kohlhase-omdoc — formula report

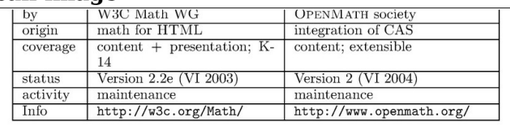
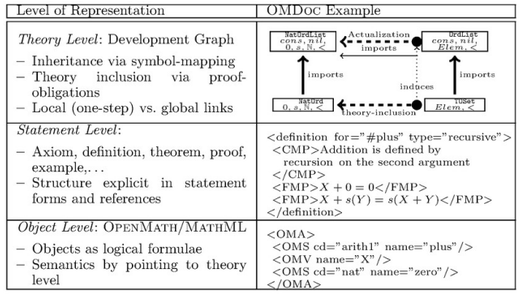
459 inline formulas (section omitted; 4 did not render), 6 display equations, 103 tables, 271 unrecovered image regions.

Display equations

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_ EQ0004 (26.1) **[conf 0.035]**	297	■ 0.035 ● U|+44	\backslash \text { CSum\{k\}1\infty\{\Cexp\{x\}k\} instead of } \backslash \text { sum_\{k = 1\}^ }{ }_{1} \text { infty x^k }	*(not rendered)*	\CSum{k}1\infty{\Cexp{x}k} instead of \sum_{k = 1}^\infty x^k
kohlhase-omdoc_ EQ0005 **[conf 0.092]**	309	■ 0.092 ● U|+105	\begin{figure} \[\begin{aligned} \left.\mathcal{R} \frac{\mathbf{A}: \mathbb{B} \rightarrow \mathbb{C} \quad \mathbf{B}: \mathbb{B}}{\mathbf{A B}: \mathbb{C}} \right) & =\frac{\frac{\forall X \cdot \mathbb{B}(X) \Rightarrow \mathbb{C}(\mathbf{A} X)}{\mathbb{B}(\mathbf{B}) \Rightarrow \mathbb{C}(\mathbf{A B})}}{ \mathbb{C}(\mathbf{A B})} \quad \mathbb{B}(\mathbf{B}) \ \ \mathcal{R} & \left.\frac{\forall X_{\mathbb{B}} \cdot \mathbf{A} \quad \mathbf{B}: \mathbb{B}}{[\mathbf{B} / X] \mathbf{A}}\right)=\frac{\forall X \cdot \mathbb{B}(X) \Rightarrow \mathcal{R}(\mathbf{A})}{\mathbb{B}(\mathcal{R}(\mathbf{B})) \Rightarrow \mathcal{R}([\mathbf{B} / X] \mathbf{A})}{\mathcal{R}([\mathbf{B} / X] \mathbf{A})} \quad \mathbb{B}(\mathbf{B})} \end{aligned} \] \captionsetup{labelformat=empty} \caption{Fig. 26.26. Relativization Morphism on Proofs} \end{figure}	*(not rendered)*	$\mathcal{R}\ \frac{\mathbf{A}:\mathbb{B}\to\mathbb{C}\quad\mathbf{B}:\mathbb{B}}{\mathbf{AB}:\mathbb{C}}\Big) = \frac{\frac{\forall X.\mathbb{B}(X)\Rightarrow\mathbb{C}(\mathbf{A}X)}{\mathbb{B}(\mathbf{B})\Rightarrow\mathbb{C}(\mathbf{AB})}\quad\mathbb{B}(\mathbf{B})}{\mathbb{C}(\mathbf{AB})}$ $\mathcal{R}\ \frac{\forall X_{\mathbb{B}}.\mathbf{A}\quad\mathbf{B}:\mathbb{B}}{[\mathbf{B}/X]\mathbf{A}}\Big) = \frac{\frac{\forall X.\mathbb{B}(X)\Rightarrow\mathcal{R}(\mathbf{A})}{\mathbb{B}(\mathcal{R}(\mathbf{B}))\Rightarrow\mathcal{R}([\mathbf{B}/X]\mathbf{A})}\quad\mathbb{B}(\mathbf{B})}{\mathcal{R}([\mathbf{B}/X]\mathbf{A})}$
kohlhase-omdoc_ EQ0003	188	■ 0.131 ● C|+3	\begin{aligned} & \mathcal{T}_{2} \longrightarrow \mathcal{B}_{2} \xrightarrow{\sigma} \mathcal{C}_{2} \quad \mathcal{B}_{1} \stackrel{\beta}{-} \mathcal{B}_{2} \xrightarrow{\sigma} \mathcal{C}_{2} \\ & \mathcal{T}_{1} \longrightarrow \mathcal{A}_{2} \longrightarrow \mathcal{C}_{2} \\ & \mathcal{A}_{1}-\stackrel{\alpha}{\rightarrow} \mathcal{A}_{2} \longrightarrow \mathcal{C}_{2} \end{aligned}	$\mathcal{T}_2 \longrightarrow \mathcal{B}_2 \xrightarrow{\sigma} \mathcal{C}_2 \quad \mathcal{B}_1 \stackrel{\beta}{-} \mathcal{B}_2 \xrightarrow{\sigma} \mathcal{C}_2$ $\mathcal{T}_1 \longrightarrow \mathcal{A}_2 \longrightarrow \mathcal{C}_2$ $\mathcal{A}_1 - \stackrel{\alpha}{\rightarrow} \mathcal{A}_2 \longrightarrow \mathcal{C}_2$	$\mathcal{T}_2 \longrightarrow \mathcal{B}_2 \xrightarrow{\sigma} \mathcal{C}_2 \quad \mathcal{B}_1 \stackrel{\beta}{- - \rightarrow} \mathcal{B}_2 \xrightarrow{\sigma} \mathcal{C}_2$ $\mathcal{T}_1 \longrightarrow \mathcal{A}_2 \longrightarrow \mathcal{C}_2 \quad \mathcal{A}_1 \stackrel{\alpha}{- - \rightarrow} \mathcal{A}_2 \longrightarrow \mathcal{C}_2$
kohlhase-omdoc_ EQ0006	332	■ 0.672 ● S|+1	\begin{aligned} & ([0-9]|,| .) \\ & (* \mid \mathrm{e}([0-9]|,| .) *) ? \end{aligned}	$([0-9]\|,\|.)$ $(*\mid \mathrm{e}([0-9]\|,\|.)*)?$	([0-9]|,|.) (*|e([0-9]|,|.)*)?
kohlhase-omdoc_ EQ0001	060	■ 0.863 ● U|+38	\forall M . \operatorname{magma}(M) \Leftrightarrow \exists E, F . M=(E, F) \wedge \text { law_of_composition }(E, F)	*(not rendered)*	$\forall M.magma(M) \Leftrightarrow \exists E, F.M = (E, F) \wedge law_of_composition(E, F)$
kohlhase-omdoc_ EQ0002	121	■ 1.000 ● N|+0	\frac{1}{1+\frac{1}{1+\cdots}}	$\frac{1}{1+\frac{1}{1+\cdots}}$	$\frac{1}{1+\frac{1}{1+\cdots}}$

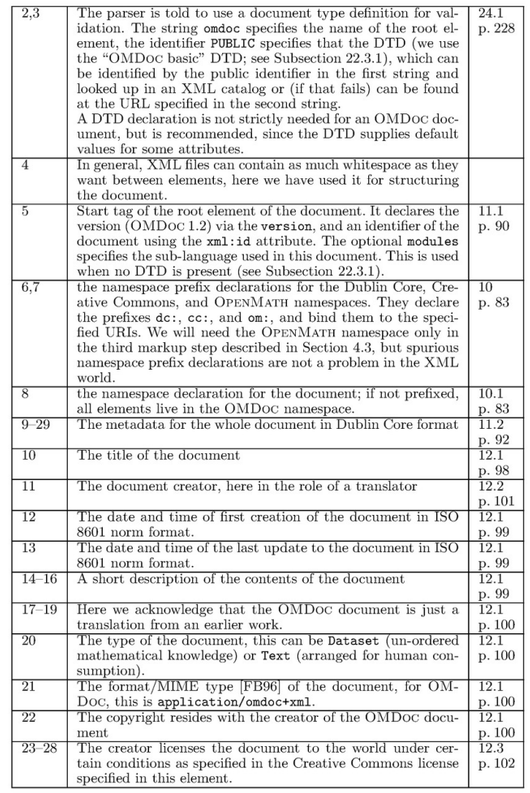
Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value
Residual render vs scan (inkdrill): ● C component ● W weak ● S stable ● N noise ● K clean ● not measured

Tables

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_001	028	—	(no LaTeX source; 1084 × 302 px region)	—	 by | W3C Math WG | OpenMath society origin | math for HTML | integration of CAS coverage | content + presentation; K-14 | content; extensible status | Version 2.2e (VI 2003) | Version 2 (VI 2004) activity | maintenance | maintenance Info | http://w3c.org/Math/ | http://www.openmath.org/ **Fig. 2.1.** The status of markup standardization for mathematical formulae OpenMath was originally a development driven mainly by the Computer
kohlhase-omdoc_TAB_002	041	—	(no LaTeX source; 1135 × 637 px region)	—	Doc uses three levels of modeling corresponding to the concerns raised previously. We have visualized this architecture in Figure 3.1.  Level of Representation | OMDoc Example *Theory Level*: Development Graph – Inheritance via symbol-mapping – Theory inclusion via proof-obligations – Local (one-step) vs. global links *Statement Level*: – Axiom, definition, theorem, proof, example,. . . – Structure explicit in statement forms and references *Object Level*: OpenMath/MathML – Objects as logical formulae – Semantics by pointing to theory level <definition for="#plus" type="recursive"> <CMP>Addition is defined by recursion on the second argument </CMP> <FMP>$X + 0 = 0$</FMP> <FMP>$X + s(Y) = s(X + Y)$</FMP> </definition> <OMA> <OMS cd="arith1" name="plus"/> <OMV name="X"/> <OMS cd="nat" name="zero"/> </OMA> **Fig. 3.1.** OMDoc in a nutshell (the three levels of modeling)
kohlhase-omdoc_TAB_003	050	—	(no LaTeX source; 1142 × 120 px region)	—	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

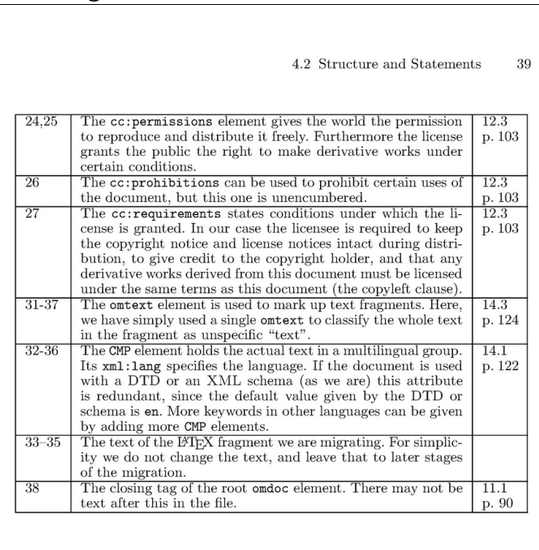
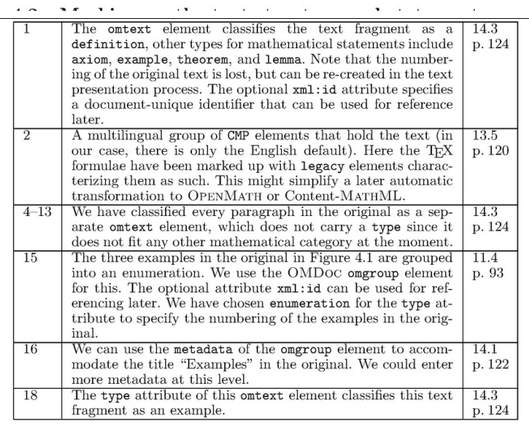
Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_004	051	—	(no LaTeX source; 1141 × 1740 px region)	—	

38 4 Textbooks and Articles

2,3	The parser is told to use a document type definition for validation. The string `omdoc` specifies the name of the root element, the identifier `PUBLIC` specifies that the DTD (we use the "OMDoc basic" DTD; see Subsection 22.3.1), which can be identified by the public identifier in the first string and looked up in an XML catalog or (if that fails) can be found at the URL specified in the second string. A DTD declaration is not strictly needed for an OMDoc document, but is recommended, since the DTD supplies default values for some attributes.	24.1 p. 228
4	In general, XML files can contain as much whitespace as they want between elements, here we have used it for structuring the document.	
5	Start tag of the root element of the document. It declares the version (OMDoc 1.2) via the `version`, and an identifier of the document using the `xml:id` attribute. The optional `modules` specifies the sub-language used in this document. This is used when no DTD is present (see Subsection 22.3.1).	11.1 p. 90
6,7	the namespace prefix declarations for the Dublin Core, Creative Commons, and OpenMath namespaces. They declare the prefixes `dc:`, `cc:`, and `om:`, and bind them to the specified URIs. We will need the OpenMath namespace only in the third markup step described in Section 4.3, but spurious namespace prefix declarations are not a problem in the XML world.	10 p. 83
8	the namespace declaration for the document; if not prefixed, all elements live in the OMDoc namespace.	10.1 p. 83
9–29	The metadata for the whole document in Dublin Core format	11.2 p. 92
10	The title of the document	12.1 p. 98
11	The document creator, here in the role of a translator	12.2 p. 101
12	The date and time of first creation of the document in ISO 8601 norm format.	12.1 p. 99
13	The date and time of the last update to the document in ISO 8601 norm format.	12.1 p. 99
14–16	A short description of the contents of the document	12.1 p. 99
17–19	Here we acknowledge that the OMDoc document is just a translation from an earlier work.	12.1 p. 100
20	The type of the document, this can be `Dataset` (un-ordered mathematical knowledge) or `Text` (arranged for human consumption).	12.1 p. 100
21	The format/MIME type [FB96] of the document, for OMDoc, this is `application/omdoc+xml`.	12.1 p. 100
22	The copyright resides with the creator of the OMDoc document	12.1 p. 100
23–28	The creator licenses the document to the world under certain conditions as specified in the Creative Commons license specified in this element.	12.3 p. 102

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_005	052	—	(no LaTeX source; 1141 × 890 px region)	—	
kohlhase-omdoc_TAB_006	053	—	(no LaTeX source; 1125 × 931 px region)	—	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

4.2 Structure and Statements 39

24,25	The `cc:permissions` element gives the world the permission to reproduce and distribute it freely. Furthermore the license grants the public the right to make derivative works under certain conditions.	12.3 p. 103
26	The `cc:prohibitions` can be used to prohibit certain uses of the document, but this one is unencumbered.	12.3 p. 103
27	The `cc:requirements` states conditions under which the license is granted. In our case the licensee is required to keep the copyright notice and license notices intact during distribution, to give credit to the copyright holder, and that any derivative works derived from this document must be licensed under the same terms as this document (the copyleft clause).	12.3 p. 103
31-37	The `omtext` element is used to mark up text fragments. Here, we have simply used a single `omtext` to classify the whole text in the fragment as unspecific "text".	14.3 p. 124
32-36	The `CMP` element holds the actual text in a multilingual group. Its `xml:lang` specifies the language. If the document is used with a DTD or an XML schema (as we are) this attribute is redundant, since the default value given by the DTD or schema is `en`. More keywords in other languages can be given by adding more `CMP` elements.	14.1 p. 122
33–35	The text of the LaTeX fragment we are migrating. For simplicity we do not change the text, and leave that to later stages of the migration.	
38	The closing tag of the root `omdoc` element. There may not be text after this in the file.	11.1 p. 90

1	The `omtext` element classifies the text fragment as a `definition`, other types for mathematical statements include `axiom`, `example`, `theorem`, and `lemma`. Note that the numbering of the original text is lost, but can be re-created in the text presentation process. The optional `xml:id` attribute specifies a document-unique identifier that can be used for reference later.	14.3 p. 124
2	A multilingual group of `CMP` elements that hold the text (in our case, there is only the English default). Here the TeX formulae have been marked up with `legacy` elements characterizing them as such. This might simplify a later automatic transformation to OpenMath or Content-MathML.	13.5 p. 120
4–13	We have classified every paragraph in the original as a separate `omtext` element, which does not carry a `type` since it does not fit any other mathematical category at the moment.	14.3 p. 124
15	The three examples in the original in Figure 4.1 are grouped into an enumeration. We use the OMDoc `omgroup` element for this. The optional attribute `xml:id` can be used for referencing later. We have chosen `enumeration` for the `type` attribute to specify the numbering of the examples in the original.	11.4 p. 93
16	We can use the `metadata` of the `omgroup` element to accommodate the title "Examples" in the original. We could enter more metadata at this level.	14.1 p. 122
18	The `type` attribute of this `omtext` element classifies this text fragment as an example.	14.3 p. 124

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_007	055	—	(no LaTeX source; 1141 × 1584 px region)	—	42 4 Textbooks and Articles Of course all the other mathematical statements in the documents have to be treated in the same way. line | Description | ref. 1–4 | The omdoc-basic document type definition is no longer sufficient for our purposes, since we introduce new symbols that can be used in other documents. The DTD for OMDoc content dictionaries (see Chapter 5), which allows this. Correspondingly, we would specify the value cd for the attribute module. The part in line 4 is the internal subset of the DTD, which sets a parameter entity for the modularized DTD to instruct it to accept OpenMath elements in their namespace prefixed form. Of course a suitable namespace prefix declaration is needed as well. | 22.3.2 p. 218 5 | The start tag of a theory. We need this, since symbols and definitions can only appear inside theory elements. | 15.6 p. 149 6,7 | We need to import the theory products to be able to use symbols from it in the definition below. The value of the from is a relative URI reference to a theory element much like the one in line 5. The other imports element imports the theory relation1 from the OpenMath standard content dictionaries[1]. Note that we do not need to import the theory sets here, since this is already imported by the theory products. | 15.6.1 p. 150 9–11 | A symbol declaration: For every definition, OMDoc requires the declaration of one or more symbol elements for the concept that is to be defined. The name attribute is used to identify it. The dc:description element allows to supply a multilingual (via the xml:lang attribute) group of keywords for the declared symbol | 15.2.1 p. 136 12 | Upon closer inspection it turns out that the definition in Listing 4.4 actually defines three concepts: "law of composition", "composition", and "magma". Note that "composition" is just another name for the value under the law of composition, therefore we do not need to declare a symbol for this. Thus we only declare one for "law of composition". | 15.2.1 p. 136 14 | A definition: the definition element carries a name attribute for reference within the theory. We need to reference the two symbols defined here in the for attribute of the definition element; it takes a whitespace-separated list of name attributes of symbol elements in the same theory as values. | 15.2.4 p.139 16 | We use an OpenMath object for the set E. It is an om:OMOBJ element with an om:OMV daughter, whose name attribute specifies the object to be a variable with name E. We have chosen to represent the set E as a variable instead of a constant (via an om:OMS element) in the theory, since it seems to be local to the definition. We will discuss this further in the next section, where we talk about formalization. | 13.1.1 p. 108 [1] The originals are available at http://www.openmath.org/cd; see Chapter 5 for a discussion of the differences of the original OpenMath format and the OMDoc format used here.
kohlhase-omdoc_TAB_008	056	—	(no LaTeX source; 1142 × 671 px region)	—	4.3 Marking up the Formulae 43 17–21 | This om:OMOBJ represents the Cartesian product $E \times E$ of the set E with itself. It is an application (via an om:OMA element) of the symbol for the binary Cartesian product relation to E. | 13.1.1 p. 108 18 | The symbol for the Cartesian product constructor is represented as an om:OMS element. The cd attribute specifies the theory that defines the symbol, and the name points to the symbol element in it that declares this symbol. The value of the cd attribute is a theory identifier. Note that this theory has to be imported into the current theory, to be legally used. | 13.1.1 p. 108 22 | We use the term element to characterize the defined terms in the text of the definition. Its role attribute can used to mark the text fragment as a definiens, i.e. a concept that is under definition. | 14.5 p. 128 24–28 | This object stands for $f(x, y)$ | 30–39 | This object represents $(x, y) \in E \times E$. Note that we make use of the symbol for the elementhood relation from the OpenMath core content dictionary set1 and of the pairconstructor from the theory of products from the Bourbaki collection there. |

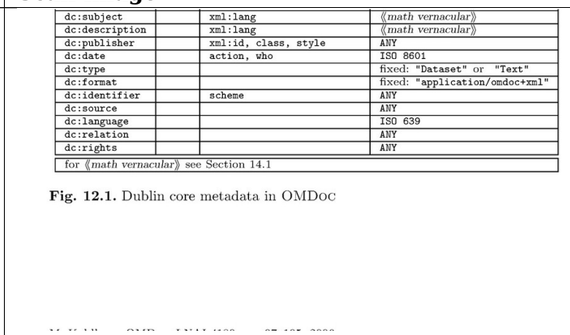
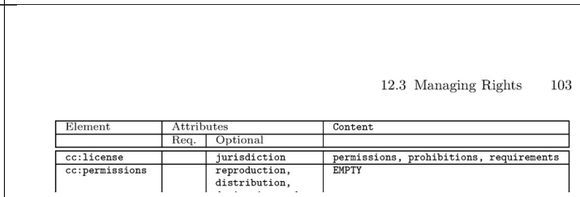
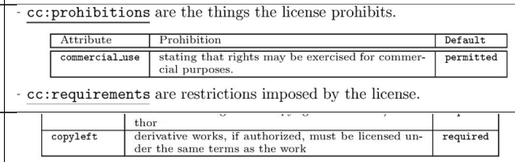
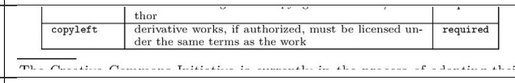
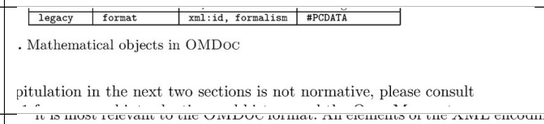
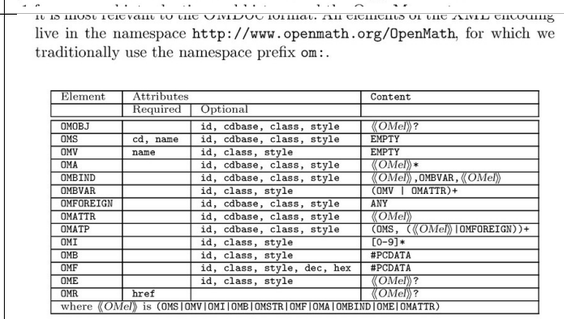
Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_009	093	—	(no LaTeX source; 1152 × 1648 px region)	—	84 10 OMDoc as a Modular Format Module | Title | Required? | Chapter **MOBJ** | Mathematical Objects | yes | Chapter 13 *Formulae are a central part of mathematical documents; this module integrates the content-oriented representation formats* OpenMath *and* MathML *into* OMDoc **MTXT** | Mathematical Text | yes | Chapter 14 *Mathematical vernacular, i.e. natural language with embedded formulae* **DOC** | Document Infrastructure | yes | Chapter 11 *A basic infrastructure for assembling pieces of mathematical knowledge into functional documents and referencing their parts* **DC** | Dublin Core Metadata | yes | Sections 12.1 and 12.2 *Contains bibliographical "**data about data**", which can be used to annotate many* OMDoc *elements by descriptive and administrative information that facilitates navigation and organization* **CC** | Creative Commons Metadata | yes | Section 12.3 *Licenses for text use* **RT** | Rich Text Structure | no | Section 14.6 *Rich text structure in mathematical vernacular (lists, paragraphs, tables, . . .)* **ST** | Mathematical Statements | no | Chapter 15 *Markup for mathematical forms like theorems, axioms, definitions, and examples that can be used to specify or define properties of given mathematical objects and theories to group mathematical statements and provide a notion of context.* **PF** | Proofs and proof objects | no | Chapter 17 *Structure of proofs and argumentations at various levels of details and formality* **ADT** | Abstract Data Types | no | Chapter 16 *Definition schemata for sets that are built up inductively from constructor symbols* **CTH** | Complex Theories | no | Chapter 18 *Theory morphisms; they can be used to structure mathematical theories* **DG** | Development Graphs | no | Section 18.5 *Infrastructure for managing theory inclusions, change management* **EXT** | Applets, Code, and Data | no | Chapter 20 *Markup for applets, program code, and data (e.g. images, measurements, . . .)* **PRES** | Presentation Information | no | Chapter 19 *Limited functionality for specifying presentation and notation information for local typographic conventions that cannot be determined by general principles alone* **QUIZ** | Infrastructure for Assessments | no | Chapter 21 *Markup for exercises integrated into the* OMDoc *document model* **Fig. 10.1.** The OMDoc Modules
kohlhase-omdoc_TAB_010	094	—	(no LaTeX source; 1096 × 190 px region)	—	OMDoc also uses the following namespaces[1]: Format | namespace URI | see Dublin Core | http://purl.org/dc/elements/1.1/ | Sections 12.1 and 12.2 Creative Commons | http://creativecommons.org/ns | Section 12.3 MathML | http://www.w3.org/1998/Math/MathML | Section 13.2 OpenMath | http://www.openmath.org/OpenMath | Section 13.1 XSLT | http://www.w3.org/1999/XSL/Transform | Chapter 19
kohlhase-omdoc_TAB_011	099	—	(no LaTeX source; 1142 × 331 px region)	—	omdoc | version, xmlns | xml:id, type, class, style, version, modules | + | (⟪*top-level*⟫)∗ omgroup | | xml:id, modules, type, class, style | + | (⟪*top-level*⟫)∗ metadata | | xml:id, inherits, class, style | – | ⟪*MDelt*⟫∗ ref | xref | type, class, style | – | ignore | | type, comment | – | ANY where ⟪*top-level*⟫ stands for top-level OMDoc elements, and ⟪*MDelt*⟫ for those introduced in Chapter 12 **Fig. 11.1.** OMDoc Elements for Specifying Document Structure.

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_012	105	—	(no LaTeX source; 1121 × 516 px region)	—	
kohlhase-omdoc_TAB_013	111	—	(no LaTeX source; 1144 × 299 px region)	—	
kohlhase-omdoc_TAB_014	111	—	(no LaTeX source; 1044 × 159 px region)	—	
kohlhase-omdoc_TAB_015	111	—	(no LaTeX source; 1017 × 100 px region)	—	
kohlhase-omdoc_TAB_016	111	—	(no LaTeX source; 1019 × 186 px region)	—	
kohlhase-omdoc_TAB_017	114	—	(no LaTeX source; 829 × 156 px region)	—	
kohlhase-omdoc_TAB_018	115	—	(no LaTeX source; 1087 × 500 px region)	—	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_019	120	—	(no LaTeX source; 1117 × 935 px region)	—	13.1 OpenMath 113 Shared / Exploded **Fig. 13.5.** The OpenMath objects from Figure 13.4 in XML encoding
kohlhase-omdoc_TAB_020	121	—	(no LaTeX source; 1160 × 218 px region)	—	<OMOBJ> <OMA id="bar"> <OMS cd="nat" name="plus"/> <OMI>1</OMI> <OMR href="#baz"/> </OMA> </OMOBJ> <OMOBJ> <OMA id="baz"> <OMS cd="nat" name="plus"/> <OMI>1</OMI> <OMR href="#bar"/> </OMA> </OMOBJ>
kohlhase-omdoc_TAB_021	122	—	(no LaTeX source; 1142 × 439 px region)	—	13.2 Content MathML 115 Element / Attributes (Required, Optional) / Content
kohlhase-omdoc_TAB_022	128	—	(no LaTeX source; 1146 × 469 px region)	—	Required / Optional / C **Fig. 14.1.** The OMDoc elements for specifying mathematical properties
kohlhase-omdoc_TAB_023	129	—	(no LaTeX source; 1107 × 265 px region)	—	Language [CMLD03]: Module / Elements / Comment / see

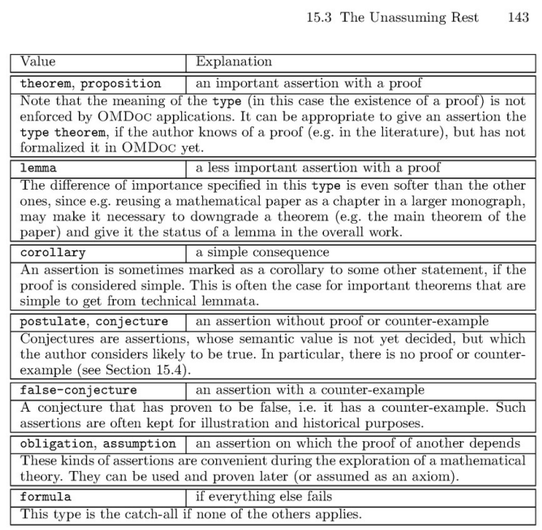
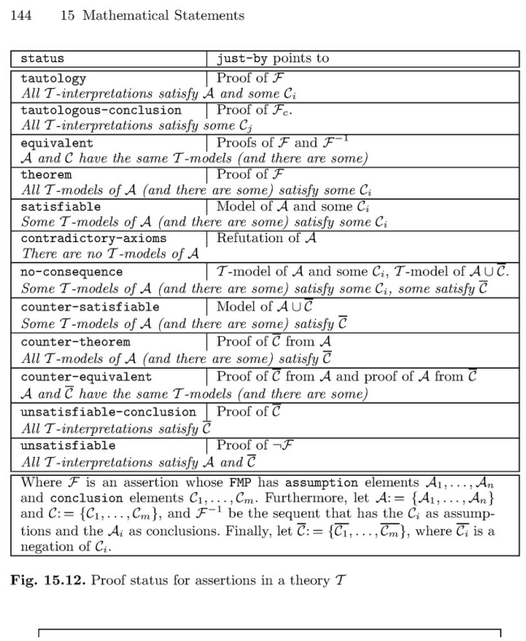
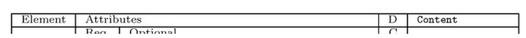
Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_024	136	—	(no LaTeX source; 1110 × 564 px region)	—	14.6 Rich Text Structure 129 Element | Optional Attributes | DC | Content p | xml:id, style, class, index, verbalizes | + | ⟪math vernacular⟫ ol | xml:id, style, class, index, verbalizes | + | li* ul | xml:id, style, class, index, verbalizes | + | li* li | xml:id, style, class, index, verbalizes | + | ⟪math vernacular⟫ dl | xml:id, style, class, index, verbalizes | + | di* di | xml:id, style, class, index, verbalizes | + | dt*,dd* dt | xml:id, style, class, index, verbalizes | + | ⟪math vernacular⟫ dd | xml:id, style, class, index, verbalizes | + | ⟪math vernacular⟫ idx | (xml:id|xref) | – | idt?, ide+ ide | index, sort-by, see, seealso, links | – | idp* idt | style, class | – | ⟪math vernacular⟫ idp | sort-by, see, seealso, links | – | ⟪math vernacular⟫ table | xml:id, style, class, index, verbalizes | + | tr* tr | xml:id, style, class, index, verbalizes | + | td* td | xml:id, style, class, index, verbalizes | + | ⟪math vernacular⟫ th | xml:id, style, class, index, verbalizes | + | ⟪math vernacular⟫ link | xml:id, style, class, index, verbalizes | – | ⟪math vernacular⟫
kohlhase-omdoc_TAB_025	141	—	(no LaTeX source; 1143 × 262 px region)	—	The exponential function $e^{\cdot}$ | The **exponential function** $e^{\cdot}$ is the solution to the differential equation $\partial f = f$ [where $f(0) = 1$]. | implicit The addition function $+$ | **Addition** on the natural numbers is defined by the equations $x + 0 = x$ and $x + s(y) = s(x + y)$. | recursive **Fig. 15.2.** Some common definitions Definitions can have many forms, they can be
kohlhase-omdoc_TAB_026	142	—	(no LaTeX source; 1135 × 444 px region)	—	Element | Attributes (Required | Optional) | D/C | Content symbol | name | xml:id, role, scope, style, class | + | type* type | | xml:id, system, style, class | – | CMP*,⟪mobj⟫ axiom | | xml:id, for, type, style, class | + | CMP*,FMP* definition | for | xml:id, type, style, class, uniqueness, existence, consistency, exhaustivity | + | CMP*, (FMP* | requation+ | ⟪mobj⟫)?, measure?, ordering? requation | | xml:id, style, class | – | ⟪mobj⟫,⟪mobj⟫ measure | | xml:id, style, class | – | ⟪mobj⟫ ordering | | xml:id, style, class | – | ⟪mobj⟫ where ⟪mobj⟫ is (OMOBJ |m:math |legacy) **Fig. 15.3.** Theory-constitutive elements in OMDoc
kohlhase-omdoc_TAB_027	148	—	(no LaTeX source; 1137 × 469 px region)	—	142 15 Mathematical Statements Element | Attributes (Required | Optional) | D/C | Content assertion | | xml:id, for, type, theory, class, style, status, just-by | + | CMP*, FMP* type | system | xml:id, for, just-by, theory, class, style | – | CMP*, ⟪mobj⟫,⟪mobj⟫ example | for | xml:id, type, assertion, theory, class, style | + | CMP* | ⟪mobj⟫* alternative | for, theory, entailed-by, entails, entailed-by-thm | xml:id, type, theory, class, style | + | CMP*, (FMP* | requation* | ⟪mobj⟫)

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_028	149	—	(no LaTeX source; 1171 × 1052 px region)	—	
kohlhase-omdoc_TAB_029	150	—	(no LaTeX source; 1135 × 1126 px region)	—	
kohlhase-omdoc_TAB_030	156	—	(no LaTeX source; 1132 × 217 px region)	—	

15.3 The Unassuming Rest 143

Value	Explanation
`theorem`, `proposition`	an important assertion with a proof
Note that the meaning of the `type` (in this case the existence of a proof) is not enforced by OMDoc applications. It can be appropriate to give an assertion the `type theorem`, if the author knows of a proof (e.g. in the literature), but has not formalized it in OMDoc yet.	
`lemma`	a less important assertion with a proof
The difference of importance specified in this `type` is even softer than the other ones, since e.g. reusing a mathematical paper as a chapter in a larger monograph, may make it necessary to downgrade a theorem (e.g. the main theorem of the paper) and give it the status of a lemma in the overall work.	
`corollary`	a simple consequence
An assertion is sometimes marked as a corollary to some other statement, if the proof is considered simple. This is often the case for important theorems that are simple to get from technical lemmata.	
`postulate`, `conjecture`	an assertion without proof or counter-example
Conjectures are assertions, whose semantic value is not yet decided, but which the author considers likely to be true. In particular, there is no proof or counter-example (see Section 15.4).	
`false-conjecture`	an assertion with a counter-example
A conjecture that has proven to be false, i.e. it has a counter-example. Such assertions are often kept for illustration and historical purposes.	
`obligation`, `assumption`	an assertion on which the proof of another depends
These kinds of assertions are convenient during the exploration of a mathematical theory. They can be used and proven later (or assumed as an axiom).	
`formula`	if everything else fails
This type is the catch-all if none of the others applies.	

Fig. 15.10. Types of mathematical assertions

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status	just-by points to
`tautology` *All $\mathcal{T}$-interpretations satisfy $\mathcal{A}$ and some $\mathcal{C}_i$*	Proof of $\mathcal{F}$
`tautologous-conclusion` *All $\mathcal{T}$-interpretations satisfy some $\mathcal{C}_j$*	Proof of $\mathcal{F}_c$.
`equivalent` *$\mathcal{A}$ and $\mathcal{C}$ have the same $\mathcal{T}$-models (and there are some)*	Proofs of $\mathcal{F}$ and $\mathcal{F}^{-1}$
`theorem` *All $\mathcal{T}$-models of $\mathcal{A}$ (and there are some) satisfy some $\mathcal{C}_i$*	Proof of $\mathcal{F}$
`satisfiable` *Some $\mathcal{T}$-models of $\mathcal{A}$ (and there are some) satisfy some $\mathcal{C}_i$*	Model of $\mathcal{A}$ and some $\mathcal{C}_i$
`contradictory-axioms` *There are no $\mathcal{T}$-models of $\mathcal{A}$*	Refutation of $\mathcal{A}$
`no-consequence` *Some $\mathcal{T}$-models of $\mathcal{A}$ (and there are some) satisfy some $\mathcal{C}_i$, some satisfy $\overline{\mathcal{C}}$*	$\mathcal{T}$-model of $\mathcal{A}$ and some $\mathcal{C}_i$, $\mathcal{T}$-model of $\mathcal{A} \cup \overline{\mathcal{C}}$.
`counter-satisfiable` *Some $\mathcal{T}$-models of $\mathcal{A}$ (and there are some) satisfy $\overline{\mathcal{C}}$*	Model of $\mathcal{A} \cup \overline{\mathcal{C}}$
`counter-theorem` *All $\mathcal{T}$-models of $\mathcal{A}$ (and there are some) satisfy $\overline{\mathcal{C}}$*	Proof of $\overline{\mathcal{C}}$ from $\mathcal{A}$
`counter-equivalent` *$\mathcal{A}$ and $\overline{\mathcal{C}}$ have the same $\mathcal{T}$-models (and there are some)*	Proof of $\overline{\mathcal{C}}$ from $\mathcal{A}$ and proof of $\mathcal{A}$ from $\overline{\mathcal{C}}$
`unsatisfiable-conclusion` *All $\mathcal{T}$-interpretations satisfy $\overline{\mathcal{C}}$*	Proof of $\overline{\mathcal{C}}$
`unsatisfiable` *All $\mathcal{T}$-interpretations satisfy $\mathcal{A}$ and $\overline{\mathcal{C}}$*	Proof of $\neg\mathcal{F}$

Where $\mathcal{F}$ is an assertion whose `FMP` has `assumption` elements $\mathcal{A}_1, \ldots, \mathcal{A}_n$ and `conclusion` elements $\mathcal{C}_1, \ldots, \mathcal{C}_m$. Furthermore, let $\mathcal{A} := \{\mathcal{A}_1, \ldots, \mathcal{A}_n\}$ and $\mathcal{C} := \{\mathcal{C}_1, \ldots, \mathcal{C}_m\}$, and $\mathcal{F}^{-1}$ be the sequent that has the $\mathcal{C}_i$ as assumptions and the $\mathcal{A}_i$ as conclusions. Finally, let $\overline{\mathcal{C}} := \{\overline{\mathcal{C}_1}, \ldots, \overline{\mathcal{C}_m}\}$, where $\overline{\mathcal{C}_i}$ is a negation of $\mathcal{C}_i$.

Fig. 15.12. Proof status for assertions in a theory $\mathcal{T}$

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Element	Attributes		D	Content
	Req	Optional	C	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

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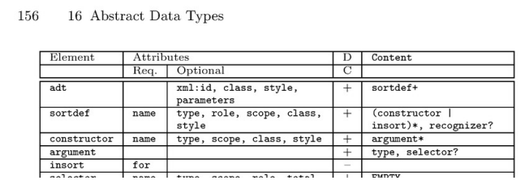
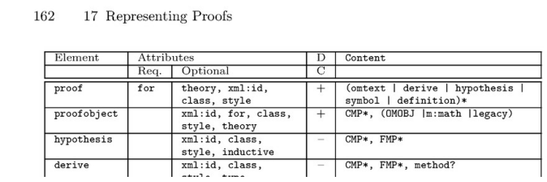
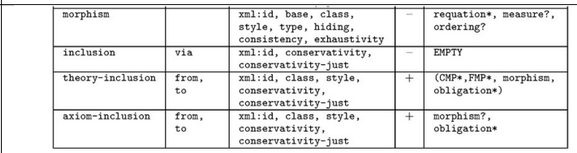
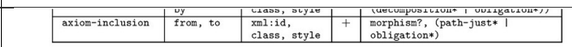
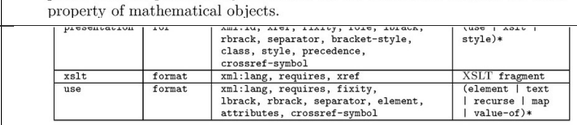
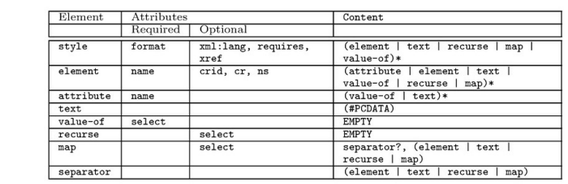
Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_031	162	—	(no LaTeX source; 1058 × 387 px region)	—	 156 16 Abstract Data Types Element | Attributes: Req. / Optional | D: C | Content adt | | xml:id, class, style, parameters | + | sortdef+ sortdef | name | type, role, scope, class, style | + | (constructor | insort)*, recognizer? constructor | name | type, scope, class, style | + | argument* argument | | | + | type, selector? insort | for | | − |
kohlhase-omdoc_TAB_032	168	—	(no LaTeX source; 1107 × 385 px region)	—	 162 17 Representing Proofs Element | Attributes: Req. / Optional | D: C | Content proof | for | theory, xml:id, class, style | + | (omtext | derive | hypothesis | symbol | definition)* proofobject | | xml:id, for, class, style, theory | + | CMP*, (OMOBJ |m:math |legacy) hypothesis | | xml:id, class, style, inductive | − | CMP*, FMP* derive | | xml:id, class,
kohlhase-omdoc_TAB_033	178	—	(no LaTeX source; 1146 × 525 px region)	—	 morphism | | xml:id, base, class, style, type, hiding, consistency, exhaustivity | − | requation*, measure?, ordering? inclusion | via | xml:id, conservativity, conservativity-just | − | EMPTY theory-inclusion | from, to | xml:id, class, style, conservativity, conservativity-just | + | (CMP*,FMP*, morphism, obligation*) axiom-inclusion | from, to | xml:id, class, style, conservativity, conservativity-just | + | morphism?, obligation* **Fig. 18.1.** Complex theories in OMDoc M. Kohlhase: OMDoc, LNAI 4180, pp. 173–186, 2006.
kohlhase-omdoc_TAB_034	189	—	(no LaTeX source; 1135 × 272 px region)	—	 axiom-inclusion | from, to | xml:id, class, style | + | morphism?, (path-just* | obligation*) **Fig. 18.10.** Development graphs in OMDoc Furthermore module DG provides path-just elements as children to the axiom-inclusion elements to justify that this relation holds, much like a proof element provides a justification for an assertion element for some property of mathematical objects.
kohlhase-omdoc_TAB_035	192	—	(no LaTeX source; 1150 × 317 px region)	—	 presentation | for | xml:id, xref, fixity, role, lbrack, rbrack, separator, bracket-style, class, style, precedence, crossref-symbol | (use | xslt | style)* xslt | format | xml:lang, requires, xref | XSLT fragment use | format | xml:lang, requires, fixity, lbrack, rbrack, separator, element, attributes, crossref-symbol | (element | text | recurse | map | value-of)* **Fig. 19.1.** The OMDoc elements for notation information The normal (but of course not the only) way to generate presentation from XML documents is to use XSLT style sheets (see Chapter 25 for other ap- namespace) of the elements for the presentation to work.[2]
kohlhase-omdoc_TAB_036	195	—	(no LaTeX source; 1141 × 380 px region)	—	 Element | Attributes: Required / Optional | Content style | format | xml:lang, requires, xref | (element | text | recurse | map | value-of)* element | name | crid, cr, ns | (attribute | element | text | value-of | recurse | map)* attribute | name | | (value-of | text)* text | | | (#PCDATA) value-of | select | | EMPTY recurse | | select | EMPTY map | | select | separator?, (element | text | recurse | map) separator | | | (element | text | recurse | map)

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_037	201	—	(no LaTeX source; 717 × 258 px region)	—	ation and Presentation Precedence | Operators | Comment 200 | +,- | unary 200 | ^ | exponentiation
kohlhase-omdoc_TAB_038	201	—	(no LaTeX source; 781 × 234 px region)	—	fixity | bracket-style | separator | yields prefix | lisp | " " | $(f\ 1\ 2\ 3)$ postfix | lisp | " " | $(1\ 2\ 3\ f)$ prefix | math | "," | $f(1,2,3)$ postfix | math | "," | $(1,2,3)f$ assuming lbrack="(" and rbrack=")" Attribute combination and function style
kohlhase-omdoc_TAB_039	202	—	(no LaTeX source; 1133 × 586 px region)	—	19.3 Notation of Symbols 197 Notation specification | Example <presentation for="#forall" role="binding" separator=".">| <OMBIND> <OMS cd="quant1" name="forall"/> <OMBVAR> <OMV name="X"/> </OMBVAR> <OMS cd="logic1" name="true"/> </OMBIND> <use format="TeX">\forall</use> <use format="html">∀</use> </presentation> Using XSLT templates induced from the presentation element on the OpenMath expression yields $\forall X.$true, where the glyph ∀ carries a hyperlink[6] to it definition, as the crossref-symbol on the presentation element has the default value yes. Internally, the hyperlinks are format-dependent, we have: LaTeX: \href{../ocd/logic1.ps#true}{\forall}X. \href{../ocd/logic1.ps#true}{{\sf true}} HTML: <a href="../ocd/logic1.html#forall">∀</a> X. <a href="../ocd/logic1.html#true">true</a>
kohlhase-omdoc_TAB_040	206	—	(no LaTeX source; 1133 × 329 px region)	—	output | | xml:id, style, class | + | CMP*, FMP* effect | | xml:id, style, class | + | CMP*, FMP* data | | format, href, size, original, pto, pto-version | − | <![CDATA[...]]> Fig. 20.1. The OMDoc auxiliary elements for non-XML data [1] Compare Chapter 9 in the OMDoc Primer.
kohlhase-omdoc_TAB_041	210	—	(no LaTeX source; 1151 × 158 px region)	—	actuate, class, style param | name | value, valuetype | - | EMPTY Fig. 20.5. The OMDoc elements for external objects
kohlhase-omdoc_TAB_042	214	—	(no LaTeX source; 1153 × 247 px region)	—	solution | | xml:id, for, class, style | + | ⟨top-level element⟩ mc | | xml:id, for, class, style | − | choice, hint?, answer choice | | xml:id, class, style | + | CMP*, FMP* answer | verdict | xml:id, class, style | + | CMP*, FMP* Fig. 21.1. The OMDoc auxiliary elements for exercises The QUIZ module provides the top-level elements exercise, hint, and solution. The first one is used for exercises and assessments. The ques-
kohlhase-omdoc_TAB_043	220	—	(no LaTeX source; 1157 × 457 px region)	—	tributes differ. | data dc:title solution 3 | DAG encoding | Directed acyclic graphs built up using om:OMR elements are equal, iff their tree expansions are equal. | om:OMR ref 4 | Dataset | If the content of the dc:type element is Dataset, then the order of the siblings of the parent metadata element is irrelevant. | dc:type Fig. 22.4. The OMDoc document model

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

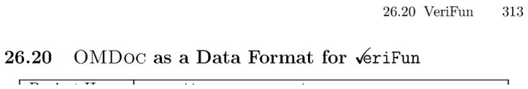
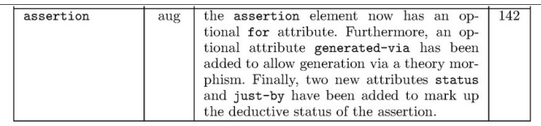
Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_044	227	—	(no LaTeX source; 1086 × 439 px region)	—	svn co https://svn.mathweb.org/repos/mathweb.org/branches/omdoc-1.2 This will create a directory omdoc, with the sub-directories directories | content bin, lib, oz, thirdParty | programs and third-party software used in the administration and examples css, xsl | style sheets for displaying OMDoc documents on the web, see Chapter 25 for a discussion. doc | The OMDoc documentation, including the specification, papers about a the OMDoc format and tools. dtd, rnc | The OMDoc document type definition and the RELAXNG schemata for OMDoc examples | Various example documents in OMDoc format. projects | various contributed developments for OMDoc. Documentation is usually in their doc sub-directory
kohlhase-omdoc_TAB_045	233	—	(no LaTeX source; 1090 × 270 px region)	—	
kohlhase-omdoc_TAB_046	245	—	(no LaTeX source; 1089 × 134 px region)	—	244 26 Applications and Projects 26.2 QMath: A Human-Oriented Language and Batch Formatter for OMDoc
kohlhase-omdoc_TAB_047	248	—	(no LaTeX source; 1087 × 133 px region)	—	26.3 Sentido Integrated Environment 247 26.3 Sentido: An Integrated Environment for OMDoc
kohlhase-omdoc_TAB_048	253	—	(no LaTeX source; 1090 × 216 px region)	—	252 26 Applications and Projects 26.4 MBase, an Open Mathematical Knowledge Base Project Home | http://www.mathweb.org/mbase Authors | Andreas Franke[1], Michael Kohlhase[2]
kohlhase-omdoc_TAB_049	255	—	(no LaTeX source; 1090 × 136 px region)	—	254 26 Applications and Projects 26.5 A Search Engine for Mathematical Formulae
kohlhase-omdoc_TAB_050	259	—	(no LaTeX source; 1088 × 133 px region)	—	258 26 Applications and Projects 26.6 Semantic Interrelation and Change Management
kohlhase-omdoc_TAB_051	263	—	(no LaTeX source; 1088 × 178 px region)	—	262 26 Applications and Projects 26.7 MathDox: Mathematical Documents on the Web
kohlhase-omdoc_TAB_052	267	—	(no LaTeX source; 1088 × 256 px region)	—	266 26 Applications and Projects 26.8 OMDoc in ActiveMath Project Home | http://www.activemath.org/ Authors | The ActiveMath group: Erica Melis, Giorgi Goguadse, Alberto Gonzales-Palomo, Adrian
kohlhase-omdoc_TAB_053	273	—	(no LaTeX source; 1088 × 135 px region)	—	272 26 Applications and Projects 26.9 Authoring Tools for ActiveMath
kohlhase-omdoc_TAB_054	275	—	(no LaTeX source; 1088 × 133 px region)	—	274 26 Applications and Projects 26.10 SWiM – An OMDoc-Based Semantic Wiki

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value
Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_055	279	—	(no LaTeX source; 1088 × 301 px region)	—	278 26 Applications and Projects **26.11 Induction Challenge OMDoc Manager (ICOM)** Project Home: http://www.cs.nott.ac.uk/~lad/research/challenges/challenge_manager.html Authors: Thomas D. Attfield, Monica C. Duarte, Lin Li, Ho-Ying Mak, Adam M. Neal, Lewis M. Toft, Zixuan Wang, Louise A. Dennis
kohlhase-omdoc_TAB_056	282	—	(no LaTeX source; 1088 × 260 px region)	—	26.12 Maya 281 **26.12 Maya: Maintaining Structured Developments** Project Home: www.dfki.de/~inka/maya.html Authors: Serge Autexier[1], Dieter Hutter[1], Till Mossakowski[2], Axel Schairer[1]
kohlhase-omdoc_TAB_057	287	—	(no LaTeX source; 1090 × 134 px region)	—	286 26 Applications and Projects **26.13 Hets: The Heterogeneous Tool Set**
kohlhase-omdoc_TAB_058	291	—	(no LaTeX source; 1088 × 175 px region)	—	290 26 Applications and Projects **26.14 CPoint: An OMDoc Editor in MS PowerPoint**
kohlhase-omdoc_TAB_059	295	—	(no LaTeX source; 1090 × 136 px region)	—	294 26 Applications and Projects **26.15 sTeX: A LaTeX-Based Workflow for OMDoc**
kohlhase-omdoc_TAB_060	299	—	(no LaTeX source; 1088 × 175 px region)	—	298 26 Applications and Projects **26.16 An Emacs Mode for Editing OMDoc Documents** Project Home: http://www.cs.cmu.edu/~ccaps
kohlhase-omdoc_TAB_061	302	—	(no LaTeX source; 1090 × 175 px region)	—	26.17 Converting Mathematica Notebooks to OMDoc 301 **26.17 Converting Mathematica Notebooks to OMDoc**
kohlhase-omdoc_TAB_062	305	—	(no LaTeX source; 1090 × 133 px region)	—	**26.18 Standardizing Context in System Interoperability**
kohlhase-omdoc_TAB_063	306	—	(no LaTeX source; 1099 × 421 px region)	—	26.18 Standardizing Context in System Interoperability 305 PVS / ΩMEGA: set / ; member / in; empty? / empty; emptyset / emptyset; nonempty? / not-empty; full? / ; fullset / ; singleton? / singleton; singleton / ; complement / set-complement PVS / ΩMEGA: subset? / subset; / subset2; strict_subset? / proper-subset; / superset; union / union; / union2; / union-over-collection; intersection / intersection; / intersection-over-coll.; disjoint? / misses
kohlhase-omdoc_TAB_064	310	—	(no LaTeX source; 1088 × 258 px region)	—	**26.19 Integrating Proof Assistants as Plugins in a Scientific Editor** Project Home: http://www.ags.uni-sb.de/~omega/projects/verimathdoc Authors: Serge Autexier, Christoph Benzmüller, Armin Fiedler, and Henri Lesourd

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

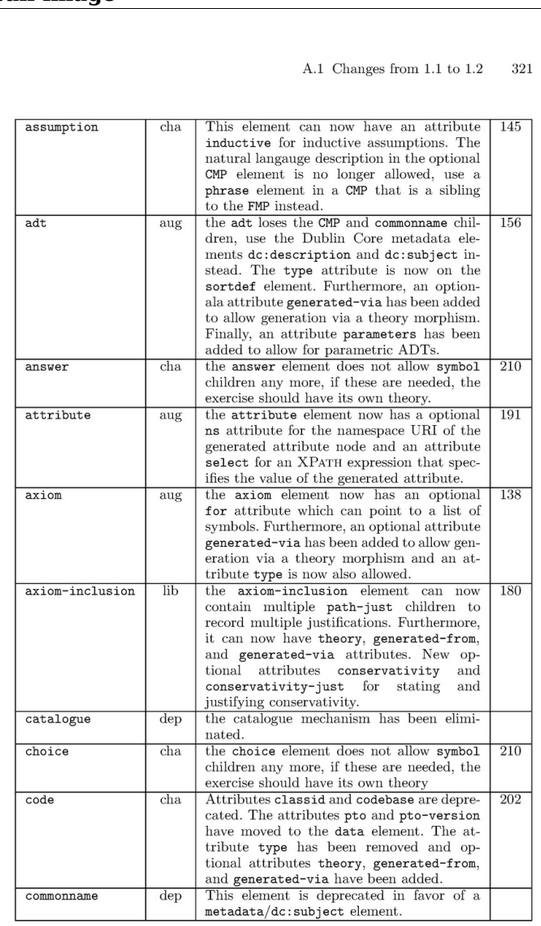
Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_065	314	—	(no LaTeX source; 1088 × 173 px region)	—	 26.20 VeriFun 313 26.20 OMDoc as a Data Format for VeriFun
kohlhase-omdoc_TAB_066	320	—	(no LaTeX source; 1152 × 479 px region)	—	

assertion	aug	the assertion element now has an optional for attribute. Furthermore, an optional attribute generated-via has been added to allow generation via a theory morphism. Finally, two new attributes status and just-by have been added to mark up the deductive status of the assertion.	142

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_067	321	—	(no LaTeX source; 1150 × 1786 px region)	—	

A.1 Changes from 1.1 to 1.2 321

assumption	cha	This element can now have an attribute inductive for inductive assumptions. The natural langauge description in the optional CMP element is no longer allowed, use a phrase element in a CMP that is a sibling to the FMP instead.	145
adt	aug	the adt loses the CMP and commonname children, use the Dublin Core metadata elements dc:description and dc:subject instead. The type attribute is now on the sortdef element. Furthermore, an optionala attribute generated-via has been added to allow generation via a theory morphism. Finally, an attribute parameters has been added to allow for parametric ADTs.	156
answer	cha	the answer element does not allow symbol children any more, if these are needed, the exercise should have its own theory.	210
attribute	aug	the attribute element now has a optional ns attribute for the namespace URI of the generated attribute node and an attribute select for an XPATH expression that specifies the value of the generated attribute.	191
axiom	aug	the axiom element now has an optional for attribute which can point to a list of symbols. Furthermore, an optional attribute generated-via has been added to allow generation via a theory morphism and an attribute type is now also allowed.	138
axiom-inclusion	lib	the axiom-inclusion element can now contain multiple path-just children to record multiple justifications. Furthermore, it can now have theory, generated-from, and generated-via attributes. New optional attributes conservativity and conservativity-just for stating and justifying conservativity.	180
catalogue	dep	the catalogue mechanism has been eliminated.	
choice	cha	the choice element does not allow symbol children any more, if these are needed, the exercise should have its own theory	210
code	cha	Attributes classid and codebase are deprecated. The attributes pto and pto-version have moved to the data element. The attribute type has been removed and optional attributes theory, generated-from, and generated-via have been added.	202
commonname	dep	This element is deprecated in favor of a metadata/dc:subject element.	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_068	322	—	(no LaTeX source; 1150 × 1822 px region)	—	

322 A Changes to the Specification

conclusion	cha	The natural langauge description in the optional CMP element is no longer allowed, use a phrase element in a CMP that is a sibling to the FMP instead.	124
constructor	cha	The role attribute is now fixed to object. The commonname child has been replaced by an initial metadata element.	156
data	aug	new optional attributes original to specify whether the external resource referenced by the href attribute (value external) or the data content is the original (value local). The data element has acquired attributes pto and pto-version from the code and private elements.	203
dc:*	aug	All Dublin Core tags have been lowercased to synchronize with the tag syntax recommended by the Dublin Core Initiative. The tags were capitalized in OMDoc1.1. Furthermore, dc:contributor, dc:creator, dc:publisher have received an optional xml:id attribute, so that they can be cross-referenced by the new who of the dc:date element.	98
decomposition	aug	The for attribute is now optional, it need not be given, if the element is a child of a theory-inclusion element. Furthermore, it can now have a theory, generated-from, and generated-via attributes.	184
dc:description	aug	The dc:description can now have the optional xml:id, and CSS attributes	99
definition	aug	The definition element can now have the type pattern for pattern-defined functions. This is a degenerate case of the type inductive. Furthermore, an optional attribute generated-via has been added to allow generation via a theory morphism.	139
effect	aug	allows an optional xml:id attribute	204
example	aug	The example element now has the optional theory attribute that specifies the home theory. Furthermore, it can now have attributes theory, generated-from, and generated-via.	146
exercise	cha	the exercise element does not allow symbol children any more, if these are needed, the exercise should have its own theory. Furthermore, it can now have a theory, generated-from, and generated-via attributes.	209
extradata	cha	The content of the old extradata element can now be directly in the metadata/dc:subject element.	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_069	323	—	(no LaTeX source; 1148 × 1680 px region)	—	

element	aug	The element element now allows the map and separator elements in the body. Furthermore, it carries the optional attributes crid for parallel markup, cr for cross-references, and ns for specifying the namespace.	190
hint	aug	the hint element can now appear on top-level and has a for attribute. It does not allow symbol children any more, if these are needed, the exercise should have its own theory. Furthermore, the exercise can now have a theory, generated-from, and generated-via attributes.	209
hypothesis	cha	the discharged-in attribute has been eliminated. Scoping is now specified in terms of the enclosing proof element. Furthermore, the symbol child is no longer allowed inside the element. A sibling symbol should be used.	162
inclusion	aug	allows optional attributes xml:id, conservativity, and conservativity-just for stating and justifying conservativity.	179
imports	lib	the xml:id is now optional. New optional attributes conservativity and conservativity-just for stating and justifying conservativity.	150
input	aug	allows an optional xml:id attribute	204
legacy	new	An element for encapsulating legacy mathematics, can be used wherever m:math and om:OMOBJ are allowed.	120
loc	dep	The catalogue mechanism has been eliminated.	
m:math	new	Content-MathML is now allowed wherever OpenMath objects were allowed before.	114
map	new	this element allows to map its style directives over a list of e.g. arguments	191
mc	aug	the mc element can now have a for attribute. It does not allow symbol children any more, if these are needed, the dominating exercise element should have its own theory. Furthermore, the mc element can now have a theory, generated-from, and generated-via attributes.	210
measure	aug	allows an optional xml:id attribute	141
metacomment	dep	This element is superseded by the omtext element.	124

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_070	324	—	(no LaTeX source; 1150 × 1822 px region)	—	

morphism	aug	The morphism element now carries the optional attributes consistency, exhaustivity, hiding, and type. Furthermore the content model allows optional elements measure and ordering after the requation children to specify termination information like in definition.	92
obligation	aug	allows an optional xml:id attribute	178
omdoc	aug	This element can now have a theory, generated-from, and generated-via attributes.	90
omgroup	cha	The values dataset and labeled-dataset are deprecated in Version 1.2 of OMDoc, since we provide tables in module RT; see Section 14.6 for details. Furthermore, the element can now have the attributes, modules, theory, generated-from, and generated-via.	93
omlet	cha	omlet can no longer occur at top-level (it just does not make sense). The data model for this element has been totally reworked, inspired by the xhtml:object element.	205
omstyle	aug	This element can now have generated-from, and generated-via attributes. New attribute xref that allows to inherit the information from another omstyle element.	188
om:*	aug	with OpenMath2, the OpenMath elements carry an optional id attribute for structure sharing via the om:OMR element. Furthermore, in OMDoc, they carry cref attributes for parallel markup with cross-references.	108
om:OMFOREIGN	new	The om:OMFOREIGN element can be used to encapsulate arbitrary XML data in OpenMath attributions.	110
om:OMR	new	In the OpenMath2 standard, this element is the main vehicle of the structure sharing representation.	112
omtext	aug	the type attribute can now also have the values axiom, definition, theorem, proposition, lemma, corollary, postulate, conjecture, false-conjecture, obligation, assumption, and formula. Furthermore, omtext can now have theory, generated-from, and generated-via and verbalizes attributes.	124
ordering	aug	Now allows the optional xml:id and terminating attributes. The latter points to a termination assertion.	141

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_071	325	—	(no LaTeX source; 1150 × 1750 px region)	—	

output	aug	allows an optional xml:id attribute	204
pattern	aug	this element is no longer used, the pattern of a recursive equation is determined by the position as the first child.	
path-just	aug	The element can now appear as a top-level element, if it does, the attribute for must point to the axiom-inclusion element it justifies. It also now allows an optional xml:id attribute	184
phrase	new	used to mark up phrases in CMPs and supply them with identifiers and links to context that can be used for presentation and referencing.	126
presentation	cha	The theory is not allowed any more, to refer to a symbol outside its theory use its xml:id attribute. The element now also allows a mutilingual CMP group, so that it can be used as a notation definition element in mathematical vernacular.	192
private	cha	The replaces attribute is now called reformulates. The attributes pto and pto-version have moved to the data element. The attribute type has been removed and optional attributes theory, generated-from, and generated-via have been added.	202
proof	lib	The for attribute is now optional to allow for proofs as objects of mathematical discourse. Furthermore, it can now have generated-from and generated-via attributes.	161
proofobject	lib	The for attribute is now optional to allow for proofs as objects of mathematical discourse. Furthermore, it can now have generated-from and generated-via attributes.	169
recognizer	cha	The role attribute was fixed to object. The commonname child has been replaced by an initial metadata element.	157
ref	aug	ref now has an optional xml:id attribute that identifies it.	94
selector	cha	The role attribute was fixed to object. The commonname child has been replaced by an initial metadata element.	157
solution	cha	the solution element now allows arbitrary OMDoc top-level elements as children. Furthermore, it can now have a theory, generated-from, and generated-via attributes.	209

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

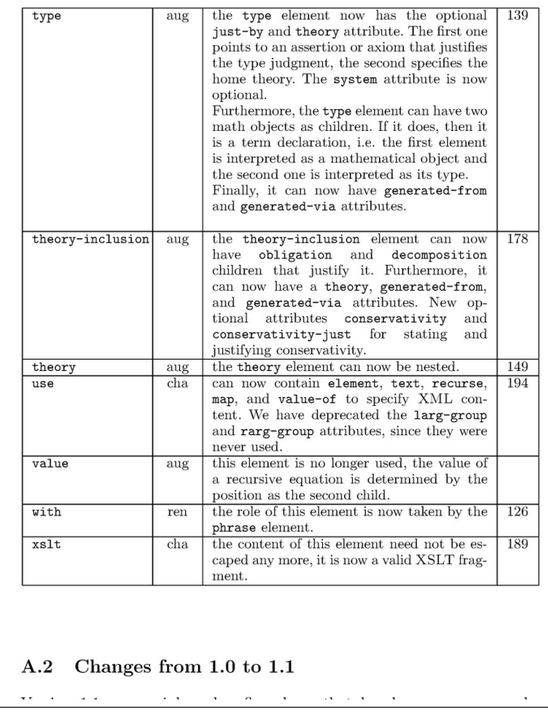
Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_072	326	—	(no LaTeX source; 1150 × 1501 px region)	—	

326 A Changes to the Specification

sortdef	cha	The role attribute was fixed to sort. The type from the adt element is now on the sortdef element. The commonname child has been replaced by an initial metadata element.	156
dc:subject	aug	The dc:subject can now have the optional dc:id, and CSS attributes	99
style	aug	The style element now allows a map element in the body	189
symbol	cha	may no longer contain selector, since it only makes sense for constructors in data types. The kind attribute has been renamed to role for compatibility with OpenMath2 and can have the additional values binder, attribution, semantic-attribution, and error corresponding to the OpenMath 2 roles. Furthermore, an optional attribute generated-via has been added to allow generation via a theory morphism.	136
term	new	the term element can appear in mathematical text and contain it. It is used to link technical terms to symbols defined in content dictionaries via its cd and name attributes.	128
theory	cha	the theory element loses the CMP and commonname children, use the Dublin Core metadata elements dc:description and dc:subject instead. The theory element also gains the optional cdbase attribute to specify the disambiguating string prescribed for content dictionaries by the OpenMath2 standard. The xml:id is now optional, it only needs to be specified, if the theory has constitutive elements. Finally, the element has gained the optional attributes cdurl, cdbase, cdreviewdate, cdversion, cdrevision, and cdstatus attributes for encoding the management metadata of OpenMath content dictionaries.	149
dc:title	aug	The dc:title can now have the optional dc:id, and CSS attributes.	98
tgroup	new	The tgroup can be used to structure theories like documents.	149

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value
Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

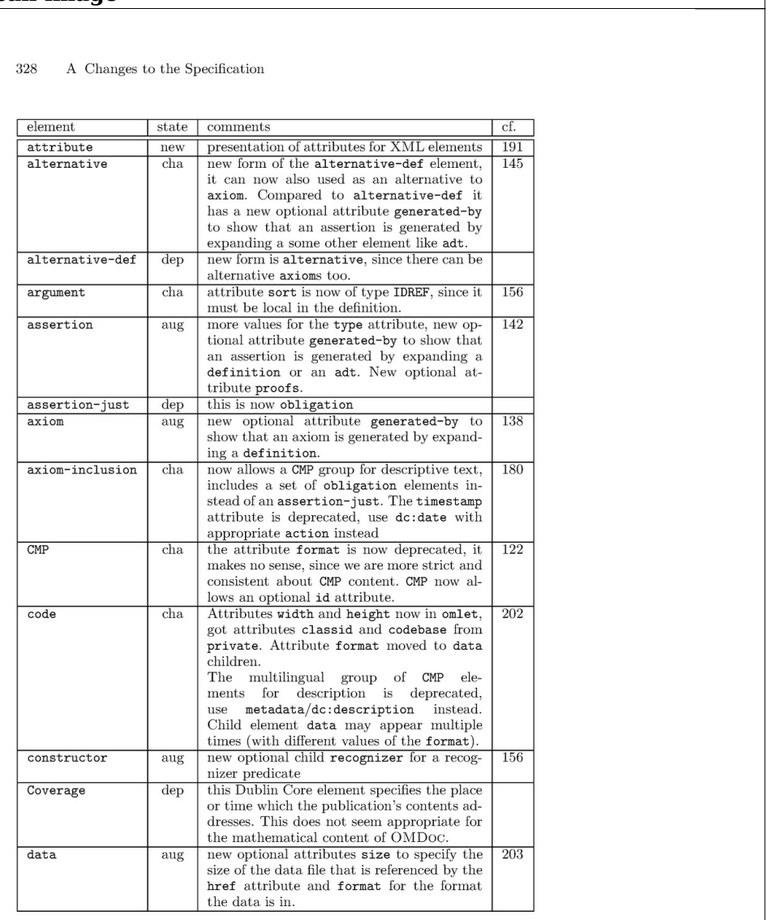
Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_073	327	—	(no LaTeX source; 1150 × 1284 px region)	—	

A.2 Changes from 1.0 to 1.1 327

type	aug	the type element now has the optional just-by and theory attribute. The first one points to an assertion or axiom that justifies the type judgment, the second specifies the home theory. The system attribute is now optional. Furthermore, the type element can have two math objects as children. If it does, then it is a term declaration, i.e. the first element is interpreted as a mathematical object and the second one is interpreted as its type. Finally, it can now have generated-from and generated-via attributes.	139
theory-inclusion	aug	the theory-inclusion element can now have obligation and decomposition children that justify it. Furthermore, it can now have a theory, generated-from, and generated-via attributes. New optional attributes conservativity and conservativity-just for stating and justifying conservativity.	178
theory	aug	the theory element can now be nested.	149
use	cha	can now contain element, text, recurse, map, and value-of to specify XML content. We have deprecated the larg-group and rarg-group attributes, since they were never used.	194
value	aug	this element is no longer used, the value of a recursive equation is determined by the position as the second child.	
with	ren	the role of this element is now taken by the phrase element.	126
xslt	cha	the content of this element need not be escaped any more, it is now a valid XSLT fragment.	189

A.2 Changes from 1.0 to 1.1

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value
Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_074	328	—	(no LaTeX source; 1150 × 1763 px region)	—	

328 A Changes to the Specification

element	state	comments	cf.
attribute	new	presentation of attributes for XML elements	191
alternative	cha	new form of the alternative-def element, it can now also used as an alternative to axiom. Compared to alternative-def it has a new optional attribute generated-by to show that an assertion is generated by expanding a some other element like adt.	145
alternative-def	dep	new form is alternative, since there can be alternative axioms too.	
argument	cha	attribute sort is now of type IDREF, since it must be local in the definition.	156
assertion	aug	more values for the type attribute, new optional attribute generated-by to show that an assertion is generated by expanding a definition or an adt. New optional attribute proofs.	142
assertion-just	dep	this is now obligation	
axiom	aug	new optional attribute generated-by to show that an axiom is generated by expanding a definition.	138
axiom-inclusion	cha	now allows a CMP group for descriptive text, includes a set of obligation elements instead of an assertion-just. The timestamp attribute is deprecated, use dc:date with appropriate action instead	180
CMP	cha	the attribute format is now deprecated, it makes no sense, since we are more strict and consistent about CMP content. CMP now allows an optional id attribute.	122
code	cha	Attributes width and height now in omlet, got attributes classid and codebase from private. Attribute format moved to data children. The multilingual group of CMP elements for description is deprecated, use metadata/dc:description instead. Child element data may appear multiple times (with different values of the format).	202
constructor	aug	new optional child recognizer for a recognizer predicate	156
Coverage	dep	this Dublin Core element specifies the place or time which the publication's contents addresses. This does not seem appropriate for the mathematical content of OMDoc.	
data	aug	new optional attributes size to specify the size of the data file that is referenced by the href attribute and format for the format the data is in.	203

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_075	329	—	(no LaTeX source; 1150 × 1825 px region)	—	

dc:date	aug	new optional who attribute that can be used to specify who did the action on this date.	99
Translator	dep	this element is not part of Dublin Core, it got into OMDoc by mistake, we use dc:contributor with role=trl for this.	98
decomposition	aug	has a new required id attribute. It is no longer a child of theory-inclusion, but specifies which theory-inclusion it justifies by the new required attribute for.	184
definition	aug	new optional children measure and ordering to specify termination of recursive definitions. New optional attribute generated-by to show that it is generated by expanding a definition.	139
element	new	presentation of XML elements	190
FMP	aug	now allows multiple conclusion elements, to represent general Gentzen-type sequents (not only natural deduction.) FMP now allows an optional id attribute.	123
hypothesis	cha	new required attribute discharged-in to specify the derive element that discharges this hypothesis.	162
measure	new	specifies a measure function (as an OMOBJ)	141
metadata	aug	new optional attribute inherits that allows to inherit metadata from other declarations	92
method	cha	first child that used to be an om:OMSTR or ref element is now moved into a required xref attribute that holds an URI that points to the element that defines the method. The om:OMOBJ content of the other children (they were parameter elements) is now directly included in the method element.	164
obligation	new	takes over the role of assertion-just.	
omgroup	aug	also allows the elements that can only appear in theory elements, so that omgroups can also be used for grouping inside theory elements. The type attribute is now restrained to one of narrative, sequence, alternative, contrast.	93
omlet	aug	obtained attributes width and height from private. New optional attributes action for the action to be taken when activated, and data a URIref to data in a private element. New optional attribute type for the type of the applet.	205
omstyle	new	for specifying the style of OMDoc elements	188
omtext	cha	the from is deprecated, we only leave the for attribute, to specify the referential character of the type.	124
ordering	new	specifies a well-founded ordering (as an OMOBJ)	141

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_076	330	—	(no LaTeX source; 1150 × 1754 px region)	—	

330 A Changes to the Specification

parameter	dep	the om:OMOBJ element child is now directly a child of method	
pattern	cha	the child can be an arbitrary OpenMath element.	
premise	cha	new optional attribute rank for the importance in the inference rule. The old href attribute is renamed to xref to be consistent with other cross-referencing.	
presentation	aug	New attribute xref that allows to inherit the information from another presentation element. New attribute theory to specify the theory the symbol is from; without this, referencing in OMDoc is not unique. The parent attribute has been renamed to role and now takes the values applied, binding, and key, since we want to be less OpenMath-centric	192
private	cha	new optional attribute for to point to an OMDoc element it provides data for. As a consequence, private elements are no longer allowed in other OMDoc elements, only on top-level. New attribute replaces as a pointer to the OMDoc elements that are replaced by the system-specific information in this element. Old attributes width and height now in omlet. Attribute format moved to data children. The descriptive CMP elements are deprecated, use metadata/dc:description instead. Child element data may appear multiple times (with different values of the format). The attributes classid and codebase are deprecated, since they only make sense on the code element.	q 202
proof	cha	attribute theory is now optional, since the element can appear inside a theory element.	161
proofobject	cha	attribute theory is now optional, since the element can appear inside a theory element.	161
recognizer	new	specifies the recognizer predicate of a sort.	157
recurse	new	recursive calls to presentation in style.	191
ref	cha	attribute kind renamed to type.	94
selector	cha	the old type attribute (had values total and partial) is deprecated, its duty is now carried by an attribute total (values yes and no).	157
signature	dep	for the moment	
sortdef	cha	has a mandatory name attribute, otherwise the defined symbol has no name.	156

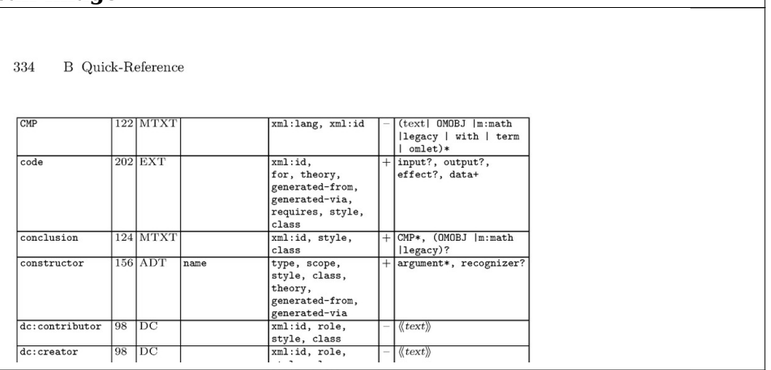
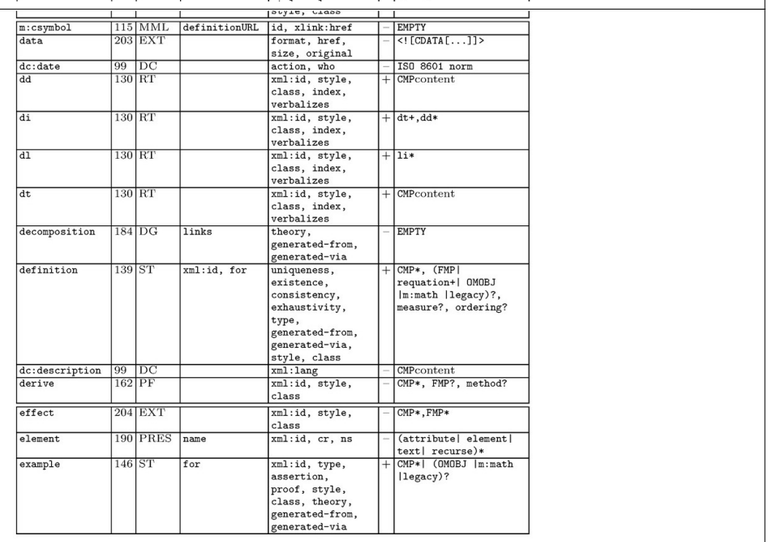
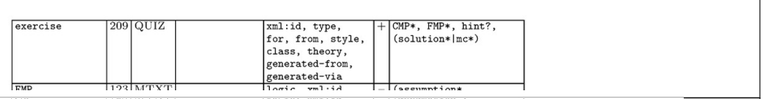
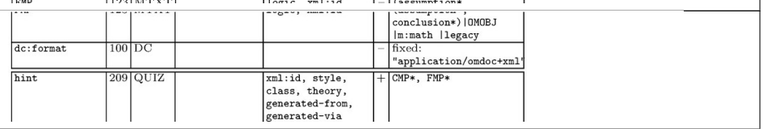
Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_077	331	—	(no LaTeX source; 1148 × 1005 px region)	—	A.2 Changes from 1.0 to 1.1 331 style | new | allows to specify style information in presentation and omstyle elements using a simplified OMDoc-internalized version of XSLT. | 189 symbol | aug | new optional attribute generated-by to show that it is generated by expanding a definition. | 136 text | new | presentation of text in omstyle. | 190 theory-inclusion | cha | now allows CMP group for descriptive text, no longer has a decomposition child, this is now attached by its for attribute. The timestamp attribute is deprecated, use dc:date with appropriate action instead. | 178 type | aug | can now also appear on top-level. Has an optional id attribute for identification, and an optional for attribute to point to a symbol element it declares type information for. | 139 use | aug | New attribute element allows to specify that the content should be encased in an XML element with the attribute-value pairs specified in the string specified in the attribute attributes. | 194 value-of | new | presentation of values in style. | 190 with | new | used to supply fragments of text in CMPs with style and id attributes that can be used for presentation and referencing. | 126 xslt | new | allows to embed XSLT into presentation and omstyle elements. | 189
kohlhase-omdoc_TAB_078	332	—	(no LaTeX source; 1141 × 64 px region)	—	Element | p. | Mod. | Required Attribs | Optional Attribs | D C | Content
kohlhase-omdoc_TAB_079	332	—	(no LaTeX source; 1139 × 990 px region)	—	adt | 156 | ADT | | xml:id, type, style, class, theory, generated-from, generated-via | + | sortdef+ alternative | 145 | ST | for, entailed-by, entails, entailed-by-thm, entails-thm | xml:id, type, theory, generated-from, generated-via, uniqueness, exhaustivity, consistency, existence, style, class | + | CMP*, (FMP| requation*| (OMOBJ |m:math |legacy)*) answer | 210 | QUIZ | verdict | xml:id, style, class | + | CMP*, FMP* m:apply | 115 | MML | | id, xlink:href | – | bvar?,((CMel))* argument | 156 | ADT | sort | | + | selector? assertion | 142 | ST | | xml:id, type, theory, generated-from, generated-via, style, class | + | CMP*, FMP* assumption | 124 | MTXT | | xml:id, inductive, style, class | + | CMP*, (OMOBJ |m:math |legacy)? attribute | 191 | PRES | name | | – | (value-of| text)* axiom | 138 | ST | name | xml:id, type, generated-from, generated-via, style, class | + | CMP*, FMP* axiom-inclusion | 180 | CTH | from, to | xml:id, style, class, theory, generated-from, generated-via | + | morphism?, (path-just| obligation*) m:bvar | 115 | MML | | id, xlink:href | – | ci* m:ci | 115 | MML | | id, xlink:href | – | PCDATA m:cn | 115 | MML | | id, xlink:href | – | ([0-9]|,|.) (*|e([0-9]|,|.)*)? choice | 210 | QUIZ | | xml:id, style, class | + | CMP*, FMP* M. Kohlhase: OMDoc, LNAI 4180, pp. 333–338, 2006.
kohlhase-omdoc_TAB_080	332	—	(no LaTeX source; 1139 × 175 px region)	—	

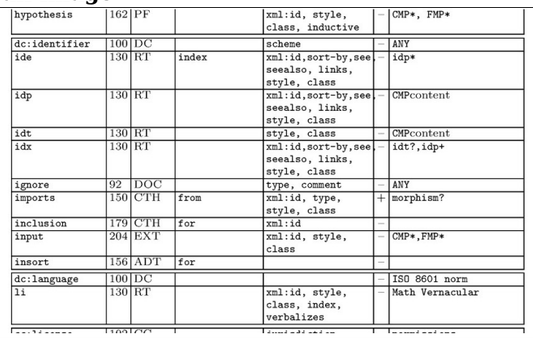
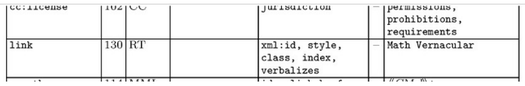
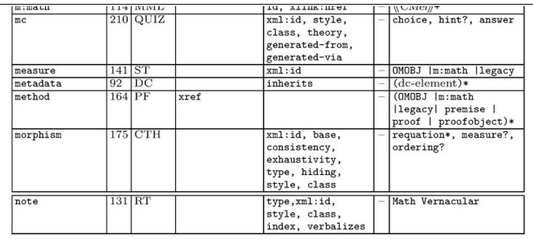
Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_081	333	—	(no LaTeX source; 1142 × 568 px region)	—	
kohlhase-omdoc_TAB_082	333	—	(no LaTeX source; 1141 × 852 px region)	—	
kohlhase-omdoc_TAB_083	333	—	(no LaTeX source; 1141 × 286 px region)	—	
kohlhase-omdoc_TAB_084	334	—	(no LaTeX source; 1142 × 288 px region)	—	
kohlhase-omdoc_TAB_085	334	—	(no LaTeX source; 1139 × 174 px region)	—	

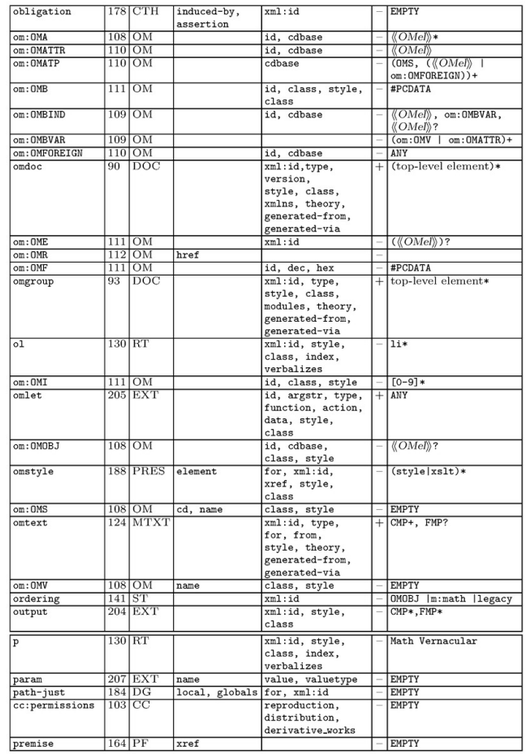
Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_086	334	—	(no LaTeX source; 1141 × 519 px region)	—	
kohlhase-omdoc_TAB_087	334	—	(no LaTeX source; 1141 × 120 px region)	—	
kohlhase-omdoc_TAB_088	334	—	(no LaTeX source; 1142 × 600 px region)	—	
kohlhase-omdoc_TAB_089	334	—	(no LaTeX source; 1139 × 90 px region)	—	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

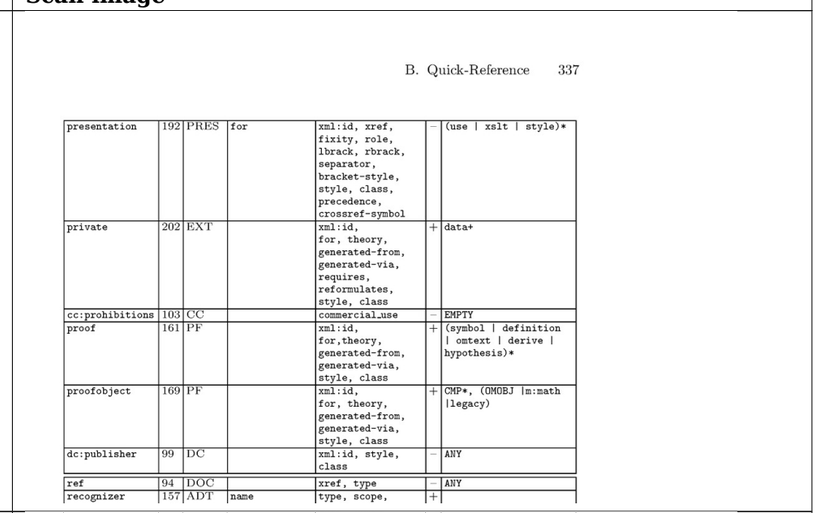
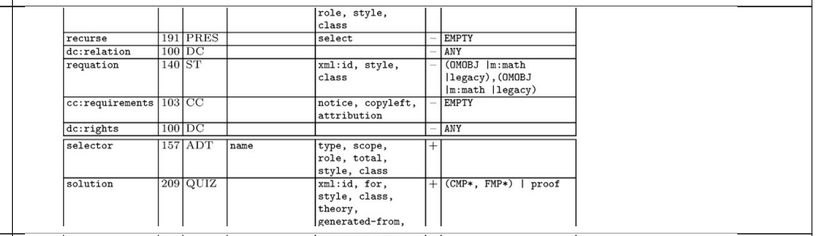
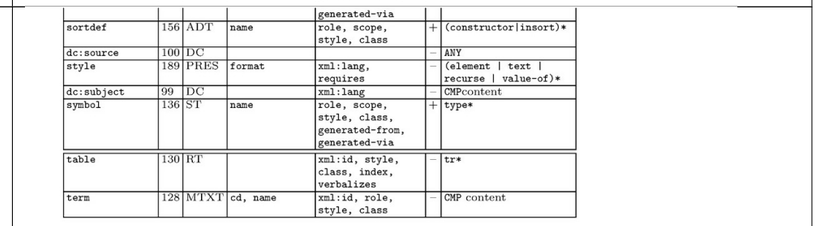
Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_090	335	—	(no LaTeX source; 1142 × 1395 px region)	—	
kohlhase-omdoc_TAB_091	335	—	(no LaTeX source; 1141 × 260 px region)	—	

336 B Quick-Reference

obligation	178	CTH	induced-by, assertion	xml:id	–	EMPTY
om:OMA	108	OM		id, cdbase	–	⟪OMel⟫*
om:OMATTR	110	OM		id, cdbase	–	⟪OMel⟫
om:OMATP	110	OM		cdbase	–	(OMS, (⟪OMel⟫ | om:OMFOREIGN))+
om:OMB	111	OM		id, class, style, class	–	#PCDATA
om:OMBIND	109	OM		id, cdbase	–	⟪OMel⟫, om:OMBVAR, ⟪OMel⟫?
om:OMBVAR	109	OM			–	(om:OMV | om:OMATTR)+
om:OMFOREIGN	110	OM		id, cdbase	–	ANY
omdoc	90	DOC		xml:id,type, version, style, class, xmlns, theory, generated-from, generated-via	+	(top-level element)*
om:OME	111	OM		xml:id	–	(⟪OMel⟫)?
om:OMR	112	OM	href		–	
om:OMF	111	OM		id, dec, hex	–	#PCDATA
omgroup	93	DOC		xml:id, type, style, class, modules, theory, generated-from, generated-via	+	top-level element*
ol	130	RT		xml:id, style, class, index, verbalizes	–	li*
om:OMI	111	OM		id, class, style	–	[0-9]*
omlet	205	EXT		id, argstr, type, function, action, data, style, class	+	ANY
om:OMOBJ	108	OM		id, cdbase, class, style	–	⟪OMel⟫?
omstyle	188	PRES	element	for, xml:id, xref, style, class	–	(style|xslt)*
om:OMS	108	OM	cd, name	class, style	–	EMPTY
omtext	124	MTXT		xml:id, type, for, from, style, theory, generated-from, generated-via	+	CMP+, FMP?
om:OMV	108	OM	name	class, style	–	EMPTY
ordering	141	ST		xml:id	–	OMOBJ |m:math |legacy
output	204	EXT		xml:id, style, class	–	CMP*,FMP*
p	130	RT		xml:id, style, class, index, verbalizes	–	Math Vernacular
param	207	EXT	name	value, valuetype	–	EMPTY
path-just	184	DG	local, globals	for, xml:id	–	EMPTY
cc:permissions	103	CC		reproduction, distribution, derivative_works	–	EMPTY
premise	164	PF	xref		–	EMPTY

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

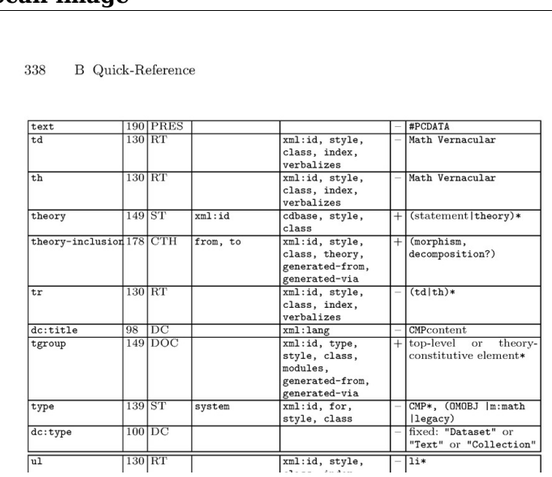
Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_092	336	—	(no LaTeX source; 1142 × 790 px region)	—	
kohlhase-omdoc_TAB_093	336	—	(no LaTeX source; 1141 × 349 px region)	—	
kohlhase-omdoc_TAB_094	336	—	(no LaTeX source; 1141 × 514 px region)	—	
kohlhase-omdoc_TAB_095	336	—	(no LaTeX source; 1141 × 147 px region)	—	

B. Quick-Reference 337

presentation	192	PRES	for	xml:id, xref, fixity, role, lbrack, rbrack, separator, bracket-style, style, class, precedence, crossref-symbol	–	(use | xslt | style)*
private	202	EXT		xml:id, for, theory, generated-from, generated-via, requires, reformulates, style, class	+	data+
cc:prohibitions	103	CC		commercial_use	–	EMPTY
proof	161	PF		xml:id, for,theory, generated-from, generated-via, style, class	+	(symbol | definition | omtext | derive | hypothesis)*
proofobject	169	PF		xml:id, for, theory, generated-from, generated-via, style, class	+	CMP*, (OMOBJ |m:math |legacy)
dc:publisher	99	DC		xml:id, style, class	–	ANY
ref	94	DOC		xref, type	–	ANY
recognizer	157	ADT	name	type, scope, role, style, class	+	
recurse	191	PRES		select	–	EMPTY
dc:relation	100	DC			–	ANY
requation	140	ST		xml:id, style, class	–	(OMOBJ |m:math |legacy),(OMOBJ |m:math |legacy)
cc:requirements	103	CC		notice, copyleft, attribution	–	EMPTY
dc:rights	100	DC			–	ANY
selector	157	ADT	name	type, scope, role, total, style, class	+	
solution	209	QUIZ		xml:id, for, style, class, theory, generated-from, generated-via	+	(CMP*, FMP*) | proof
sortdef	156	ADT	name	role, scope, style, class	+	(constructor|insort)*
dc:source	100	DC			–	ANY
style	189	PRES	format	xml:lang, requires	–	(element | text | recurse | value-of)*
dc:subject	99	DC		xml:lang	–	CMPcontent
symbol	136	ST	name	role, scope, style, class, generated-from, generated-via	+	type*
table	130	RT		xml:id, style, class, index, verbalizes	–	tr*
term	128	MTXT	cd, name	xml:id, role, style, class	–	CMP content

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

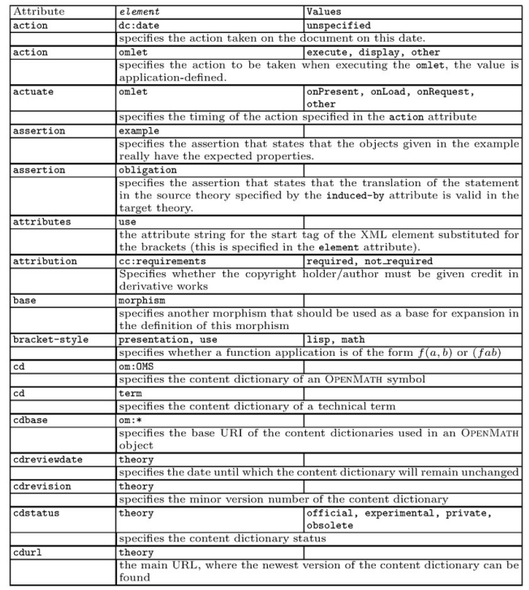
Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_096	337	—	(no LaTeX source; 1141 × 740 px region)	—	
kohlhase-omdoc_TAB_097	337	—	(no LaTeX source; 1139 × 455 px region)	—	

338 B Quick-Reference

text	190	PRES			–	#PCDATA
td	130	RT		xml:id, style, class, index, verbalizes	–	Math Vernacular
th	130	RT		xml:id, style, class, index, verbalizes	–	Math Vernacular
theory	149	ST	xml:id	cdbase, style, class	+	(statement|theory)*
theory-inclusion	178	CTH	from, to	xml:id, style, class, theory, generated-from, generated-via	+	(morphism, decomposition?)
tr	130	RT		xml:id, style, class, index, verbalizes	–	(td|th)*
dc:title	98	DC		xml:lang	–	CMPcontent
tgroup	149	DOC		xml:id, type, style, class, modules, generated-from, generated-via	+	top-level or theory-constitutive element*
type	139	ST	system	xml:id, for, style, class	–	CMP*, (OMOBJ |m:math |legacy)
dc:type	100	DC			–	fixed: "Dataset" or "Text" or "Collection"
ul	130	RT		xml:id, style, class, index, verbalizes	–	li*
use	194	PRES	format	xml:lang, requires, fixity, lbrack, rbrack, separator, crossref-symbol, element, attributes	–	(use | xslt | style)*
value-of	190	PRES	select		–	EMPTY
phrase	126	MTXT		xml:id, style, class, index, verbalizes, type	–	CMP content
xslt	189	PRES	format	xml:lang, requires	–	XSLT fragment

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_098	338	—	(no LaTeX source; 1142 × 1291 px region)	—	

Attribute	*element*	Values
action	dc:date	unspecified
	specifies the action taken on the document on this date.	
action	omlet	execute, display, other
	specifies the action to be taken when executing the omlet, the value is application-defined.	
actuate	omlet	onPresent, onLoad, onRequest, other
	specifies the timing of the action specified in the action attribute	
assertion	example	
	specifies the assertion that states that the objects given in the example really have the expected properties.	
assertion	obligation	
	specifies the assertion that states that the translation of the statement in the source theory specified by the induced-by attribute is valid in the target theory.	
attributes	use	
	the attribute string for the start tag of the XML element substituted for the brackets (this is specified in the element attribute).	
attribution	cc:requirements	required, not_required
	Specifies whether the copyright holder/author must be given credit in derivative works	
base	morphism	
	specifies another morphism that should be used as a base for expansion in the definition of this morphism	
bracket-style	presentation, use	lisp, math
	specifies whether a function application is of the form $f(a, b)$ or $(f\,a\,b)$	
cd	om:OMS	
	specifies the content dictionary of an OpenMath symbol	
cd	term	
	specifies the content dictionary of a technical term	
cdbase	om:*	
	specifies the base URI of the content dictionaries used in an OpenMath object	
cdreviewdate	theory	
	specifies the date until which the content dictionary will remain unchanged	
cdrevision	theory	
	specifies the minor version number of the content dictionary	
cdstatus	theory	official, experimental, private, obsolete
	specifies the content dictionary status	
cdurl	theory	
	the main URL, where the newest version of the content dictionary can be found	

M. Kohlhase: OMDoc, LNAI 4180, pp. 339–344, 2006.

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_099	339	—	(no LaTeX source; 1141 × 1817 px region)	—	

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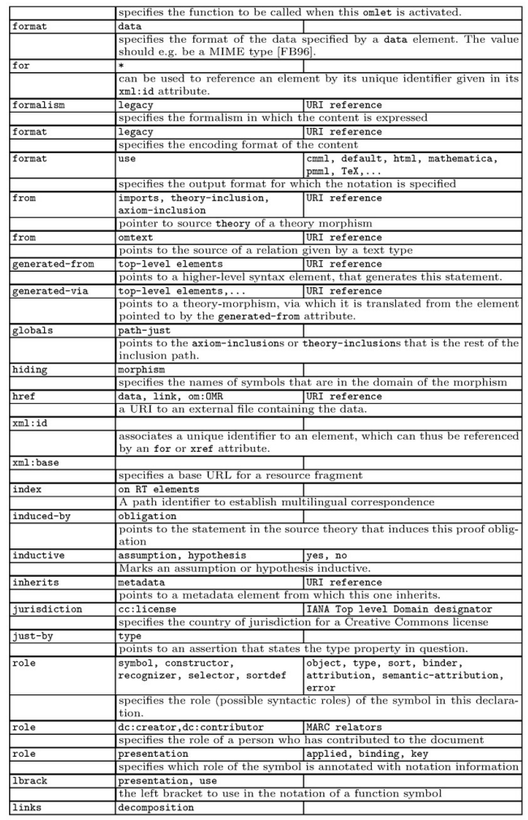
cdversion	theory	
	specifies the major version number of the content dictionary	
comment	ignore	
	specifies a reason why we want to ignore the contents	
crossref-symbol	presentation, use	all, brackets, lbrack, no, rbrack, separator, yes
	specifies whether cross-references to the symbol definition should be generated in the output format.	
class	*	
	specifies the CSS class	
commercial_use	cc:permissions	permitted, prohibited
	specifies, whether commercial use of the document with this license is permitted	
consistency	morphism, definition	OMDoc reference
	points to an assertion stating that the cases are consistent, i.e. that they give the same values, where they overlap	
copyleft	cc:restrictions	required, not_required
	specifies whether derived works must be licensed with the same license as the current document.	
cr	element	yes/no
	specifies whether an xlink:href cross-reference should be set on the result element.	
cref	om:*	URI reference
	extra attribute for cross-references in parallel markup	
crid	element	XPATH expression
	the path to the sub-element that corresponds to the result element.	
crossref-symbol	presentation, use	no, yes, brackets, separator, lbrack, rbrack, all
	specifies which generated presentation elements should carry cross-references to the definition.	
data	omlet	
	points to a private element that contains the data for this omlet	
definitionURL	m:*	URI
	points to the definition of a mathematical concept	
derivative_works	cc:permissions	permitted, not_permitted
	specifies whether the document may be used for making derivative works.	
distribution	cc:permissions	permitted,not_permitted
	specifies whether distribution of the current document fragment is permitted.	
element	use	
	the XML element tags to be substituted for the brackets.	
element	omstyle	
	the XML element, the presentation information contained in the omstyle element should be applied to.	
encoding	m:annotation,om:OMFOREIGN	MIME type of the content
	specifies the format of the content	
entails, entailed-by	alternative	
	specifies the equivalent formulations of a definition or axiom	
entails-thm, entailed-by-thm	alternative	
	specifies the entailment statements for equivalent formulations of a definition or axiom	
exhaustivity	morphism, definition	OMDoc reference
	points to an assertion that states that the cases are exhaustive.	
existence	definition	OMDoc reference
	points to an assertion that states that the symbol described in an implicit definition exists	
fixity	presentation	assoc, infix, postfix, prefix
	specifies where the function symbol-of a function application should be displayed in the output format	
function	omlet	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

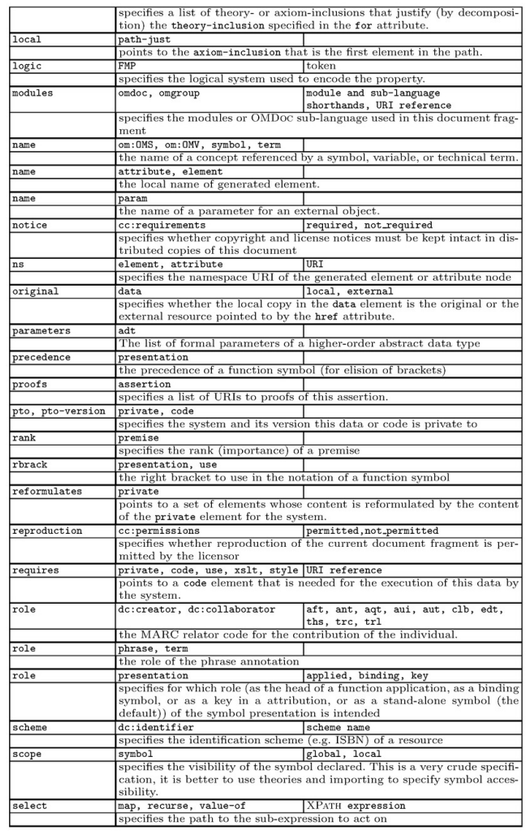
Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_100	340	—	(no LaTeX source; 1141 × 1798 px region)	—	

C. Table of Attributes 341

	specifies the function to be called when this omlet is activated.	
format	data	
	specifies the format of the data specified by a data element. The value should e.g. be a MIME type [FB96].	
for	*	
	can be used to reference an element by its unique identifier given in its xml:id attribute.	
formalism	legacy	URI reference
	specifies the formalism in which the content is expressed	
format	legacy	URI reference
	specifies the encoding format of the content	
format	use	cmml, default, html, mathematica, pmml, TeX,...
	specifies the output format for which the notation is specified	
from	imports, theory-inclusion, axiom-inclusion	URI reference
	pointer to source theory of a theory morphism	
from	omtext	URI reference
	points to the source of a relation given by a text type	
generated-from	top-level elements	URI reference
	points to a higher-level syntax element, that generates this statement.	
generated-via	top-level elements,...	URI reference
	points to a theory-morphism, via which it is translated from the element pointed to by the generated-from attribute.	
globals	path-just	
	points to the axiom-inclusions or theory-inclusions that is the rest of the inclusion path.	
hiding	morphism	
	specifies the names of symbols that are in the domain of the morphism	
href	data, link, om:OMR	URI reference
	a URI to an external file containing the data.	
xml:id		
	associates a unique identifier to an element, which can thus be referenced by an for or xref attribute.	
xml:base		
	specifies a base URL for a resource fragment	
index	on RT elements	
	A path identifier to establish multilingual correspondence	
induced-by	obligation	
	points to the statement in the source theory that induces this proof obligation	
inductive	assumption, hypothesis	yes, no
	Marks an assumption or hypothesis inductive.	
inherits	metadata	URI reference
	points to a metadata element from which this one inherits.	
jurisdiction	cc:license	IANA Top level Domain designator
	specifies the country of jurisdiction for a Creative Commons license	
just-by	type	
	points to an assertion that states the type property in question.	
role	symbol, constructor, recognizer, selector, sortdef	object, type, sort, binder, attribution, semantic-attribution, error
	specifies the role (possible syntactic roles) of the symbol in this declaration.	
role	dc:creator,dc:contributor	MARC relators
	specifies the role of a person who has contributed to the document	
role	presentation	applied, binding, key
	specifies which role of the symbol is annotated with notation information	
lbrack	presentation, use	
	the left bracket to use in the notation of a function symbol	
links	decomposition	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_101	341	—	(no LaTeX source; 1141 × 1823 px region)	—	

342 C Table of Attributes

	specifies a list of theory- or axiom-inclusions that justify (by decomposition) the `theory-inclusion` specified in the `for` attribute.	
`local`	`path-just`	
	points to the `axiom-inclusion` that is the first element in the path.	
`logic`	`FMP`	`token`
	specifies the logical system used to encode the property.	
`modules`	`omdoc, omgroup`	`module and sub-language shorthands, URI reference`
	specifies the modules or OMDoc sub-language used in this document fragment	
`name`	`om:OMS, om:OMV, symbol, term`	
	the name of a concept referenced by a symbol, variable, or technical term.	
`name`	`attribute, element`	
	the local name of generated element.	
`name`	`param`	
	the name of a parameter for an external object.	
`notice`	`cc:requirements`	`required, not_required`
	specifies whether copyright and license notices must be kept intact in distributed copies of this document	
`ns`	`element, attribute`	`URI`
	specifies the namespace URI of the generated element or attribute node	
`original`	`data`	`local, external`
	specifies whether the local copy in the `data` element is the original or the external resource pointed to by the `href` attribute.	
`parameters`	`adt`	
	The list of formal parameters of a higher-order abstract data type	
`precedence`	`presentation`	
	the precedence of a function symbol (for elision of brackets)	
`proofs`	`assertion`	
	specifies a list of URIs to proofs of this assertion.	
`pto, pto-version`	`private, code`	
	specifies the system and its version this data or code is private to	
`rank`	`premise`	
	specifies the rank (importance) of a premise	
`rbrack`	`presentation, use`	
	the right bracket to use in the notation of a function symbol	
`reformulates`	`private`	
	points to a set of elements whose content is reformulated by the content of the `private` element for the system.	
`reproduction`	`cc:permissions`	`permitted,not_permitted`
	specifies whether reproduction of the current document fragment is permitted by the licensor	
`requires`	`private, code, use, xslt, style`	`URI reference`
	points to a `code` element that is needed for the execution of this data by the system.	
`role`	`dc:creator, dc:collaborator`	`aft, ant, aqt, aui, aut, clb, edt, ths, trc, trl`
	the MARC relator code for the contribution of the individual.	
`role`	`phrase, term`	
	the role of the phrase annotation	
`role`	`presentation`	`applied, binding, key`
	specifies for which role (as the head of a function application, as a binding symbol, or as a key in a attribution, or as a stand-alone symbol (the default)) of the symbol presentation is intended	
`scheme`	`dc:identifier`	`scheme name`
	specifies the identification scheme (e.g. ISBN) of a resource	
`scope`	`symbol`	`global, local`
	specifies the visibility of the symbol declared. This is a very crude specification, it is better to use theories and importing to specify symbol accessibility.	
`select`	`map, recurse, value-of`	XPATH `expression`
	specifies the path to the sub-expression to act on	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

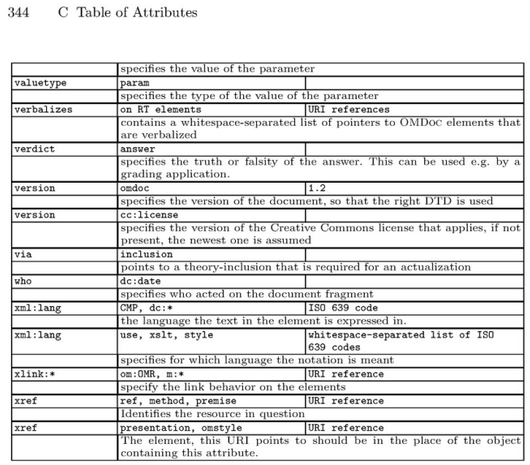
Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_102	342	—	(no LaTeX source; 1141 × 1814 px region)	—	

separator	presentation, use	
	the separator for the arguments to use in the notation of a function symbol	
show	omlet	new, replace, embed, other
	specifies the desired presentation of the external object.	
size	data	
	specifies the size the data specified by a data element. The value should be number of kilobytes	
sort	argument	
	specifies the argument sort of the constructor	
style	*	
	specifies a token for a presentation style to be picked up in a presentation element.	
system	type	
	A token that specifies the logical type system that governs the type specified in the type element.	
theory	*	
	specifies the home theory of an OMDoc statement.	
to	theory-inclusion, axiom-inclusion	
	specifies the target theory	
total	selector	no, yes
	specifies whether the symbol declared here is a total or partial function.	
type	adt	free, generated, loose
	defines the semantics of an abstract data type free = no junk, no confusion, generated = no junk, loose is the general case.	
type	assertion	theorem, lemma, corollary, conjecture, false-conjecture, obligation, postulate, formula, assumption, proposition
	tells you more about the intention of the assertion	
type	definition	implicit, inductive, obj, recursive, simple
	specifies the definition principle	
type	derive	conclusion, gap
	singles out special proof steps: conclusions and gaps (unjustified proof steps)	
type	example	against, for
	specifies whether the objects in this example support or falsify some conjecture	
type	ignore	
	specifies the type of error, if ignore is used for in-place error markup	
type	imports	global, local
	local imports only concern the assumptions directly stated in the theory. global imports also concern the ones the source theory inherits.	
type	morphism	
	specifies whether the morphism is recursive or merely pattern-defined	
type	omgroup, omdoc	enumeration, sequence, itemize
	the first three give the text category, the second three are used for generalized tables	
type	omtext	abstract, antithesis, comment, conclusion, elaboration, evidence, introduction, motivation, thesis
	a specification of the intention of the text fragment, in reference to context.	
type	phrase	
	the linguistic or mathematical type of the phrase	
type	ref	include, cite
	specifies whether to replace the ref element by the fragment referenced by href attribute or to merely cite it.	
uniqueness	definition	URI reference
	points to an assertion that states the uniqueness of the concept described in an implicit definition	
value	param	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Identifier	Page	Conf.	LaTeX source	Rendered	Scan image
kohlhase-omdoc_TAB_103	343	—	(no LaTeX source; 1139 × 885 px region)	—	

344 C Table of Attributes

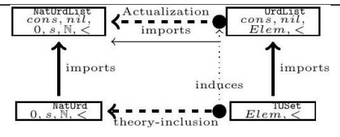
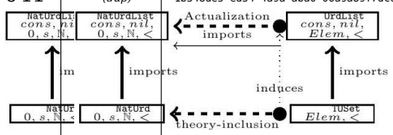
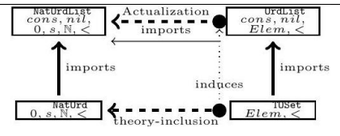
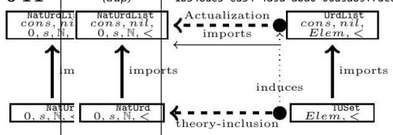
	specifies the value of the parameter	
valuetype	param	
	specifies the type of the value of the parameter	
verbalizes	on RT elements	URI references
	contains a whitespace-separated list of pointers to OMDoc elements that are verbalized	
verdict	answer	
	specifies the truth or falsity of the answer. This can be used e.g. by a grading application.	
version	omdoc	1.2
	specifies the version of the document, so that the right DTD is used	
version	cc:license	
	specifies the version of the Creative Commons license that applies, if not present, the newest one is assumed	
via	inclusion	
	points to a theory-inclusion that is required for an actualization	
who	dc:date	
	specifies who acted on the document fragment	
xml:lang	CMP, dc:*	ISO 639 code
	the language the text in the element is expressed in.	
xml:lang	use, xslt, style	whitespace-separated list of ISO 639 codes
	specifies for which language the notation is meant	
xlink:*	om:OMR, m:*	URI reference
	specify the link behavior on the elements	
xref	ref, method, premise	URI reference
	Identifies the resource in question	
xref	presentation, omstyle	URI reference
	The element, this URI points to should be in the place of the object containing this attribute.	

Conf. MathPix confidence: ■ ≥0.9 ■ 0.5–0.9 ■ <0.5 — no value

Residual render vs scan (inkdrill): • C component • W weak • S stable • N noise • K clean • not measured

Image regions — rendered against scan

Two comparable cells per row. **Rendered**: the region's own LaTeX compiled as its OWN document, or — where no LaTeX exists — the scan again, so every row has two cells and the ink difference reads as a floor rather than as missing-versus-present. A duplicated row is marked *(dup)* and its distance is a SELF-comparison, not agreement between two sources. **Scan**: the `tex.zip` image whose filename region 5-tuple matches this row, else the CDN crop. The Class column carries the residual class beside MathPix's confidence, as the equation rows do. Setting a region's LaTeX does NOT say it renders to what is on the page — that is what the two columns are for, and 281 is the open question they exist to let a reader answer. A region with no LaTeX can be reconstructed with `pdfdrill vision`; verify any LLM result against the real ink with inkdrill.

Identifier	Page	Class	Source	Author source	Rendered	Scan
kohlhase-omdoc_PIC_0001	033	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-033_27_448_1649_193.jpg	<FMP>$\forall a, b.a + b = b + a$</FMP>	<FMP>$\forall a, b.a + b = b + a$</FMP>	<FMP>$\forall a, b.a + b = b + a$</FMP>
kohlhase-omdoc_PIC_0002	041	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-041_192_504_539_762.jpg			
kohlhase-omdoc_PIC_0003	041	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-041_192_504_539_762.jpg			
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kohlhase-omdoc_PIC_0008	072	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-072_32_256_1791_215.jpg	$\forall S \subseteq M.S^* = S \backslash \{e\}$	$\forall S \subseteq M.S^* = S \backslash \{e\}$	$\forall S \subseteq M.S^* = S \backslash \{e\}$
kohlhase-omdoc_PIC_0009	073	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-073_29_990_1110_193.jpg	<axiom xml:id="inv.ax"><FMP>$\forall x \in M.\exists y \in M.x \circ y = e$</FMP></axiom>	<axiom xml:id="inv.ax"><FMP>$\forall x \in M.\exists y \in M.x \circ y = e$</FMP></axiom>	<axiom xml:id="inv.ax"><FMP>$\forall x \in M.\exists y \in M.x \circ y = e$</FMP></axiom>
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kohlhase-omdoc_PIC_0014	131	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-131_29_582_1415_168.jpg	<CMP>If $a \in U$ and $a \in V$, then $a \in U \cap V$ or	<CMP>If $a \in U$ and $a \in V$, then $a \in U \cap V$ or	<CMP>If $a \in U$ and $a \in V$, then $a \in U \cap V$ or
kohlhase-omdoc_PIC_0015	148	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-148_29_856_1694_193.jpg	<FMP>$\forall S.sgrp(S) \rightarrow \forall x, y.unit(x, S) \wedge unit(y, S) \rightarrow x = y$</FMP>	<FMP>$\forall S.sgrp(S) \rightarrow \forall x, y.unit(x, S) \wedge unit(y, S) \rightarrow x = y$</FMP>	<FMP>$\forall S.sgrp(S) \rightarrow \forall x, y.unit(x, S) \wedge unit(y, S) \rightarrow x = y$</FMP>
kohlhase-omdoc_PIC_0016	158	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-158_30_1039_965_218.jpg	<CMP>$\texttt{neut}$ is a left unit for $\texttt{op}$.</CMP><FMP>$\forall x \in \texttt{set.op}(x, \texttt{neut}) = x$</FMP>	<CMP>$\texttt{neut}$ is a left unit for $\texttt{op}$.</CMP><FMP>$\forall x \in \texttt{set.op}(x, \texttt{neut}) = x$</FMP>	<CMP>$\texttt{neut}$ is a left unit for $\texttt{op}$.</CMP><FMP>$\forall x \in \texttt{set.op}(x, \texttt{neut}) = x$</FMP>
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kohlhase-omdoc_DIA_0002	019	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0003	022	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
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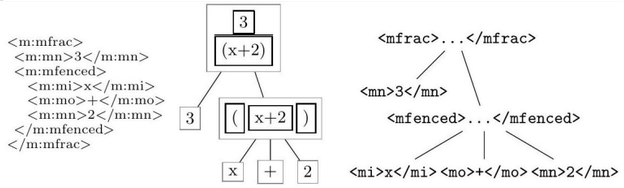
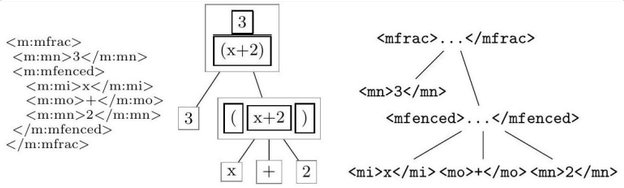
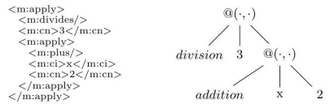
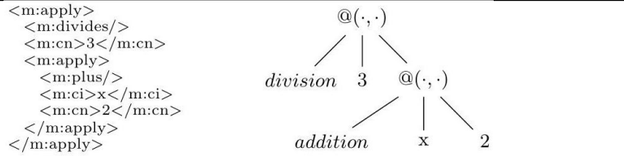
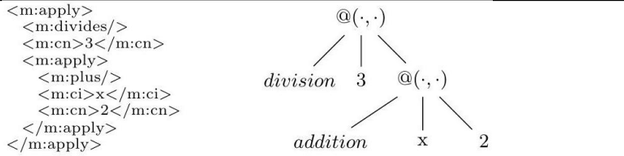
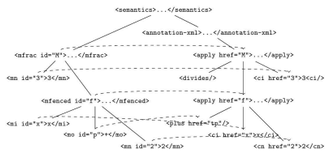
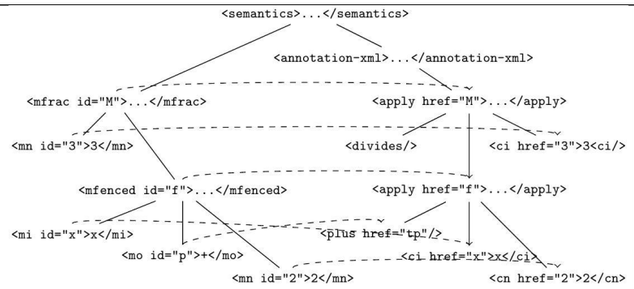
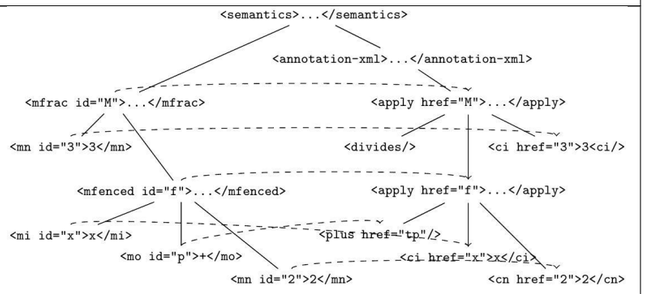
kohlhase-omdoc_DIA_0005	030	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-030_343_1141_196_172.jpg			
kohlhase-omdoc_DIA_0006	030	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-030_249_786_1199_341.jpg			
kohlhase-omdoc_DIA_0007	031	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-031_502_1107_720_192.jpg			
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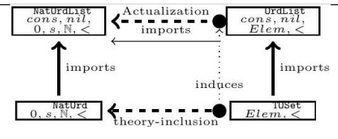
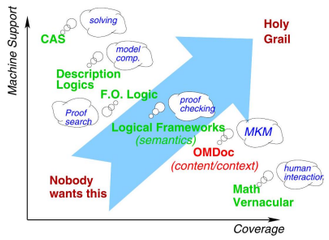
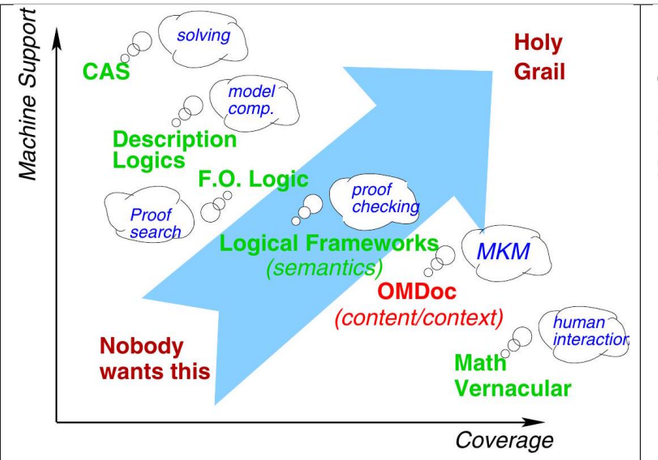
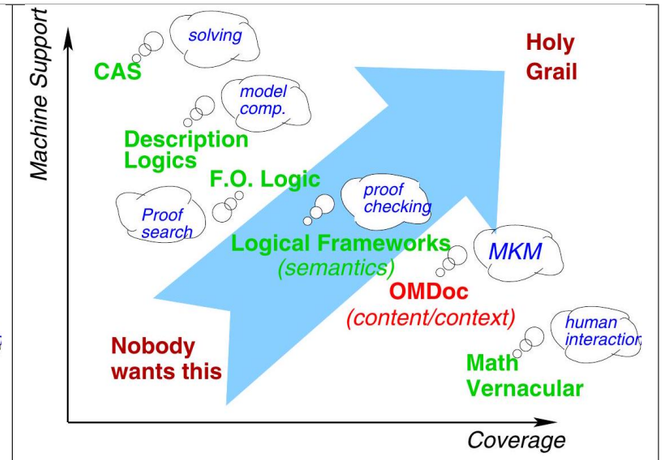
kohlhase-omdoc_DIA_0009	033	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0010 *contested: 3 rows* *share this crop*	041	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-041_192_504_539_762.jpg			

kohlhase-omdoc_DIA_0011	042	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-042_796_1094_1139_200.jpg			
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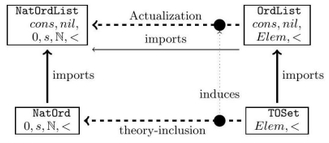
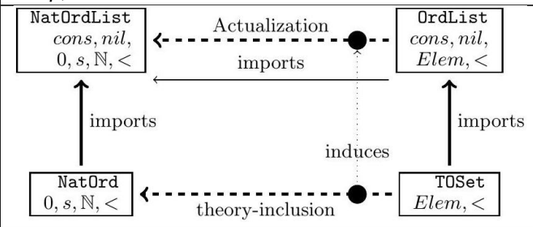
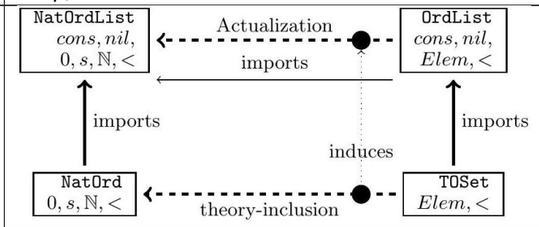
kohlhase-omdoc_DIA_0029	067	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-067_346_824_1214_333.jpg			

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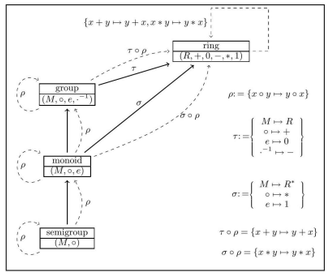
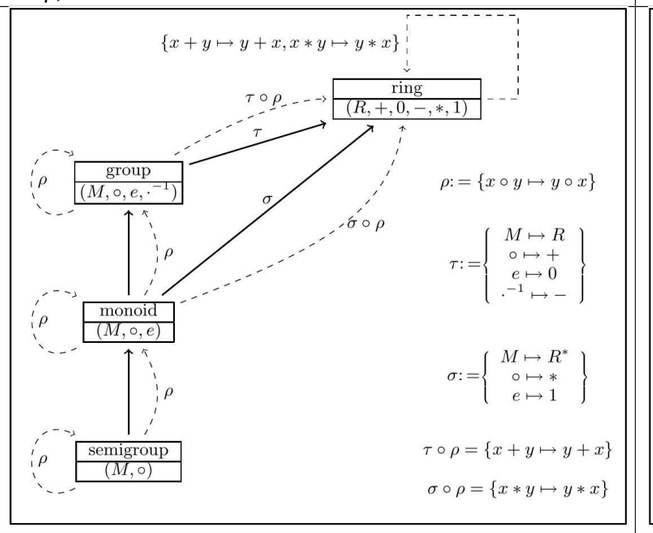
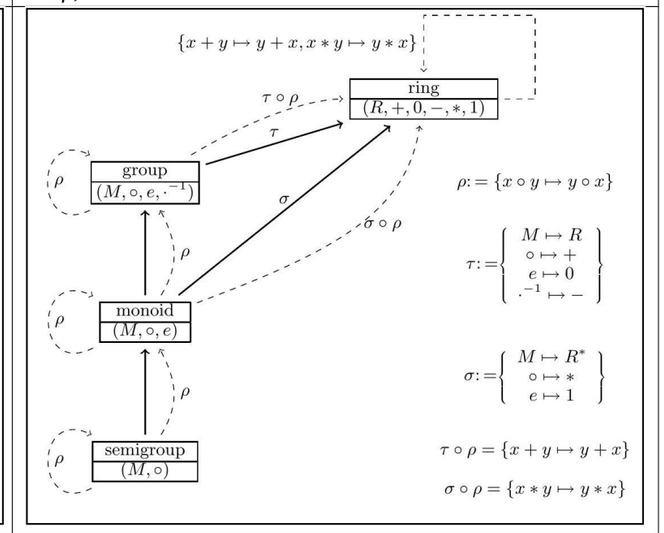
kohlhase-omdoc_DIA_0035	071	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-071_919_1096_1017_177.jpg			
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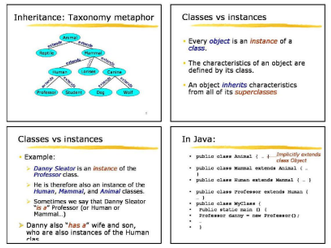
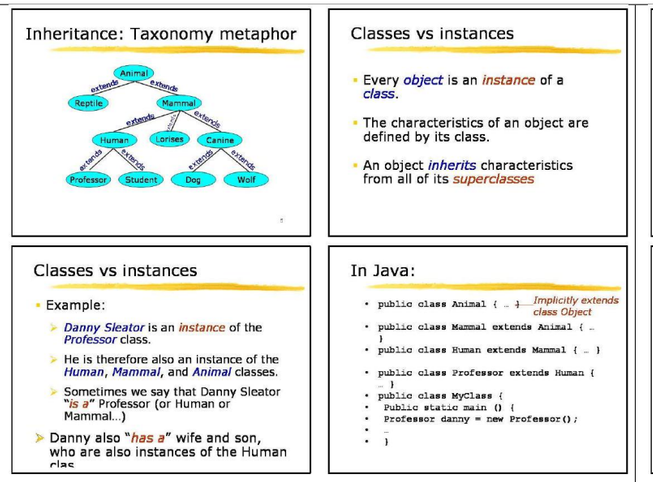
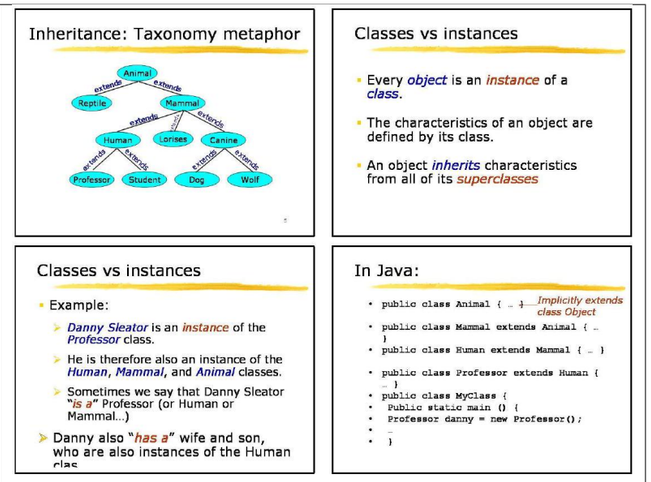
kohlhase-omdoc_DIA_0043	075	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*

kohlhase-omdoc_DIA_0044	076	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-076_843_1110_1056_168.jpg			
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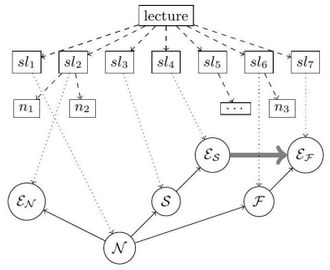
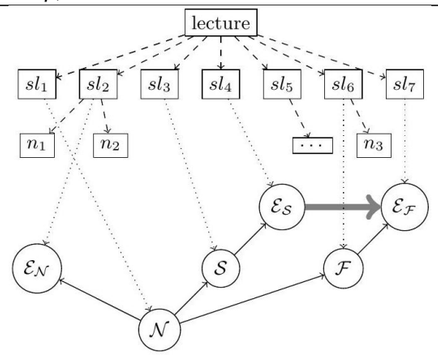
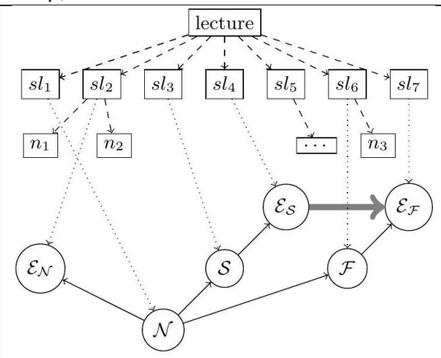
kohlhase-omdoc_DIA_0051	084	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-084_560_679_1001_405.jpg			
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kohlhase-omdoc_DIA_0056	089	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
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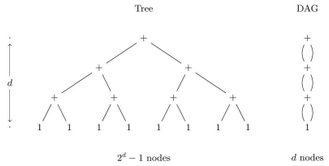
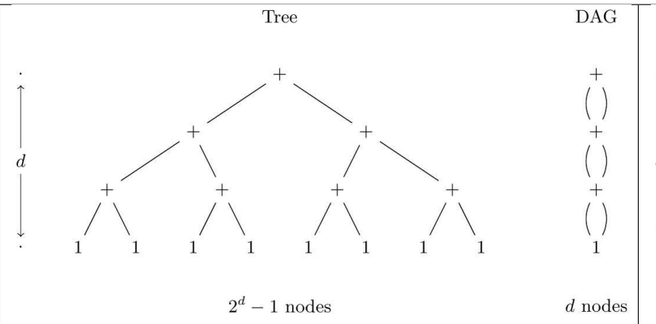
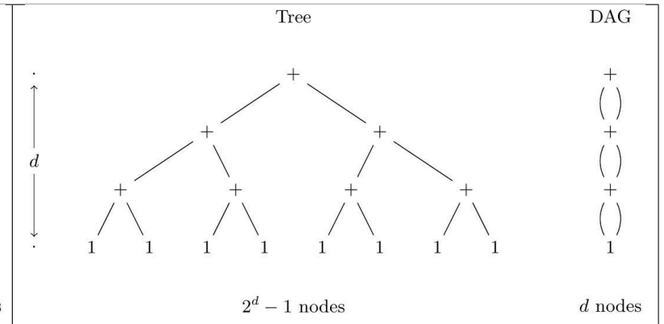
kohlhase-omdoc_DIA_0073	119	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-119_534_1060_481_215.jpg			
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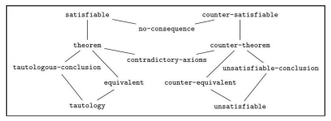
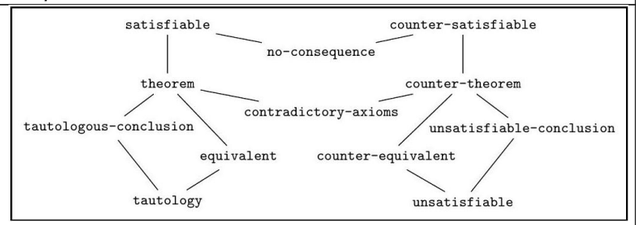
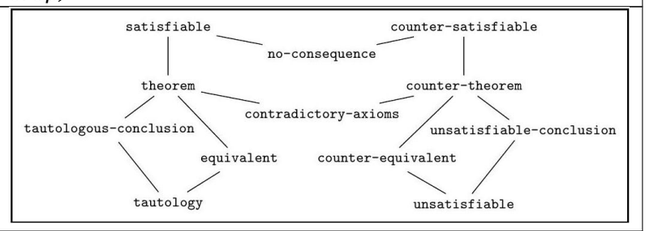
kohlhase-omdoc_DIA_0097	150	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-150_360_1033_1484_228.jpg			
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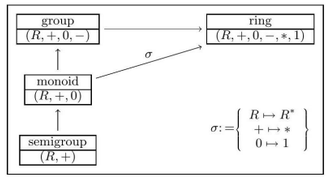
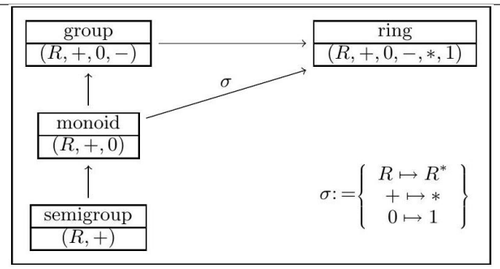
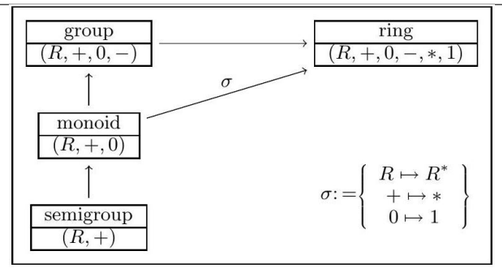
kohlhase-omdoc_DIA_0113	175	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0114	176	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-176_1157_1155_537_168.jpg	$\dfrac{\dfrac{\dfrac{[A\wedge B]}{B}\wedge E_r \quad \dfrac{[A\wedge B]}{A}\wedge E_l}{B\wedge A}\wedge I}{A\wedge B \Rightarrow B\wedge A}\Rightarrow I$ The schema on the left shows the proof as a natural deduction proof tree, the OMDoc representation gives the proof object as a λ term. This term would be written as the following term in traditional (mathematical) notation: $\Rightarrow I(\lambda X : A\wedge B.\wedge I(\wedge E_r(X), \wedge E_l(X)))$	<proofobject xml:id="ac.p" for="#and−comm"> <metadata> <dc:description> Assuming $A\wedge B$ we have B and A from which we can derive $B\wedge A$. </dc:description> </metadata> <OMOBJ> <OMBIND id="andcom.pf"> <OMS cd="PL0ND" name="impliesI"/> <OMBVAR> <OMATTR> <OMATP> <OMS cd="PL0ND" name="type"/> $A\wedge B$ </OMATP> <OMV name="X"/> </OMATTR> </OMBVAR> <OMA> <OMS cd="PL0ND" name="andI"/> <OMA> <OMA> <OMS cd="PL0ND" name="andEr"/> <OMV name="X"/> </OMA> <OMA> <OMS cd="PL0ND" name="andEl"/> <OMV name="X"/> </OMA> </OMA> </OMA> </OMBIND> </OMOBJ> </proofobject>	$\dfrac{\dfrac{\dfrac{[A\wedge B]}{B}\wedge E_r \quad \dfrac{[A\wedge B]}{A}\wedge E_l}{B\wedge A}\wedge I}{A\wedge B \Rightarrow B\wedge A}\Rightarrow I$ The schema on the left shows the proof as a natural deduction proof tree, the OMDoc representation gives the proof object as a λ term. This term would be written as the following term in traditional (mathematical) notation: $\Rightarrow I(\lambda X : A\wedge B.\wedge I(\wedge E_r(X), \wedge E_l(X)))$
kohlhase-omdoc_DIA_0115	177	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0116	177	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0117	179	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-179_422_809_762_341.jpg	$\begin{tikzcd} \boxed{\text{group}^+ \mid (R,+,0,-)} & \boxed{\text{ring}^{+,*} \mid (R,R^*,+,0,-,*,1)} \arrow[l] \\ \boxed{\text{monoid}^+ \mid (R,+,0)} \arrow[u] & \boxed{\text{monoid}^* \mid (R^*,*,1)} \arrow[u] \\ \boxed{\text{semigroup}^+ \mid (R,+)} \arrow[u] & \boxed{\text{semigroup}^* \mid (R^*,*)} \arrow[u] \end{tikzcd}$	$\begin{tikzcd} \boxed{\text{group}^+ \mid (R,+,0,-)} & \boxed{\text{ring}^{+,*} \mid (R,R^*,+,0,-,*,1)} \arrow[l] \\ \boxed{\text{monoid}^+ \mid (R,+,0)} \arrow[u] & \boxed{\text{monoid}^* \mid (R^*,*,1)} \arrow[u] \\ \boxed{\text{semigroup}^+ \mid (R,+)} \arrow[u] & \boxed{\text{semigroup}^* \mid (R^*,*)} \arrow[u] \end{tikzcd}$

kohlhase-omdoc_DIA_0118	180	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-180_421_779_201_356.jpg			
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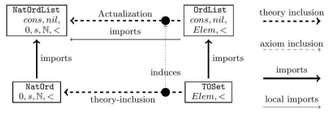
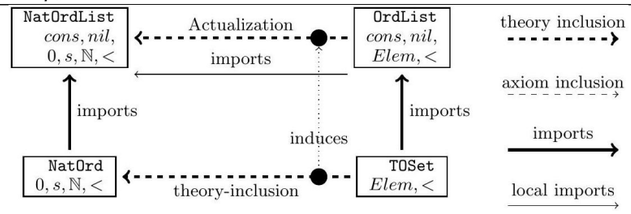
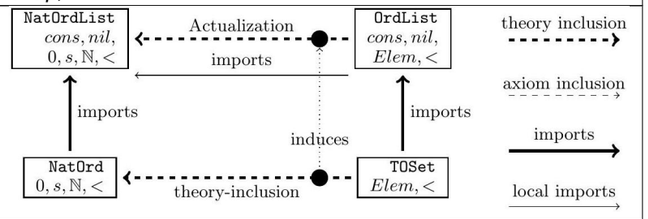
kohlhase-omdoc_DIA_0121	185	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-185_365_1101_210_195.jpg			
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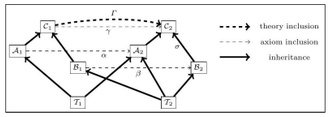
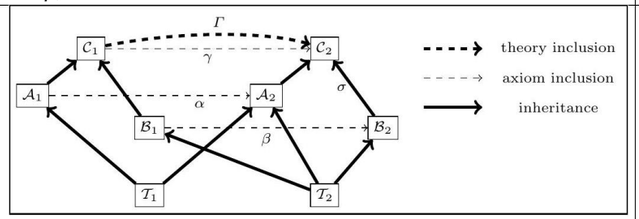
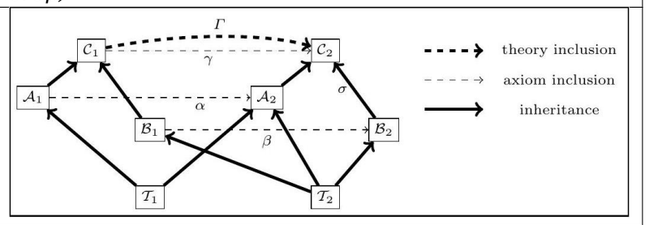
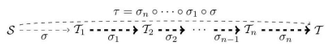
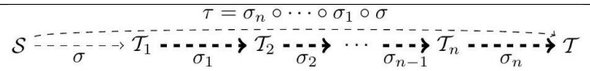
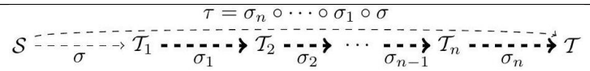
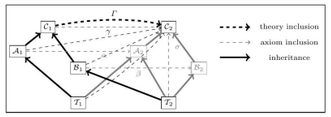
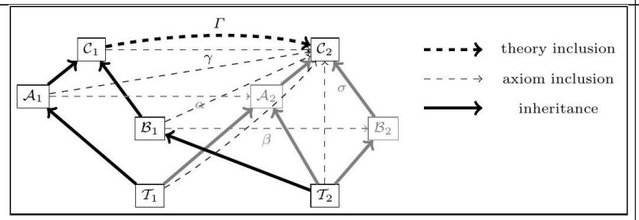
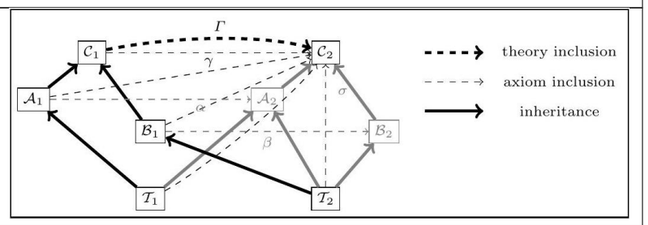
kohlhase-omdoc_DIA_0123	188	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-188_355_1045_204_223.jpg			
kohlhase-omdoc_DIA_0124	188	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-188_104_922_805_281.jpg			
kohlhase-omdoc_DIA_0125	189	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-189_356_1046_202_222.jpg			
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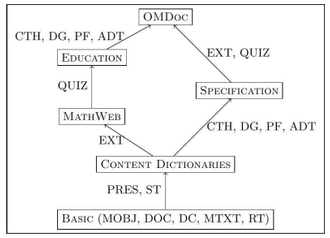
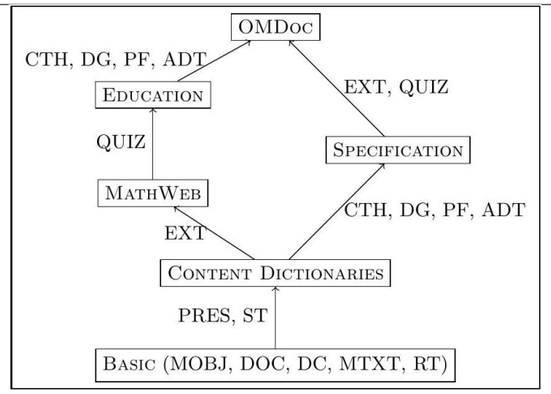
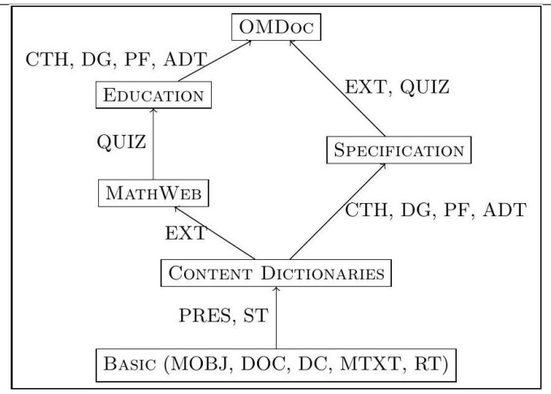
kohlhase-omdoc_DIA_0157	222	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-222_618_856_202_317.jpg			
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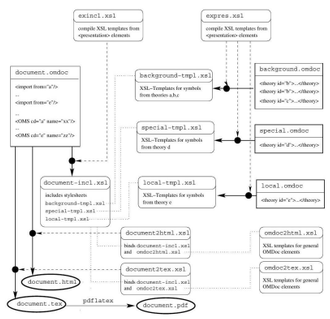
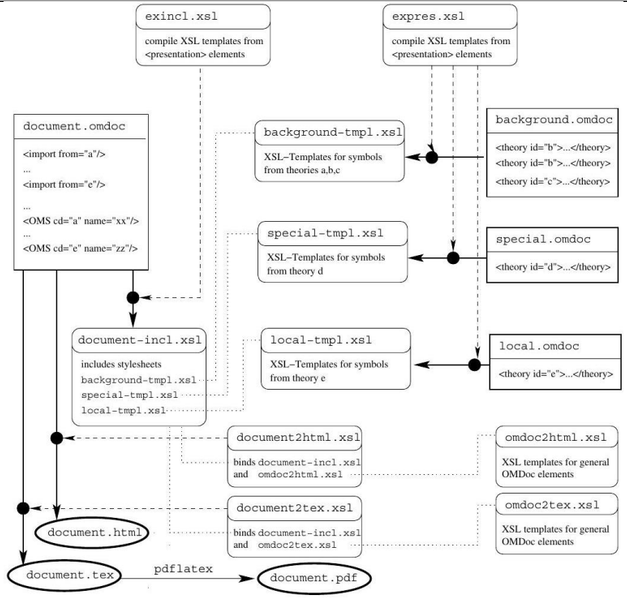
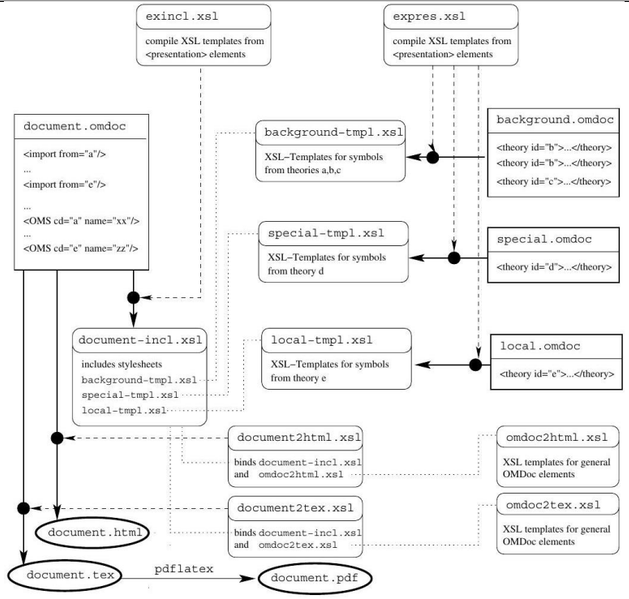
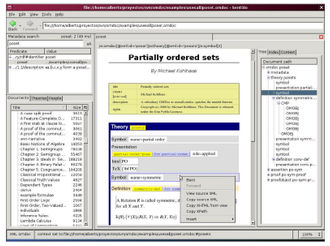
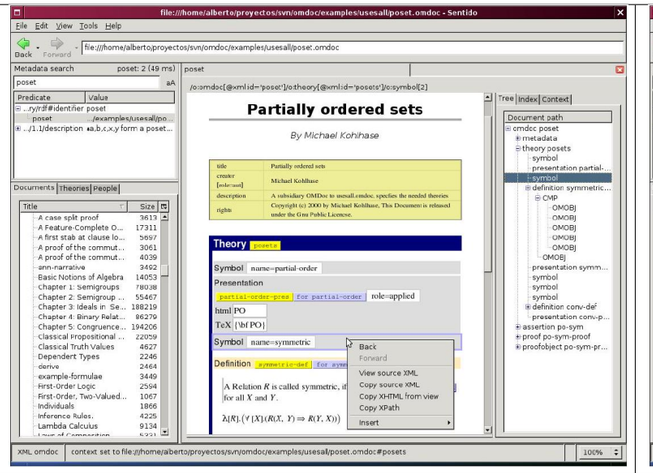
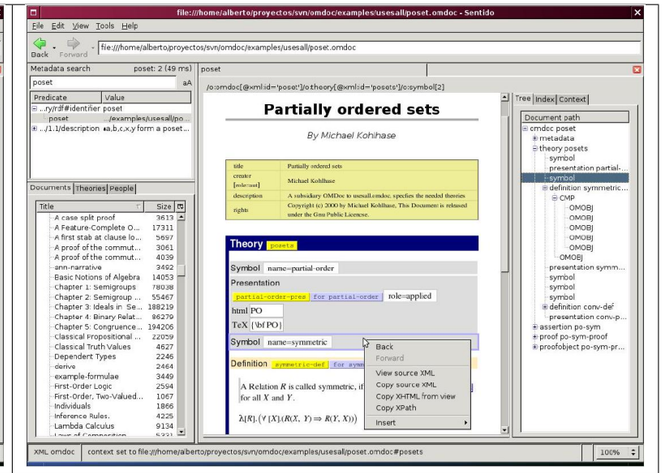
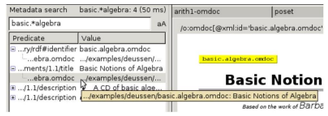
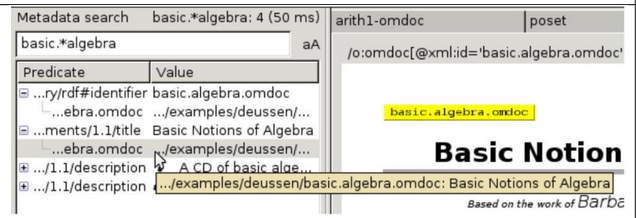
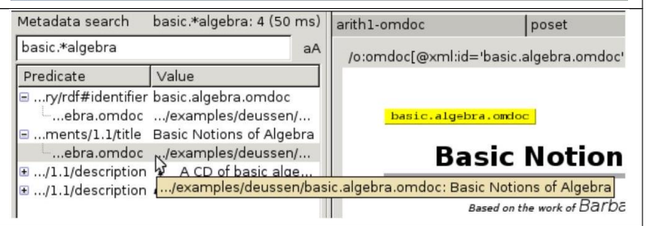
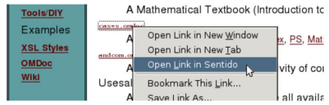
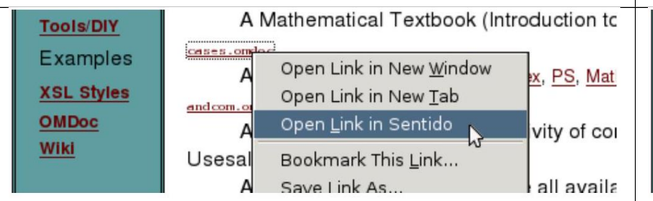
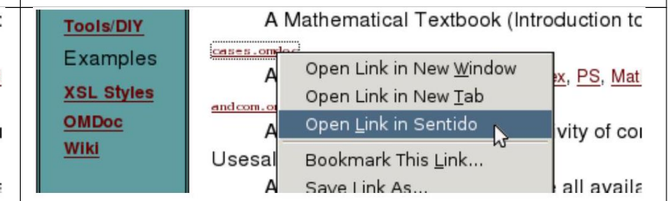
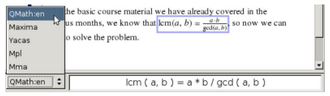
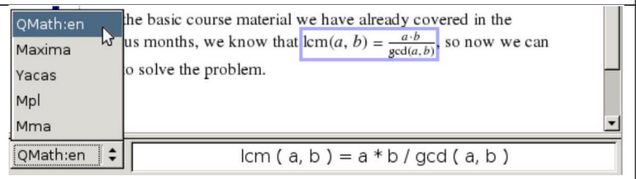
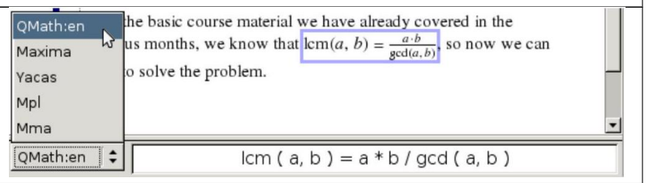
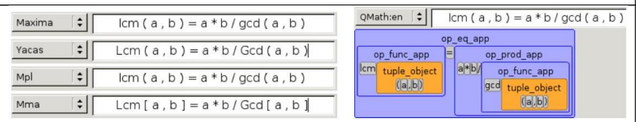
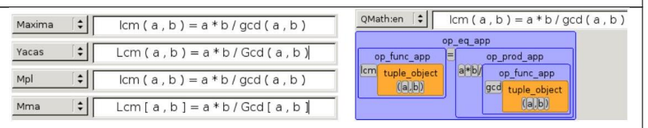
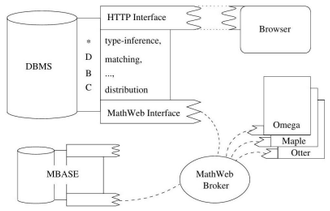
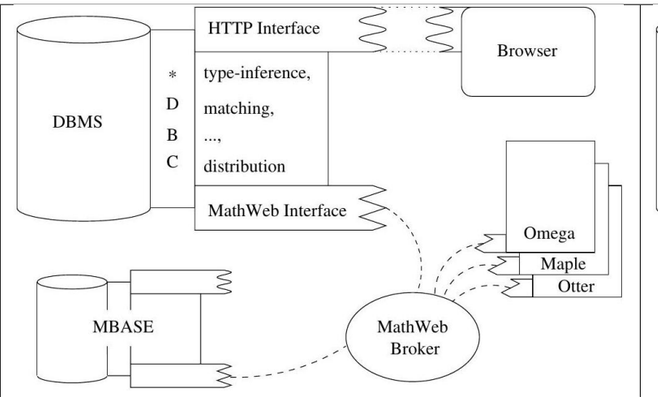
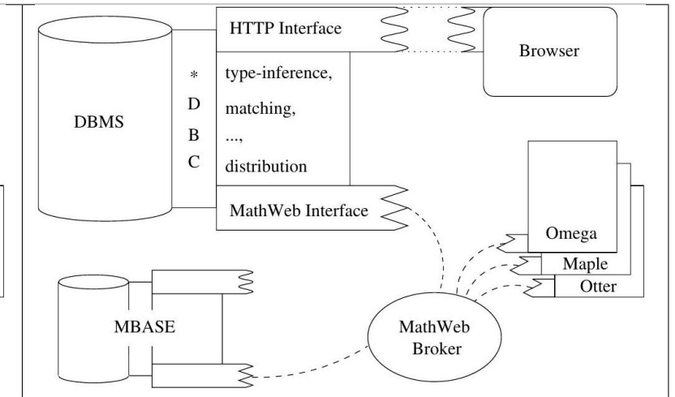
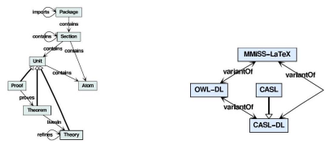
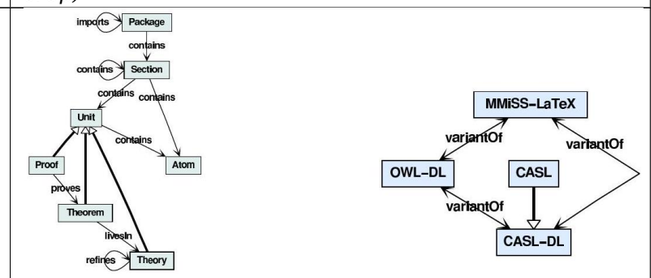
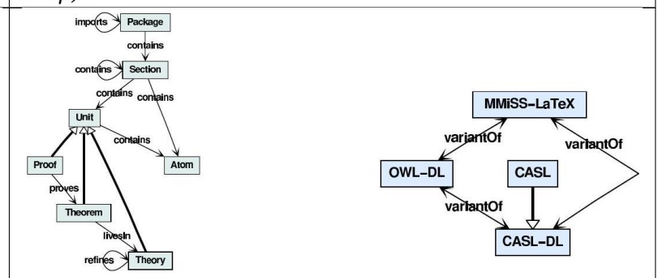
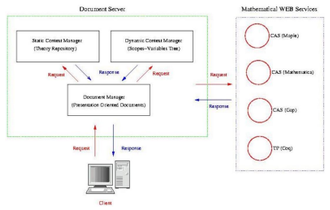
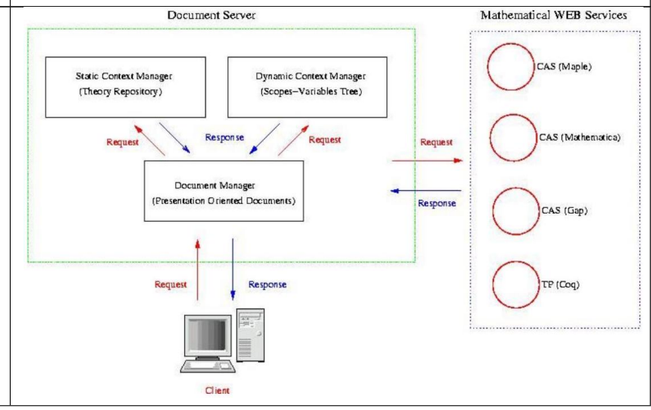
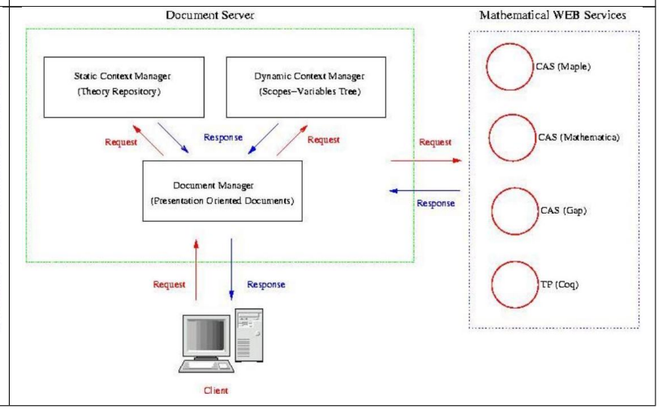
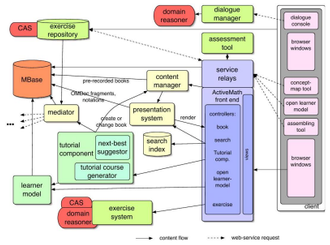
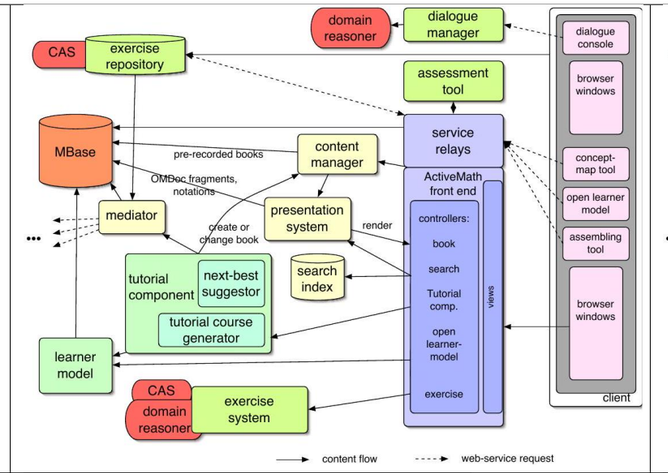
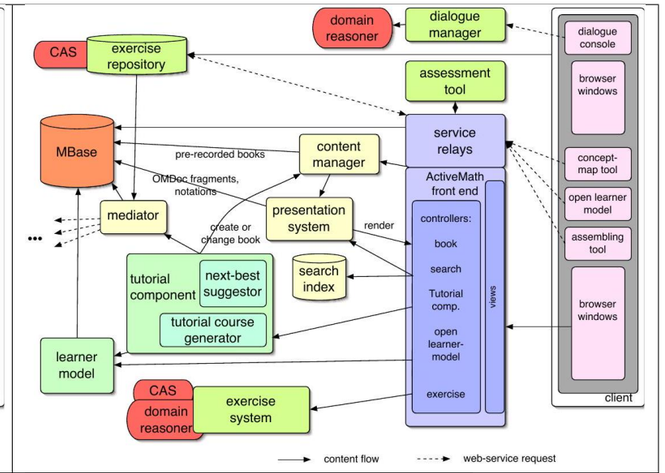
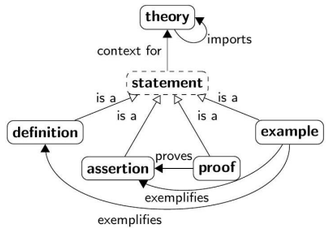
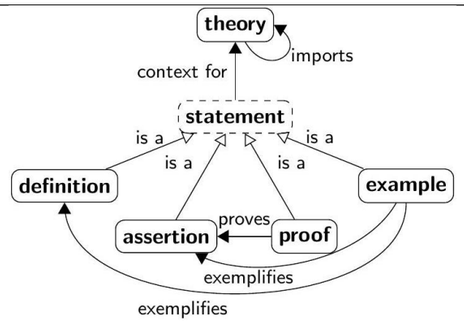
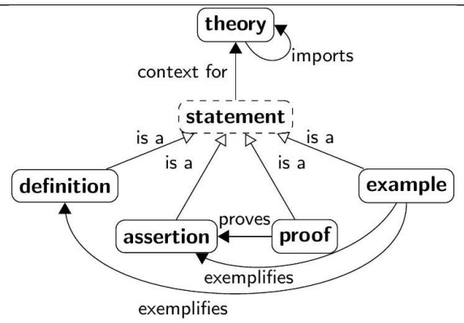
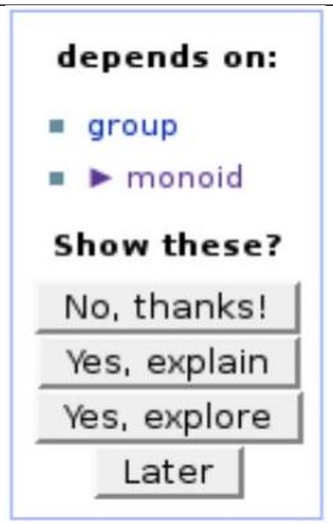
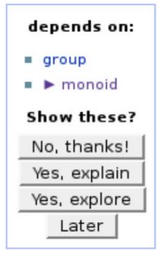
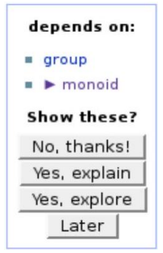
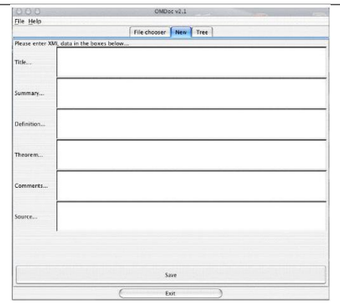
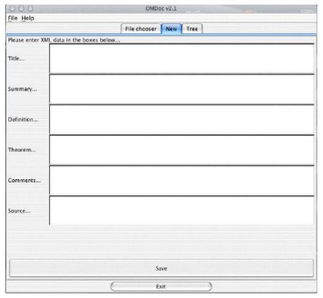
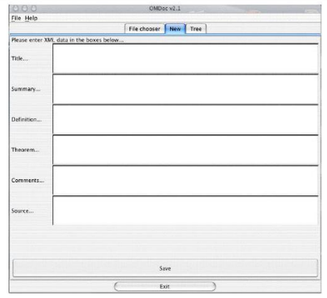
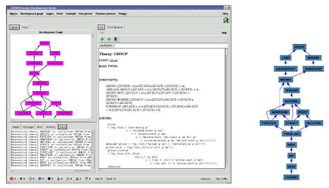
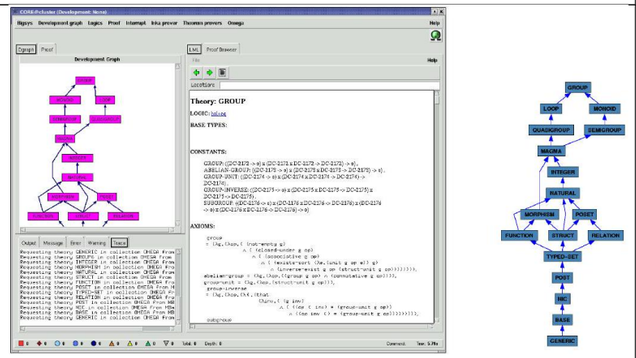
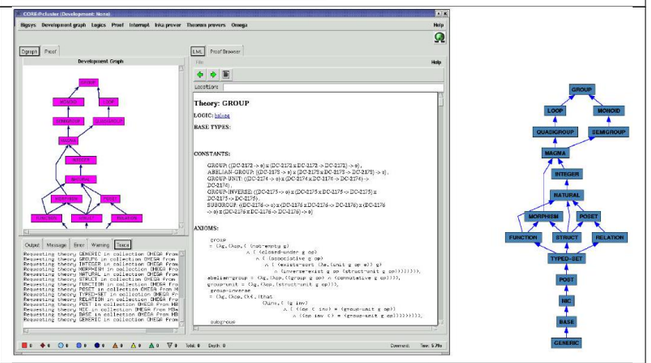
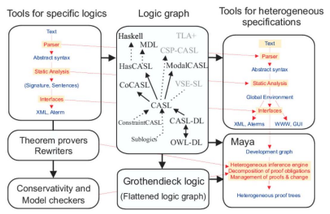
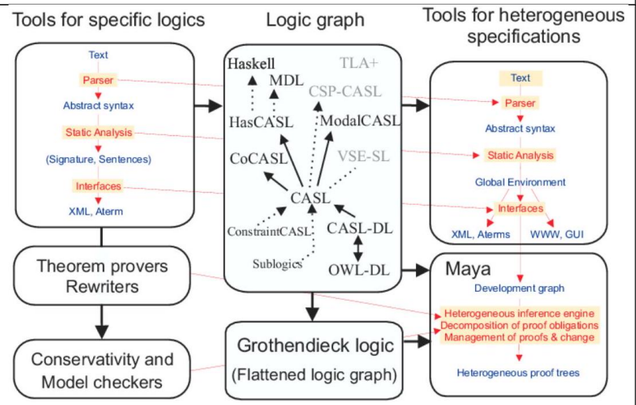
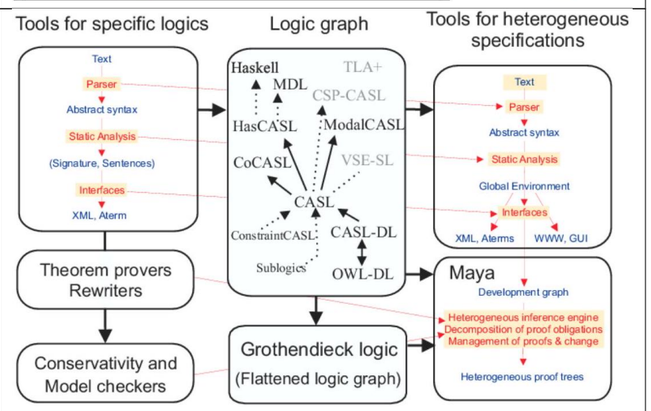
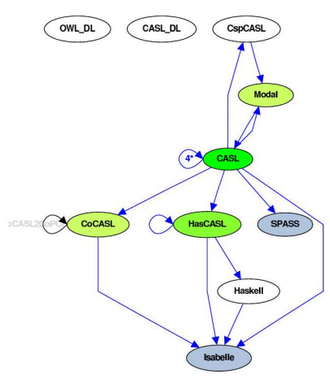
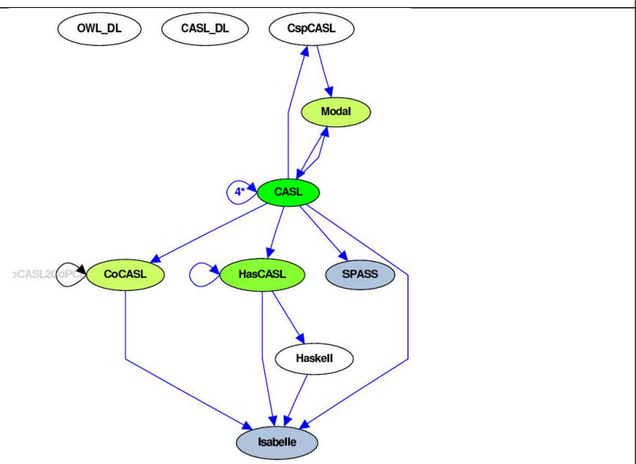
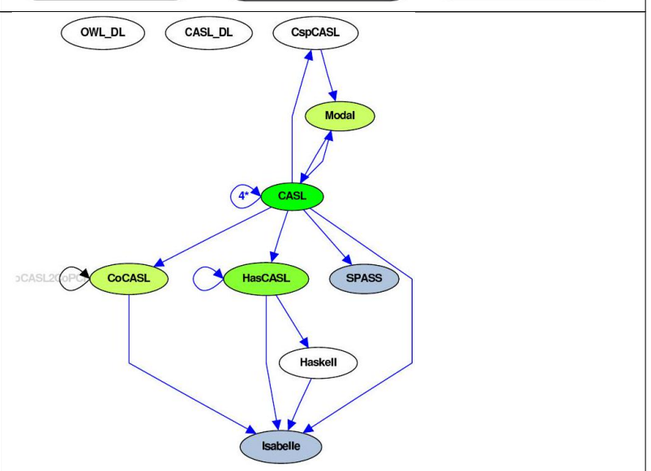
kohlhase-omdoc_DIA_0164	235	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0165	238	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-238_998_1039_202_224.jpg			
kohlhase-omdoc_DIA_0166	240	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0167	246	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0168	247	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*

kohlhase-omdoc_DIA_0169	248	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-248_811_1089_748_201.jpg		 
kohlhase-omdoc_DIA_0170	249	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-249_338_996_1135_249.jpg		 
kohlhase-omdoc_DIA_0171	250	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-250_305_982_649_262.jpg		 
kohlhase-omdoc_DIA_0172	250	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-250_272_988_1644_253.jpg		 
kohlhase-omdoc_DIA_0173	251	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-251_207_1124_609_183.jpg		 

kohlhase-omdoc_DIA_0174	254	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-254_618_979_204_258.jpg			
kohlhase-omdoc_DIA_0175	257	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0176	260	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-260_454_1060_213_185.jpg			
kohlhase-omdoc_DIA_0177	265	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-265_688_1092_547_198.jpg			

kohlhase-omdoc_DIA_0178	268	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-268_803_1082_392_207.jpg			
kohlhase-omdoc_DIA_0179	277	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-277_505_718_494_536.jpg			
kohlhase-omdoc_DIA_0180	278	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-278_396_245_611_1031.jpg			

kohlhase-omdoc_DIA_0181	281	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-281_468_505_213_818.jpg			
kohlhase-omdoc_DIA_0182	284	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-284_583_1037_200_166.jpg			
kohlhase-omdoc_DIA_0183	289	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-289_692_1079_206_211.jpg			
kohlhase-omdoc_DIA_0184	290	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-290_730_645_226_404.jpg			
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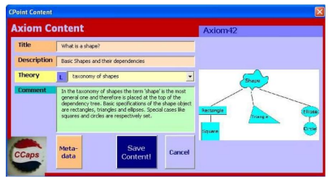
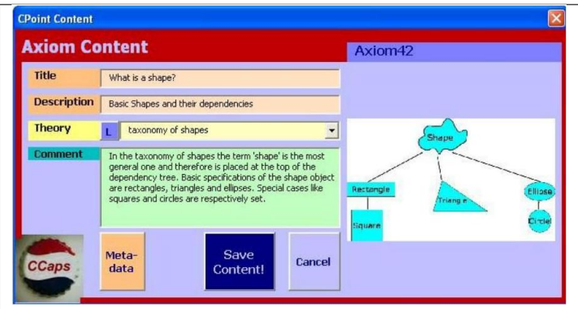
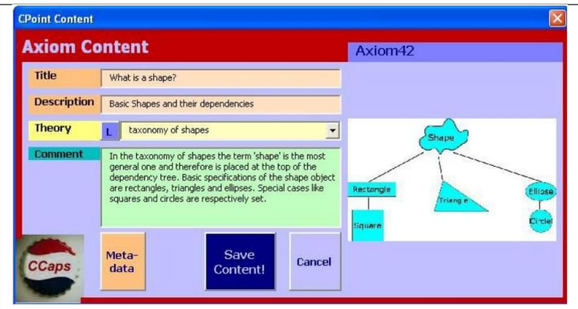
kohlhase-omdoc_DIA_0186	293	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-293_481_890_202_300.jpg			
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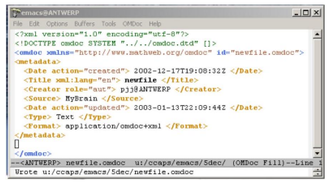
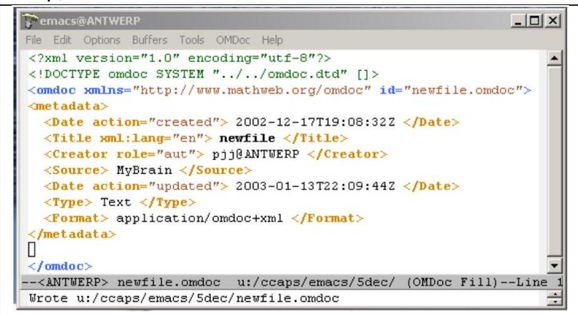
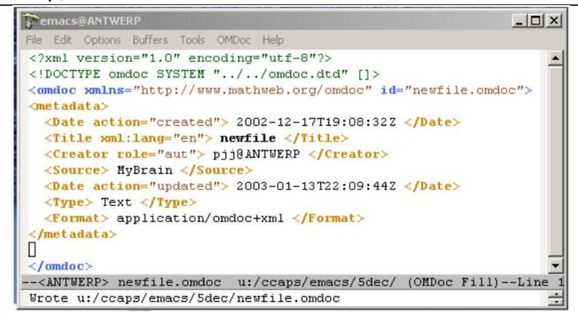
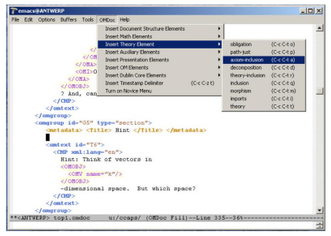
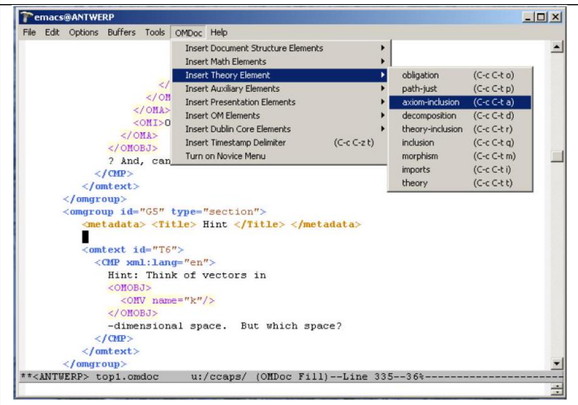
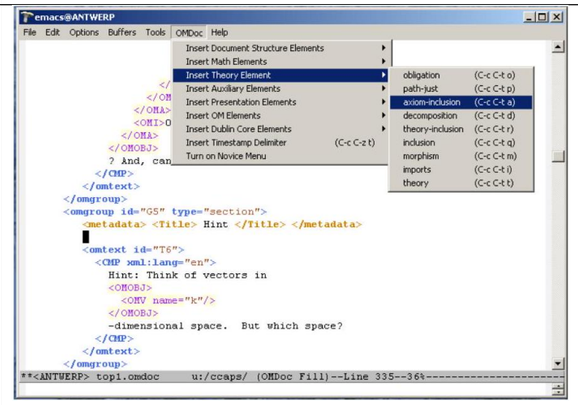
kohlhase-omdoc_DIA_0189	301	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-301_491_894_199_299.jpg			
kohlhase-omdoc_DIA_0190	301	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-301_634_892_806_299.jpg			
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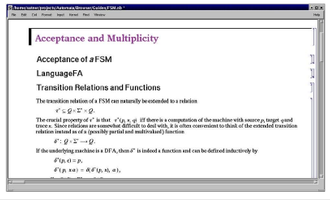
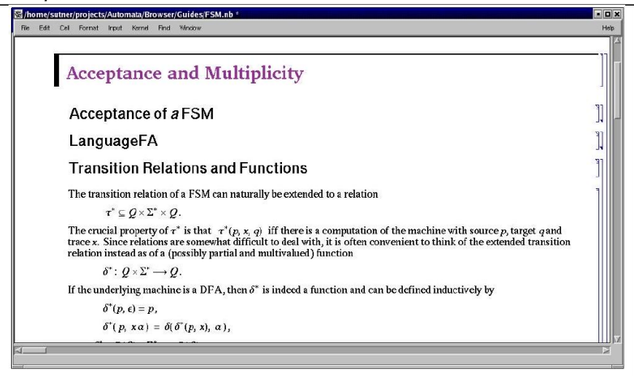
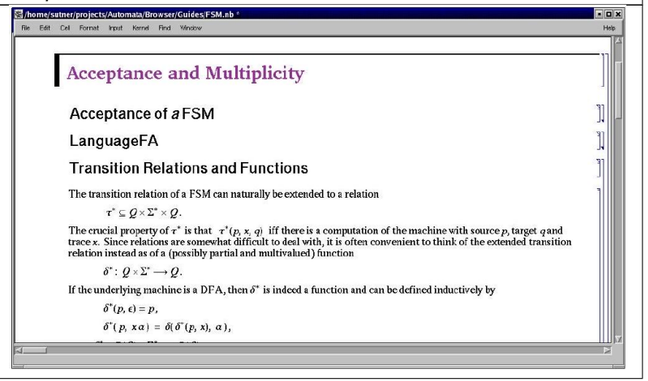
kohlhase-omdoc_DIA_0192	303	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-303_586_990_201_249.jpg			

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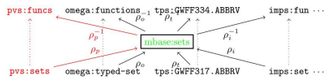
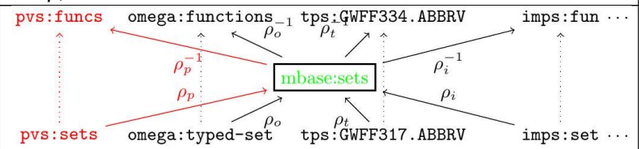
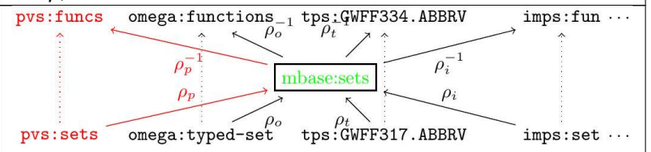
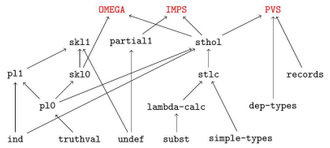
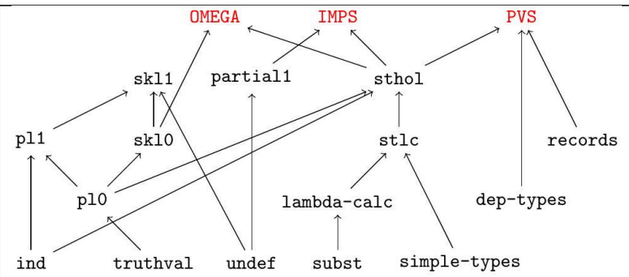
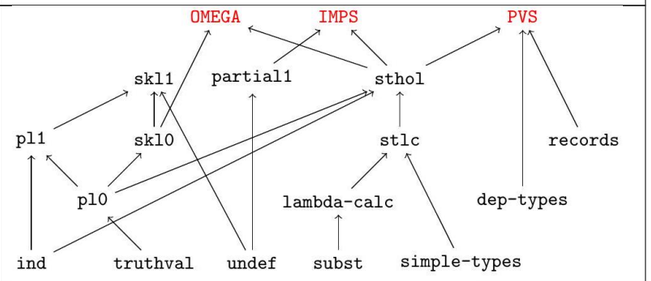
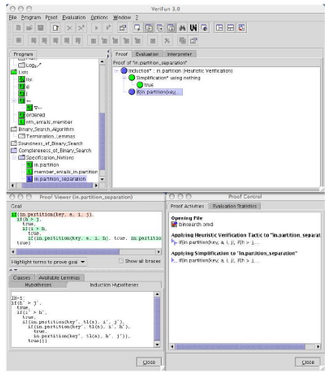
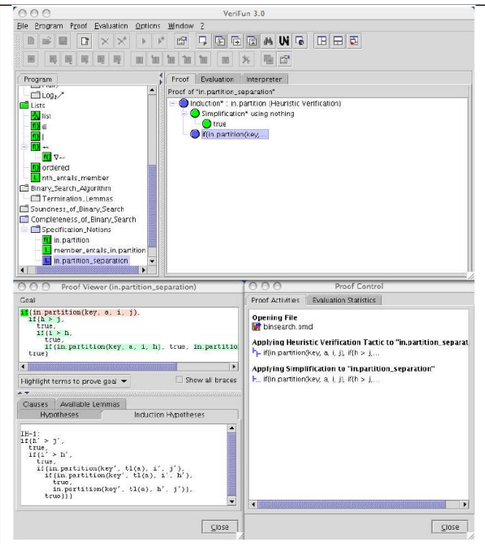
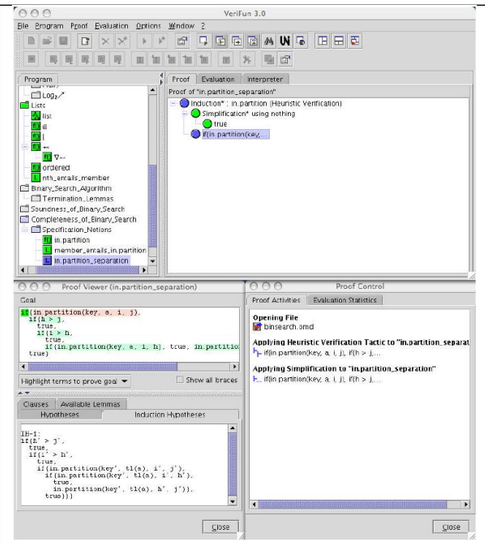
kohlhase-omdoc_DIA_0196	307	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-307_238_1035_207_224.jpg			
kohlhase-omdoc_DIA_0197	308	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-308_432_979_560_255.jpg			
kohlhase-omdoc_DIA_0198	314	— *(dup)*	1b348de5-ed54-4a9a-aba0-06a9a89f7dc6-314_858_745_1120_579.jpg			
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kohlhase-omdoc_DIA_0243	370	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0244	371	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*
kohlhase-omdoc_DIA_0245	387	— *(dup)*	*no image for this region (68 in zip)*	*(no tex.zip crop for this row)*	*(image not on disk — pass –texzip or download the CDN crop)*	*(image not on disk — pass –texzip or download the CDN crop)*