The FrameNet tagset for frame-semantic and syntactic coding of predicate-argument structure

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Abstract

This paper presents the syntactic and semantic tags used to annotate predicate-argument structure in the Berkeley FrameNet Project. It briefly explains the theory of frame semantics on which semantic annotation is based, discusses possible applications of FrameNet annotation, and compares FrameNet to other prominent lexical resources.

Introduction

This paper presents the tagset used to annotate the predicate-argument structures of English verbs, adjectives, and nouns in the Berkeley FrameNet Project (NSF IRI-9618838, "Tools for Lexicon Building"), a corpus-based computational lexicography project based on the theory of **frame semantics** (see Fillmore 1982). It briefly explains the theoretical background and shows how frame-semantic annotation creates lexicographic generalizations that are not possible with more traditional linguistic approaches to argument structure based on thematic roles.

1 The FrameNet Project

1.1 What is frame semantics?

Frame semantics characterizes the semantic and syntactic properties of predicating words by relating them to **semantic frames**. These are schematic representations of situations involving various participants, props, and other conceptual roles, each of which is a **frame element** (FE). The semantic arguments of a predicating word correspond to the FEs of the frame or frames associated with that word.

Frames are organized in a structure that can be modeled by an inheritance lattice. They range from being very general, like case frames (Fillmore 1968) or other simple event schemas underlying thematic roles, to being lexically specific. The most interesting frames are those at an intermediate level of specificity which encapsulate generalizations about the semantic and syntactic properties of word classes that are overlooked by thematic role analyses.

1.2 An example

One example is the commercial transaction frame, which includes the following FEs: **Buyer, Seller, Goods,** and **Money**. The following sentence schemas show how these FEs are expressed differently by different Commercial Transaction words:

Buyer **bought** Goods from Seller for Money

Buyer **paid** Seller Money for Goods

Buyer **paid** Money to Seller for Goods

Seller **sold** goods to Buyer for Money

Seller **sold** Buyer Goods for Money

Buyer **spent** Money on Goods
(Seller not expressed)

Goods **cost** Buyer Money
(Seller not expressed)

Different words assign the Commercial Transaction FEs to different Phrase Types (PTs) and Grammatical Functions (GFs). For example, *buy* treats the **Buyer** as an NP subject (i.e.

External Argument) and the **Seller** as a PP complement headed by *from*, while *sell* treats the **Buyer** as a direct object or a PP complement headed by *to* and the **Seller** as a subject. The purpose of FrameNet annotation is to gather information like this about the grammatical realization of FEs for various frames.

1.2 Project goals

The goals of the project are to create a database of information about English words and the frames they inherit, provide annotated corpus examples that illustrate how information about FEs is expressed by complements and modifiers of these words in attested sentences, and contribute to a suite of software tools to support annotation, database building, and database interface.

An important part of FrameNet work is the annotation of corpus sentences with frame-semantic information. We use the British National Corpus (BNC), because no equally comprehensive corpus exists for American English (though efforts are underway to create a comparable American National Corpus—see Fillmore et al. 1998). Each annotated example sentence shows argument-structure properties of one **target** verb, adjective or noun. The main task of annotation is to tag the arguments (and occasionally modifiers) of the target with the names of the FEs that they express. A secondary task is to mark other lexicographically relevant elements, such as support verbs of target nouns, and certain non-meaningful elements that indicate lexicographically relevant grammatical constructions (e.g. extraposition and the existential construction). (See Fillmore & Atkins 1998 on lexicographic relevance.)

Here is an example sentence from the BNC showing the annotation properties of the complements of the target verb *tell*:

(1) [Maltravers (Speaker, NP, Ext)] decided not
   to **tell**
   [Stephen (Addressee, NP, Obj)]
   [about the inscription in the Le Carré book
      (Topic, PP*about*, Comp)].

The annotated constituents appear in brackets. Following each constituent is a set of parentheses containing the FE, PT and GF associated with that constituent (actual

annotations consist of XML markup created using the Alembic Workbench software from the Mitre Corporation). PT and GF information is added by an automatic phrase labeler developed by the technical team.

2 The FrameNet tagset

2.1 Phrase Types

Below are the FrameNet Phrase Types. This is intended to be a comprehensive list of the types of syntactic constituent that can express FEs of major predicating words of English (nouns, verbs and adjectives). These constituents occur either as arguments or as lexicographically relevant modifiers. In constructing this list, we made extensive reference to the Comlex syntax (Meyers et al. 1995).

2.1.1 Noun phrase types

NP	Noun phrase (*the witness*)
N	Non-maximal nominal (personal *chat*)
Poss	Possessive NP (*the child's* decision)
There	Expletive *there* (*there* was a fight)
It	Expletive *it* (*it's* nice that you came)

2.1.2 Prepositional phrase types

PP	Prepositional phrase (look *at me*)
Ping	PP with gerundive object (keep *from laughing*)
Part	Particle(look it *up*)

2.1.3 Verb phrase types

VPfin	Finite verb phrase (we *ate fish*)
VPbrst	Bare stem VP (let us *eat fish*)
VPto	*To*-marked infinitive VP (we want *to eat fish*)
VPwh	WH-VP (we know *how to win*)
VPing	Gerundive VP (we like *winning*)

2.1.4 Complement clause types

Sfin	Finite clause (it's nice *that you came*)
Swh	WH-clause (ask *who won*)
Sif	*If/whether* clause (ask *if we won*)
Sing	Gerundive clause (we saw *them running*)
Sto	*To*-marked clause (we want *them to win*)
Sforto	*For-to*-marked clause (we would like *for them to win*)
Sbrst	Bare stem clause (we insist *that they win*)

In certain cases FrameNet marks as two constituents what are treated as "small clauses" in some analyses. For example, in the sentence *I consider Pat a genius*, *Pat* and *a genius* would be tagged separately.

2.1.5 Other phrase types

AjP   Adjective phrase (an *interesting* idea)
AdvP   Adverb phrase (you put that *nicely*)
Quo   Quote (*"Indeed,"* she said)

2.2 Grammatical Functions

Below is a list of the FrameNet GFs. This list is intended to characterize all the grammatical contexts relative to English verbs, adjectives and nouns that are regularly occupied by FE-expressing constituents. In this list, we do not make the traditional distinction between obliques and arguments/complements (the former are simply PP complements).

2.2.1 FrameNet grammatical functions

Ext   External Argument
(Argument outside phrase headed by target verb, adjective or noun)

Comp Complement
(Argument inside phrase headed by target verb, adjective or noun)

Mod   Modifier
(Non-argument expressing FE of target verb, adjective or noun)

Xtrap Extraposed
(Verbal or clausal complement extraposed to end of VP)

Obj   Object
(Post-verbal argument; passivizable or does not alternate with PP)

Pred   Predicate
(Secondary predicate complement of target verb or adjective)

Head Head
(Head nominal in attributive use of target adjective)

Gen   Genitive Determiner
(Genitive Determiner of nominal headed by target)

2.3 Nonexpression of FEs

Besides being expressed by the PTs and GFs listed above, FEs may remain unexpressed under the different conditions discussed below (see Fillmore 1986).

2.3.1 Indefinite Null Instantiation

In sentence (1), the FEs Message, Medium and Code are not expressed. It can however be inferred that there must be a Message, Medium and Code in a communicative event of the type described by this sentence. These FEs, while conceptually present in this sentence, are optionally expressed, and there are no particular restrictions on their nonexpression. This is called **Indefinite Null Instantiation** (INI).

2.3.2 Definite Null Instantiation

With some words, an FE may be unexpressed in a sentence only if it assumed that the person to whom the sentence is addressed has specific information about the frame element in question. This kind of non-expression is called **Definite Null Instantiation** (DNI). For example, the words *tell*, *inform* and *notify* allow a Message to be omitted when it is clear what the Message is, e.g. *How did I know you won? Because Pat already told me.*

2.3.3 Constructionally licensed null instantiation

Certain grammatical constructions, such as Passive and Imperative, allow an External Argument FE to be unexpressed, e.g. *Harsh things were said, Tell me about yourself.* This is **Constructionally Licensed Null Instantiation** (CNI).

FrameNet annotation marks prominent unexpressed FEs as well as FEs that are expressed overtly. In order to achieve this, we place the symbols INI, DNI and CNI immediately after the target word in every annotated sentence, and place the appropriate FE tag on the appropriate symbol. For example, the case of DNI discussed above would be annotated as follows:

(2) [Pat (Speaker)] already **told** INI [DNI (Message)] CNI [me (Addressee)].

2.4 Frame Elements

Frames are organized into the following domains: Body, Chance, Cognition, Communication, Emotion, Health, Life Stages, Motion, Perception, Society, Space, Time, Transaction, and a General domain. Each domain contains several frames that characterize different word classes. Because there are many frames, it is not possible to give the complete list of FEs. The next section discusses FEs from the Communication domain.

3 Communication frames

It is typically the case that different frames in the same domain share FEs. For that reason, each domain can be characterized by a basic frame that defines its FEs in general terms, and more specific frames, corresponding to word classes, that are based on this basic frame through inheritance or some other principled relation. Let us consider the basic frame of verbal communication.

3.1 Basic Verbal Communication frame

The following FEs consistently appear in frames relating to verbal communication:

Speaker
   (A person who performs an act of verbal communication)

Addressee
   (An actual or intended recipient of a verbal message)

Message
   (A communicated proposition)

Topic
   (The subject matter of a message)

Medium
   (A physical channel of communication)

Code
   (The language or other code used to communicate)

These FEs all derive their meaning from the concept of a basic communicative event. Clearly a true frame representation cannot just consist of a list of role names, but must characterize such events. Currently FrameNet frame descriptions

exist only in text form, but the ultimate aim is to express them in a machine-readable format. An important component of such a representation will be feature structures that express relations between frames symbolically. These might be combined with computational event models that are able to generate inferences, such as the x-schemas developed by Bailey et al. (1997) and Narayanan (1997).

The FEs of the Basic Verbal Communication frame are relevant to sentence (1) above, in which the Speaker is expressed as an NP Ext, the Addressee is expressed as an NP Obj, and the Topic is expressed as a PP Comp headed by *about*. The other FEs are not expressed.

We will examine how the FEs above are realized in different Communication frames, and in the process, will see some of the kinds of generalizations that can be expressed through frame-semantic lexical analysis.

3.2 Other frames in the Communication domain

The Basic Verbal Communication frame characterizes events of verbal communication in the most general terms. Different Communication words represent different types of communicative event and different ways of construing such events. Generalizations over these words are captured by different frames in the domain. Some focus on, or *profile*, in Langacker's (1987) terminology, the relation between a Speaker and a propositional Message. These are grouped into frames characterizing different speech acts, e.g. asking (Questioning frame), requesting (Request frame), asserting (Statement frame), and promising (Commitment frame). A few words profile the relation between a Speaker and an act of speaking, but not the propositional Message communicated (*talk, speak*). Some denote events of reciprocal communication (e.g. *discuss, argue, conversation*, etc.). And so on.

The following sections summarize properties of specific frames, and discuss some assumptions about the ontology of the Communication domain that might account for these properties.

3.3 The Statement frame

Verbs and nouns in the Statement frame profile a relation between a Speaker and a propositional

Message that has the speech act status of an assertion. Because of the importance of the Message FE, these words frequently occur with Sfin Comp (finite clausal complements):

(3) [Others (Speaker, NP, Ext)] **assert** [that anthropology is the tree and sociology the branch (Message, Sfin, Comp)].

(4) [Managers (Speaker, NP, Ext)] **claim** [there was no radiological hazzard to staff or the public (Message, Sfin, Comp)].

(5) [His (Speaker, Poss, Gen)] **claims** [to have more energy (Message, VPto, Comp)] are simply laughable.

Message can be expressed with different PPs as well. For example, with the target noun *claim*, it can be expressed as a to-marked infinitive VP, as in example (5).

3.4 The Speaking frame

Verbs and nouns in the Speaking frame profile a relation between a Speaker and an act of speaking, but do no allow a Message to be expressed:

(6) [She (Speaker, NP, Ext)] never **spoke** [about her feelings (Topic, PP*about*, Comp)].

This fact can be explained if we analyze the basic meaning of Speaking words as being something like 'X say something'. The Message role can be thought of as being **incorporated** into this meaning, with incorporation in this case being equivalent to obligatory INI.

3.5 The Request frame

Like words in the Statement frame, these words frequently occur with clausal Complements. However, because these Complements express requests rather that assertions, they often occur as bare stem clauses:

(7) In all cases [the respondent (Speaker, NP, Ext)] may **request** [in writing (Medium, PP*in*, Comp)] [that the disciplinary findings be published (Message, Sbrst, Comp)].

3.6 The Conversation frame

One class of words in the Communication domain does not use the FEs Speaker and Addressee as they occur in other frames. These are nouns and verbs or reciprocal communication, which are treated in the Conversation frame. In this frame, the human interlocutors can be expressed in separate constituents, assigned the roles **Protagonist-1** (Prot-1) and **Protagonist-2** (Prot-2), or they can be expressed in a single conjoined or plural constituent, assigned the role **Protagonists** (Prots).

This class of words demonstrates the complex interaction of frames. The FEs Prot-1, Prot-2 and Prots are not equivalent to any of the Basic Verbal Communication FEs, but do relate to them in a regular way. Each of these roles must be thought of as relating to two or more Communicative subevents, and as corresponding to a Speaker in some and an Addressee in others. This basic structure is taken not from any frame in the domain of Communication, but from a Reciprocity frame, which is in the General domain. The Reciprocity frame may be thought of as an Aktionsart frame that structures events and relations from other frames in a particular way, such that there are multiple subeventualities of the same type as that of the input frame, and the bindings or fillers of the roles are reversed from one subeventuality to the another.

The complexity introduced by frames such as these points to the need to distinguish between conceptual roles and FEs in any given frame. While the Communication roles Speaker and Addressee are not FEs in the Conversation frame, they are conceptual roles, because the conceptual representation of Conversation makes reference to them. (In the Speaking frame discussed above, we can also think of the incorporated Message role as being a conceptual role rather than an FE.) FEs in any given frame should therefore be defined as those roles for which the frame specifies conventional means of syntactic expression, even if these means are not employed in all sentences.

3.6.1 Disjoint expression: Prot-1 and Prot-2

Here is a BNC example of *argue* with a disjoint expression of interlocutors:

(8) "[You (Prot-1, NP, Ext)] can't **argue** [politics (Topic, NP, Comp)] [with foreigners (Prot-2, PP*with*, Comp)]", sighed the policeman.

Prot-2, the less prominent interlocutor, is regularly expressed in this frame by a PP Comp

headed by *with*. This is consistent with the general behavior of the Reciprocity frame as it occurs in combination with other frames and domains (e.g. *Pat had a collision/relationship/agreement with Kim*).

3.6.2 Joint expression: Protagonists

Here are BNC examples of the joint expression of interlocuters with argue:

(9) [They (Prots, NP, Ext)] **argued** [angrily (Manner, AdvP, Mod)] [over who was the real "Prince of Sleaze" (Topic, PP*over*, Comp)].

(10)   [Mr. and Mrs. Popple (Prots, NP, Ext)] always **argued** [INI (Topic)] at least once a week.

3.7 FrameNet complements existing lexical resources

FrameNet annotations provide more detail than existing lexical resources about the way in which particular semantic roles (i.e. FEs) are linked with particular means of syntactic expression. Since different senses of ambiguous words are defined relative to different frames, this linking information could potentially be used for lexical disambiguation.

For example, consider the verb *argue* as it is treated in the WordNet database (Fellbaum 1998). Below are the three WordNet senses of *argue*, and the sentence frames that are associated with each sense:

Sense 1: argue, reason — (present reasons and arguments)

> EX: Sam and Sue argue

> EX: Sam wants to argue with Sue

Sense 2: argue, contend, debate, fence — (have an argument about something)

> EX: Sam and Sue argue

> EX; Sam wants to argue with Sue

Sense 3: argue, indicate — (give evidence of; "The evidence argues for your claim"; "The results indicate the need for more work")

The three senses listed above correspond to three different frames: Sense 1 corresponds to the Statement frame, Sense 2 to the Conversation frame, and Sense 3 to the Evidence frame in the

Cognition domain. However, the information about sentence frames provided in WordNet does not correspond to the generalizations that are apparent in FrameNet. For example, WordNet gives the same sentence frames for Senses 1 and 2, while in the FrameNet database, the senses of *argue* defined relative to the Statement and Conversation frames are characterized by different argument structures: only Statement *argue* allows finite clausal complements expressing Message; Conversation *argue* has the properties of other reciprocal communication words, which Statement *argue* lacks, and does not allow clausal Complements (or any other expression of Message).

COMLEX (Meyers et al. 1995) recognizes the syntactic frames in which *argue* occurs, but does not provide information about the linking of syntactic constituents with semantic roles, or about the different complementation properties of different senses of ambiguous words.

Conclusion

FrameNet semantic annotation captures human knowledge about the ways in which semantic roles (FEs) are conventionally expressed by different words in various word classes and domains. The kind of information in the FrameNet database is not expressed in the same level of depth in any existing print dictionary or computational lexical resource. While WordNet describes semantic relations between words, it does not recognize the conceptual schemas, i.e. frames, that mediate in these relations, and therefore does not have the means to link arguments of predicating words with the semantic roles they express. COMLEX and NOMLEX provide detailed information about the syntactic frames in which verbs and nouns occur, but also lack a means to link syntactic arguments with semantic roles. FrameNet therefore provides information that complements major existing lexical resources.

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