OpenMath Meeting Pisa

James H. Davenport (minutes)

28–29 September 2002

Present: Stephen Buswell (Stilo), Antonio Capani (Explo-IT Research, Genova), Olga Caprotti[1], David Carlisle (NAG), Arjeh M. Cohen[2] (Eindhoven), Stéphane Dalmas (INRIA), James Davenport (Univ. Bath), Mike Dewar (NAG), Andreas Franke[2] (Saarbrücken), Marc Gaëtano (Univ. Nice & INRIA), Patrizia Gianni[1] (Univ. Pisa), George Goguadze[3] (ActiveMath), Michael Kohlhase (Carnegie Mellon), Stéphane Lavirotte (Univ. Nice), Winfried Neun (ZIB Berlin), Ralf Scholl (SkillsOnline, Heidelberg), Mika Seppälä (Univ. Helsinki), Barry Trager[1] (IBM), Jouko Väänänen (Univ. Helsinki).

1 Opening

DPC opened the meeting and described the changes to the agenda.

2 Mathematics Rendering In Current Browsers

DPC described the current support for MathML in current browsers. It was now reasonable to deploy web pages which included MathML. He demonstrated rendering presentation MathML using Internet Explorer plus Mathplayer, Netscape 7, Mozilla and Amaya. He also showed how Mozilla could render content MathML via an XSLT stylesheet. MCD asked about rendering expressions using `cysmbol` in Mathplayer. DPC explained that the default rendering was the content of the element. The only "hole" in browser support was that Amaya didn't support content MathML (or XSLT or Javascript). WRI had helped get MathML support working in Mozilla on the Macintosh.

DPC demonstrated how inline mathematics wrapped in Mozilla/Netscape but not in Internet Explorer. However lines would not be broken inside a `mrow`.

In Internet Explorer there was a problem that Microsoft behaviors (*sic*) only worked under HTML not XML! DPC's stylesheet handled this problem by taking MathML served as XML and turning it into HTML, but this led to a performance hit in Mozilla when rendering presentation MathML. The stylesheet

[1]Part Saturday and Sunday
[2]Sunday only.
[3]Saturday only.

would also transform content to presentation if necessary and transform elements in the XHTML namespace into unprefixed forms. SB asked whether you had to use the `mml` prefix. DPC said that you could use any namespace you wanted. The stylesheet was available from W3C.

There were security issues with downloading the stylesheet automatically in IE, so it was recommended to reference a local copy.

DPC reiterated that any file using his stylesheet had to be served as XML. For entities to work in XML requires a DTD. Unfortunately until recently the IE6 parser would not read the MathML DTD due to a bug in its XML parser. Moreover it is expensive to download large DTDs and in particular Mozilla will never download DTDs so they have to be installed by hand.

Unicode has a range of Mathematics characters in plane 1. IE cannot parse them and most browsers won't render them. The TEX and Mathematica fonts provide these symbols, and there are some free fonts available from Design Science.

DPC pointed out that other XML vocabularies could adapt his stylesheet to their own needs. He demonstrated this with SVG. MK had an example of an HTML page containing an SVG diagram annotated with MathML. This worked fine in Amaya because everything was rendered natively. In IE the SVG renderer didn't know how to invoke MathPlayer and so the grand plan was for the stylesheet to split the document up and hand the components off to the appropriate application. Unfortunately MathPlayer and SVG viewer didn't currently agree on units so this didn't currently work! SB asked if this could ever work in general. DPC explained that there had been some discussion about developing an API for interoperation between plugins but nothing had come of it so far.

3 Advanced Learning Technologies

MS introduced a paper by himself and JV on an "Advanced Learning Technologies" Proposal to FrameWork VI. He noted that OpenMath/MathML had been going for 10 years, and we now had practical results: MathML can be used for the display of mathematics. In his view, the time had come to apply this. He commented that we had:

- the right balance between ease-of-use and versatility;
- the technology for developing powerful eduational applications;
- technology allowing one to create adaptive multilingual systems.

There has been an existing project at Helsinki. There are 20 instructors at Florida State University teaching calculus, all developing their own on-line materials. There was no sharing, partly due to the n^2 problem. Their efforts also had no permanency. He proposed a "Course Content Dictionary" (CCD) which would define the content of a specific course.

He reminded the meeting that the EU had allocated 3,000 MEuro for "Information Science Technologies", in which "Electronic Learning" is a major component. Projects may be 10 MEuro. He thought that there should be:

- a core group of companies producing on-line materials, professors writing CCDs and project management;
- content generation and on-line testing and tools, involving (Open) Universities and large companies (Siemens, Nokia etc.);
- user support in as many countries as possible.

MCD pointed out that every university had a different syllabus, so that material re-use had been a major problem in previous initiatives. MS noted this, and said that he was envisaging small units which could be fitted together in (by?) different universities to their own needs. To make this feasible (i.e. not "cut/paste in Word"') one needed genuine content markup. MS gave the analogy of cellular telephones, when there was a European standard for short messages, but not an American one. The Wall Street Journal had asked why America was the only continent not to use them. MK asked why MS was proposing a new standard: he mentioned IMS and OMDoc. MS replied that he was not against using existing technology, but he had found an appropriate technology so far. MK replied that there would be strong resistance to yet another standard. He introduced his concept of structured problems, where the system would, if the student could not, break down the problem into sub-problems.

MS pointed out that Finland had two official languages, so that multilinguality was essential. In the EU this would be a strong selling point. AC asked what the main goal was: CCD development or use? MS said that the main goal was to develop and promote education material sharing. He thought that tools existed, but his main priority was developing content. MCD asked what the long-term business plan was: would Universities continue to pay licence fees. MS said that he believed that (at least initially) the material should be free to Universities. However, publishers were interested in selling textbooks, and would be willing to pay to have their books connected to such problem databases. MK commented that his past experience was that it was about 10 times as expensive to create mathematical content-based courseware as it was to create Powerpoint courseware. He asked the fundamental economic question: is it worth an instructor's time to create courseware? MS commented that M.I.T. had made a very ambitious statement about free availability of their courseware, but in practice almost nothing was available. JV said that he and MS had discussed the problem of rewarding (not necessarily financially) instructors who put "extra effort" into coursework.

4 SkillsOnline

RS introduced "Teaching Scientific Computation through the Web", originally taught by Gaston Gonnet in the 5th semester at ETHZ. The requirements were:

- to deliver the material in a a completely web-based form;
- instant automatic feedback;
- minimal hardware/software requirements: in particular a normal browser with no plug-ins.

The initial approach was through applets, but this was too expensive (in terms of authoring time), so an XML-based approach was taken instead. In 2001/2 the paper-based exercises were completely eliminated: 27 interactive exercises were written by 5 students and 3 assistants. He gave a demonstration — online access could be granted by giving RS (`mailto:rasch@skillsonline.de`) data for a password. It was pointed out that the syntax of the students' input did not have to be in strict Maple syntax: for example the system translated `2x` to `2*x`.

MK asked whether RS had looked at work done in the 1980s in similar areas. RS had not. RS emphasised that tutors could programme in specific feedback for particular wrong answers. SB asked if they had looked at AMC's *Algebra Interactive!*: one of RS's colleagues had. RS thought that the level of detail in the feedback was greater than other systems, and this was key to retaining student motivation.

He concluded with the following URLs: `http://linneus20.ethz.ch:8080` and `http://linneus20.ethz.ch:8093/W3T/approximation.jsp` etc.

5 ActiveMath

GG spoke to this item. ActiveMath is a Web-based learning environment. This has a "learning model" in which the user's preferences (e.g. language) as well as competencies (based on the user's self-assessment, which can be updated) are recorded. The key concept is a "book", which can either be pre-recorded by a lecturer, or created by a student from the content database. The currently available set includes one chapter of *Algebra Interactive!* (translated into OMDoc). The process of book creation involves selecting topics, and then the course generator program selects all the pre-requisites (not defined as known in the user model). The mathematical and pedagogical dependencies are hard-coded in the metadata of the learning items. This book creation is done on the server side.

The system tracks the amount of time the user spends on each item. There is an option called "eye-tracker" in which items are only visible if moused over. Prolonged lack of mouse movement implies a "coffee break". Correct answers to exercises update the model's view of the user's knowledge of the particular concept. The system is linked to the proof planner Omega, which the student can try to use. Where appropriate, existing OpenMath CDs are used, after translation into OMDoc theories (with CMPs present in a clickable form). The user (student or teacher) can add notes to a page in his books, either private or world-readable. There is also a textual search facility, which produces all the items containing the word (sorted by category: Definition/Example/etc.).

The next phase includes the deisgn of a generic architecture for interactive exercises and the evaluation of a user's responses. Another task is to have different presentations: book, article or slide. JV asked what the structure was like behind the book. GG replied that the book consisted of items, whose metadata provided mathematical and/or pedagogical dependencies. In the ActiveMath extension of OMDoc, an item can have more than one classification, e.g. a definition can also be an example. It is the symbols from CDs (e.g. `monoid`) that provide the connection between items.

6 Mathematical Applications Involving Non-Linear Information for Networked Education

SL spoke to the MAINLINE project. He presenting a diagram showing the qualities of various ways of displaying mathematics on the Web. Presentation MathML was generally the best, but there were problems with fonts, diagrams and printing (at PDF-like resolution). He claimed that SVG was essentially "PostScript for the Web". It is an XML Language and a W3C recommendation. He was using the Batik tool from `arache.org`. This supports interaction of the zoom/rotate variety, but more complicated interactions are scripted into the SVG document. This tool is a JAVA program which can run as a plug-in for Mozilla, Netscape and IE. This has many advantages: vectorial, interactive, possible inclusion into drawings, conversion to PDF (via the FOP program), but it was noted that it was heavier than MathML (but smaller than images). On-the-fly `gzip` is mandated by the W3C recommendation. He then updated his diagram to show that SVG was probably the best option.

`http://www.schemasoft.com/MathML` was an existing MathML-P to SVG converter. Why not OpenMath to SVG? He presented a program Fixidea which could convert OpenMath or MathML-C into other formats, based on "resource files". The formats were part of "Components", which including displaying components, editing components and content components, such as graphics or mathematics. They are currently working on navigation in formulae.

The tool currently uses LaTeX fonts, converted from TTF format to SVG. In the future they would like to be able to mix graphs, diagrams and formulae. It currently supports MathML-C (apart from `csymbol` and annotations). It needs to support all rendering types, e.g. for division. `http://mainline.essi.fr/wiki/bin/view/Fixidea`. SB asked if this used any Jome work, to which the answer was affirmative. MK asked about extensibility, since this was fundamental to OpenMath. This has not yet been considered, but CDs should be related to Fixidea resource files. For the complex example he showed, 75% of the SVG file was font information.

AC asked about navigation and editing. SL replied that both depending on the fundamental concept of selection, which is what is currently being worked on. GG asked for clarification of the relationship between the SVG and the underlying structure. DPC said that embedded fonts were good for portability,

but bad for bulk. He thought most people had the TEX fonts available. SL showed that there were references to TEX fonts in the SVG document. GG worried about the cost of editing, but SL pointed out that rendering changes were done incrementally.

SL also demonstrated an engineering diagram containing several formulae, done by having the diagram in a master component which pointed to mathematical components.

7 OpenMath Tools

OC spoke to this item. Several weeks ago she sent out a message asking for OpenMath tools. She only had five replies. MK said that this was not bad, but OC pointed out that he had not replied. He thought he had. **MK**

Libraries RIACA Java and JSP (tag) libraries; OMDoc Jdom library; INRIA C and Java Libraries; CORBA Library from LBA. It was felt that the NAOMI library was obsolete.

Editors Jome and Jome extension. GG pointed out that Jome was released under LGPL two days ago. QMath converts its syntax into OMDoc. MK said that they had released an OMDoc (and therefore OpenMath) mode for emacs. SB said that STARS should really be classed here.

Rendering MR had done some work. Brian Palmer had an OpenMath → MathML stylesheets, as had DPC, MK and SMW. GG said that they had a LATEX → SVG converter.

Miscellaneous Various style sheets, e.g. DPC's CD checker (now on the OpenMath CD site).

Markup Languages OMDoc, MathBook (a DocBook/OpenMath mixture), Mathbroker (a WSDL generalisation).

Backends GAP and Axiom bi-directionally. MK can convert Mathematica to OMDoc but not *vice versa*. MCD reported that Reduce had Content MathML support. MK reported that some MathWeb theorem provers supported OpenMath. CoCoA, linbox and Cinderella are in the works.

High–Level OpenXM from Fujitsu (talks to ASIR/RISA). The Logic Broker Architecture (Genova).

Math. Services JavaMath API; OpenXM; IAMC (internet Accessible Mathematical Communication).

DPC made the general comment that OpenMath was hiding its light under a bushel, unlike, say, MathML. MCD said that everyone should fill in OC's form via the Internet connection before they left. **All**
MCD asked that OC should circulate the URL for her form. **OC**

There was a discussion of how much to automate. MK thought that human editing was necessary. He offered to work with OC to incorporate his Chicago tutorial where appropriate. **MK/OC**

8 OpenMath Standard

DPC introduced this item and its agenda.

8.1 `OMBIND`

DPC reminded people of AS[4]'s e-mails on the subject, suggesting that the currying rule be abolished. DPC said that the original drafters had `OMBIND`s such as $\forall$, $\exists$ in mind, but OpenMath standard allowed for the binder to be an arbitrary OpenMath construct. MK pointed out that many people, e.g. those using dependent type λ-calculi, could not support currying, and the NuPRL group were using this as a reason (excuse?) for not using OpenMath. DPC said that STS should be extended to allow the `nary` descriptor on binders, but JHD pointed out that `nassoc` was really what was intended.

Simply deleting the two paragraphs leaves dangling the question of what happens with repeated variables. He proposed to add text specifying that all but the last occurrence be α-converted to new names: this is equivalent to the semantics of the current text. OC pointed out, and JHD concurred, that the definition of "new" should be "does not occur in the body of the **binding**".

The change to the OpenMath standard was approved. JHD had to update the definition of STS, and the relevant `.sts files`. **JHD**

8.2 Arbitrary XML in OpenMath `OMATTR`

MCD raised this issue, which had been started by SMW[5]. He reminded the meeting of the format for `OMATTR`: an `OMS` as the name, and any OpenMath as the value. SMW wants to have arbitrary XML as the value, and MCD pointed out that MathML would allow arbitrary XML in an `annotation-xml` term. The `altenc` CD encodes the XML as a string, which means that the XML special characters have to be encoded as entites, which are unfortunately illegal in the OpenMath standard (probably a bug). Even fixing this would mean that the XML tools still would not understand the XML. Some-one had suggested a "reference" CD, but this loses the integrity of the object, and XML tools would not understand this.

Watt/So had proposed a pseudo-CD called XML, which could be used to point out that the value was XML. MCD proposed a new symbol `OMDATA`, with two fields, an encoding (e.g. `"MathML-Presentation"`) and a value. MK worried about using a string as the encoding, and would rather have a symbol. MCD accepted this point.

[4]Andreas Strotmann: Florida State University.
[5]Stephen Watt, University of Western Ontario.

There was a debate about what this meant at the abstract OpenMath level. MCD pointed out that the binary encoding question needed to be resolved. He also said that the OpenMath standard used a restricted subset of XML, so that the child of `OMDATA` could be legal XML, but not legal OpenMath-XML. Since all OpenMath applications *must* support the XML encoding, this would mean that every OpenMath application would need a full XML-encoding, and that the DTD would not longer be a complete validation. MCD presented a spectrum of changes.

1. Support a minimal set of entities (DPC suggested that this meant the five pre-defined entities) in OpenMath strings — this should probably be done anyway — and use `altenc`. This would be a minimal change, but would not deploy the power of XML tools.

2. Allow any XML, but only mandate that applications handle the existing subset. This would probably need a new `OMERROR`, and could be a source of great confusion.

3. Drop all restrictions on XML encoding, which would require all OpenMath applications to have a full XML parser, but would allow us to make the best use of XML tools. The original restriction was made when very few XML parsers existed. This change would probably require a new major version.

AMC asked whether we could force `OMDATA` only to occur in attributes. DPC said that the DTD could do this. SB worried about a change to schemata, but others thought that this would be possible. JHD proposed that we adopt route 1, since it was basically a bug fix, and let route 3 lie on the table until such time as it was forced by other changes. SB pointed out that, while SMW was talking about MathML, this was really a general way to put non-OpenMath attributions on OpenMath objects.

Route 1 was agreed. The Watt/So proposal was rejected on the grounds that it was not really at the abstract OpenMath object level. OC and AMC thought that `OMB` was meant to solve the problem of putting non-OpenMath data with OpenMath objects. OC suggested putting `mime-type` attributes on `OMB`. MCD pointed out that `OMB` could occur anywhere, whereas, in his proposal, `OMDATA` could only occur in an attribute, and, as JHD pointed out, could therefore be ignored. Others pointed out that the ignorer would still need to be able to parse to the end of the ignorand.

SB thought that we now knew what the questions were, and moved the next question. This was carried.

8.3 Sharing

MK spoke to this. OpenMath objects could be very large, e.g. Bologna had single MathML-C (which could be OpenMath since they only used `csymbol`) which were gigabytes long. Much of this was caused by the repeated appearances

of sub-formulae. He therefore proposed adding an `OMR` reference objects, to let one encode these as directed acyclic graphs (using the `xlink` mechanism). MK emphasised that this was a change to the XML (and comparably to the binary) encoding, but not to the object model, which was still about trees.

He noted that acyclicity was a non-local constraint, which was hard to enforce, particularly if the `OMR`s pointed into other `OMOBJ`s. MK proposed that `OMR`s only be allowed on a subset of objects. Others queried this, and it was proposed that they be allowed on all, except `OMOBJ` (which would be equivalent to nesting `OMOBJ`, which is not allowed). However, it should be legal to put `id=` on `OMOBJ`, but make it illegal for `OMR` (as opposed to any other linking mechanism) to refer to them.

MK pointed out that this meant that the encoding was more powerful than the data model. One could make the data model be one of DAGs, but, as JHD had previously pointed out, this changed the semantics of many objects, e.g. intervals. Fateman had proposed that cyclic data structures should be allowed, as in Lisp. This would allow the encoding of periodic continued fractions etc. This would be a major change to many OpenMath applications. He characterised his proposal as conservative, the data model change as innovative, and the change to cyclicity as radical.

AC asked why *we* were trying to solve an XML compression problem. MK said that W3C had done this, via `xlink`, and all he was proposing was to import this mechanism. SB said that changing `id=` to `rdf-resource` would allow links into different documents. DPC pointed out that there was no concept of "document" in the OpenMath standard. MK formally proposed his model, as amended, and allowing `uriref` as well as `href`. JHD said that, having opposed the previous proposal, he was in favour of this conservative proposal. The meeting approved this in principle.

9 Kinds of FMP

JHD spoke to this discussion item — he was not making a concrete proposal. JHD's slides will be on the Web.

MK said that he was in favour of this proposal, and had a "drop-in" solution in terms of OMDoc2 (which only existed on his laptop). JHD welcomed this. **MK/JHD**

10 Namespaces

DPC said that the DTD was a grammar for an XML language, but there was also a grammar in the standard itself in terms of characters, which was MCD's point that OpenMath was restricted XML. OC had written an XML schema (DPC himself considered XML-Schema a loathsome language). Should a new version of the OpenMath standard emerge, we could consider replacing the character grammar by a schema.

While we might consider making every OpenMath application have a full

XML parser, making it have a Schema processor was unrealistic in the light of todays technology. This is related to the debate about making more use of namespaces (see his slides at the OpenMath Linz 2001 meeting). The standard currently permits, but does not recommend, `om:OMS` rather than `OMS`. We could use one namespace per CD, which would replace

```
<OMS name="times" cd="arith1"/>
```

by `<arith1:times/>`. If we then replaced CDs by schemata, then we would lose the existence of a global grammar. Instead one could use

```
<OMS name="arith1:times"/>
```

but this is using namespace syntax in "the wrong place". XSLT and xpath do this, which causes great confusion. In particular, the namespace document implies that the prefixes can be α-converted, which would be difficult/impossible to do inside strings. His main point was that decisions on this need to be taken *before* a schema was written.

MK proposed going to XML Qnames, which were essentially multiple colon-delimited names. DPC pointed out that this would allow Unicode characters in names. SB had rewritten the `arith1` CD in RDF, and found that one needed at least one namespace per CD to place FMPs relating different symbols.

MCD proposed that we now discuss the XML issue. MK pointed out that his sharing proposal doubled the length of the character-production grammar. SB mentioned the MathML solution: XML definition (schema or, in MathML's case, DTD) + side conditions. This meant that one level of validation was available "out of the box". DPC said that we would almost certainly wish to drop certain restrictions, such as the restriction to UTF8, since parsers also understood, say, UTF-16. There was a discussion of compatibility between current XML encodings and a new one.

OC asked if this meant our Fujitsu users would no longer see Kanji: the consensus was that not. It is the viewer that controls this, not the XML encoding. SB summarised the debate as follows

- Do we want to make the XML DTD (or a schema) into the reference syntax for the XML encoding?
- If so, which side-conditions do we want to maintain. MCD pointed out that some side-conditions referred to the reference model, e.g. variable names, and changing this would imply a chnage to the reference model and the binary encoding.

MCD said that many items were stalled until some such decision was made. JHD proposed that we should have a new encoding *in addition to* the current XML encoding, and that a group should make such a proposal. MCD felt this was insufficient to support his proposal to allow arbitrary XML in annotations since this involved a change to the object layer and hence to all encodings. MK said that OpenMath-2 could well have a different encoding than OpenMath-1.

SB said that almost any change we had discussed today meant a new version of the standard. MCD asked whether there was a mandate to pursue OpenMath-2? DPC said that many of the things in TEX were sub-optimal, since it had been essentially frozen since 1982, and totally so since 1989, but it had many more users, and the users supplied far more to the community than the OpenMath ones. JHD pointed out that we had established that the OpenMath abstract model was too tied to the XML encoding, and the charter for the group should include the desire to minimise this. The move to establish a working group was carried. SB said that the obvious suspects were SB, OC, DPC, MCD, MG and MK, and it was decided that MCD, as a member of the OpenMath Steering Committee, would act as convenor. **Group**

There was a question of time-scale. MCD pointed out that it would have to be circulated well in advance of the next meeting, which was probably Easter 2003. SB said that the group would propose a timescale. OC asked whether we should amend version 1.01 of the standard about binding etc. JHD proposed that, since these were changes to the reference model, they should be formally adopted, even if the process of formally adopting a revised OpenMath-1 was overtaken by events. **DPC**

11 Other projects

11.1 MoWGLI

AMC spoke to "Mathematics on the Web: Get it by Logic and Interfaces" at `http://www.mowgli.cs.unibo.it`. He said that they were using Content MathML, rather than OpenMath. OC explained that they thought that their `csymbol`s were more precise than OpenMath's. JHD noted that they have never communicated with him over this issue. MK hopes that this is less of an issue now. This project started March 1st, 2002. With HELM, they can translate Coq into MathML and display it in a (largely) human-readable form on the Web. He likened it to a "Napster for formal proofs". They are also making much progress on metadata for formal proofs.

11.2 MKM

JHD spoke to the Mathematical Knowledge Management network, which was a 15-month network started on 1 September 2002. He emphasised that a goal for the project, from the EU's point of view, was to cause to be submitted a large Framework 6 project in the area of Mathematics and the Semantic Web. He stressed "cause to be submitted" since it was not clear that all current members would be part of a Framework 6 consortium, and conversely such a consortium would probably have to include big industry, whereas the MKMnet consortium was deliberately publisher-free.

11.3 Math-Net

WN spoke to the use of OpenMath and MathML in the Math-Net project. Math-Net was established at the ICM in 1998, and is part of the IMU. `http://www.math-net.org/charter`. Part of Math-Net was that every institution would have a standard Math-Net page, which had a fixed layout and metadate, and a restricted (English) vocabulary. There could also be an alternative page, which could be in any language. The standard page was produced by Math-Net Pagemaker to generate metadata etc. according to an RDF-Scheme extending Dublin Core. There is also a Math-Net navigator to find such pages. There is also a Σ search engine to run across these pages. This can analyse TEX, PDF, PostScript and HTML. Adding OpenMath and MathML would be important, and would also give access to courseware etc. They were having the obvious problems with presentation MathML.

11.4 Advanced Learning Technologies

MS spoke to this, continuing the discussion from the previous day. He stressed that this was a proposed FP6 Integrated Project. He wanted, and this project would provide the opportunity, to use the tools already devloped in a serious application. The core group would be Helsinki, Eindhoven, INRIA, SkillsOnline and others. He invited other to join the project in any rôle by `mailto:Jouko.Vaananen@Helsinki.Fi` with a copy to him. **Interested**

12 Content Dictionaries

12.1 Licencing

MCD presented a draft licence for CDs. This was adopted with some minor changes to ensure that it covered STS files etc.

12.2 JHD

JHD spoke to several new CDs.

- He first discussed polynomial CDs (in the extra view). AMC asked how one extracted the i-th element of a `factored` object. JHD had intended to use Xpath.
- He then spoke to `transc2` and `transc3`. `transc3` contains the multivalued versions of the elementary inverse functions. AMC asked why `arctan` appeared in several places. JHD replied that `transc1` contain the one argument/one value version, `transc2` the two argument/one value version, and `transc3` the one argument/multiple values version.

- He mentioned the `list2` CD, which had been expanded following suggestions from PL[6], to include functions like `reverse`.
- He then introduced the `logic3` CD, which contained proof/deduction symbols for propositional and predicate calculus. He explained that this was a first stab at moving OpenMath closer to theorem provers. MK said that he had other things in this area.
- JHD then spoke to special functions. He pointed out, in the context of Ei, that the Abramowitz & Stegun text was very vague, and called for a formal definition of "analytically continued acroos the complex plane slit along the negative real axis". MK thought that JHD had no option but to write several CDs.

JHD called both for new CDs, and for "missing functionality" comments, as PL had done, and he had responded to. MK asked whether JHD would accept OMDoc CDs. JHD said that CDs had to be in the OpenMath standard format, but he would be delighted to receive CDs exported from OMDoc.

12.3 CDs: some new ones, some comments, some questions and an editor

AMC spoke to this.

- He asked why there was `left_compose` in `fns1`, but not `right_compose`? JHD replied that this was for mathematical consistency, and there was a `right_compose` in `fns2`.
- The introduction to `range` says that `range` contains image, but the FMP says the converse.
- There is a mispselling: "whos" for "whose".
- `CDUses` uses the short form of a CD. How does one find the true location of the CD. The general consensus was that this was consistent, though possibly wrong. There was a need for some resolution mechanism, possibly namespaces.
- In his permutation CD, he had initially two constructors `list_perm` and `cycle_perm`. But really a permutation was a bijection from a finite set to itself. Furthermore, this set should be labeled. How does one do this? MK responded that OpenMath CDs did not have the right infrastructure for this, which was one reason he was working on OMDoc.

  MK and DPC thought that there should be several CDs: one for list-represented permutations, cycle-represented permutations and bijection-represented permutations, as JHD had done for polynomials.

[6]Paul Libbrecht (Saarbrücken).

- AMC asked what a constructor was. He gave as an example the `group1` CD from Andrew Solomon. There was `group` which took a set of generators, but `declare_group` took a set and operators. The second was described to be a "constructor". MK said that this called out for the record extension he had proposed in Nice. MG said that almost all modern programming languages included such a construct, and he thought that there was a view against having programming in OpenMath. OC said that a Σ-type was all that was needed.

- His `plangeo1` CD used variables in a different way, e.g.

```
<Example>
Given two lines  l and m,  a point  A  on l and m
is defined by:

<OMOBJ>
  <OMA>
    <OMS cd="plangeo1" name="point"/>
    <OMV name="A"/>
    <OMA>
      <OMS cd="plangeo1" name="incident"/>
      <OMV name="A"/>
      <OMV name="l"/>
    </OMA>
    <OMA>
      <OMS cd="plangeo1" name="incident"/>
      <OMV name="A"/>
      <OMV name="m"/>
    </OMA>
  </OMA>
</OMOBJ>

</Example>
```

  Was this correct, and where were things bound? He had four such CDs, and hoped that they would soon be useful for Cinderella. He would like add objects such as `coordinatise`. Then would define the ideal of the geometrical configuration. AF asked why these variables weren't in some form of binding. JHD and DPC wondered much the same thing. **JHD,AMC**

- AMC has, but it had stopped working today, an editor for CDs. This was a Java program.

He also had a list of new developments in OpenMath dissemination.

- RISA/ASIR supports OpenMath.

- CoCoA will soon support OpenMath. They want a C++ library: INRIA has written one. Giromini[7] and Saunders[8] also want one.
- The exact linear algebra library under construction intend to support OpenMath.
- Cinderella will support OpenMath.

13 Thematic Network Business Meeting

MCD took the chair.

13.1 Review

This will be in Luxembourg in December, and will probably take about half a day. MCD asked for suggestions about what should be prsented. OC thought we should demonstrate the on-line version of the standard. MK thought that we could use MBase to render the CDs. MCD said that the real problem was browsing CDs, and quoted AMC's problems with `right_compose` earlier. OC said that dissemination was an important task in the plan. MK said that some-one should go through `citeseer` to look for OpenMath citations. OC had done so. OC mentioned MK's tutorial at the MathML conference (there was also hers at the Calculemus 2002 Autumn School). MCD thought that consolidating OC's work on OpenMath tools and applications would provide evidence of the wide range of OpenMath activities. It was agreed that the team would be MCD, JHD and, preferably, some-one from Saarbrücken.

13.2 Next Meeting

The next meeting will be in Eindhoven, probably the week after Easter (19–21 April 2003). The Dutch Mathematical Congress is 1–2 May. AMC is not available before March 31.

There was some debate about the length: MCD pointed out that MONET + OpenMath with the new standard draft would easily fill three days.

MCD said that the next round of cost statements would be due before the next meeting, and that MONET cost statements were due imminently. **Site leaders**
DPC asked people for their slides, by some means or other. **Speakers**

[7] Saarbrücken `corrado@ags.uni-sb.de`.
[8] Delaware