

# Sigma as an OOR

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<http://www.ontologyportal.org>  
<http://sigmakee.sourceforge.net>

Pease A., and Benzmuller C. (2010). Sigma: An Integrated Development Environment for Logical Theories, in Proceedings of the ECAI 2010 Workshop on Intelligent Engineering Techniques for Knowledge Bases (I-KBET-2010), August 16-17, 2010, Lisbon, Portugal.  
<http://www.adampease.org/professional/IKBET-Sigma.pdf>

# Requirements

- Repository must “understand” the full semantics of the content
  - Otherwise just use the far more mature document management systems available
- Repository must support most expressive content
  - Otherwise, least common denominator is just RDF

# Requirements

- Focus on existing software
  - Clearly delineate that from plans and promises
- Meta-requirement
  - Be specific and technical
    - We're not the UN where we're dealing with politics. We're selecting or building software

# Functional Requirements

- Minimum – formal consistency checking of content
  - NP complete for FOL, but good “statistical” coverage is possible
  - proof of consistency possible with model finders, although not practical for large theories

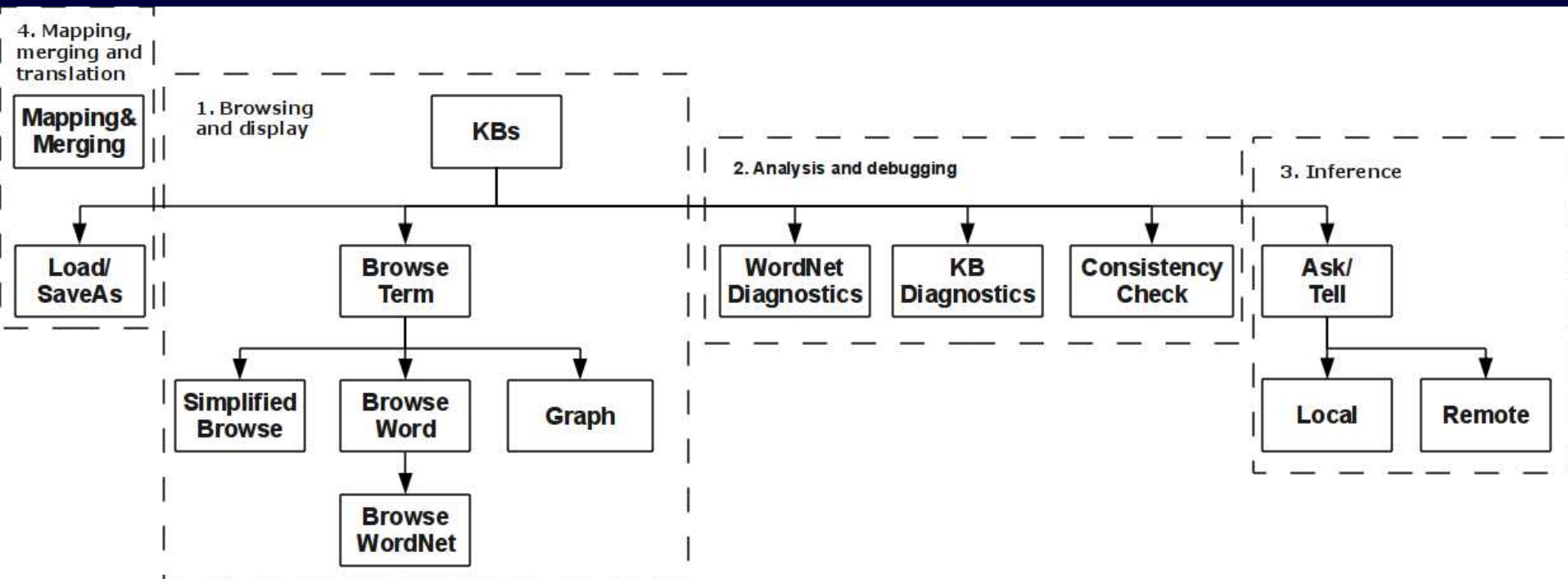
# Sigma

- Browsing, inference and analysis for FOL + equality
- Experimental HOL capability
- Embeds worlds top performing theorem provers
  - As determined by the open, independent CASC competitions (each year for ~15yrs)

# Sigma Functions

- Browsing and display
- Analysis and debugging
- Inference
- Mapping, merging and translation
- 
- Many different ontologies can be loaded at the same time

# Sigma Architecture



# Sigma Languages

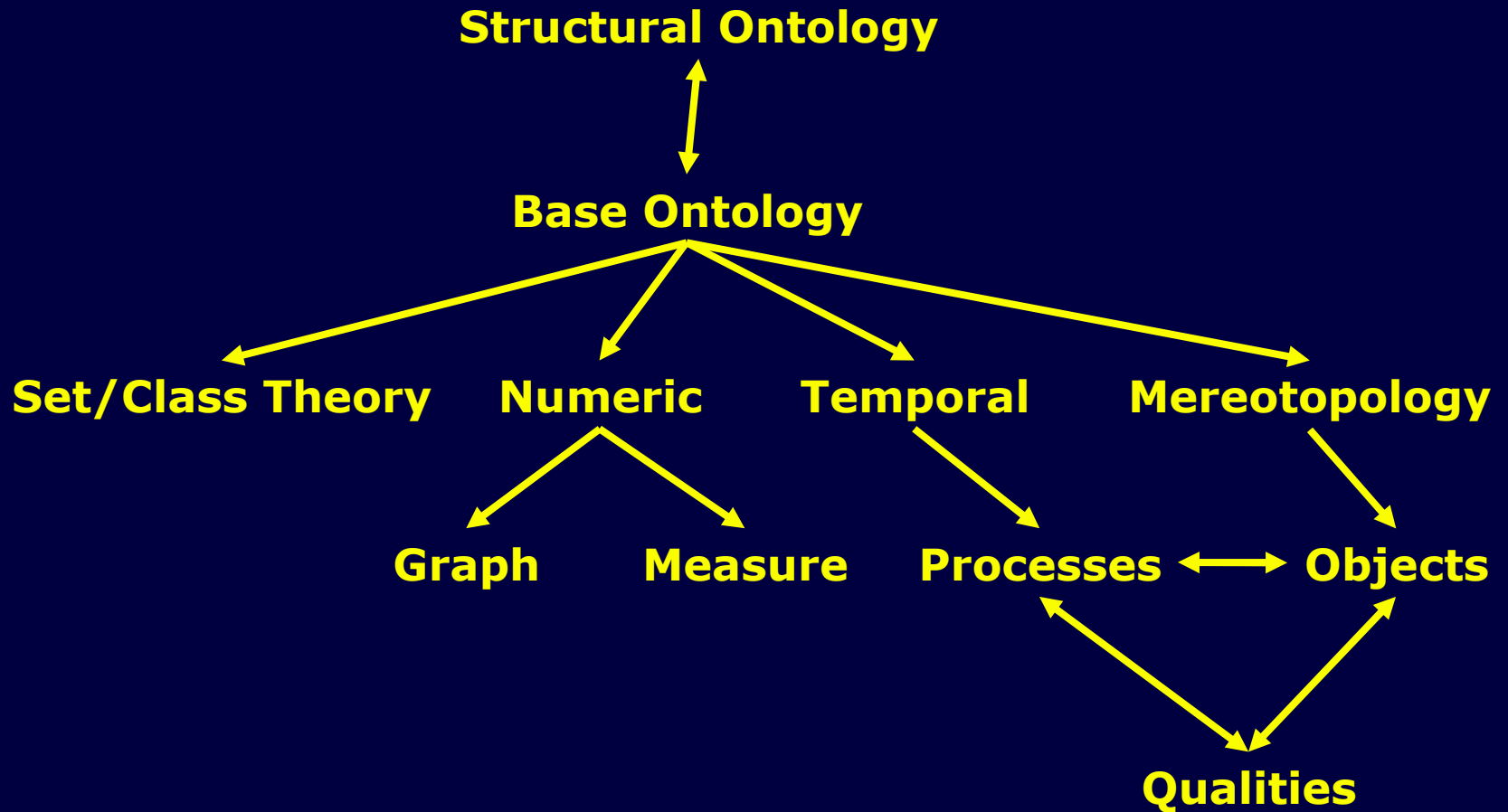
- Supports SUO-KIF
  - A syntactic variant of Genesereth's KIF
  - FOL + Equality (plus experimental higher order extensions)
  - Another concrete syntax for common logic (a claim that needs verification)
- Support for TPTP
  - De facto standard for the ATP community
- Support (to some degree) for OWL, Prolog
- Support for CLIF should be easy (but not done)



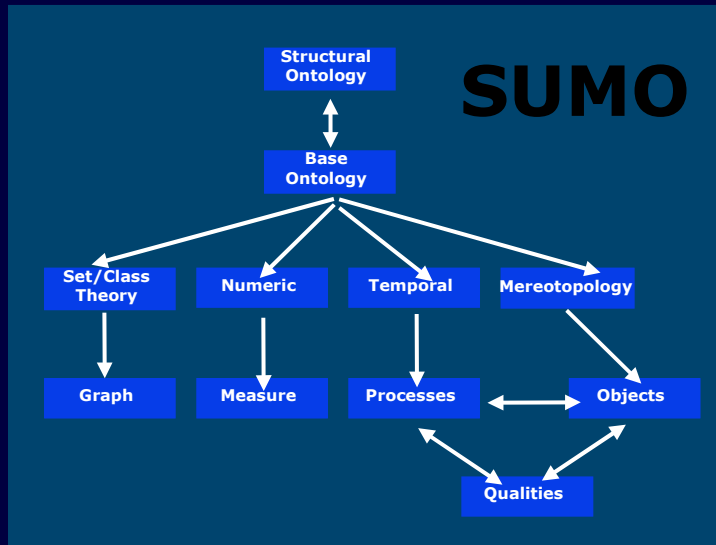
# Persistence

- Use Sigma with CVS (or Subversion etc)
- No need to reinvent version control etc

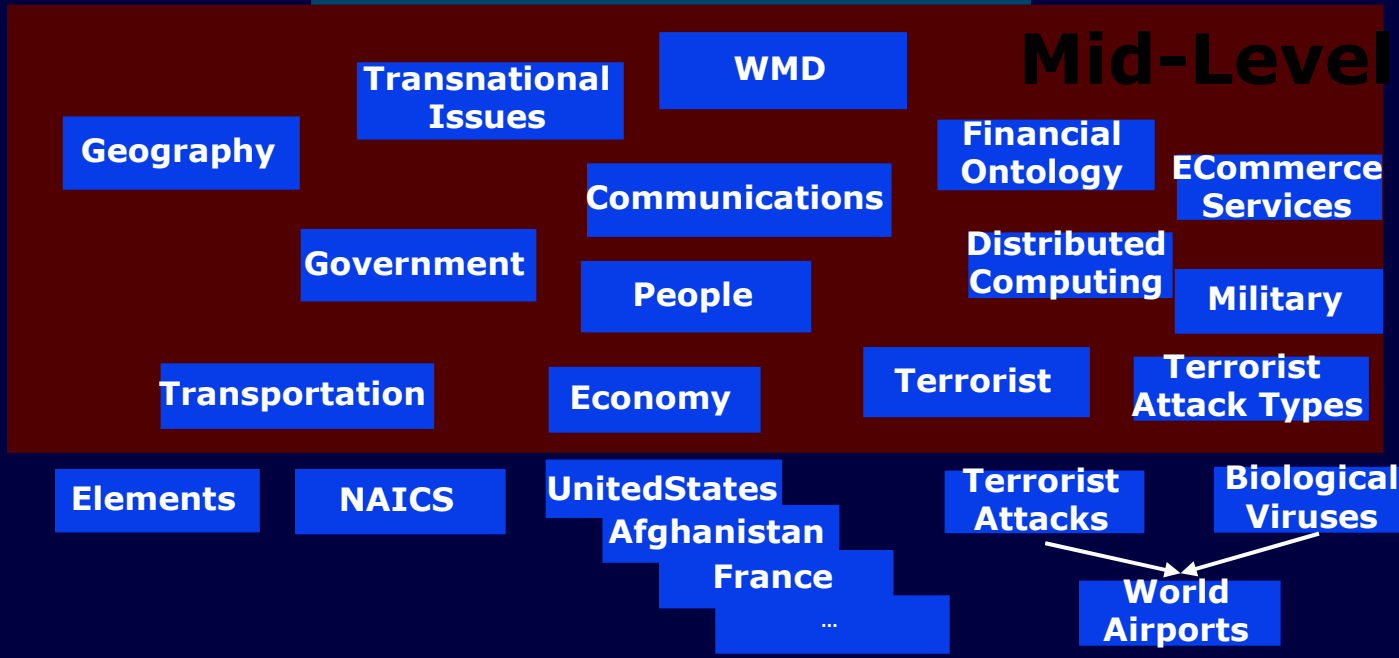
# SUMO Structure



# SUMO+Domain Ontology



**Total Terms**    **Total Axioms**  
**Rules**  
**20399**            **67108**            **2500**



# Taxonomy versus Ontology: Examples

```
(subclass Physical Entity) (subclass ObjectAttitude IntentionalRelation)
(subclass Abstract Entity)
(partition Entity Physical Abstract)
```

```
(subclass Object Physical)
(subclass Process Physical)
(partition Physical Object Process)
```

```
(<=>
  (instance ?PHYS Physical)      (=>
    (exists (?LOC ?TIME)
      (and
        (located ?PHYS ?LOC)
        (time ?PHYS ?TIME))))
    (and
      (instance ?REL ObjectAttitude)
      (?REL ?AGENT ?THING))
    (instance ?THING Physical))
```

# Sigma Inference

- Reasoners integrated with Sigma First-Order (work had strong impact on CASC: LTB division)
  - KIF-Vampire
  - SiNE relevance filter
  - SystemOnTPTP FOL (> 40 reasoning systems)
- Higher-Order
  - LEO-II
  - SystemOnTPTP THF (soon; 6 reasoning systems)


# Browsing

File Edit View History Bookmarks Tools Help  
http://sigma.ontologyportal.org:4010/sigma/Browse.jsp?kb=SUMO&lang=EnglishLanguage&term=Walking&sin

Knowledge base Browser - Wal...  
**Sigma** knowledge engineering environment  
**Browsing Interface**  
[ Home | Graph | ]  
KB: SUMO Language: EnglishLanguage

KB Term: Walking Show  
English Word: Noun Show

## Walking (walking)



[Rollerblade](#), [afoot](#), [amble](#), [ambulate](#), [ambulation](#), [angry walk](#), [backpack](#), [break](#), [bumble](#), [canter](#), [career](#), [circumambulate](#), [clamber](#), [climb](#), [climb up](#), [clomp](#), [clump](#), [cock](#), [coggle](#), [constitutional](#), [constitutionalize](#), [countermarch](#), [crab](#), [creep](#), [curvet](#), [dash](#), [debouch](#), [dodder](#), [dogtrot](#), [drag](#), [dressage](#), [drift](#), [err](#), [escalade](#), [exhibit](#), [falter](#), [fast break](#), [file](#), [file in](#), [file out](#), [fire walking](#), [flounce](#), [flounder](#), [foot](#), [footer](#), [footslog](#), [footstep](#), [forage](#), [gait](#), [gallop...](#)

### appearance as argument number 1

<a href="#">(documentation Walking EnglishLanguage "ambulating relatively slowly, i.e. moving in such a way that at least one foot is always in contact with the ground.")</a>	<a href="#">Merge.kif 8825-8826</a>
<a href="#">(externalImage Walking "http://upload.wikimedia.org/wikipedia/commons/0/ 0f/ Robotpeintre.gif")</a>	<a href="#">pictureList.kif 3030-3030</a> <a href="#">externalImage walking</a> and "http://upload.wikimedia.org/wikipedia /commons/0/0f/ Robotpeintre.gif"
<a href="#">(externalImage Walking "http://upload.wikimedia.org/wikipedia/commons/6/ 6f/ Walk-Cycle.gif")</a>	<a href="#">pictureList.kif 3276-3276</a> <a href="#">externalImage walking</a> and "http://upload.wikimedia.org/wikipedia /commons/6/6f/ Walk-Cycle.gif"
<a href="#">(externalImage Walking "http://upload.wikimedia.org/wikipedia/commons/d/ d2/ Marcheurl_en_comp%C3%A9tion.jpg")</a>	<a href="#">pictureList.kif 3277-3277</a> <a href="#">externalImage walking</a> and "http://upload.wikimedia.org/wikipedia /commons/d/d2/ Marcheurl_en_comp%C3%A9tion.jpg"
<a href="#">(subclass Walking Ambulating)</a>	<a href="#">Merge.kif 8824-8824</a> <a href="#">Walking</a> is a <a href="#">subclass</a> of <a href="#">ambulating</a>

### appearance as argument number 2

<a href="#">(partition Ambulating Walking Running)</a>	<a href="#">Merge.kif 8819-8819</a> <a href="#">Ambulating</a> is <a href="#">exhaustively partitioned</a> into <a href="#">walking</a> and <a href="#">running</a>
<a href="#">(subclass Wading Walking)</a>	<a href="#">Mid-level-ontology.kif 236-236</a> <a href="#">Wading</a> is a <a href="#">subclass</a> of <a href="#">walking</a>
<a href="#">(termFormat EnglishLanguage Walking "walking")</a>	<a href="#">english_format.kif 792-792</a> <a href="#">term format english language, walking</a> and "walking"

### antecedent

<a href="#">(=&gt;</a> <a href="#">(and</a> <a href="#">(instance ?WALK Walking)</a> <a href="#">(instance ?RUN Running)</a> <a href="#">(agent ?WALK ?AGENT)</a> <a href="#">(agent ?RUN ?AGENT)</a> <a href="#">(holdsDuring</a> <a href="#">(WhenFn ?WALK)</a> <a href="#">(measure ?AGENT</a> <a href="#">(SpeedFn ?LENGTH1 ?TIME)))</a> <a href="#">(holdsDuring</a> <a href="#">(WhenFn ?RUN)</a> <a href="#">(measure ?AGENT</a> <a href="#">(SpeedFn ?LENGTH2 ?TIME)))</a> <a href="#">(greaterThan ?LENGTH2 ?LENGTH1))</a>	<a href="#">Merge.kif 8833-8841</a> <ul style="list-style-type: none"><li>If a <a href="#">process</a> is an <a href="#">instance</a> of <a href="#">walking</a> and <a href="#">process</a> is an <a href="#">instance</a> of <a href="#">running</a> and <a href="#">an agent</a> is an <a href="#">agent</a> of <a href="#">process</a> and <a href="#">agent</a> is an <a href="#">agent</a> of <a href="#">process</a> and the <a href="#">measure</a> of <a href="#">agent</a> is a <a href="#">length measure per a time duration</a> holds <a href="#">during</a> the <a href="#">time</a> of existence of <a href="#">process</a> and the <a href="#">measure</a> of <a href="#">agent</a> is <a href="#">length measure per time duration</a> holds <a href="#">during</a> the <a href="#">time</a> of existence of <a href="#">process</a></li><li>then <a href="#">length measure</a> is <a href="#">greater</a> than <a href="#">length measure</a></li></ul>
---	--

### consequent

Find: ontology Previous Next Highlight all Match case Reached end of page, continued from top  
Done

# Simplified Browsing

File Edit View History Bookmarks Tools Help

http://localhost:8080/sigma/TreeView.jsp?kb=SUMO&simple=yes&term=Objec

store 24 middletown


TreeView Knowledge Base Bro...

**Sigma** knowledge engineering environment  
Simplified Browsing Interface

[ Home ]  
KB: SUMO Language: EnglishLanguage

KB Term:  Show

- Object
  - Agent
    - Organism
    - ITAgent
    - Group
      - GroupOfAnimals
      - Organization
        - FinancialOrganization
        - NonprofitOrganization
        - SecurityUnit
        - Corporation
        - ShipCrew
        - LegislativeOrganization
        - ReligiousOrganization
        - MetallurgicalPlant
        - Commission
        - CopyrightAuthority
        - CommunicationOrganization
        - GovernmentOrganization
        - MediaOrganization
        - TransportationAuthority
        - SportsLeague
        - ServiceOrganization
        - UnionOrganization
        - InternationalOrganization
        - EducationalOrganization
        - StockMarket
        - OrganizationalBoard
        - PoliticalOrganization
        - JudicialOrganization
        - CareOrganization
        - Business
        - GroupOfPeople
        - FileSystem



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

## object

Corresponds roughly to the class of ordinary objects. Examples include normal physical objects, geographical regions, and locations of [processes](#), the complement of [objects](#) in the [physical](#) class. In a 4D ontology, an [object](#) is something whose spatiotemporal extent is thought of as dividing into spatial parts roughly parallel to the time-axis.

Relationships		
Parents	<a href="#">physical</a>	An entity that has a location in space-time. Note that locations are themselves understood to have a location in space-time.
Children	<a href="#">agent</a>	Something or someone that can act on its own and produce changes in the world.
	<a href="#">artifact</a>	An <a href="#">object</a> that is the product of a <a href="#">making</a> .
	<a href="#">collection</a>	Collections have <a href="#">members</a> like <a href="#">classes</a> , but, unlike <a href="#">classes</a> , they have a position in space-time and <a href="#">members</a> can be added and subtracted without thereby changing the identity of the <a href="#">collection</a> . Some examples are toolkits, football teams, and flocks of sheep.
	<a href="#">ContactSite</a>	A <a href="#">ContactSite</a> is an <a href="#">object</a> , typically a Place or a <a href="#">residence</a> or a <a href="#">communication device</a> such as a <a href="#">telephone</a> , that has some kind of address identifier and can serve as a point of contact for a <a href="#">human</a> or <a href="#">organization</a> .
	<a href="#">prepared food</a>	Food that is the result of <a href="#">cooking</a> .
	<a href="#">raw food</a>	Food that is not the result of <a href="#">cooking</a> .

Done