PreTeXt RELAX-NG Schema

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May 28, 2022

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This is a literate programming version of the RELAX-NG schema for PreTeXt. As such, it is used to generate the RELAX-NG compact syntax version (pretext.rnc) and other versions are derived from the compact version with standard tools.

We intend this to be helpful for both authors and implementers. The schema is the contract between authors and implementers. If an author's source validates against the schema, then an implementer's conversion should render the content accurately, or warn about why it cannot. That said, it is still a work in progress:

- New features are not added until they are reasonably stable. Validating the sample article can be a good way to see what these are.
- Even for stable features, the schema will sometimes lag behind the code.
- There will be other inaccuracies here, so reports or pull requests are welcome.

The RELAX-NG syntax is built on patterns, which describe how XML elements and attributes may be combined. It begins with a start pattern. Patterns separated by commas must appear in that order. Elements separated by a vertical bar represent a choice. Parentheses are used for grouping. Braces are basic syntax, reminiscent of the syntax for Java. An equals sign is assignment and |= is a continuation of an assignment. Finally, optional and/or multiple occurrences can be specified with modifiers:

- Zero or one. Optional, at most one.
- Zero or more. Optional, with no limit.
- One or more. Required, with no limit.

Appendix A contains a list of all the fragments described here, in order of appearance, and may be useful if you are looking for some particular topic, element, or attribute.

1 Gross Structure

A PreTeXt document is always a single pretext element below the root. There are two divisions, a docinfo, which is a database of sorts about the document, along with a sibling element that indicates the type of the document and contains all the content. start is the way to specify the lone top-level element as part of the schema, so it will not be used again.

\[
\text{(641 Gross structure)} \equiv
\]

\[
\text{start =}
\]

\[
\text{element pretext {
XMLLang?,
DocInfo?,
(Book | Article | Letter | Memorandum)
}}
\]
2 Document Types

letter and memo elements are not documented.

\begin{verbatim}
≡

Article =
  element article {
    MetaDataLinedSubtitle,
    ArticleFrontMatter?,
    (  
      Objectives?,
      (BlockDivision | Paragraphs | Commentary)+,
      (ReadingQuestions? & Exercises? & Solutions? & References? & Glossary?),
      Outcomes?
    )
  |
  (  
    (Objectives? & IntroductionDivision?),
    Section,
    (Section | ReadingQuestions | Exercises | Solutions | References | Glossary)*,
    (Outcomes? & ConclusionDivision?),
    ArticleBackMatter?
  )
}

Book =
  ## Here is what a book looks like.
  element book {
    MetaDataLinedSubtitle,
    BookFrontMatter?,
    (Part+ | Chapter+ ),
    BookBackMatter?
  }

Letter =
  element letter {empty}

Memorandum =
  element memo {empty}
\end{verbatim}

3 Document Structure

A document is typically divided into sections. But we reserve the word section for one very specific type of division. To avoid confusion, we speak generically of divisions. So, for example, a section is a division of a chapter. Here we list all of the possible divisions, even if they are not available in each document type.

An appendix looks like a chapter of a book, with the option to have a notation-list as its entire contents. It is possible this is not the best structure for an article, which might best be divided by subsection.
There are several things to note (expand this): always a title, dead-end with blocks, or subdivide with optional intro and conclusion.

$$\langle 643\text{ Divisions} \rangle \equiv$$

Part =
  element part {
    MetaDataLinedTitle, Chapter+
  }
Chapter =
  element chapter {
    MetaDataLinedTitle,
    AuthorByline*,
    (
      (Objectives?,
        (BlockDivision | Paragraphs | Commentary)+,
        (ReadingQuestions? & Exercises? & Solutions? & References? & Glossary?),
        Outcomes?
      )
      |
      (Objectives? & IntroductionDivision?),
      Section,
      (Section | ReadingQuestions | Exercises | Solutions | References | Glossary)*,
      (Outcomes? & ConclusionDivision?)
    )
  }
Section =
  element section {
    MetaDataLinedTitle,
    AuthorByline*,
    (  
      (Objectives?,
        (BlockDivision | Paragraphs | Commentary)+,
        (ReadingQuestions? & Exercises? & Solutions? & References? & Glossary?),
        Outcomes?
      )
      |
      (Objectives? & IntroductionDivision?),
      Subsection,
      (Subsection | ReadingQuestions | Exercises | Solutions | References | Glossary)*,
      (Outcomes? & ConclusionDivision?)
    )
  }
Subsection =
element subsection {
   MetaDataAltTitle,
    AuthorByline*,
    
    
    
    Objectives?,
    (BlockDivision | Paragraphs | Commentary)*,
    (ReadingQuestions? & Exercises? & Solutions? & References? & Glossary?),
    Outcomes?
    
    |

    |

    (Objectives? & IntroductionDivision?),
    Subsubsection,
    (Subsubsection | ReadingQuestions | Exercises | Solutions | References | Glossary)*,
    (Outcomes? & ConclusionDivision?)

}

Subsubsection =
    element subsubsection {
   MetaDataAltTitle,
    AuthorByline*,
    Objectives?,
    (BlockDivision | Paragraphs | Commentary)*,
    (ReadingQuestions? & Exercises? & Solutions? & References? & Glossary?),
    Outcomes?
    
    |

    |

    (Objectives? & IntroductionDivision?),
    Subsection,
    (Subsection | ReadingQuestions | Exercises | Solutions | References | Glossary)*,
    (Outcomes? & ConclusionDivision?)

}

ArticleAppendix =
    element appendix {
   MetaDataAltTitle,
    AuthorByline*,
    
    
    
    Objectives?,
    (BlockDivision | Paragraphs | Commentary | NotationList)*,
    (ReadingQuestions? & Exercises? & Solutions? & References? & Glossary?),
    Outcomes?
    
    |

    |

    (Objectives? & IntroductionDivision?),
    Subsection,
    (Subsection | ReadingQuestions | Exercises | Solutions | References | Glossary)*,
    (Outcomes? & ConclusionDivision?)

}
4 Lightweight Divisions

The paragraphs element, which is not to be confused with a real paragraph as implemented by the p element, is an exceptional type of division (both in design and utility). It must have a title, can appear anywhere within any of the divisions, cannot be further subdivided, and is not ever numbered. Its contents are conceptually a run of paragraphs, but as described here allow much more than that.

It is especially useful in a short document (like a class handout, letter, memorandum, or short proposal) where numbered divisions might feel like overkill.

The NoNumber variant allows for light-weight sectioning of un-numbered divisions, such as a Preface.

<commentary> is elective, so should not have any numbered items ever, so the “NoNumber” provision is implicit.

(644 Paragraphs division) ≡

Paragraphs =
 element paragraphs {
    MetaDataTitle,
    Index*,
    BlockDivision+
  }
ParagraphsNoNumber =
5 Specialized Divisions

We add specialized divisions, which may appear within any of the above divisions. Titles will be provided as defaults.

(645 Specialized divisions) \equiv

ReadingQuestions =
  element reading-questions {
    MetaDataAltTitleOptional,
    IntroductionDivision?,
    Exercise*,
    ConclusionDivision?
  }

Exercises =
  element exercises {
    MetaDataAltTitleOptional,
    IntroductionDivision?,
    (Exercise | ExerciseGroup)+ | Subexercises+,
    ConclusionDivision?
  }

Subexercises =
  element subexercises {
    MetaDataAltTitleOptional,
    IntroductionDivision?,
    (Exercise | ExerciseGroup)+,
    ConclusionDivision?
  }

Solutions =
  element solutions {
    MetaDataAltTitleOptional,
    attribute inline {text}?,
    attribute divisional {text}?,
    attribute project {text}?,
    attribute admit {"all"|"odd"|"even"},
    IntroductionDivision?,
    ConclusionDivision?
  }
6 Paragraphs

Most PreTeXt elements are about delineating structure. What you actually write happens in very few places. Principally paragraphs, but also titles, captions, index headings, and other short bursts. The shorter the burst, the more likely the text will be recycled in other places (Table of Contents, List of Figures, or Index perhaps). And the more text gets re-purposed, the more care we need to take with its contents.

**Simple text** is simply runs of characters, some of which is accomplished with empty elements. This is used for names of people, etc. It should not be confused with the RELAX-NG keyword `text` which matches runs of (Unicode) characters, with no intervening markup. So the latter is used for things like URLs, internal identifiers, configuration parameters, and so on.

**Short text** is used for titles, subtitles, names, index headings, and so on. It allows a variety of characters, font styling, groupings, and convenience constructions. It does not allow for references, nor anything that typographically requires more than the linearity of a sentence. In other words, no lists, no images, no tables, no displayed equations. Because of the potential for movement, we also do not include footnotes within short text.

**Long text** is everything that is short text, but also allows for references, both external (internet URLs) and internal (cross-references). It is used for the content of footnotes and captions. The WeBWorK variant allows for variables in inline mathematics.

$\langle 646\ \text{Running text}\rangle$ \equiv

$$
\begin{align*}
\text{TextSimple} & = \text{mixed} \{ \text{Character}^* \} \\
\text{TextShort} & = \text{mixed} \{ ( \text{Character} | \text{Generator} | \text{Verbatim} | \text{Group} | \text{MathInline} | \text{Music})^* \} \\
\text{TextLong} & = \text{mixed} \{ ( \text{Character} | \text{Generator} | \text{Verbatim} | \text{Group} | \text{MathInline} | \text{Music})^* \}
\end{align*}
$$
A paragraph is a key bottleneck between structure and prose. You can use a variety of constructs in a paragraph, and you may use a paragraph in many places. So the name of the element is very simple, just a `p`. Now you can include footnotes, display mathematics, display verbatim text, and lists. Note that a list can only occur in a paragraph, so to make nested lists you must structure a list item of the exterior list with a paragraph to contain the interior list. A paragraph can contain some metadata, like index entries and mathematical notation. It does not have a title, nor is it ever numbered. It can be the target of a cross-reference, but only with some care.

A **lined paragraph** is a variant, for use when the line-by-line structure is necessary. The WeBWorK variant of a `p` element allows for using the `var` element as an answer blank or generated content, possibly inside mathematics, and possibly inside lists.

**Note:** A paragraph effectively could have the `MetaDataTarget` pattern, except that we allow index elements `<idx>` to go anywhere within the paragraph.

〈647 Paragraphs〉

\[
\text{Paragraph} = \text{element } p \{ \\
\quad \text{UniqueID?}, \\
\quad \text{PermanentID?}, \\
\quad \text{TextParagraph}
\}
\]

\[
\text{ParagraphLined} = \text{element } p \{ \\
\quad \text{UniqueID?}, \\
\quad \text{PermanentID?}, \\
\quad \text{element line } \{\text{TextShort}\}+
\}
\]

Fundamentally PreTeXt allows for conversion to other markup languages, such as \LaTeX{} or HTML, and of course XML is a syntax for designing a markup
vocabulary. As such, certain characters traditionally found on keyboards have been co-opted for special purposes. And once you actually want one of those special characters, you need an escape character to indicate a “normal” use. For these reasons, certain characters have empty elements to represent them.

Special characters for XML are the ampersand, less than, greater than, single quote and double quote: &<>,'.". The ampersand is the escape character for XML. In practice, the first two characters are the most important, since processing of your XML will be confused by any attempt to use them directly. So in regular text (not mathematics, not verbatim), always use the the escaped versions: &; &lt; &gt; ', ".

See below for elements that can be used to form groupings with left and right delimiters. For example, a simple quotation should use a left double quote and a right double quote, and these characters should look different (so-called smart quotes). Notice that a keyboard only has a single dumb quote. If you need these characters in isolation (i.e., not in pairs), these elements are the best way to ensure you get what you want in all possible conversions. Note that left and right braces , { }, (”curly brackets”); brackets, [, ]; may be used directly. To create individual, left or right, create angle brackets us the elements here, not the keyboard characters (which are different).

(648 Delimiter characters) ≡

```
Character =
  element lsq {empty} |
  element rsq {empty} |
  element rq {empty} |
  element lq {empty} |
  element langle {empty} |
  element rangle {empty}
```

A space is a space. But sometimes you want a space between two associated items which will not get split across two lines (e.g., Chapter 23). An element will create a non-breaking space using the right technique for the conversion at hand.

There is a variety of dashes of various lengths. Use the keyboard character for a hyphen, use an ndash to separate a range of numbers or dates, and use an mdash as punctuation within a sentence to isolate a clause. These are implemented differently for different conversions, so their use is strongly encouraged.

(649 Dash characters) ≡

```
Character |=
  element nbsp {empty} |
  element ndash {empty} |
  element mdash {empty}
```

A fillin blank is not really a character, but maybe a really long, low dash? The characters attribute controls the length. It is atomic, indivisible, and content-less, like all the other characters. fillin is also unusual due to its allowed use within mathematics.

(650 Fill-in blank character) ≡
We define a few characters to help with simple arithmetic expressions authored within regular text. (Perhaps you are writing a novel with PreTeXt.) These are for simple uses in regular text, not for actual mathematics, which is described later. The solidus is slightly different from the slash found on a keyboard and is used for fractions and ratios. The minus is for subtraction and negation, and is not a hyphen or dash. An obelus is better known as a division sign. degree/, prime/, and dblprime/ are designed for specifying coordinates in degrees, minutes, and seconds. Use the unambiguous + keyboard character for addition.

(651 Arithmetic characters) ⇒

Character |=
  element minus {empty} |
  element times {empty} |
  element solidus {empty} |
  element obelus {empty} |
  element plusminus {empty} |
  element degree {empty} |
  element prime {empty} |
  element dblprime {empty}

The following are largely conveniences. They are typically not available on keyboards, and their implementations for various conversions can involve some subtleties. Again, their use is encouraged for the best quality output.

(652 Exotic characters) ⇒

Character |=
  element ellipsis {empty} |
  element midpoint {empty} |
  element swungdash {empty} |
  element permille {empty} |
  element pilcrow {empty} |
  element section-mark {empty} |
  element copyright {empty} |
  element registered {empty} |
  element trademark {empty} |
  element phonomark {empty} |
  element servicemark {empty}

Icons are available through a @name attribute, which is meant to usually be more semantic than just a description of the picture, though that may sometimes be the case. These are intended for use when describing elements of computer interfaces. Icons which are decorative should be supplied as part of styling, not as part of the source language.

(653 Icon characters) ⇒

Character |=
  element icon {

The `<kbd>` element will produce something akin to a calculator key or a keyboard key. It may have (simple) content, which will be reproduced as the label of the key, or it may have a `@name` attribute which describes a key that looks more like a graphic, such as an arrow key.

(654 Keyboard characters) ≡

```
Character |=
  element kbd {
    (text | attribute name {text})
  }
```

We support musical notation as if they were characters: accidentals, scale degrees, notes, and chords. Implementation of these is about as complicated as inline mathematical notation, hence they have identical rules about placement.

(655 Music characters) ≡

```
Music =
  element doublesharp {empty} |
  element sharp {empty} |
  element natural {empty} |
  element flat {empty} |
  element doubleflat {empty} |
  element scaledeg ("0"|"1"|"2"|"3"|"4"|"5"|"6"|"7"|"8"|"9"|"10") |
  element timesignature {
    attribute top {text},
    attribute bottom {text}
  } |
  element n {
    attribute pc {
      "A"|"B"|"C"|"D"|"E"|"F"|"G"|"a"|"b"|"c"|"d"|"e"|"f"|"g"|
      "1"|"2"|"3"|"4"|"5"|"6"|"7"|"8"|"9"|"10"
    },
    attribute acc {"doublesharp"|"sharp"|"flat"|"doubleflat"},
    attribute octave {"1"|"2"|"3"|"4"|"5"}?
  } |
  element chord {
    attribute root {text}?,
    attribute mode {text}?,
    attribute bps {text}?,
    attribute bass {text}?,
    attribute suspended {"yes"|"no"}?,
    attribute parentheses {"yes"|"no"}?,
    element alteration {
      (TextSimple |
      element sharp {empty} |
      element flat {empty})*
    }
  }
```

(656 Characters) ≡

(649 Dash characters)
There are empty elements to generate certain items, like the date, or names of commonly referenced tools, such as PreTeXt itself. These include some common Latin abbreviations, for the purpose of handling the periods properly in conversions to \LaTeX.

A large class of similarly indivisible items are units on physical quantities. The \texttt{<quantity>} element is allowed to be empty, and the code should silently produce no output. Expressing non-emptiness here might get a bit messy, so a Schematron warning could be a good alternative.
Some markup is for just ASCII characters, in other words, unadorned verbatim text.

Verbatim =
  element c {text} |
  element email {text}

Simple markup is groupings of text that get a different typographic appearance, either through font changes or through delimiters. Examples are emphasis or paired quotations, non-examples are cross-references or footnotes.

Abbreviations are sequences of characters that shorten some longer word or words (e.g. vs. for the Latin versus), initialisms are formed from the first letters of a sequence of words (e.g. HTML), acronyms are pronounceable as words (e.g. SCUBA).

Group |=
  element abbr {TextSimple} |
  element acro {TextSimple} |
  element init {TextSimple}

Notice that long text can be part of a grouping construction, and that long text can contain a group construction. The effect is that these groupings can be nested arbitrarily deep.

Group |=
  element q {TextLong} |
  element sq {TextLong} |
  element angles {TextLong} |
  element dblbrackets {TextLong}

Group |=
  element em {TextLong} |
  element term {TextLong} |
  element alert {TextLong} |
  element pubtitle {TextLong} |
  element articletitle {TextLong} |
  element foreign {
    XMLLang?,
    TextLong
  }

Group |=
  element delete {TextLong} |
  element insert {TextLong} |
  element stale {TextLong}
We use elements to get consistent typography when discussing PreTeXt itself. We could probably limit the content of these elements to lowercase letters and a hyphen. The definitions here will preclude any contained markup.

〈664 XML syntax groups〉 ≡ 

Group |=
  element tag {text} |
  element tage {text} |
  element attr {text}

An empty taxon will match either version.

〈665 Taxonomic groups〉 ≡ 

Group |=
  element taxon {
    attribute ncbi {xsd:integer}?,
    ( 
      TextSimple |
      ( element genus {TextSimple}?,
        element species {TextSimple}? 
      )
    )
  }

〈666 Text groups〉 ≡ 

〈Abbreviations 660 [15]〉
〈Delimited groups 661 [15]〉
〈Highlighted groups 662 [15]〉
〈Editing groups 663 [15]〉
〈XML syntax groups 664 [16]〉
〈Taxonomic groups 665 [16]〉

7 Mathematics

All mathematics appears inside paragraphs, and the syntax is that of \LaTeX, as supported by MathJax, whose supported commands and macros are meant to be very similar to those of the AMSMath package. Note that the content is typically unstructured, excepting “fill-in-the-blank”, WeBWorK variables (see variants), and internal cross-references in multi-row display mathematics. Also, \texttt{md} and \texttt{mdn} are not targets of cross-references, though their rows can be.

〈667 Mathematics〉 ≡ 

MathInline =
  element m {
    mixed {(FillIn | WWVariable)*}
  }
MathRow =
  element mrow {
8 Blocks

A text block is very similar to a paragraph. It can be an actual paragraph, a sequence of paragraphs enclosed as a block quote (with attribution, perhaps), or a large chunk of unformatted text presented typically in a monospace font. Certain “atomic” objects, such as an `<image>` may be placed as peers of paragraph-like objects.

A statement block is used in statements. What are those? Theorems have statements, exercises have statements, questions have statements. Some of these blocks with statements also have peers of statements that are proofs, hints, answers, and solutions. In statements, and their peers, we include text blocks, captioned items, asides, side-by-side layouts, and Sage computations, but exclude many of the numbered and titled division blocks. A slight extension is a solution block, which is everything that can go in a `<statement>`, plus one or more `<proof>`, only as part of a `<hint>`, `<answer>`, or `<solution>`.
A **division block** includes text blocks, statement blocks, plus topical chunks of text that can have numbered headings or numbered captions, with optional titles, and are set apart slightly from the surrounding narrative. These are placed mostly as children of divisions, and so one cannot contain another. They certainly contain paragraphs, and all that goes into them, such as mathematics (inline and display) and figures (and other captioned items). The **sidebyside** element can be used to illustrate a division block with a variety of images and displayed text in flexible layouts.

A `<fragment>` is used for literate programming, and is numbered, so it is allowed places where other numbered items go.

Other division blocks include **poem**, **aside**, and **assemblage**. These are never numbered, but can have titles. The **list-of** mechanism is a convenience device to automatically create lists of contents, and so we leave surrounding divisional structure to the author. A **sidebyside**, and its cousin, **sbsgroup**, are strictly layout devices. The **sage** element is unique for its possibilities in certain electronic formats.

**demonstration** is slated for removal or an overhaul, and so is in the **Bad Bank**. Avoid using them for now.

(668 Blocks) ≡

```
BlockText =
    Paragraph | BlockQuote | Preformatted |
    Image | Video | Program | Console | Tabular
BlockStatementNoCaption =
    BlockText | Aside |
    SideBySideNoCaption | SideBySideGroupNoCaption
BlockStatement =
    BlockText |
    Figure | Aside |
    SideBySide | SideBySideGroup | Sage
BlockSolution =
    BlockStatement | Proof
BlockDivision =
    BlockStatement |
    Remark | Computation | Theorem | Proof | Definition |
    Axiom | Example | Exercise | Project |
    Poem | Assemblage | ListGenerator | Fragment |
    Demonstration
```

Blocks are often structured, in a light way. Hints, answers, and solutions adorn exercises, examples, and projects. A simple introduction or conclusion is sometimes useful. A **prelude** or **postlude** are authored inside a block and so are associated with it. But they are presented before and after the block visually. An **interlude** will be used between the statement of a theorem and its proof.

When a block is structured to allow some of the ancillary parts, a **statement** element is used to structure the main part. Hints, answers, and solutions can be the target of cross-references, but do not get author-supplied titles.

(669 Common components of blocks) ≡

```
Prelude =
    element prelude {BlockText+}
```

18
9 Introductions, Conclusions, and Headnotes

The introduction and conclusion containers can be used in a variety of other structured elements. They come in three levels, according to what they can contain, and are meant to be consonant with their surroundings. As children of a division, they may carry a title, which in turn allows them to be cross-referenced by that text.

A <headnote> is like an <introduction>, but does not have a symmetric concluding element, and is typically meant for specialized divisions, such as a <glossary>.

IntroductionText = element introduction {BlockText+}
ConclusionText = element conclusion {BlockText+}
IntroductionStatementNoCaption = element introduction {BlockStatementNoCaption+}
ConclusionStatementNoCaption = element conclusion {BlockStatementNoCaption+}
IntroductionStatement = element introduction {BlockStatement+}
ConclusionStatement = element conclusion {BlockStatement+}
IntroductionDivision = element introduction {
  MetaDataTitleOptional,
  BlockDivision+
}
10 References

There are a variety of referencing mechanisms, external references, internal cross-references, index entries, and specialized support for a table of mathematical notation.

Footnotes are especially dangerous. They should contain quite a bit of content, and should be targets of cross-references. So the content is not as expansive
as a regular paragraph, which is possibly too restrictive.

Footnote =
  element fn {
   _MetaDataDataTarget,
    TextLong
  }

Index entries have two forms, simple and structured. The start and finish attributes are meant to use xml:id to create an index range that crosses XML boundaries. (Replace principal tags with idx/h/h.)

The actual index is generated within the index-part via the index-list element.

Note that we might point to another index entry as part of a “see also” mechanism.

IdxHeading =
  element h {
    attribute sortby {text}?,
    TextShort
  }

Index =
  element idx {
   _MetaDataDataTarget,
    attribute sortby {text}?,
    attribute start {text}?,
    attribute finish {text}?,
    (TextShort
    |
    (IdxHeading,
    IdxHeading?,
    IdxHeading?,
    (element see {TextShort} | element seealso {TextShort})?)
    )
  }

IndexList = element index-list {empty}

11 Objectives

A division may lead (first) with an optional list of objectives for the division and may be followed by a (final) optional list of outcomes. The element names are only chosen to reflect a pre- and post- behavior and so could be used for objectives, outcomes, and standards in a variety of ways.
Objectives =
   element objectives {
      MetaDataTitleOptional,
      IntroductionText?,
      List,
      ConclusionText?
   }
Outcomes =
   element outcomes {
      MetaDataTitleOptional,
      IntroductionText?,
      List,
      ConclusionText?
   }

12 Block Quotes

These are a run of paragraphs, but may optionally have an attribution.

(675 Block quotes) ≡

BlockQuote =
   element blockquote {
      MetaDataTitleOptional,
      Paragraph+, 
      Attribution?
   }
SimpleLine =
   element line {TextSimple}
ShortLine =
   element line {TextShort}
LongLine =
   element line {TextLong}

13 Verbatim Text

Large blocks of verbatim material, rather than just little bits in a sentence. A
code display, cd, is an analog of a math display, and meant to be used within
a paragraph, either as a single line of text, or optionally structured as several
lines by using code lines, cline. pre is a block, which preserves line breaks and
sanitizes whitespace to the left. It can be optionally structured as code lines.
It should be thought of as a monospace analogue of a “regular” paragraph,
minus indentation and automatic line-breaking.

(676 Verbatim displays) ≡

CodeLine =
   element cline {text}
CodeDisplay =
   element cd {
      attribute latexsep {text}?,
      (text | CodeLine*)}
14 Lists

Are complicated. Maybe we need a special type of paragraph which does not allow nesting a description list down into some other list?

As a container, the lists themselves get no metadata. But the numbered or titled list items do get metadata. To point to an entire list, make it a named list and point to that.

(677 Lists) ≡

List =
element ol {
    PermanentID?,
    attribute cols {"2" | "3" | "4" | "5" | "6"}?,
    attribute marker {text}?,
    element li {
        (MetaDataTarget, TextParagraph)
        | (MetaDataTitleOptional, BlockStatement+)
    }+
} |
element ul {
    PermanentID?,
    attribute cols {"2" | "3" | "4" | "5" | "6"}?,
    attribute marker {"disc" | "circle" | "square" | ""}?,
    (Meta...
15 Definitions

Definitions are special, there is nothing else quite like them. A statement, no proof, and also a natural place for notation entries.

\(\text{Definitions} \equiv \)

\(\text{DefinitionLike} = \)

\(\text{MetaDataTitleOptional},\)
\(\text{Notation*},\)
\(\text{Statement}\)

\(\text{Definition} = \)
\(\text{element definition} \{\text{DefinitionLike}\}\)

16 Theorems, And Other Results

Theorems, corollaries, lemmas — they all have statements, and should have proof(s). Otherwise they are all the same. A proof may be divided with cases, in no particular rigid way, just as a marker of any number of different, non-overlapping portions of a proof. Titles can be used to describe each case, or implication arrows may be used (typically with a proof of an equivalence). A proof is also allowed to stand on its own as a block, independent of a structure like a theorem or algorithm.

\(\text{Theorems, and similar} \equiv \)

\(\text{Case} = \)
\(\text{element case} \{\)
\(\text{MetaDataTitleOptional},\)
\(\text{attribute direction } \{\text{text}\}?,,\)
\(\text{BlockStatement+}\)
\(\}\)

\(\text{Proof} = \)
\(\text{element proof} \{\)
\(\text{MetaDataTitleOptional},\)
\(\text{Notation*},\)
\(\text{Statement}\)
\(\}\)

24
17 Axioms and Other Mathematical Statements

Mathematical statements that do not have proofs (in other words, no proof is known, or a proof is not appropriate).

\[(680 \text{ Axioms, and similar}) \equiv\]

AxiomLike =
    MetaDataTitleCreatorOptional,
    Statement
Axiom =
    element axiom {AxiomLike} |
    element principle {AxiomLike} |
    element conjecture {AxiomLike} |
    element heuristic {AxiomLike} |
    element hypothesis {AxiomLike} |
    element assumption {AxiomLike}

18 Projects and Activities

A favorite of Inquiry-Based Learning textbooks. Numbered independently. Possibly structured with task. Three different ways to structure this, we combine the second two so that the derived XML Schema (XSD) version is less-confusing to certain tools (e.g. the Red Hat XML schema validator used within VS Code).

\[(681 \text{ Projects, and similar}) \equiv\]

ProjectLike =
    MetaDataTitleOptional,
    (BlockStatement+ |
    (Prelude?, |
    (Statement, Hint*, Answer*, Solution*) |
    (IntroductionStatement?, Task+, ConclusionStatement?,))
Postlude?

Project =
element activity {ProjectLike} |
element investigation {ProjectLike} |
element exploration {ProjectLike} |
element project {ProjectLike}

Task =
element task {
   MetaDataTitleOptional,
   (BlockStatement+ |
    (Statement, Hint*, Answer*, Solution*) |
    (IntroductionStatement?, Task+, ConclusionStatement?)
   )
}

19 Remarks and Other Comments

Really simple blocks, they do not have much structure, and so are just runs of paragraphs, though <figure>, <table>, <listing>, and <list> may be included.

(682 Remarks, and similar) ≡

RemarkLike =
   MetaDataTitleOptional,
   BlockStatement+
Remark =
element remark {RemarkLike} |
element convention {RemarkLike} |
element note {RemarkLike} |
element observation {RemarkLike} |
element warning {RemarkLike} |
element insight {RemarkLike}

20 Computations and Technology

Somewhat simple blocks, they do not have much structure, but can hold more than a Remark.

(683 Computation, and similar) ≡

ComputationLike =
   MetaDataTitleOptional,
   BlockStatement+
Computation =
element computation {ComputationLike} |
element technology {ComputationLike}
21 Asides

An aside is a deviation from the narrative, and might physically move in the presentation (say, to a margin, or to a knowl). biographical and historical may be further developed.

\[684\text{ Asides, and similar} \equiv\]

\[
\text{AsideLike} = \\
\text{MetaDataTitleOptional,} \\
\text{BlockText+}
\]

\[
\text{Aside} = \\
\text{element aside }\{\text{AsideLike}\} | \\
\text{element biographical }\{\text{AsideLike}\} | \\
\text{element historical }\{\text{AsideLike}\}
\]

22 Assemblages

Since an assemblage is meant to accumulate significant content (as a review or summary, or for initial presentation) lists are allowed here, an exception to their restriction to paragraphs. We are also mildly restrictive about what can be content here—in particular blocks are excluded, despite not strictly being blocks themselves.

\[685\text{ Assemblages} \equiv\]

\[
\text{Assemblage} = \\
\text{element assemblage }\{ \\
\text{MetaDataCaption,} \\
\text{(BlockText | SideBySideNoCaption | SideBySideGroupNoCaption)+}
\}
\]

23 Figures, Tables, Listings and Named Lists

These are containers that all carry titles (mandatory and optional), captions for two, and numbers. They need to be filled with other (atomic) items, which we generally call planar due to their two-dimensional and rigid characteristics. These have also called captioned items in the code, even if not all allow a caption.

\[686\text{ Captioned and titled displays} \equiv\]

\[
\text{Caption} = \\
\text{element caption }\{\text{TextLong}\}
\]

\[
\text{Figure} = \\
\text{element figure }\{ \\
\text{MetaDataCaption,} \\
\text{(Image | Video | SideBySide | SideBySideGroup |}
\text{SideBySideNoCaption | SideBySideGroupNoCaption)+}\}
\]
The guts of a table go in a tabular element.

(BorderThickness = "none" | "minor" | "medium" | "major")

BorderTop =
   attribute top {BorderThickness}

BorderBottom =
   attribute bottom {BorderThickness}

BorderLeft =
   attribute left {BorderThickness}

BorderRight =
   attribute right {BorderThickness}

AlignmentHorizontal =
   attribute halign {"left" | "center" | "right" | "justify"}

AlignmentVertical =
   attribute valign {"top" | "middle" | "bottom"}

TableCell =
   element cell {
      AlignmentHorizontal?,
      BorderBottom?,
      BorderRight?,
      attribute colspan {text}?,
      (TextLong | LongLine+ | Paragraph+ )
   }

TableRow =
   element row {
      AlignmentHorizontal?,
      AlignmentVertical?,
      (TextLong | LongLine+ | Paragraph+ )
   }
Page width or screen width, both are at a premium. Height goes on forever (barring physical page breaks) and we have many devices for demarcating that flow. But sometimes you need to organize items horizontally, i.e. side-by-side. We place the components of a sideby-side into generic regions of specified width called panels.

This is a pure layout device. So you cannot title it, nor caption it. It does not admit a xml:id attribute, since you cannot make it the target of a cross-reference. Nor can you reference it from the index (but you can point to its surroundings from the index).

Because of its utility, it can go anywhere a block can go (i.e., as a child of a division) and it can go many other places as a sibling of a paragraph (such as to illustrate an example).

Note that widths given on a sideby-side override any width given to the components of the panels.

A <stack> allows non-captioned, non-titled elements to accumulate vertically in a single panel. It is a basic container.

A group of side-by-sides is designed to stack vertically with common controls on widths, etc. Its implementation is entirely experimental right now, even if we are relatively confident of the markup.

(688 Side-by-side layouts) ≡

Stack =
   element stack {
   }
SidebySideAttributes =
   PermanentID?,
   attribute margins {text}?,
   (attribute width {text} | attribute widths {text})?,
   (AlignmentVertical | attribute valigns {text})?
SideBySide =
   element sidebyside {
      SidebySideAttributes,
      (Figure | Poem | Tabular | Image | Video | Program | Console | Paragraph | Preformatted | List | Stack )+
   }
SideBySideNoCaption =
   element sidebyside {
      SidebySideAttributes,
      (Poem | Tabular | Image | Video | Program | Console | Paragraph | Preformatted | List | Stack )+
   }
SideBySideGroup =
   element sbsgroup {
      SidebySideAttributes, SideBySide+
   }
SideBySideGroupNoCaption =
element sbsgroup {
  SidebySideAttributes,
  SideBySideNoCaption+
}

25 Images and Graphics

Raster, and described by languages, plus 100% duplicates. The WeBWorK variant is quite different.

Note: the ImageCode pattern allows an @xml:id attribute since it is used to construct a filename.

〈689 Images〉 ≡

\[
\text{Image} = \text{ImageRaster} \mid \text{ImageCode}
\]

\[
\text{ImageRaster} =
\begin{align*}
&\text{element image} ( \\
&  \quad \text{UniqueID?}, \\
&  \quad \text{PermanentID?}, \\
&  \quad \text{attribute width \{text\}?}, \\
&  \quad \text{attribute margins \{text\}?}, \\
&  \quad \text{attribute archive \{text\}?}, \\
&  \quad \text{attribute source \{text\}}, \\
&  \quad \text{attribute decorative \{"yes" | "no"\}?}, \\
&  \quad \text{element description \{TextShort\}?}
\end{align*}
\]

\[
\text{ImageCode} =
\begin{align*}
&\text{element image} ( \\
&  \quad \text{UniqueID?}, \\
&  \quad \text{PermanentID?}, \\
&  \quad \text{attribute width \{text\}?}, \\
&  \quad \text{attribute margins \{text\}?}, \\
&  \quad \text{attribute archive \{text\}?}, \\
&  \quad \text{attribute decorative \{"yes" | "no"\}?}, \\
&  \quad \text{element description \{TextShort\}?}, \\
&  \quad ( \\
&  \quad \quad \text{element latex-image \{text\} |} \\
&  \quad \quad \text{element asymptote \{text\} |} \\
&  \quad \quad \text{element sageplot { \\
&  \quad \quad \quad \text{attribute variant \{"2d" | "3d"\}?}, \\
&  \quad \quad \quad \text{attribute aspect \{text\}?}, \\
&  \quad \quad \quad \text{text} \\
&  \quad \quad } \\
&  \quad )
\end{align*}
\]

\[
\text{ImageWW} =
\begin{align*}
&\text{element image} ( \\
&  \quad \text{attribute pg-name \{text\}?}, \\
&  \quad \text{attribute width \{text\}?}, \\
&  \quad \text{attribute decorative \{"yes" | "no"\}?}, \\
&  \quad \text{element description {\{TextShort | WWVariable\}†}}, \\
&  \quad \text{element latex-image { \\
&  \quad \quad \text{attribute syntax \{"PGtikz"\},}
\end{align*}
\]
26 Sage Code

Sage is integral.

Sage = element sage {
   PermanentID?,
   attribute doctest {text}?,
   attribute tolerance {text}?,
   attribute language {text}?,
   attribute type {text}?,
   (element input {text}, element output {text})?}

27 Interactive Elements

Some specific interactive goodies. These are being phased-out in favor of a more general <interactive> element.

MuseScore =

   element score {
      attribute musescoreuser {text},
      attribute musescore {text}
   }

28 Audio and Video

Well, just video right now. The xml:id is not used as a target, but rather as a name for a static preview image that is auto-generated by the pretext script thumbnail file, hence optional. preview may be one of two reserved switches, or the filename of a static preview image.

Note: the Video pattern allows an @xml:id attribute since it is used to construct a filename for preview images (“poster”), especially when scraped.

Video =

   element video {
      UniqueID?,
      PermanentID?,
      attribute width {text}?,
      attribute margins {text}?,
      attribute aspect {text}?,
      attribute start {xsd:integer}?,
      attribute end {xsd:integer}?,
   }
attribute play-at {"embed" | "popout" | "select"}?,
attribute preview {"default" | "generic" | text}?,
AttributesSourceFile | AttributesNetwork | AttributesYouTube |
AttributesYouTubePlaylist | AttributesVimeo
)

AttributesSourceFile =
    attribute source {text}
AttributesNetwork =
    attribute href {text}
AttributesYouTube =
    attribute youtube {text}
AttributesYouTubePlaylist =
    attribute youtubeplaylist {text}
AttributesVimeo =
    attribute vimeo {text}

29 Poetry

Poems!
⟨693 Poems⟩ ≡

AlignmentPoem = attribute halign {"left" | "center" | "right"}
Poem =
    element poem {
        MetaDataTitleOptional,
        AlignmentPoem?,
        element author {
            AlignmentPoem?,
            TextShort
        }?,
        (PoemLine+ | Stanza+)
    }
Stanza =
    element stanza {
        MetaDataTitleOptional,
        PoemLine+
    }
PoemLine =
    element line {
        attribute indent {xsd:integer}?,
        TextShort
    }

30 Exercises

Inline, divisional, and WeBWorK. Exercises use task to structure parts, where
before they used ordered lists for parts of a statement (to eventually be depre-
cated).
⟨694 Exercises⟩ ≡
31 Bibliography

This is all stop-gap and will change radically. But it seems to work for now. So these rules should not be taken as definitive, at all.

(695 Bibliography) ≡

TextBib = mixed { (Character | MathInline)* }  
BibliographyItem =  
  element biblio {  
   MetaDataTarget,  
    {  
      attribute type {"raw"},  
      (TextLong |  
      Ibid |  
      BibTitle |  
      BibYear |  
      BibJournal |  
      BibNumber |
A <glossary> is primarily built up as a sequence of "glossary items," using the <gi> element, by analogy with list items.

(696 Glossary) ≡

GlossaryItem =
  element gi {
    MetaDataTitle,
    BlockStatementNoCaption+
  }
33 Examples and Questions

Expository, but with solutions, etc. (Borrows from exercises and projects.)

(697 Examples, and similar) ≡

ExampleLike =
  MetaDataTitleOptional,
  (BlockStatement)+ | (Statement, Hint*, Answer*, Solution*) | (IntroductionStatement?, Task+, ConclusionStatement?)

Example =
  element example {ExampleLike} | element question {ExampleLike} | element problem {ExampleLike}

34 WeBWorK Exercises

Modified versions of various aspects to allow authoring WeBWorK exercises.

Notes:

- Statements, hints and solutions do not require at least one paragraph, so
  may be just a table or figure (say).
- Are static and set elements mutually exclusive?
- Can the usage part of the var element be split across math and para-
  graphs?

(698 WeBWorK) ≡

WebWork = (WebWorkAuthored | WebWorkSource)
WebWorkSource =
  element webwork {
    attribute source {text}?,
    attribute seed {xsd:integer}?
  }
WebWorkAuthored =
  element webwork {
    UniqueID?,
    attribute seed {xsd:integer}?,
    attribute copy {text}?,
    element description {
      (TextSimple | SimpleLine+)
    }?,
    WWMacros?,
    element pg-code {text}?,
    (}?
Literate programming is a technique for documenting programs, with code fragments rearranged to create a syntactically correct program. A root fragment is indicated by @filename which could have an @xml:id, otherwise the @xml:id is required.

Frequently used items, with no natural place to associate them.

There is a handful of elements which describe an item, but do not necessarily get processed as content. Titles are an obvious example, and index entries
are another. Here we isolate a few common patterns to use for consistency throughout.

Notes:

- Language tags go on the root element to affect variants of names of objects, like theorems.
- `@permid` is part of managing editions, and is supplied by a script. You should not be adding these manually as an author. (You do want to manually author `@xml:id`.)
- The `xinclude` mechanism may pass language tags down through the root element of included files to make them universally available.
- The `xinclude` mechanism inserts a `@xml:base` attribute on the root element of an included file. So we allow this attribute on any element that allows a title.
- These are not unordered specifications since they contain several attributes, and we enforce a `title`, `subtitle`, `<shorttitle>`, `<plaintitle>`, `creator`, `caption`, `idx` order.
- `MetaDataTarget` is for items that are targets of cross-references, but without even optional titles. Since they will be knowled, they can appear in an index. But without the potential to be titled, we do not set them up as possible root elements of a file to `xinclude`.
- `MetaDataTitle` has a required `<title>`.
- `MetaDataAltTitle` has a required `<title>`, and allows optional `<shorttitle>` and `<plaintitle>`.
- `MetaDataSubtitle` implicitly has a required `<title>`, and allows optional `<subtitle>`, `<shorttitle>` and `<plaintitle>`.
- A `<plaintitle>` means no markup whatsoever in the content, this is what “plain” means.
- `MetaDataLinedTitle` and `MetaDataLinedSubtitle` are variants of the `AltTitle` or `Subtitle` versions for use on larger divisions with `<line>` elements used to suggest line breaks in titles.
- `MetaDataCaption` implicitly has an optional title.
- Titles may contain external references (`url`) or internal cross-references (`xref`), but implementers need not make them active (i.e., they maybe text only), since titles are prone to migrating to other locations.

(702 Metadata) ≡

```
UniqueID =
  attribute xml:id {text}
PermanentID =
  attribute permid {text}
Title =
  element title {TextLong}
LinedTitle =
  element title {LongLine+}
```
Subtitle =
    element subtitle {TextLong}
LinedSubtitle =
    element subtitle {LongLine+}
ShortTitle =
    element shorttitle {TextShort}
PlainTitle =
    element plaintitle {text}
Creator =
    element creator {TextShort}
XMLBase = attribute xml:base {text}
XMLLang = attribute xml:lang {text}
MetaDataTarget =
    UniqueID?,
    PermanentID?,
    Index*
MetaDataTitle =
    UniqueID?,
    PermanentID?,
    XMLBase?,
    XMLLang?,
    Title,
    Index*
MetaDataAltTitle =
    UniqueID?,
    PermanentID?,
    XMLBase?,
    XMLLang?,
    Title,
    ShortTitle?,
    PlainTitle?,
    Index*
MetaDataLinedTitle =
    UniqueID?,
    PermanentID?,
    XMLBase?,
    XMLLang?,
    (Title | LinedTitle),
    ShortTitle?,
    PlainTitle?,
    Index*
MetaDataSubtitle =
    UniqueID?,
    PermanentID?,
    XMLBase?,
    XMLLang?,
    Title,
    Subtitle?,
    ShortTitle?,
    PlainTitle?,
    Index*
MetaDataLinedSubtitle =
    UniqueID?,
    PermanentID?,
    XMLBase?
37 Miscellaneous

Provisional items, with uncertain futures.

〈703 Miscellaneous or uncertain〉 ≡

38 Organizational Devices

A list generator is a convenient device. It can create appendices, or smaller table-of-contents at the start of divisions.

Notation can be automatically generated. We restrict its locations to appendices.

〈704 List generator〉 ≡
39 Front Matter

Articles and books have material at the start, which gets organized in interesting ways. minilicense is very restrictive, shortlicense allows references (e.g. URLs). titlepage is like a very small database—for HTML it migrates to the top of the page for the frontmatter, and for LaTeX it migrates to the half-title and title pages. Since it generally makes no sense as the target of a cross-reference, titlepage does not allow an @xml:id attribute.

\[(705 \text{ Front matter}) \equiv\]

ArticleFrontMatter =
  element frontmatter {
    MetaDataTitleOptional, TitlePage, Abstract?
  }

BookFrontMatter = element frontmatter {
  MetaDataTitleOptional, TitlePage, ColophonFront?, Biography*, Dedication?, Acknowledgement?, Preface*
}

TitlePage =
  element titlepage {
    (Author, Author*, Editor*)
    | (Editor, Editor*)
    ), Credit*, Date?
  }

Author =
  element author {
    element personname {TextSimple}, element department {TextSimple | ShortLine+}?, element institution {TextSimple | ShortLine+}?, element email {text}?
  }
40 Contributors

A single contributors element may be placed into a preface and is a list of contributor. It can be optionally preceded, or followed, by all the usual things that can go into any preface. An AuthorByline is a special instance of acknowledging a contributor on a division.

\[
\begin{align*}
\langle 706 \text{ Contributor} \rangle & \equiv \\
\text{Contributor} & = \\
& \text{element contributor} \{ \\
& \quad \text{MetaDataTarget}, \\
& \quad \text{element personname} \{\text{TextSimple}\}, \\
& \quad \text{element department} \{\text{TextSimple}\}? , \\
& \quad \text{element institution} \{\text{TextSimple}\}? , \\
& \quad \text{element location} \{\text{TextSimple}\}? , \\
& \quad \text{element email} \{\text{text}\}? 
\}
\end{align*}
\]

\[
\begin{align*}
\text{Contributors} & = \\
& \text{element contributors} \{ \\
& \quad \text{Contributor}+ 
\}
\end{align*}
\]

\[
\begin{align*}
\text{AuthorByline} & = \\
& \text{element author} \{(\text{TextSimple}|\text{Xref})\}
\end{align*}
\]

41 Back Matter

Articles and books have material at the end, structured as a sequence of appendix. A solutions division should be numbered and rendered as if it was one of the appendix, and so can mix-in in any order.

\[
\begin{align*}
\langle 707 \text{ Back matter} \rangle & \equiv 
\end{align*}
\]
Document Information

The docinfo section is like a small database for the document.

A nice icon near the top of an electronic version is a nice touch, and can link back to a project landing page.
We add some items to the preamble for \LaTeX, <latex-image>, and <asymptote>. For a package to be in a <latex-preamble>, it needs to have an identical implementation, and be of the same name, as a version that exists for MathJax. Images specified by \LaTeX or Asymptote syntax sometimes need extra information in their preambles.

(710 Preambles) ≡

\[
\text{Configuration} \models \\
\begin{array}{l}
\text{element latex-preamble} \\
\text{element package} \{ \text{text} \}^*
\end{array}
\]

\[
\text{Configuration} \models \\
\begin{array}{l}
\text{element latex-image-preamble} \\
\text{attribute syntax} \{ \text{"PGtikz"} \}?, \\
\text{text}
\end{array}
\]

\[
\text{Configuration} \models \\
\begin{array}{l}
\text{element asymptote-preamble} \{ \text{text} \}
\end{array}
\]

Macros for \LaTeX are shared across implementations. This should move under some general \LaTeX section, the name is too vague.

(711 \LaTeX macros) ≡

\[
\text{Configuration} \models \\
\begin{array}{l}
\text{element macros} \{ \text{text} \}
\end{array}
\]

The style of text used in a cross-reference (the \texttt{xref} element) is contained in the source and uses the same per-item choices.

(712 Cross-reference text style) ≡

\[
\text{Configuration} \models \\
\begin{array}{l}
\text{element cross-references} \\
\text{attribute text} \{ \text{XrefTextStyle} \}
\end{array}
\]

An initialism is a useful short version of a book title.

(713 Project initialism) ≡

\[
\text{Configuration} \models \\
\begin{array}{l}
\text{element initialism} \{ \text{text} \}
\end{array}
\]

Online versions can request feedback via a URL for some form. Maybe this should really be an \texttt{href} for consistency. There should be a device to provide text to go with the link.

(714 Feedback link) ≡
Some elements can be renamed. This should be a rare event. Since the content of this element can (optionally) be specified in different languages, the @xml:lang attribute is appropriate.\footnote{https://www.w3.org/International/questions/qa-when-xmllang}

\begin{quote}
(715 Element renaming) ≡
\end{quote}

Image archives have some global specification. The from attribute gives a root for only working on a subtree of the document. The content is a comma-separated list of file extensions.

\begin{quote}
(716 Image archives) ≡
\end{quote}

An author biography (or several) might be a paragraph or two each, or each one might be several pages. This style can be controlled.

\begin{quote}
(717 Author biographies) ≡
\end{quote}

Many aspects of numbering are configurable. These choices affect the numbers printed, and so are an author’s decision, and hence run with the source.

\begin{quote}
(718 Numbering of part divisions) ≡
\end{quote}
43 Hierarchical Structure

We collect all the specifications, roughly in a top-down order, so the generated schema files have a rational ordering to them, even if the order presented here is different.

(719 Hierarchical Structure) \equiv
Root of file: pretext.rnc

grammar {
  (Gross structure 641 [3])
  (Document types 642 [4])
  (Divisions 643 [5])
  (Front matter 705 [42])
  (Back matter 707 [44])
  (Paragraphs division 644 [7])
  (Specialized divisions 645 [8])
  (Blocks 668 [18])
  (Common components of blocks 669 [18])
  (Introductions, conclusions, headnotes 670 [19])
  (Objectives and outcomes 674 [21])
  (Block quotes 675 [22])
  (Verbatim displays 676 [22])
  (Lists 677 [23])
  (Definitions 678 [24])
  (Theorems, and similar 679 [24])
  (Axioms, and similar 680 [25])
  (Examples, and similar 697 [36])
  (Projects, and similar 681 [25])
  (Remarks, and similar 682 [26])
  (Computation, and similar 683 [26])
  (Asides, and similar 684 [27])
  (Assemblages 685 [27])
  (Captioned and titled displays 686 [27])
  (Side-by-side layouts 688 [29])
  (Images 689 [31])
  (Tabular display 687 [28])
  (Sage code 690 [32])
  (Interactives 691 [32])
  (Video and audio 692 [32])
  (Exercises 694 [33])
  (Poems 693 [33])
  (Bibliography 695 [34])
  (Glossary 696 [35])
  (Contributor 706 [44])
  (WeBWorK 698 [36])
  (Literate programming 699 [38])
  (Miscellaneous or uncertain 703 [41])
  (Frequent constructions 700 [38])
  (Paragraphs 647 [10])
  (Running text 646 [9])
  (Footnotes 672 [21])
  (Index entries 673 [21])
}
44 Bad Bank

Bad bank $\equiv$

Demonstration $= \text{element demonstration} \{$

Title,
Paragraph,
Sage

$\}$

A Fragments

Fragment 641  Gross structure
Fragment 642  Document types
Fragment 643  Divisions
Fragment 644  Paragraphs division
Fragment 645  Specialized divisions
Fragment 646  Running text
Fragment 647  Paragraphs
Fragment 648  Delimiter characters
Fragment 649  Dash characters
Fragment 650  Fill-in blank character
Fragment 651  Arithmetic characters
Fragment 652  Exotic characters
Fragment 653  Icon characters
Fragment 654  Keyboard characters
Fragment 655  Music characters
Fragment 656  Characters
Fragment 657  Text generators
Fragment 658  SI units
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