# Lecture 12: Figurative language processing

Literal and figurative language

Statistical modelling of metaphor

Metaphor interpretation

# Lecture 12: Figurative language processing

Literal and figurative language

Statistical modelling of metaphor

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.

# 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.

# 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.

# 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.

# 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.

# 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!*)

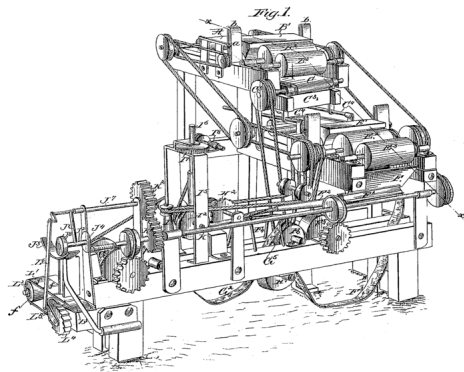Interpretation of figurative language and humor is very challenging for NLP.

# Lecture 12: Figurative language processing

Literal and figurative language

Statistical modelling of metaphor

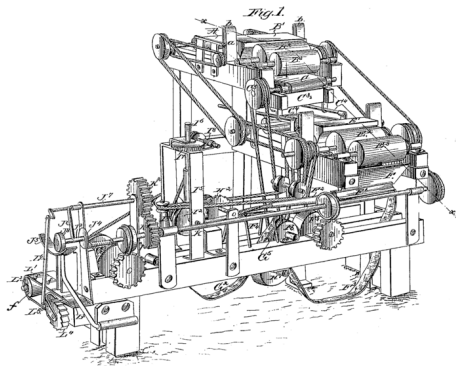Metaphor interpretation

## What is metaphor?

# What is metaphor?

"*A political machine*"

"*The wheels of the regime were well oiled and already turning*"

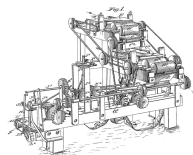"*Time to mend our foreign policy*"

"*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

$\underbrace{POLITICALSYSTEM}_{target}$ is a $\underbrace{MECHANISM}_{source}$

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
...

## Example feature vectors (verb–object relations)

| N: game | | N: politics | |
|---|---|---|---|
| 1170 | **play** | 31 | **dominate** |
| 202 | win | 30 | **play** |
| 99 | miss | 28 | enter |
| 76 | watch | 16 | discuss |
| 66 | lose | 13 | leave |
| 63 | start | 12 | understand |
| 42 | enjoy | 8 | study |
| 22 | finish | 6 | explain |
| ... | | 5 | shape |
| 20 | **dominate** | 4 | influence |
| 18 | quit | 4 | change |
| 17 | host | 4 | analyse |
| 17 | follow | ... | |
| 17 | control | 2 | transform |
| ... | | ... | |

# Example feature vectors (verb–object relations)

| N: game | N: politics |
|---------|-------------|
| 1170 play | 31 dominate |
| 202 win | 30 play |
| 99 miss | 28 **enter** |
| 76 watch | 16 discuss |
| 66 lose | 13 **leave** |
| 63 start | 12 understand |
| 42 enjoy | 8 study |
| 22 finish | 6 explain |
| ... | 5 shape |
| 20 dominate | 4 influence |
| 18 quit | 4 change |
| 17 host | 4 analyse |
| 17 follow | ... |
| 17 control | 2 transform |
| ... | ... |

# Example feature vectors (verb–object relations)

<div style="display: flex">

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
...

</div>

# 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
...

## Example feature vectors (verb–object relations)

| N: game | N: politics |
|---|---|
| 1170 play | 31 dominate |
| 202 win | 30 play |
| 99 miss | 28 enter |
| 76 watch | 16 discuss |
| 66 lose | 13 leave |
| 63 start | 12 understand |
| 42 enjoy | 8 study |
| 22 finish | 6 explain |
| ... | 5 **shape** |
| 20 dominate | 4 influence |
| 18 quit | 4 change |
| 17 host | 4 analyse |
| 17 follow | ... |
| 17 control | 2 **transform** |
| ... | ... |

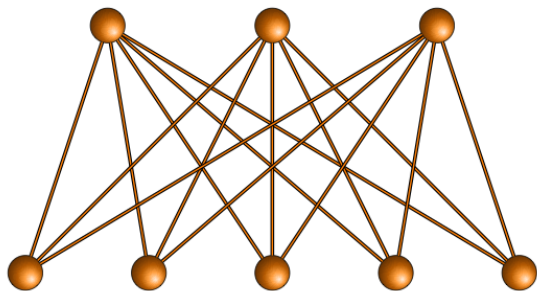# Example feature vectors (verb–object relations)

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**
...

# 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**
...

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*
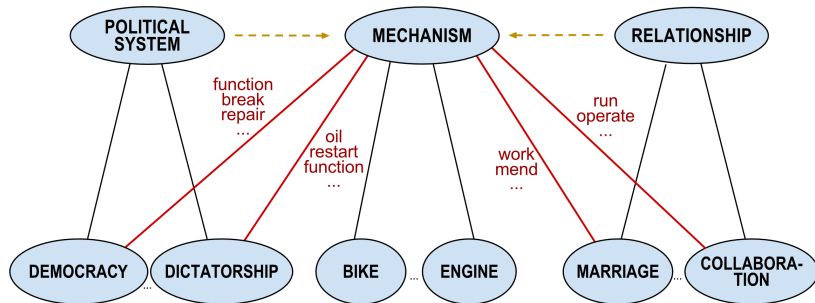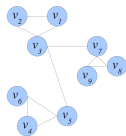
# Creating the graph

- 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)
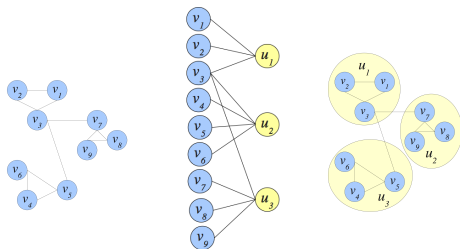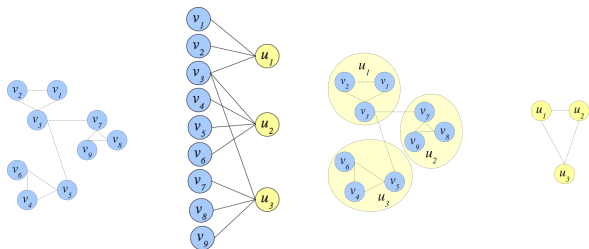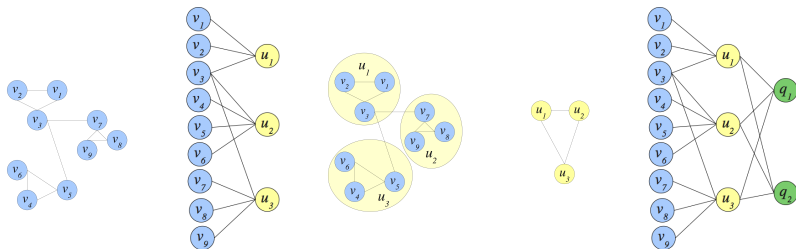- LEVELS: 10

# Hierarchical clustering using graph factorization

# Hierarchical clustering using graph factorization
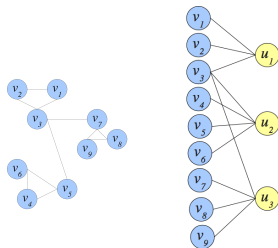
# Hierarchical clustering using graph factorization

# Hierarchical clustering using graph factorization

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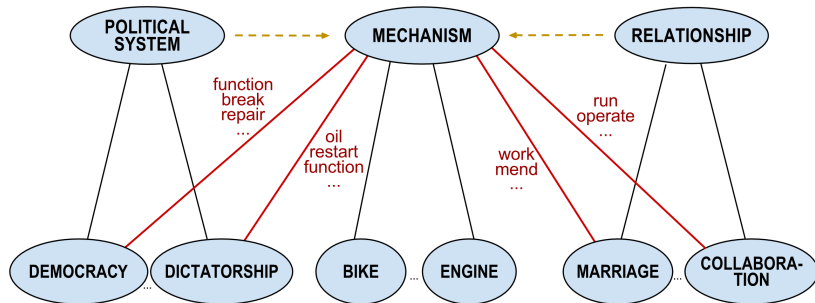TARGET: coup **violence** fight resistance clash rebellion battle drive fighting riot revolt war confrontation volcano row revolution struggle

### SOURCE: disease
TARGET: fraud outbreak offence connection leak count **crime** violation abuse conspiracy corruption terrorism suicide
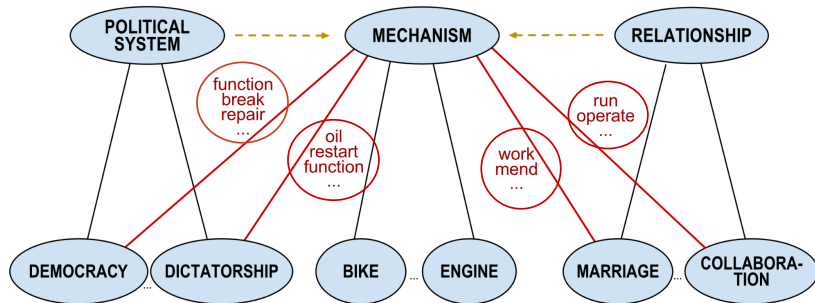TARGET: **opponent** critic rival

# 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

# Lecture 12: Figurative language processing

Literal and figurative language

Statistical modelling of metaphor

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 –> carelessly ($w_1$) ... ($i$) report ($w_2$)

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

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

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)

$$S_R(v) = D(P(c|v)||P(c)) = \sum_c P(c|v) \log \frac{P(c|v)}{P(c)}$$

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

<div>

**Initial ranking**

*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 |

</div>

<div>

**SP reranking**

*stir* excitement:

| | |
|---|---|
| 0.0696 | **provoke** |
| 0.0245 | elicit |
| 0.0194 | arouse |
| 0.0061 | conjure |
| 0.0028 | create |
| 0.0001 | stimulate |
| $\approx 0$ | raise |
| $\approx 0$ | make |
| $\approx 0$ | excite |

</div>