

Dynamic Queries in Semantic Wiki Systems

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Abstract. *Semantic wiki systems have gained major attention of the academic community in the past few years. The idea of integrating the semantic web with fast and lightweight content management systems seems to be good direction towards web 3.0 or the social semantic web. Herein we analyze how to take advantage of such systems through dynamic querying facilities. Particularly we analyze the τ AOPIs system which has a build in frame logic reasoning engine, and show how queries can enhance the presented content through dynamically generated class hierarchies, dictionaries, FAQ-s, tables of content, issue tracking and others. We conclude that by enriching wiki syntax with dynamic queries semantic wikis can gather additional functionality in organizing knowledge.*

Keywords. semantic wiki; dynamic queries; frame logic; taopis

1 Introduction

Wiki systems, a progressive technology that hasn't been predicted a bright future by prominent scientists, are in wide usage today. These systems, that allow any user to add different content to the system, are autopoietically evolving into more and more impressive knowledge repositories. Maybe the best known example of such systems, Wikipedia, the free Internet encyclopedia, had over 2.2 million articles in its English version at the time of writing this text, whilst there are versions in almost all world languages.

Still, it seems that wiki systems came to their edge [33]. It is more and more often the case that various rules concerning behavior, knowledge orga-

nization as well as metadata are implemented in order to facilitate search and reasoning in these often huge (predominant textual) data repositories [5, 19, 22, 13].

As argued in [26] semantic wiki systems are an extension to common wiki systems that use additional functionality borrowed from the semantic web. In order to ease search, integration and reasoning, users can provide metadata, which yields additional semantics or meaning [27].

The τ AOPIs system that was developed by the authors and presented in [3, 25, 27, 17, 26] has a semantic wiki subsystem that is based on frame logic [11], and particularly uses the \mathcal{F} LORA-2 reasoning engine [35] to allow its users to query the dynamically created knowledge base. τ AOPIs uses a syntax entitled **niKlas** that comprises the possibility to cast dynamic queries inside any wiki page. The τ AOPIs systems and likewise its **niKlas** syntax is work in progress that is aimed on a wide range of users. At its current version the system is still not enough user-friendly to achieve the stated goals. The main idea of hiding complex semantic technologies in the background of the system and providing users with easy-to-use graphical query builders is still to be implemented.

Herein we show how such dynamic queries can be used to generate new and useful content, using the **niKlas** syntax. The queries are dynamic in terms that their results are always up to date with the dynamically created knowledge base.

2 τ OPIS Object – Oriented Framework

τ OPIS is an open source social web application that aims to provide a platform for self-organizing communities. Such communities can be either organizations or projects for which τ OPIS provides suitable tools like semantic wiki systems, forums, blogs, ranking mechanisms, content filtering, tagging etc.

Its unique feature is to approach any content (forum posts, blog entries, blog comments, and particularly wiki pages) as objects in the sense of the object-oriented paradigm. Such objects can have relations to other objects (manifested in hyperlinks), attributes (manifested through attribute-value tags, provided through a social tagging system), methods (manifested in web services), and can be classified into user-defined classes (manifested through a special case of attribute-value tags).¹

This object-oriented approach to semantic wiki systems, allows us to query any wiki page (or object in a boarder sense) for its class, attribute names, attribute values, relation names, related objects as well as methods. Additionally, τ OPIS allows the querying of authorship (users also represent objects), project or organization membership and provides sorting facilities.

3 niKlas Syntax for Dynamic Queries

The niKlas syntax, which is similar to phpBB code², defines beside different text formatting commands, a query command:

```
[ query flora2_query . ]
{ [ header ] header_formatting [ / header ] }
answer_formatting
[ / query ]
```

whereby *flora2_query* is a normal (restricted) FLORA-2 query with defined return variables,

¹For a better understanding of τ OPIS semantics please refer to [26]

²phpBB is a free open-source forum and messaging board system available at <http://www.phpbb.net>

header_formatting is the optional header (possibly formatted using niKlas code),³ and *answer_formatting* is a τ OPIS formatting that can contain variables used in the FLORA-2 query. The *answer_formatting* is repeated for any answer returned by the FLORA-2 reasoning engine by using the generated FLORA-2 ontology of the semantic wiki as a knowledge base.

As an illustrative example the following query would generate a list of users.

```
[ query ?_ : user [ name->?n ]. ]
[ header ] [ b ] Users [ / b ] [ / header ]
name: ?n
[ / query ]
```

The FLORA-2 query *?_ : user [name->?n, surname->?s]* is issued against the dynamic knowledgebase of the system. The obtained results are then replicated in the answer formatting; each answer prints out one answer formatting. On the other hand the header section will be printed only once. Thus the result of this query would be similar to:

```
[ b ] Users [ / b ]
name: Markus
name: Mirko
name: Jurica
```

In the second phase, after the query generated a formatting, the rest of the niKlas code is translated to HTML but other target languages could be implemented. In this case, the HTML encoded answer would be:

```
<b>Users</b>
name: Markus<br />
name: Mirko<br />
name: Jurica<br />
```

4 Use Cases

In the following a few interesting use cases of dynamic queries shall be analyzed. We will show how niKlas can be used to dynamically generate new content that is usable in a wide range of community projects like current class hierarchies, dictionaries, FAQ's, tables of content, lists of editors, issue and bug tracking, as well as what links here links.

³In the current version subqueries are not allowed.

4.1 Class Hierarchies

In order to obtain a dynamically generated list of classes with corresponding subclasses one can issue the following query:

```
[ query ?sub::?super . ]
?sub is a subclass of ?super
[/ query ]
```

The first line defines the $\mathcal{FLORA-2}$ query which is in particular a class expression with variables. In the second line the formatting for the given list (which could have been a table or any other formatting) is defined. The third line closes the formatting.

Such a query will yield a list similar to:

```
apple is a subclass of fruit .
banana is a subclass of fruit .
fruit is a subclass of food .
```

Such a query would be useful if using a semantic wiki system as an ontology management tool, to provide a detailed overview of existing classes with corresponding subclasses. There are variations to this query that would allow to obtain only strict subclasses, subclasses of a special class etc.

4.2 Dictionaries

Another interesting feature that can be provided using a dynamic query is a dictionary. Some wiki systems provide such a facility as a build-in function. Herein we show how such a functionality can be simulated in **niKlas** through a series of queries similar to the following, provided that any wiki page is tagged with its corresponding first letter.⁴

```
[ query ?_:wiki_page [
  title ->?title ,
  url ->?address ,
  letter ->A ] ,
  sort(?title , asc) . ]
[ header ][ h1]A[/ h1 ][/ header ]
[ link=?address>?title ]
[/ query ]
```

⁴This tag is needed due to the fact that $\mathcal{FLORA-2}$ syntax is a bit complex when it comes to string processing. A better solution using wildcards or regular expressions should be provided in some future version of **niKlas**.

The query if provided on some wiki page would yield a result similar to the following whereby the corresponding titles would be links to the particular wiki pages dealing with them.

```
[ h1]A[/ h1 ]
[ link=AnanasPage>Ananas ]
[ link=ApplePage>Apple ]
...
```

To provide a full dictionary at the current version of **niKlas** the user has to make a query for any letter of a given alphabet. This is an unpleasant solution that implies that some future version of **niKlas** has to provide a facility for subqueries and functionality similar to the SQL *group by* clause.

Such a query is usable in almost any wiki system. Especially in encyclopedia-like wikis such a query can be of great value.

4.3 Frequently Asked Questions

The popular FAQ section of some project or service can be simulated using a dynamic query. Provided that any wiki page that is an actual answer to a frequently asked question is tagged with attribute *question* and the corresponding question as its value, the query would look like the following.

```
[ query ?_:wiki_page [
  question ->?question ,
  url ->?address ] ,
  sort(?question , asc) . ]
[ link=?address>?question ]
[/ query ]
```

The query would yield a sorted list of frequently asked questions with links to their answers similar to:

```
[ link=ApplePie>What is apple pie? ]
[ link=PineApple>What is pineapple? ]
...
```

Queries similar to this can be useful in almost any project or organization that interacts closely with their users/customers. Especially open source projects, customer relationship sites as well as others could have considerable benefits.

4.4 Tables of Content

In order to provide a book-like “linearization” of a wiki site one could provide a table of content using a series of queries similar to the following, provided that wiki pages are tagged with the chapter they belong to.

```
[ query ?_:wiki_page[
  chapter->KM,
  title->?title ,
  url->?address ] ,
  sort(?title , asc). ]
[ header ] Knowledge management [ / header ]
[ link=?address>?title ]
[ / query ]
```

Such a query would provide a list of sections of a given chapter with hyperlinks to the corresponding pages.

```
Knowledge management
[ link=Explicit>Explicit knowledge ]
[ link=Tacit>Tacit knowledge ]
...
```

In this case again **niKlas** current version shows a drawback for not supporting subqueries, since the user has to issue a query for any chapter.

Such a query (or series of queries) is interesting in any documentation project, thesis, on-line book etc.

4.5 Who Edited this Page

One sometimes would like to know which users contributed to a given page. In **niKlas** this is achieved to a bit more complex query as follows.

```
[ query ?_:wiki_page[
  title->'Page title ' ,
  author->?_a ] ,
  ?_a: person [
  name->?name ,
  surname->?surname ,
  email->?email ]. ]
[ header ] Contributors: [ / header ]
?name ?surname
[ url ] mailto:?email [ / url ]

[ / query ]
```

By issuing this particular query we would obtain a list of users’ names and surnames with links to their e-mail addresses.

```
Contributors :

Mirko Cubrilo
[ url ] mailto:mcubrilo@foi.hr [ / url ]

Markus Schatten
[ url ] mailto:mschatte@foi.hr [ / url ]

Jurica Seva
[ url ] mailto:jseva@foi.hr [ / url ]
```

Such queries are useful in any wiki site that wants to keep track of contributors to (for instance) facilitate the creation of a social network.

4.6 Issue Tracking

Lots of projects (especially information system based projects) have a particular need to keep track of issues that arise during the project (bugs, feature requests etc.). Provided that any wiki page that holds a bug description is tagged with *class:bug* as well as with *status:open* the following query would yield a list of open bugs.

```
[ query ?_:bug[
  status->open ,
  not( status->closed ) ,
  title->?title ,
  url->?address ] ,
  sort(?title , asc). ]
[ header ] Open bugs [ / header ]
[ link=?address>?title ]
[ / query ]
```

The list would look similar to the following:

```
Open bugs
[ link=BuildBug>Build crashes ]
[ link=ErrorOpen>Error on open ]
...
```

In order to close an issue, a project member that solved it, just needs to tag the wiki page with *status:closed*, and the issue would be removed from the list. As indicated above, such a dynamic query can be useful on any project related site that deals with any kind of issues that one needs to keep track of.

4.7 What Links Here

A feature often included into conventional wiki systems is a list of pages that link to the current page. Provided that *'Page title'* is the title of the current page, this functionality can be simulated in **niKlas** as follows.

```
[query ?_:wiki_page[
  title->>?title ,
  url->>?address ,
  ?_->>?_this_page ] ,
 ?_this_page:wiki_page[
  title->'Page title' ]. ] .
[header]What links here?[/header]
[link=?address>?title]
[/query]
```

Thereby the result to this query would be a list of page titles with corresponding hyperlinks to the current page including links to them.

```
What links here?
[link=BananaPage>Banana]
[link=OrangePage>Orange]
...
```

This functionality is useful especially on wiki sites that have complex mutual hyperlinks (encyclopedia-like wikis, technical documentation etc.).

5 Related Work

There has been a fair deal of publishing presenting prototypes of semantic wiki systems [5, 13, 19, 22, 24, 26, 33, 32, 31, 6, 34, 10, 22, 12, 18, 2, 30, 9, 16, 4, 15, 19, 14, 1, 23, 7, 20, 21, 8] most of the building upon description logic, tagging (or structured tagging like in [29]) and link annotation.

Maybe the most interesting from our perspective is Semantic Media Wiki [28] which since recently has support for dynamic queries (called inline queries). Nevertheless, the used syntax is very complex using a lot of different types of braces. The following example of such a query would yield a list of cities with their corresponding population and size which are located in Germany.

```
{{#ask:
  [[Category:City]]
```

```
[[located in::Germany]]
| ?population
| ?area#km2 = Size in km2
}}
```

The output format is built-in: a table. To change the output one has to use keywords or rather complex templates that have to be defined previously. In contrast the same query in **niKlas** would look similar to:

```
[query ?c:City[
  location->Germany,
  population->>?p,
  area->?a ]. ]
?c has a population
of ?p and occupies
the area ?a.
[/query]
```

niKlas allows for formatting in place but on the other hand does not define built-in output. Such output could be defined and implemented in some future version of the language.

6 Conclusion

Semantic wiki systems with dynamic querying facilities are useful in almost any knowledge management environment where summary information is needed. The paper showed how dynamic queries can be used to generate additional and useful content from the knowledge base of a semantic wiki system. Particularly by analyzing the τ ΑΟΠΙΣ system and its **niKlas** syntax we were able to show that one can gather various summary information from the knowledge base including class hierarchies, dictionaries, frequently asked questions, tables of content, contributor lists, issue tracking lists as well as lists of pages that link to the current one. Such facilities are of value to different project and organization related situations.

niKlas showed a few drawbacks in its current version due to the impossibility to issue subqueries, use grouping in queries as well as wildcards nor regular expressions. These and other issues should be addressed in future versions of the language. On the other hand, due to the strong formalism of frame logic in its background, **niKlas** proved to solve interesting object-oriented tasks as shown herein.

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