Openmath

and

Editing

Wend Werner
Fachbereich 17
Universit" at–GH–Paderborn

Further applications of CA-systems:

1. Interactive Textbooks:

2. Structured Search in Mathematical Documents

$$\texttt{search}\ H^p(X)$$

$$\texttt{search}\quad \Delta f = 0$$

$$\texttt{search}\quad \sum_{i=1}^{n} \frac{\partial^2 f_i}{\partial x_i^2} = 0$$

$$\texttt{search}\quad \frac{\partial^2 f_i}{\partial x_i^2} = 0$$

$$\texttt{search}\quad \frac{\partial^2 f^i}{\partial x_i^2} = 0$$

Axioms:

- Adhere to SGML.
- Be quick enough as to facilitate interactivity.
- Mathematics is prone to unpredictable changes (affecting notation).
  Respect that.
- Be modular.

Ingredients:

- A lean DTD comprising (only) the necessary definitions for the graphical lay-out of mathematical expressions.

- A parser SGML-Code$\leftrightarrow$Openmath-Expressions respecting semantic content according to preselected Openmath-dictionaries.

Basic Process:

- A Mathematical Document:
  (Text(SGML), Math-Expr.(SGML),
  Openmath-Dictionaries)

- The Parser:
  (*Text(SGML)*, Math-Expr.(SGML), Openmath-Dictionaries)

  $\longrightarrow$

  (*Text(SGML)*, Math-Obj.(Openmath),
  Openmath-Dictionaries)

- An Application

- The Parser:
  (*Text(SGML)*, Math-Obj.(Openmath), Openmath-Dictionaries)
  $\longrightarrow$

  (*Text(SGML)*, Math-Expr.(SGML), Openmath-Dictionaries)

Example:

`search` $H^p(X)$ `and 46/cc`
resp.
`search` $H^p(X)$ `and 55/cc`

invokes the *FunctAn*– resp. *AlgTop*–dictionary and searches for expressions such as — in the second example — $H^{n-p}(X)$ which carry the same semantic attributes.

$$\texttt{search}\quad \Delta f = 0 \quad \texttt{and 35/cc}$$

invokes the *PartDiff*–Dictionary, parses $\Delta f = 0$ into Openmath-code ($\Delta f = 0$ now comprises the correct semantics), pipes it into a CA-system which expands this expression into several equivalent ones. The actual search then might become

$$\texttt{search}\quad (\Delta f = 0 \quad \texttt{or} \quad \sum_{i=1}^{n} \frac{\partial^2 f_i}{\partial x_i^2} = 0$$

$$\texttt{or} \quad \frac{\partial^2 f_i}{\partial x_i^2} = 0 \quad \texttt{or} \quad \frac{\partial^2 f^i}{\partial x_i^2} = 0)$$

$$\texttt{and 35/cc}$$

References

- ISO SC4WG6 discussion list, especially the workitem *Mathematics DTD*, via *http://mish161.cern.ch/sc4wg6/overview.htm*

- S. Collart, G. Gonnet, Structured Search in Mathematical Documents, *Euromath Bull., 2:1, 61–74, 1996*

- H. Lenzing (with input from W. Wiwianka and R. Timoney) Euromath as an Interface to Computer Algebra, *Report, 1992*

- B. von Sydow, Representing Mathematics in SGML: The Euromath DTD, *Euromath Bull., 1996*