Lecture 12: Figurative language processing

Literal and figurative language

Statistical modelling of metaphor

Metaphor interpretation
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Metaphor interpretation
Figurative language

Semantic shift: words do not appear in their default meanings, some semantic incongruity is evident

- Metaphor (*Inflation has eaten up all my savings.*)
- Metonymy (*He played Bach. He bought a Picasso.*)
- Irony (*November... my favourite month!*)
- Humor (*Exaggeration is a billion times worse than understatement!*)

Interpretation of figurative language and humor is very challenging for NLP.
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Statistical modelling of metaphor

Metaphor interpretation
What is metaphor?
What is metaphor?

“A political machine”

“The wheels of the regime were well oiled and already turning”

“Time to mend our foreign policy”

“20 Steps towards a Modern, Working Democracy”
How does it work?

Conceptual Metaphor Theory
(Lakoff and Johnson, 1980. *Metaphors we live by.)*

Metaphorical associations between concepts

`POLITICALSYSTEM` is a `MECHANISM`

Cross-domain knowledge projection and inference
Reasoning about the target domain in terms of the properties of the source
Metaphor influences our decision-making

Thibodeau and Boroditsky, 2011. *Metaphors We Think With: The Role of Metaphor in Reasoning*

► investigated how metaphor influences decision-making
► subjects read a text containing metaphors of either
   1. CRIME IS A VIRUS
   2. CRIME IS A BEAST
► then they were asked a set of questions on how to tackle crime in the city
   1. preventive measures
   2. punishment, restraint
Metaphor processing tasks

1. Learn metaphorical associations from corpora
   
   “POLITICAL SYSTEM is a MECHANISM”

2. Identify metaphorical language in text
   
   “mend the policy”

3. Interpret the metaphorical language
   
   “mend the policy” means “improve the policy; address the downsides of the policy”
Example feature vectors (verb–object relations)

N: game
1170 play
202 win
99 miss
76 watch
66 lose
63 start
42 enjoy
22 finish
...
20 dominate
18 quit
17 host
17 follow
17 control
...

N: politics
31 dominate
30 play
28 enter
16 discuss
13 leave
12 understand
8 study
6 explain
5 shape
4 influence
4 change
4 analyse
...
2 transform
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Statistical modelling of metaphor
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NEED TO FIND A WAY TO PARTITION THE SPACE.


Soft clustering

- **Hard clustering**: each data point assigned to one cluster only (as in our k-means experiment)
- **Soft clustering**: each data point is associated with multiple clusters with a membership probability
Soft clustering for metaphor identification

Shutova and Sun, 2013. *Unsupervised metaphor identification using hierarchical graph factorization clustering*
Creating the graph

- **ALGORITHM**: Hierarchical graph factorization clustering (Yu, Yu and Tresp, 2006. *Soft clustering on graphs*)
- **DATASET**: 2000 most frequent nouns in the BNC
- **FEATURES**: subject, direct and indirect object relations; verb lemmas indexed by relation type (extracted from the Gigaword corpus)
- **LEVELS**: 10
Hierarchical clustering using graph factorization
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Hierarchical clustering using graph factorization
Identifying metaphorical associations in the graph

- start with the source concept, e.g. "fire"
- output a ranking of potential target concepts

SOURCE: fire
TARGET: sense hatred emotion passion enthusiasm sentiment hope interest feeling resentment optimism hostility excitement anger

TARGET: coup violence fight resistance clash rebellion battle drive fighting riot revolt war confrontation volcano row revolution struggle

SOURCE: disease
TARGET: fraud outbreak offence connection leak count crime violation abuse conspiracy corruption terrorism suicide
TARGET: opponent critic rival
Identifying metaphorical expressions
Identifying metaphorical expressions
Metaphorical expressions retrieved

FEELING IS FIRE
anger *blazed* (Subj), passion *flared* (Subj), interest *lit* (Subj), *fuel* resentment (Dobj), anger *crackled* (Subj), *light* with hope (Iobj) etc.

CRIME IS A DISEASE
cure crime (Dobj), abuse *transmitted* (Subj), *suffer from* corruption (Iobj), *diagnose* abuse (Dobj) etc.

Output sentences from the BNC

EG0 275 In the 1930s the words "means test" was a curse, *fuelling the resistance* against it both among the unemployed and some of its administrators.

HL3 1206 [...] he would strive to *accelerate progress* towards the economic integration of the Caribbean.

HXJ 121 [...] it is likely that some *industries will flourish* in certain countries as the *market widens*. 
Multilingual metaphor processing

- Statistical methods are portable to other languages
- Metaphor identification systems for Russian and Spanish:
  - work!
  - reveal a number of interesting cross-cultural differences

Cross-cultural differences identified by the system

**Spanish**: stronger metaphors for poverty ("fight poverty, eradicate poverty" -> POVERTY IS AN ENEMY, PAIN etc.)
**English**: stronger metaphors for immigration (IMMIGRATION IS A DISEASE, FIRE etc.)
**Russian**: sporting events / competitions associated with WAR
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Metaphor interpretation
Metaphor interpretation as paraphrasing

- Derive literal paraphrases for single-word metaphors

**Phrases**
All of this *stirred* an uncontrollable excitement in her.
a carelessly *leaked* report

**Paraphrases**
All of this *provoked* an uncontrollable excitement in her.
a carelessly *disclosed* report

Shutova 2010. *Automatic metaphor interpretation as a paraphrasing task.*
Paraphrasing system overview

“carelessly leaked report” → “carelessly ... report”

1. Paraphrase selection model: meaning retention
2. WordNet similarity filtering
3. Selectional preference model: quantifying literalness
Context-based paraphrase ranking model

Example

carelessly *leaked* report $\rightarrow$ carelessly ($w_1$) ... ($i$) report ($w_2$)

$$P(i, w_1, w_2) \approx P(i)P(w_1|i)P(w_2|i) = \frac{f(w_1, i) \cdot f(w_2, i)}{f(i) \cdot \sum_k f(i_k)}$$

$$P(i) = \frac{f(i)}{\sum_k f(i_k)} \quad P(w_n|i) = \frac{f(w_n, i)}{f(i)}$$

where $f(i)$ is the frequency of the interpretation on its own

$f(w_n, i)$ - the frequency of the co-occurrence of the interpretation with the context word $w_n$. 
Shared features in WordNet

- The paraphrasing model overgenerates
- Thus we need to filter out unrelated verbs
- Metaphor is based on similarity
- We define similarity as sharing a common hypernym in WordNet

Example
How can I *kill* a process?  
How can I *terminate* a process?  
*Kill* and *terminate* share a common hypernym.
Example output

Candidate paraphrases

*stir* excitement:

-14.28 create
-14.84 *provoke*
-15.53 make
-15.53 elicit
-15.53 arouse
-16.23 stimulate
-16.23 raise
-16.23 excite
-16.23 conjure
Selectional preference model

Selectional preference strength (Resnik, 1993)

\[ S_R(v) = D(P(c|v) \parallel P(c)) = \sum_c P(c|v) \log \frac{P(c|v)}{P(c)} \]

Selectional association (Resnik, 1993)

\[ A_R(v, c) = \frac{1}{S_R(v)} P(c|v) \log \frac{P(c|v)}{P(c)} \]

\( P(c) \) is the prior probability of the noun class, \( P(c|v) \) its posterior probability given the verb; \( R \) is the GR
Paraphrasing system output

<table>
<thead>
<tr>
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<th>SP reranking</th>
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<tr>
<td>-14.28 create</td>
<td>0.0696 provoke</td>
</tr>
<tr>
<td>-14.84 <em>provoke</em></td>
<td>0.0245 elicit</td>
</tr>
<tr>
<td>-15.53 make</td>
<td>0.0194 arouse</td>
</tr>
<tr>
<td>-15.53 elicit</td>
<td>0.0061 conjure</td>
</tr>
<tr>
<td>-15.53 arouse</td>
<td>0.0028 create</td>
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<tr>
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