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

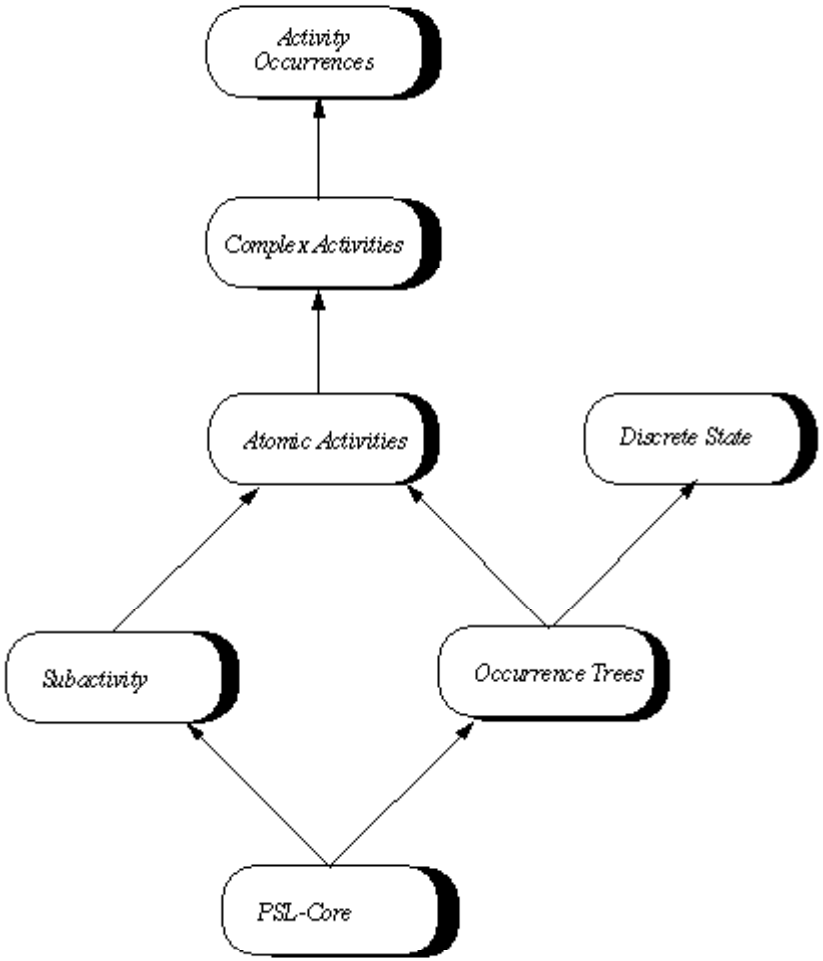
Formal Properties of PSL

- 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
  - http://www.mel.nist.gov/psl/psl-ontology/
- 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



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.

```
(forall (?a)
      (iff       (ilcActivity ?a)
                 (and    (activity ?a)
                         (or      (nondet_res_activity ?a)
                                  (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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http://ats.nist.gov/psl/