Feature Models are Views on Ontologies

Krzysztof Czarnecki[1], Chang Hwan Peter Kim[1], and Karl Trygve Kalleberg[2]

University of Waterloo[1]
University of Bergen[2]

Motivation

- Two domain modeling approaches
  - Feature Modeling
  - Ontology Modeling
- Both approaches are used to model domain concepts
- Two parts to the talk
  - How do these approaches differ and when are they appropriate?
  - Can they be used together?

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Overview

➡ Feature Modeling

- Ontology Modeling

- Feature Models vs. Ontologies

- Feature Models as Views on Ontologies

- Related Work

- Conclusion

Feature Modeling

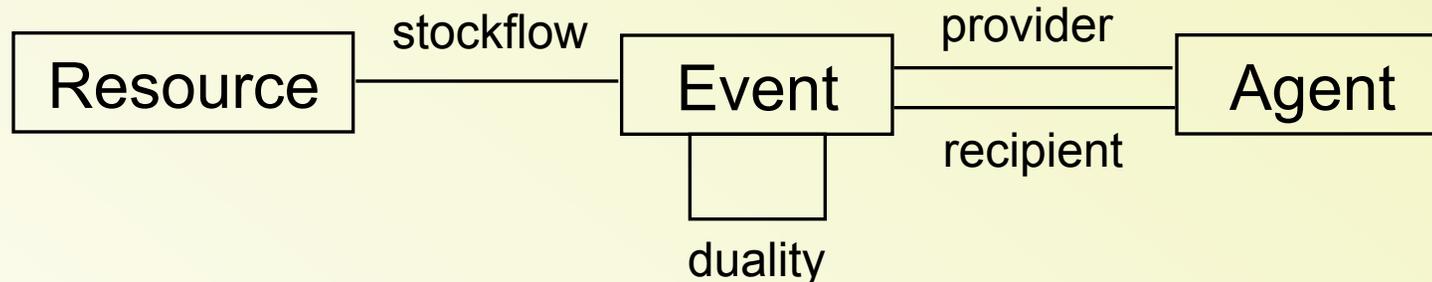- A domain-modeling technique for modeling commonality and variability
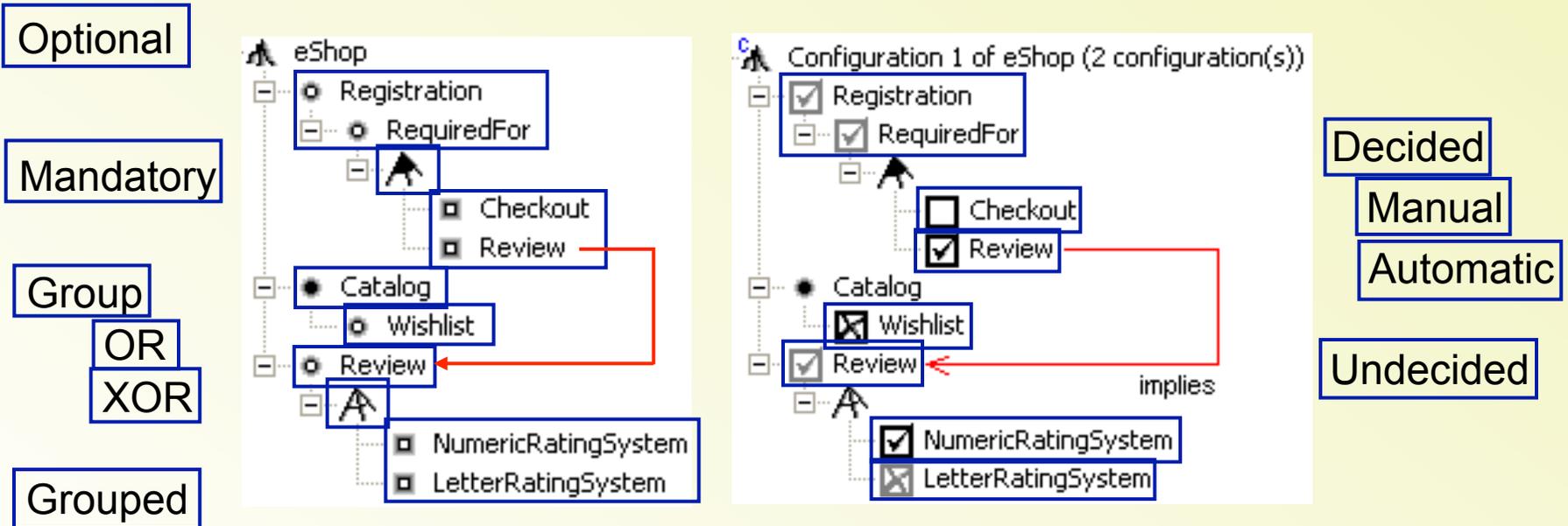
Overview

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- ➡ Ontology Modeling
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Ontology Modeling

- Rich form of concept modeling
- At least two kinds of ontology modeling in software engineering
  - Description logic (e.g. OWL for Semantic Web)
  - Class modeling (e.g. UML)
- Only class modeling considered in this talk
  - Based on an ontological framework called Resource Event Agent (REA) for modeling business concepts
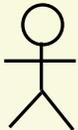 - Profiled class diagram used
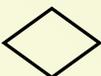
Resource Event Agent (REA)

```
                      stockflow              provider
  ┌──────────┐                ┌──────────┐             ┌──────────┐
  │ Resource │────────────────│  Event   │─────────────│  Agent   │
  └──────────┘                └────┬─────┘─────────────└──────────┘
                                   │          recipient
                                ┌──┴───┐
                                └──────┘
                                 duality
```

- Benefits
  - Requirements elicitation and completeness
    - Sale and cash receipt
  - Increased stability due to focus on logical structure, not implementation detail
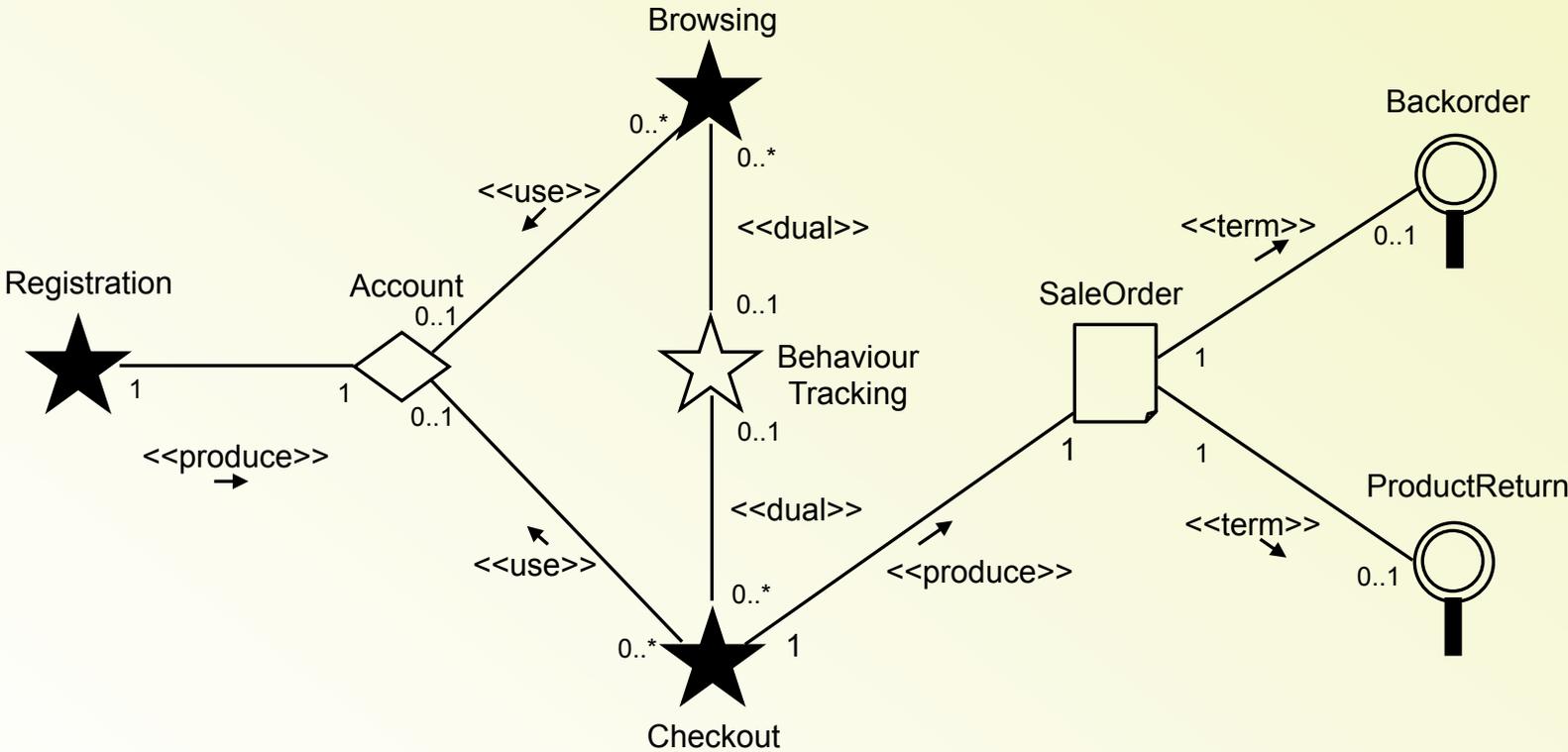   - Order of events

REA Modeling

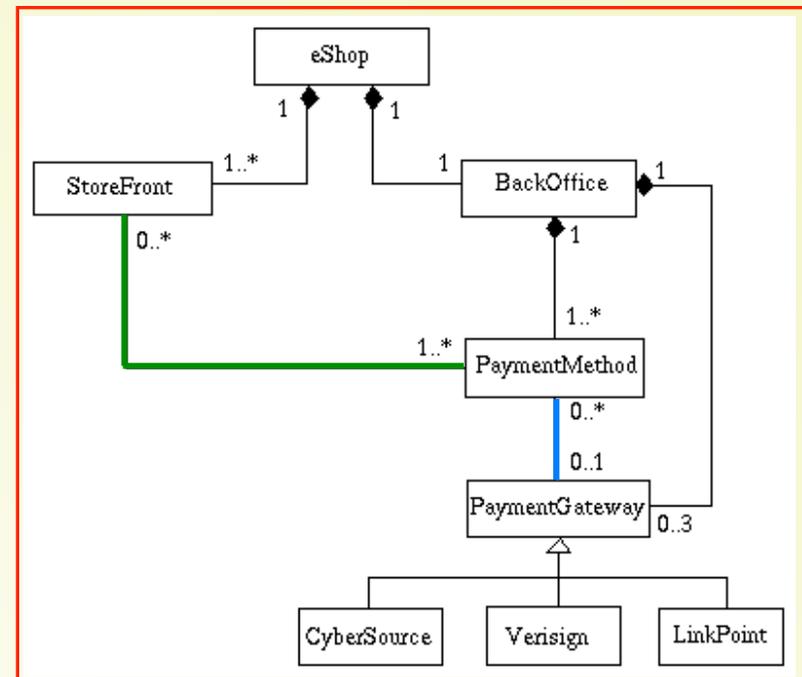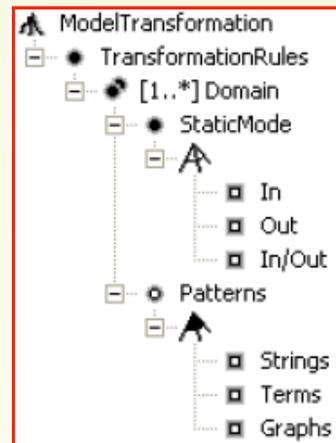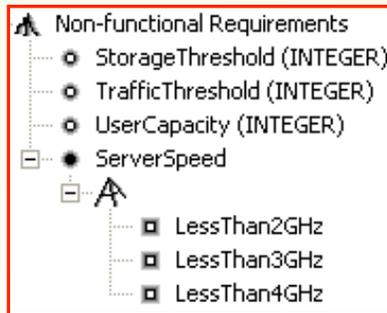Agent (Enterprise)   Resource   Incremental Event   Decremental Event   Contract   Term

Browsing

Backorder

Registration   Account

0..* <<use>>

0..* <<dual>> <<term>> 0..1

SaleOrder

0..1

1

1 <<produce>>

Behaviour Tracking

0..1

0..1

<<dual>>

1 1

1 0..1

<<use>>
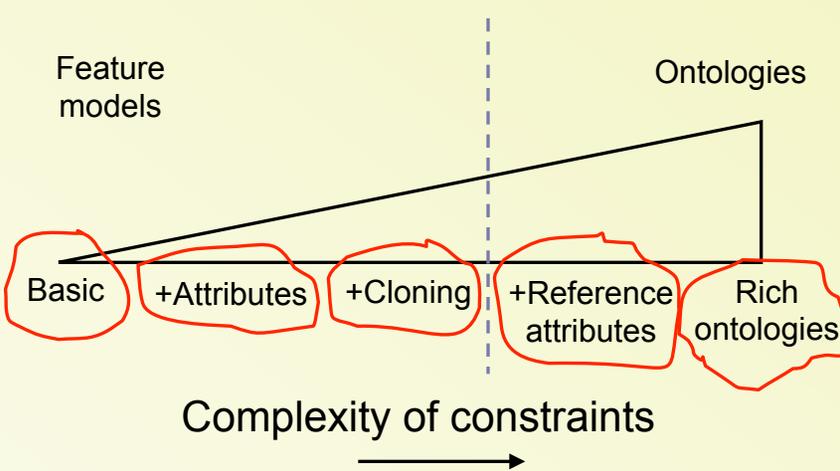
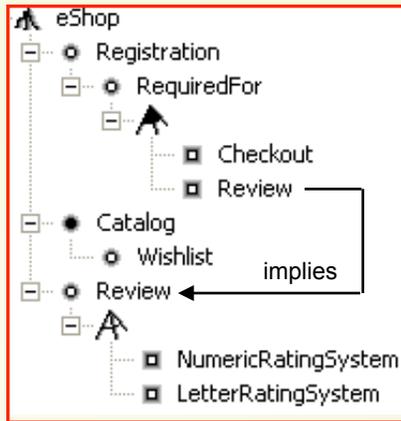0..* 1

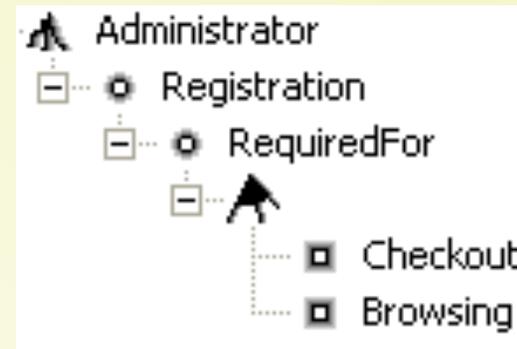<<produce>> <<term>> 0..1

Checkout

ProductReturn

Overview
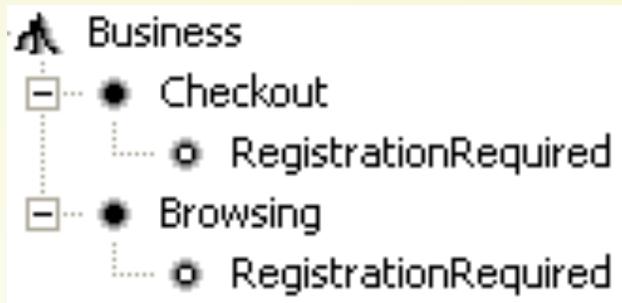
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Notational Spectrum

Feature models

Ontologies

Basic   +Attributes   +Cloning   +Reference attributes   Rich ontologies

Complexity of constraints
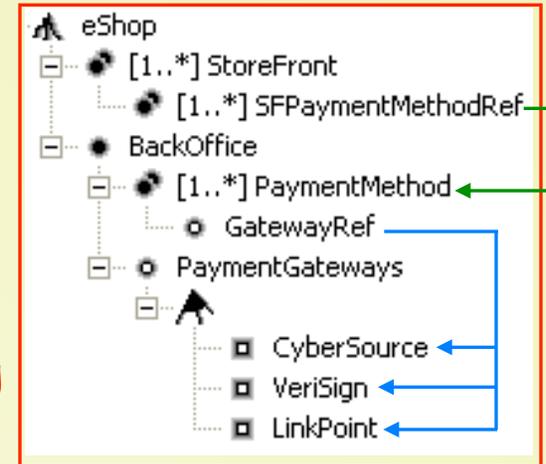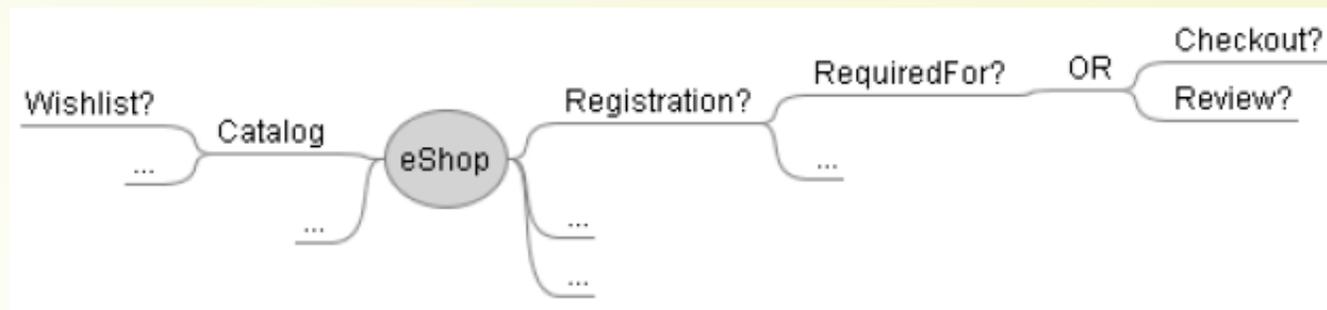
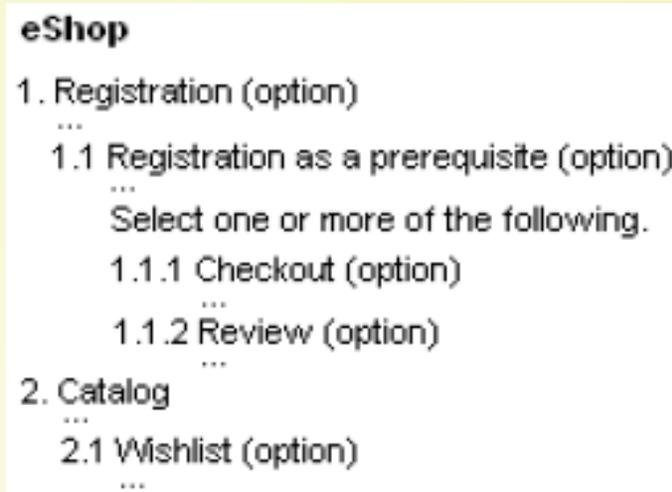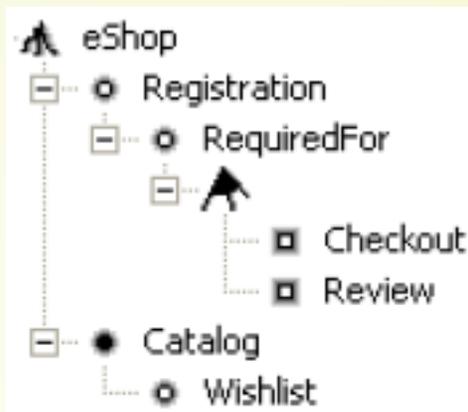# Essence of Feature Models

- Essence of feature models distinguishes them from ontologies
  - **Hierarchy**: configuration *and* viewpoint organization

  - **Variability**
    - Optional features
    - Groups
    - Cardinalities
    - Extra constraints

Renderings of Feature Models
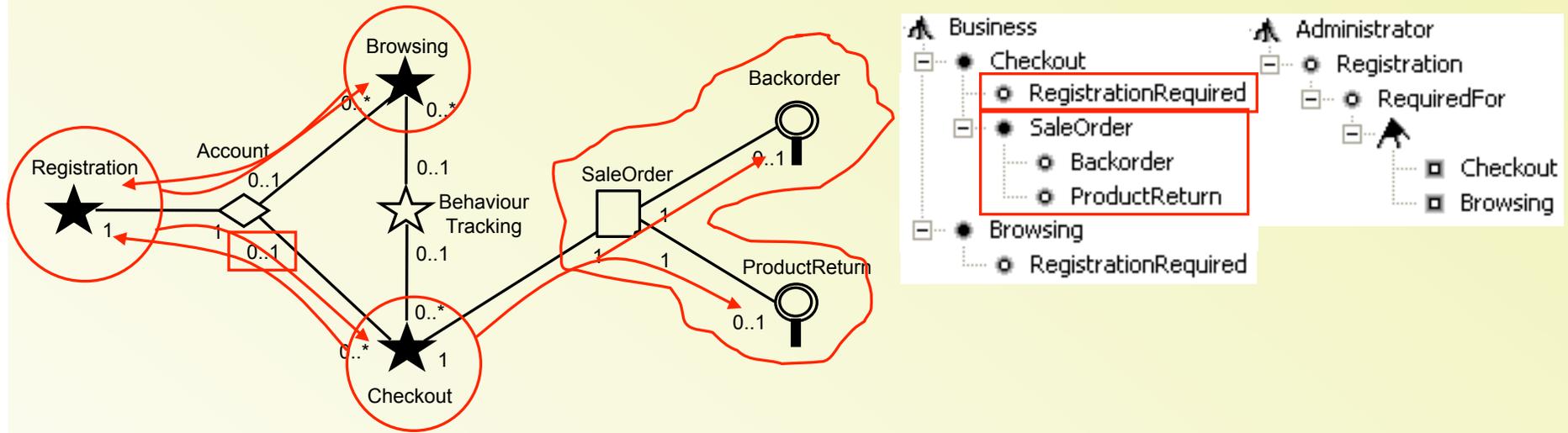
- More feature models than commonly thought

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Feature Models as Views on Ontologies

- Feature modeling and ontology modeling are complementary
  - Project feature models from an existing ontology
    - Agile feature modeling
    - Ontology modularization
  - Integrate existing feature models into an ontology
    - Agile ontology modeling
    - Feature model composition

- Views defined by syntactic and semantic mapping between feature models and ontologies

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Syntactic Mapping

- Different traversals

- Traceability links

  - Isomorphic

  - Feature-to-association

Semantic Mapping
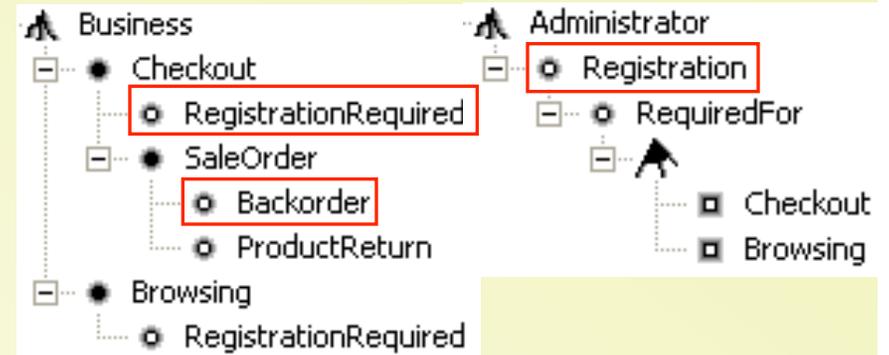
Positive

context *Checkout* **inv**:
    <<Checkout/…/RequiredRequired>> implies (self.account->size() =1)

Negative

context *Registration* **inv**:
    not(<<Registration>>) implies (Registration.allInstances()->size() = 0)

Full

context *SaleOrder* **inv**:
    (<<Backorder>>) = (self.backorder->size() =1)

• Evaluation time of constraints is unspecified

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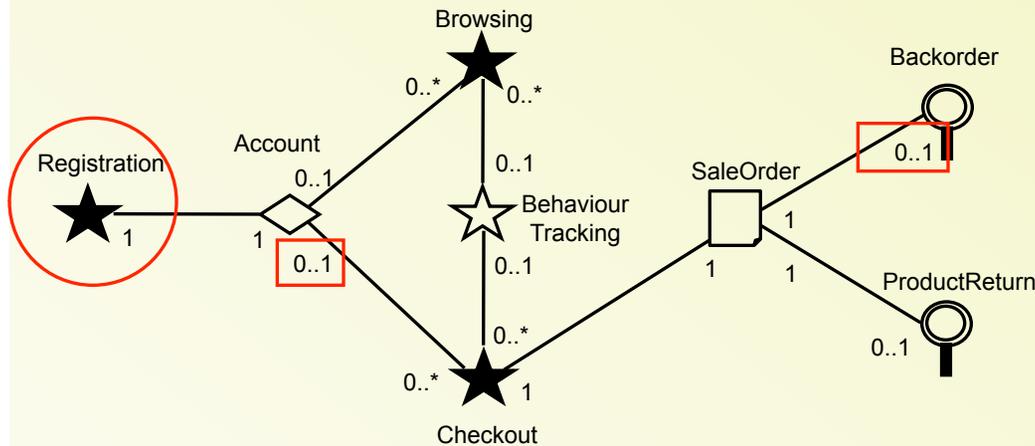- Feature Models as Views on Ontologies
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Related Work

- Feature-dependency analysis (Lee et al., Zhang et al.)
- Semantics of feature models (Batory, Bomtemps)
- Ontology views (Noy et al, Lieberherr et al.)
- Viewpoint-oriented requirements engineering (Sommerville et al.)
- Early aspects (Baniassad et al.)
- Feature-based configuration of models (Wasowski)
- Expressing feature models in ontology languages (Wagelaar)

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Conclusion

- From basic feature models to class diagrams
- Hierarchy and variability as the essence of feature models
  - Feature models in *disguise*
- Feature modeling and ontology modeling are complementary
  - View projection
  - View integration
- Mapping between feature models and ontologies
  - Syntactically, traversals, traceability links
  - Semantically, feature-based restriction

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