— FSE Blue Note* —
qvar: Meta characters in MathSearch

Moritz Schubotz

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In order to mark anonymous variables, MathWebSearch introduced a new XML element called `qvar`. This element might have content, but no attributes accoring to the initial definition at `https://trac.mathweb.org/MWS/wiki/MwsQuery`.

We analysed the behaviour of the [search pattern]-[math object] tuple matching by the MathWebSearch implementation downloaded from `https://github.com/KWARC/mws`. We identified three cases:

Case 1 Given a search pattern that does not contain any qvar elements: The tuple is a match, if the math object contains the search pattern as a subtree.

Case 2 Given a search pattern that contains one qvar: The tuple is a match, if the math object has an arbitrary non-empty tree structure at the position where the pattern has the qvar element.

Case 3 Given the pattern contains multiple qvar elements: In addition to case 2, matching subtrees must be the same if the content of the qvar element in the search pattern is the same.

In the NTCIR-11 Math-2 task, this definition was not communicated to the participants and it was a task for each participant to find a good interpretation of the qvar elements contained in the query.

1 Formal Definition

The qvar element can formally be seen as α equivalence ($\lambda x.x$ is α-equivalent to $\lambda y.y$)for XML sub-tree matching. Let s be the content MathML tree that represent the search pattern m the content mathml tree that represents the math object. We define a that s matches m if the following holds $\lambda q_1, q2 \dots q_n.s(q_1, q2 \dots q_n) \subset m$...

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2 Example

On the XML level `<a><qvar>x</qvar></a>` matches `<a><b /></a>` and `<a><c><d/>text</c><a>` but not `<a>text</a>` or `<a><e /><f /></a>`.

In the following example we visualize `<qvar>x</qvar>` via $?\{x\}$. The search pattern $\hat{\mathrm{H}}\,?\{x\} = E?\{x\}$ matches $\hat{\mathrm{H}}\,(a+b) = E(a+b)$ or $\hat{\mathrm{H}}\,\Psi = E\Psi$ but not $\hat{\mathrm{H}}\,\Psi = E\phi$.

*Inspired by the "blue book" in Alan Bundy's group at the University of Edinburgh, FSE blue notes, are documents used for fixing and discussing ϵ-baked ideas in projects by the FSE group (see `http://www.formulasearchengine.com`). Unless specified otherwise, they are for project-internal discussions only. Please only distribute outside the FSE group after consultation with the author.