

Word representations and modelling ambiguity: A case study of metaphor

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2 May 2018

Polysemy and word senses

The children **ran** to the store

If you see this man, **run**!

Service **runs** all the way to Cranbury

She is **running** a relief operation in Sudan

the story or argument **runs** as follows

Does this old car still **run** well?

Interest rates **run** from 5 to 10 percent

Who's **running** for treasurer this year?

They **ran** the tapes over and over again

These dresses **run** small

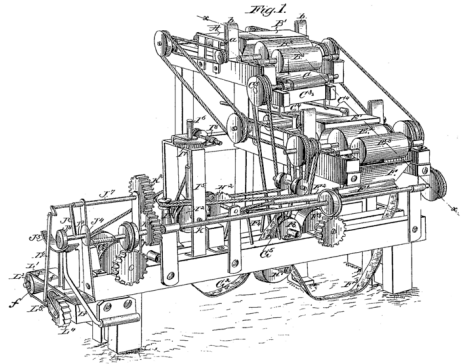
Polysemy

- **homonymy**: unrelated word senses. *bank* (raised land) vs *bank* (financial institution)
- *bank* (financial institution) vs *bank* (in a casino): related but distinct senses.
- **regular polysemy** and sense extension
 - zero-derivation, e.g. *tango* (N) vs *tango* (V), or *rabbit*, *turkey*, *halibut* (meat / animal)
 - metaphorical senses, e.g. *swallow* [food], *swallow* [information], *swallow* [anger]
 - metonymy, e.g. he played *Bach*; he drank his *glass*.
- vagueness: *nurse*, *lecturer*, *driver*
- cultural stereotypes: *nurse*, *lecturer*, *driver*

No clearcut distinctions.

Dictionaries are not consistent.

What is metaphor?



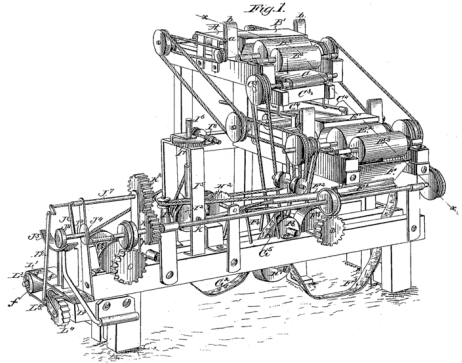
What is metaphor?

“A political *machine*”

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

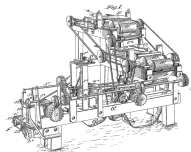
“Time to *mend* our foreign policy”

“20 Steps towards a Modern, *Working* Democracy”



How does it work?

Conceptual Metaphor Theory
(Lakoff and Johnson, 1980)



Metaphorical associations between concepts

POLITICALSYSTEM is a ***MECHANISM***
target *source*

Cross-domain knowledge projection and inference

Reasoning about the target domain in terms of the properties of the source

Computational 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”

Metaphor in the distributional space

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
...
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...

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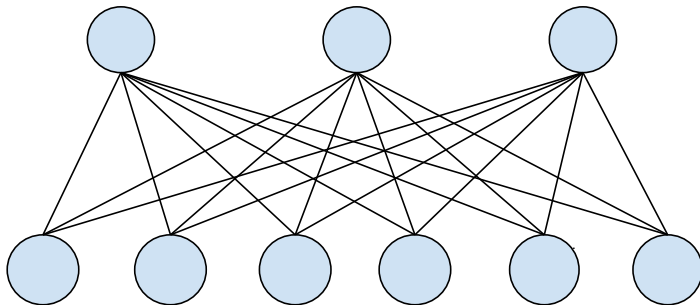
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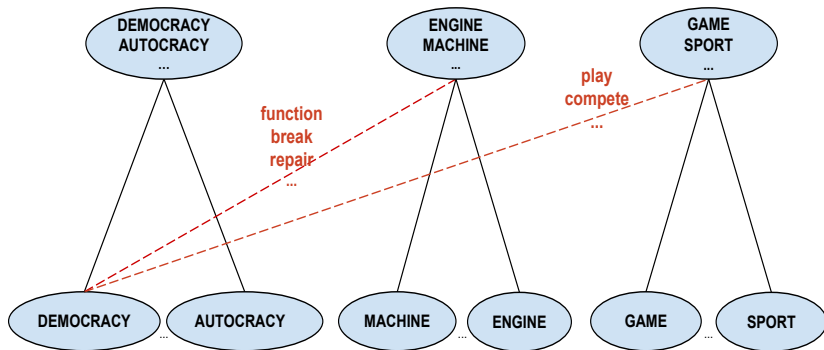
NEED TO FIND A WAY TO PARTITION THE SPACE

Learning metaphorical associations by soft clustering

Unsupervised Metaphor Identification Using Hierarchical Graph Factorization Clustering. Shutova and Sun, 2013. NAACL.



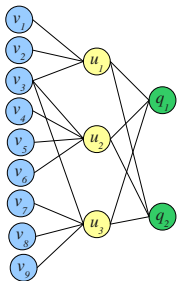
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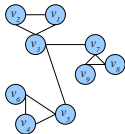
Creating the graph

Experimental setup

- **ALGORITHM:** Hierarchical graph factorization clustering (Yu, Yu, Tresp, 2006)
- **DATASET:** 2000 frequent nouns
- **FEATURES:** verbs in subject, direct and indirect object relations (Gigaword corpus)
- **LEVELS:** 10



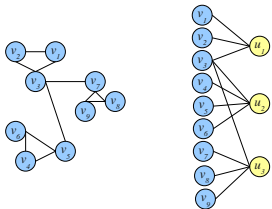
Hierarchical clustering using graph factorization



Similarity matrix W :

$$w_{ij} = JSD(v_i, v_j)$$

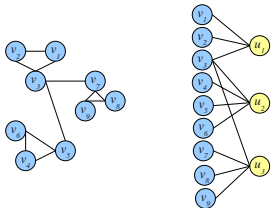
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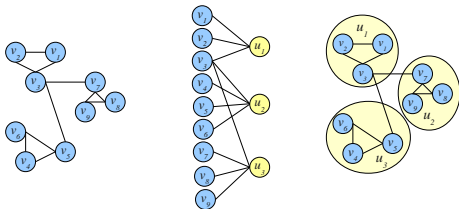
Similarity matrix W :
 $w_{ij} = JSD(v_i, v_j)$

$$W': w'_{ij} = \sum_{p=1}^m \frac{b_{ip}b_{jp}}{\lambda_p}$$

b_{ip} – connection weight

$$\lambda_i = \sum_{i=1}^n b_{ip}$$

Hierarchical clustering using graph factorization



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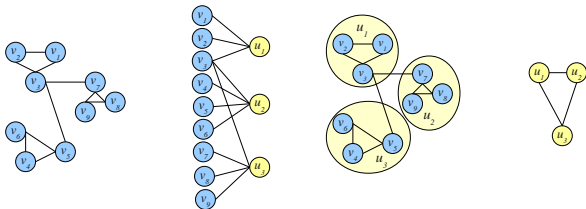
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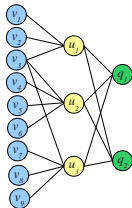
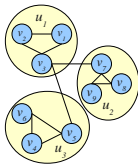
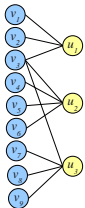
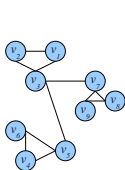
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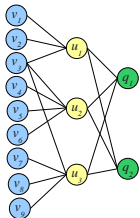
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Identifying metaphorical associations in the graph

- 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

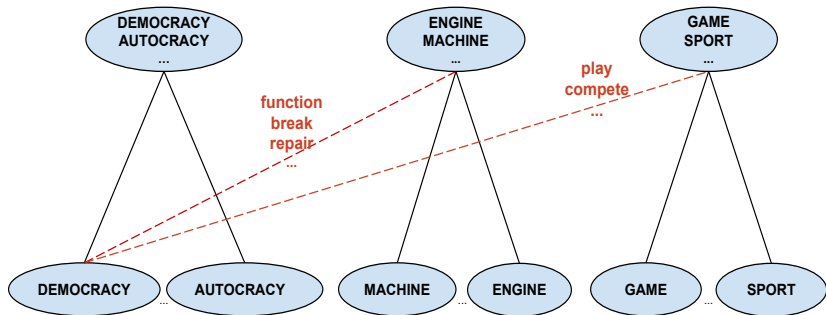
TARGET: coup **violence** fight resistance clash rebellion battle drive fighting riot revolt war confrontation volcano row revolution struggle

SOURCE: disease

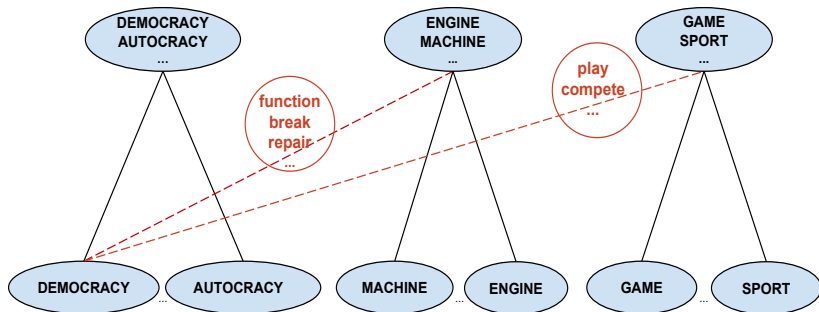
TARGET: fraud outbreak offence connection leak count **crime** violation abuse conspiracy corruption terrorism suicide

TARGET: **opponent** critic rival

Identifying metaphorical expressions



Identifying metaphorical expressions



Metaphorical expressions retrieved

FEELING IS FIRE

anger *blazed*
passion *flared*
fuel resentment
anger *crackled* etc.

CRIME IS A DISEASE

cure crime
abuse *transmitted*
suffer from corruption
diagnose abuse etc.

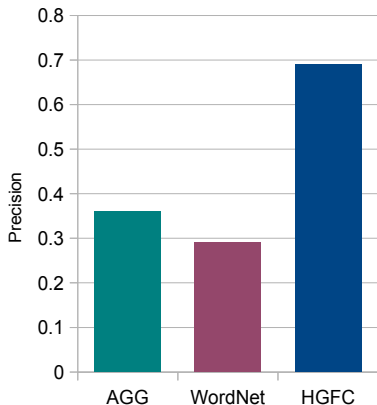
Output sentences from the BNC

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**.

How well does it work?



Multilingual metaphor processing
(Shutova et al. 2017,
Computational Linguistics)

Cross-cultural differences

Spanish: poverty metaphors
POVERTY IS AN ENEMY, PAIN

English: immigration metaphors
IMMIGRATION IS A DISEASE, FIRE

Russian: sporting events / competi-
tions associated with WAR