

# Combining Semantic Wikis and Controlled Natural Language

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## ABSTRACT

We demonstrate AceWiki that is a semantic wiki using the controlled natural language Attempto Controlled English (ACE). The goal is to enable easy creation and modification of ontologies through the web. Texts in ACE can automatically be translated into first-order logic and other languages, for example OWL. Previous evaluation showed that ordinary people are able to use AceWiki without being instructed.

## Keywords

Controlled Natural Language, Attempto Controlled English (ACE), Semantic Web, Semantic Wiki, AceWiki, Ontology

## 1. INTRODUCTION

Most of the tasks the Semantic Web is eventually supposed to fulfill rely on the availability of ontologies. However, the creation and maintenance of ontologies is difficult because a number of domain experts — most of which are not familiar with formal languages — have to agree on a conceptualization of the respective domain. For that reason, it is crucial for the future of the Semantic Web to provide tools that make the creation of ontologies easy for everybody.

AceWiki<sup>1</sup> tackles this problem by combining semantic wikis with controlled natural language. The goal of AceWiki is to enable ordinary people with no background in formal languages to create expressive ontologies in a collaborative and intuitive way without the need of installing an application.

## 2. BACKGROUND

There are several existing semantic wiki systems, see e.g. [3] for a brief survey. Unfortunately, most of those wikis do not support expressive ontology languages in a general way. Furthermore, they are often hard to understand for people who are not familiar with the technical terms.

Attempto Controlled English (ACE)<sup>2</sup> is the controlled natural language that is used for AceWiki. Being a subset of English, ACE looks completely natural. Restrictions of the syntax and the definition of a small set of interpretation rules make it a formal language that is automatically translatable into first-order logic. ACE covers a large part of natural English: singular and plural noun phrases, active and passive voice, relative phrases, anaphoric references, existential and universal quantifiers, negation, and much more.

<sup>1</sup>See [3], [4], and <http://attempto.ifi.uzh.ch/acewiki>

<sup>2</sup>See [1] and <http://attempto.ifi.uzh.ch>

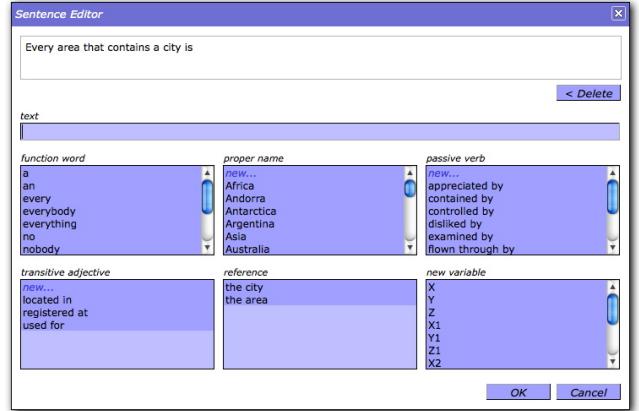


Figure 1: A screenshot of the predictive editor of AceWiki. The fragment “Every area is” has already been entered and now the editor shows all possibilities to continue the sentence.

ACE has been used as a natural language front-end to OWL with a bidirectional mapping of ACE to OWL [2]. AceWiki uses this for translating ACE sentences into OWL. The same work also introduces a Protégé plugin called “ACE View” which enables to manage ontologies in ACE within the Protégé environment.

## 3. SYSTEM

In AceWiki, the ontological entities are represented by natural language words and phrases. Proper names (e.g. “Zurich”, “Switzerland”, “Europe”) are interpreted as individuals, nouns (e.g. “city”, “country”) are interpreted as classes, and transitive verbs (e.g. “borders”), *of*-constructs (e.g. “part of”), and transitive adjectives (e.g. “located-in”) are interpreted as binary relations. Using those words together with the predefined function words of ACE (e.g. “a”, “every”, “if”, “then”, “and”, “not”, “is”, “that”), ontological statements are expressed as ACE sentences:

- ▷ Zurich is a city that is a part of Switzerland.
- ▷ Every country that borders Switzerland is a part of Europe.

As those examples show, the formal statements are easily readable and understandable by any English speaking person. In order to enable easy creation and modification of ACE sentences, AceWiki integrates a predictive editor that shows step-by-step the words that are syntactically possi-



Figure 2: A screenshot of the web interface of AceWiki showing the wiki article for the class “continent”.

ble at a given position in the sentence. Figure 1 shows a screenshot of this editor.

Each of the ontological entities gets its own wiki article. Figure 2 shows an example. Every article consist of ACE sentences most of which can be translated into OWL, e.g.:

- ▷ Every country that borders no sea is a landlocked-country.
- ▷ If X borders Y then Y borders X.
- ▷ Antarctica contains no country.
- ▷ Switzerland is located in Europe and borders exactly 5 countries.

ACE is more expressive than OWL, and thus we can write statements that go beyond the semantic expressivity of OWL (e.g. rule-like statements). Such statements are marked with a red triangle (and are currently ignored by the reasoner):

- ▷ No country borders every country.
- ▷ If Liechtenstein is a country then Andorra is a country.
- ▷ If a country contains an area and does not control the area then the country is an unstable-country.

Furthermore, questions can be used to query the knowledge base, e.g.:

- ▷ Which continents contain more than 10 countries?
- ▷ Zurich is a part of what?
- ▷ Switzerland borders which country that borders Spain?
- ▷ Which rivers flow through a country that borders Germany?

Thus, ACE is an ontology language, a rule language, and a query language at the same time.

AceWiki uses the OWL reasoner Pellet<sup>3</sup> to perform reasoning tasks over the sentences of the wiki that are OWL-compliant. In order to ensure the consistency of the ontology, every new sentence is checked — immediately after its creation — whether it would introduce a contradiction. If this is the case then the sentence is not included in the ontology and displayed in red font:

- ▷ Every country is a part of exactly 1 continent.
- ▷ Every country that borders Switzerland is a part of Europe.
- ▷ Germany borders Switzerland.
- ▷ **Germany is a part of Asia.**

<sup>3</sup><http://pellet.owldl.com/>

The reasoner is also used to infer the class memberships of individuals. The results are presented in ACE again:

- ▷ Switzerland is an area.
- ▷ Switzerland is a country.
- ▷ Switzerland is a landlocked-country.
- ▷ Switzerland is an object.

The same is done for class hierarchies:

#### Upward

- ▷ Every country is an area.
- ▷ Every country is an object.

#### Downward

- ▷ Every baltic-state is a country.
- ▷ Every landlocked-country is a country.

This shows that not only asserted but also inferred knowledge is represented in ACE. Finally, the reasoner is also used to answer questions:

- ▷ Which cities are located in Switzerland?
  - Berne
  - Geneva
  - Lucerne
  - Zurich

In general, we can say that AceWiki communicates with the users on a very natural level. No knowledge about formal languages is required to deal with AceWiki.

## 4. EVALUATION

In our previous work [3], we conducted a user experiment that showed that ordinary people with no background in logic and ontologies are able to deal with AceWiki. The participants — without being instructed how to interact with the interface — were asked to add knowledge to AceWiki. About 80% of the created sentences were correct and sensible. Remarkably, more than 60% of those sentences were complex in the sense that they contained an implication or a negation.

## 5. CONCLUSIONS

AceWiki shows how ontologies can be created and modified in a natural way within a wiki. It demonstrates how semantic wikis using controlled natural language can be expressive and easy to use at the same time. Our previous evaluation showed that AceWiki is indeed easy to learn.

## 6. REFERENCES

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