A Hierarchical Unification of LIRICS and VerbNet Semantic Roles

Claire Bonial, William Corvey, Martha Palmer, Volha V. Petukhova, and Harry Bunt

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Overview and Purpose

• Compares thematic roles of VerbNet (VN) and thematic roles of the Linguistic InfRrastructure for Interoperable ResourCes and Systems (LIRICS)

• Replace existing VN semantic roles and develop a standard set of thematic roles that would be appropriate for a variety of NLP applications
How do we label arguments with one set of thematic roles?
Proposal: A unified set of semantic roles that will be incorporated into VN

- Map more easily to an ISO standard set
- Arranged hierarchically based on semantic feature inheritance and feature constraints
LIRICS

• Semantic roles should be defined
  – As semantic categories (not syntactic or lexical structures)
  – By distinctive semantic properties
  – As not restricted to only a few specific verb (/ noun/adjective) classes
  – As relational notions that link participants to an event
    • Intentional action? Affected by other participants? Exist through the event?
LIRICS

• Set of 29 roles
  – 11 central roles (agent, theme, patient)
  – 10 adjunct roles (time, location, manner)
  – 8 subroles for time and location (duration, frequency, path)
LIRICS

Example: theme role

• Essential to the event taking place, does not have control over the way the event occurs
  • Not structurally changed by the event
• In a fixed position/condition throughout the state
  • Essential to the state being in effect
  • Not as essential as the pivot role
LIRICS

• Granularity
  – Low-level roles inherit all the properties of high-level roles and have an additional feature
  – Result: a shallow hierarchy for several semantic roles
  – Example:
    • Time: Initial_Time, Final_Time, Frequency, and Duration
**VerbNet**

- Describes the sets of diathesis alternations that are compatible with each verb in the lexicon
- Example:

<table>
<thead>
<tr>
<th></th>
<th>Break</th>
<th>Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inchoative variation</strong></td>
<td>The window broke</td>
<td>A rabbit appeared out of the magician’s hat</td>
</tr>
<tr>
<td><strong>Causative variation</strong></td>
<td>The boy broke the window</td>
<td>*The magician appeared a rabbit out of his hat</td>
</tr>
</tbody>
</table>
VerbNet

• Fundamental assumption: syntactic frames that are compatible with a particular verb are a reflection of the underlying semantics
• Thematic roles are assigned to each syntactic argument in a given verb class
• Use of semantic predications denoting relationships between participants and events
VerbNet

• Example:
  I put the book on the table

<table>
<thead>
<tr>
<th>Syntactic Representation</th>
<th>Semantic Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP  V  NP  PP</td>
<td>MOTION(DURING(E), THEME)</td>
</tr>
<tr>
<td>Agent V Theme Destination</td>
<td>NOT(PREP: on (START(E), THEME, DESTINATION))</td>
</tr>
<tr>
<td></td>
<td>PREP: on (END(E), THEME, DESTINATION)</td>
</tr>
<tr>
<td></td>
<td>CAUSE(AGENT, E)</td>
</tr>
</tbody>
</table>
Current State of VN makes use of:

- Commonly used, coarse-grained roles like those of LIRICS (e.g. agent)
- Roles that are specific to certain classes of events, which are intended to convey key semantic components of some verb classes (e.g. topic)
- Roles that are partially syntactically motivated (e.g. predicate)
- Roles that are distinguished by internal properties of the participant (e.g. +/- animate)
LIRICS only makes use of roles that are:

• Not restricted to specific verb classes
• Not linked to particular syntactic structures
• Not related to internal properties of participants
<table>
<thead>
<tr>
<th>Old VN role</th>
<th>New VN role</th>
<th>LIRICS role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor</td>
<td>Agent</td>
<td>Agent</td>
</tr>
<tr>
<td>Actor 1</td>
<td>Agent</td>
<td>Agent</td>
</tr>
<tr>
<td>Actor 2</td>
<td>Co-Agent</td>
<td>Partner</td>
</tr>
<tr>
<td>Agent</td>
<td>Agent</td>
<td>Agent</td>
</tr>
<tr>
<td>Asset</td>
<td>Asset</td>
<td>Amount</td>
</tr>
<tr>
<td>Attribute</td>
<td>Attribute</td>
<td>Attribute</td>
</tr>
<tr>
<td>Beneficiary</td>
<td>Beneficiary</td>
<td>Beneficiary</td>
</tr>
<tr>
<td>Cause</td>
<td>Cause</td>
<td>Cause</td>
</tr>
<tr>
<td>Destination</td>
<td>Destination</td>
<td>Final_Location</td>
</tr>
<tr>
<td>Experiencer</td>
<td>Experiencer</td>
<td>Pivot</td>
</tr>
<tr>
<td>Extent</td>
<td>Extent</td>
<td>Amount/Distance</td>
</tr>
<tr>
<td>Instrument</td>
<td>Instrument</td>
<td>Instrument</td>
</tr>
<tr>
<td>Location</td>
<td>Location</td>
<td>Location</td>
</tr>
<tr>
<td>Material</td>
<td>Material</td>
<td>Source</td>
</tr>
<tr>
<td>Patient</td>
<td>Patient</td>
<td>Patient</td>
</tr>
<tr>
<td>Patient 1</td>
<td>Patient</td>
<td>Pivot</td>
</tr>
<tr>
<td>Patient 2</td>
<td>Co-Patient</td>
<td>Patient</td>
</tr>
<tr>
<td>Predicate</td>
<td>Product</td>
<td>Proposition</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>-</td>
<td>Result/Product</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>Result</td>
<td>-</td>
</tr>
</tbody>
</table>
Roles specific to VN

• Example:
• Topic
  – Fine-grained
  – Specific to verbs of communication
  – More likely to be realized in the form of a complement clause
• Theme
  – Coarse-grained
  – More likely to be realized in the form of a noun phrase
Fig. 1. Hierarchy of Unified Semantic Roles
Hierarchy

• Coarse-grained roles: for tasks that require a roleset that has the broadest coverage across all verbs
• Fine-grained roles/Class specific roles: for tasks that benefit from info that helps to distinguish classes of verbs
Revised Roleset

- Roles: Participant, Actor, Undergoer, Pivot
- Roles adapted or revised from LIRICS: Cause, Agent, Instrument, Theme, Patient, Attribute, Beneficiary, Place, Source, Initial_Location, Goal, Time, Initial_Time, Final_Time, Frequency, Duration
- Roles specific to certain event types: Co-Agent, Stimulus, Co-Theme, Topic, Co-Patient, Experiencer, Location, Material, Destination, Recipient, Result, Product, Value, Extent, Asset
Examples

- He talked about politics
LIRICS: He\textsubscript{AGENT} talked\textsubscript{RELATION} about\textsubscript{THEME}_politics
VN 1 (coarse-grained): He\textsubscript{AGENT} talked\textsubscript{RELATION} about\textsubscript{THEME}_politics
VN 2 (fine-grained): He\textsubscript{AGENT} talked\textsubscript{RELATION} about\textsubscript{THEME}_politics\textsubscript{TOPIC}

- He sent the letter to Mary
LIRICS: He\textsubscript{AGENT} sent\textsubscript{RELATION} the\textsubscript{THEME}_letter to\textsubscript{GOAL}_Mary
VN 1 (coarse-grained): He\textsubscript{AGENT} sent\textsubscript{RELATION} the\textsubscript{THEME}_letter to\textsubscript{GOAL}_Mary
VN 2 (fine-grained): He\textsubscript{AGENT} sent\textsubscript{RELATION} the\textsubscript{THEME}_letter\textsubscript{RECIPIENT}_Mary
Examples

• John collaborated with Paul on the task.
LIRICS: John$_{AGENT}$ collaborated$_{RELATION}$ with$_{PARTNER}$ Paul$_{PARTNER}$ on$_{THEME}$ the$_{THEME}$ task$_{THEME}$
VN: John$_{AGENT}$ collaborated$_{RELATION}$ with$_{CO-AGENT}$ Paul$_{CO-AGENT}$ on$_{THEME}$ the$_{THEME}$ task$_{THEME}$

• The tourists admired the paintings.
LIRICS: The$_{PIVOT}$ tourists$_{PATIENT}$ admired$_{RELATION}$ the$_{CAUSE}$ paintings$_{CAUSE}$
VN 1 (coarse-grained): The$_{PATIENT}$ tourists$_{PATIENT}$ admired$_{RELATION}$ the$_{CAUSE}$ paintings$_{CAUSE}$
VN 2 (fine-grained): The$_{EXPERINER}$ tourists$_{EXPERINER}$ admired$_{RELATION}$ the$_{STIMULUS}$ paintings$_{STIMULUS}$