PSL and SWSL

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Goal

• Ontology for web services
  – Generic classes of services
  – Classes of constraints in service specifications
    • ordering
    • temporal
    • occurrence
    • triggers (state-based constraints)
    • duration

• Language for web service specifications (SWSL)
Approach

• Specify a first-order semantics for DAML-S concepts through PSL translation definitions
• Use the grammars associated with PSL classes as the abstract syntax for SWSL
Semantics

• Why do we want a first-order model theory?
  – inference (sound and complete with respect to models)
  – easily integrated with other ontologies (which are all first-order)
Reasoning Problems

• Reasoning problems for web service specifications
  – Consistency of constraints
  – Composability of services
  – Search queries
Formal Properties of PSL

• The meaning of terms in the ontology is characterized by models for first-order logic.

• The PSL Ontology has a first-order axiomatization of the class of models.

• Classes in the ontology arise from classification of the models with respect to invariants (properties of the models preserved by isomorphism).

• Process descriptions are specified by definable types for elements in the models.
Organization of PSL

- PSL is a modular, extensible ontology capturing concepts required for process specification
- There are currently 300 concepts across 50 extensions of a common core theory (PSL-Core), each with a set of axioms written using the Knowledge Interchange Format.
- Two kinds of extensions:
  - Core theories
  - Definitional extensions
PSL Core Theories

- Activity Occurrences
- Complex Activities
- Atomic Activities
  - Subactivity
  - Occurrence Trees
- Discrete State
- PSL-Core
Additional Core Theories

- Duration
- Subactivity Occurrence Ordering
- Iterated Occurrence Ordering
- Resource Requirements
- Resource Sets
- Activity Performance
Definitional Extensions

• Preserving semantics is equivalent to preserving models of the axioms.
  – preserving models = isomorphism

• We classify models by using invariants (properties of models that are preserved by isomorphism).
  – automorphism groups, endomorphism semigroups

• Classes of activities and objects are specified using these invariants.
Semantic Translation

Translation definitions specify the mappings between PSL and application ontologies.

Example: The *ilcActivity* concept in ILOG Schedule maps to the *activity* concept in PSL only if the activity is either primitive or its nondeterminism arises only from resource selection.

\[
\text{forall} \ (?a) \\
\qquad (\text{iff} \quad \text{ilcActivity} \ ?a) \\
\qquad (\text{and} \quad \text{activity} \ ?a) \\
\qquad (\text{or} \quad \text{nondet_res_activity} \ ?a) \\
\qquad (\text{primitive} \ ?a)))
\]
Twenty Questions

How can we generate translation definitions?

• Each invariant from the classification of models corresponds to a different question.
• Any particular activity or object will have a unique value for the invariant.
• Each possible answer to a question corresponds to a different value for the invariant.
Process Descriptions

• If we shared an ontology of algebraic fields, we would not share arbitrary sentences; rather, we would share polynomials.

• Within PSL, process descriptions are boolean combinations of definable types realized in some model of the ontology.

• Example: precondition axioms are types for markov_precond activities
Major Project Milestones

- April 2000: PSL accepted as a New Work Item ISO 18629 within ISO SC4/SC5
- October 2001: ISO 18629-1 passed CD ballot
- June 2002: ISO 18629-12 (Outer Core) submitted for CD ballot.
- September 2002: PSL 2.0 released (including grammars for process descriptions)
- November 2002: ISO 18629-11 (PSL-Core) passed CD ballot
Discussion

• Do we want an ontology of services or a language for building service ontologies?
• What are the scope and applications of a service ontology?
• What is the language for the ontology?
  – What is the relationship between this ontology and other standardization efforts?
• How heavy does the “semantic machinery” need to be?
Further Questions?

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