Integrating FrameNet and MetaNet

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Road Map

• Introduction
• What is FrameNet?
• What is MetaNet?
• Integrating FrameNet and MetaNet
• So What?
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Acknowledgements

• Gerard de Melo, Ellen K Dodge

• FrameNet
  – Chuck Fillmore, Collin Baker, Michael Ellsworth

• MetaNet
  – Oana David, Jisup Hong, Elise Stickles
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• So What?
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
What’s “in” FrameNet?

- 1,215 semantic frames (including FEs)
- > 13,300 lexical units
- ~ 201,475 manually annotated examples
- ~ 1,825 frame-to-frame relations that constitute 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: Apply_heat, 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
Apply_heat: Definition

A *Cook* applies heat to *Food*, where the *Temperature_setting* of the heat and *Duration* of application may be specified. A *Heating_instrument*, generally indicated by a locative phrase, may also be expressed. Some cooking methods involve the use of a *Medium* (e.g. milk or water) by which heat is transferred to the *Food*.

This frame focuses on the process of handling the ingredients, rather than the end result *(See Cooking_creation).*
Apply _heat_: Frame Elements

**Cook**

**Food**

**Temperature_setting**

**Duration**

**Heating_instrument**

**Medium**

Lila **FRIED** the eggs in a copper pan.
Frame Elements: Coreness

• Core: uniquely defines a frame
  Commerce: **Buyer, Seller, Money, Goods**

• Peripheral: for aspects of events in general
  e.g. **Time, Place, Manner**

• Extrathematic: situate an event against the backdrop of another state of affairs; conceptually do not belong to the frame in which they occur
  — e.g. **Iteration, Recipient**
  
  Sue **BAKED** the cookies [twice **Iteration**].
  Sue **BAKED** the cookies [for me **Recipient**].
Frame Elements

Triple of Information

Frame Element

- semantic role

Grammatical Function

- External, Object, Dependent

Phrase Type

- full range of PTs for language
Apply_heat: Lexical Units

bake.v, baking.n, barbecue.v, blanch.v, boil.v, braise.v, braising.n, broil.v, brown.v, char.v, coddle.v, cook.v, deep fry.v, fry.v, frying.n, grill.v, microwave.v, parboil.v, plank.v, poach.v, roast.v, saute.v, scald.v, scorch.v, sear.v, searing.n, simmer.v, singe.v, steam.v, steep.v, stew.v, toast.v
BAKE the potatoes, then open them lengthways.
BAKE the soufflés for 12 minutes.
BAKE the aubergines in a preheated 180°C/350°F/Gas 4 oven for half an hour or until limp and lightly browned.
BAKE the tart on a preheated baking sheet at 350°F (180°C) gas mark 4 for 40–45 min until the filling is creamily set.
BAKE spanakopitta for about 40 minutes, then increase the heat for another 5 minutes to crisp the top.
BAKE the eliot for about 45 minutes or until the base sounds hollow when tapped.
The mix is BAKED for 20 minutes in moulds and served with a vegetable cream sauce, lentils, and sautéed mushrooms.
BAKE for 2–2 ½ hours, or until a skewer inserted into the cake comes out cleanly.
BAKE for 12-15 minutes until barely golden.
BAKE at 180°C/350°F/Gas 4 for 30 minutes.
The way to get the maximum flavour out of dried apricots is to BAKE them slowly in the oven instead of stewing them.
Cover and BAKE in a preheated 200°C/400°F/Gas 8 oven for 15-20 minutes.
Annotation: Apply_heat.bake.v

FE: BAKE [the souffle] [for 12 minutes]
GF: Object Dep
PT: NP PP

Cook CNI
Heating_instrument INI

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Frame-to-Frame Relations in FN

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

Keywords:
- metarelational: pointer to user
- regular lexical relations
Inheritance

- Relationship between a more general frame, the **parent** frame, and a more specific one, the **child** frame
- Child frame **elaborates** parent frame
- **Corresponding entities**, FE, frame relation, and semantic characteristics, in both child and parent
- Child frame entity is the same as or more specific than in parent frame

`Apply_heat` **inherits** `Intentionally_affect`
Current Frame: Apply_heat

Legend

Parent frame ➔ Child frame

Parent ➔ Child Relation Types:

- Interface
- Subframe
- Perspective On
- Using
- Subframe Of
- Indirect Of
- See Also

Ordering Relation:

- Proceeds
Road Map

• Introduction
• What is FrameNet?
• What is MetaNet?
• Integrating FrameNet and MetaNet
• So What?
What’s “in” MetaNet

• Conceptual metaphors
• Relations between source and target domains, represented as semantic frames
  • 650 frames
• Relations between metaphors
  • 785 metaphors
• Linguistic expressions of CMs in terms of CMT
• Rich annotation of linguistic expressions
  • tens of thousands (~100K?)
MetaNet: Objectives

- Develop repository of conceptual metaphors
- Build database of examples of linguistic expressions of conceptual metaphors
- Develop system to identify metaphors in text automatically.
- Add rich annotation to examples, facilitating various types of data analysis [thus gaining insights into domain(s) of interest, as well as further refining conceptual metaphor theory and extraction system.]
System Overview

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

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

Data Analysis

Data Analysis Toolkit
- Repository viewer
- Visualization tool
- Statistical analysis
Metaphor Repository

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Metaphor Repository

– Formalization of Conceptual Metaphor Theory (Lakoff and Johnson 1980)

– Source and Target domains: represented as semantic frames (Fillmore 1976, 1982, 1985)

– Conceptual metaphors: represented as mappings from Source frames to Target frames

– Networks of frames and conceptual metaphors
  • Structured relations between frames and metaphors
Metaphor Repository

• Initial repository focused on conceptual metaphors previously identified in literature (including, e.g. MWLB and PITF)

• Repository expanded via analysis of various domains of interest: social issues such as poverty, taxation, democracy, gun rights and gun control.

• Analysis of new domains builds on and is linked to existing networks of frames and metaphors already in repository
Category:Frame

This is the Frame category. This category uses the form Frame.
Create or edit a Frame:

Total number of Frame pages: 656

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 cont.
- 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
Frame: Physical Affliction
Disease Frame Family

Relations between frames in this family:

- Experience pain
- Harm to living entity
- Physical affliction
- Diagnosis of affliction
- Treating a physical affliction
- Disease spread
- Disease treatment
- Health treatment

is a subcase of
makes use of

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CogNetwork
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Category: Metaphor

This is the Metaphor category page. This category uses the form Metaphor.

Create or edit a Metaphor:

Total number of Metaphor pages: 787

A
- ABILITY TO ACT IS ABILITY TO MOVE
- ABILITY TO EVALUATE GOVERNMENT IS ABILITY TO SEE
- ABILITY TO EVALUATE IS ABILITY TO SEE
- ABILITY TO KNOW IS ABILITY TO SEE
- ABUSIVE POLITICAL LEADERS ARE PHYSICAL BULLIES
- ACCESS TO EDUCATION IS ACCESS TO AN OBJECT
- ACCESS TO KNOWLEDGE IS ACCESS TO AN OBJECT
- ACHIEVING A PURPOSE IS ACQUIRING A DESIRED OBJECT
- ACHIEVING A PURPOSE IS GETTING SOMETHING TO EAT
- ACHIEVING A PURPOSE IS REACHING A DESTINATION
- ACHIEVING GUN RIGHTS IS REACHING A DESTINATION
- ACHIEVING POWER IS MOVING UPWARDS
- ACQUIRING IDEAS IS EATING
- ACQUIRING RESOURCE IS CONSUMING FOOD
- ACTION IS BEING IN A LOCATION

E cont.
- EMOTIONS ARE SUBSTANCES
- ENABLE ABILITY TO UTILIZE RESOURCES IS ENABLE ABILITY TO ACCESS LOCATIONS
- ENABLEMENT OF WORSENING OF ECONOMIC CONDITION IS ENABLEMENT OF DOWNWARD MOTION
- ENACTING LEGISLATION IS CAUSING MOTION ALONG A PATH
- END OF AN ACTION IS THE END OF A PATH
- ENJOYING A RIGHT IS POSSESSING AN OBJECT
- ENTITLEMENT HOLDERS ARE LEECHES
- ENVIRONMENTAL HARM IS PHYSICAL INJURY
- EQUALITY IS BEING ON THE SAME VERTICAL LEVEL
- ESSENTIAL IS INTERNAL
- EVALUATION OF EDUCATION IS COMPETITION
- EVALUATION OF GOVERNMENT IS SENSORY EVALUATION
- EVENTS ARE OBJECTS
Metaphor: SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS

Poverty is infecting our nation.
We are experiencing an epidemic of drug abuse.

Target frame:  

Source frame:
Metaphor Network

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

is a subcase of

is an entailment of
Road Map

• Introduction
• What is FrameNet?
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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
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


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

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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: \textit{Attack.attack.v}

[The bear $\text{ASSAILANT}$] ATTACKED [the man $\text{VICTIM}$].

[Poverty $\text{ASSAILANT}$] ATTACKS [children $\text{VICTIM}$].
Example: \texttt{Attack.attack.v}

- Frame-to-Frame Relations: \texttt{Attack} and \texttt{Cause_harm} are related via a higher-level \texttt{frame}. \texttt{Attack} and \texttt{Cause_harm} inherit from \texttt{Transitive_action}.

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

Transitive_action

Intentionally_affect

Attack

Cause_bodily_experience

Cause_harm

Inheritance

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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

- Attacking
- Cut
- Danger

Harm

is a subcase of
makes use of
Conceptual Metaphor: Poverty is a Harmful Agent

Linguistic Expression: Poverty *attacks* children.
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”.
Combined FrameNet and MetaNet Annotation (current soa)
Road Map

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So What?

• Address pertinent research questions
• Improve consistency of frame-based knowledge bases (FN and MN)
• Increase formal rigor of in FN and MN
• Facilitate corpus-based research for disciplines involving analysis of metaphorical language
• Advance/Refine Frame Semantics and Conceptual Metaphor Theory
Research Questions: 1

• How do the different objectives of FN and MN affect the formal representation of meaning?
• Can the integration of FN and MN reconcile the differences? How?
• Do the conceptual differences in the two knowledge bases necessitate using different sets of relations?
• Is using the same relations possible? Is doing so advantageous?
Research Questions: 2

• Does leveraging the common understanding about the nature of meaning in FN and MN lead to a high degree of interconnectedness of the two knowledge bases?

• Given the differences in levels of semantic granularity between FN frames and MN frames, what criteria will determine the appropriateness of integrating two similarly defined frames from each resource?
  – e.g. FN: Cause_harm vs. MN: Harm
Consistency and Formal Rigor

• Improve each knowledge base, independent of the other, including definitions of relations
• Extend frame-based representations to metaphoric language
• Facilitate computation over frames
• Develop NLP applications using new entity
  – comprehensive resource including rich semantic representations and annotations for literal and metaphoric language
Thanks!

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