Case Grammar
Semantic Role Labeling

Semantics of events in sentences

- In a sentence, a verb and its semantic roles form a proposition; the verb can be called the predicate and the roles are known as arguments.

When Disney offered to pay Mr. Steinberg a premium for his shares, the New York investor didn't demand the company also pay a premium to other shareholders.

Example semantic roles for the verb "pay" (using verb-specific roles)

When [$_{payer}$ Disney] offered to [$_{V}$ pay] [$_{recipient}$ Mr. Steinberg] [$_{money}$ a premium] for [$_{commodity}$ his shares], the New York investor …

CASE Grammar

- **Fillmore, Charles (1968) *"The Case for Case."***
  - A response to Chomsky's disregard for any semantics
    - "A semantically justified syntactic theory"

- Given a sentence, it is possible to say much more than this NP is the subject and this NP is the object

- Chomsky's Transformational Grammar would reduce active & passive versions of the same deep structure, but doesn't go far enough to reveal why this is is possible semantically
  - *A crowbar could open that door easily.*
  - *That door could be opened easily with a crowbar.*

CASE Grammar

- Focuses on conceptual events
  - for each event or situation, there is a limited number of roles/cases which people or objects play in the situation
  - roles reflect ordinary human judgments about:
    - Who did the action?
    - Who / what was it done to?
    - What was it done with?
    - Where was it done?
    - What was the result?
    - When was it done?

Syntactic structure vs. semantic structure

- Syntactic similarities hide semantic dissimilarities
  - ***We*** *baked every Saturday morning.*
  - *The* ***pie*** *baked to a golden brown.*
  - *This* ***oven*** *bakes evenly.*
  - 3 subject NPs perform very different roles in regard to *bake*

- Syntactic dissimilarities hide semantic similarities
  - $\text{John}_{\text{agent}}$ broke the $\text{window}_{\text{theme}}$.
  - $\text{John}_{\text{agent}}$ broke the $\text{window}_{\text{theme}}$ with a $\text{rock}_{\textit{instrument}}$.
  - The $\text{rock}_{\textit{instrument}}$ broke the $\text{window}_{\text{theme}}$.
  - The $\text{window}_{\text{theme}}$ broke.
  - The $\text{window}_{\text{theme}}$ was broken by $\text{John}_{\text{agent}}$.

Cases (aka Thematic Roles or Theta Roles)

- Some of Fillmore's original set of roles still in use as general descriptors of roles
  - **Agentive (A)**
    - the instigator of the action, an animate being
      - ***John*** *opened the door.*
      - *The door was opened by* ***John****.*
  - **Instrumental (I)**
    - the thing used to perform the action, an inanimate object
      - *The* ***key*** *opened the door.*
      - *John opened the door with the* ***key****.*
  - **Locative (L)**
    - the location or spatial orientation of the state or action of the verb
      - *It's windy in* ***Chicago****.*
- Other original roles not typically used
  - **Dative (D), Neutral (N), Objective (O), Factitive (F)**

Verb-specific Roles

- Difficult to fit many verbs and roles into the general thematic roles
  - Many general sets are proposed; not uniform agreement
  - Generalized semantic roles now often called
    - Proto roles: Proto-agent, proto-patient, etc.
    - Or theta roles
- Verb-specific roles are proposed in systems
  - PropBank annotates the verbs of Penn Treebank
    - Extended with NomBank for nominalizations
  - FrameNet annotates the British National Corpus
    - Uses domains of semantically similar verbs called frames.

Propbank

- Propbank is a corpus with annotation of semantic roles, capturing the semantic role structure of each verb sense
  - Funded by ACE to Martha Palmer and Mitch Marcus at U Penn
- Each verb sense has a frameset, listing its possible semantic roles
    - Argument notation uses numbers for the annotation
    - First sense of accept (accept.01)
      - Arg0: acceptor
      - Arg1: thing accepted
      - Arg2: accepted-from
      - Arg3: attribute
- The frameset roles are standard across all syntactic realizations in the corpus of that verb sense
  - Each verb has a frameset file describing the args as above
    - Example texts are also given

Roles consistent with VerbNet

- Propbank builds on VerbNet to assign more specific roles.
- VerbNet is one extension of Levin's verb classes, giving semantic roles from about 20 possible roles
  - Agent, Patient, Theme, Experiencer, etc.
  - Similar to the theta roles
- Each class consists of a number of synonymous verbs that have the same semantic and syntactic role structure in a frame
- Whenever possible, the Propbank argument numbering is made consistent for all verbs in a VerbNet class.
  - There is only 50% overlap between Propbank and VerbNet verbs.
- Example from frameset file for "explore", which has a VN class:

```
<roleset id="explore.01" name="explore, discover new places or things" vncls="35.4">
<roles> <role descr="explorer" n="0">
                    <vnrole vncls="35.4" vntheta="Agent"/></role>
        <role descr="thing (place, stuff) explored" n="1">
                    <vnrole vncls="35.4" vntheta="Location"/></role>
</roles>
```

Semantic Role Notation for Propbank

- The first two numbered arguments correspond, approximately, to the core case roles:
  - Arg0 – Prototypical Agent
  - Arg1 – Prototypical Patient or Theme
  - Remaining numbered args are verb specific case roles, Arg2 through Arg5
- Another large groups of roles are the adjunctive roles (which can be applied to any verb) and are annotated as ArgM with a suffix:
  - ArgM-LOC – location
  - ArgM-EXT – extent
  - ArgM-DIR – direction
  - ArgM-ADV – general purpose adverbial
  - ArgM-DIS – discourse connective
  - ArgM-MOD – modal verb

ArgM-CAU - cause
ArgM-TMP - time
ArgM-PNC – purpose
ArgM-MNR - manner
ArgM- NEG – negation

Adjunctive and additional arguments

- Example of adjunctive arguments
  - Not all core arguments are required to be present
    - See Arg2 in this example.
  - Arguments can be phrases, clauses, even partial words.

When Disney offered to pay Mr. Steinberg a premium for his shares, the New York investor didn't demand the company also pay a premium to other shareholders.

Example of Propbank annotation (on demand):

[$_{ArgM-TMP}$ When Disney offered to pay Mr. Steinberg a premium for his shares], [$_{Arg0}$the New York investor] did [$_{ArgM-NEG}$ n't] [$_{V}$ demand] [$_{Arg1}$ the company also pay a premium to other shareholders].

Where for demand, Arg0 is "asker", Arg1 is "favor", Arg2 is "hearer"

Prepositional phrases and additional args

- Arguments that occur as the head of a prepositional phrase are annotated as the whole phrase
  - Consistent with other ArgM's that are prepositional phrases

    [$_{Arg1}$ Its net income] [$_{V}$ declining] [$_{ArgM-EXT}$ 42%] [$_{Arg4}$ to $121 million] [$_{ArgM-TMP}$ in the first 9 months of 1989]

- Additional arguments are
  - ArgA – causative agents
  - C-Arg* - a continuation of another arg (mostly for what is said)
  - R-Arg* - refererence to another arg (mostly for "that")

Propbank Annotations

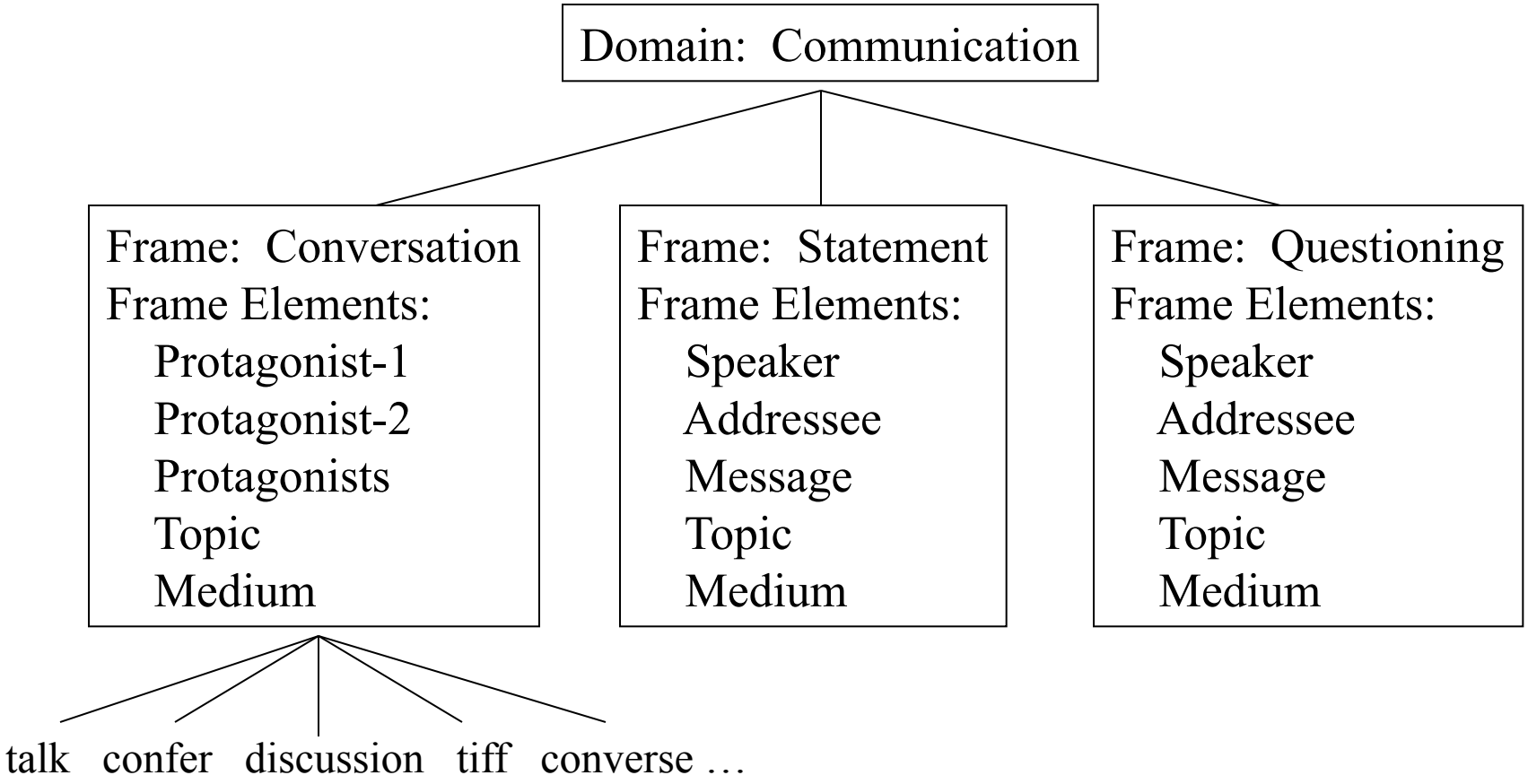
- Framesets were created by looking at sample sentences containing each verb sense.
  - ~ 4500 frames (in 3314 framesets for each verb)
- Corpus is primarily newswire text from Penn Treebank
  - Annotated the Wall Street Journal section, and, more recently, the "Brown" corpus
  - Verbs and semantic role annotations added to the parse trees
- Annotators are presented with roleset descriptions of a verb and the (gold) syntactic parses of a sentence in Treebank, and they annotate the roles of the verb.
  - Lexical sampling – annotated on a verb-by-verb basis.
  - ~40,000 sentences were annotated
- Interannotater agreement
  - Identifying argument and classifying role: 99%
    - kappa statistic of .91overall and .93 if ArgM's excluded

FrameNet

- Project at International Computer Science Institute with Charles Fillmore
  - http://framenet.icsi.berkeley.edu/
- Similar goal to document the syntactic realization of arguments of predicates in the English language
- Starts from semantic frames (e.g. Commerce) and defines frame elements (e.g. Buyer, Goods, Seller, Money)
- Annotates example sentences chosen to illustrate all possibilities
  - But recent release includes 132,968 sentences
  - British National Corpus

Example of FrameNet frames

- Semantic frames are related by topic domain



Comparison of FrameNet and Propbank

- FrameNet semantic roles are consistent for semantically related verbs (not just synonyms as in the VerbNet subset of PropBank)
- Commerce examples:

FrameNet annotation:

[Buyer Chuck] *bought* [Goods a car] [Seller from Jerry][Payment for $1000].
[Seller Jerry] *sold* [Goods a car] [Buyer to Chuck] [Payment for $1000].

Propbank annotation:

[Arg0 Chuck] *bought* [Arg1 a car] [Arg2 from Jerry][Arg3 for $1000].
[Arg0 Jerry] *sold* [Arg1 a car] [Arg2 to Chuck] [Arg3 for $1000].

Frame for buy:
Arg0: buyer
Arg1: thing bought
Arg2: seller
Arg3: price paid
Arg4: benefactive

Frame for sell:
Arg0: seller
Arg1: thing sold
Arg2: buyer
Arg3: price paid
Arg4: benefactive