

# Semantic Assistants Wiki-NLP Showcase

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## Introduction

As part of the [Semantic Assistants](#) project, we developed the idea of a "self-aware" wiki system that can develop and organize its own content using state-of-art techniques from the Natural Language Processing (NLP) and Semantic Computing domains. This is achieved with our open source [Wiki-NLP integration](#), a Semantic Assistants add-on that allows to incorporate NLP services into the MediaWiki environment, thereby enabling wiki users to benefit from modern text mining techniques.

Here, we want to exhibit how a seamless integration of NLP techniques into wiki systems helps to increase their acceptability and usability as a powerful, yet easy-to-use collaborative platform. We hope this will help you to identify new human-computer interaction patterns for other scenarios, allowing you to make the best possible use of this new technology. A short summary is also available in our WikiSym demo paper [\[1\]](#), [Sateli, B.](#), and [R. Witte](#), "[Supporting Wiki Users with Natural Language Processing](#)", *The 8th International Symposium on Wikis and Open Collaboration (WikiSym 2012)*, Linz, Austria : ACM, 08/2012. You can also look at our SMWCon 2013 presentation slides [\[2\]](#), [Sateli, B.](#), and [R. Witte](#), "[Smarter Wikis through Integrated Natural Language Processing Assistants](#)", *Semantic MediaWiki Conference (SMWCon) Spring 2013*, New York City, NY, USA, 03/2013.

## Background

Natural Language Processing (NLP) is a branch of computer science that employs various Artificial Intelligence (AI) techniques to process content written in natural language. NLP-enhanced wikis can support users in finding, developing and organizing knowledge contained inside the wiki repository. We realized this idea by developing a comprehensive architecture that offers novel NLP solutions within a wiki environment through a user-friendly interface.

**MediaWiki Native Interface**

**Test Page**

Catherine's paternal family came from Leeds, West Riding of Yorkshire, and her great-grandmother Olivia was a member of the Lupton family, who were active for generations in Leeds in commercial and municipal work. Her ancestors include The Rev. Thomas Davis, a Church of England hymn-writer. Carola Middleton's maternal family, the Harrisons, were working class labourers and miners from Sunderland and County Durham.

Catherine's parents were based in Amman, Jordan, working for British Airways from May 1984, to September 1986, where Catherine went to an English language nursery school, before returning to their home in Berkshire. After her return from Amman, Catherine was educated at St Andrew's School near the village of Pangbourne in Berkshire, then briefly at Downe House. She continued her studies at Marlborough College, a co-educational independent boarding school in Wiltshire, followed by the University of St Andrews in Fife, Scotland where she met William. She graduated with an MA (2:1 Hons) in the History of Art.

**Person and Location Extractor on Test\_Page** [\(View\)](#)

| Content           | Type     | Start | End | Features         |
|-------------------|----------|-------|-----|------------------|
| Catherine         | Person   | 0     | 9   | gender: female   |
| Olivia            | Person   | 97    | 103 | gender: female   |
| Rev. Thomas Davis | Person   | 240   | 257 | gender: male     |
| William           | Person   | 954   | 971 | gender: male     |
| Leeds             | Location | 38    | 43  | locType: city    |
| Yorkshire         | Location | 60    | 69  | locType: region  |
| Amman             | Location | 452   | 457 | locType: city    |
| Jordan            | Location | 459   | 465 | locType: country |

**NLP Results Embedded in Wiki Page**

**Wiki-NLP Integration Interface**

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Available Assistants Results Target Global Settings Console

Step 1. Select the service you wish to execute on your collection. Once you add this page to your collection, you can continue browsing as your collection is saved.

Available Assistants Person and Location Extractor

Runtime Parameters Select a service

Yahoo Search Information Extractor English Durm Indexer OrganismTagger mycoMINE DR Information Extractor Person and Location Extractor

Collection [http://localhost/mediawiki-1.16/index.php/Test\\_Page](http://localhost/mediawiki-1.16/index.php/Test_Page)

## The Wiki-NLP integration user interface embedded in a wiki page

With this interface, users can easily execute sophisticated NLP analysis pipelines on wiki content. The NLP analysis results can be formatted and stored in the wiki in different, user-definable locations (original page, discussion page, new page, etc.)

## NLP-enhanced Wikis: Case Studies

We present three different deployments of our Wiki-NLP integration and show how various NLP services can help users in their tasks: (1) Cultural Heritage Data Management (DurmWiki), (2) Biomedical Knowledge Curation (*IntelliGenWiki*), and (3) Software Requirements Engineering (ReqWiki).

### Cultural Heritage Data Management in DurmWiki

Cultural heritage data of a society, such as books, are often preserved in a digitized format and stored in distributed repositories. Such a body of content can be turned into a knowledge base accessible to both humans and machines using modern techniques from the Semantic Computing domain. Our DurmWiki contains a digitized version of a German historical encyclopedia of architecture. As browsing and keyword-based search are the only information retrieval means of a classical wiki system, discovering significant knowledge is a major challenge for users of the heritage data. This is further compounded by the fact that these texts contain outdated terminology no longer in use, thus cannot be found through keyword search.

Within DurmWiki, we integrated an NLP service that can perform automatic indexing of a wiki's content, storing it in the wiki itself, similar to classical back-of-the-book indexes. The generated index page, as shown in the figure below, presents an alphabetically-ordered list of terms found in the wiki, together with a direct link to the pages inside the wiki where they appear. In

experiments with end users, we found that the presence of such an automatically maintained index page not only aggregates the wiki's embodied content on a high level and enables users to find information at-a-glance, but also helps them to "discover" interesting concepts or entities that they did not know were present in the wiki.



The screenshot shows a Wikipedia-like interface for the 'German Durm Indexer' page. The page title is 'German Durm Indexer'. The sidebar on the left contains 'navigation' links (Main page, Community portal, Current events, Recent changes, Random page, Help) and a 'toolbox' section with links (What links here, Related changes, Upload file, Special pages, Printable version, Permanent link, Semantic Assistants, Browse properties). The main content area displays an automatically generated index table:

|             |  |  |
|-------------|--|--|
| Abbildung   | Durm:Glaswände   |  |
| Abbildungen | Durm:Wände aus natürlichen und künstlichen Materialien |  |
| Abbrechen   | Wiederholtes   | Durm:Wände aus Eisen und verschleierte |
| Abfluß      | nach außen   | Durm:Glaswände                         |
| Abkühlung   | Durm:Wände für besondere Zwecke                        |  |
|             | ausgehende   | Durm:Wände aus Eisen und verschleierte |
|             | rascher  | Durm:Glaswände                         |
| Ablösung    | Durm:Glaswände   |  |
| Abmessung   | teilbare   | Durm:Glaswände                         |
| Abmessungen | gleiche  | Durm:Glaswände                         |
|             | ihre   | Durm:Glaswände                         |
|             | sehr großen  | Durm:Wände für besondere Zwecke        |
| Aborten     | Durm:Wände aus natürlichen und künstlichen Steinen     |  |
| Abortgruben | Durm:Wände für besondere Zwecke                        |  |

Automatic

#### back-of-the-book index generation for wiki content

For more information, please refer to the [Durm project page](#) and [\[3\]](#), [\[4\]](#). You can also browse a (limited) [demo version](#) online, where you can see the automatically generated index.

### Biomedical Knowledge Curation in IntelliGenWiki

IntelliGenWiki is our solution for life science researchers that need to analyze and manage large amounts of research publications, e.g., for knowledge curation tasks.

By storing research publications and other relevant textual content in a wiki, entities of interest can be automatically detected and added to each page through our Wiki-NLP integration. For example, using our open source [OrganismTagger](#), each species name can be automatically detected and added to the corresponding wiki page, together with additional information, such as the scientific name or a link to the NCBI Taxonomy Database.

| Content            | Type     | Start | End | Features   |
|--------------------|----------|-------|-----|--|
| Magnaporthe oryzae | Organism | 143   | 161 | <ul style="list-style-type: none"> <li>NCBI_Taxonomy_WebPage: <a href="http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=318829&amp;mode=info">http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=318829&amp;mode=info</a> ↗</li> <li>organism_scientific_name: Magnaporthe oryzae</li> <li>organism_alias: Magnaporthe oryzae</li> <li>google_search: <a href="http://www.google.com/search?q=Magnaporthe+oryzae">http://www.google.com/search?q=Magnaporthe+oryzae</a> ↗</li> <li>NCBI_Taxonomy_ID: 318829</li> </ul> |

**Entity detection example in *IntelliGenWiki***

In addition to automatic information extraction from wiki content, *IntelliGenWiki* implicitly produces semantic metadata that can be exploited in various ways, e.g., to be exported to external repositories or to provide semantic entity retrieval capabilities in the wiki, where applicable. In the figure below, we illustrate how curators using *IntelliGenWiki* can find wiki pages containing specific entities of their interest based on their type.

## Property:Enzyme

| <input checked="" type="checkbox"/> Page Name | <input checked="" type="checkbox"/> Enzyme Entities Found   |
|---|---|
| PMID: 20709852                                | <ul style="list-style-type: none"> <li>Cellobiohydrolase</li> <li>Cellulases</li> <li>endoglucanases</li> <li>β-glucosidases</li> <li>Invitrogen</li> <li>DNA polymerase</li> </ul> |

**Semantic Entity Retrieval in *IntelliGenWiki***

In a user study with expert biologists, the NLP support in the wiki reduced the curation time by nearly 20%. For more information, please refer to our [IntelliGenWiki page](#), as well as [\[5\]](#) and [\[6\]](#).

## Collaborative Software Requirements Engineering with ReqWiki

Software requirements engineering is the process of eliciting and documenting the needs of various stakeholders of a software project. Wikis, as an affordable, lightweight documentation and distributed collaboration platform, have demonstrated their capabilities in requirements engineering processes.

However, because of the lenient structure of wikis and the natural language that is used in software requirements specifications (SRS), the presence of semantic defects, such as ambiguity or vagueness, in SRS documents is inevitable. ReqWiki is a novel open source web-based approach based on a semantic wiki that includes our NLP assistants, which work collaboratively with humans on the requirements specification documents. In ReqWiki, users can invoke various generic or domain-specific quality assurance NLP services on the SRS documents using the Wiki-NLP user interface, in order to detect and amend the extracted defects. The figure below shows the results of a readability and a writing quality analysis service invoked on a use case document excerpt.

|                              |  |
|------------------------------|--|
| <b>Pre-Conditions</b>        | The manager must be identified and authenticated in the application        |
| <b>Success end condition</b> | The tasks is created and assigned to the technicians with status Assigned. |

**Readability Metrics** on UC/Manage\_Tasks ([View](#)) 

| Content  | Type          | Start | End | Features  |
|--|---------------|-------|-----|---|
| The tasks is created and assigned to the technicians with status Assigned. | Passive Voice | 686   | 760 | <ul style="list-style-type: none"><li>The sentence has been detected as passive and can be improved by changing the verb phrase</li></ul> |

**Writing Quality** on UC/Manage\_Tasks ([View](#)) 

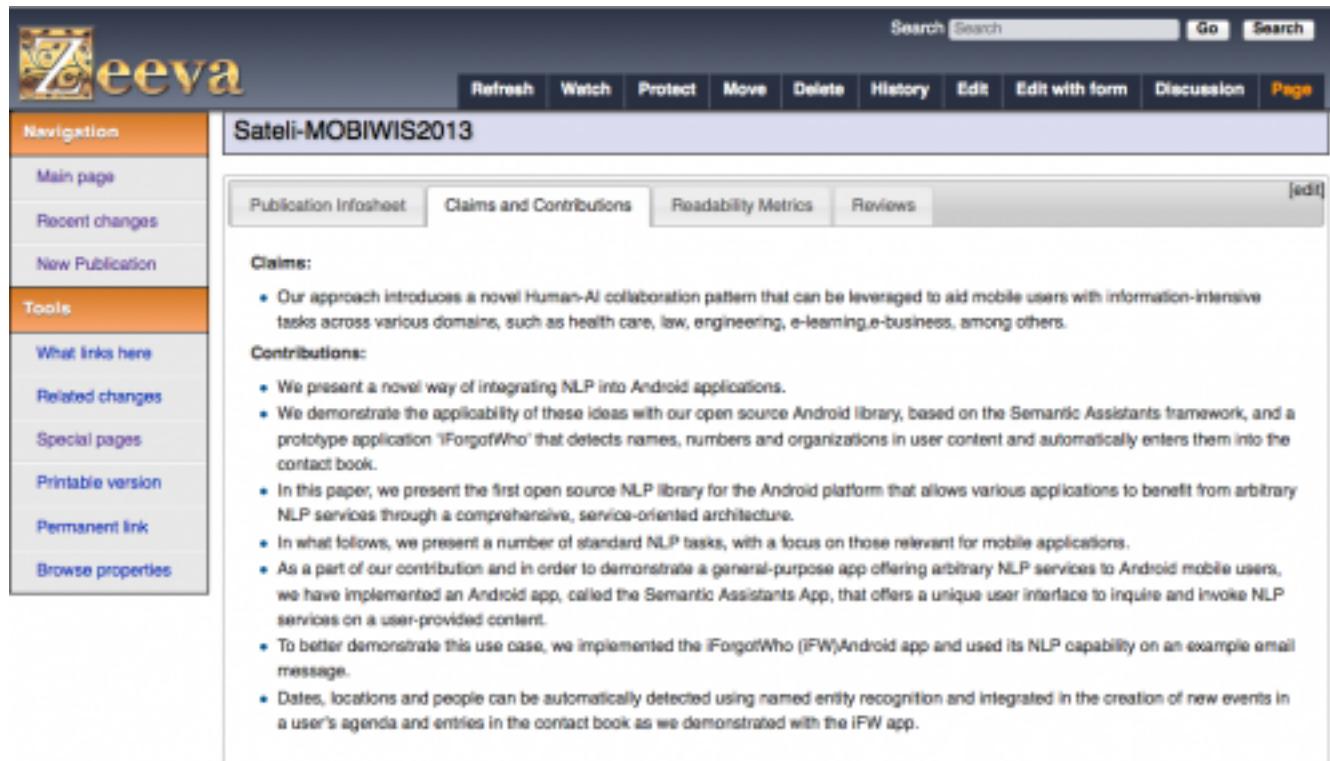
| Content      | Type    | Start | End | Features  |
|--------------|---------|-------|-----|---|
| The tasks is | Grammar | 686   | 698 | <ul style="list-style-type: none"><li>problem: Wrong Auxiliary Verb</li><li>suggestion: The task is</li></ul> |

**Automatic Quality Assurance of Wiki Content in ReqWiki**

Within a user study with a large number of software engineering students, we confirmed that our assistants can be easily used without prior knowledge of NLP, and that they can significantly improve the quality of a specification, compared to a version without NLP support [7]. For more information, please refer to our [ReqWiki page](#) and our publications [7], [8], and [9].

**Semantic Research Literature Management with Zeeva**

This overabundance of literature available in online repositories is an ongoing challenge for scientists that have to efficiently manage and analyze content for their information needs. Most of the existing literature management systems merely provide support for storing bibliographical metadata, tagging, and simple annotation capabilities. Here, we go beyond these approaches by demonstrating how an innovative combination of semantic web technologies with natural language processing can mitigate the information overload by helping in curating and organizing scientific literature. *Zeeva* is our latest research prototype for demonstrating how we can turn existing papers into a queryable knowledge base.



The screenshot shows the Zeeva interface with a sidebar on the left containing navigation links like 'Main page', 'Recent changes', 'New Publication', 'Tools', 'What links here', 'Related changes', 'Special pages', 'Printable version', 'Permanent link', and 'Browse properties'. The main content area is titled 'Sateli-MOBIWIS2013' and includes tabs for 'Publication Infosheet', 'Claims and Contributions', 'Readability Metrics', and 'Reviews'. The 'Claims' section lists bullet points about a novel Human-AI collaboration pattern. The 'Contributions' section lists bullet points about integrating NLP into Android applications, including the implementation of the iForgotWho app.

## Semantic infosheet of bibliographical metadata extracted from a sample paper

In Zeeva, users can upload the scientific publications to the wiki, where they are analyzed by a number of NLP pipelines. One of these detects rhetoric entities like *claims* and *contributions* in the publications, which is then transformed into semantic markup that can be queried from other pages. This allows Zeeva to create summary "factsheets" for each paper, which show the detected claims and contributions, as well as other NLP generated content, like an index or a writing quality assessment.

For more information, please refer to our [Zeeva](#) page, as well as our publications [\[10\]](#), [\[11\]](#), [\[12\]](#), [\[13\]](#).

## Further Information

Please refer to the following pages for more information:

- The main page describing the [Wiki-NLP](#) integration
- An overview for the [Semantic Assistants](#)
- We also have a tutorial on NLP in wikis that was last presented at SMWCon Spring 2014 [\[14\]](#).

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