



Methods of AI

Practice Session 11
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Today

- Organization
 - Assignment 8
- Roles
 - Theta theory
 - Proto roles
- Situation calculus
 - Frame axioms
 - An example for blocks world



Organization

- Final Examination
 - Sign up the sheets
 - Dates
 - 07.02.2003, 12:00 – 14:00
 - 07.02.2003, 14:00 – 16:00
 - Topics
 - Everything we discussed in this course
 - Exception: Machine learning / temporal or spatial reasoning



Last Assignments

- Assignment 8
 - Deadline: 31th of January, 2003
 - Topics
 - Planning
- Programming assignment
 - Deadline: 16th of February, 2003
 - Will be online soon



Role Frames

Remarks on Roles and Linguistic
Applications



Theta Theory in GB

- In government and binding theory (GB) the standard theory for roles is called Theta theory
 - „John moved the rock“
 - Argument-NPs „John“ and „the rock“ have different semantic relations to the verb „moved“
 - The subject position refers to someone who is the AGENT of the activity
 - The argument position refers to the THEME of the activity
 - Relations between verbs and their arguments are called theta roles in GB
 - These roles are governed by the verb (thematic structure)



Theta Theory

- Here is a list of theta roles
 - AGENT
 - Someone who initiates the action
 - PATIENT
 - Something undergoing the action
 - THEME
 - Something moved by the action
 - EXPERIENCER
 - Something that experiences some state
 - BENEFACTIVE
 - Something that benefits from the action
 - GOAL
 - Something towards which the action is directed



Theta Theory

- List continued
 - SOURCE
 - Something from which something is moved as a result of the action
 - LOCATION
 - The place in which the action is situated
- Examples
 - The ball rolls towards the chair
THEME GOAL
 - John is in Osnabrück
THEME LOCATION
 - Science fiction novels please John
THEME EXPERIENCER
 - John gave the book to Mary
 - AGENT THEME BENEFACTIVE/GOAL



Theta Theory

- Remarks

- In GB, the information of the argument structure is usually assumed to be a part of lexical knowledge
- The question arises whether it is possible to present a complete list of theta roles
- What about adverbial modifications?
 - The number of arguments can be increased by adverbial modifications
 - Example
 - John butters the toast
 - John butters the toast with a knife
 - John butters the toast with a knife in the bathroom
 - John butters the toast with a knife in the bathroom at midnight
 - John butters the toast with a knife in the bathroom at midnight himself



Theta Theory

- Remarks

- Unclear boundaries
 - AGENT vs.
 - AGENT/ACTOR (Jackendoff) vs.
 - VOLITIVE/EFFECTIVE/INITIATIVE/AGENTIVE (Cruse)
 - Fourteen different forms of Agency (Lakoff)
- Cases where there may be no role that can distinguish two arguments
 - This is similar to / equal to that
 - If a is equal to b then b is equal to a
 - No asymmetry between in what is predicated of the two arguments



Proto Roles (Dowty)

- Thematic roles are considered as prototypes
 - Role types are not discrete categories but cluster concepts
 - There are degrees of membership
 - There are only two proto types
 - Proto-Agent
 - Proto-Patient



Proto Roles (Dowty)

- Important entailments of Proto-Agent
 - Volitional involvement in the event or state
 - John is being polite to Bill
 - Sentence (and/or perception)
 - John sees Mary
 - Causing an event or change of state in a participant
 - Teenage unemployment causes delinquency
 - Movement
 - He fell
 - Exists independently of the event
 - John needs a new car



Proto Roles (Dowty)

- Important entailments of Proto-Patient
 - Undergoes change of state
 - John moved the rock
 - Incremental theme
 - John crossed the street
 - Causally affected by another participant
 - Smoking causes cancer
 - Stationary relative to movement of another participant
 - The bullet entered the target
 - Existence not independent of the event
 - John built a house



Proto Roles (Dowty)

- Each entailment is hypothesized to be semantically independent
 - But clearly most verbs have more than one entailment
 - Some separate these entailments
 - John sees Mary (sentience / perception)
 - His loneliness causes his unhappiness (causation)
 - John filled the glass with water (incremental theme)
 - The bullet entered the target (stationary relative to another participant)



Proto Roles (Dowty)

- Argument selection principle
 - In predicates with grammatical subject and object, the argument for which the verb entails the greatest number of Proto-Agent properties will be lexicalized as subject
 - A dual claim holds for the object
- Corollary 1
 - If two arguments have equal numbers of entailed Proto-Agent and Proto-Patient properties then either or both may be lexicalized as subject
- Corollary 2
 - Three-placed case: the non-subject argument having the greater number of entailed Proto-Patient properties will be lexicalized as direct object, the one with the fewer number as oblique or propositional object



Proto Roles (Dowty)

- Further features
 - Role hierarchies
 - Example: Strong agents outrank strong patients
 - Dowty's theory is not dependent on particular representation formats
 - For a particular formal semantics one can extend the theory with proto roles
 - Examples for formal semantics
 - DRT (discourse representation theory) (Kamp)
 - Event semantics (Davidson)
 - Situation theory (Barwise)
 - Dynamic semantics (van Benthem)



References

- KL-ONE
 - Kai von Luck: KL-One. Eine Einführung, IWBS Report 106, 1990.
 - Handbuch der Künstlichen Intelligenz, edited by G. Görtz, C. Rollinger, and J. Schneeberger, München, Wien 2000.
- Theta Theory
 - Each good introduction in government and binding theory
- Proto Types
 - David Dowty: Thematic Proto-Roles and Argument Structure, Language, vol. 67, No.3 (1991).