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Saving C02

Top SMW Performance Issues and How to Address Them

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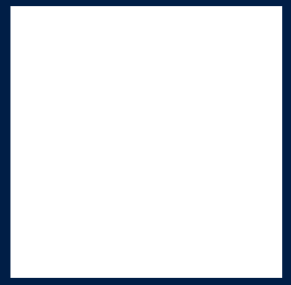


September 22, 2011

SMW and Performance

- Why care?
  - Critical: “Our site is down again!”
  - Severe: “Our users are complaining about speed.”
  - Tautological: “Our site could speed up a bit.”
  - Economical: “We might use less hardware/energy.”
- “SMW slows down our servers?”
  - In practice: rarely directly
  - But it suggests usage patterns that stress MediaWiki

Optimising SMW
Step 0: Configure MediaWiki for Performance

Configuring MediaWiki for Performance

- Most work is still done by MediaWiki
- Many performance hints available online,
  often very easy to enable
- Do not start to optimise SMW performance before configuring MW properly!

Caching, caching, caching …

- Don't have your server do repeated work!
- **Important caches:**
  - PHP bytecode caches (APC, PHP accelerator, …)
  - Object caches (memcached, ...)
    - Parser cache
    - Message cache
  - Page cache
    - File caches
    - HTTP-level caches (squid, varnish, Web server)

PHP Bytecode Caching

- Cache the “pre-compiled” PHP source code instead of parsing PHP text files on each request
- Possibly the most important cache for small sites, especially if not much editing happens
- Trivial to enable:
  - Install APC for your PHP distribution, e.g. in Debian: “apt-get install php-apc”
  - Done. MediaWiki is much faster now.

Object Caching

- Cache frequently used PHP data objects

- Speeding up user interaction, esp. for logged in users.
- Taking load from the DB.

- Trivial to enable:
  - Enable APC (or some other PHP bytecode cache), then add to LocalSettings.php:

    $wgMainCacheType = CACHE_ACCEL;
  - Sites with many app servers need *memcached*
  - Sites on untrusted servers should avoid this

Parser Caching

- Special object cache for parser output
- Speed up content page rendering if page is unchanged
- Enabled by default
  - *Small* sites could set in LocalSettings.php:

    ```
    $wgParserCacheExpireTime = 2592000; // 30 days
    $wgParserCacheType = CACHE_DB; // for relatively low traffic
    ```

    → assumes relatively low traffic; else keep default
  - Cache will be cleared on edits,
    but not on indirect changes (e.g. SMW #ask)

Message Caching

- Special caches for interface messages
- Speed up all page rendering
- Setup:
  - Basic object caching enabled by default
  - Advanced file based caching since MW 1.16:

    ```
    $wgCacheDirectory = 'PHP-writable, not Web-readable directory';
    ```

    → Directory may need to be created manually

File Caching

- Cache for complete HTML output pages

- Speed up all anonymous viewing
- Simplest page caching method for single servers

- Setup is easy:
  - In LocalSettings.php:

```
$wgUseFileCache = true;
$wgFileCacheDirectory = "{$wgCacheDirectory}/html";  // MW 1.16 default
$wgShowIPinHeader = false; // no personalization of pages
$wgUseGzip = true; // compress files
```

  - No expiry! Refresh on edit/move/purge/... as usual.

HTTP-Level Caching

- Cache for complete HTML output pages

- Speed up all anonymous viewing
- Advanced method for larger sites and multiple servers

- Setup
  - Usually requires installation of tools like Squid or Varnish
  - Possibly also supported by Web server (for individual servers)
  - See manual for details …

The Limits of Caching

- Caching cannot solve all performance issues!
- Even cached outputs need to be recreated fast (see also the famous "MJ incident" at Wikipedia)
- Aggressive caching vs. up-to-date results (esp. for extensions like SMW)

→ Fast page creation remains crucial

Other Generic MW Performance Measures

- Some other settings can help:

```
$wgEnableSidebarCache = true;
$wgDisableCounters = true;
$wgMiserMode = true; // cache expensive Specials
$wgCompressRevisions = true; // needs PHP zlib
// For sites with many writes:
$wgAntiLockFlags = ALF_NO_LINK_LOCK | ALF_NO_BLOCK_LOCK;
```

- Use fast native tools for Diff (set $wgDiff and $wgDiff3)
- Make sure PHP mbstring module is installed
- Use low setting for $wgJobRunRate; maybe “0” and use cron to run update jobs regularly (runJobs.php)
- Scale hardware (more/better, split DB/Web/caching)

Optimising SMW
Step 1: Know Your Problem

What's the Problem?

- Difficult to identify cause of performance problems
- Questions to ask:
  - Where does the problem occur?
    (CPU, Mem, DB, …)
  - When does the problem occur?
    (Particular function, high traffic, DoS attack, …)
  - Which software components are involved?
    (MW, SMW, extensions [of SMW], …)

Tracking Down Performance Issues

- Server level: which process does the work?
- Log files:
  - Apache log, also to identify impolite crawlers
  - MySQL log, especially slow query log
- MediaWiki profiling: get times for individual methods
  → requires familiarity with MW code to interpret

Careful: logging/profiling also slows down a site!

Tracking Down Performance Issues

- Know your wiki, know your users
- What are the complex templates/queries on your wiki?
- Which functions are reported to be too slow?
- What are the slow pages?
  - Careful: slowdown can come from background jobs, independent of the page that is displayed

Performance Impact of Semantic MediaWiki

- Possible causes for SMW performance issues:
  - Many small DB reads (e.g. find default Form)
  - Many small DB writes (update data on *all* edits)
  - Complex read queries (difficult #ask queries)
  - Long, complex pages (#ask makes this easy)
  - Complex templates (SMW users *love* templates)
- Two main areas: database activity and PHP activity
- PHP activity dominates on small sites

Optimising SMW
Step 2: Escaping Template Hell

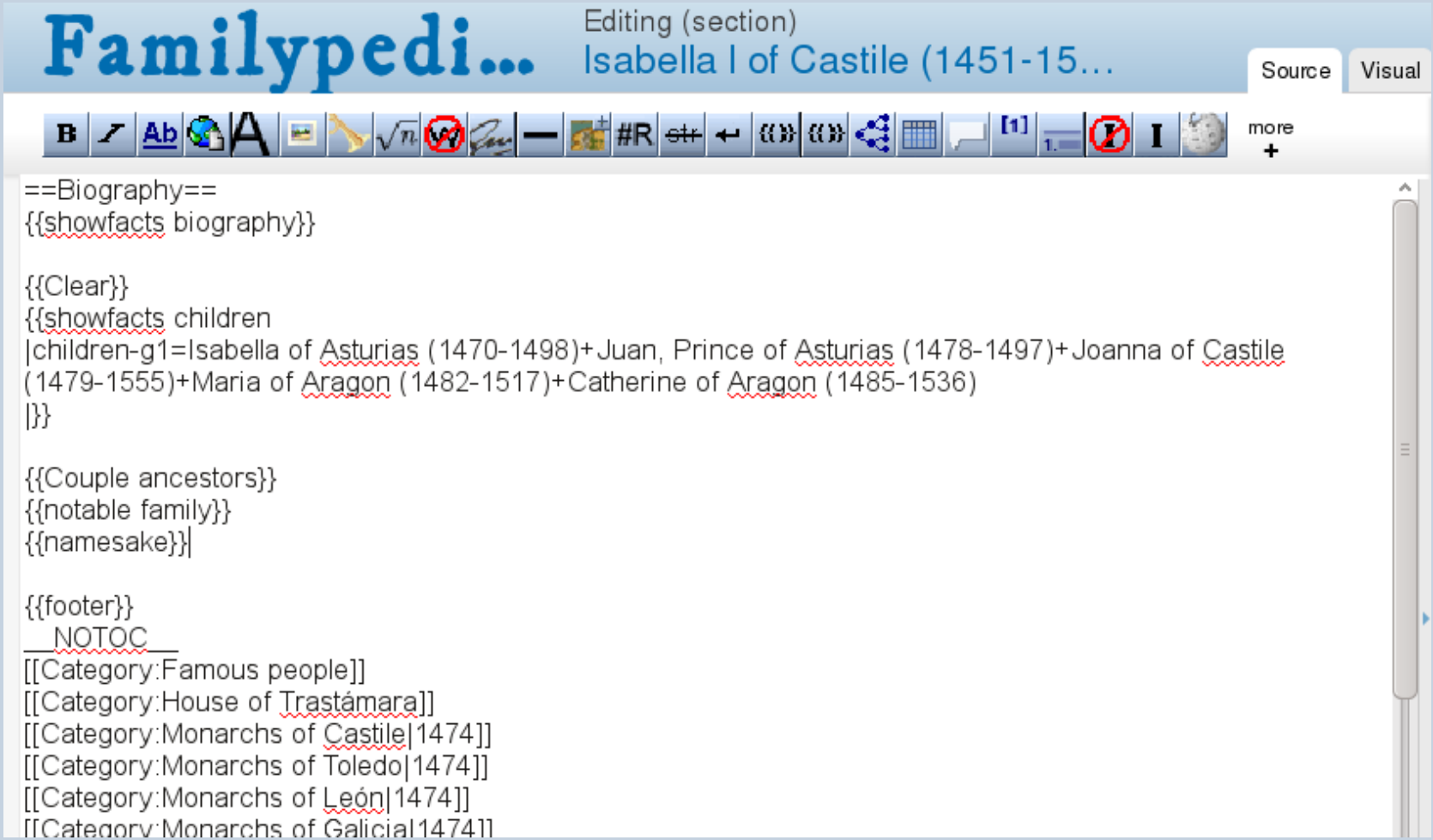
Templates and Parser Functions

- Original intention:
  - Templates: re-use common parts of a page for consistent layout, customised with parameters
  - Parser functions: enable some further customisation, e.g. with conditionals
- What users make of it:
  - In-page data processing in an extremely inefficient and unreadable script language
  - Even more fun when mixed with SMW queries

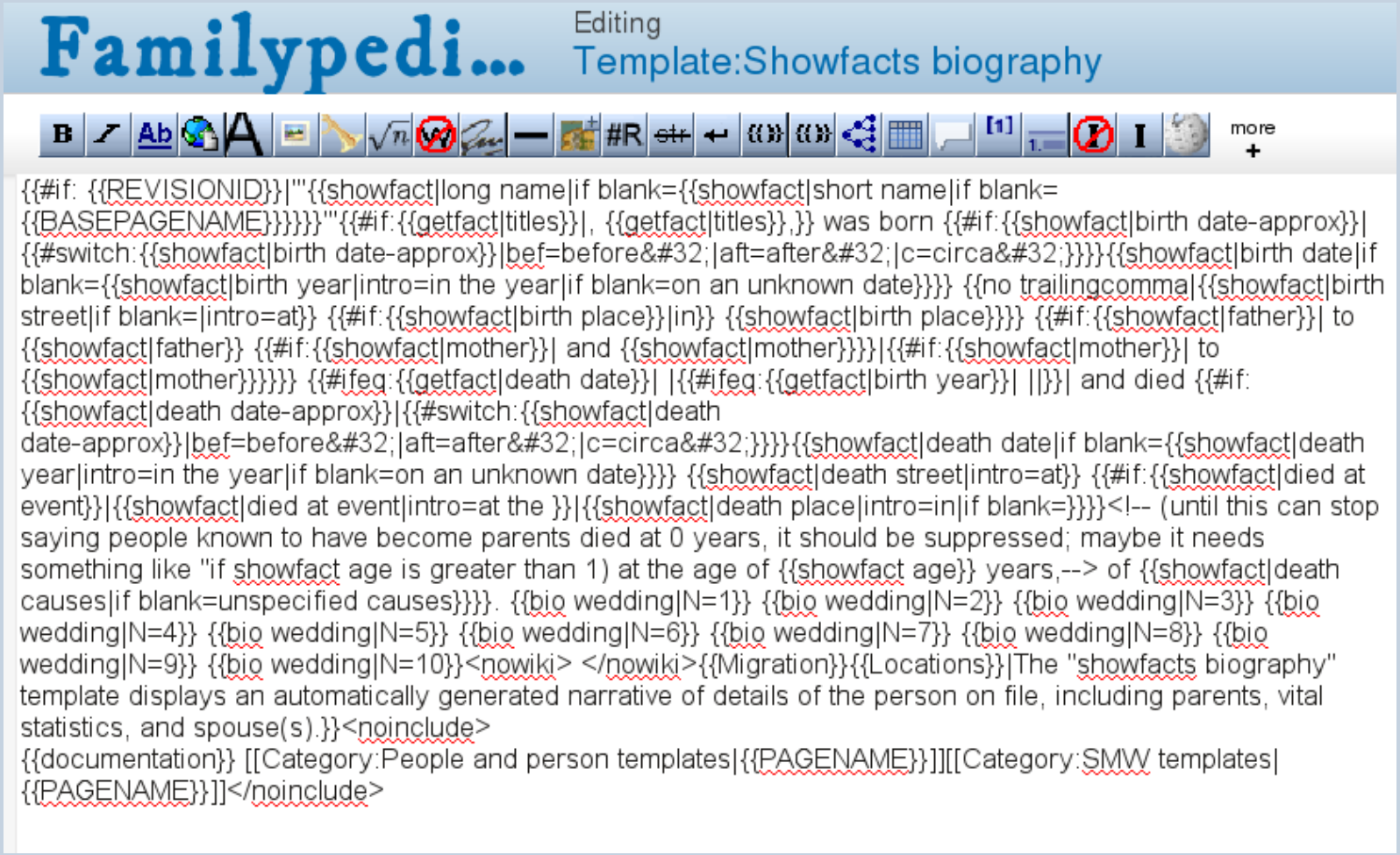
Example


Familypedia
Create new article
Help: Creating articles
Indexes of ancestors
Isabella I of Castile (1451-1504)
0 Talk
Like
Edit with form
Main
tree
descendants
Biography Edit
Isabella I of Castile, Queen regnant of Castile, Queen regnant of Toledo, Queen regnant of León, Queen regnant of Galicia, was born 22 April 1451 to John II of Castile (1405-1454) and Isabella of Portugal (c1428-1496) and died 26 November 1504 of unspecified causes. She married Ferdinand II of Aragon (1452-1516) 19 October 1469 . Ancestors are from Spain, France, Germany, Byzantium, Belarus, United Kingdom, Russia.
Isabella of Castile
Birth: April 22, 1451
Death: November 26, 1504
Father: John II of Castile (1405-1454)
Mother: Isabella of Portugal (c1428-1496)
Spouse: Ferdinand II of

Example


Familypedi...
Editing (section)
Isabella I of Castile (1451-15...
Source
Visual
more
==Biography==
{{showfacts biography}}
{{Clear}}
{{showfacts children
|children-g1=Isabella of Asturias (1470-1498)+Juan, Prince of Asturias (1478-1497)+Joanna of Castile (1479-1555)+Maria of Aragon (1482-1517)+Catherine of Aragon (1485-1536)
|}}
{{Couple ancestors}}
{{notable family}}
{{namesake}}
{{footer}}
__NOTOC__
[[Category:Famous people]]
[[Category:House of Trastámara]]
[[Category:Monarchs of Castile|1474]]
[[Category:Monarchs of Toledo|1474]]
[[Category:Monarchs of León|1474]]

Example


Familypedi...
Editing
Template:Showfacts biography
more
{{#if: {{REVISIONID}}|'''{{showfact|long name|if blank={{showfact|short name|if blank={{BASEPAGENAME}}}}}}'''{{#if:{{getfact|titles}}|, {{getfact|titles}},}} was born {{#if:{{showfact|birth date-approx}}|{{#switch:{{showfact|birth date-approx}}|bef=before |aft=after |c=circa }}}}{{showfact|birth date|if blank={{showfact|birth year|intro=in the year|if blank=on an unknown date}}}} {{no trailingcomma|{{showfact|birth street|if blank=|intro=at}} {{#if:{{showfact|birth place}}|in}} {{showfact|birth place}}}} {{#if:{{showfact|father}}| to {{showfact|father}} {{#if:{{showfact|mother}}| and {{showfact|mother}}}}|{{#if:{{showfact|mother}}| to {{showfact|mother}}}}}} {{#ifeq:{{getfact|death date}}| |{{#ifeq:{{getfact|birth year}}| ||}}| and died {{#if:{{showfact|death date-approx}}|{{#switch:{{showfact|death date-approx}}|bef=before |aft=after |c=circa }}}}{{showfact|death date|if blank={{showfact|death year|intro=in the year|if blank=on an unknown date}}}} {{showfact|death street|intro=at}} {{#if:{{showfact|died at event}}|{{showfact|died at event|intro=at the }}|{{showfact|death place|intro=in|if blank=}}}}<!-- (until this can stop saying people known to have become parents died at 0 years, it should be suppressed; maybe it needs something like "if showfact age is greater than 1) at the age of {{showfact age}} years,--> of {{showfact|death causes|if blank=unspecified causes}}}}. {{bio wedding|N=1}} {{bio wedding|N=2}} {{bio wedding|N=3}} {{bio wedding|N=4}} {{bio wedding|N=5}} {{bio wedding|N=6}} {{bio wedding|N=7}} {{bio wedding|N=8}} {{bio wedding|N=9}} {{bio wedding|N=10}}<nowiki> </nowiki>{{Migration}}{{Locations}}|The "showfacts biography" template displays an automatically generated narrative of details of the person on file, including parents, vital statistics, and spouse(s).}}<noinclude>
{{documentation}} [[Category:People and person templates|{{PAGENAME}}]][[Category:SMW templates|{{PAGENAME}}]]</noinclude>

Example

Familypedi... Editing Template:Showfact


```
<includeonly>{{showfact/aux1|{{#show:{{{page|{{BASEPAGENAME}}}}}}|default=|link={{#switch:
{{{link|}}}|none=none|subject=subject|all}}|intro={{#if:{{{intro|}}}|{{{intro|}}}&#32;}}|outro={{{outro|}}}|?
{{{1}}}}}|page={{{page|{{BASEPAGENAME}}}}}|link={{#switch:{{{link|}}}|none=none|subject=subject|all}}|intro=
{{#if:{{{intro|}}}|{{{intro|}}}&#32;}}|outro={{{outro|}}}|default={{{if blank|}}}|shortname={{{2|}}}|property={{{1}}}
}}</includeonly><noinclude>
{{documentation}}
[[category:facts templates]]</noinclude>
```

Example: Results

- Significant time for building page
  - parsing templates is slow and memory intensive
  - easily above 1 min for page rendering
- Many database reads …

Example: Results

- Significant time for building page
  - parsing templates is slow and memory intensive
  - easily above 1 min for page rendering
- Many database reads …

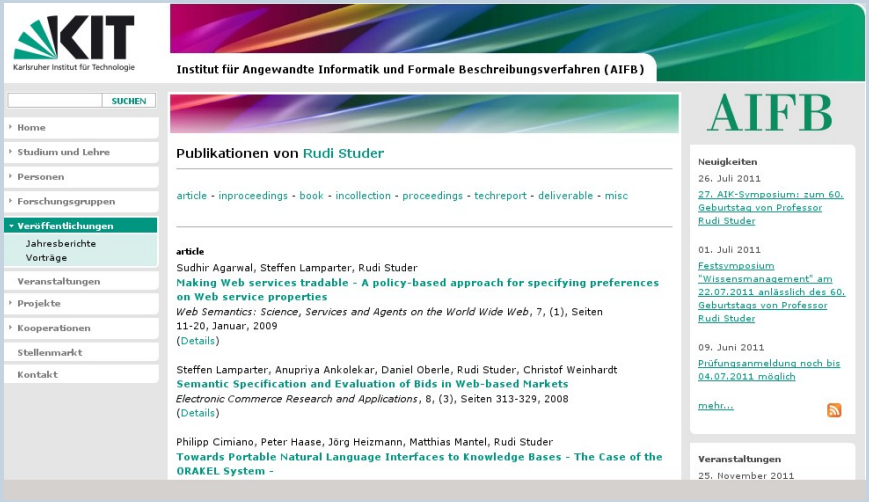
… more than 3000 queries for one page!

Toward a Solution

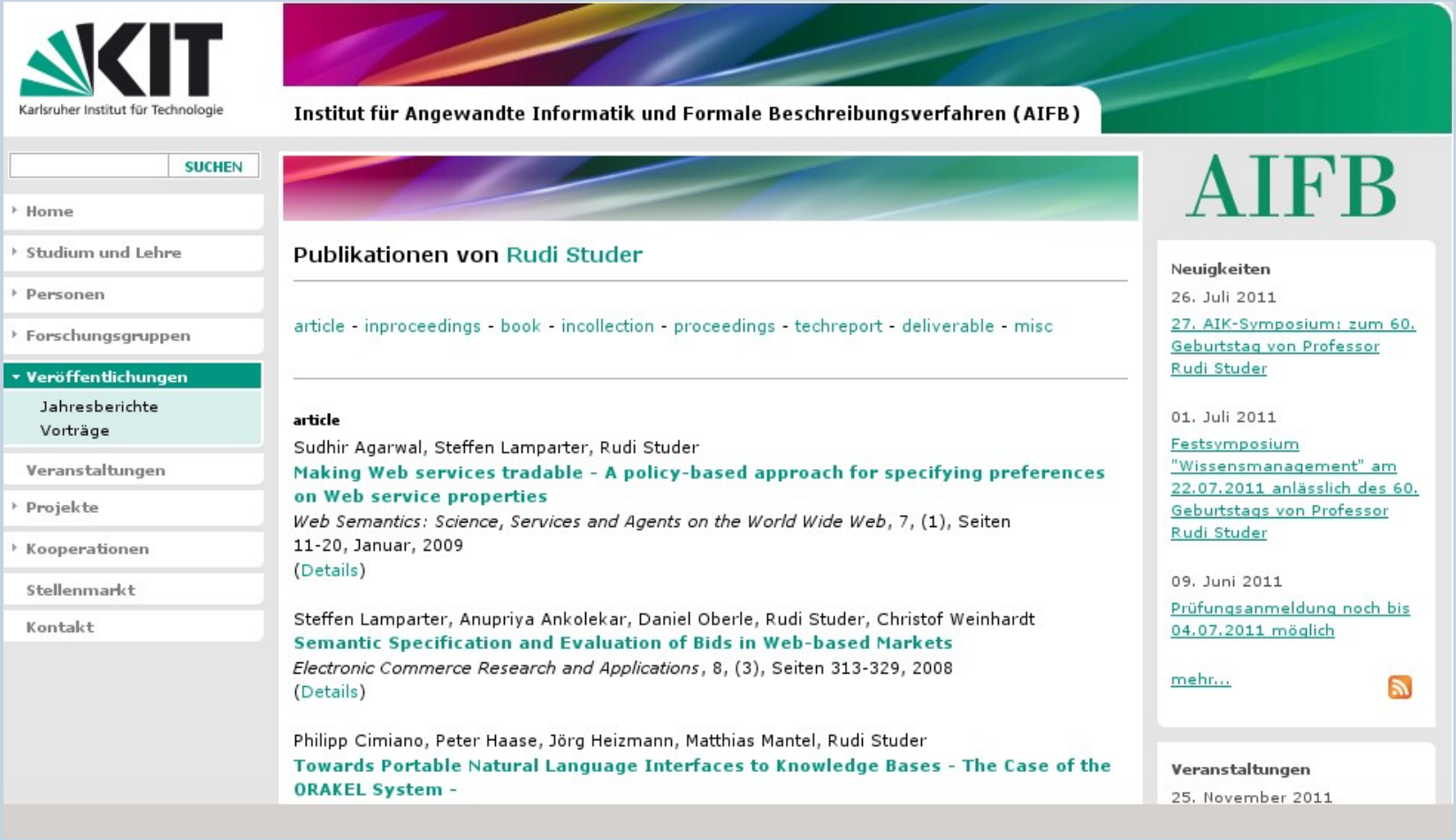
- Are these DB reads really needed?
- Good: Global queries
  - Aggregate data from many pages (“Show all upcoming events,” “How many cities are there?”)
  - Answer global questions (“What's the largest city?”)
- Bad: Local formatting
  - Fetch and process data for a single source (#show)
  - Complex result formatting (format=template)

Eliminating Local Formatting

- Local formatting expensive: complex template parsing, easily for hundreds of query result items
- Example: AIFB Portal publication listing



Eliminating Local Formatting: Example



Eliminating Local Formatting

- Publication data already known when editing source (i.e. publication page)
  → no need to rebuild it on all query pages!

- Solution:
  - Store complete, pre-formatted output string on source page (property of Type:Text)
  - Simply recall this text in all queries
    → Pre-expanded wiki text,
    no templates, no #show, no parser functions

Eliminating Local Formatting: Summary

- A way to escape Template Hell (at least at query time)
- Essentially a user-controlled, DB-based parser cache for snippets used elsewhere
- Some work needed to implement, requires understanding of wiki structure
- Harder to apply if item formatting includes non-local information (stale data problem: even source page refresh will not update the SMW database records!)

Optimising SMW
Step 3: Crazy Queries

SMW Queries

- Three stages:
  - (1) Page selection (query string)
  - (2) Data selection (printout parameters)
  - (3) Formatting
- Local formatting is a combination of (2) and (3): many queries, many templates, many parser functions
- But slow MySQL queries (see log) usually are based on (1)

Crazy Queries

- Example annotation model:

  <Bus line> Property:stops at <Bus stop>
  <Bus stop> Property:served by <Bus line>

- Example query:

  {{#ask: [[served by.stops at::Some bus stop]] }}

Crazy Queries

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Crazy Queries

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  <Bus line> Property:stops at <Bus stop>
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- Example query:

```
{{#ask:  [[served by.stops at.
          served by.stops at.
          …
          served by.stops at.
          served by.stops at::Some bus stop]] }}
```

Three Possible Solutions

- Stop such madness early on: limit query complexity
- Aggressively cache query results: Concepts
- Use a query engine that can handle this: RDF store

Limitting Query Complexity

- SMW has a number of parameters for this
- Set in LocalSettings.php – defaults:

```
$smwgQMaxSize = 12;
$smwgQMaxDepth = 4;
$smwgQFeatures = SMW_PROPERTY_QUERY | SMW_CATEGORY_QUERY |
                 SMW_CONCEPT_QUERY | SMW_NAMESPACE_QUERY |
                 SMW_CONJUNCTION_QUERY | SMW_DISJUNCTION_QUERY;
$smwgQMaxInlineLimit = 500;
$smwgQPrintoutLimit = 100;
$smwgQDefaultNamespaces = null;
$smwgQComparators = '<|>|!~|!|~|≤|≥|<<|>>';
$smwgIgnoreQueryErrors = true;
```

Concept Caching

- Concepts as “Virtual Categories”:
  SMW page selection queries that can be re-used in #ask
- Managed on pages in Concept: namespace
- May be pre-computed with maintenance script SMW_conceptCache.php
- Rationale: Usually very few queries are really “hard,” concepts allow manual control of what can be supported

Concept Caching: Example configuration

- In LocalSettings.php:

```
// Restict size of inline queries:
$smwgQMaxSize = 6;
$smwgQMaxDepth = 3;

// Allow larger concept queries
$smwgQConceptMaxSize = 20;
$smwgQConceptMaxDepth = 8;

// Hard queries rely on pre-computed cache (default):
$smwgQConceptCaching = CONCEPT_CACHE_HARD;
```

RDF Stores

- SMW can use RDF database systems instead of RDBMS to answer queries
- Special form of “noSQL” databases
- Different architecture, optimised for different query types
- More in tomorrow's talk “Connecting SMW to RDF Databases”

Optimising SMW
Step 4: Improve the Software

Do it Yourself (or find someone who does it for you)

- Instead of using complicated queries and formatting templates, write some PHP code to do it directly
- Help needed in making SMW more efficient
  - For example, to take advantage of object caching
- Some extensions need help to become more efficient
  - For example Semantic Drilldown

Optimising SMW
Conclusions

Summary & Conclusion

- Step 0: Configure MediaWiki properly for your site!
  (At the very least: install APC!)
- Step 1: Find out where your problem is (SMW?)
- Step 2: Escape Template Hell
- Step 3: Restrict or tame Crazy Queries
- Step 4: Develop your own Perfect Solution

Optimisation can be easy. Give it a try.

Further Reading

- http://www.mediawiki.org/wiki/Manual:Performance_tuning
  and the links in “See also” on this page, esp.:
  - http://www.mediawiki.org/wiki/User:Aaron_Schulz/How_to_make_MediaWiki_fast
  - http://www.mediawiki.org/wiki/User:Ilmari_Karonen/Performance_tuning
- http://www.mediawiki.org/wiki/Manual:Cache
- http://www.mediawiki.org/wiki/Manual:Configuration_settings#Cache
- http://semantic-mediawiki.org/wiki/Help:Configuration
  especially the section on Query Settings
- http://semantic-mediawiki.org/wiki/Help:Concept_caching
- http://semantic-mediawiki.org/wiki/Help:Using_SPARQL_and_RDF_stores