The naproche package*

Marcel Schütz

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This naproche package¹ provides markup for Naproche formalizations written in the LATEX dialect of ForTheL. It is intended to be a "beginner-friendly" LaTeX package (i.e. one that can be easily adapted to experiment with the typesetting it provides) to be used for small Naproche formalizations that

- ullet do not depend on libraries of Naproche formalizations and
- are *not* intended to be converted to interactive HTML.

For formalizations that require any of the above features, consider to use the "advanced" naproche package (see footnote 1) instead.

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^{*}This document corresponds to naproche v1.0.2, dated 2025-10-08.

 $^{^1\}mathrm{There}$ is another naproche package for more advanced use cases, shipped with Naproche at $\mathtt{math/latex/lib/naproche.sty}$

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Part I

Documentation

1 Usage

To use the naproche package (without installing it), write

\usepackage{path/to/naproche}

in the preamble of the .ftl.tex file of your Naproche formalization, where path/to/naproche is the path to the .sty file of this package. See the .ftl.tex files in the math/examples directory for examples.

2 Package Options

puzzle This package provides two typesetting styles: A "standard" and a "puzzle" style, where – as the name suggests – the "standard" style is the default one. To use the "puzzle" style, provide the package option puzzle. The "standard" style is used by all formalizations in the math/examples directory; the "puzzle" style is used by, e.g., math/examples/puzzles/agatha.ftl.tex and math/examples/puzzle s/dwarfs.ftl.tex. The following sections contain notes on how they differ from each other.

numbers within section If the option numbers within section or numbers within subsection is given, the numbers within subsection numbering of top-level sections (i.e. definitions, theorems, axioms etc.) is reset at every new section or subsection, resp.

3 Commands Required by ForTheL

The syntax of ForTheL specifies keywords that have the shape of TEX macros. This package loads certain LATEX packages that provide some of those macros and provides its own definitions for the remaining ones:

\dom The domain of a map, rendered as "dom".

\fun The λ -operator for locally defined maps, rendered as " λ ".

Logos 4

\Naproche Prints the Naproche logo, i.e. "Naproche". Note that it is not required to append an empty pair of curly braces to \Naproche to get its trailing whitespace right. E.g. \Naproche foo will be rendered as "Naproche foo" and not (as you might expect) as "Naprochefoo".

\ForTheL Prints the ForTheL logo, i.e. "ForTheL". As with the \Naproche macro it is not

required to append an empty pair of curly braces to \ForTheL to get its trailing whitespace right.

5 Comprehension Terms

```
\label{eq:class} $$ \class{\langle lhs\rangle \mid \langle rhs\rangle \}}$$ Prints a comprehension term: "$$ {\langle lhs\rangle \mid \langle rhs\rangle \}$". $$ $$ \classtext $$ \classtext{\langle arg\rangle }$$
```

When using the \class command to print a comprehension term it sometimes happens that its right-hand side requires more space than is left in the current line. In this situation the right-hand side can be wrapped in the \classtext command which behaves much like the \text command (i.e. leaves math mode²) but automatically insert linebreaks at appropriate positions. Thus, when using the \classtext command, the containing \class command should only be used in display math mode. For example,

```
\[ \class{n \in X | \classtext{n is an odd prime number that is greater than $5$ and divides every number that is contained in $Y$}} \]
```

is rendered as:

```
\left\{n \in X \;\middle|\; \begin{array}{c} n \text{ is an odd prime number that is greater than 5 and divides every} \\ \text{number that is contained in } Y \end{array}\right\}
```

6 Printing Labels

```
\printref \printref{\langle id \rangle}
```

Prints the label $\langle id \rangle$ of a top-level section verbatimly. This can be usefull to print labels of top-level sections that are defined in an imported file (and therefore not accessible for LATEX).

For example, assume that we have a file foo.ftl.tex which contains the following theorem environment:

```
\begin{forthel}
  \begin{theorem}\label{cantor}
   There exists no surjection from $X$ to the powerset of $X$.
  \end{theorem}
\end{forthel}
```

Moreover, assume that we have another file bar.ftl.tex which imports foo.ftl.tex (e.g. via [readtex \path{foo.ftl.tex}]) and in which we want to

²In most cases an overlong right-hand side of a comprehension term is due to a long piece of text anyway, and not due to a long formula.

reference the above theorem. Then LATEX would complain if we would try to use, e.g.,

|X| is strictly smaller than $|2^{X}|$ (by \ref{cantor}).

in a ForTheL proof since the label cantor has not been defined in the file bar.ft 1.tex. To reference that theorem anyway we can use

|X| is strictly smaller than $|2^{X}|$ (by \printref{cantor}).

instead, which is rendered as "|X| is strictly smaller than $|2^X|$ (by cantor).".

7 The ForTheL Environment

forthel (env.) Content wrapped in a forthel environment is recognized by Naproche which means that Naproche tries to check whether it is a formally correct piece of mathematical text.

> It is displayed with a gray background to distinguish its formal content from the other *informal* parts of the document it is contained in. Moreover, paragraphs within a forthel environment are not indented and are separated vertically from each other by 0.5 em.

8 Top-level Section Environments

signature (env.) Top-level sections, i.e. signature extensions, axioms, definitions, assertions or signature* (env.) conventions, can be typset via the respective environments listed in figure 1.

axiom (env.)

axiom*(env.)

definition (env.)

definition*(env.)

theorem (env.)theorem* (env.)

lemma (env.)

lemma*(env.)

proposition (env.)

proposition* (env.)

corollary (env.)

corollary* (env.)

convention (env.)

convention* (env.)

Top-Level Sections in the "Standard" Typesetting

In the "standard" typesetting, top-level section environments take an optional argument $\langle title \rangle$ which is intended to contain the title of the respective top-level section. They are rendered as "theorem-like" sections, whose heading consists of the name of the top-level section (see figure 1), followed by an automatically generated number (only in the unstarred variants), the title (if given via \(\lambda title \rangle \)) and a punctuation mark to separate the heading from the body of the section. Unstarred top-level section environments or top-level section environments with a $\langle title \rangle$ argument may be annotated with $\boldsymbol{\lambda}$ which allows to reference them via \ref or \nameref. For instance,

\begin{theorem}[Cantor's Theorem]\label{cantor} There is no surjection from \$X\$ to the powerset of \$X\$. \end{theorem}

is rendered as:

Theorem 1 (Cantor's Theorem). There is no surjection from X to the powerset of X.

Top-Level Section	Environments	Name in the "standard" typesetting
signature extension	signature	Signature
	signature*	
axiom	axiom	Axiom
	axiom*	
definition	definition	Definition
	definition*	
assertion	theorem	Theorem
	theorem*	
	lemma	Lemma
	lemma*	
	proposition	Proposition
	proposition*	
	corollary	Corollary
	corollary*	
convention	convention	Convention
	convention*	

Figure 1: Top-Level Section Environments

To suppress the numbering, we can replace theorem by theorem* which causes the environment to be rendered as:

Theorem (Cantor's Theorem). There is no surjection from X to the powerset of X.

Since in the first case the environment is both starred and has a label, we can reference it via \ref. For example,

|X| is strictly smaller than $|2^{X}|$ (by \ref{cantor}).

is rendered as "|X| is strictly smaller than $|2^X|$ (by 1).". Alternatively, since it also has a title, we can reference it via \nameref. For example,

|X| is strictly smaller than $|2^{X}|\$ (by \nameref{cantor}).

is rendered as "|X| is strictly smaller than $|2^X|$ (by Cantor's Theorem)." instead.

8.2 Top-Level Sections in the "Puzzle" Typesetting

In the "puzzle" typesetting, top-level section environments take no argument and just print their body verbatimly. In case of an assertion, an additional "Therefore:" is prepended to the body. Note that in the "puzzle" typesetting, using the starred or the unstarred variant of a top-level section environment has the same effect.

For instance³,

\begin{axiom}

 $^{^3{}m Taken}$ from math/examples/puzzles/dwarfs.ftl.tex.

```
If some dwarf $D$ names the color of the hat of $D$ then all dwarfs get released.

\end{axiom}
\begin{axiom}
Sigbert names the opposite color of the color of the hat of Tormund.
\end{axiom}
\begin{axiom}
Tormund names the color of the hat of Sigbert.
\end{axiom}
\begin{theorem}
All dwarfs get released.
\end{theorem}
```

is rendered as:

"If some dwarf D names the color of the hat of D then all dwarfs get released. Sighert names the opposite color of the color of the hat of Tormund. Tormund names the color of the hat of Sighert. Therefore: All dwarfs get released."

9 The Proof Environment

proof (env.) Proofs can be typeset via the proof environment which takes an optional argument $\langle method \rangle$. It is rendered as a "proof-like" section whose heading consists of the string "Proof", followed by $\langle method \rangle$ (if given) and a punctuation mark to separate the heading from the body of the section. Moreover, a QED symbol is added to the end of the body.

For example,

```
\begin{proof}[by induction]
  Let $n$ be a natural number.
  Then $n + 1 = 1 + n$.
  Hence ...
\end{proof}
```

is rendered as:

Proof by induction. Let n be a natural number. Then n+1=1+n. Hence ... \square

Part II

Implementation

This section is only relevant for *developers* of the naproche package. If you are an *end-user* of this package, you can ignore this section.

10 Preliminary Setup

```
Oforthel A Boolean variable that tracks iff we are currently in a forthel environment.
```

```
1 \newbool{@forthel}
2
```

@puzzle A Boolean variable whose value determines if the "puzzle" typesetting is to be used instead of the "standard" typesetting.

```
\begin{array}{c} 3 \verb| newbool{@puzzle}| \\ 4 \end{array}
```

Otlscounter A counter for numbered top-level section environments.

```
5 \newcounter{@tlscounter}
```

11 Options

```
19 \DeclareOption*{
             \PackageWarning{naproche}{Unknown option '\CurrentOption'}
         21 }
         22
           Process the options.
         23 \ProcessOptions\relax
               Commands Required by ForTheL
         12
    \dom See section 3
         25 \NewDocumentCommand{\dom}{}{\textrm{dom}}
         26
    \fun See section 3
         27 \NewDocumentCommand{\fun}{}\mathrm{\lambda}}
         28
         13
               Logos
\Naproche See section 4
         29 \ensuremath{\mathbf{N}}\ aproche}{\lambda \ Naproche}\.
\ForTheL See section 4
         {\tt 31 \ NewDocumentCommand{\ForTheL}{}{\mbox{ForTheL}} \\ \tt xspace} \\
               Comprehension Terms
         14
 \@lproj Left and right projection.
 \@rproj
         33 \NewDocumentCommand{\@lproj}{m m}{#1}
         34 \NewDocumentCommand{\@rproj}{m m}{#2}
  \class See section 5
         \left\{\@lproj#1~\middle\vert~\@rproj#1\right\}
         38 }
         39
```

Throw a warning for any unknown option.

```
\label{lem:classtext} See section 5 $$ 40 \end{\classtext}_{m}{\scriptstyle 1}$ $$ 41 $$
```

15 Printing Labels

```
\printref See section 6

42 \NewDocumentCommand{\printref}{m}{\path{#1}}
43
```

16 The ForTheL Environment

```
Oforthelgray Background color of forthel environments.
               44 \colorlet{@forthelgray}{lightgray!30}
forthel (env.) See section 7.
               46 \NewDocumentEnvironment{forthel}{}{
                   \begin{mdframed} [backgroundcolor=@forthelgray,linecolor=@forthelgray]
                   \setbool{@forthel}{true}
               48
                  \setlength{\parindent}{0pt}
               49
                  \setlength{\parskip}{0.5em}
               50
                   \end{mdframed}
               53
                   \setbool{@forthel}{false}
               54 }
               55
```

17 Top-Level Section Environments

```
\@SetCurrentLabelName Redefine the \@currentlabelname macro. (See https://ctan.net/macros/latex/contrib/hyperref/doc/nameref.pdf for details.)

56 \NewDocumentCommand{\@SetCurrentLabelName}{m}{
57 \protected@edef\@currentlabelname{#1}
58 }
59
```

17.1 Markup for the Standard Layout

```
\label{local_env} $$ \end{ard} \env} $$ {\end} \env} $$ defines an environment $$ \end{\env} \[ \langle env \rangle \} \[ \langle title \rangle ] \dots \end{\env} $$ that does the following: $$ \end{\env} $$ $$ \end{\env} $$ $$ $$ \end{\end} $$ \end{\en
```

1. Increase the counter @tlscounter (whose value is referred to as $\langle tls \rangle$ in the following) is increased.

- 2. Enter a new paragraph and if @forthel is false (i.e. if we are currently not in a forthel environment), insert a horizontal space of 0.5 em. (Inside a forthel environment this is not necessary since there all paragraphs are separated by 0.5 em anyway.)
- 3. Print " $\langle name \rangle \langle tls \rangle$." or, if $\langle title \rangle$ is given, " $\langle name \rangle \langle tls \rangle$ ($\langle title \rangle$)." without indentation.
- 4. Print the body of the environment.
- 5. Enter a new paragraph and if @forthel is false (i.e. if we are currently not in a forthel environment), a horizontal space of 0.5 em is inserted (cf. step 2).

```
60 \NewDocumentCommand{\@NewTLS@standard}{m m}{
    \NewDocumentEnvironment{#1}{o}{
61
      \refstepcounter{@tlscounter}
62
      \par
63
      \ifbool{@forthel}{}\vspace{0.5em}}
64
      \noindent\textbf{#2~\the@tlscounter\IfValueT{##1}{~(##1)}.}%
65
      \IfValueT{##1}{\@SetCurrentLabelName{##1}}%
66
    }{
67
68
      \par
      \ifbool{@forthel}{}{\vspace{0.5em}}
69
70
    }
71 }
72
```

 $\label{lem:local_continuous_con$

- 1. Enter a new paragraph and if @forthel is false (i.e. if we are currently not in a forthel environment), insert a horizontal space of 0.5 em. (Inside a forthel environment this is not necessary since there all paragraphs are separated by 0.5 em anyway.)
- 2. Print " $\langle name \rangle$." or, if $\langle title \rangle$ is given, " $\langle name \rangle$ ($\langle title \rangle$)." without indentation.
- 3. Print the body of the environment.
- 4. Enter a new paragraph and if @forthel is false (i.e. if we are currently not in a forthel environment), a horizontal space of 0.5 em is inserted (cf. step 1).

```
73 \NewDocumentCommand{\@NewTLS@standard@starred}{m m}{
74 \NewDocumentEnvironment{#1}{o}{
75 \par
76 \ifbool{@forthel}{}{\vspace{0.5em}}
77 \noindent\textbf{#2\IfValueT{##1}{^(##1)}.}%
78 \IfValueT{##1}{\@SetCurrentLabelName{##1}}%
79 }{
80 \par
81 \ifbool{@forthel}{}{\vspace{0.5em}}
```

```
82 }
83 }
```

17.2 Markup for the Puzzle Layout

17.3 Defining Top-Level Section Environments

Top-level section environments (see section 8). If <code>Qpuzzle</code> is <code>true</code>, define them via <code>\QNewTLSQpuzzle</code>, otherwise via <code>\QNewTLSQstandardQstarred</code>.

17.3.1 Signatures

```
signature (env.) Signature environments.
signature* (env.)

89 \ifbool{@puzzle}{
90 \@NewTLS@puzzle{signature}
91 \@NewTLS@puzzle{signature*}
92 }{
93 \@NewTLS@standard{signature}{Signature}
94 \@NewTLS@standard@starred{signature*}{Signature}
95 }
96
```

17.3.2 Axioms

17.3.3 Definitions

```
definition (env.) Definition environments.
definition* (env.)

105 \ifbool{@puzzle}{
106      \@NewTLS@puzzle{definition}
107      \@NewTLS@puzzle{definition*}
108 }{
109      \@NewTLS@standard{definition}{Definition}
110      \@NewTLS@standard@starred{definition*}{Definition}
111 }
112
```

17.3.4 Assertions

```
theorem (env.) Assertion environments.
    theorem* (env.)
                    113 \ifbool{@puzzle}{
       lemma (env.)
                         \@NewTLS@puzzle{theorem}[Therefore:]
                    114
      lemma* (env.)
                         \@NewTLS@puzzle{theorem*}[Therefore:]
                    115
 proposition (env.)
                         \@NewTLS@puzzle{lemma}[Therefore:]
                   116
proposition* (env.) 117
                         \@NewTLS@puzzle{lemma*}[Therefore:]
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                         \@NewTLS@puzzle{proposition*}[Therefore:]
                         \@NewTLS@puzzle{corollary}[Therefore:]
                    120
                         \@NewTLS@puzzle{corollary*}[Therefore:]
                    121
                    122 }{
                    123
                         \@NewTLS@standard{theorem}{Theorem}
                         \@NewTLS@standard@starred{theorem*}{Theorem}
                    124
                    125
                         \@NewTLS@standard{lemma}{Lemma}
                    126
                         \@NewTLS@standard@starred{lemma*}{Lemma}
                         \@NewTLS@standard{proposition}{Proposition}
                    127
                         \@NewTLS@standard@starred{proposition*}{Proposition}
                    128
                         \@NewTLS@standard{corollary}{Corollary}
                    129
                         \@NewTLS@standard@starred{corollary*}{Corollary}
                    130
                    131 }
                    132
```

17.3.5 Conventions

```
convention (env.) Convention environments.
convention* (env.)

133 \ifbool{@puzzle}{
134  \@NewTLS@puzzle{convention}
135  \@NewTLS@puzzle{convention*}
136 }{
137  \@NewTLS@standard{convention}{Convention}
138  \@NewTLS@standard@starred{convention*}{Convention}
139 }
140
```

18 The Proof Environment

146 { 147 \h

148 \par 149 }

150

Change History

v1.0.0	v1.0.2
General: Initial version i	
v1.0.1	General: Clean up definitions of
General: Add ForTheL logoi	top-level section environments . i

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