

# Semantic Interrelation, Change Management

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Bernd Krieg-Brückner et al.

23 April 2004

**MMiSS**

**Multi-Media Instruction in  
Safe and Secure Systems**

# Goals: Sustainable Development

- develop **slides**, lecture notes, **courses**
- work on the **board**, with slides, interactively with **tools**
- manage **English** and **German** documents in parallel
- embed mathematical formulae, **programs**, etc.
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- agree with your colleague on a **uniform terminology**
  - semantic interrelation via an ontology

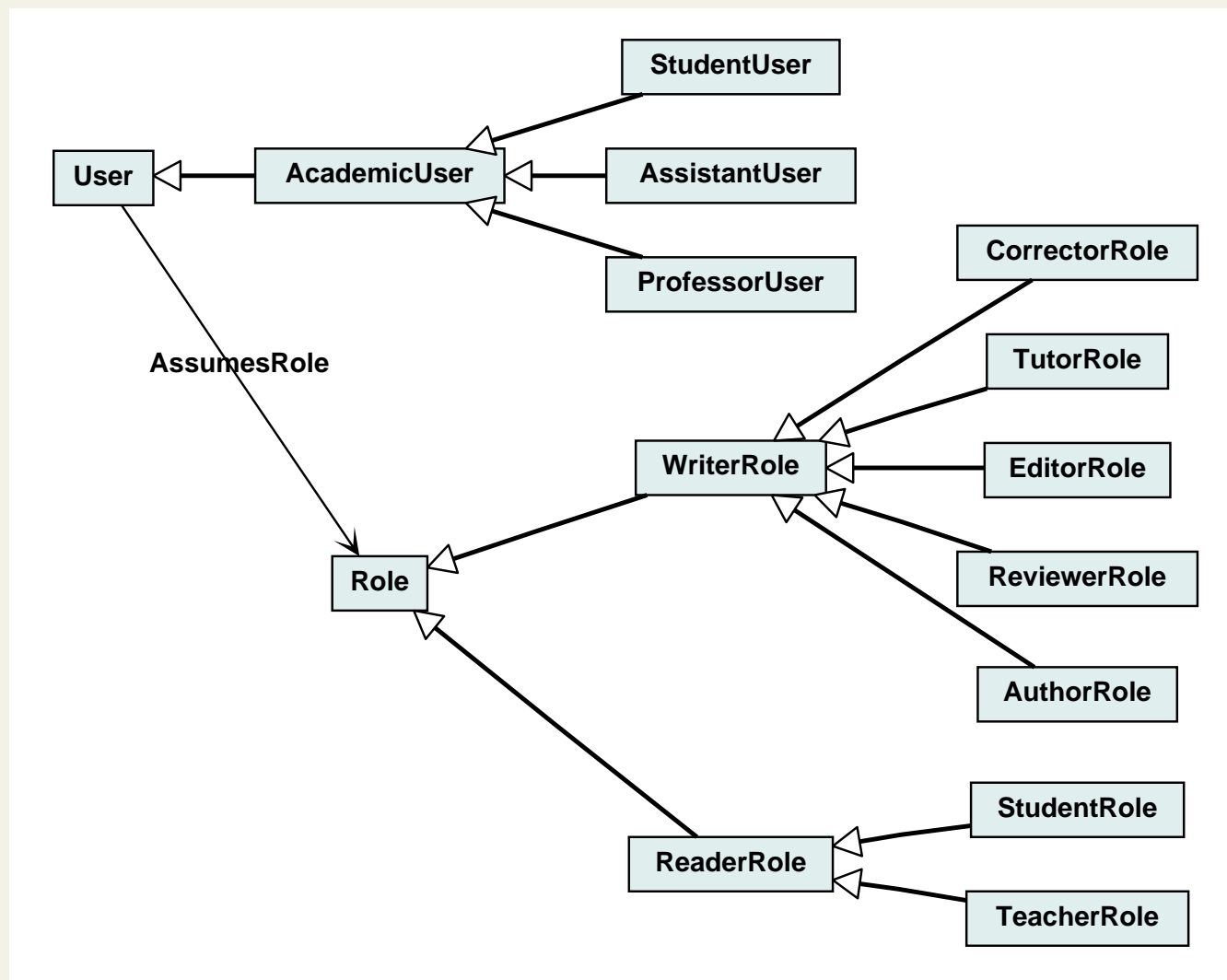
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- be made aware of **changes**
  - versions, configuration management

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- achieve **completeness** and **consistency**
  - change management

# Semantic Interrelation via an Ontology





# Ontology

- **Classes**
- **Relations**
  - “typed” by source and target Classes
- **subClasses, subRelations**
  - inheritance of formal properties
- **Objects**
  - of a Class, related by Relations
- **Axioms**
  - Description Logic: OWL
  - FOL: CASL Common Algebraic Specification Language

# Ontology: Resolution of Ambiguity

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```
1 \Class{User}{user}{}
2 \Class{AcademicUser}{academic user}{User}
3 \Class{StudentUser}{student}{AcademicUser}
4 \Class{Role}{role}{}
5 \Class{ReaderRole}{reader}{Role}
6 \Class{StudentRole}{student}{ReaderRole}
7 \Relation{*-*}{assumesRole}{assumes the role}{}
8 \RelType{assumesRole}{User}{Role}
```

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a `\StudentUser{}` `\Ref{assumesRole}` of a `\StudentRole{}`

- **Declaration** in Prelude (“signature” of a Package)  
`\Class{StudentRole}{Student}{ReaderRole}`
- **Definition** embedded in text at defining occurrence  
`\Def{StudentRole}  $\rightsquigarrow$  student`
- **Reference** embedded in text  
`\StudentRole{}`  $\rightsquigarrow$  student or **student**

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  - hierarchy of **local ontologies**
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- Embedding foreign documents: **Package** as wrapper
  - **local ontology**, e.g. for POWERPOINT document
  - future: point (in)to individual slide + fine-grain change management

# Ontologies Help Translation

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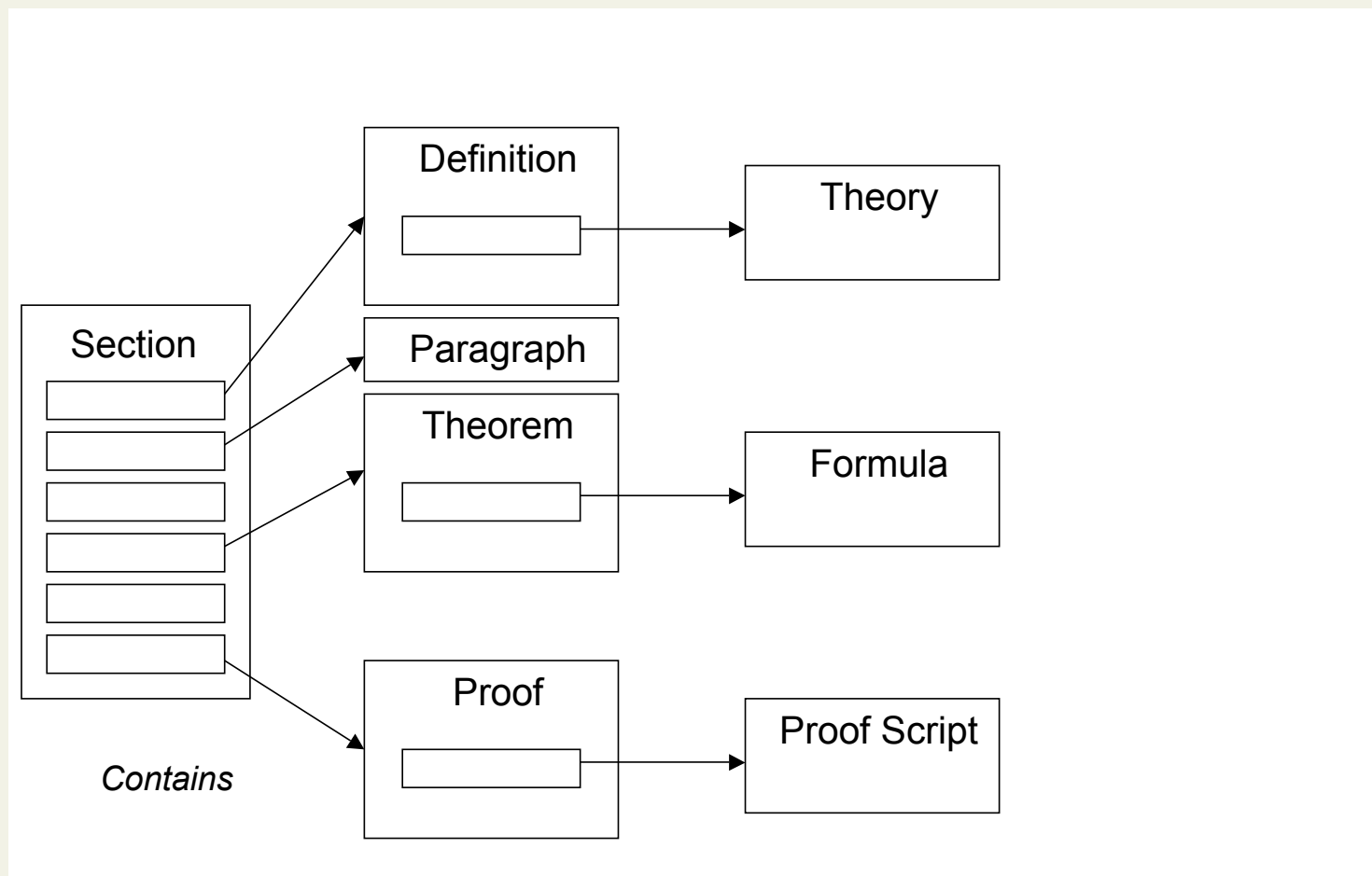
```
1 \Class{Boolean}{Boolean value}{BasicDataType}
2 \Class{Number}{number}{BasicDataType}
3   \Class{Natural}{natural number}{Number}
4   \Class{Integer}{integer number}{Number}
```

MMiSS<sub>AT</sub>EX

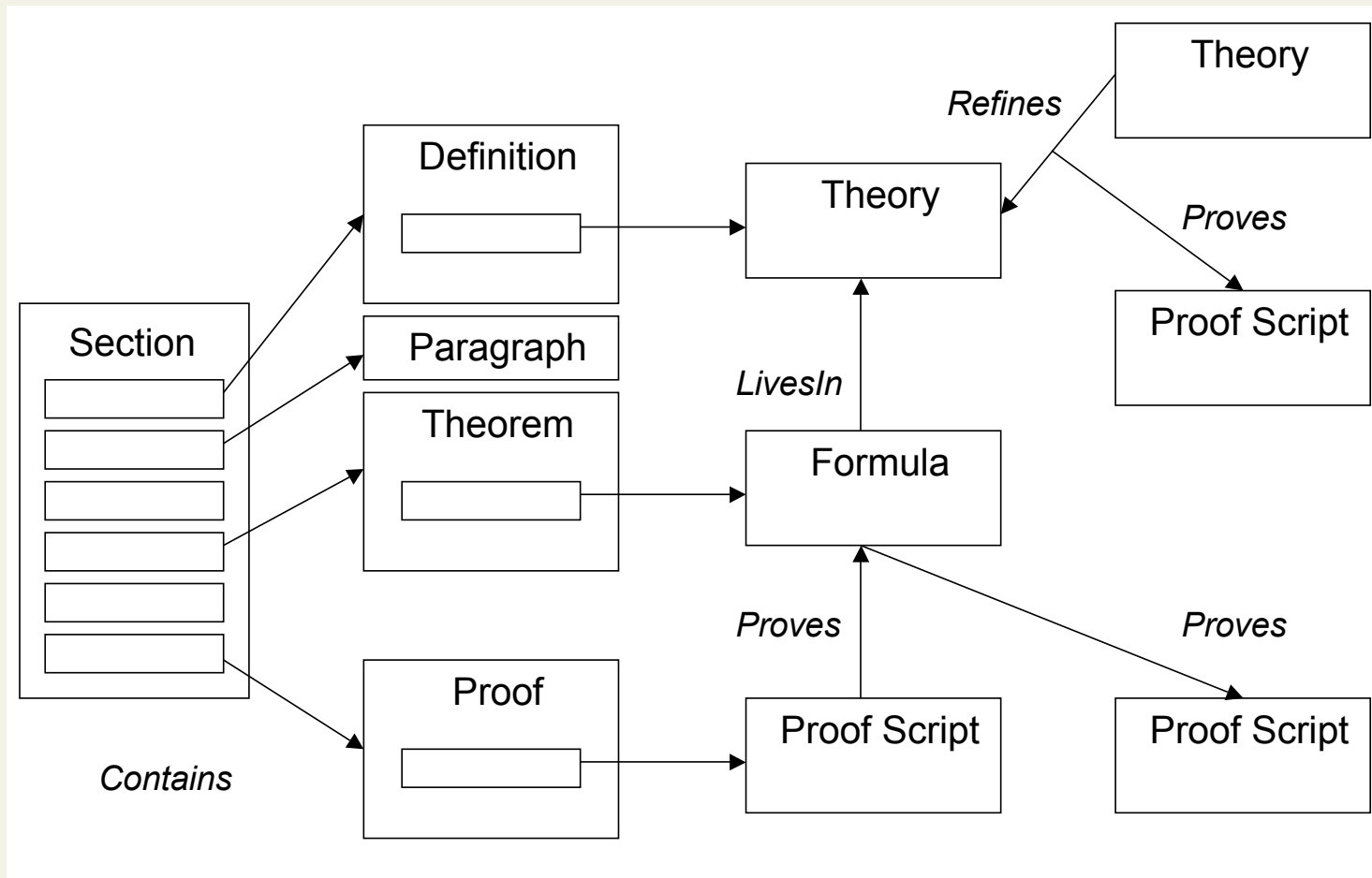
```
1 \Class{Boolean}{valeur de v\'erit\'e}{BasicDataType}
2 \Class{Number}{nombre}{BasicDataType}
3   \Class{Natural}{nombre naturel}{Number}
4   \Class{Integer}{nombre entier}{Number}
```

# Configuration Management

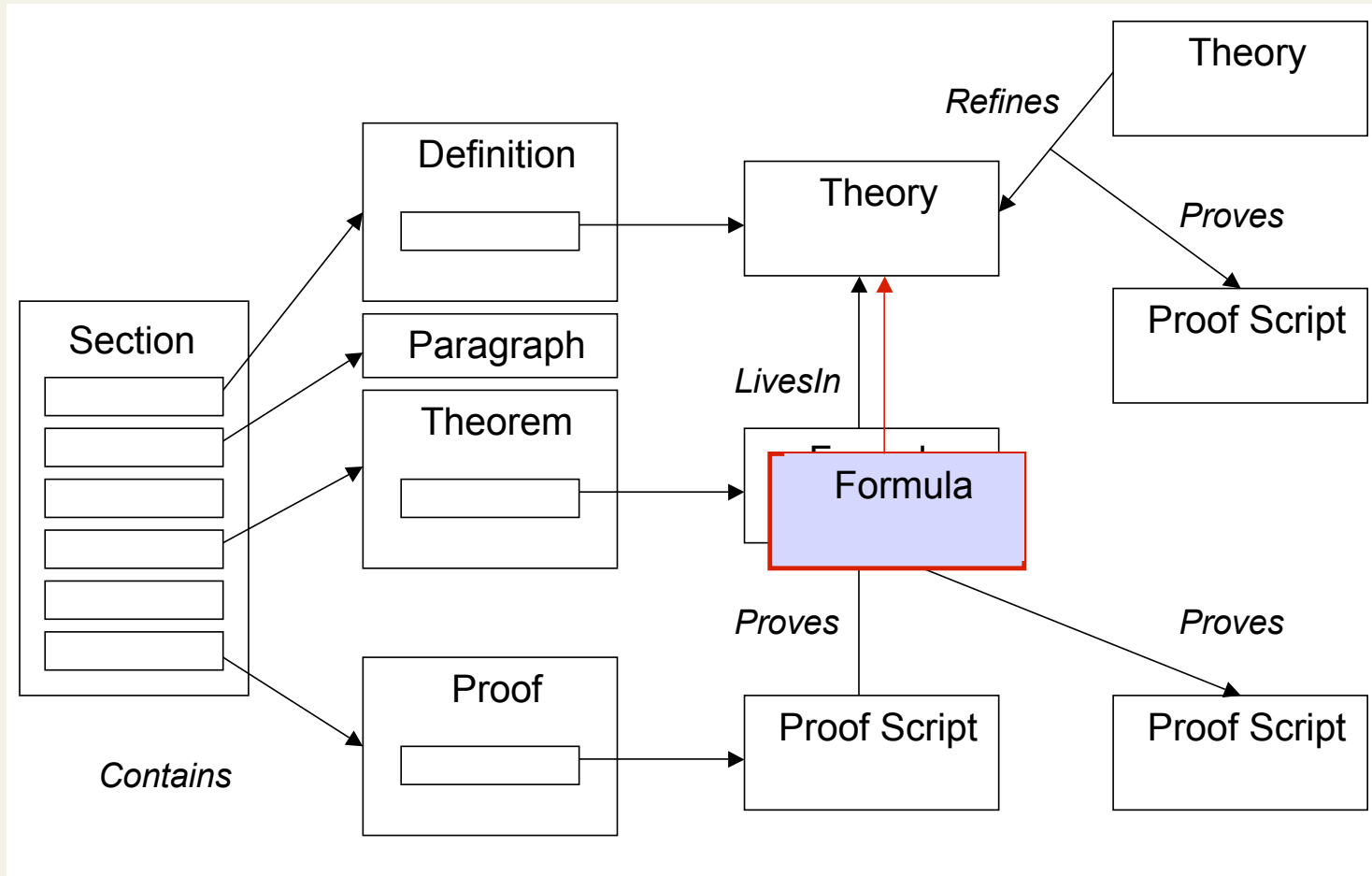
# Structure of Nesting



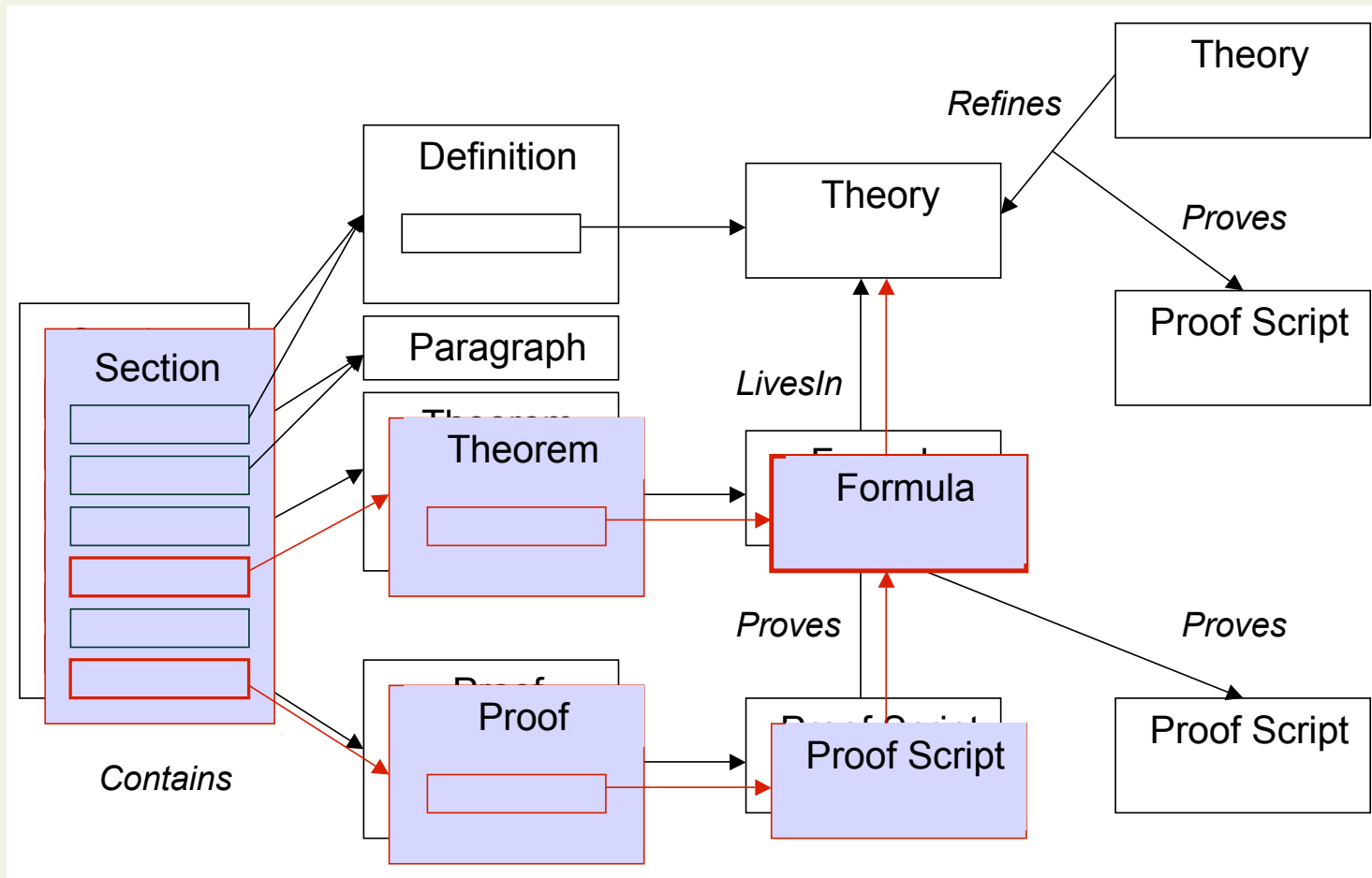
# Semantically Interrelated Structure



# Versions and Configurations



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# Versions, Configurations, Views

- revision
  - **merge** of revisions
- (partial) configuration
  - Start: node in the development graph
- complete configuration, selected views
  - German slides for a particular lecture
  - Exercises and model solutions, incomplete Proofs
- consistent configuration
  - compatible versions
  - change management

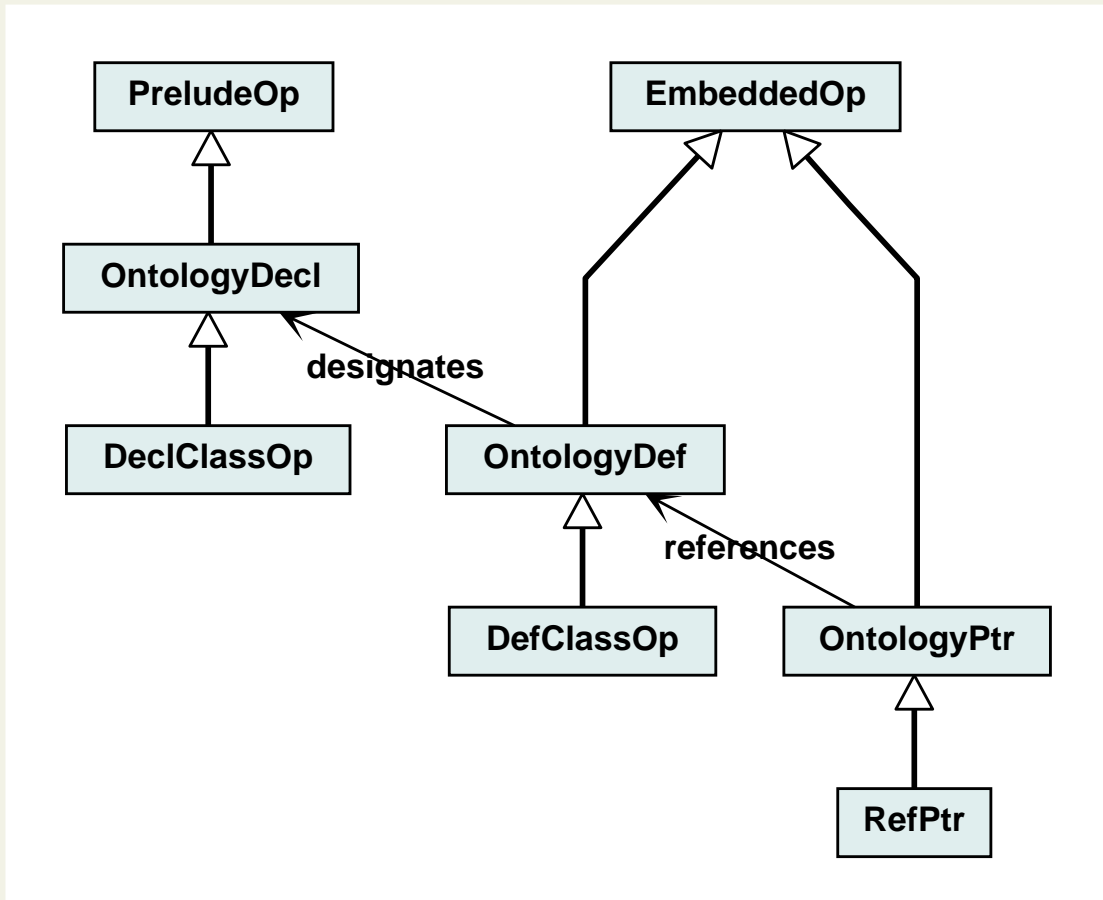


# Change Management

# Inheritance for Relations in System's Ontology

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```
1 \Relation{}{comprises}{comprises}{relatesDocConstructs}
2   \Relation{<-}{contains}{contains}{comprises}
3 \Relation{->}{pointsTo}{pointsTo}{relatesDocConstructs}
4   \Relation{}{designates}{designates}{pointsTo}
5   \Relation{}{references}{references}{pointsTo}
6 \Relation{>}{reliesOn}{reliesOn}{relatesDocConstructs}
7   \Relation{}{imports}{imports}{reliesOn}
8   \Relation{}{livesIn}{livesIn}{reliesOn}
9   \Relation{}{proves}{proves}{reliesOn}
10  \Relation{}{after}{after}{reliesOn}
```



- Declaration in Prelude
- Definition defining occurrence
- Reference in text
- points to relations
  - Def designates Decl
  - Ref references Def

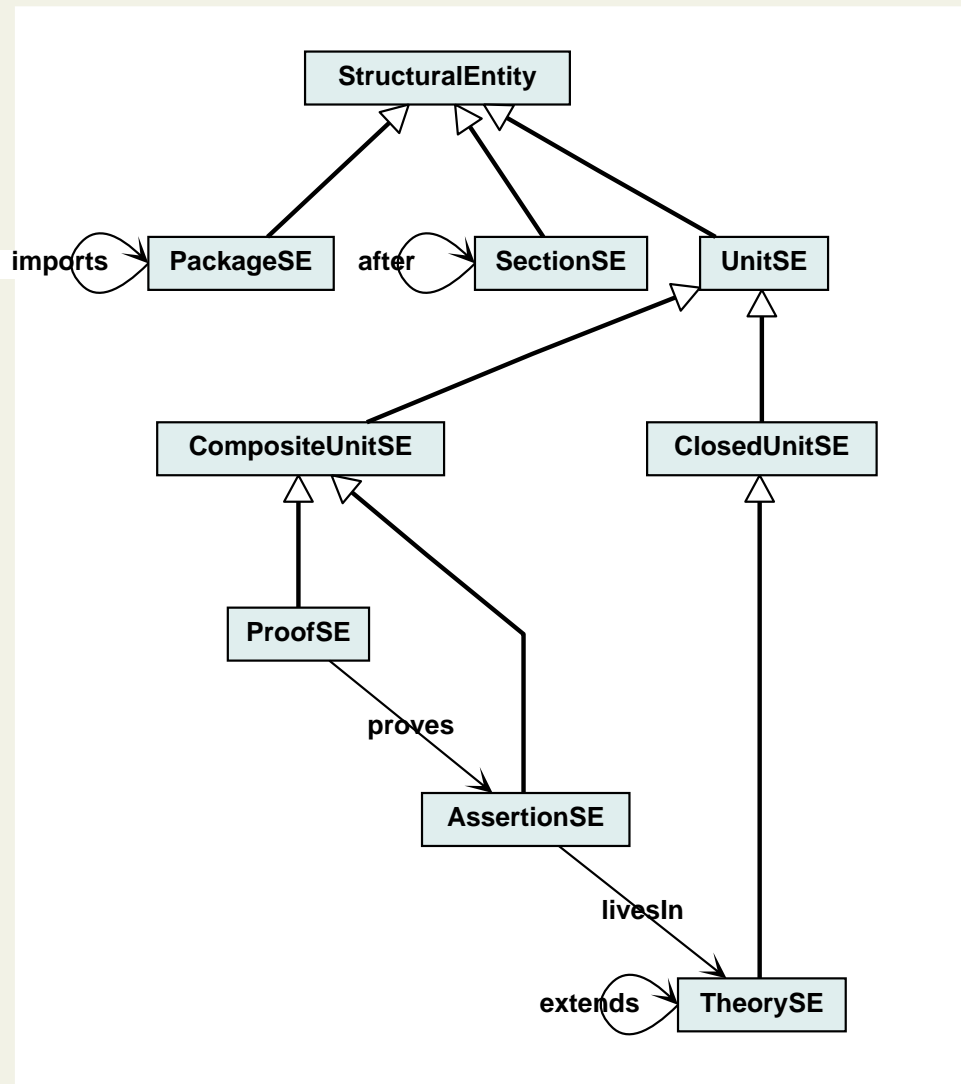
# Consistency and Completeness

- points to relations
  - **completeness**: at least one target,  
e.g. no dangling Def designates Decl, or Ref references Def
  - **consistency**: at most one target
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- relies on relations
  - Package imports Package
  - Section after Section
  - Assertion lives in Theory
  - Proof proves Assertion



# Consistency and Completeness

- relies on relations
  - strict order (irreflexive, transitive)
  - **completeness**: at least one target,  
e.g. no dangling Assertion lives in Theory
  - **consistency**: relies on relations internally consistent  
e.g. C after B and B after A implies C after A
  - **consistency**: relies on relations consistent with each other  
e.g. B lives in A implies B after A

# Conclusion



# Contributions to Sustainability

- **Reusability**
  - structuring in-the-large, “packages”
  - structuring in-the-small, views, **variants**
- **Compatibility**
  - **standardizing(?)** exchange formats + meta-data, **tool integration**
- **Extensibility**
  - of exchange formats, of tools, of the system, ...
  - via the **system's ontology**
- **Changeability**
  - versions, configurations, **semantic interrelation, change management**