

Scheffczyk et al.

Linking FrameNet to the Suggested Upper Merged Ontology

Presentation by Torsten Marek

Universität des Saarlandes

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Outline

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

1 Introduction

2 Linking Approach

3 Conclusion

Fillmore, 1976: Frame Semantics

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Example

The original sword may have chipped off of the statue long ago.

Fillmore, 1976: Frame Semantics

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Example

The original sword may have **chipped** off of the statue long ago.

Frame Components

- **event / state**
 - Building, Hair_configuration, Suspicion
 - organized in hierarchy

Fillmore, 1976: Frame Semantics

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Example

[The original sword SUB_PART] may have **chipped** [off of the statue WHOLE] [long ago TIME].

Frame Components

- **event / state**
 - Building, Hair_configuration, Suspicion
 - organized in hierarchy
- ROLES: Frame Elements (FE)
 - triggered by main concept
 - obligatory (verbal arguments) or optional (adjuncts)
 - agent, created_entity, hair, suspect
 - each FE has a semantic type (ST)

Berkeley FrameNet

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Components

- 820+ semantic frames
- 10k+ lexical units
 - specific word sense evoking a frame, e.g. **chip off**
- 135k+ annotated sentences
- tools

Overview: (Ruppenhofer et al., 2006)

URL: <http://framenet.icsi.berkeley.edu>

The SUMO

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Suggested Upper Merged Ontology

- candidate for the Standard Upper Ontology (IEEE working group 1600.1)
- will eventually contain 1000 - 2500 terms
- originally created by Teknowledge, now free
- written in SUO-KIF, a knowledge representation language

Overview: (Niles and Pease, 2001)

URL: <http://www.ontologyportal.org>

Why Linking at All?

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Problem

Semantic frame parsers need information about the types of FE to find/suggest possible fillers in a sentence.

Why Linking at All?

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Problem

Semantic frame parsers need information about the types of FE to find/suggest possible fillers in a sentence.

ST Hierarchy

STs are organized in a type hierarchy, but:

- there are only very few types (around 40)
- the type hierarchy is only lexicographically motivated
- the hierarchy is very shallow
- no relation between types except hypernymy
- missing axiomatization

Motivation for Combining SUMO and FrameNet

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- Mapping is adaptable to SUMO's domain ontologies
- SUMO has rich semantic information, more relations etc.
- SUMO provides axiomatizations
- FrameNet provides more examples sentences for SUMO

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Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

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- SUMO provides axiomatizations
- FrameNet provides more examples sentences for SUMO

Reasons for using SUMO

- SUMO is free
- SUMO is large
- SUMO has been mapped to WordNet

Process Outline

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

① Express STs in SUO-KIF along with axioms

Process Outline

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- 1 Express STs in SUO-KIF along with axioms
- 2 **Manually link STs to SUMO-classes**
 - domain-independent
 - few STs only (40)

Process Outline

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- 1 Express STs in SUO-KIF along with axioms
- 2 Manually link STs to SUMO-classes
 - domain-independent
 - few STs only (40)
- 3 Design semi-automatic algorithm to map FEs to SUMO classes
 - domain-dependent
 - number of FEs is potentially unbounded

ST - SUMO Links

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FrameNet and
SUMO

Scheffczyk et.
al.

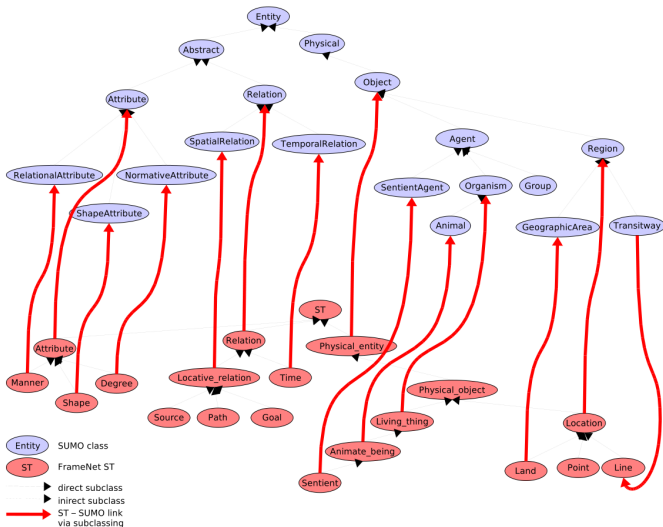
Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion



(Scheffczyk et al., 2006, p. 4)

Binding Kinds

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Scheffczyk et.
al.

- ST matches single SUMO class

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Binding Kinds

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- ST matches single SUMO class
 - ST inherits from SUMO class
 - `Animate_beingst` *subclass-of* `Animalsumo`

Binding Kinds

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- ST matches single SUMO class
 - ST inherits from SUMO class
 - $\text{Animate_being}_{st}$ *subclass-of* Animal_{sumo}
- ST corresponds to intersection of several SUMO classes

Binding Kinds

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- ST matches single SUMO class
 - ST inherits from SUMO class
 - $\text{Animate_being}_{\text{st}}$ *subclass-of* $\text{Animal}_{\text{sumo}}$
- ST corresponds to intersection of several SUMO classes
 - ST inherits from all those SUMO classes
 - $\text{Sentient}_{\text{st}}$ *subclass-of* $\text{SentientAgent}_{\text{sumo}} \cap \text{Animal}_{\text{sumo}}$

Binding Kinds

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

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 - Sentient_{st} *subclass-of* $\text{SentientAgent}_{sumo} \cap \text{Animal}_{sumo}$
- ST definition is broader than SUMO class

Binding Kinds

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- ST matches single SUMO class
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- ST definition is broader than SUMO class
 - SUMO class inherits from ST
 - Transitway_{sumo} *subclass-of* Line_{st}

Binding Kinds

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- ST matches single SUMO class
 - ST inherits from SUMO class
 - $\text{Animate_being}_{st}$ *subclass-of* Animal_{sumo}
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- ST definition is broader than SUMO class
 - SUMO class inherits from ST
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- ST class corresponds to instance of SUMO classes

Binding Kinds

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- ST matches single SUMO class
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 - Sentient_{st} *subclass-of* $\text{SentientAgent}_{sumo} \cap \text{Animal}_{sumo}$
- ST definition is broader than SUMO class
 - SUMO class inherits from ST
 - Transitway_{sumo} *subclass-of* Line_{st}
- ST class corresponds to instance of SUMO classes
 - Make SUMO instance an instance of the ST class, too.

FE Linking: Outline

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Requirements

For a given FE, find a corresponding class in SUMO or any of its domain ontologies.

FE Linking: Outline

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Requirements

For a given FE, find a corresponding class in SUMO or any of its domain ontologies.

Candidate Selection

- 1 Collect FE filler phrases from annotations
- 2 Retrieve WordNet synsets of phrase head words
- 3 Determine candidate SUMO classes based on existing SUMO-WordNet mapping

Candidate Selection, cont'd: Ranking

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Frequency

How often is a SUMO class evoked by the filler synonyms?

Candidate Selection, cont'd: Ranking

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Frequency

How often is a SUMO class evoked by the filler synonyms?

Coverage

How many fillers does a SUMO class cover?

Candidate Selection, cont'd: Ranking

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Frequency

How often is a SUMO class evoked by the filler synonyms?

Coverage

How many fillers does a SUMO class cover?

Class Selection

Use classes with coverage equal to their superclasses' coverage.

The Frame

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

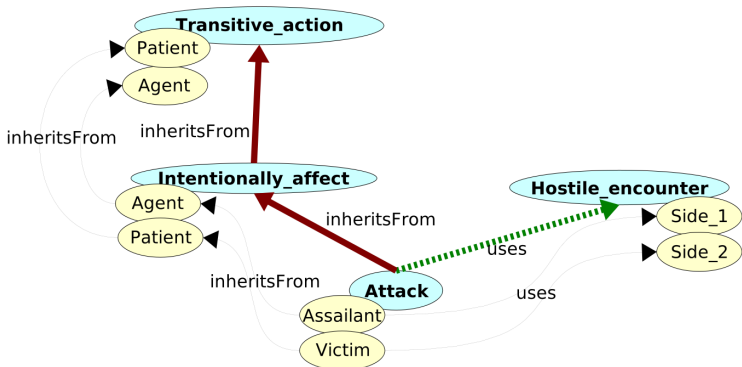
Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion



Find a suitable SUMO link for Assailant_{fe} (ST: Sentient)

(Scheffczyk et al., 2006, p. 3)

Domain-Specific Results for *Assailant*

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Filler Frequencies

Headword	Frequency
it	3
Iraqi	2
Iran	2
terrorist	2

Associations Frequencies

SUMO link	Frequency
Nation	4
UnitedStates: Nation	4
ViolentContest	4
GroupOfPeople	2

(Scheffczyk et al., 2006), page 6, abridged.

Link Creation

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Final Link

$\text{Assailant}_{fe} \subseteq$

$\text{Nation}_{sumo} \cup \text{Government}_{sumo} \cup \text{PoliticalOrganization}_{sumo} \cup$

$\text{EthnicGroup}_{sumo} \cup \text{MilitaryOrganization}_{sumo}$

Restrictions on Candidate Classes

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Consistency with ST Links

The candidate class must inherit from the classes the frame element's ST is linked to.

Restrictions on Candidate Classes

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Consistency with ST Links

The candidate class must inherit from the classes the frame element's ST is linked to.

Consistency with FE Hierarchy

The candidate class must inherit from SUMO classes linked to any supertypes of the FE in question.

Restrictions on Candidate Classes

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Consistency with ST Links

The candidate class must inherit from the classes the frame element's ST is linked to.

Consistency with FE Hierarchy

The candidate class must inherit from SUMO classes linked to any supertypes of the FE in question.

Consistency with STs Links of FE Supertypes

Combination of the two restrictions above.

Constraint Violations

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Hierarchy Inconsistencies

$\text{Nation}_{\text{SUMO}}$ and $\text{EthnicGroup}_{\text{SUMO}}$ are not subclasses of $\text{SentientAgent}_{\text{SUMO}}$, the mapping of $\text{Sentient}_{\text{ST}}$!

Constraint Violations

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO

Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Hierarchy Inconsistencies

$\text{Nation}_{\text{SUMO}}$ and $\text{EthnicGroup}_{\text{SUMO}}$ are not subclasses of $\text{SentientAgent}_{\text{SUMO}}$, the mapping of $\text{Sentient}_{\text{ST}}$!

Solution

In the domain of terrorism, those classes are understood as agents via implied metonymies.

Results

Linking FrameNet and SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

- As suggested by the existing SUMO–WordNet mappings, SUMO relates well to natural language
- WordNet-SUMO and ST-SUMO links make it possible to find a set of SUMO classes that describes the fillers for an FE.
- A number number of inconsistencies in SUMO and FrameNet were discovered.

Results, cont'd: FE linking

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

A lot of human judgement is still required for:

- deciding between activated classes and their supertypes
- finding classes that were not suggested by the data
- finding sources of errors

References

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion



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Thank You!

Linking
FrameNet and
SUMO

Scheffczyk et.
al.

Introduction

Frame
Semantics
SUMO
Linking
Motivation

Linking
Approach

Semantic Types
Frame Elements
Example: Attack

Conclusion

Questions?