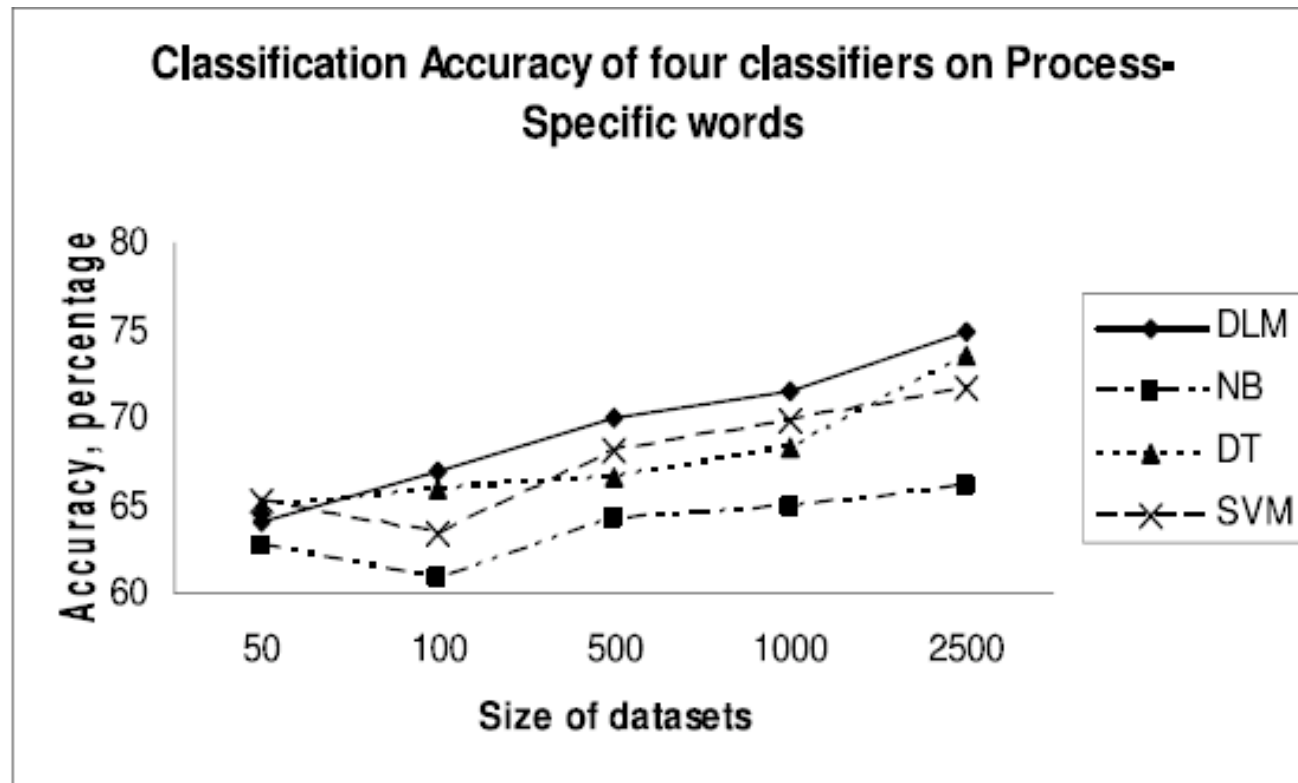


Accuracy of Classification (numerical attributes)

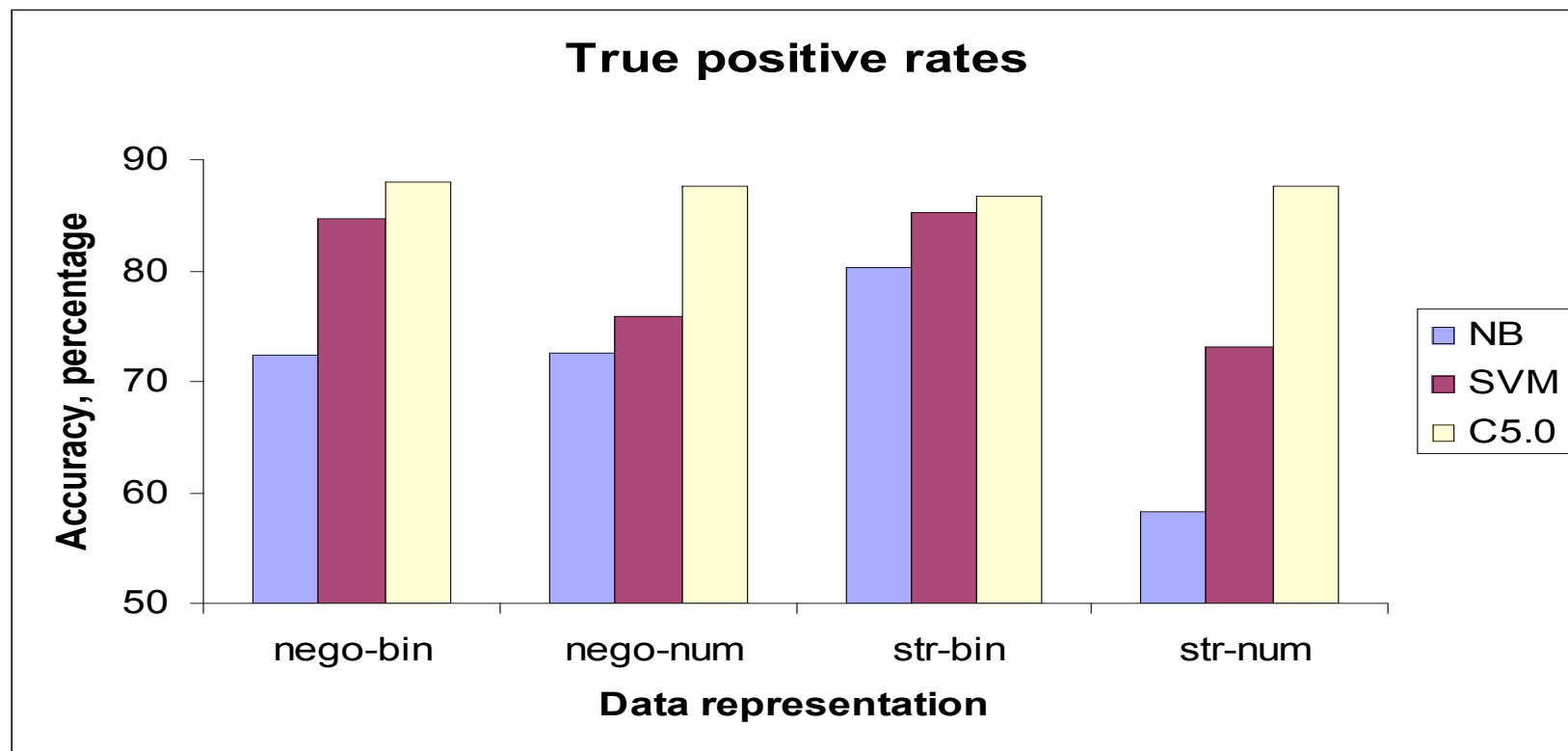
Features	NB	SVM	C5.0	DLM
<i>Negotiation</i>	66.1	71.7	72.4	75.0
<i>BestFirst</i>	62.4	70.6	73.5	71.4
<i>InfoGain</i>	65.3	71.7	71.8	70.8
<i>Casual Talk</i>	65.3	66.5	72.6	71.1

Baseline accuracy = 55.8 = 1427/(1427+1130)

Classification on various data sizes

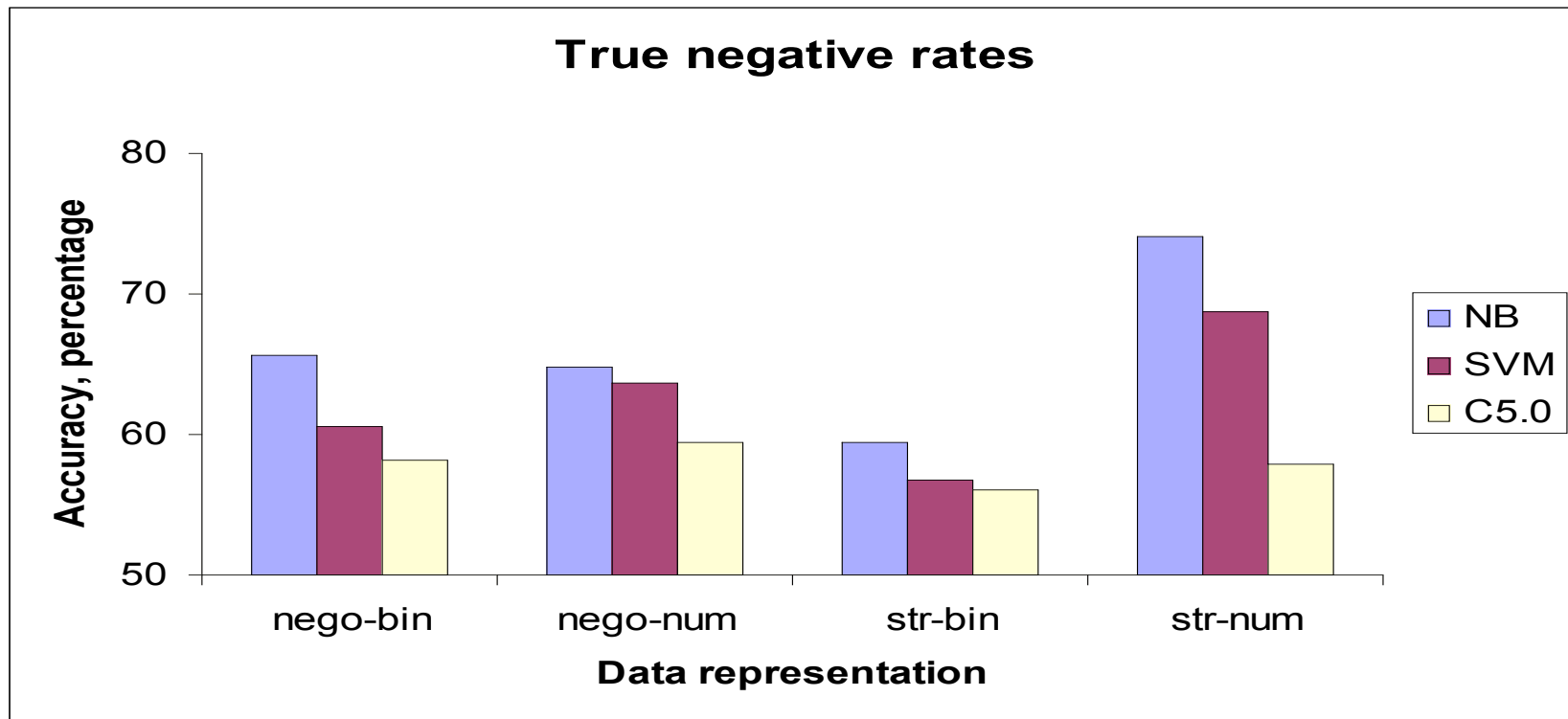


Classification of successful negotiations



(M. Sokolova, V. Nastase, M. Shah, S. Szpakowicz, RANLP'05)

Classification of unsuccessful negotiations



(M. Sokolova, V. Nastase, M. Shah, S. Szpakowicz, RANLP'05)



Other Learning Problems

- Hierarchical Classification
- Multiple Viewers
- Dialogue Analysis
- Implicit Questions
- Emotion Detection



Characteristics of Communication

Politeness

InfOrmal language

Casual Talk

Personal

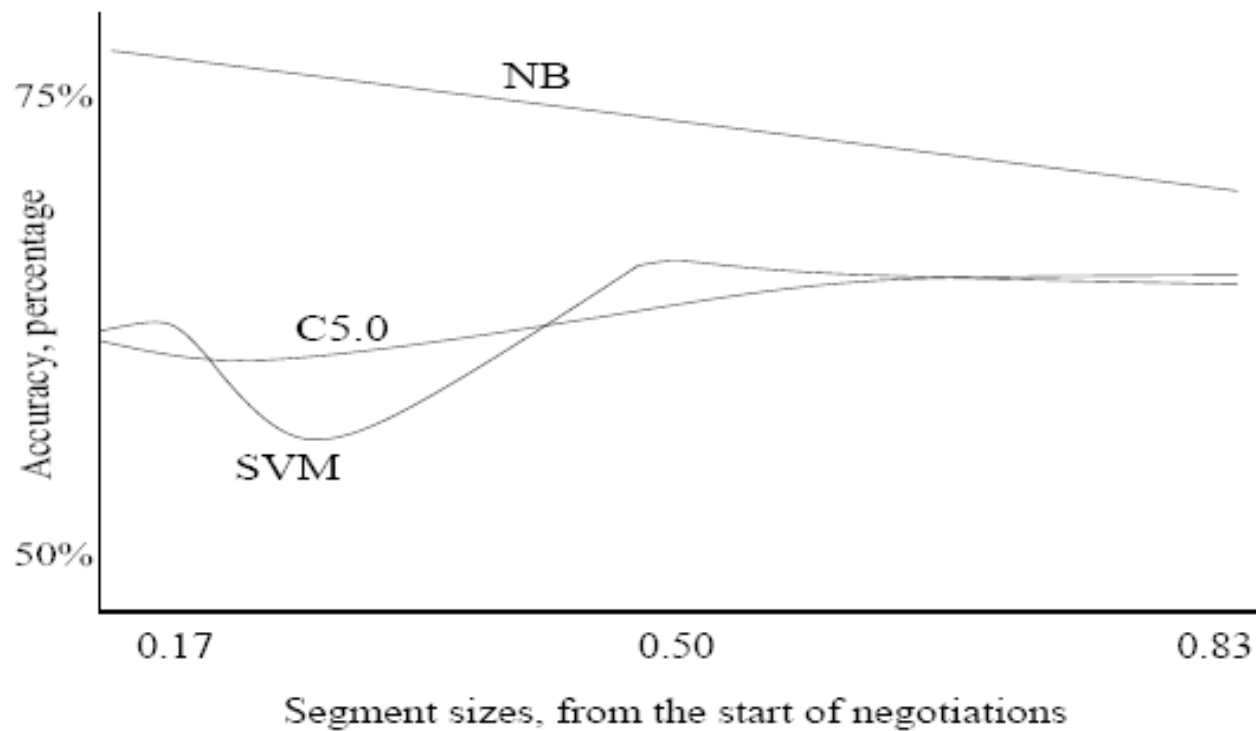
Involvement



A Line of Research

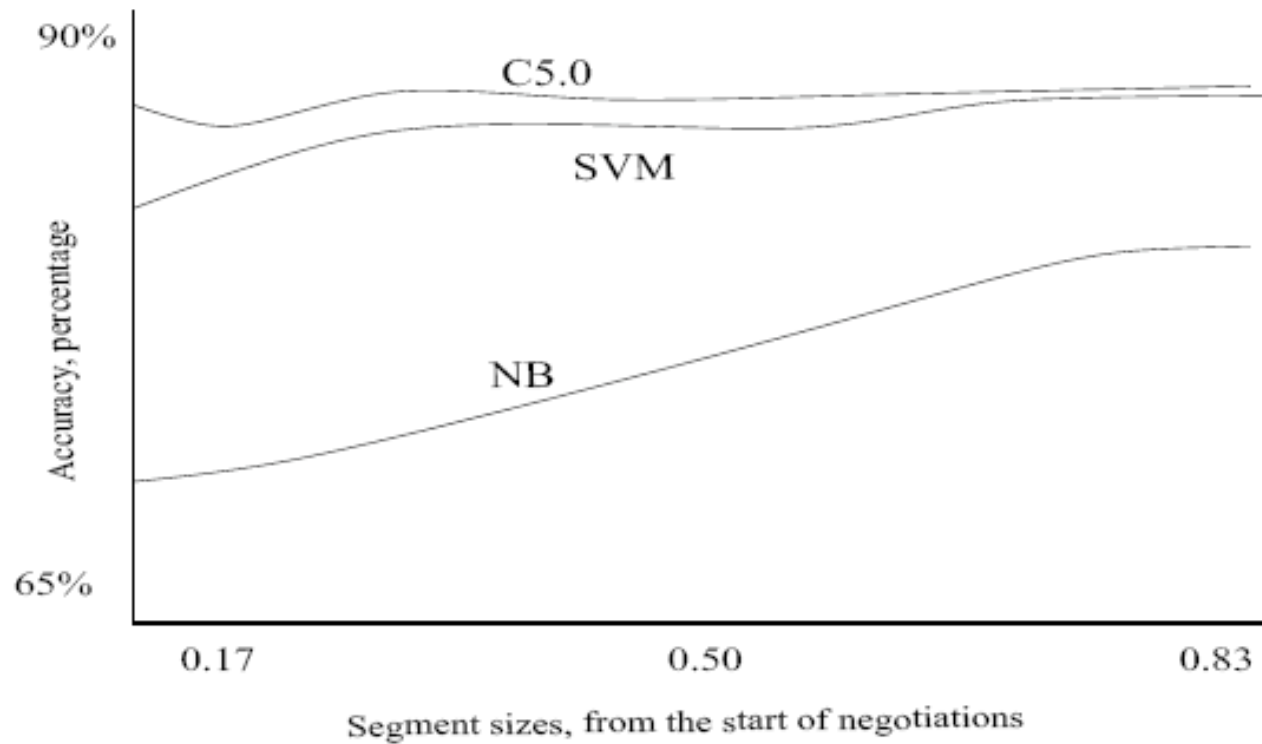
- Background: The language of the ***first part of negotiations*** is the better predictor of the outcome (*this happens in face-to-face negotiations*).
- We want to try other communication trends, for example, exchange of information (questions and answers) and personal power (emotions).

Prediction of unsuccessful outcomes





Prediction of successful outcomes





Personal Power

- Attractiveness
- **Emotion**
 - subjectivity analysis by *Wiebe et al.*,
 - sentiment analysis by *Lee et al.*,
 - analysis of conversation by *Lapalme et al.*
- Integrity
- ***Persistence – implicit questions***
- Tenacity



Other Future Work

- Other languages.
- Transcripts of phone negotiations.
- Chat boards, news groups, email, AIM.
- Language patterns signaling threats, intimidation.
- And so on.



References

Journal paper

- M. Sokolova, M. Shah and S. Szpakowicz, "Comparative Analysis of Text Data in Successful Face-to-Face and Electronic Negotiations", *Group Decision and Negotiations*, to appear in 2006, 15 pages.

Book chapters

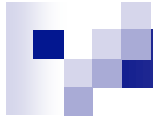
- M. Sokolova, V. Nastase, S. Szpakowicz and M. Shah (2005), "Analysis and Models of Language in Electronic Negotiations", *Issues in Systems. Models and Techniques*, M. Draminski *et al* (ed), 197 - 211;

Conference papers

- M. Sokolova, V. Nastase, M. Shah and S. Szpakowicz (2005), "Feature Selection for Electronic Negotiation Texts", *Proceedings of RANLP'05*, 518 - 524 ;
- M. Sokolova and S. Szpakowicz, (2005), "Analysis and Classification of Strategies in Electronic Negotiations", *Advances in Artificial Intelligence (Proceedings of AI'05)*, 18, 145 - 157;
- M. Sokolova, V. Nastase and S. Szpakowicz, (2004), "Language in Electronic Negotiations: Patterns in Completed and Uncompleted Negotiations", *Natural Language Processing (Proceedings of ICON'2004)*, 142 -151;
- M. Shah, M. Sokolova and S. Szpakowicz (2004), "The Role of Domain-Specific Knowledge in Classifying the Language of E-negotiations", *Natural Language Processing (Proceedings of ICON'2004)*, 99 - 108;
- M. Sokolova, S. Szpakowicz and V. Nastase, (2004), "Using language to Determine Success in Negotiations: A Preliminary Study", *Advances in Artificial Intelligence (Proceedings of Canadian AI'04)*, 449 – 454.

Submitted

- M. Sokolova and S. Szpakowicz, "Strategies and Language Trends in Electronic Business Negotiations".



Thank you!



Face-to-face Negotiations – the Cartoon case study

Environment	<i>Business</i>
Means	<i>Face-to-face</i>
Goal	<i>To make a purchase</i>
Roles	<i>Buyer and seller</i>
Protocol	<i>Imposed by Cartoon</i>

40 negotiations



Cartoon negotiations - example

Buyer: Why are you selling the program for re-runs earlier than scheduled?

Seller: Because it's been very popular, and the demand is very high. It's expected to achieve high rating. 10% during the early evening hours.

Buyer: But if I want to show the program to adults also, I cannot show it during early evening hours.

Seller: That's true.

Buyer: That means that I may not be able to achieve high rating.

Seller: But during the time that mothers are preparing dinner, kids can watch and have the control of what programs they want to watch, so it's a good time to show the program.



Cartoon negotiations – example

Buyer : You said that it's still very popular, right?

Seller : Yes. You may have seen goods and related products being very popular. Ultra Ranger is phenomenal! There are many children who like the program like crazy.

Buyer : How much did you spend to develop the program?

Seller : Production costs?

Buyer : Yes, only if you can give me the information.

Seller : Hmm...Sorry I don't have the number today.



Inspire Negotiations - example

Buyer : Hello dex What's the weather like in **germany?**. I'm glad to see i'm going to be negotiating with someone who know's their products. But the offer you sent **me,seemed** a bit closed off. I'm sure you don't quote this price to all your clients. I know your bicycle line is of high quality, that's why I came to you in the first place. My company and I would love to have you as a long term supplier, so again if want to look over my offer and get back to me.. Thank you and I'll hear from you soon.. -Eddie

Buyer: Hey dex Are we still negotiating**????**, Hope everything is ok in your part of the world...Over here in Aussie is fine, so when your ready, i'll will here from you.
~Eddie :)



Inspire Negotiations - example

Seller: Hi Ed. Our negotiation is still going on... don't **panik** :-)) We've checked your offer until now. At first glance the offer seems much better than the first one. With all due respect we could not really understand the price you've quoted us. You can be sure that we've quoted your firm the best price for our products unrivaled in quality because we know the pressure of competition in our market. But –we're so sorry- in the moment we've some serious problems with early delivery due to a strike of our staff. For this reason we would prefer a 45 day delivery at a bargain price: \$3.98/piece Finally we perfectly sure about the high quality of our products so If any piece is fault you get the full price and we pay the shipping on all returned goods. Does that sounds ok for you? I look forward to hearing from you... schneidex

Vocabulary

<i>Characteristics</i>	<i>Funct(N)</i>	<i>Cartoon</i>	<i>Inspire</i>
<i>diversity</i>	TT(N)	0 . 027	0 . 023
<i>growth</i>	P(N)	0 . 4	0 . 5
<i>homogeneity</i>	S(N)	0 . 076	0 . 002
<i>diversity</i>	Bi(N)	0 . 29	0 . 3
<i>diversity</i>	Tri(N)	0 . 68	0 . 49

N is the number of words in the data:

1,500,000 words in Inspire, 160,000 words in Cartoon