

Content Ontology for Formal Methods

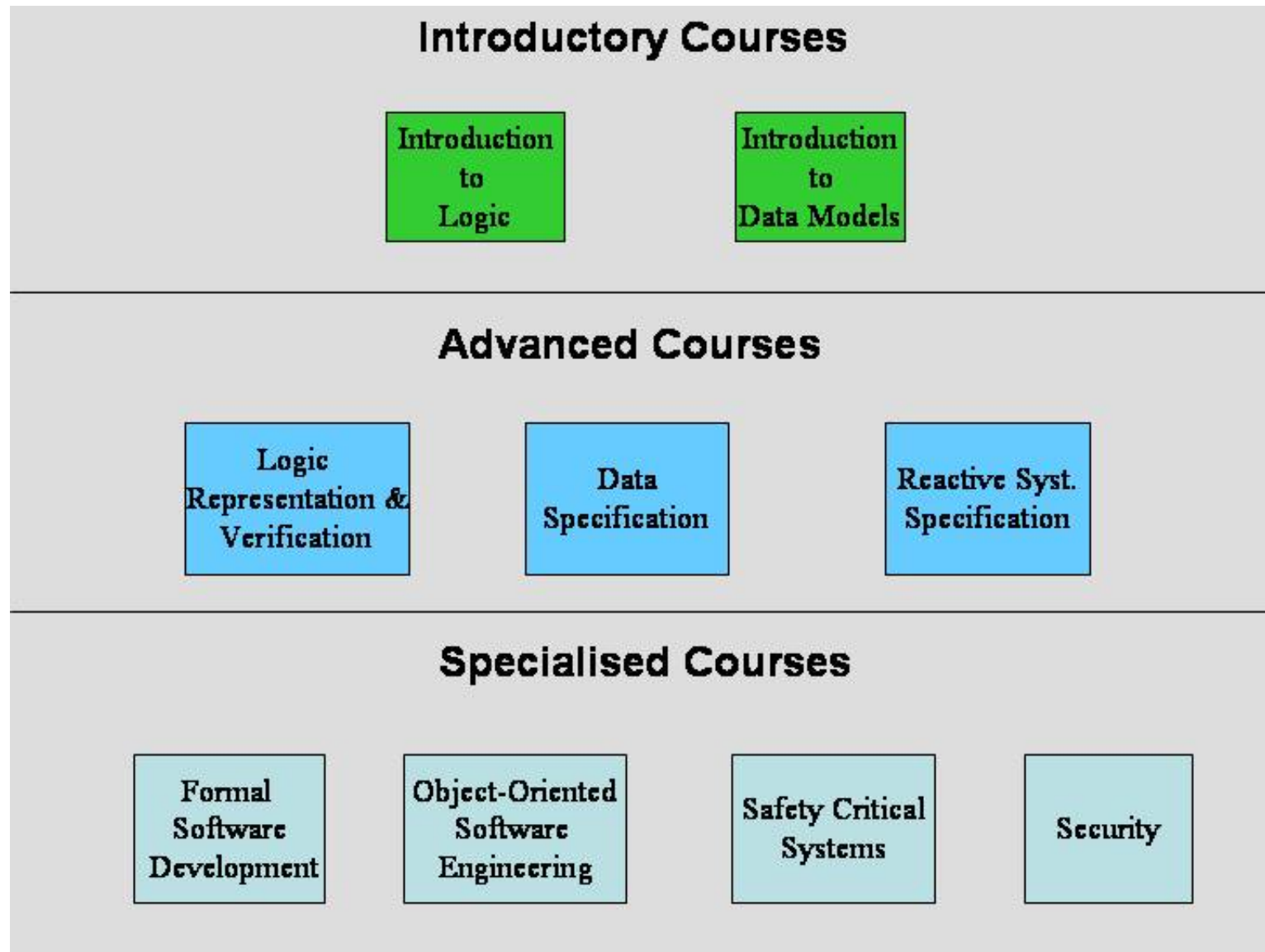
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MMISS Courses



Introduction to Ontologies

An ontology is a

- formal explicit description of concepts
- in a domain of discourse

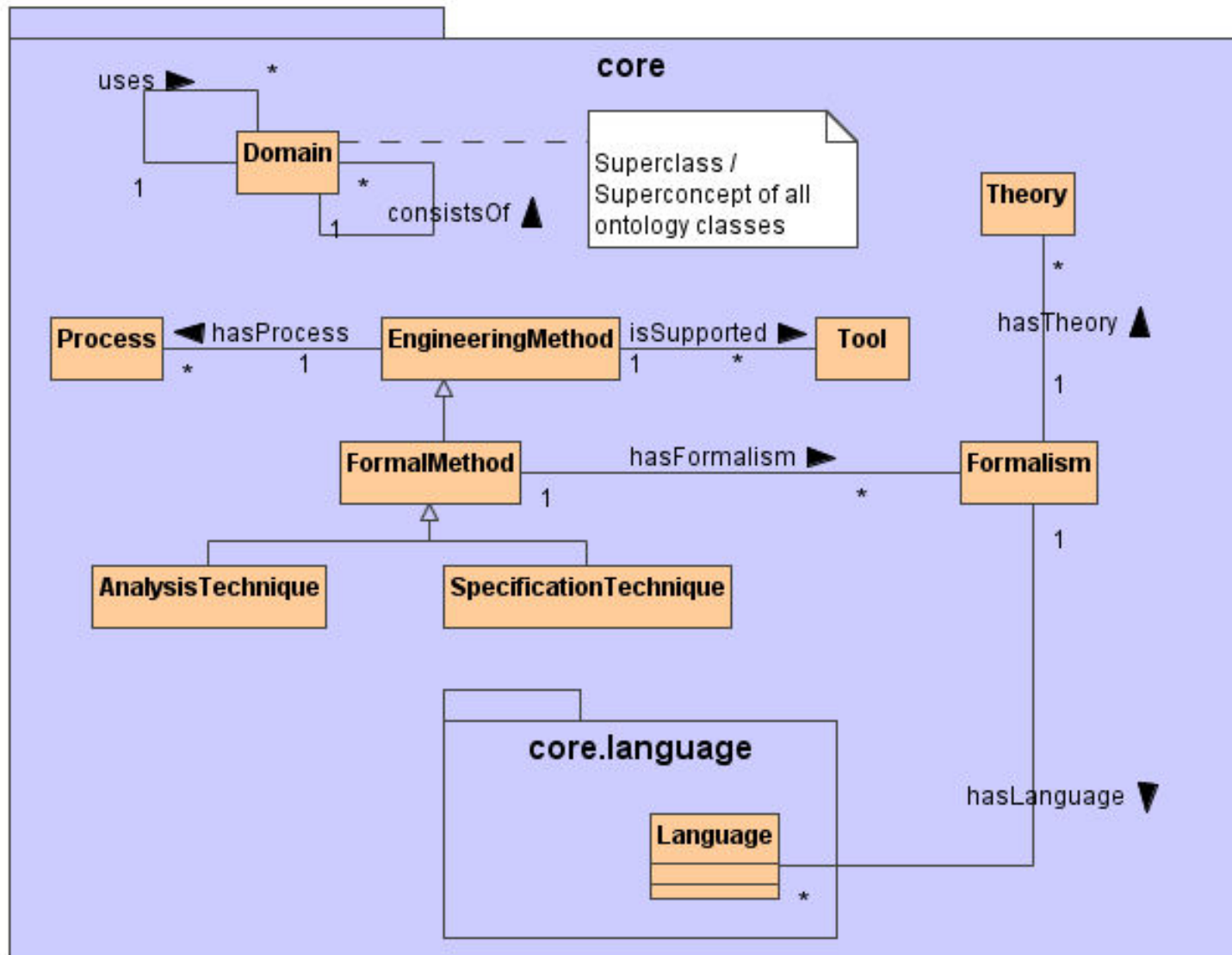


It specifies the properties of each concept by describing the various features and attributes of the concept

Ontology for Formal Methods

- Choose UML as Ontology Language
- With a textual representation in $\text{MMISS}\text{\LaTeX}$
- Class Diagrams (Core Concept Ontology) for representing abstract notions such as
 - Domain
 - FormalMethod
 - Language
- Object Diagrams for representing specific notions
 - CASL1.0 is instance of class Language
 - SFDESystemDevelopment is instance of class SystemDevelopment

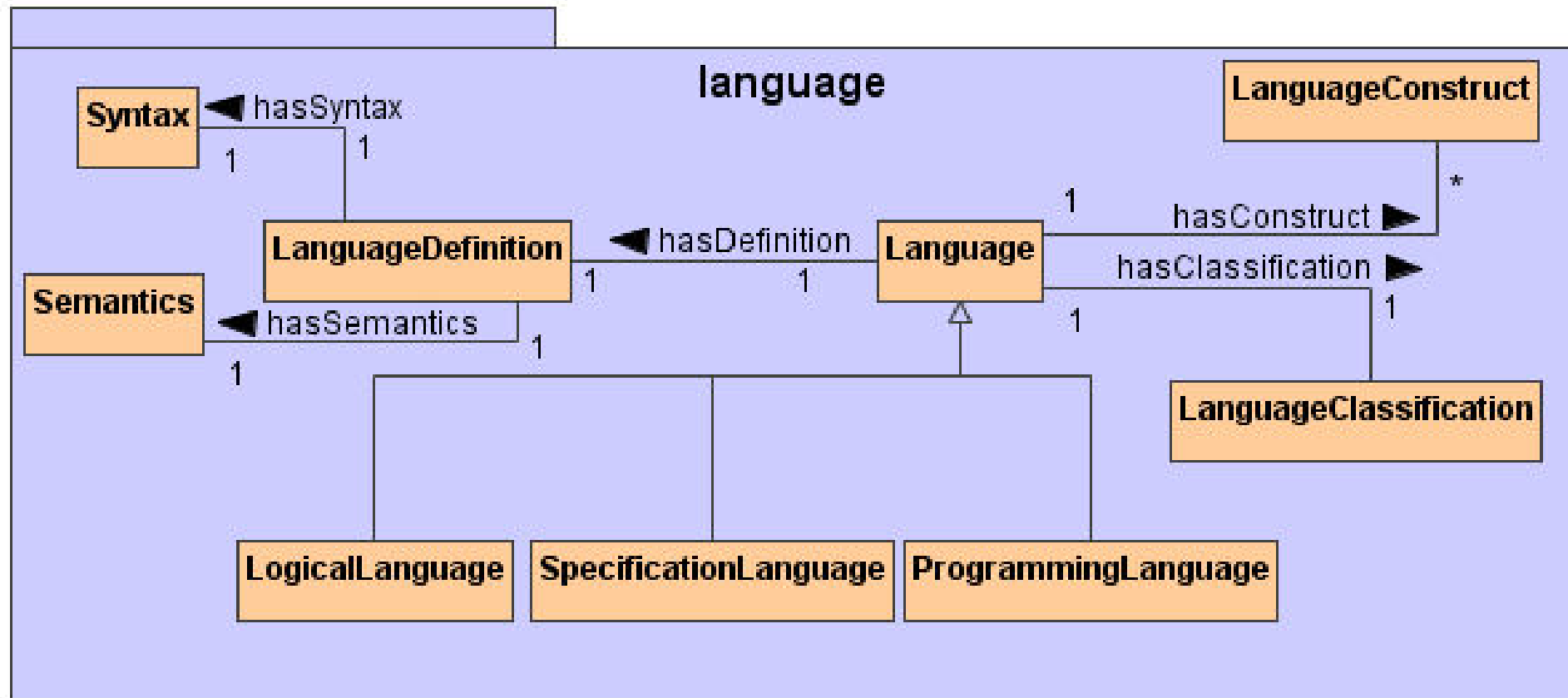
Ontology for Formal Methods: Core Concept Ontology



Ontology for Formal Methods: Core Concept Ontology Continued

```
\Class{Domain}{Domain}{}
  \Class{EngineeringMethod}{Engineering Method}{Domain}
    \Class{FormalMethod}{Formal Method}{EngineeringMethod}
      \Class{AnalysisTechnique}{Analysis Technique}{FormalMethod}
      \Class{SpecificationTechnique}
        {Specification Technique}{FormalMethod}
  \Class{Tool}{Tool}{Domain}
  \Class{Process}{Process}{Domain}
  \Class{Formalism}{Formalism}{Domain}
  \Class{Theory}{Theory}{Domain}
\Relation{1-*}{consistsOf}{consists Of}{}
\RelType{consistsOf}{Domain}{Domain}
\Relation{1-*}{hasFormalism}{has formalism}{}
\RelType{hasFormalism}{FormalMethod}{Formalism}
... ..
```

Ontology for Formal Methods: Core Concept Ontology Continued



Ontology for Formal Methods: Core Concept Ontology Continued

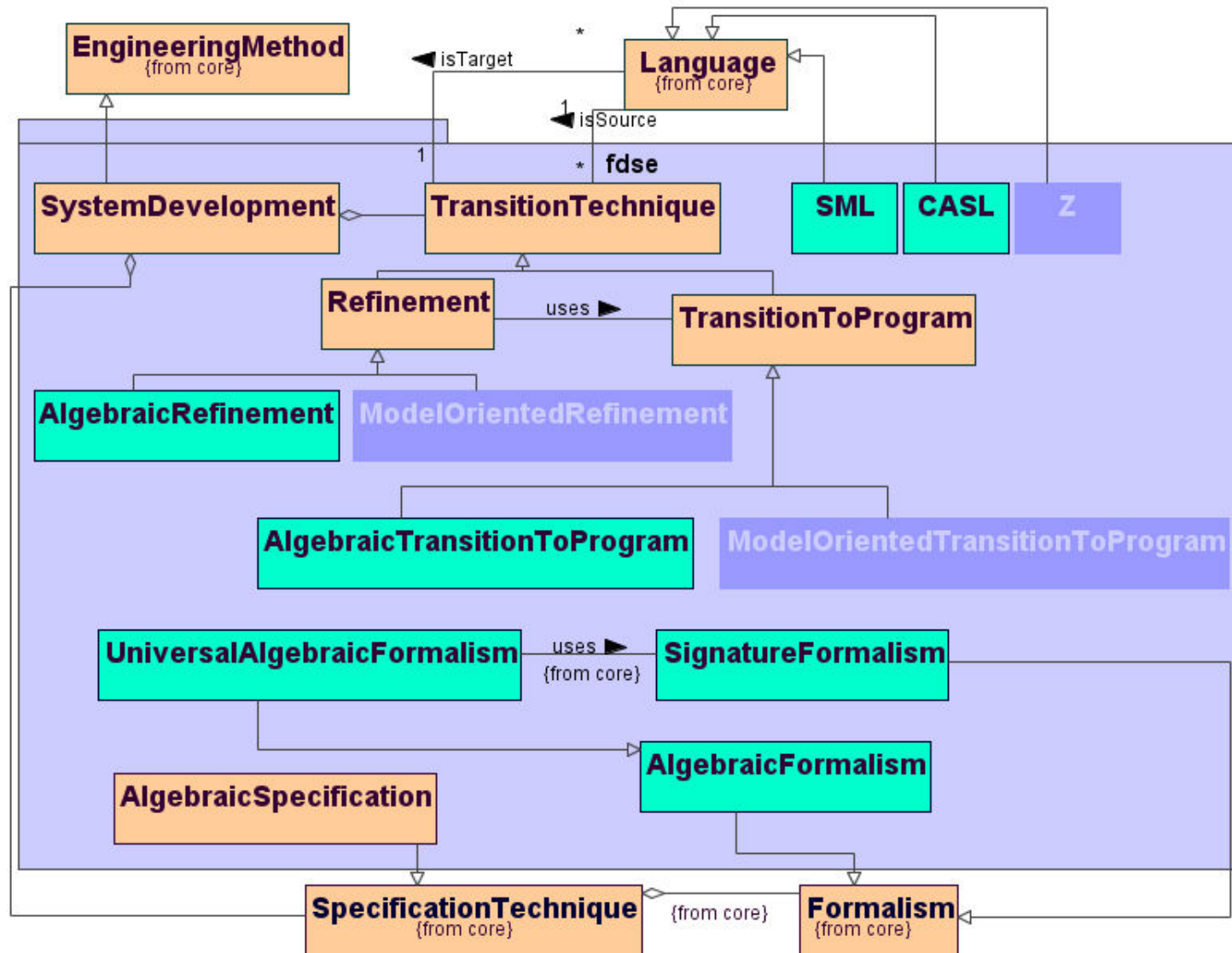
```
\Class{Language}{Language}{Domain}
  \Class{ProgrammingLanguage}
    {Programming Language}{Language}
  \Class{SpecificationLanguage}
    {Specification Language}{Language}
  \Class{LogicalLanguage}
    {Logical Language}{Language}
  ... ..
```

Ontology for Formal Methods: Construction of MMISS Course Ontologies

1. Declare the concepts/classes and associations of the course based on the core ontology; i.e. extend the core ontology for your concepts.
2. Declare the instances and links of these concepts that will be used in the course.
3. Define the concepts, instances, associations and links within the course.

In the following: Concentrating on the section **Algebraic Specification** of the course **Foundations of System Development**

Step 1: Extended Core Content Ontology



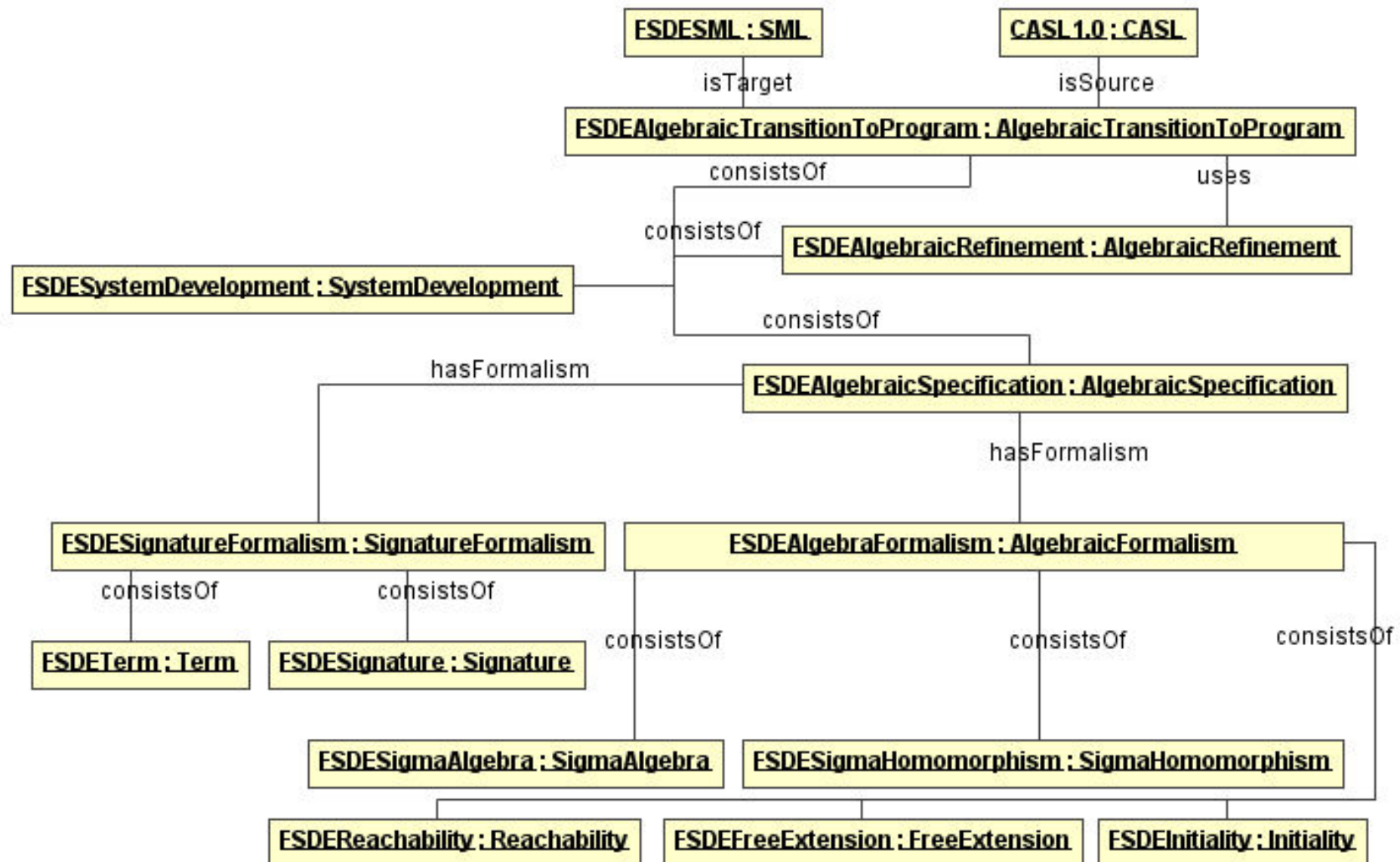
Step 1: Extended Core Content Ontology Continued

```
\Class{UniversalAlgebraicFormalism}
      {Universal Algebraic Formalism}{AlgebraicFormalism}
\Class{TransitionTechnique}{Transition technique}{Domain}
  \Class{TransitionToProgram}
      {Transition To Program}{TransitionTechnique}

\Relation{1-1}{isSource}{is source}{}
\RelType{isSource}{Language}{TransitionTechnique}

\Relation{1-1}{isTarget}{is target}{}
\RelType{isTarget}{Language}{TransitionTechnique}
... ..
```

Step 2: Declare Course Specific Instances



Step 2: Declare Course Specific Instances Continued

```
\Object{FSDESystemDevelopment}
    {FSDE Algebraic System Development}
    {SystemDevelopment}
\Object{FSDEAlgebraicTransitionToProgram}
    {FSDE Algebraic Transition To Program}
    {AlgebraicTransitionToProgram}
    \Object{FSDESML}{FSDE sm1}{SML}
    \Object{CASL1.0}{CALS1.0}{CASL}
... ..
```

Step 3: Defining the Course Specific Concepts and Instances

Use

`\Def [Signature] {FSDESsignature}`

to define the instance `FSDESsignature` as follows:

Signature:

An **algebraic signature** Σ is a pair (S, F) with

- S : a set of sorts
- F : an $S^* \times S$ -sorted family of function symbols, whereby
 - $\langle s_1, \dots, s_n \rangle \in S^*$: the domain of $F_{\langle \langle s_1, \dots, s_n \rangle, s \rangle}$
 - $s \in S$: the range of $F_{\langle \langle s_1, \dots, s_n \rangle, s \rangle}$

Summary

- Core Content Ontology for formal methods
- Systematic construction of course specific ontologies
 - Extend
 - Instantiate
 - Define
- MMISS Courses: A basis for formal methods education in Europe
 - * IFIP WG1.3 has approved MMISS system and courses as repository for formal methods