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1 Introduction

We will show how to semantically mark up mathematics in the SᴛEX format [Koh08] and how to convert it into OMDoc [Koh10].

We have some mathematical material in which will serve as example content. In the rest of this section we will explain the setup of the example and present an approach to automation of the OMDoc conversion via Unix Makefiles.

1.1 The Setup

Module 1.1[setup]: The source of this note is contained in the file `paper.tex`. We call it the **target**, since formatting it with LᴀTEX will generate the main document. The content in and comes from included files `continuous.tex` and `differentiable.tex`, we will call them **module**s, since they may be used (i.e. included) by other target documents as well.

As the modules are built for inclusion into other documents, they are not self-contained:

1. they do not contain a LᴀTEX preamble and `\begin/\end{document}`, and
2. they may depend on other modules, whose semantic macros they need to include,
3. to facilitate this a module file `modf.tex` comes with a "semantic macro short form" `modf.sms` that can be included without generating output in the PDF.

This will have consequences for the automation. Concretely, the module on differentiable functions in depends on that for continuous functions in . Both of them depend on modules for real numbers, sets and functions that we do not want to cover in this note. We assume that they have already been marked up with the same methods as we describe here and are accessible to us and call them **background module**s. In our setup we keep them in the subdirectory `background`.

1.2 Formatting and OMDoc conversion

To format an SᴛEX document — i.e. to produce a PDF file from the SᴛEX marked-up sources — we only need to run the `pdflatex` program over the target document — assuming that all modules (regular or background) have semantic macro short forms.

To convert an SᴛEX document to OMDoc, we need to run `latexml` over it, post-process the result by `latexmlpost`, and finally massage away all remaining LaTeXML islands with a stylesheet, see [**?**] for details.

1.3 Makefile-based Automation

As the conversion to OMDoc is rather complex (the programs in the three steps take a variety of options), we support an automation by Unix Makefiles. There are three main `make` targets.

`make omdoc` will trigger the OMDoc transformation of the target document.

that the BUTFILE variable is set to `pre.tex` and `post.tex`, so that they are not converted. In the directory `background` we have followed good practice by establishing a phony

2 Mathematical Content

2.1 Calculus

We present some standard mathematical definitions, here from calculus.

2.1.1 Continuous Functions

Module 2.1[continuous]: **Symbol** continuousfunctions: **Symbol** ContRR:

Definition 2.1 A function f is called **continuous** at x, iff for all $\epsilon > 0$ there is a $\delta > 0$, such that $f(x) - f(y) < \epsilon$ for all $x - y < \delta$. It is called **continuous on** a set S, iff is is continous at all xS, the set of all such functions is denoted with $\mathcal{C}^0(S, T)$, if $f(S)T$.

2.1.2 Differentiable Functions

Module 2.2[differentiable]: **Symbol** difffunctions: **Symbol** DiffRR:

Definition 2.2 A function f is called **differentiable** at x, iff for all $\epsilon > 0$ there is a $\delta > 0$, such that $f(x) - f(y)x - y < \epsilon$ for all $x - y < \delta$.

2.2 A Theory Graph for Elementary Algebra

Here we show an example for more advanced theory graph manipulations, in particular imports via morphisms.

Module 2.3[magma]: **Symbol** magbase: **Symbol** magmaopOp: **Symbol** magmaop:

Definition 2.3 A **magma** is a structure $G, \circ$, such that G is closed under the operation $\circ G, GG$.

Module 2.4[semigroup]:

Definition 2.4 A magma $G, \circ$, is called a **semigroup**, iff $\circ$ is associative.

Module 2.5[monoid]: **Symbol** monneut: **Symbol** noneut:

Definition 2.5 A **monoid** is a structure $G, \circ, e$, such that $G, \circ$ is a semigroup and e is a **neutral element**, i.e. that $(x \circ e) = x$ for all xG.

Definition 2.6 In a monoid $G, \circ, e$, we use denote the set $xSx \neq e$ with S^*.

Module 2.6[group]: **Symbol** ginvOp: **Symbol** ginv:

Definition 2.7 A **group** is a structure $G, \circ, e, i$, such that $G, \circ, e$ is a monoid and i acts as a **inverse**, i.e. that $(x \circ i(x)) = e$ for all xG.

Module 2.7[cgroup]:

Definition 2.8 We call a group $G, \circ, e, i$ a **commutative group**, iff $\circ$ is commutative.

Module 2.8[ring]: **Symbol** rbase: **Symbol** rtimesOp: **Symbol** rtimes: **Symbol** rone:
importing module monoid via $rbase \mapsto G$, $rtimesOp \mapsto \circ$, $rone \mapsto e$, end import**Symbol** rplusOp: **Symbol** rplus: **Symbol** rzero: **Symbol** rminusOp: **Symbol** rminus:
importing module cgroup via $rplus \mapsto \circ$, $rzero \mapsto e$, $rminusOp \mapsto i$, end import

Definition 2.9 A **ring** is a structure $R, +, 0, \cdot, 1, -$, such that $R^*, \cdot, 1$ is a monoid and $R, +, 0, -$ is a commutative group.

3 Conclusion

In this note we have given an example of standard mathematical markup and shown how a a SᴛEX collection can be set up for automation.

References

[Koh08] Michael Kohlhase. Using LaTeX as a semantic markup format. *Mathematics in Computer Science*, 2(2):279–304, 2008.

[Koh10] Michael Kohlhase. An open markup format for mathematical documents OMDoc [version 1.3]. Draft Specification, 2010.