



# **Multilingual AceWiki**

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**AceWiki: a user-friendly  
expressive semantic wiki  
system**

# Semantic Wiki

- problem with traditional wikis
  - content of different pages goes out of sync
  - poor querying possibilities
- semantic wiki = traditional wiki extended with formal semantics
- semantics is usually RDF-like (*subj-pred-obj* triples)
  - e.g. typed wiki links
- two languages: natural + formal
- examples: Semantic Mediawiki, Freebase

# AceWiki vs other semantic wikis

## *Similarities*

- collaborative editing (web-based)

## *Differences*

- semantically more expressive reasoning language
  - OWL instead of RDF
- more natural front-end language (ACE)
  - single language, instead of a combination of free-form natural language and formal language
  - scales to handle the increase in expressivity
  - reasoning language hidden from the user

# Attempto Controlled English (ACE)

- main product of the Attempto project at Uni Zurich
- goal: highly expressive knowledge representation language with a natural syntax
- both a natural and a formal language
  - natural: syntax and semantics compatible with a subset of English
  - formal: clearly defined translation into first-order logic (FOL)
- multiple reasoners: RACE, OWL/SWRL-based, AceRules, TPTP

# Web Ontology Language (OWL)

- decidable fragment of FOL
- reasoning tasks:
  - consistency checking
  - entailment checking
  - sub/super concept hierarchy calculation
  - ...
- multiple reasoners: Hermit, Pellet, Fact++, ...
- W3C Recommendation (2004, 2009)

# ACE vs OWL

*Every country that does not border a sea is a landlocked-country.*

```
SubClassOf(  
  ObjectIntersectionOf(  
    :country  
    ObjectComplementOf(  
      ObjectSomeValuesFrom(  
        :border  
        :sea  
      )  
    )  
  )  
  :landlocked-country  
)
```

*Which country is a landlocked-country?*

```
ObjectIntersectionOf(  
  :country  
  :landlocked-country  
)
```



## **Article (screenshot)**



Navigation:

- [Main Page](#)
- [Index](#)
- [Random Article](#)
- [Search:](#)

Actions:

- [New Word...](#)
- [Export...](#)


## planet

- ▶ *We use here the definition of "planet" according to the International Astronomical Union (see <http://www.iau.org> ) without the restriction to solar planets.*
- ▶ Every planet is a celestial-body.
- ▶ No planet is a star.
- ▶ No planet is a dwarf-planet.
- ▶ *The distinction between planet and dwarf-planet has been introduced by the International Astronomical Union in 2006.*
- ▶ No planet is a moon.
- ▶ Every planet orbits a star.
- ▶ Every planet that does not orbit the Sun is an extrasolar planet.
- ▶ Which planets orbit the Sun?
  - Earth
  - Jupiter
  - Mars
  - Mercury
  - Neptune
  - Saturn
  - Uranus
  - Venus

# Word creator (screenshot)

Word Creator ✕

Proper Name   Noun   Of-Construct   **Verb**   Transitive Adjective

 Every verb represents a certain relation between things. For example, the verb "owns" relates persons to their possessions.

*third singular*  \*  
*examples: owns, applies to, touches*

*bare infinitive*  \*  
*examples: own, apply to, touch*

*past participle*   
*examples: owned, applied to, touched*

\* required field

# Articles and words

Every wiki article has a 1-1 correspondence to a content word

## *Word*

- word classes correspond to logical entities
  - proper name: *individual*
  - noun: *concept*
  - transitive verb, *of*-noun, transitive adjective: *(binary) relation*
- morphological forms: singular, plural, past participle

## *Article*

- sequence of sentences, questions and informal comments
- has corresponding views (automatically generated and uneditable), e.g. *references, hierarchy*

# Sentences, questions, comments

## *Declarative sentence*

- look-ahead editing
- checked by the reasoner when added/edited, to exclude sentences that
  - would introduce inconsistency, or
  - express something that cannot be expressed in OWL

## *Question*

- look-ahead editing
- reasoner supplies the answer and updates it if declarative sentences are changed
  - answer = set of words

## *Comment*

- plain wiki text (with `[[ hyperlinks ]]`)
- ignored by the reasoner

# **Look-ahead editor (screenshot)**

ACE Text Editor



Every country that has a capital controls ...

< Delete

text

function word

a  
an  
at least  
at most  
every  
everybody  
everything  
exactly  
less than  
more than  
no  
nobody  
nothing  
somebody  
something  
what

proper name

new...  
Austria  
Berlin  
Bill  
Canada  
France  
Germany  
Italy  
Jane  
John  
Lara  
Mary  
Mike  
Paris  
Rome  
Russia

new variable

X  
Y  
Z  
X1  
Y1  
Z1  
X2  
Y2  
Z2  
X3  
Y3  
Z3  
X4  
Y4  
Z4  
X5

reference

itself  
it  
the capital  
the country

OK

Cancel

# Reasoning (screenshot)

The screenshot shows the AceWiki web interface. At the top left is the AceWiki logo and the text "AceWiki test". Below this is a navigation menu with links for "Main Page", "Index", "Search", "About", and "Random Article". To the right of the navigation menu are "Actions" for "New Word..." and "Export...". The main content area is titled "birth-place" and contains a list of logical statements:

- ▶ No person has more than 1 birth-place.
- ▶ A person has at least 2 birth-places.
- ▶ Every person has a birth-place.
- ▶ John is a person.
- ▶ Bill is a fireman.
- ▶ Who has a birth-place?
  - Bill
  - John

A dialog box titled "Conflict" is overlaid on the right side of the page. It contains the text: "The sentence is in conflict with the current knowledge. For that reason, it cannot be added to the knowledge base." and an "OK" button at the bottom.



# **Multilingual AceWiki**

# Generalization of AceWiki

- multiple languages
  - natural: English, German, ACE, ...
  - formal: ACE, Sage, ...
  - languages for content, UI, meta information
- multiple grammars
  - ACE (or its subsets)
  - Math Grammar Library
  - Phrasebook
  - ...
- multiple reasoners
  - ACE-based (RACE, OWL-based, ...)
  - Math reasoners, e.g. Sage, WolframAlpha
  - ...

# Multiple languages

- multiple languages for
  - content
  - UI (labels etc.)
  - meta queries (authors, edits)
- the content
  - viewable/editable/queryable in every language
  - automatically kept in sync
- some languages are formal, i.e. they are (mainly) meant for the reasoners
- implemented using Grammatical Framework (GF)
  - **single** abstract syntax corresponds to **multiple** concrete syntaxes
  - Resource Grammar Library

# Multiple languages (screenshots)

The screenshot shows the AceWiki interface. On the left, there is a logo for AceWiki and the text "MGL in English". Below this are navigation links: "Main Page", "Index", "Search", and "About". There are also "Actions" and "Languages" sections. The main content area is titled "Main Page" and contains a list of mathematical tasks in German. The tasks are:

- approximiere den Rest des minimalen Elementes von  $\mathbb{Z}/12\mathbb{Z}$ .
- berechne das Produkt der oktalen Zahl 12 und der binären Zahl 100.
- berechne den größten gemeinsamen Teiler von  $x$  und  $y$ .
- berechne den Realteil der Ableitung der Exponentialfunktion an  $\pi$ .
- berechne den Imaginärteil der Ableitung der Exponentialfunktion an  $\pi$ .
- berechne die zweite iterierte Ableitung des Cosinus an  $\infty$ .
- berechne die Summe von 1.0, 2.0, 3.0, 4.0 und 5.0.
- berechne die Summation von  $x$  für  $x$  von 1.0 bis 100.0.
- berechne das Integral des Cosinus auf dem offenen Intervall von 0.0 bis  $\infty$ .
- berechne die Summation von 1.0 über die Fakultäten von  $x$  für  $x$  von 1 bis  $\infty$ .
- lass  $A$  das abgeschlossene Intervall von 0.0 bis 4.0 sein.
- lass  $B$  das abgeschlossene Intervall von 3.0 bis 5.0 sein.
- lass  $C$  die Schnittmenge von  $A$  und  $B$  sein.
- lass  $D$  das offene Intervall von 2.0 bis 4.0 sein.
- berechne die Schnittmenge von  $A$  und  $D$ .
- annahme:  $x > 0.0$ .

On the right side of the screenshot, there is a list of code snippets for the same tasks, using the `compute_last` function. The snippets are:

- `compute_last(float( RR ( RealSet.oct( 12 ), BinarySet.oct( 100 ) ) ) )`
- `compute_last( GCD([ x, y ] ) )`
- `compute_last( real_part ( diff ( exp ( x ), x ) ) )`
- `compute_last( imag_part ( diff ( exp ( x ), x ) ) )`
- `compute_last( sum([ 1.0, 2.0, 3.0, 4.0, 5.0 ] ) )`
- `compute_last( sum ( x for x in range ( 1, 100 ) ) )`
- `compute_last( RealSet.oct( 12 ).sum ( x for x in range ( 1, 100 ) ) )`
- `compute_last( sum ( 1.0 / fact ( x ) for x in range ( 1, 100 ) ) )`

# Multiple grammars

- different grammars in different sections of the wiki
- interaction between grammars
  - e.g. detecting sentences that can be parsed by multiple grammars
- integrated grammar editor
  - full GF editor
  - UI for adding/editing words and their forms
- implemented by having multiple GF grammars

# Multiple reasoners

- API for calling an external reasoner which provides services of
  - consistency checking
  - Q&A
  - ...
  - explanation of reasoning results
- called over the whole content of the wiki or its fragment

# Links

## AceWiki

- source: <https://github.com/AceWiki/AceWiki>
- demos and publications: <http://attempto.ifi.uzh.ch/acewiki/>
  - *Tobias Kuhn. Controlled English for Knowledge Representation. Doctoral thesis, Faculty of Economics, Business Administration and Information Technology of the University of Zurich, 2010*

## Attempto Controlled English

- <http://attempto.ifi.uzh.ch>

# Links (AceWiki in MOLTO)

## AceWiki

- source: <https://github.com/AceWiki/AceWiki/tree/gfservice>

## ACE in GF

- <https://github.com/Attempto/ACE-in-GF>

## Multi-lingual demo (JPGF-powered Foods-grammar)

- *English*: <http://attempto.ifi.uzh.ch/webapps/gfeng/>
- *German*: <http://attempto.ifi.uzh.ch/webapps/gfger/>
- *Italian*: <http://attempto.ifi.uzh.ch/webapps/gfita/>



**Thank You!**