MetaNet: Repository, Identification System, and Applications

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Schedule Overview

14:00  High-level Overview
14:05  I: Background to FrameNet and the Constructicon
14:45  II: Overview of MetaNet
   a. Conceptual Metaphor Theory
   b. The MetaNet Repository
15:30-16:00  COFFEE BREAK
   c. The Metaphor Identification System
16:00  III: Applications
16:45  IV: Challenges and Opportunities
17:30  END of TUTORIAL
High-level Introduction

– What are *metaphors*?
– Why is *metaphor* important?
– Approaches to *metaphor analysis*
What are Metaphors?

• Metaphors provide a way to reason about one domain of experience (the target domain) in terms of some other domain (the source domain).

• Prototypically, the source domain draws on our rich and complex knowledge of the world
Metaphor Examples

Social problems (the target domain) are often discussed in terms of disease (the source domain):

- Poverty is the world's deadliest disease.

• This city is experiencing an epidemic of gun violence.
Why are Metaphors Important?

• Metaphoric phrases are expressions of more general systems of conceptual metaphors.

• For example:
  – Poverty and gun violence are plagues/epidemics/infections
  – We need to cure/alleviate/treat/eradicate these problems.

→ Social problems are diseases that need to be cured

• Comprehensive metaphor analysis needs to do more than just identify whether specific words are being used metaphorically (or not)
Challenges of Analyzing Metaphor

• While humans are not necessarily conscious of using and understanding metaphors, they are pervasive in language.

• Comprehensive metaphor analysis must do more than just identify whether specific words are used metaphorically (or not).

• Current metaphor research methodologies cannot perform both large-scale and in-depth metaphor analysis adequately.
Challenges of Analyzing Metaphor

• Manual methods that rely on human experts (e.g. Pragglejaz Group 2007):
  – Find metaphors in text accurately, and support in-depth detailed analyses
  – Time and resource intensive, and difficult to scale

• Computational approaches (e.g. Neuman et al. 2013, Shutova et al. 2010, Shutova et al. 2012):
  – Well equipped to perform large-scale data processing
  – Typically produce shallow results and fail to capture much relevant information needed for in-depth metaphor analysis
Challenges of Analyzing Metaphor

• Corpus linguistic approach (Stefanovich & Gries 2006; Lederer 2015, 2016, forthcoming)
  • Intermediate in scale of processing
  • Time-consuming to expand to new domains

• MetaNet (Dodge et al. 2015)
  • Computational metaphor identification system supports analysis of large-scale text corpora
  • Knowledge base of metaphors facilitates in-depth metaphor analysis
  • Readily extendable to new domains
Thanks!
Background to FrameNet and the FrameNet Constructicon

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Road Map

• Frame Semantics and FrameNet

• Construction Grammar and the FrameNet Constructicon

• FrameNet’s Treatment of Metaphor
Road Map

✓ Frame Semantics and FrameNet

• Construction Grammar and the FrameNet Constructions

• FrameNet’s Treatment of Metaphor
What is FrameNet?

• A unique knowledge base with information on the mapping of meaning to form through the theory of Frame Semantics (Fillmore 1975, 1985, Fillmore and Atkins 1986, Fillmore and Baker 2010, Fillmore 2012, Fontenelle 2003, Petruck 1996)

• A resource that provides rich semantics for the core English vocabulary based on manually annotated corpus evidence, including valence descriptions for each item analyzed
Frame Semantics

...defines words in terms of experience-based schematizations of the speaker’s world – i.e. semantic frames, or script-like structures of inferences that characterize a type of situation, object, or event in terms of its semantic roles, i.e. frame elements, or participants and other conceptual roles thus providing the background and motivation for the existence and meaning of words in a language.
What’s “in” FrameNet?

• ~ 1,200 semantic frames (including FEs)
• ~ 13,500 lexical units
• > 202,000 manually annotated examples
• > 1,800 frame-to-frame relations constituting a hierarchy of semantic frames
What’s a Frame?

A Semantic Frame is a script-like structure of inferences, linked by linguistic convention to the meanings of linguistic units - here, lexical items - constituting a schematic representation of a situation, object, event, or relation providing the background structure against which words are understood. Each frame identifies a set of frame elements – participants in the frame.
Semantic Frames in FrameNet

• Situation: Being_attached, Being_necessary, Being_strong, Being_wet, etc.

• Event: Attack, Borrowing, Catching_fire, Cooking_creation, Hiring, Replacing, etc.

• Object: Buildings, Containers, Intoxicants, Offenses, People_by_origin, etc.

• Relations: Locative_relation, Spacial_co-location, Interior_profile_relation, Similarity, etc.
What’s “in” a Frame?

• **Frame Definition**
  a prose description of a *situation* involving various participants and other conceptual roles, each of which constitutes a frame element

• **Frame Elements (FEs):**
  semantic roles as the basic unit of a frame, defined specifically to each frame

• **Lexical Units (LUs):**
  pairing of a lemma and a frame, i.e. “word” in one of its senses; LU evokes a frame
Example: Attack.attack.v

- **Attack:** a situation in which an **ASSAILANT** physically attacks a **VICTIM** (usually sentient), causing or intending to cause the **VICTIM** physical damage; a **WEAPON** that the **ASSAILANT** uses may also be mentioned

- LUs: ambush.n, assailant.n, assail.v, assault.n, assault.v, attacker.n, attack.v, bomb.v, charge.n, bombardment.n, bombing.n, charge.v, offensive.a, set (upon).v, small arms fire.n
Example: Attack.attack.v

Cannonical Example:

[The bear \textit{Assailant}] \textbf{ATTACKED} [the man \textit{Victim}].

Corpus Examples:

Why they \textbf{ATTACKED} in such numbers] and with such determination is beyond my ken.
Two Cookstown men who \textbf{ATTACKED} a pair of undercover police have been jailed by
Belfast Crown Court.
### Valence Pattern Table: attack.v

<table>
<thead>
<tr>
<th>Number Annotated</th>
<th>Patterns</th>
<th>Place</th>
<th>Victim</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Assailant</td>
<td>Assailant</td>
<td>Place</td>
</tr>
<tr>
<td>(2)</td>
<td>NP Ext</td>
<td>NP Ext</td>
<td>2nd</td>
</tr>
<tr>
<td>(1)</td>
<td>NP Ext</td>
<td>NP Ext</td>
<td>PP[att] Dep</td>
</tr>
<tr>
<td>1 TOTAL</td>
<td>Assailant</td>
<td>Assailant</td>
<td>Victim</td>
</tr>
<tr>
<td>(1)</td>
<td>NP Ext</td>
<td>NP Ext</td>
<td>NP Obj</td>
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<tr>
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<td>Assailant</td>
<td>Depictive</td>
<td>Manner</td>
</tr>
<tr>
<td>(1)</td>
<td>NP Ext</td>
<td>PP[in] Dep</td>
<td>PP[with] Dep</td>
</tr>
<tr>
<td>1 TOTAL</td>
<td>Assailant</td>
<td>Depictive</td>
<td>Victim</td>
</tr>
<tr>
<td>(1)</td>
<td>PP[by] Dep</td>
<td>PP[in] Dep</td>
<td>NP Ext</td>
</tr>
<tr>
<td>3 TOTAL</td>
<td>Assailant</td>
<td>Direction</td>
<td>Victim</td>
</tr>
<tr>
<td>(1)</td>
<td>DNI --</td>
<td>PP[from] Dep</td>
<td>DNI --</td>
</tr>
<tr>
<td>(1)</td>
<td>DNI --</td>
<td>PP[from] Dep</td>
<td>NP Obj</td>
</tr>
<tr>
<td>(1)</td>
<td>NP Ext</td>
<td>PP[from] Dep</td>
<td>NP Obj</td>
</tr>
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<td>Victim</td>
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<tr>
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<td>NP Ext</td>
<td>AVP Dep</td>
<td>NP Obj</td>
</tr>
<tr>
<td>(1)</td>
<td>PP[by] Dep</td>
<td>AVP Dep</td>
<td>NP Ext</td>
</tr>
<tr>
<td>1 TOTAL</td>
<td>Assailant</td>
<td>Means</td>
<td>Victim</td>
</tr>
<tr>
<td>(1)</td>
<td>NP Ext</td>
<td>PP[ing][by] Dep</td>
<td>NP Obj</td>
</tr>
</tbody>
</table>
Annotation Report

- NPman, woman, to-T(1)
  1. A TRANSMIT man who ATTACKED two sisters at a party told police he remembered little or nothing about it because of the quantity of drink he had consumed.

- T-PPfor, by, in(1)
  1. Their sordid dormitory was ATTACKED by hooligans.
  2. On Feb. 26 the UK forces suffered their worst losses when nine soldiers were killed after being mistakenly ATTACKED by a US aircraft.
  3. The man was speaking two days after his 14-year-old daughter was ATTACKED in a garden 100 yards from her home in Manchester, Co. Durham, CNI.
  4. Two American destroyers, the Maddox and the C. Turner Joy, were ATTACKED by North Vietnamese boats in the Gulf of Tonkin.
  5. The troops fired blanks into the air, but were ATTACKED by the Uzbeks with stones and petrol bombs, and only succeeded in clearing the area by firing live rounds over the heads of the crowd.
  6. `But why `they ATTACKED in such numbers and with such determination is beyond my ken, DNI.

- T-NPpolice, man, woman (1)
  1. He and a Ukrainian Nazi ATTACKED and killed a woman during the Russian campaign.
  2. Jack and Rose Hayward were ATTACKED by two men who fired at them at close range.

- matched (1)
  1. Mr Peter Halliday, the district police commander for the area surrounding the Whitehead Detention Centre, Hong Kong's largest camp for boat people, said the victims were ATTACKED in their sleep by 10 men.
  2. When Gerard Salvin wanted redress against the men who had ATTACKED his house at Croxdale, just a few miles south of Durham itself, it was Gloucester to whom he appealed.
  3. Mr Foxon himself was ATTACKED with a crowbar at the same site just last week and the firm has had to double its guard at the retail park, CNI.
  4. Anderson, married with two children, ATTACKED the woman in a deserted allotment after agreeing to give her and a boyfriend a lift home from a discotheque.
  5. Two Cookstown men who ATTACKED a pair of undercover police have been jailed by Belfast Crown Court.
  6. A WOMAN ATTACKED by a suspected serial rapist was saved when her dog bit him.
  7. Plotters ATTACKED one man with pool cues, breaking his fingers and smashing his cheekbone.
  8. He was ATTACKED by Dark Elf assassins on the road to Avalon and was only just saved by the timely intervention of a party of Chraclan hunters.
Frame-to-Frame Relations in FN

- Inheritance
- Using
- Subframes
- Precedes
- Perspective_on
- See also
- Inchoative_of
- Causative_of

regular lexical relations
## FN’s frame-to-frame Relations

<table>
<thead>
<tr>
<th>Relation</th>
<th>Super_frame</th>
<th>Sub_frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inheritance</td>
<td>Parent</td>
<td>Child</td>
</tr>
<tr>
<td>Subframes</td>
<td>Complex</td>
<td>Component</td>
</tr>
<tr>
<td>Precedes</td>
<td>Earlier</td>
<td>Later</td>
</tr>
<tr>
<td>Using</td>
<td>Parent</td>
<td>Child</td>
</tr>
<tr>
<td>Perspective_on</td>
<td>Neutral</td>
<td>Perspectivized</td>
</tr>
<tr>
<td>See_also</td>
<td>Main Entry</td>
<td>Referring Entry</td>
</tr>
<tr>
<td>Inchoative_of</td>
<td>Inchoative</td>
<td>State</td>
</tr>
<tr>
<td>Causative_of</td>
<td>Causative</td>
<td>Inchoative/State</td>
</tr>
</tbody>
</table>
FN’s frame-to-frame Relations

- link semantically related frames
- allows paraphrasing and facilitates drawing inferences about events and participants in and across frames
- Inheritance

Commerce_buy inherits Getting
Inheritance

\texttt{Commerce\_buy} \textit{inherits} \texttt{Getting}

\begin{center}
\includegraphics[width=0.5\textwidth]{inheritance_diagram.png}
\end{center}

\textit{Inheritance}
Paraphrase: Inheritance

Commerce\_buy inherits from Getting.

Example: $[\text{Sam}_{\text{Buyer}}]$ BOUGHT a new telephone

Paraphrase: $[\text{Sam}_{\text{RECIPIENT}}]$ GOT a new telephone.

The paraphrase structure parallels that of original.

The participants of the Commerce\_buy event and that of the Getting event are “the same”.
Road Map

- Frame Semantics and FrameNet
- Construction Grammar and the FrameNet Construction
- FrameNet’s Treatment of Metaphor
A **lexicon** should specify the grammatical affordances of its entries; a **grammar** should specify the kinds of lexical units capable of occurring in specifiable positions within **grammatical constructions**. The most consistent way to represent such mutual dependencies would be to provide both kinds of information in a single well-articulated **grammar + lexicon** (2006: 35).
Construction Grammar

What must *speakers* of a language know and what can they figure out based on what that *knowledge* to use their *language* successfully?
Grammar

...intricate networks of overlapping and complementary patterns, i.e. constructions that serve as ‘blueprints’ for encoding and decoding linguistic expressions of all types.
Grammatical Construction

form-meaning pairing integrated in conventionalized, and in some respects non-compositional ways

— form: any combination of syntactic, morphological, or prosodic patterns

— meaning: understood broadly and includes lexical semantics, pragmatics, and discourse structure
Construction Grammar

Construction: Constructions are the rules that license ‘new‘ linguistic signs based on other linguistic signs (Fillmore 2012 et al.)

Example: Location in Calendar_unit

Construction Elements: LTN + Calendar Unit

Construct: linguistic manifestation of grammatical expression that a construction licenses.

Example: Last Thursday
The FrameNet Constructicon


<table>
<thead>
<tr>
<th>Construction</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclamative CxN</td>
<td>What a beautiful boy.</td>
</tr>
<tr>
<td>“Clause-level” CxNs</td>
<td>These events in mind, he wrote a book.</td>
</tr>
<tr>
<td>Gap CxN</td>
<td>He made no attempt to flirt with her nor she with him.</td>
</tr>
<tr>
<td>Adjective-as-noun CxN</td>
<td>She is a friend to the poor.</td>
</tr>
<tr>
<td>Verb-way CxN</td>
<td>He made her way to through the crowd.</td>
</tr>
</tbody>
</table>
The FrameNet Constructicon

“Beyond the Core” project (2011-2012)
  • extending FrameNet to FrameNet Constructicon
  • collection of approximately 80 analyzed and annotated and grammatical constructions

  • Fillmore, Lee-Goldman, Rhomieux (2012):
    “The kinds of constructions being collected and analyzed in the FrameNet Constructicon are mainly those that cannot be explained simply as instances of familiar constructions with ordinary lexical items.”
Constructicon Viewer

list of constructions

Notations used in annotated sentences

1. { ... }: Construct
2. <CEE ... >: Construction evoking element
3. [CEE ... ]: Construction element
5. Supp: Support verb or preposition
6. Cop: Copula
7. Gov: Governor; X: Governed

https://framenet2.icsi.berkeley.edu/frameSQL/cxn/CxNeng/cxn00/21colorTag/index.html
The Location_in_calendar_unit construction picks out a Calendar_unit that precedes, follows, or is identified with the calendar unit which contains a deictically-determined reference time. That time is in general "now," i.e., speech time, but may also be the time of reception of communication, as in correspondence that is read significantly after it is written.

- **Calendar_unit** indicates the type of the Calendar Unit that is being referred to. The identity of the **LTN** CE determines whether the Calendar_unit in question precedes (last), is identified with (this), or follows (next) the reference time.

  *ex.:* The huge, gently tilting summit plateau is vast and it is easy to believe that locals held horse races here in the last LTN century.

**TRANSLATIONS**

1. References

- **Calendar_unit**(cal): Calendar_unit indicates the type of the calendar unit that is made reference to in locating the described state-of-affairs.
- **LTI**(ln): LTN indicates the temporal relation between the current (deictically-defined) calendar unit and the calendar unit containing the temporally-located state of affairs.
Location_in_CU: Annotation

1. A survey by the Committee of Vice-Chancellors and Principals found that a fifth of eligible students applied for help from the government-funded Access Fund. Translations 1 2 3
2. Although Intel was talking about getting P6 out of the door by the end of this year (UX No 405), it is not about to sweat for it. Translations 1 2 4
3. Daphne Parish, a British nurse, has been held incommunicado since 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4
4. England’s performance confirmed the impressions they made in the second half of their 1-1 draw with Italy at Brighton. Translations 1 2 4
5. France’s total wine exports declined for the first time in a decade in 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4
6. Her promotion, following the appointment of Ms Margaret Beckett as shadow Treasury Chief Secretary, underlines Mr Kinnock’s willingness to put women MPs into subject areas traditionally regarded as male preserves. Translations 1 2 4
7. Imagine that we could directly observe a particular person’s or group’s expectation formed in the current period’s value of an economic variable. Translations 1 2 4
8. Mr. Ramaphosa — who accused journalists of lending themselves to “mischievous purposes” to discredit Nelson Mandela and the ANC — was co-investigator in January 1989 for a crucial internal ANC document which accused Mrs. Mandela of assaulting Stompie. Translations 1 2 4
9. The huge, gently tilting summit plateau is vast and it is easy to believe that locals held horse races here in 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4
10. And some time in 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4
11. Christie’s seems to be becoming the shipwreck specialist in 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4
12. Do not initiate new ideas within a relationship, because they are not likely to succeed: wait until 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4
13. I very much look forward to maintaining contact with you all in the future and still hope you will meet my diving husband on his sabbatical here in 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4
14. Next month: In 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4
15. Storage Technology Corp’s Hinsdale, Illinois-based XL/Datocomp Inc will ship its Nearline Library System for IBM Corp AS/400 users. Translations 1 2 4
16. THE ADVANTAGES of living in Ireland may become more apparent in 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4
17. They trade with each other and then in 1992 for giving information on casualties caused by an explosion at an Iraqi missile plant in August. Translations 1 2 4

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**Location_in_CU: Summary**

| 27. Integrated appositive                                      |
| 28. Inversion with preposed element                           |
| 29. Let alone                                                |
| 30. **Location in calendar subunit**                         |
| 31. **Location in calendar unit**                            |
| 32. Measurement plus adjective                               |
| 33. Measurement plus prepositional phrase                    |
| 34. Modifier-head                                            |
| 35. Noun-noun compound                                       |
| 36. Ones very eyes                                           |
| 37. Open interrogative.non-subject                          |
| 38. Own_right                                                |
| 39. Postpositive adjective                                   |
| 40. Proper name embellishments                               |
| 41. Rate.cost_time                                           |
| 42. Rate.frequency                                           |

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**Construction elements**

```
<table>
<thead>
<tr>
<th>CEEs:</th>
<th>last</th>
<th>next</th>
<th>this</th>
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<tbody>
<tr>
<td>32</td>
<td>LTN</td>
<td>Calendar_unit</td>
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<tr>
<td>32</td>
<td>AJP_</td>
<td>N_</td>
<td></td>
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<tr>
<td>01</td>
<td>LTN</td>
<td>Calendar_unit</td>
<td>LTN</td>
</tr>
<tr>
<td>01</td>
<td>AJP_</td>
<td>N_</td>
<td>AJP_</td>
</tr>
</tbody>
</table>
```
Location_in_CU: Example

33. Mr Gorbachev first called for a Helsinki 2 summit {Location_in_calendar_unit[LTN<next>] [Calendar_unit_year]} in Rome {Location_in_calendar_unit[LTN<last>] [Calendar_unit_week]}.
FrameNet Constructicon

• Proof of concept
• Add-on to FrameNet lexicon
• Inspiration for new constructicon development
  – Japanese
  – Brazilian Portuguese
  – Swedish
# Lexicon-Constructicon Analogues

<table>
<thead>
<tr>
<th>FrameNet Frames</th>
<th>FrameNet Constructicon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame</td>
<td>Construction</td>
</tr>
<tr>
<td>Instantiations of valence patterns</td>
<td>Construct</td>
</tr>
<tr>
<td>Frame Evoking Element (Lexical Unit, LU)</td>
<td>Construction Evoking Element (CEE)</td>
</tr>
<tr>
<td>Frame Element (FE)</td>
<td>Construction Element</td>
</tr>
<tr>
<td>lexicographic annotation</td>
<td>constructicographic annotation</td>
</tr>
</tbody>
</table>
FN = Repository of Constructions

- **Frames** as semantic constructions
- **LUs** as lexical constructions
- **Valence** patterns as realization constructions
- **Phrase types** as building-block constructions
- **Grammatical Functions** as meta-realization constructions
- **Control CxN and Supports** (non-local argument realization)
Road Map

• Frame Semantics and FrameNet

• Construction Grammar and the FrameNet Constructicon

✓ FrameNet’s Treatment of Metaphor
Metaphor

• CMT defines metaphor as a cognitive process, not simply a linguistic or literary phenomenon.
• Frame Semantics considers the metaphoric use of a word a separate sense of the lemma.
• FrameNet recognizes the ubiquity of metaphor in language, and records instances of its occurrence in certain circumstances.
Metaphor in FrameNet

- FN only distinguishes between **productive** and **lexicalized metaphors**, basing its decision about productivity on criteria about semantically similar LUs behaving similarly, and the **mapping of FEs in a source domain to those in the target domain**.

\[
\text{[Poverty}_{\text{ASSAILANT}}] \text{ ATTACKS [children}_{\text{VICTIM}}].
\]
Metaphorical: Cure.cure.v
Metaphor: a relation between a Source frame and a Target frame where many or all of the LUs in the Target frame are understood, at least partially, in terms of the Source frame.

Example: FrameNet defines a metaphor relation between Cause_motion and Suasion, but not all LUs in these frames have the same strength of connection to the metaphor.

Data:
1. The judge was **MOVED** by the lawyer's argument.
2. The judge was **SWAYED** by the lawyer's argument.
3. The judge was **CONVINCED** by the lawyer's argument.
Thanks!

http://framenet.icsi.berkeley.edu
MetaNet

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MetaNet Team

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  • Luca Gilardi, Jisup Hong

– Conceptual Grounding
  • George Lakoff, Srini Narayanan, Eve Sweetser
Road Map

• Overview of MetaNet:
  – Theoretical framework
  – Project background
  – Knowledge base: metaphor and frame networks
  – Metaphor Identification System
  – Database of annotated sentences, Data analytics

• Applications
Road Map

• Overview of MetaNet:
  – *Theoretical framework*
  – Project background
  – Knowledge base: metaphor and frame networks
  – Metaphor Identification System
  – Database of annotated sentences, Data analytics

• Applications
Theoretical Framework

Conceptual Metaphor Theory (Lakoff & Johnson 1980)

– **Metaphors** are a means to understand and reason about one domain (the **Target**) using knowledge of another domain (the **Source**)

– **Metaphors** are not just linguistic, but language points to conceptually active **metaphor(s)**

– Many **metaphors** are more specific versions of more general, primary **metaphors**
Theoretical Framework

• Frame semantics (Fillmore, 1976; Ruppenhofer et al., 2010):
  – Source and Target domains can each be represented as frames
  – Metaphors are asymmetric, systematic source to target mappings

Target frame:
- Cancer
  - cancer-patient
  - cancer

Source frame:
- Physical combat
  - fighter1
  - fighter2

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Theoretical Framework

- Interconnected structures:
  - Lexical items and expressions evoke frames
  - Frames populate source and target domains of metaphors
  - Individual frames and metaphors are parts of larger networks

Social Problems Are Physical Afflictions

Social Problem → Poverty → Disease → Physical Affliction

Poverty Is A Disease

crime
felony
criminal
perpetrator ...

poverty
impoveryishment
destitution
Indigence ...

disease
illness
sickness
sick ...

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Road Map

• **Overview of MetaNet:**
  – Theoretical framework
  – **Project background**
  – Knowledge base: metaphor and frame networks
  – Metaphor Identification System
  – Database of annotated sentences, Data analytics

• **Applications**
MetaNet Project: Background

• Started in 2012 as part of IARPA’s Metaphor Project
  (https://www.iarpa.gov/index.php/research-programs/metaphor)

• Initial Program Objectives:
  – Build a multi-lingual metaphor repository
  – Automatically extract metaphors from text
  – Compare conceptual metaphors that different groups and cultures use to understand their different beliefs and worldviews better than currently understood.
  – Support multilingual analysis
Background: MetaNet System

MetaNet metaphor identification system (Dodge, Hong, & Stickles 2015)

• Knowledge base of frame and metaphor networks
• Processing method for metaphor identification in text corpora
• Database of corpora annotated for frame semantic and metaphoric information
MetaNet System: Background

• Beyond metaphor detection – the MetaNet system facilitates performing many kinds of linguistic analysis of metaphors in text

• Iterative developmental process
  – Analysis of extracted data informs linguistic analysis, which improves knowledge base and CMT, and in turn improves quality of output of metaphor identification process

• Valuable resources
  – Knowledge base of frames and metaphors
  – Large database of annotated examples
  – Computational tools for metaphor identification and data analysis
MetaNet: What is its use?

• Determining and analyzing some of the known metaphors for talking about a particular social domain:
  – Poverty
  – Democracy
  – Gun rights/Gun control
  – Cancer
• Finding frequencies of particular metaphors across prohibitively large corpora
• Finding frequencies of particular metaphors across
  – genres of texts (blogs, news wire, forum conversations, Twitter)
  – viewpoints/authors (progressive/conservative, doctor/patient/institutional, etc.)
Road Map

• **Overview of MetaNet:**
  – Theoretical framework
  – Project background
  – *Knowledge base: metaphor and frame networks*
  – Metaphor Identification System
  – Database of annotated sentences, Data analytics

• Applications
MetaNet System Diagram

Linguistic Analysis

Cognitive Linguistic Resources
- Repository of frames and metaphors
- Constructional patterns
- Metaphoric relational patterns

Extraction Process
- Text pre-processing
- Custom system processing

Text Resources
- Gigaword, BNC corpora
- Hand-built web corpora
- Gold standard

Linguistic Metaphors Database
- Automatically annotated:
  - Frame
  - Metaphor
  - Construction
  - Lemma, Wordform

Data Analysis

Data Analysis Toolkit
- Repository viewer
- Visualization tool
- Statistical analysis
MetaNet Knowledge Base (KB)

- Unique resource functions both as a structured inventory of conceptual metaphors and as a key component in the automatic metaphor identification process (David et al. 2014, Dodge et al. 2013, Hong et al. 2013).

**Key features:**

- Individual frames and **metaphors** defined in relation to other frames and metaphors, thus defining larger frame and metaphor networks.
- **Metaphors** represented as mappings between frames.
- Frames include lists of words that evoke those frames.
- Metaphors for new domains of interest build on existing frames and **metaphors** in the repository.
MetaNet Knowledge Base

• Implemented in Semantic Media Wiki (Krötzsch et al. 2007)
• Provides collaborative tool for knowledge-based construction.
• Multi-lingual Wikis: American English, Mexican Spanish, Russian, and Persian
• English developmental KB currently contains:
  – Over 650 frames
  – 800 conceptual metaphors
Category:Frame

This is the Frame category. This category uses the form Frame.

Create or edit a Frame:

Total number of Frame pages: 666

A
- Ability to act
- Absorption
- Access
- Access to a location
- Access to an object
- Access to education
- Access to knowledge
- Accompany
- Across
- Action
- Activity
- Addiction
- Addressing poverty
- Addressing social problems
- Adoption
- Advocacy

E
- Evil
- Evil creature
- Excess body weight
- Existence
- Experience pain
- Experiencing a negative state
- Experiencing a state
- Experiencing an economic status
- Extinguish

F
- Factory
- Fairness
- Family
- Fierce animal
- Finance
MetaNet Knowledge Base

• Publicly-accessible English wiki
  – Release 1.0: contains large portion of development wiki
  – **MetaNet Wiki**: metaphor.icsi.berkeley.edu/pub/en
  – Read-only, with discussion pages
  – Will be updated and expanded in future releases

– Other Data Formats

  Wiki contents are expressible in terms of an ontology defined in the industry standard Web Ontology Language (OWL), using Resource Description Framework (RDF) triples, making it easily portable and reusable for different applications.
Frame: Physical Affliction
### Frame: Physical Affliction

<table>
<thead>
<tr>
<th>Role Name</th>
<th>Definition/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>affliction</strong></td>
<td></td>
</tr>
<tr>
<td><strong>patient</strong></td>
<td>Animate Entity</td>
</tr>
<tr>
<td><strong>symptoms</strong></td>
<td></td>
</tr>
<tr>
<td><strong>affected_area</strong></td>
<td></td>
</tr>
</tbody>
</table>

#### Relevant Lexical Units:
- **affliction.n**
- **symptom.n**
- **illness.n**
- **sick.a**
- **sickness.n**
- **disability.n**
- **hurt.a**
- **wound.n**
- **scar.n**
- **scar.v**
- **ail.v**
Frame: Physical Affliction

Related Frames:

<table>
<thead>
<tr>
<th>Current Frame:</th>
<th>Physical affliction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relation Type:</td>
<td>is subcase of</td>
</tr>
<tr>
<td>Related Frame:</td>
<td>Harm to living entity</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Frame:</th>
<th>Physical affliction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relation Type:</td>
<td>makes use of</td>
</tr>
<tr>
<td>Related Frame:</td>
<td>Experience pain</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
</tbody>
</table>

Metaphors that use this frame:

<table>
<thead>
<tr>
<th>as Target frame</th>
<th>as Source frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>● GUN VIOLENCE IS A PHYSICAL AFFLICTION</td>
<td></td>
</tr>
<tr>
<td>● IMPEDIMENTS TO IMPROVING ECONOMIC STATUS IS EXPERIENCING A PHYSICAL AFFLICTION</td>
<td></td>
</tr>
<tr>
<td>● INDICATIONS OF SOCIAL PROBLEMS IS PHYSICAL AFFLICATION</td>
<td></td>
</tr>
<tr>
<td>● SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS</td>
<td></td>
</tr>
</tbody>
</table>
Disease Frame Family
Metaphor: SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS

e.g. Our nation is plagued with many social ills.

Target frame: Social problems

Source frame: Physical Affliction
Metaphor: SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS

<table>
<thead>
<tr>
<th>Source Frame</th>
<th>Physical affliction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Frame</td>
<td>Social problems</td>
</tr>
</tbody>
</table>

Mappings:

<table>
<thead>
<tr>
<th>Source</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>society</td>
<td>patient</td>
</tr>
<tr>
<td>social_problem</td>
<td>affliction</td>
</tr>
<tr>
<td>result_of_problem</td>
<td>symptoms</td>
</tr>
</tbody>
</table>

Related Metaphors:

<table>
<thead>
<tr>
<th>Current Metaphor</th>
<th>SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relation Type</td>
<td>is an entailment of</td>
</tr>
<tr>
<td>Related Metaphor</td>
<td>SOCIETY IS A PERSON</td>
</tr>
<tr>
<td>Description</td>
<td>societies have social problems and people have physical problems</td>
</tr>
</tbody>
</table>
Metaphor Network

- Society is a person
- Social problems are physical afflictions
- Poverty is a disease
- Crime is a disease
- Drug abuse is a disease
- Extent of social problem is extent of physical affliction
Demonstration: MN Wiki

Metaphor Wiki (English)

Contents [hide]
1 Metaphor Data Guide
2 Metaphor Summary Pages
3 Metaphor Glossary and Property Guide
4 Metaphor Standards

Metaphor Data Guide

To edit a metaphor or create a new metaphor, type its name in the box below. If the metaphor already exists, you will be taken to its edit page, otherwise, you can create it from scratch.

- Metaphor names should be in all caps

The Glossary (work in progress, only for Analysis Team)
The list of metaphors is now found here: Metaphors.
A list of metaphor families can be found here: Metaphor Families
Metaphors listed by type: Metaphors by Type
The list of frames can be found here: Frames.
A list of frame families can be found here: Frame Families (with LUs).
Coffee Break
Road Map

• **Overview of MetaNet:**
  – Theoretical framework
  – Project background
  – Knowledge base: metaphor and frame networks
  – *Metaphor Identification System*
  – Database of annotated sentences, Data analytics

• Applications
Extraction Process

Linguistic Analysis

Cognitive Linguistic Resources
- Repository of frames and metaphors
- Constructional patterns
- Metaphoric relational patterns

Extraction Process

Text pre-processing

Custom system processing

Linguistic Metaphors Database
- Automatically annotated:
  - Frame
  - Metaphor
  - Construction
  - Lemma, Wordform

Data Analysis

Text Resources
- Gigaword, BNC corpora
- Hand-built web corpora
- Gold standard

Data Analysis Toolkit
- Repository viewer
- Visualization tool
- Statistical analysis
Extraction Process Overview

Corpus pre-processing using standard NLP methods

Text Input and Preprocessing → POS Tagging (TreeTagger) → Lemmatization (TreeTagger) → Dependency parsing
Extraction Process

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Metaphor Extraction Process

1. Term search
2. Constructional pattern matching
3. Metaphor likelihood estimation
4. Linguistic metaphors

Filter by terms in the corpus:

- **Target** term(s) for a given semantic domain, e.g. *poverty, destitution, impoverished*...

  OR

- **Source** term(s) for a given semantic domain, e.g. *battle, fight, war, defeat, enemy*...

Dodge, Hong, & Stickles NAACL Proceedings 2015.
Metaphor Extraction Process

1. Term search
2. Constructional pattern matching
3. Metaphor likelihood estimation
4. Linguistic metaphors

Conceptual metaphors are typically expressed in particular syntactic patterns
Target and source lexemes reliably occupy certain grammatical slots. (Croft 2002; Sullivan 2013). E.g.:
• Source is verb, Target is argument: Prices rose
• not Target is verb, Source is argument: ??Higher locations priced
## Metaphoric Constructions

<table>
<thead>
<tr>
<th>Constructional pattern</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-subj_S-verb</td>
<td>poverty infects</td>
</tr>
<tr>
<td>T-subj_S-verb-conj</td>
<td>poverty infects and maims</td>
</tr>
<tr>
<td>T-subj-conj_S-verb</td>
<td>homelessness and poverty infect</td>
</tr>
<tr>
<td>S-verb_T-dobj</td>
<td>escape poverty</td>
</tr>
<tr>
<td>S-verb_T-dobj-conj</td>
<td>escape despair and poverty</td>
</tr>
<tr>
<td>S-verb_Prepp_T-noun</td>
<td>slide into poverty / pull up out of poverty</td>
</tr>
<tr>
<td>S-noun_of_T-noun</td>
<td>trap of poverty</td>
</tr>
<tr>
<td>T-noun_poss_S-noun</td>
<td>poverty's undertow</td>
</tr>
<tr>
<td>S-noun_prep_T-noun</td>
<td>path to poverty</td>
</tr>
<tr>
<td>T-noun_mod_S-noun</td>
<td>poverty trap</td>
</tr>
<tr>
<td>S-adj_mod_T-noun</td>
<td>burdensome poverty</td>
</tr>
<tr>
<td>T-noun_cop_S-noun-adj</td>
<td>poverty is a disease / poverty is burdensome</td>
</tr>
</tbody>
</table>
Metaphoric Constructions
Neither the free market nor central planning had been able to alleviate unemployment and poverty (BNC:HKT)
Constructional Pattern Matching Process

• Identify candidate items which appear in appropriate constructional pattern

• E.g., if Target term is poverty:
• Construction: Source (noun) – of – Target (noun)
  – Trap of poverty
  – problem of poverty
Constructional Pattern Matching Process

• Identify candidate items which appear in appropriate constructional pattern
• E.g., if Target term is poverty:
  • Construction: Source (noun) – of – Target (noun)
    – Trap of poverty
    – problem of poverty
• Constructional patterns are a necessary constraint on metaphoric expression, but are not sufficient to guarantee metaphoricity
Metaphor Extraction Process

1. Term search
2. Constructional pattern matching
3. Metaphor likelihood estimation
4. Linguistic metaphors

Frame identification
• Using the KB, determine which frames the candidate source and target terms evoke, and add this as annotated data
Metaphor Extraction Process

1. Term search
2. Constructional pattern matching
3. Metaphor likelihood estimation
4. Linguistic metaphors

Assess metaphoricality of candidate expressions:
• Repository is searched to determine the relational path(s) that connect these two frames
• Expressions are scored based on the path
Non-metaphoronic Pattern: *cure cancer*.
Non-metaphoric Pattern: \textit{cure cancer}.
Non-metaphoric Pattern: *cure cancer*. 
Metaphoric Pattern: *cure poverty*

**Social Problems Are Physical Afflictions**

- Social Problem
- Poverty

**Treating a Physical Affliction**

- Physical Affliction
- Disease
  - Cancer
  - Polio

- *cure.v*

---

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MetaNet Tutorial ACL Berlin
Metaphoric Pattern: cure poverty

- Social Problems Are Physical Afflictions
  - Social Problem
    - Poverty
  - Physical Affliction
    - Disease
      - Cancer
      - Polio
  - Treating a Physical Affliction
    - cure.v

poverty.n
Metaphoric Pattern: *cure poverty*

**SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS**

- Social Problem
  - Poverty
    - poverty.n

**Treating a Physical Affliction**

- Physical Affliction
  - Disease
    - Cancer
    - Polio

- cure.v
Metaphor Extraction Process


- The output of the metaphor identification process is a database of annotated sentences
- Annotation includes syntactic and semantic information:
  - Dependency parse
  - Lemmas, POS, Frames for source and target words
  - Metaphor(s) identified by system, if any
Database and Data Analysis

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• Applications
Applications: Road Map

• Metaphor analysis -- case studies:
  – Poverty
  – Gun debate
  – Cancer

• Multilinguality

• Information extraction
Case Study: Poverty

• Extracted metaphor data can provide insights into metaphors and constructions used to talk about particular domains
• **Target** domain: Poverty
  • Defined by Poverty frame family in repository
• Input:
  • Gigaword corpus (Graff & Cierri 2003)
• Output
  • Annotated ~175,000 sentences (including duplicates)
Poverty Metaphor Examples

A year after signing their autonomy agreement with Israel, Palestinians believe they are close to obtaining the hundreds of millions of dollars of foreign aid needed to tackle poverty.

-- Chapter 3 (Inter-relationships between Population, Sustained Economic Growth and Sustainable Development): The action plan reflects growing awareness that population factors are "inextricably linked" to human development concerns, including poverty alleviation, women's empowerment and environmental protection.

The UN population conference has adopted a global plan that for the first time puts women out front in a war on poverty and soaring birthrates.

Meanwhile, poverty rose 4.7 percent and 1,140,600 New Yorkers are receiving public assistance.

Chiapas was the site of a surprise uprising staged on New Year's Day by Zapatista rebels, who protested abuse and grinding poverty in the southern state.
At the same time, though, only one in 10 university graduates have found work, creating a daunting challenge for the country, which overall remains mired in poverty despite the economic successes.
Poverty: commonly occurring source frames

- Treating a physical affliction
- Being in a bounded region
- Vertical position
- War
- Being at a low location
- Upward motion
- Downward motion
- Physical combat
- Attacking
- Constructed confinement
Poverty Metaphors: Source Domain = War

A crowd of roughly 10,000 people were on hand for an inaugural address in which the new president was expected to pledge to combat unemployment, crime, poverty and the drug trade.

The UN population conference has adopted a global plan that for the first time puts women out front in a war on poverty and soaring birthrates.

"We must help South Africa to create jobs, housing and schools, to improve health care" and to battle illiteracy and poverty.

"Any credible attack on world poverty must include a large increase in development cooperation -- and some increase in development assistance -- at its core," said Speth.

Industry minister Muraosli Maran warned India's leaders here Wednesday that free-market reforms should have a "human heart" to tackle poverty and unemployment.
Poverty metaphors: **Source domain = Treatming a physical affliction**

Bangladesh and Pakistan Tuesday called for a concerted drive by the seven-nation South Asian Association for Regional Cooperation (SAARC) to **alleviate poverty** in the region.

"The draft declaration will also focus on **poverty eradication** programmes in one of the world's poorest regions and appeal to developed nations to reduce the barriers of protectionism," they said.

SAARC members say they plan to **eradicate poverty** by the year 2002.
Case Study: Gun Debate

Overall objective:
Analyze metaphors used in the US national debate on guns to gain insights into two contrasting perspectives:

• Individual oversight (IO):
  • advocates of the Second Amendment, gun rights
  • believe in individual oversight of gun ownership and use

• Government oversight (GO):
  • advocates of gun control laws (as a means to reduce gun violence)
  • believe in government oversight of gun ownership and use
Case Study: Gun Debate

- **Corpora**
  - Custom-built, web-based corpora
  - Two data sets
    1. Pro-individual oversight perspective
    2. Pro-government oversight perspective

- **Search terms – Gun debate frame family**
  - Gun control, e.g., *gun control movement, control of guns, gun restrictions, anti-gun*
  - Gun rights, e.g. *right to bear arms, gun freedom, firearms rights, gun rights advocacy, pro-gun*
  - Gun violence, e.g. *gun violence, gun death, gun crime*
  - Other gun-related terms, e.g. *gun lobby, gun owner, gun grabber*
Gun Debate Metaphor Examples

We should look at fixing the mental health system in the United States in conjunction with implementing gun control, but we should not place the blame for the gun death epidemic in our country on those who were unfortunate enough to be born with mental problems.

In fact, the reduction of gun availability in our society would help alleviate the epidemic of gun violence that we are living in and would save many lives.

Or how about discussing the potential merits of a national no-sell list that would give law enforcement and mental health personnel the opportunity to flag potentially dangerous people to licensed gun-merchants? Would these kinds of modest regulations of gun ownership end the scourge of gun violence in America? Of course not, people will always snap.

In the wake of Sandy Hook, US President Barack Obama announced the most aggressive federal gun-control plan in decades to combat what he termed an "epidemic of gun violence". This lobby diverts attention from the fact that although revisiting gun control will not solve America's cancerous gun violence, well-considered changes in legislation and enforcement will make a difference, and probably a big difference.
Case Study: Gun Debate

**Target:** Gun violence

**Source:** Disease frame family

- Legend:
  - government_oversight
  - individual_oversight

- Top 10 source-schemanames:
  - Disease spread
  - Disease
  - Physical affliction
  - Treating a physical affliction
Case Study: Gun Debate

**Target:** Gun violence

**Source:** Disease frame family, with lemmas
Target: Gun rights

- Top 5 source schema families
- Top 5 source frame families
Target: Gun rights
Source: Physical combat frame family
-- Top 4 source frames, with lemmas
Case Study: Cancer

• **Objective:** Investigate metaphoric construal of cancer in patient discourse

• **Challenges:**
  – Prior investigations focused on Disease as a *source* domain (*cure poverty, gun epidemic*, etc.)
  – Differences in genre
    • Specialized jargon and slang: *mets* (metastases), *chemo*
    • Casual discourse – increased slang, shorthand; non-standard syntax
Case Study: Cancer

• Corpora
  – Global Web-based English (Davies 2013), American blogs
    • 48,116 websites
    • 106,365 webpages
    • 133,061,093 words
  – Collected data from 3 cancer patient forums
    • 656,171 words

• Knowledge Base
  – Increased coverage of Cancer domain
  – Added metaphors based on cancer metaphor literature
Case Study: Cancer

- Global Web-based English (GloWbE)
  - Extracted only metaphors with Cancer, Cancer Treatment, Cancer Patient target domains

- Forum data – two searches
  - Extracted metaphors with any Disease-related target domain
  - Source domain search focused on Physical Combat and Motion source domains
    - Extracted any metaphors with Physical Combat or Motion source domains, regardless of target domain
Cancer Study: Frequent Source Domains

- Violence: 38%
- Competition: 12%
- Journey: 29%
- Other: 19%

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Cancer Study: Frequent **Source** Domains

Top 6 `source` frames (with lemmas):
- Attacking
- Physical combat
- Burden
- War
- Competition
- Journey
Cancer Study: Violence metaphors

Cancer as an enemy or harmful entity
The cancer that we face is a resilient enemy.
Cancer is such a sneaky monster! You just never know when it's going to rear its ugly head.

Physical combat with cancer
Live life and breathe it in, stay positive and defeat CANCER.
You kick some cancer butt, girl!
Mom battled breast cancer for nearly 12 years from Stage IIIA, to Stage II recurrence, to Stage IV mets.

Cancer as the attacker
You'll find plenty of seemingly healthy people -- some who have never smoked and others who quit smoking decades earlier -- that lung cancer attacks.

Cancer treatment as weaponry
Remember that 'good nourishment' is a crucial weapon in the fight against cancer and any illness.
Cancer Study: Journey Metaphors

Cancer treatment as a path with recovery as destination

Share your personal story, diagnosis and treatment path, and stories of survival, hope and success.

It is expensive for the insurance companies to approve, hence, it appears to be the *last* in the list (at least, this was how it went with my sister’s long, long road to diagnosis).

Different treatments are different paths

I am located in Canada, could have had HIFU here, but would have been required to go biopsy route, so Wheeler and London it was.

I think too often, we, the members of this board, try to soften the blow to others who have just started down the cancer road. nov/24/13-sadly but peacefully moms cancer journey is at an end, she will start her new spiritual journey together hand in hand with dad.
Cancer Study: Competition Metaphors

I want you to know that cancer will not win.

I am not ready to let this cancer win.

Armstrong's triumph over cancer and his tireless efforts to fund medical research were the compelling reason in his popularity -- not Jenkins's glowing prose.

Every round we win is worth ringing the bell for.
Some Other Source Domains

Cancer as moving entity

Palliative radiation would only have helped with any pain she was experiencing, but it wouldn’t slow down the cancer as there are micro-metastatic cancer cells traveling via her blood system.

Seaweeds such as fucoidan and kombu, eaten in Asia, contain molecules that slow cancers of the breast, prostate, skin and colon cancer.

Ridding the body of colon plaque and buildup is the most effective way to stop cancer of the bowel, digestive issues and to improve kidney and liver function.

My physiotherapist even suggested that I could have paraneoplastic syndrome—basically you get symptoms from your immune system trying to contain the cancer before it's even detectable.
Cancer Study: Some Other Source domains

Shadow of cancer

I know we will forever live under the cancer shadow, but as the doctor’s nurse practitioner told us, healthy people face death in an instant, whether it’s an oncoming bus or a plane crash.

If we don’t move out of the shadow of cancer...

Cancer burden – technical use

One thing I can tell you is that the human body is an amazing work of art and often can continue to thrive even with a heavy cancer burden.
Cancer Study Results: Frequent Metaphors

- CANCER IS PHYSICAL COMBAT: 20%
- SURVIVING CANCER IS HARMING CANCER: 16%
- CANCER TREATMENT IS WAR: 12%
- HARM IS PHYSICAL INJURY: 8%
- SURVIVING CANCER IS WINNING A COMPETITION: 14%
- PROCESSES ARE MOVEMENTS: 6%
- DISEASES ARE BURDENS: 4%
- ACTION IS BEING IN A LOCATION: 2%
- CANCER IS A JOURNEY: 10%
- END OF AN ACTION IS THE END OF A PATH: 6%
- ENCOURAGEMENT IS PHYSICAL SUPPORT: 8%
- CURING DISEASE IS STOPPING MOTION: 4%
- SOCIAL RELATIONS ARE PHYSICAL CONNECTIONS: 2%

- Percent of Data
- 7 August 2016
- MetaNet Tutorial ACL Berlin
Cancer Study Results: Constructions
Cancer Study Results: lemmas in *verb cancer*

- **fight**: 90
- **battle**: 50
- **beat**: 40
- **kick**: 20
- **stop**: 10
- **end**: 10
- **contain**: 10
- **destroy**: 10
- **catch**: 10
- **boost**: 5

Examples:
- *Survivor, I am fighting cancers for 23 years now.*
- *It's a very emotional song about battling cancer.*
Cancer Study Results: lemmas in *cancer verb*

![Graph showing the frequency of lemmas in cancer verb context.](image)
Cancer Study: no explicit target lemma

**Source: Battle**

I tried to visualize tiny resistance fighters living in my breast, my own Polish forest, beating away the Nazis inside of me.

We all deserve the medal of honor as we are the soliders on the frontline of a terrible struggle.

Pat is a savior to a lot of us fighting the battle.

At your stage, surgery will give you the absolute best chance of beating this thing for good.

**Source: Journey**

I just want to help in any way I can since we're all in this mysterious journey searching for the hope of light at the end of the tunnel! Thanks =)

Not an easy journey for any of us.

This applies also to those traveling the road with us.
Applications

• Metaphor Analysis: case studies

• Multilinguality

• Information extraction
Multilinguality

– Basic experiential frames
– Primary metaphors

• Differences across languages:
  – Lexical items
  – Culturally-specific frames and metaphors
Multilinguality

Metaphor Identification System accommodates different languages

— NLP pre-processing

• Taggers:
  — English, Spanish, Russian: TreeTagger
  — Persian: Custom

• Dependency Parsers:
  — English: RASP
  — Spanish: Freeling
  — Russian/Persian: MALT
Multilinguality

Metaphor identification system accommodates different languages

- NLP pre-processing

- **Custom processing:**
  - Process is very similar across languages
  - Uses frames, *metaphors*, and lexical items from language-specific KBs
  - Searches for language-specific constructional patterns of metaphor expression
  - Identifies frames and *metaphors*
Multilinguality

Metaphor identification system accommodates different languages
  – NLP pre-processing
  – Custom processing
  – **Data analysis:**
    • Use of the same annotation framework facilitates use of the same analytic tools for the different languages
Applications

✓ Metaphor analysis -- case studies:

✓ Multilinguality

• Information extraction
Information Extraction

Correct Event Identification

• Frames and frame elements provide a powerful way to represent which events and event participants are being expressed by a sentence information.

• Literal example:

  \textit{The doctors cured his disease.}

  \textbf{Event type:} Treating a Physical Affliction

  \textbf{Roles:}

  \textbf{treatment provider:} the doctors

  \textbf{treated affliction:} his disease

  \textbf{treatment procedure:} cure
Information Extraction

Correct Event Identification

• For metaphoric expressions, must identify relevant metaphor to identify relevant frame and participant roles

• **Metaphoric** example:

  *The government cured poverty.*

  **Event type:** Treating a Physical Affliction ➔ **Addressing Poverty**

  **Roles:**

  - treatment provider ➔ **policy makers:** *the government*
  - treated affliction ➔ **poverty:** *poverty*
  - treatment procedure: *cure* ➔ **policies**
MetaNet Analysis of FN Annotations

• Provides a semi-automatic way to identify metaphoric expressions in FN annotated sentences
• Output used to expand and improve recognition of metaphor in FrameNet
  – Evaluate previous uses of metaphor tag
  – Identify and tag additional metaphorical sentences
  – Refine methods for dealing with metaphor in FrameNet

Links to the MN KB provide a way to determine the relevant target frames for FN examples, and thus facilitate identification of the relevant event type and participants.
Thanks!

http://www.metaphor.icsi.berkeley.edu/pub/en
https://metanet.icsi.berkeley.edu
Integrating FrameNet and MetaNet

Miriam R L Petruck

miriamp@icsi.berkeley.edu
Road Map

• Motivation
  – Why bother?

• Challenges
  – Why difficult?

• Integrated Annotation
  – Why not?
Road Map

✓ Motivation
  – Why bother?

• Challenge
  – Why difficult?

• Example
  – Why not?
Motivation

• shared approach to meaning representation
• richness of each knowledge base alone
• complementarity of the two KBs together
• increased value and computational tractability of frame-based meaning representations
• high degree of interconnectedness (de Melo 2014)
Similarities of FN and MN

• frame-based meaning representation
• characterize the conceptual and linguistic means that (a) language provides to describe situations (states of affairs, events, objects)
• situate individual frames within a larger structure of interrelated frames, offering a broad perspective on the conceptual structure that (a) language expresses
Challenge of Integration

• Heterogenous structures preclude merging FN and MN through alignment and linking, a much simpler method of achieving integration than creating a new entity, albeit far from simple.
  – Multilingual FrameNet: proposal to align FNs (Brazilian Portuguese, English, French, Italian, Japanese, Swedish, etc.)
  – preliminary work shows that alignment of DBs with same structures is not “simple”.
Differences Between FN and MN

• State of Development
  – FN: 1997 – ongoing
  – MN: 2012 – “on hold”

• Objectives
  – FN: repository of frames, LUs, annotation sets, manual FS analysis of contemporary English lexicon; semantico-syntactic mappings
  – MN: repository of conceptual metaphors; CMT analysis of linguistic metaphor; source-target domain mappings; automatic extraction and analysis system
Differences Between FN and MN

• Semantic Granularity of Frames
  – FN: mostly general vocabulary of language
  – MN: tends to be specific for metaphor
FN: poverty.n – Wealthiness frame, including affluent.a, rich.adj, wealth.n, etc.
MetaNet:
  Conceptual Metaphor: Poverty is a Harmful Agent
  Linguistic Metaphor: Poverty attacks children.

• Frame-to-Frame Relations
### Frame-to-Frame Relations in FN and MN

<table>
<thead>
<tr>
<th>FrameNet</th>
<th>FrameNet Only</th>
<th>MetaNet</th>
<th>MetaNet Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inheritance</td>
<td></td>
<td>is subcase of</td>
<td></td>
</tr>
<tr>
<td>Uses</td>
<td></td>
<td>makes use of</td>
<td></td>
</tr>
<tr>
<td>Subframes</td>
<td></td>
<td>is a subprocess of</td>
<td></td>
</tr>
<tr>
<td>Perspective_on</td>
<td></td>
<td>is a perspective on</td>
<td></td>
</tr>
<tr>
<td>Precedes</td>
<td></td>
<td></td>
<td>incorporates as a role</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>is in scalar opposition to</td>
</tr>
<tr>
<td>Inchoative_of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Causative_of</td>
<td></td>
<td>is in causal relation with</td>
<td></td>
</tr>
<tr>
<td>See_also⁵</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example: **Attack.attack.v**

- **Frame-to-Frame Relations:** *Attack* and *Cause_harm* are related via a higher-level frame. *Attack* and *Cause_harm* inherit from *Transitive_action*.

- The two FN frames share a grandparent, not a parent; *Attack* and *Cause_harm* are NOT in a parent-child relationship.
Inheritance

**Transitive_action**

- **Intentionally_affect**
  - **Attack**
- **Cause_bodily_experience**
  - **Cause_harm**

**Inheritance**

*MetaNet Tutorial ACL Berlin 152*

*7 August 2016*
MetaNet: Attacking Frame

• Roles:
  - attacker (ASSAILANT)
  - attackee (VICTIM)
  - effect_of_attack (RESULT)

• MN’s Attacking is a subcase of a more general Physical_harm frame.
Physical harm is a subcase of harm and makes use of cut and danger.
Conceptual Metaphor: Poverty is a Harmful Agent

Linguistic Expression: Poverty *attacks* children.
<table>
<thead>
<tr>
<th>Sentence:</th>
<th>Poverty</th>
<th>attacks</th>
<th>children</th>
</tr>
</thead>
</table>

**FrameNet**

<table>
<thead>
<tr>
<th>Frame Element</th>
<th>Assailant</th>
<th>Victim</th>
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<tbody>
<tr>
<td>Metaphor Info</td>
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</table>

**MetaNet**

<table>
<thead>
<tr>
<th>Frame</th>
<th>Poverty</th>
<th>Attacking</th>
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</thead>
<tbody>
<tr>
<td>Metaphor Info</td>
<td>Target</td>
<td>Source</td>
<td></td>
</tr>
</tbody>
</table>

**POVERTY IS A HARMFUL AGENT**

Combined FrameNet and MetaNet Annotation (current soa)
Thanks!

http://framenet.icsi.berkeley.edu

https://metanet.icsi.berkeley.edu
MetaNet: Development Plans

Two Key Areas

• Improvement of validation and evaluation methods

• Expanded annotation
MetaNet: Development Plans

Improvement of validation and evaluation methods

• Expand the manually compiled gold-standard, which currently contains approximately 400 example sentences that metaphor analysts annotated.
• Use gold standard for regression testing to ensure that future changes improve rather than degrade the system
• Modify existing data analytic tool to facilitate manual validation of correctly annotated examples via the automatic metaphor identification process, thus creating a much larger high-quality gold-standard.
• Use larger gold-standard as training data for machine learning methods for further system improvements.
MetaNet: Development Plans

Expanded annotation and analysis:

– By defining additional constructional patterns, the MN system could be used to analyze larger patterns of metaphor expression and additional participant roles. Example:

  • Current: *The government* attacked poverty.
  • Future: *The government* attacked poverty.
MetaNet: Development Plans

Expanded annotation and analysis:
✓ additional constructional patterns
• Combine MetaNet with Automatic Semantic Role Labeling (ASRL)
  – Use ASRL systems such as SEMAFOR (Das et al. 2014) to produce frame-based annotation of events and participant roles
  – MetaNet metaphor identification system produces metaphor-related annotation, but without explicit identification of participant roles.
  – Combined annotation would provide more comprehensive semantic analysis, and could serve as basis for expansion and enhancement of MN metaphor identification system
MetaNet: Development Plans

Expanded annotation and analysis:

✓ additional constructional patterns
✓ MetaNet plus ASRL

• Combining MetaNet with Embodied Construction Grammar (ECG)
  – Feldman et al. 2010, Dodge et al. 2014
  – Use existing ECG grammars to expand the range of constructional patterns that the system analyzes
MetaNet: Development Plans

Expanded annotation and analysis:

✓ additional constructional patterns
✓ MetaNet plus SRL
✓ MetaNet plus ECG

Ultimately, the goal is creating a system that produces frame-based semantic analyses of both literal and metaphorical sentences.
Acknowledgements

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