The schemata package

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Abstract

The schemata package facilitates the creation of topical schemata, outlines that use braces (or facsimiles thereof) to illustrate the breakdown of concepts and categories in Scholastic thought from late medieval and early modern periods. This packages functions with both plain TeX and LaTeX.

Contents

1 Introduction

This package emerged from my personal need to typeset diagrams based on seventeenth-century theology books. I have chosen to make it use a very "bare-bones" approach that is platform-agnostic in many cases, simple to implement, and immune to a number of special cases because it requires manual formatting.

I would recommend that a package like *TikZ*, PSTricks, METAPOST, or some other powerful solution may have advantages, especially for those seeking a top-to-bottom diagram, such as that in; H. DEMBOWSKI, *Einführung in die Christologie* (Darmstadt, 1993), 146. This package is meant to be basic and available in minimal TeX installations.

This package allows one to mimic (to some degree) the left-to-right schemata seen in books like the *Loci Theologici* of Martin Chemnitz and the *Clavis Scripturae Sacrae* of M. Flacius Illyricus.

2 Usage

2.1 Package Options and Loading

LaTeX users can choose among three package options: `braces`, `brackets`, and `parens`. These set the defaults for the "branches." If no options are chosen, the default is `braces`. Plain TeX and LaTeX users can use the `\DoBraces`, `\DoBrackets`, and `\DoParens` macros for the same effect. The default still remains braces.

Users of LaTeX invoke: `\usepackage[`⟨*options*⟩`]{schemata}`

Plain TeX users will use: `\input schemata.sty`

2.2 Overview

`\schema` The "simple" form of a schema consists of one left-hand side containing vertically-centered vertical material, a brace, and one right-hand side containing vertically-centered vertical material:

`\schema[`⟨*type*⟩`]{`⟨*left-hand side*⟩`}{`⟨*right-hand side*⟩`}`

The ⟨*type*⟩ of a schema is `open` by default. Anything other than the exact string `open` will make it a "closed" schema where the left-hand side is bigger than the right and the direction of the brace reflects that. This approach is based on my experience that trying to figure out the size of left-hand and right-hand sides automatically can lead to strange corner cases. This manual solution recognizes that most schemata read and open from left to right.

The ⟨*left-hand side*⟩ and ⟨*right-hand side*⟩ are vertically-centered material in a `\vbox`. This is intentional because one might want to insert a `\smallskip` or other adjustment as needed. One can put whatever is desired in these arguments. An example in LaTeX might be a one-column tabular environment, e.g.:

Code:

```
\schema%
{%
  \hbox{\begin{tabular}{@{}l@{}}
    This conists\\
    of stuff
  \end{tabular}}
}%
{%
  \schemabox{%
    And here\\
    we have\\
    more stuff%
  }%
}
```

Result:

This conists of stuff $\left\{ \begin{array}{l} \text{And here} \\ \text{we have} \\ \text{more stuff} \end{array} \right.$

Note how the results of the two sides are similar. In fact, if one uses a `p{`⟨*width*⟩`}` argument with a tabular, one will get similar results seen with a `\schemabox` using a width argument. The formar still must be enclosed in an `\hbox`. The latter is intended for use in plain TeX.

The `\schemabox` macro is a "stack" of `\hbox` content within a `\vbox`. We will cover it below after we introduce the `\Schema` macro.

\Schema The "complex" form of a schema consists of one left-hand side containing vertically-centered vertical material, a brace, and one right-hand side of vertically-centered vertical material:

$$\texttt{\textbackslash Schema[}\langle \textit{type}\rangle\texttt{]\{}\langle \textit{adjust}\rangle\texttt{\}\{}\langle \textit{size}\rangle\texttt{\}\{}\langle \textit{left-hand side}\rangle\texttt{\}\{}\langle \textit{right-hand side}\rangle\texttt{\}}$$

The $\langle \textit{type}\rangle$ of a schema is `open` by default. Anything other than the exact string `open` will make it a "closed" schema as above.

Both $\langle \textit{adjust}\rangle$ and $\langle \textit{size}\rangle$ should be expressed in "ex", loosely interpreted as multiples of lines. Since an `hbox{\strut}` is 2.88538 ex high and `\vcenter` halves vertical height, the values are multiplied internally by 1.44265.

Actually, $\langle \textit{adjust}\rangle$ must be *double* the number of "ex" lines that a brace must go up (negative value) or down (positive value). By making one enter `-5ex` to pull a brace up 2.5 lines, one can use a whole number instead of entering many decimals.

Note: The value of $\langle \textit{size}\rangle$ always should be positive.

Admittedly, this method is nothing short of ugly. Yet it scales quite well and allows one to guess lengths by counting lines (even in the source) instead of measuring printed or displayed output.

\schemabox This box stacks one or more lines of `\hbox`-enclosed material in a `\vbox`. It redefines the control sequence `\\` in a manner that terminates the current `\hbox` and begins a new one.

$$\texttt{\textbackslash schemabox[}\langle \textit{width}\rangle\texttt{]\{}\langle \textit{text}\rangle\texttt{\}}$$

The $\langle \textit{width}\rangle$ of a `\schemabox` is a dimension, e.g. 3cm. No wrapping takes place. Each line of $\langle \textit{text}\rangle$ must be terminated explicitly by `\\`, except the final line. The first line of a `\schemabox` inserts a `\strut` for aesthetic reasons.

Certainly, it is not mandatory to use a `\schemabox`. Indeed, anything that creates a box whose width is smaller than `\textwidth` can be useful. For example, one can create 1cm^2 boxes:

```
\def\Box{\hbox{\vrule\vbox to 1cm{%
            \hrule\hbox to 1cm{\hfil}\vfil\hrule}\vrule}}
```
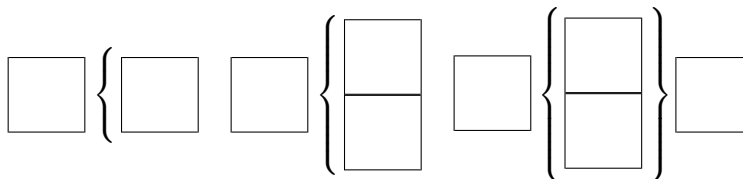
Both `\schema` and `\Schema` are vertical, so they will stack vertically if invoked sequentially. A `tabular` environment prevented that stacking above. If one does not use "ex" height for $\langle \textit{size}\rangle$ in a `\Schema`, one should specify a $\langle \textit{size}\rangle$ slightly less than half the height of the contents. Above, a $\langle \textit{size}\rangle$ of `0.9cm` suffices for a content of `2cm`. This approach is meant to facilitate sizing content according to lines of text, which is what schemata usually hold.

2.3 Tutorial

2.3.1 Starting Off Basic

Imagine that you are using a computer to simulate the physical typesetting of a seventeenth-century schema. To begin with, you try the following schema:

Code: Result:

```
\schema{a}{b\\c}
```

$$a \qquad\qquad \left\{ {{\rm b} \atop {\rm c}} \right.$$

That did not go well. Then you remember this weird `\schemabox` that just might work. You `\let` the control sequence to the shorter `\SB` and you get:

Code: Result:

```
\let\SB\schemabox
\schema{\SB{a}}{\SB{b\\c}}
```

$$a \left\{ {{\rm b} \atop {\rm c}} \right.$$

Now we are getting somewhere! Note that the side of the schema that "opens up" really should be more than one line high:

$$a \left\{ {\rm b} \right. \quad a \left\{ {{\rm b}\atop{\rm c}} \right. \quad a \left\{ {{\rm b}\atop{\rm c}} \right\} {\rm d} \quad a \left[{\rm b} \right. \quad a \left[{{\rm b}\atop{\rm c}} \right. \quad a \left[{{\rm b}\atop{\rm c}} \right] {\rm d} \quad a \left({\rm b} \right. \quad a \left({{\rm b}\atop{\rm c}} \right. \quad a \left({{\rm b}\atop{\rm c}} \right) {\rm d}$$

`\DoBraces`
`\DoBrackets`
`\DoParens`
The left three examples use braces. This is the default, but it is also triggered by `\DoBraces`. The center three examples are achieved with `\DoBrackets`. The right three result from using `\DoParens`. All three macros should precede `\schema` and `\Schema` within a particular scope, and they remain in force in that scope unless changed. A height of 1.44265ex is added automatically to the height of the delimiters to aid the appearance of multi-line schemata.

2.3.2 *Loci* 101

Since we know something about schemata and how to do them, let's try a few examples from *Loci Theologici*. We begin with this simple example:

$$\text{Subjectum theologiæ est Notitia Dei. Considerat ergo, Dei, vel} \left\{ \begin{array}{l} \text{Essentiam,} \left\{ \begin{array}{l} \text{Unitate naturæ.} \\ \text{Trinitate personarum.} \\ \text{Operibus ad intra.} \end{array} \right. \\ \\ \text{Voluntatem, manifestatam in operibus ad extra; ut in} \left\{ \begin{array}{l} \text{Creatione.} \\ \text{Sustentatione naturæ lapsæ.} \\ \text{Reparatione.} \\ \text{Conversione.} \\ \text{Justificatione.} \\ \text{Sanctificatione \&} \\ \text{Glorificatione ejusdem.} \end{array} \right. \end{array} \right.$$

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Something is off here. The "simple" schema automatically adjusts the brace height to the right-hand side. But that includes the *entire* right-hand side. Moreover, \schema will produce cumulatively larger braces when nesting.

This package requires the user to make manual alignment and adjustment to the braces when the entire right-hand side is not to be enclosed. This is because one might insert vertical space at various points that make automatic calculation of brace height somewhat less than trivial. This example is fairly simple and requires only two changes at the places indicated, namely:

```
\schema% Change to \Schema{-1ex}{8.6ex}       \schema
{%                                            {%
  \schemabox{Subjectum theo-\\                  \schemabox{\textsc{Voluntatem},\\
      logi\ae{} est Notitia\\                       manifestatam in\\
      Dei. Considerat\\                             operibus ad extra;\\
      ergo, Dei, vel}                               ut in}
}                                             }
{%                                            {%
  \schema                                       \schemabox{Creatione.\\
  {%                                                Sustentatione natur\ae{} %
    \schemabox{\textsc{Essentiam},}                 laps\ae{}.\\
  }                                               Reparatione.\\
  {%                                              Conversione.\\
    \schemabox{Unitate natur\ae{}.\\              Justificatione.\\
        Trinitate personarum.\\                   Sanctificatione \&\\
        Operibus ad intra.}                       Glorificatione ejusdem.}
  }% Add\smallskip here                         }
                                              }
```

The commented text `% Add\smallskip here` at the bottom of the left column indicates where a little vertical space between the right-hand "leaves" of the "tree" might help. We remove the comment and insert a \smallskip. The general rule is:

\schema...{⟨*right-hand side*⟩}⟨*vert-space*⟩
\Schema...{⟨*right-hand side*⟩}⟨*vert-space*⟩

One also may insert space within a \schemabox, but one should avoid doing that in either the first or last lines when inside a \schema.

Having adjusted the "leaves," we now work toward the "root." The \Schema macro requires manual brace adjustment and sizing. It is best used in cases where either the left or right-hand sides include a \schema or a \Schema. Manual adjustment is achieved by counting lines, estimating, and refining the estimate.

Even in the source above, one can estimate eight lines of output text from "Essentiam" down to "ut in." Set ⟨*size*⟩ to 8ex and ⟨*adjust*⟩ to 0ex. The large brace will be a little too low. Set ⟨*adjust*⟩ to -1ex to raise the brace about half a line and to lower the left-hand side about half a line, keeping everything centered. Finally, setting ⟨*size*⟩ to 8.6ex gives a better result.

$$
\text{Subjectum theologiæ est Notitia Dei. Considerat ergo, Dei, vel}
\begin{cases}
\textsc{Essentiam,} \begin{cases} \text{Unitate naturæ.} \\ \text{Trinitate personarum.} \\ \text{Operibus ad intra.} \end{cases} \\[2em]
\begin{array}{l}\textsc{Voluntatem,} \\ \text{manifestatam in} \\ \text{operibus ad extra;} \\ \text{ut in}\end{array}
\begin{cases} \text{Creatione.} \\ \text{Sustentatione naturæ lapsæ.} \\ \text{Reparatione.} \\ \text{Conversione.} \\ \text{Justificatione.} \\ \text{Sanctificatione \&} \\ \text{Glorificatione ejusdem.} \end{cases}
\end{cases}
$$

Many schemata, such as ones that illustrate the relationship of figures and tropes to the literal sense of a text, are no more complex than this:

$$
\text{sensus literalis}
\begin{cases}
\begin{array}{l}\text{sensus} \\ \text{literalis} \\ \text{(improprie)}\end{array}
\begin{cases} \text{ex parallelismo clarior} \\ \text{ex analogia fidei} \\ \text{ex evidentia rei} \end{cases} \\[2em]
\text{sensus literae}
\end{cases}
$$

```
\LCschema%
\Schema{-1ex}{5ex}
{\hbox{Sensus literalis}}
{%
  \schema{\schemabox{Sensus\\literalis\\(improprie)}}%
       {\schemabox{Ex parallelismo clarior\\%
                   Ex analogia fidei\\Ex evidentia rei}}%
           \medskip\schemabox{Sensus literae}
}
\UCschema%
```

\LCschema By default, a \schemabox automatically adds a \strut to the first line because it
\UCschema is often the case that the topics in a schema start in some fashion with a capitalized
letter. Using \Schema allows one to manually adjust the brace height, but \schema,
as used above, looks wrong with the lowercase content unless one uses \LCschema
in order to suppress adding a \strut. \UCschema restores the default.

\SwitchSB   \SwitchSB is a "per-use" macro that causes a particular \schemabox to do
the opposite of whatever \LCschema and \UCschema call for. It should be placed
immediately before the \schemabox and is reset thereafter.

     This still does not correct for the fact that \schema adjusts its height with
respect to the ascenders and descenders, not the height of the first letter. Inserting
\vskip-0.8ex before \schemabox{Ex parallelismo... causes the material in the
\schema to look centered on the first letters. Still, if one must go to all that trouble,
one could easily use Schema.

     This example also shows that one can have a heterogeneous collection of
vertically-centered material within the LHS and RHS braces of \Schema. Doing
that with \schema is not recommended.

2.3.3 Going Big

We begin with the following example, where the \Schema braces all have dummy values of 0ex ⟨*adjust*⟩ and 5ex ⟨*size*⟩. Perhaps the indentation helps to give a sense of the nesting and how the result might end up:
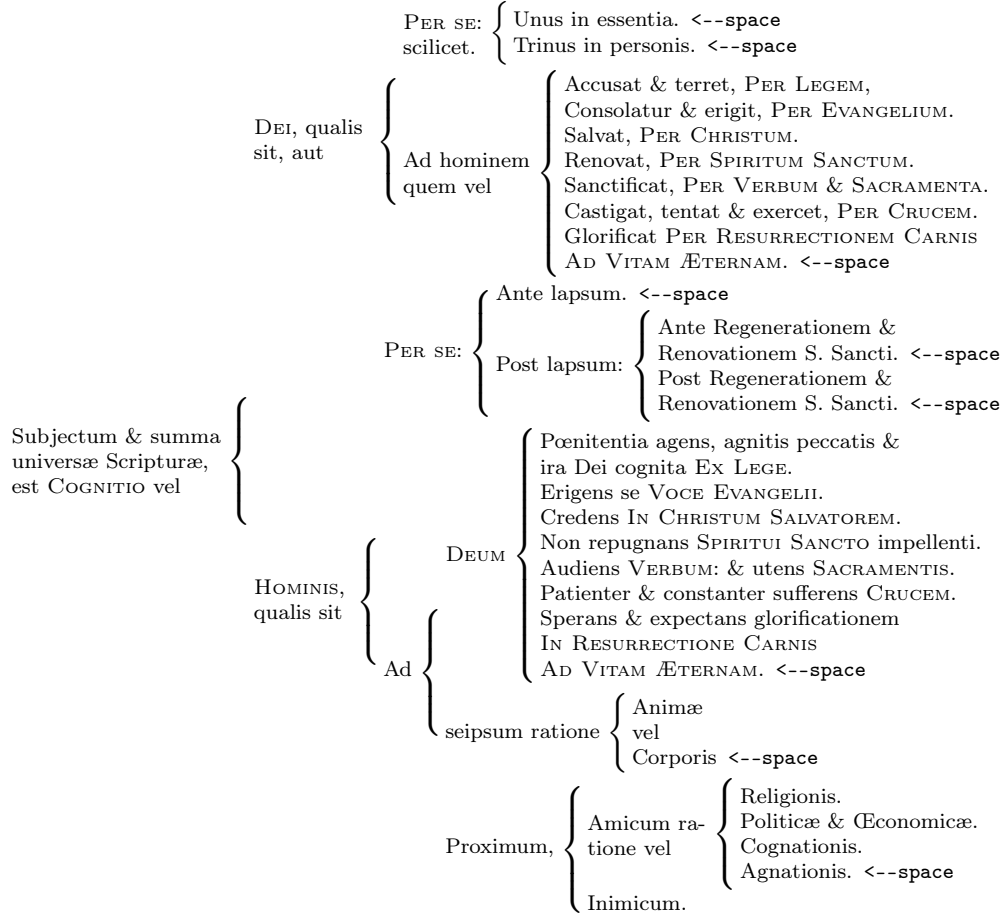
```
\Schema{0ex}{5ex}
{%
  \schemabox{Subjectum \& summa\\
    univers\ae{} Scriptur\ae{},\\
    est \textsc{Cognitio} vel}
}
{%
  \Schema{0ex}{5ex}
  {%
    \schemabox{\textsc{Dei}, qualis\\
      sit, aut}
  }
  {%
    \schema
    {\schemabox{\textsc{Per se}:\\ scilicet.}}
    {%
      \schemabox{Unus in essentia.\\
        Trinus in personis.}
    }
    \schema
    {\schemabox{Ad hominem\\ quem vel}}
    {%
      \schemabox{Accusat \& terret, %
        \textsc{Per Legem},\\
        Consolatur \& erigit, %
        \textsc{Per Evangelium}.\\
        Salvat, \textsc{Per Christum}.\\
        Renovat, \textsc{Per Spiritum%
        Sanctum}.\\
        Sanctificat, \textsc{Per Verbum} \& %
        \textsc{Sacramenta}.\\
        Castigat, tentat \& exercet, %
        \textsc{Per Crucem}.\\
        Glorificat \textsc{Per %
        Resurrectionem Carnis}\\
        \textsc{Ad Vitam \AE{}ternam}.}
    }
  }
  \Schema{0ex}{5ex}
  {%
    \schemabox
    {%
      \textsc{Hominis},\\ qualis sit
    }
  }
  {%
    \Schema{0ex}{5ex}
    {\schemabox{\textsc{Per se}:}}
    {%
      \schemabox{Ante lapsum.}
```

```
      \schema
      {\schemabox{Post lapsum:}}
      {%
        \schemabox{Ante Regenerationem \&\\
          Renovationem S. Sancti.}
        \schemabox{Post Regenerationem \&\\
          Renovationem S. Sancti.}
      }
    }
    \Schema{0ex}{5ex}
    {\schemabox{Ad}}
    {%
      \schema
      {\schemabox{\textsc{Deum}}}
      {%
        \schemabox{P\oe{}nitentia agens, %
          agnitis peccatis \&\\
          ira Dei cognita \textsc{Ex Lege}.\\
          Erigens se \textsc{Voce Evangelii}.\\
          Credens \textsc{In Christum Salvatorem}.\\
          Non repugnans \textsc{Spiritui Sancto} %
          impellenti.\\
          Audiens \textsc{Verbum}: \& utens %
          \textsc{Sacramentis}.\\
          Patienter \& constanter sufferens %
          \textsc{Crucem}.\\
          Sperans \& expectans glorificationem\\
          \textsc{In Resurrectione Carnis}\\
          \textsc{Ad Vitam \AE{}ternam}.}
      }
      \schema
      {\schemabox{seipsum ratione}}
      {\schemabox{Anim\ae{}\\ vel\\ Corporis}}
      \Schema{0ex}{5ex}
      {\schemabox{Proximum,}}
      {%
        \schema
        {\schemabox{Amicum ra-\\ tione vel}}
        {%
          \schemabox{Religionis.\\
            Politic\ae{} \& \OE{}conomic\ae{}.\\
            Cognationis.\\
            Agnationis.}
        }
        \schemabox{Inimicum.}
      }
    }
  }
}
```
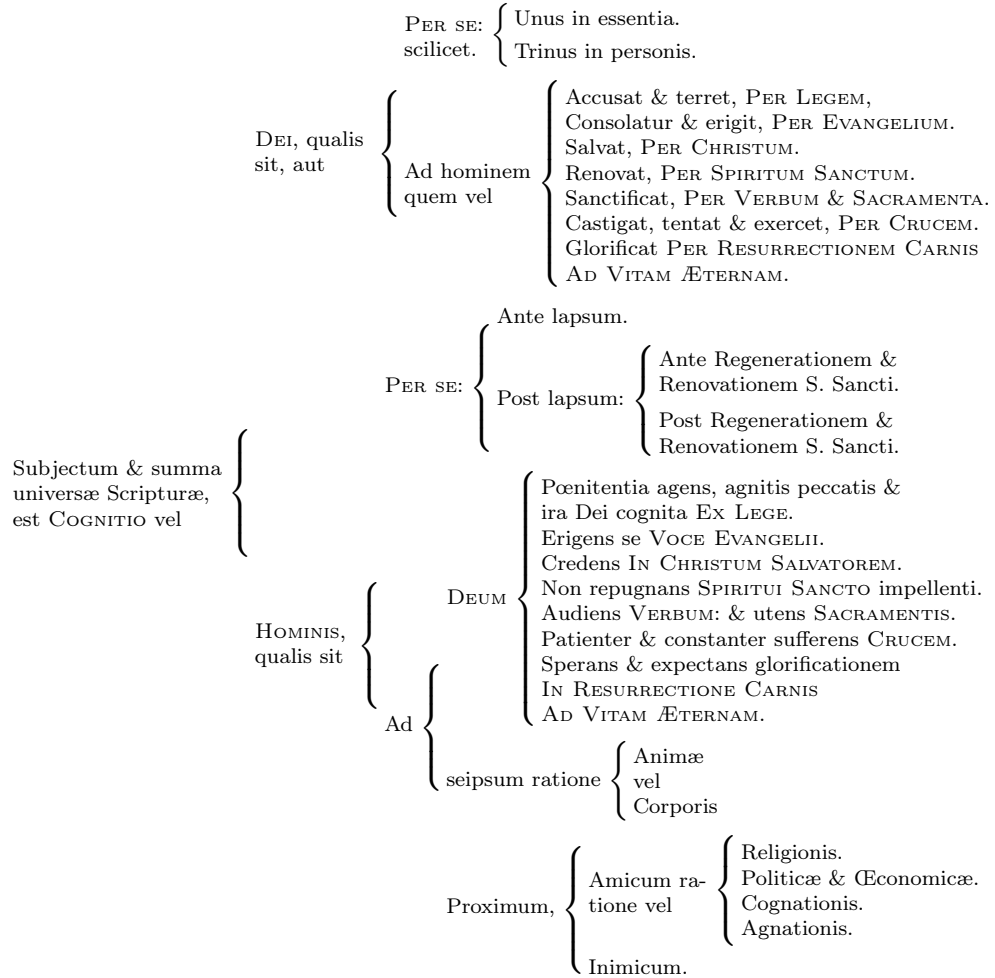
Below is the result of that code (with additions for spacing). It looks pretty bad, except where the \schema macros have extended their braces. Think of a \schema as a "leaf" on the right-hand side and you get the idea.

Per se: { Unus in essentia. <--space
scilicet. { Trinus in personis. <--space

Dei, qualis sit, aut {
Ad hominem quem vel {
Accusat & terret, Per Legem,
Consolatur & erigit, Per Evangelium.
Salvat, Per Christum.
Renovat, Per Spiritum Sanctum.
Sanctificat, Per Verbum & Sacramenta.
Castigat, tentat & exercet, Per Crucem.
Glorificat Per Resurrectionem Carnis
Ad Vitam Æternam. <--space
}

Subjectum & summa universæ Scripturæ, est Cognitio vel {

Per se: {
Ante lapsum. <--space
Post lapsum: {
Ante Regenerationem &
Renovationem S. Sancti. <--space
Post Regenerationem &
Renovationem S. Sancti. <--space
}
}

Hominis, qualis sit {
Ad {
Deum {
Pœnitentia agens, agnitis peccatis &
ira Dei cognita Ex Lege.
Erigens se Voce Evangelii.
Credens In Christum Salvatorem.
Non repugnans Spiritui Sancto impellenti.
Audiens Verbum: & utens Sacramentis.
Patienter & constanter sufferens Crucem.
Sperans & expectans glorificationem
In Resurrectione Carnis
Ad Vitam Æternam. <--space
}
seipsum ratione {
Animæ
vel
Corporis <--space
}
}
}

Proximum, {
Amicum ratione vel {
Religionis.
Politicæ & Œconomicæ.
Cognationis.
Agnationis. <--space
}
Inimicum.
}
}

The first order of business is to determine the spacing of the "leaves" of the tree, both within and between schemata. The places where one might wish to add vertical space are indicated by <---space in the figure above.

It really is necessary to work from right to left here. One might think that he or she can guess roughly how big a brace might be. While that may be true, what will happen if you try to size the braces before spacing out the text on the right-hand side is that you will have to go back and forth, tweaking this and that, until you get what you want. That is a waste of time and a source of frustration. Steel yourself to avoid temptation and begin rigorously by adding vertical space after selected instances of \Schema or \schema, or within a \schemabox. The list on the next page shows the changes.

Per se: { Unus in essentia.
scilicet. { Trinus in personis.

Dei, qualis sit, aut { Ad hominem quem vel {
Accusat & terret, Per Legem,
Consolatur & erigit, Per Evangelium.
Salvat, Per Christum.
Renovat, Per Spiritum Sanctum.
Sanctificat, Per Verbum & Sacramenta.
Castigat, tentat & exercet, Per Crucem.
Glorificat Per Resurrectionem Carnis
Ad Vitam Æternam.
}

Subjectum & summa universæ Scripturæ, est Cognitio vel {

Per se: {
Ante lapsum.
Post lapsum: {
Ante Regenerationem & Renovationem S. Sancti.
Post Regenerationem & Renovationem S. Sancti.
}
}

Hominis, qualis sit {
Ad {
Deum {
Pœnitentia agens, agnitis peccatis & ira Dei cognita Ex Lege.
Erigens se Voce Evangelii.
Credens In Christum Salvatorem.
Non repugnans Spiritui Sancto impellenti.
Audiens Verbum: & utens Sacramentis.
Patienter & constanter sufferens Crucem.
Sperans & expectans glorificationem
In Resurrectione Carnis
Ad Vitam Æternam.
}
seipsum ratione { Animæ vel Corporis }
}
}

Proximum, {
Amicum ratione vel {
Religionis.
Politicæ & Œconomicæ.
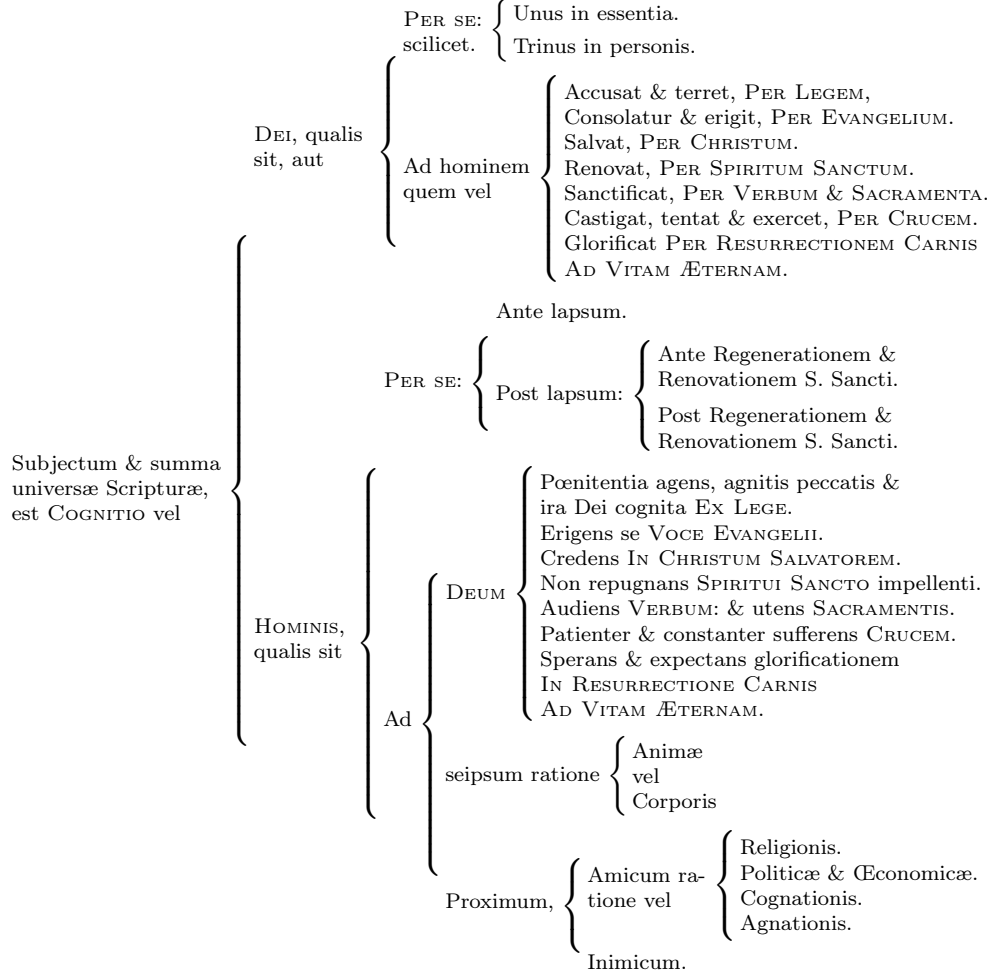Cognationis.
Agnationis.
}
Inimicum.
}
}

The following lines, shown with some surrounding context, were changed as a result of adding spaces:

```
   \schemabox{Unus in essentia.\smallskip\\%     ...
      Trinus in personis.}                          \textsc{Ad Vitam \AE{}ternam}.}
}\smallskip                                      }\smallskip
   ...                                           \schema
      \textsc{Ad Vitam \AE{}ternam}.}            {\schemabox{seipsum ratione}}
}\medskip                                        {\schemabox{Anim\ae{}\\ vel\\ Corporis}}%
   ...                                              \smallskip
   \schemabox{Ante lapsum.}\smallskip            ...
   \schema                                            Agnationis.}
   ...                                            }\smallskip
      \schemabox{Ante Regenerationem \&\\        \schemabox{Inimicum.}
         Renovationem S. Sancti.}\medskip
      \schemabox{Post Regenerationem \&\\
         Renovationem S. Sancti.}
   }\smallskip
```

Next we estimate the lines from the top of a `\Schema` brace to the bottom, e.g., from "Per se:" to "quem vel". We use those "ex" height figures for ⟨*size*⟩:

Subjectum & summa universæ Scripturæ, est Cognitio vel

- Dei, qualis sit, aut
  - Per se: scilicet.
    - Unus in essentia.
    - Trinus in personis.
  - Ad hominem quem vel
    - Accusat & terret, Per Legem,
    - Consolatur & erigit, Per Evangelium.
    - Salvat, Per Christum.
    - Renovat, Per Spiritum Sanctum.
    - Sanctificat, Per Verbum & Sacramenta.
    - Castigat, tentat & exercet, Per Crucem.
    - Glorificat Per Resurrectionem Carnis
    - Ad Vitam Æternam.
- Hominis, qualis sit
  - Per se:
    - Ante lapsum.
    - Post lapsum:
      - Ante Regenerationem & Renovationem S. Sancti.
      - Post Regenerationem & Renovationem S. Sancti.
  - Ad
    - Deum
      - Pœnitentia agens, agnitis peccatis & ira Dei cognita Ex Lege.
      - Erigens se Voce Evangelii.
      - Credens In Christum Salvatorem.
      - Non repugnans Spiritui Sancto impellenti.
      - Audiens Verbum: & utens Sacramentis.
      - Patienter & constanter sufferens Crucem.
      - Sperans & expectans glorificationem In Resurrectione Carnis Ad Vitam Æternam.
    - seipsum ratione
      - Animæ
      - vel
      - Corporis
    - Proximum,
      - Amicum ratione vel
        - Religionis.
        - Politicæ & Œconomicæ.
        - Cognationis.
        - Agnationis.
      - Inimicum.

The following lines, shown with some surrounding context, illustrate our "ball park" figures:

```
\Schema{0ex}{20ex}
{%
  \schemabox{Subjectum \& summa\\
      ...
  \Schema{0ex}{8ex}
  {%
    \schemabox{\textsc{Dei}, qualis \\%
      ...
  \Schema{0ex}{14ex}
  {%
    \schemabox
    {%
```

```
    \textsc{Hominis},\\ qualis sit
      ...
  \Schema{0ex}{4ex}
  {\schemabox{\textsc{Per se}:}}
      ...
  \Schema{0ex}{12ex}
  {\schemabox{Ad}}
      ...
    \Schema{0ex}{4ex}
    {\schemabox{Proximum,}}
```

Now we add the ⟨*adjust values*⟩ by counting the lines in the direction the brace needs to move, multiplying by two, and making it negative for up and positive for down. Using, e.g., texworks makes this easy. Work from leaves to root.
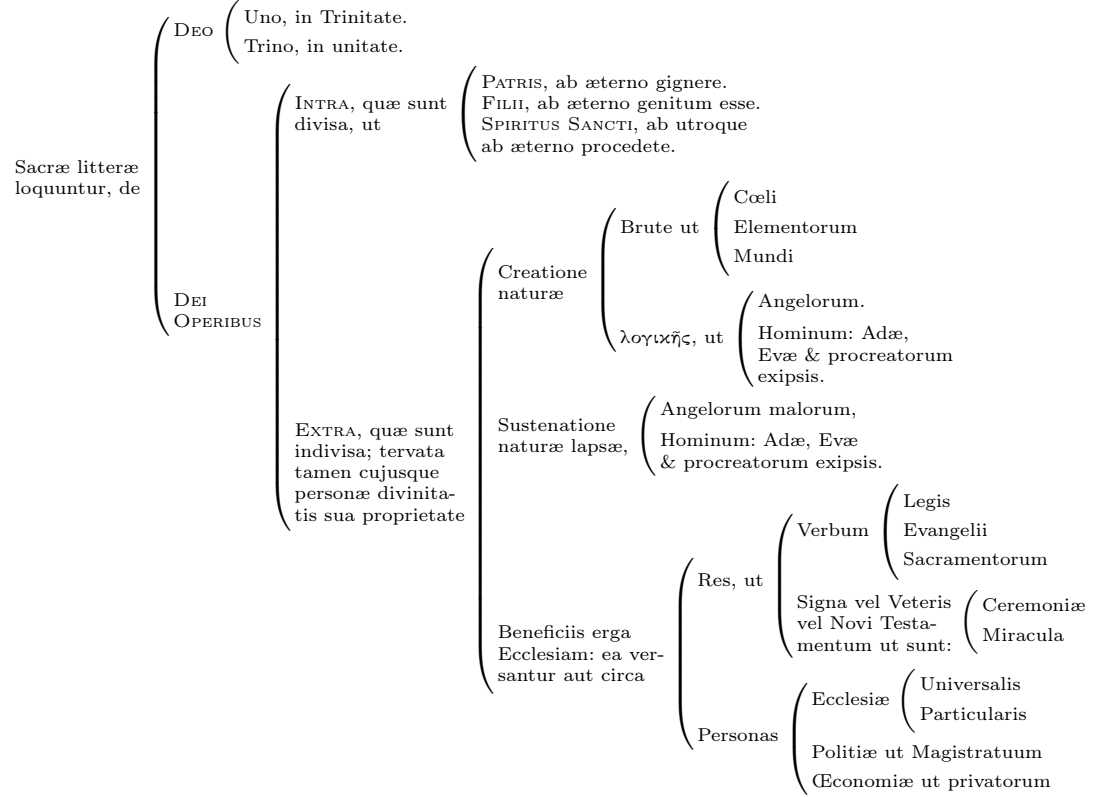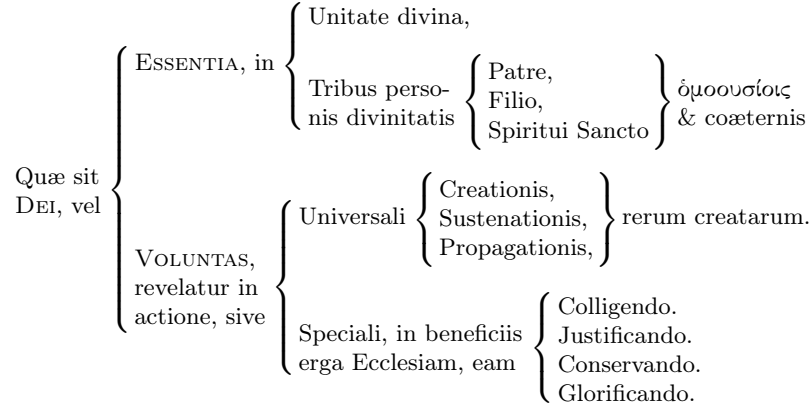
Subjectum & summa universæ Scripturæ, est Cognitio vel

Dei, qualis sit, aut

  Per se: scilicet.
    Unus in essentia.
    Trinus in personis.

  Ad hominem quem vel
    Accusat & terret, Per Legem,
    Consolatur & erigit, Per Evangelium.
    Salvat, Per Christum.
    Renovat, Per Spiritum Sanctum.
    Sanctificat, Per Verbum & Sacramenta.
    Castigat, tentat & exercet, Per Crucem.
    Glorificat Per Resurrectionem Carnis
    Ad Vitam Æternam.

Hominis, qualis sit

  Per se:
    Ante lapsum.
    Post lapsum:
      Ante Regenerationem & Renovationem S. Sancti.
      Post Regenerationem & Renovationem S. Sancti.

  Ad

    Deum
      Pœnitentia agens, agnitis peccatis & ira Dei cognita Ex Lege.
      Erigens se Voce Evangelii.
      Credens In Christum Salvatorem.
      Non repugnans Spiritui Sancto impellenti.
      Audiens Verbum: & utens Sacramentis.
      Patienter & constanter sufferens Crucem.
      Sperans & expectans glorificationem In Resurrectione Carnis
      Ad Vitam Æternam.

    seipsum ratione
      Animæ
      vel
      Corporis

    Proximum,
      Amicum ratione vel
        Religionis.
        Politicæ & Œconomicæ.
        Cognationis.
        Agnationis.
      Inimicum.

The following illustrates the final results:

```
\Schema{-25ex}{20ex}
{%
  \schemabox{Subjectum \& summa\\
      ...
  \Schema{-6.4ex}{8.2ex}
  {%
    \schemabox{\textsc{Dei}, qualis \\%
        ...
    \Schema{-14.4ex}{17ex}
    {%
      \schemabox
       {%
```

```
  \textsc{Hominis},\\ qualis sit
    ...
  \Schema{-4ex}{4.4ex}
  {\schemabox{\textsc{Per se}:}}
      ...
  \Schema{3.6ex}{14ex}
  {\schemabox{Ad}}
      ...
    \Schema{2ex}{5ex}
    {\schemabox{Proximum,}}
```

The next example illustrates spacing, adjusting, and `\DoParens`:

Sacræ litteræ loquuntur, de
- Deo
  - Uno, in Trinitate.
  - Trino, in unitate.
- Dei Operibus
  - Intra, quæ sunt divisa, ut
    - Patris, ab æterno gignere.
    - Filii, ab æterno genitum esse.
    - Spiritus Sancti, ab utroque ab æterno procedete.
  - Extra, quæ sunt indivisa; tervata tamen cujusque personæ divinitatis sua proprietate
    - Creatione naturæ
      - Brute ut
        - Cœli
        - Elementorum
        - Mundi
      - λογικῆς, ut
        - Angelorum.
        - Hominum: Adæ, Evæ & procreatorum exipsis.
    - Sustenatione naturæ lapsæ,
      - Angelorum malorum,
      - Hominum: Adæ, Evæ & procreatorum exipsis.
    - Beneficiis erga Ecclesiam: ea versantur aut circa
      - Res, ut
        - Verbum
          - Legis
          - Evangelii
          - Sacramentorum
        - Signa vel Veteris vel Novi Testamentum ut sunt:
          - Ceremoniæ
          - Miracula
      - Personas
        - Ecclesiæ
          - Universalis
          - Particularis
        - Politiæ ut Magistratuum
        - Œconomiæ ut privatorum

Next we see some closed schemata. Braces are back, thanks to scoping rules.

Quæ sit Dei, vel
- Essentia, in
  - Unitate divina,
  - Tribus personis divinitatis
    - Patre,
    - Filio,
    - Spiritui Sancto
  - ὁμοουσίοις & coæternis
- Voluntas, revelatur in actione, sive
  - Universali
    - Creationis,
    - Sustenationis,
    - Propagationis,
  - rerum creatarum.
  - Speciali, in beneficiis erga Ecclesiam, eam
    - Colligendo.
    - Justificando.
    - Conservando.
    - Glorificando.

This example merits consideration because it uses not only open schemata but closed ones nested within them. One must use `\Schema` in that case to prevent the opening braces from being slightly larger than the closing braces.

```
\Schema{-1.4ex}{10ex}                          \Schema{-0.2ex}{6.4ex}
{%                                             {%
  \schemabox{Qu\ae{} sit\\%                      \schemabox{\textsc{Voluntas},\\%
    \textsc{Dei}, vel}                             revelatur in\\ actione, sive}
}                                              }
{%                                             {%
  \Schema{-1ex}{5ex}                             \Schema{0ex}{3.4ex}
  {%                                             {%
    \schemabox{\textsc{Essentia}, in}             \schemabox{Universali}
  }                                              }
  {%                                             {%
    \vskip1ex\schemabox{Unitate divina,}          \Schema[close]{0ex}{3.4ex}
    \medskip                                       {%
    \Schema{0ex}{3.4ex}                              \schemabox{Creationis,\\%
    {%                                                 Sustenationis,\\ Propagationis,}
      \schemabox{Tribus perso-\\%                    }
        nis divinitatis}                           {%
    }                                                \schemabox{rerum creatarum.}
    {%                                             }
      \Schema[close]{0ex}{3.4ex}                  }
      {%                                         \medskip
        \schemabox{Patre,\\ Filio,\\%            \schema
          Spiritui Sancto}                       {%
      }                                            \schemabox{Speciali, in beneficiis\\%
      {%                                             erga Ecclesiam, eam}
        \schemabox{\gk{<omoous'iois}\\%          }
          \& co\ae{}ternis}                      {%
      }                                            \schemabox{Colligendo.\\ Justificando.\\%
    }                                                Conservando.\\ Glorificando.}
  }                                              }
}                                              }
  \medskip                                   }
```

Balanced open/closed schemata take the general form:

```
\Schema{0ex}{2ex}
        {\hbox{$left_1$}}{\Schema[close]{0ex}{2ex}
                        {\hbox{$left_2$}}{\hbox{$right_2$}}}
```

The result is:

$$left_1 \left\{ left_2 \right\} right_2$$

Try to produce the following. Hint: Everything to the right of the leftmost brace is the RHS of the outermost schema. Everything in that RHS to the left of the rightmost brace is the LHS of the first nested schema, and so on.

$$a \begin{bmatrix} b & \begin{bmatrix} f \\ g \\ h \end{bmatrix} & l \\ c & & m \\ d & \begin{bmatrix} i \\ j \\ k \end{bmatrix} & n \\ e & & o \end{bmatrix} p$$

This final example illustrates how one can set the width of a `\schemabox`, and for what sort of use that might be, e.g., in order to line up the braces. Invoking `\DoBrackets` after the start of the group containing the right-hand side of the first `\Schema` causes all schemas contained therein to use brackets. This remains consistent with scoping rules.

$$
\text{\textbf{Curriculum}} \begin{cases}
\begin{array}{ll}
\textbf{I. General} & \left[\begin{array}{l} \text{1. Collected Works} \\ \text{2. Encyclopedias} \end{array}\right. \\
\text{Studies} \\[1ex]
\textbf{II. Literary} & \left[\begin{array}{l} \text{1. Philology} \\ \text{2. Historical Introduction} \\ \text{3. Literary Theory} \\ \text{4. Application} \end{array}\right. \\
\text{Disciplines} \\[1ex]
\textbf{III. Philosophical} & \left[\begin{array}{l} \text{1. Source Texts} \\ \text{2. History of Philosophy} \\ \text{3. General Surveys} \\ \text{4. Specific Studies} \end{array}\right. \\
\text{Disciplines} \\[1ex]
\textbf{IV. Historical} & \left[\begin{array}{l} \text{1. General Surveys} \\ \text{2. Specialized Works} \end{array}\right. \\
\text{Disciplines}
\end{array}
\end{cases}
$$

```
\Schema{-0.2ex}{14.4ex}
{\schemabox{\bfseries Curriculum}}
{%
  \DoBrackets%
  \schema
    {\schemabox[3cm]{\bfseries%
      I. General\\Studies}}
    {\schemabox{1. Collected Works\\
      2. Encyclopedias}}
  \smallskip
  \schema
    {\schemabox[3cm]{\bfseries%
      II. Literary\\Disciplines}}
    {\schemabox{1. Philology\\
      2. Historical Introduction\\
      3. Literary Theory\\
      4. Application}}
```

```
  \smallskip
  \schema
      {\schemabox[3cm]{\bfseries%
      III. Philosophical\\Disciplines}}
      {\schemabox{1. Source Texts\\
      2. History of Philosophy\\
      3. General Surveys\\
      4. Specific Studies}}
  \smallskip
  \schema
      {\schemabox[3cm]{\bfseries%
      IV. Historical\\Disciplines}}
      {\schemabox{1. General Surveys\\
      2. Specialized Works}}
  }
```

Feedback is always welcome!

3 Implementation

The concept of using math mode to generate schemata was first implemented by me in plain TeX, then migrated to LaTeX.

3.1 Package Options and Required Packages

Three options are implemented, namely, `braces` (the default), `brackets`, and `parens`. Plain TeX does not use options as such, but simply declares braces as the default and allows the user to change that after the file is `\input`.

```
1 \expandafter\ifx\csname newenvironment\endcsname\relax%
2 \def\DoBraces{\let\schemaLD\lbrace \let\schemaRD\rbrace}\DoBraces%
3 \DoBraces%
4 \else
5 \DeclareOption{braces}{\let\schemaLD\lbrace \let\schemaRD\rbrace}
6 \DeclareOption{brackets}{\let\schemaLD\lbrack \let\schemaRD\rbrack}
7 \DeclareOption{parens}{\let\schemaLD( \let\schemaRD)}
8 \ExecuteOptions{braces}
9 \ProcessOptions\relax
10 \fi

11 \newbox\rhs%
12 \newbox\lhs%
13 \newdimen\rheight%
14 \newdimen\lheight%
```

Two box registers and two dimen registers are used to analyze the left-hand and right-hand vertical sizes of the boxes in a schema. Automation of alignment presently is a distant horizon.

```
15 \newif\ifschemaLC%
16 \newif\ifschemaSwitch%
```

3.2 Macros

\DoBraces

```
17 \def\DoBraces{\let\schemaLD\lbrace \let\schemaRD\rbrace}\DoBraces%
```

Set the default option.

\DoBrackets

```
18 \def\DoBrackets{\let\schemaLD\lbrack \let\schemaRD\rbrack}%
```

Set the "branches" to be brackets.

\DoParens

```
19 \def\DoParens{\let\schemaLD( \let\schemaRD)}%
```

Set the "branches" to be parentheses.

20 `\def\LCschema{\schemaLCtrue}%`

Set global settings to assume lowercase initial text in schemaboxes.

21 `\def\UCschema{\schemaLCfalse}%`

Set global settings to assume uppercase initial text in schemaboxes.

22 `\def\SwitchSB{\schemaSwitchtrue}%`

Flip the settings for one **\schemabox**, which will reset this value.

```
23 \expandafter\ifx\csname newenvironment\endcsname\relax%
24 {\catcode'@=11
25 \gdef\schemabox{\futurelet\testchar\schemab@x}
26 \gdef\schemab@x{\ifx[\testchar \let\next\@schemabox%
27   \else \let\next\@schemab@x \fi \next}
28 \gdef\@schemab@x#1{\@schemabox[0pt]{#1}}
29 \gdef\@schemabox[#1]#2{%
30   \ifschemaLC\def\Adj{}%
31     \ifschemaSwitch\def\Adj{\strut}\fi
32   \else
33     \def\Adj{\strut}%
34     \ifschemaSwitch\def\Adj{}\fi
35   \fi
36   \schemaSwitchfalse%
37   \ifdim#1<1pt
38     \def\\{\egroup\hbox\bgroup\ignorespaces }%
39     \vbox{\hbox\bgroup\Adj\ignorespaces #2\egroup}%
40   \else
41     \def\\{\hfil\egroup\hbox to #1\bgroup\ignorespaces }%
42     \vbox{\hbox to #1\bgroup\Adj\ignorespaces #2\hfil\egroup}%
43   \fi
44 }}\else
45 \newcommand{\schemabox}[2][0pt]{%
46   \ifschemaLC\def\Adj{}%
47     \ifschemaSwitch\def\Adj{\strut}\fi
48   \else
49     \def\Adj{\strut}%
50     \ifschemaSwitch\def\Adj{}\fi
51   \fi
52   \schemaSwitchfalse%
53   \ifdim#1<1pt
54     \def\\{\egroup\hbox\bgroup\ignorespaces }%
55     \vbox{\hbox\bgroup\Adj\ignorespaces #2\egroup}%
56   \else
```

```
57     \def\\{\hfil\egroup\hbox to #1\bgroup\ignorespaces }%
58     \vbox{\hbox to #1\bgroup\Adj\ignorespaces #2\hfil\egroup}%
59   \fi
60 }\fi
```

Wrap a stack of left-aligned hboxes with optional width in a vbox. This allows the box to be only as wide as needed. The syntax is reminiscent of a one-column tabular. Normally insert a \strut in the first \hbox.

\schema

```
61 \expandafter\ifx\csname newenvironment\endcsname\relax%
62 {\catcode`@=11
63 \gdef\schema{\futurelet\testchar\schem@}
64 \gdef\schem@{\ifx[\testchar \let\next\@schema%
65   \else \let\next\@schem@ \fi \next}
66 \gdef\@schem@#1#2{\@schema[open]{#1}{#2}}
67 \gdef\@schema[#1]#2#3{%
68   \def\Option{#1}\def\Open{open}%
69   \ifx\Option\Open
70     \setbox\rhs=\vbox{#3}%
71     \rheight=\ht\rhs%
72     \advance\rheight\dp\rhs%
73     \advance\rheight by 1.44265ex%
74     \hbox{$\vcenter{#2}\basiclbrace{\rheight}\vcenter{#3}$}%
75   \else
76     \setbox\lhs=\vbox{#2}%
77     \lheight=\ht\lhs%
78     \advance\lheight\dp\lhs%
79     \advance\lheight by 1.44265ex%
80     \hbox{$\vcenter{#2}\kern-0.2em\basicrbrace{\lheight}\vcenter{#3}$}%
81   \fi
82 }}\else
83 \newcommand{\schema}[3][open]{%
84   \def\Option{#1}\def\Open{open}%
85   \ifx\Option\Open
86     \setbox\rhs=\vbox{#3}%
87     \rheight=\ht\rhs%
88     \advance\rheight\dp\rhs%
89     \advance\rheight by 1.44265ex%
90     \hbox{$\vcenter{#2}\basiclbrace{\rheight}\vcenter{#3}$}%
91   \else
92     \setbox\lhs=\vbox{#2}%
93     \lheight=\ht\lhs%
94     \advance\lheight\dp\lhs%
95     \advance\lheight by 1.44265ex%
96     \hbox{$\vcenter{#2}\kern-0.2em\basicrbrace{\lheight}\vcenter{#3}$}%
97   \fi
98 }\fi
```

This "simple" schema vertically centers two boxes of internal vertical material and puts a "simple" brace between the boxes based on the height of the box and the options passed to the schema. By default, a schema has a box to the left, an open delimiter, and a box to the right. If any optional argument other than "open" is used, the schema prints a box to the left, a close brace, and a box to the right.

\Schema

```
 99 \expandafter\ifx\csname newenvironment\endcsname\relax%
100 {\catcode`\@=11
101 \gdef\Schema{\futurelet\testchar\Schem@}
102 \gdef\Schem@{\ifx[\testchar \let\next\@Schema \else \let\next\@Schem@ \fi \next}
103 \gdef\@Schem@#1#2#3#4{\@Schema[open]{#1}{#2}{#3}{#4}}
104 \gdef\@Schema[#1]#2#3#4#5{%
105   \def\Option{#1}\def\Open{open}%
106   \ifx\Option\Open
107     \dimen0=#2%
108     \hbox{$\vcenter{\vskip1.44265\dimen0#4}\complexlbrace{#2}{#3}\vcenter{#5}$}%
109   \else
110     \dimen0=#2%
111     \hbox{$\vcenter{\vskip1.44265\dimen0#4}\kern-0.2em%
112       \complexrbrace{#2}{#3}\vcenter{#5}$}%
113   \fi
114 }}\else
115 \newcommand{\Schema}[5][open]{%
116   \def\Option{#1}\def\Open{open}%
117   \ifx\Option\Open
118     \dimen0=#2%
119     \hbox{$\vcenter{\vskip1.44265\dimen0#4}\complexlbrace{#2}{#3}\vcenter{#5}$}%
120   \else
121     \dimen0=#2%
122     \hbox{$\vcenter{\vskip1.44265\dimen0#4}\kern-0.2em%
123       \complexrbrace{#2}{#3}\vcenter{#5}$}%
124   \fi
125 }\fi
```

This is the general-purpose form of schemata. The parameters include whether it is an open or closed schema, the vertical adjustment of the left-hand side, the size of the brace, and the contents of the left and right-hand sizes. It works the same as above, but requires manual adjustment of the braces.

\basiclbrace

```
126 \expandafter\ifx\csname newenvironment\endcsname\relax%
127   \def\basiclbrace#1{%
128     \ifmmode\left.\vcenter{\vbox to #1{\vfil}}\right\schemaLD\fi}
129 \else
130   \newcommand{\basiclbrace}[1]{%
131     \ifmmode\left.\vcenter{\vbox to #1{\vfil}}\right\schemaLD\fi}
132 \fi
```

Draw an on-center brace to the left of a simple box.

```
133 \expandafter\ifx\csname newenvironment\endcsname\relax%
134   \def\basicrbrace#1{%
135     \ifmmode\left\schemaRD\vcenter{\vbox to #1{\vfil}}\right.\fi}
136 \else
137   \newcommand{\basicrbrace}[1]{%
138     \ifmmode\left\schemaRD\vcenter{\vbox to #1{\vfil}}\right.\fi}
139 \fi
```

Draw an on-center brace to the right of a simple box.

```
140 \expandafter\ifx\csname newenvironment\endcsname\relax%
141 \def\complexlbrace#1#2{%
142   \dimen0=#1%
143   \dimen2=#2%
144   \ifdim\dimen0<0pt
145     \ifmmode\vcenter{\hbox{$\left.\vbox to 1.44265\dimen2{\vfil}\right\schemaLD%
146       \atop\vbox to -1.44265\dimen0{\vfil}$}}\fi
147   \else
148     \ifmmode\vcenter{\hbox{$\vbox to 1.44265\dimen0{\vfil}%
149       \atop\left.\vbox to 1.44265\dimen2{\vfil}\right\schemaLD$}}\fi
150   \fi
151 }\else
152 \newcommand{\complexlbrace}[2]{%
153   \dimen0=#1%
154   \dimen2=#2%
155   \ifdim\dimen0<0pt
156     \ifmmode\vcenter{\hbox{$\left.\vbox to 1.44265\dimen2{\vfil}\right\schemaLD%
157       \atop\vbox to -1.44265\dimen0{\vfil}$}}\fi
158   \else
159     \ifmmode\vcenter{\hbox{$\vbox to 1.44265\dimen0{\vfil}%
160       \atop\left.\vbox to 1.44265\dimen2{\vfil}\right\schemaLD$}}\fi
161   \fi
162 }\fi
```

Draw a brace to the left of a complex assortment of boxes.

```
163 \expandafter\ifx\csname newenvironment\endcsname\relax%
164 \def\complexrbrace#1#2{%
165   \dimen0=#1%
166   \dimen2=#2%
167   \ifdim\dimen0<0pt
168     \ifmmode\vcenter{\hbox{$\left.\vbox to 1.44265\dimen2{\vfil}\right\schemaRD%
169       \atop\vbox to -1.44265\dimen0{\vfil}$}}\fi
170   \else
171     \ifmmode\vcenter{\hbox{$\vbox to 1.44265\dimen0{\vfil}%
172       \atop\left.\vbox to 1.44265\dimen2{\vfil}\right\schemaRD$}}\fi
173   \fi
```

```
174 }\else
175 \newcommand{\complexrbrace}[2]{%
176   \dimen0=#1%
177   \dimen2=#2%
178   \ifdim\dimen0<0pt
179     \ifmmode\vcenter{\hbox{$\left.\vbox to 1.44265\dimen2{\vfil}\right\schemaRD%
180       \atop\vbox to -1.44265\dimen0{\vfil}$}}\fi
181   \else
182     \ifmmode\vcenter{\hbox{$\vbox to 1.44265\dimen0{\vfil}%
183       \atop\left.\vbox to 1.44265\dimen2{\vfil}\right\schemaRD$}}\fi
184   \fi
185 }\fi
```

Draw a brace to the right of a complex assortment of boxes.

Change History

Index

Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.