The apxproof package

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http://github.com/PierreSenellart/apxproof

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Abstract

This package makes it easier to write articles where proofs and other material are deferred to the appendix. The appendix material is written in the LATEX code along with the main text which it naturally complements, and it is automatically deferred. The package can automatically send proofs to the appendix, can repeat in the appendix the theorem environments stated in the main text, can section the appendix automatically based on the sectioning of the main text, and supports a separate bibliography for the appendix material.

1 Usage

The apxproof package is intended to simplify the writing of articles where some of the content needs to be deferred to an appendix. This is in particular useful for the submission of scientific articles to conferences or journals that limit the number of pages in the main text but allow an extra appendix, where proofs of theorems and other material can be added.

1.1 Basics

To use apxproof, first load it in the header of your document:

\usepackage{apxproof}

On its own, this does not do anything and should not change the appearance of your document. To add an appendix with some material from your document, use the toappendix environment:

toappendix

```
\begin{toappendix}
```

\end{toappendix}

The content will appear at the end of your document, in an automatically generated section that refers to the current section in the main text.

Example 1. Throughout this documentation, all examples produce content deferred to the appendix, at the very end of this document.

```
\begin{toappendix}
This content is in the appendix.
\end{toappendix}
```

When the content to put in appendix is an entire section, make sure that \section is the very first command that appears within the toappendix environment. It will disable the automatic production of a section heading.

1.2 Repeated Theorems and Proofs

In some scientific papers that include proofs, it is common to defer proofs to the appendix. This can easily be achieved using the appendixproof environment:

appendixproof

```
\begin{appendixproof}
    ...
\end{appendixproof}
```

This behaves like the toappendix environment, except that a proof environment is generated.

Example 2. We now send a proof to the appendix:

```
\begin{appendixproof}
This proof is in the appendix.
\end{appendixproof}
```

When deferring proofs to the appendix, an annoying problem is that the statement of the theorem remains in the main text; it is hard to read a proof that is far away from the statement it proves. apxproof solves this issue by allowing statements of theorems to be *repeated*: once in the main text, and once in the appendix before the proof of the statement. To use this feature, you can define a new *repeated theorem* environment using the \newtheoremrep command:

\newtheoremrep

```
\mbox{\ \ } [\langle counter \rangle] [\langle title \rangle] [\langle countersec \rangle]
```

Usage is exactly the same as that of AMS LATEX's \newtheorem macro:

- $\langle name \rangle$ (e.g., theorem) is the name of an environment that is created for this kind of theorem;
- \(\langle counter \rangle \) (e.g., definition) is an optional counter describing from which kind of environment the numbering of these environments should be inherited;
- \(\lambda title \rangle \) (e.g., Theorem) is the title that will be used to display this theorem environment;

• (countersec) (e.g., section) is an optional counter of a sectioning command indicating that counters for this theorem should be prefixed by this counter (and reset at each occurrence of the sectioning command).

 $\langle counter \rangle$ and $\langle countersec \rangle$ should not be used together. What differs from \newtheorem is that, when the following is written:

```
\newtheoremrep{foobar}{Foobar}
```

then *two* environments are defined: the **foobar** environment, which behaves as if **\newtheorem** had been used, and the **foobarrep** environment, which results in the statement of this environment being repeated in the appendix.

One interesting feature of apxproof is that in most situations, there is no need to use the appendixproof environment. Indeed, the proof environment is redefined by apxproof to automatically put the proof either in the main text (if it follows a regular theorem) or in the appendix (if it follows a repeated theorem).

Example 3. Assume we have first defined a repeated theorem environment foobar as above. We can now use this theorem environment, first for a regular theorem in the main text, then for a theorem repeated in the main text and in the appendix:

П

```
\begin{foobar}
This foobar is a regular one, in the main text.
\end{foobar}
\begin{proof}
This is the proof of the regular foobar.
\end{proof}
```

We obtain:

proof

Foobar 1. This foobar is a regular one, in the main text.

Proof. This is the proof of the regular foobar.

Now, if we use a repeated theorem:

```
\begin{foobarrep}
This foobar is repeated in the appendix.
\end{foobarrep}
\begin{proof}
This is the proof of the repeated foobar.
\end{proof}
```

We now obtain:

Foobar 2. This foobar is repeated in the appendix.

Note that, since hyperref is loaded, there are hyperlinks created between the statements of the theorems in the main text and in the appendix.

When the proof is deferred to the appendix, it is common practice to add a proof sketch in the main text. apxproof defines a simple proofsketch environment for this purpose:

proofsketch

\begin{proofsketch}

. . .

\end{proofsketch}

inlineproof

The proof sketch is typeset similarly to a proof, but is always in the main text. Similarly, an inlineproof environment is provided so as to be able to have both a proof in the appendix (using the regular proof environment, or alternatively the appendixproof environment) and a different proof in the main text (using the inlineproof environment).

Example 4. Here are simple examples of proof sketches and inline proofs:

\begin{proofsketch}
This is a proof sketch.
\end{proofsketch}

Proof sketch. This is a proof sketch.

\begin{inlineproof}
This is an inline proof.
\end{inlineproof}

Proof. This is an inline proof.

1.3 Bibliography

By default, apxproof automatically adds a bibliography in the appendix with only the references cited in the appendix material. This allows for a clean separation of references used solely in the main text, and those used in the appendix.

Example 5. Assume we have citations both in the main text and in the appendix.

This is a citation in the main text~\cite{lamport86}. \begin{toappendix}
This is a citation in the appendix~\cite{proofsAreHard}. \end{toappendix}

This is a citation in the main text [1].

The bibliography in the appendix can use a different style and heading than the bibliography in the main text (and, by default, it does). See Section 1.5 for how to configure the appearance of that bibliography.

option bibliography

In order to use a single appendix for the main text and the bibliography, one can specify the value common to the bibliography option when loading the package. (By default this option is set to separate.)

1.4 Mode

option appendix

An optional $\langle mode \rangle$ can be specified when loading the package:

 $\usepackage[appendix=\langle mode \rangle] \{apxproof\}$

 $\langle mode \rangle$ can take one of the following three values:

append This is the default. Appendix material gathered by apxproof is appended to the main text.

inline In this mode, apxproof simply inlines the content along with the main text.

strip This mode functions similarly to **append** except that the appendix is not appended at the end of the document. All appendix material is therefore removed.

1.5 Customization

apxproof provides a few macros that can be redefined (using \renewcommand) to customize the appearance of the appendix:

\mainbodyrepeatedtheorem

\mainbodyrepeatedtheorem is a macro that is executed at the beginning of the body of every repeated theorem. This can be used to notify the reader that the theorem is repeated in appendix in some way, e.g., with a margin note.

\appendixsectionformat

\appendixsectionformat{ $\langle number \rangle$ }{ $\langle title \rangle$ } is a macro that indicates how to format the section titles in the Appendix, given the number and title of the section in the main text. By default, they appear as "Proofs for Section $\langle number \rangle$ ($\langle title \rangle$)".

\appendixrefname

\appendixrefname contains the heading that is displayed before the bibliography. By default, this is "References for the Appendix". (Note that this command is also defined and used by the memoir document class.)

\appendixbibliographystyle

\appendixbibliographystyle contains the .bst bibliography style that is used in the bibliography in appendix. By default, this is alpha.

\appendixbibliographyprelim

\appendixbibliographyprelim contains arbitrary code that is executed just before the production of the bibliography in appendix, which can be used to configure the way it is displayed.

\appendixprelim

\appendixprelim contains arbitrary code that is executed just before the production of the appendix, which can be used to configure the way it is displayed. By default, this command contains \clearpage\onecolumn (the appendix is typeset on a new page in single-column mode) but redefining this option allows changing this behavior.

 $\begin{array}{c} option \\ \texttt{repeqn} \end{array}$

Another customization capability concerns numbered equations that are present within repeated theorems. An optional repeqn option can be specified when loading the package, which controls whether equation numbers should be as in the main text (by setting this option to same, the default) or independently numbered (by setting this option to independent). In the latter case, whenever a referenceable counter is set with $\adjustrel{counter}$, $\adjustrel{counter}$ references the counter in the main text, while $\adjustrel{counter}$ references the counter in the appendix (except in inline mode, where both have the same effect).

1.6 Advanced Features

We now describe a few advanced macros and environments, the usage of which is limited to special cases:

nestedproof

nestedproof is an environment that can be used within a **proof** environment deferred in the appendix; this is required because, for technical reasons, no **proof** environment can be nested within a deferred **proof** environment.

\noproofinappendix

\noproofinappendix can be used inside repeated theorems that are not followed by a proof or appendixproof environment; the point is to ensure that a further proof environment cannot be mistakenly understood as a proof of the repeated theorem. It should not be needed in most situations as apxproof tries figuring out when a proof follows a repeated theorem automatically, but may occasionally be needed in complex scenarios.

\nosectionappendix

\nosectionappendix is to be used inside a section that does contain appendix material, but for which a section in the appendix should not be created. This should be rarely needed. When this command is present, appendix material is appended to the end of the previously created section.

2 Supported Document Classes

Because apxproof modifies sectioning commands, bibliographies, and proofs, it may not work straight away with arbitrary document classes. It has currently been tested with and is supported for the following document classes:

- LATEX standard document classes (e.g., article.cls)
- KOMA-Script (e.g., scrartcl.cls, scrbook.cls)
- memoir.cls
- ACM SIG Proceedings (e.g., sig-alternate.cls, acmart.cls)
- Springer's Lecture Notes in Computer Science (e.g., llncs.cls)
- Schloß Dagstuhl's Leibniz International Proceedings in Informatics (e.g., lipics.cls, lipcs-v2016.cls)

Other classes may work out of the box. Adding support for specific classes is possible and can be requested from the author of this package.

3 Known Issues and Limitations

We report here some issues we are currently aware of:

- When using hyperref, the appendix in the bibliography is not hyperlinked. This is to avoid possible issues with multiply defined bibliography entries.
- appendixproof, proof, toappendix environments cannot be nested. This is a limitation of the fancyvrb package that apxproof relies on. Note the existence of the nestedproof environment for nested proofs.
- apxproof poorly interacts with SyncTEX: identifying which source line has
 produced which box does not work for appendix content managed by apxproof
 or repeated theorems. No obvious fix is known, though this issue will be
 investigated in the long term.
- Unless the bibliography option is set to common, the bibunits package is used
 to generate a second bibliography. This means any package, such as biblatex,
 that is incompatible with bibunits will not be compatible with apxproof unless
 bibliography is set to common.

Issues not listed here should be reported to the author.

4 License

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5 Contact

- https://github.com/PierreSenellart/apxproof

Bug reports and feature requests should preferably be submitted through the *Issues* feature of GitHub.

6 Acknowledgments

Thanks to Antoine Amarilli for feedback and proofreading. Thanks to K. D. Bauer for the implementation of the forward-linking mechanism, and for various bugfixes.

7 Implementation

We now describe the entire code of the package, in a literate programming fashion. Throughout the package, we use the <code>axp@</code> prefix to identify local macros and environment names, which are not meant to be used by the final user.

7.1 Dependencies

We first load a few package dependencies:

- environ to easily define the repeated theorem environments.
- 1 \RequirePackage{environ}
- etoolbox to define simple toggles.
- 2 \RequirePackage{etoolbox}
 - fancyvrb for the bulk of the work of exporting appendix material in an auxiliary file.
- 3 \RequirePackage{fancyvrb}
- ifthen for easier comparison of character strings.
- 4 \RequirePackage{ifthen}
 - kvoptions to manage options passed to the package.
- 5 \RequirePackage{kvoptions}
- catchfile to be able to check the content of files \input within appendix content.
- 6 \RequirePackage{catchfile}
- amsthm for its \newteorem macro. Some document classes (e.g., lipics) preload amsthm: this is fine, \RequirePackage{amsthm} will simply have no effect. On the other hand, some other document classes (e.g., llncs or sig-alternate) define a proof environment that conflicts with amsthm, so we have to undefine this environment before loading amsthm. In that case, we reestablish the existing proof environments, in case they had been customized (e.g., sig-alternate)

```
7 \@ifpackageloaded{amsthm}{
8  }{
9  \let\apx@oldamsthmproof\proof
10  \let\apx@oldamsthmendproof\endproof
11  \let\proof\undefined
12  \let\endproof\undefined
13  }
14  \RequirePackage{amsthm}
15 \ifdefined\apx@oldamsthmproof
```

7.2 Option Processing

Many names throughout the package use an arobase (②) to avoid name conflict with user-defined names. To simplify the compilation of the documentation, we simply make it a regular character in all the rest.

19 \makeatletter

We setup the processing of options using keyval facilities.

```
20 \SetupKeyvalOptions{
21 family=axp,
22 prefix=axp@
23 }
```

We declare the following options:

- appendix, with a default value of append (other possible values: strip, inline);
- bibliography, with a default value of separate (other possible value: common);
- repeqn, with a default value of same (other possible value: independent).

\axp@appendix

24 \DeclareStringOption[append] {appendix}

\axp@bibliography

25 \DeclareStringOption[separate] {bibliography}

\axp@repeqn

- 26 \DeclareStringOption[same]{repeqn}
- ${\tt 27 \ \ \ } ProcessLocal \tt Keyval Options*$

We check that the value of the options are valid, and add a message to the compilation log.

```
28 \ifthenelse{\equal{\axp@appendix}{append}}{
29 \message{apxproof: Appendix material appended to the document}
30 }{\ifthenelse{\equal{\axp@appendix}{strip}}{
31 \message{apxproof: Appendix material stripped}
32 }{\ifthenelse{\equal{\axp@appendix}{inline}}{
33 \message{apxproof: Appendix material inlined within the document}
34 }{
35 \errmessage{Error: unsupported option appendix=\axp@appendix\ for package apxproof}
37 }}
38 \ifthenelse{\equal{\axp@bibliography}{separate}}{
```

The external bibunits package is used to add a second bibliography for the appendix material.

```
39
    \RequirePackage{bibunits}
    \message{apxproof: Separate bibliography for appendix material}
41 }{\ifthenelse{\equal{\axp@bibliography}{common}}{
    \message{apxproof: Common bibliography for appendix and main text}
42
43 }{
    \errmessage{Error: unsupported option bibliography=\axp@bibliography\ for
   package apxproof}
46 }}
47 \ifthenelse{\equal{\axp@repeqn}{same}}{
    \message{apxproof: Repeated equations keep the same numbering}
49 }{\ifthenelse{\equal{\axp@repeqn}{independent}}{
    \message{apxproof: Repeated equations are independently numbered}
51 }{
    \errmessage{Error: unsupported option repeqn=\axp@repeqn\ for
53
    package apxproof}
54 }}
```

7.3 Macros Common to All Compilation Modes

axp@newtheoremrep@definetheorem

Common to all compilation modes, we define \axp@newtheoremrep@definetheorem. When called with first argument foobar, we first undefine the existing foobar environment (and its counter) if it has already been defined (e.g., by the document class), then invoke \axp@newtheorem for the regular version of the theorem foobar, saving and restoring any existing theorem counter unless the \newtheoremdep redefines the base counter.

```
55 \def\axp@newtheoremrep@definetheorem#1#2#3#4{%
    \expandafter\let\csname #1\endcsname\undefined
    \ifcsname c@#1\endcsname
58
      \expandafter\expandafter\expandafter\let\expandafter\expandafter
59
        \csname c@axp@#1\endcsname\csname c@#1\endcsname
      \expandafter\let\csname c@#1\endcsname\undefined
60
61
    \axp@newtheorem{#1}{#2}{#3}{#4}%
62
    \ifcsname c@axp@#1\endcsname
      \int x = 2 \relax
64
        \expandafter\expandafter\expandafter\let\expandafter\expandafter
65
          \csname c@#1\endcsname\csname c@axp@#1\endcsname
66
67
      \else
      \fi
68
69
    \fi
70 }
```

\axp@newtheorem \@axp@newtheorem \@@axp@newtheorem

We introduce an intermediate \axp@newtheorem command to define a new theorem, differently depending on whether there is a section counter or not. This will be useful, in particular to allow changing this definition depending on the document class. This command uses two intermediary commands, \@axp@newtheorem and

\@@axp@newtheorem, for the non-starred and starred versions.

```
71 \def\axp@newtheorem{\@ifstar\@@axp@newtheorem\@axp@newtheorem}
72 \def\@axp@newtheorem#1#2#3#4{%
73  \ifx\relax#4\relax
74  \newtheorem{#1}[#2]{#3}%
75  \else
76  \newtheorem{#1}{#3}[#4]%
77  \fi
78 }
79 \def\@@axp@newtheorem#1#2{%
80  \newtheorem*{#1}{#2}%
81 }
```

\newtheoremrep \axp@newtheoremreptmp

We define the high-level \newtheoremrep to have the same syntax as amsthm's \newtheorem. For this purpose, we need a little trick to deal with the second and fourth optional arguments, which is what \@oparg and \axp@newtheoremreptmp are used for. \axp@newtheoremrep is defined differently depending on the compilation mode.

```
82 \newcommand\newtheoremrep[1] {%
83 \@oparg{\axp@newtheoremreptmp{#1}} []%
84 }
85 \def\axp@newtheoremreptmp#1[#2]#3{%
86 \@oparg{\axp@newtheoremrep{#1}[#2]{#3}} []%
87 }
```

proofsketch

Simple proofsketch environment.

88 \newenvironment{proofsketch}{\begin{axp@oldproof}[Proof sketch]}{\end{axp@oldproof}}

\mainbodyrepeatedtheorem \appendixrefname \appendixbibliographystyle \appendixbibliographyprelim \appendixprelim

\appendixsectionformat

We provide sensible defaults for these user-customizable macros. Even though they are not all useful in all modes, we define them for all modes so that a \renewcommand works in all cases.

uprelim 89 \newcommand{\mainbodyrepeatedtheorem}{}

90 \providecommand{\appendixrefname}{References for the Appendix}

91 \newcommand{\appendixbibliographystyle}{alpha}
92 \newcommand{\appendixbibliographyprelim}{}

93 \newcommand{\appendixprelim}{\clearpage\onecolumn}

94 \newcommand{\appendixsectionformat}[2]{ $Proofs for Section~#1\ (#2)$ }

axp@oldproof

We save the definition of the existing **proof** environment.

95 \let\axp@oldproof\proof 96 \let\endaxp@oldproof\endproof

We define a utility macro that will be used to properly set the \label command (and its amsmath counterpart, \label@in@display) for equations within repeated theorems, depending on the compilation mode.

\axp@redefinelabels

97 \newcommand{\axp@redefinelabels}{%

```
\providecommand\label@in@display{}%
   98
                                \ifthenelse{\equal{\axp@appendix}{inline}}{%
   99
                                        100
                                        101
                                         \renewcommand\label[1]{%
102
103
                                                  \axp@oldlabel{##1}%
104
                                                  \axp@oldlabel{##1-apx}%
                                        }%
105
106
                                         \renewcommand\label@in@display[1]{%
                                                  \axp@oldlabel@in@display{##1}%
107
                                                  \axp@oldlabel{##1-apx}%
108
                                        }%
109
110
                               }{%
                                         \let\axp@oldlabel\label
111
                                        \let\axp@oldlabel@in@display\label@in@display
112
                                        \label[1] {\axp@oldlabel{##1-apx}} % % A substitution of the context of the con
113
                                         \renewcommand\label@in@display[1]{\axp@oldlabel@in@display{##1-apx}}%
114
                              }%
115
116
                    }
```

7.3.1 Class-Specific Behavior

Finally, some class-specific behavior common to all compilation modes.

lincs and other Springer document classes

117 \ifdefined\spnewtheorem

\@axp@newtheorem \@@axp@newtheorem

It is necessary to use \spnewtheorem instead of \newtheorem in Springer document classes to obtain standard formatting.

```
118 \ensuremath{\mbox{def}\mbox{@axp@newtheorem#1#2#3#4{\%}}
119
     \int x = \frac{4}{relax}
120
       \int x = 2 
121
         \spnewtheorem{#1}{#3}{\bfseries}{\itshape}%
122
       \else
123
         \spnewtheorem{#1}[#2]{#3}{\bfseries}{\itshape}%
       \fi
124
     \else
125
       \spnewtheorem{#1}{#3}[#4]{\bfseries}{\itshape}%
126
127
128 }
129 \def\@@axp@newtheorem#1#2{%
     130
131 }
```

proofsketch

We redefine the proofsketch environment, which is used differently in the base class.

132 \renewenvironment{proofsketch}{\begin{axp@oldproof}[sketch]}{\end{axp@oldproof}}}

We have to redefine the macro $\ensuremath{\texttt{Qthmcountersep}}$ for proper sectioned counters.

```
133 \def\@thmcountersep{.}
134 \fi
```

7.4 Inline Compilation Mode

135 \ifthenelse{\equal{\axp@appendix}{inline}}{

\axp@newtheoremrep

In inline mode, \axp@newtheoremrep uses \axp@newtheoremrep@definetheorem to define the regular theorem environment and creates a repeated theorem environment that behaves exactly as the regular theorem environment, while calling \axp@redefinelabels to make sure that -axp variants of equation counters are defined.

```
\def\axp@newtheoremrep#1[#2]#3[#4]{%
136
       \arp@newtheoremrep@definetheorem{#1}{#2}{#3}{#4}%
137
138
       \NewEnviron{#1rep}[1][]{%
         \int {\pi \pi} 
139
140
           \begin{#1}\axp@redefinelabels\BODY\end{#1}%
         \else
141
           \begin{#1}[##1]\axp@redefinelabels\BODY\end{#1}%
142
143
         \fi
144
       }
145
     }
```

inlineproof
nestedproof
appendixproof

In inline mode, these environments behave like the regular proof environment.

146 \let\inlineproof\proof147 \let\endinlineproof\endproof148 \let\nestedproof\proof

149 \let\endnestedproof\endproof

150 \let\appendixproof\proof

151 \let\endappendixproof\endproof

toappendix

In inline mode, this environment and these macros are no-ops.

\noproofinappendix \nosectionappendix

152 \newenvironment{toappendix}{}{}
153 \let\noproofinappendix\relax
154 \let\nosectionappendix\relax

155 }

7.5 Append or Strip Compilation Modes

156 {

We now deal with the case where apxproof really does something useful: either append the appendix material to the document, or strip it entirely.

7.5.1 Auxiliary File for the Appendix

\axp@proofsfile

We open a new auxiliary file, with extension .axp, where the appendix material will be dumped.

```
157  \AtBeginDocument{
158    \newwrite\axp@proofsfile
159    \immediate\openout\axp@proofsfile=\jobname.axp
160  }
```

proof
\section

At the beginning of this file, we make @ a regular character (since it will be used in several places for internal names) and reestablish the original definition of the proof environment and the \section macro.

```
\AtBeginDocument{
161
       \immediate\write\axp@proofsfile{%
162
         \noexpand\makeatletter
163
         \noexpand\let\noexpand\proof\noexpand\axp@oldproof
164
         \noexpand\let\noexpand\endproof\noexpand\endaxp@oldproof
165
         \noexpand\let\noexpand\section\noexpand\axp@oldsection
166
167
       }
    }
168
```

\axp@unactivateeightbit

We need an auxiliary macro to disable active characters that have the high bit set when writing to the .axp file. See https://tex.stackexchange.com/a/145361/166858

```
169 \def\axp@unactivateeightbit{%
170 \count@=128%
171 \loop
172 \catcode\count@=12%
173 \ifnum\count@<255%
174 \advance\count@\@ne
175 \repeat}</pre>
```

axp@VerbatimOut
\FVB@axp@VerbatimOut
\FVE@axp@VerbatimOut

Using the functionalities of the fancyvrb package, we define a custom verbatim environment axp@VerbatimOut that writes every line to the \axp@proofsfile. We also use the previous macro to disable active characters with the eighth bit set, and we make sure the catcode of @ is reset for every verbatim environment, in case it is used by the user (e.g., as in the xypic package). Finally, as an additional precaution, we reset \FV@CatCodesHook that is for example set by the commandchars or commentchar option of \fvset.

```
\DefineVerbatimEnvironment{axp@VerbatimOut}{axp@VerbatimOut}{}
176
     \def\FVB@axp@VerbatimOut{%
177
       \@bsphack
178
       \begingroup
179
         \axp@unactivateeightbit
180
         \FV@DefineWhiteSpace
181
182
         \def\FV@Space{\space}%
         \FV@DefineTabOut
183
         \def\FV@ProcessLine{\immediate\write\axp@proofsfile}%
184
         \let\FV@FontScanPrep\relax
185
         \let\@noligs\relax
186
         \def\FV@CatCodesHook{}%
187
         \FV@Scan}
188
189
     \def\FVE@axp@VerbatimOut{%
```

```
190 \immediate\write\axp@proofsfile{\noexpand\makeatletter}%
191 \endgroup\@esphack}
```

toappendix The entire content of this envi

The entire content of this environment is put in appendix, starting a new appendix section beforehand if needed.

```
192 \newenvironment{toappendix}
```

- 193 {\axp@writesection\axp@VerbatimOut}
- 194 {\endaxp@VerbatimOut}

7.5.2 Definition of New Theorems

axp@seenreptheorem

Used to indicate whether a repeated theorem was just typeset, without its proof.

195 \newtoggle{axp@seenreptheorem}

axp@rpcounter

Sequentially incremented for every repeated theorem, used to create labels.

196 \newcounter{axp@rpcounter}

axp@equation
axp@equationx

Used to save the value of the equation counter, when repeqn is set to same.

197 \newcounter{axp@equation}

198 \newcounter{axp@equationx}

axp@newtheoremrep

With first argument foobar, we use \axp@newtheoremrep@definetheorem to define the regular version of the theorem foobar. We then patch \begin{foobar} so as not to expect a proof in the appendix and define an internal theorem axp@foobarrp that will be used in the appendix to restate the existing theorem.

```
199 \def\axp@newtheoremrep#1[#2]#3[#4]{%
200 \axp@newtheoremrep@definetheorem{#1}{#2}{#3}{#4}%
201 \expandafter\pretocmd\csname #1\endcsname{\noproofinappendix}{}{}%
202 \axp@newtheorem*{axp@#1rp}{#3}%
203 \axp@forward@setup{#1}{#2}{#3}{#4}%
```

We then define a foobarrep environment that increments the axp@rpcounter and typeset the regular foobar theorem with a label derived from the counter, along with a possible custom command to identify repeated theorems. We distinguish the case when the theorem argument has a note and when it does not. We save the equation counter before typesetting the theorem environment, to reset it to the same value in the repeated environment when repequ is set to same.

```
\NewEnviron{#1rep}[1][]{%
204
        205
          \setcounter{axp@equation}{\value{equation}}%
206
207
        }{}}%
        \addtocounter{axp@rpcounter}{1}%
208
        \int {\pi \pi} 
209
          \axp@with@forward{#1}{\begin{#1}}\label{axp@r\roman{axp@rpcounter}}%
210
211
212
          \axp@with@forward{#1}{\begin{#1}[{##1}]}\label{axp@r\roman{axp@rpcounter}}%
213
214
        \mainbodyrepeatedtheorem
215
        \BODY\end{#1}%
```

We set the axp@seenreptheorem toggle to indicate that we are looking for the proof of the theorem, then store in a macro the content of the theorem's body.

```
216 \global\toggletrue{axp@seenreptheorem}%
217 \global\expandafter\let\csname rplet\roman{axp@rpcounter}%
218 \endcsname
219 \BODY
```

Possibly after starting a new appendix section if needed, we typeset a repeated version of the theorem using the axp@foobarrp environment and a reference to the previously defined label. We use \axp@redefinelabels in this environment to avoid multiply defined labels. We have to deal in a careful way with theorem notes: we want to use a theorem note to display the number of the repeated theorem, but theorem notes are usually typeset in a much different way (different font, parentheses) than theorem headings. In the case of the Springer document classes, we use the \theopargself macro to disable parentheses. For other document classes, we need to manually patch the \thmhead command at the right time. We also specially cover the case of the ACM document class where \@acmplainnotefont is used instead of \thm@notefont.

```
\axp@writesection%
220
221
         \immediate\write\axp@proofsfile{\noexpand\makeatletter}%
         \ifthenelse{\equal{\axp@repeqn}{same}}{%
222
223
           \immediate\write\axp@proofsfile{%
             \noexpand\setcounter{axp@equationx}{\value{equation}}%
224
             \noexpand\setcounter{equation}{\theaxp@equation}%
225
           ጉ%
226
         }{}%
227
         \immediate\write\axp@proofsfile{{%
228
229
           \ifdefined\theopargself
230
             \noexpand\theopargself
231
232
             \noexpand\pretocmd{\noexpand\@begintheorem}{%
               \noexpand\patchcmd{\noexpand\thmhead}{\noexpand\@acmplainnotefont}{}{}{}}
233
234
               \noexpand\patchcmd{\noexpand\thmhead}{\noexpand\thm0notefont}{}{}{}}}
235
               \noexpand\patchcmd{\noexpand\thmhead}{(){}}{}{}
               \noexpand\patchcmd{\noexpand\thmhead}{)}{}{}{}
236
237
             }{}{}
           \fi
238
           \noexpand\begin{axp@#1rp}
239
240
241
               \noexpand\ref{axp@r\roman{axp@rpcounter}}%
               \@ifnotempty{##1}{%
242
243
                 \ifdefined\theopargself
244
                  \else
245
                   \ifdefined\@acmplainnotefont
246
                      \noexpand\@acmplainnotefont
247
                   \else
                      \noexpand\ifdefined\noexpand\thm@notefont
248
```

\noexpand\fi

249

250

\noexpand\the\noexpand\thm@notefont

```
\fi
251
                  \fi
252
                  {} (\unexpanded{{##1}})%
253
                }%
254
             ]%
255
              \noexpand\axp@forward@target{axp@fw@r\roman{axp@rpcounter}}{}%
256
257
              \noexpand\axp@redefinelabels
258
              \expandafter\noexpand\csname rplet\roman{axp@rpcounter}%
259
                                    \endcsname
            \noexpand\end{axp@#1rp}
260
         }}%
261
262
         \ifthenelse{\equal{\axp@repeqn}{same}}{%
            \immediate\write\axp@proofsfile{%
263
              \noexpand\setcounter{equation}{\value{axp@equationx}}%
264
           }%
265
         }{}%
266
267
       }%
     }
268
```

7.5.3 Forward-Linking Mechanism

When hyperref is loaded, **foobarrep** environments in the main text have their number link to their repetition in the appendix.

\axp@with@forward

In order to make the number of the foobarrep theorem a link to its repeated version, we temporarily redefine the \thefoobar command, or, if we inherited the counter from a bazbar environment, the \thebazbar command. This seems to be the only robust way, to make the number a \hyperlink, without adding extensive dependence on internals of amsthm, the builtin \newtheorem and possibly document-class specific definitions.

In order to allow users to redefine \thefoobar without breaking this feature, we redefine \thefoobar only for the duration of the \begin{foobar} form, resetting it to the old value as soon as possible.

Redefining \thefoobar has the side effect of changing \newlabel entries in the .aux file, so we need to to be able to disable addition of the hyperlink, which is why we use an intermediate \axp@forward@link{ $\langle target \rangle$ }{ $\langle text \rangle$ } macro, We also redefine \theHfoobar which is used by hyperref but not defined if hyperref was loaded after \newtheoremrep was used. and \protect it to output it verbatim into the .aux file.

These hyperlinks are of course disabled in the strip compilation mode.

```
\newcommand{\axp@with@forward}[2]{%
269
        \ifthenelse{\equal{\axp@appendix}{strip}}{#2}{
270
          \global\booltrue{axp@forward}%
271
          \ifcsundef{axp@old@the\csname axp@cn@#1\endcsname}{%
272
273
            csletcs{axp@old@the\csname axp@cn@#1\endcsname}{the\csname axp@cn@#1\endcsname}
274
            \csletcs{theH\csname axp@cn@#1\endcsname}{the\csname axp@cn@#1\endcsname}%
            \csdef{the\csname axp@cn@#1\endcsname}{%
275
              \protect\axp@forward@link{axp@fw@r\roman{axp@rpcounter}}%
276
```

```
{\csname axp@old@the\csname axp@cn@#1\endcsname\endcsname}%
                    277
                    278
                                }%
                              }{}%
                    279
                              #2%
                    280
                               \ifcsdef{axp@old@the\csname axp@cn@#1\endcsname}{%
                    281
                    282
                                 \csletcs{the\csname axp@cn@#1\endcsname}{axp@old@the\csname axp@cn@#1\endcsname}%
                    283
                               \global\boolfalse{axp@forward}
                    284
                    285
                             }}%
 \axp@forward@link
                    Dummy macro, for handling the unwanted change of the \newlabel entry in the
                     .aux file caused by changing the definition of \thefoobar.
       axp@forward
                          \newbool{axp@forward}
                    286
                          \newcommand{\axp@forward@link}[2]{%
                    287
                            \ifbool{axp@forward}{%
                    288
                              \ifcsdef{hyperlink}{%
                    289
                                \hyperlink{#1}{#2}%
                    290
                              }{%
                    291
                    292
                                #2%
                    293
                              }%
                           }{%
                    294
                    295
                              #2%
                    296
                           }%
                    297
                         }%
                    Provides the needed \hypertarget. Intended to be written to the .axp file.
\axp@forward@target
                          \newcommand{\axp@forward@target}[2]{%
                    298
                    299
                            \ifcsname hypertarget\endcsname
                    300
                              \hypertarget{#1}{#2}%
                    301
                            \else
                    302
                              #2%
                    303
                            \fi
                         }
                    304
                    In order to support counter inheritance with the first optional argument of
\axp@forward@setup
                    \newtheoremrep, we need access to the name of the counter. For compliance
                    with the behavior of \@axp@newtheorem, the first optional argument (#2) is ig-
                    nored if the second optional argument (#4) is given.
                          \newcommand{\axp@forward@setup}[4]{%
                            306
                    307
                         }
                    7.5.4 Proof Environments
```

Utility macro that toggles axp@seenreptheorem to false.

\global\togglefalse{axp@seenreptheorem}%

\newcommand\noproofinappendix{%

\noproofinappendix

309

310

appendixproof We dump the content of this in appendix, within an original proof environment, possibly after creating a new appendix section.

```
\newenvironment{appendixproof}
312
313
       \axp@writesection
314
       \immediate\write\axp@proofsfile{%
         315
316
317
       \axp@VerbatimOut
318
     }
319
      {%
       \endaxp@VerbatimOut
320
       \immediate\write\axp@proofsfile{%
321
         \noexpand\end{axp@oldproof}%
322
323
       }%
324
       \noproofinappendix
     }
325
```

proof This environment either puts the proof in appendix, if we are after a repeated theorem without its proof, or inlines it otherwise.

```
326
     \renewenvironment{proof}
327
        {%
          \iftoggle{axp@seenreptheorem}{%
328
329
            \appendixproof
          }{%
330
331
            \axp@oldproof
332
          }%
       }
333
334
          \iftoggle{axp@seenreptheorem}{%
335
336
            \endappendixproof
337
            \endaxp@oldproof
338
          }%
339
       }
340
```

inlineproof
nestedproof

These two environments are synonyms for the original proof environment.

```
    341 \let\inlineproof\axp@oldproof
    342 \let\endinlineproof\endaxp@oldproof
    343 \let\endrestedproof\axp@oldproof
    344 \let\endrestedproof\endaxp@oldproof
```

7.5.5 Section Management

axp@seccounter Sequentially incremented for every section, used to create labels.

345 \newcounter{axp@seccounter}

\axp@sectitle Saves the title of the last encountered section.

 $346 \ \def\axp@sectitle{}$

\axp@section \axp@@sectiontestinput \axp@@sectiontestsection

This command \axp@section behaves similarly to \axp@oldsection, except that it first tests whether a \section follows, and if so, does not produce anything. This is useful to avoid producing empty sections in the appendix. Using the catchfile package, we also check whether a \section is within an \input that immediately follows.

```
{\axp@@sectiontestsection{#1}}%
350
351
     \def\axp@@sectiontestinput#1\input#2{%
352
       \CatchFileDef{\axp@tmp}{#2}{}%
353
       \def\axp@tmptmp{\axp@@sectiontestsection{#1}}%
354
       \expandafter\axp@tmptmp\axp@tmp%
355
356
     }
     \def\axp@@sectiontestsection#1{\@ifnextchar\section{\makeatother}{\axp@oldsection{#1}\makeat
357
```

\axp@oldsection

\@section \@@section 347

348

349

\def\axp@section#1{%

\@ifnextchar\input

{\axp@@sectiontestinput{#1}}%

We redefine the \section command to create a label based on axp@seccounter \section and to store its title in \axp@sectitle. In order to support starred and unstarred versions, as well as the optional short-title argument, the intermediate macros \@section and \@@section are needed.

```
358
   \let\axp@oldsection\section
359
   \def\section{\@ifstar\@section\@@section}
   360
    361
    \newcommand{\axp@@@section}[3]{%
362
     \global\def\axp@sectitle{#3}%
363
     \int {\pi \pi} = \pi \pi
364
       \axp@oldsection#1{#3}%
365
366
     \else
367
       \axp@oldsection#1[{#2}]{#3}%
368
     \addtocounter{axp@seccounter}{1}%
369
     \label{axp@s\roman{axp@seccounter}}%
370
371
```

\nosectionappendix

We remove the current section title, to indicate no section should be created in the appendix.

```
\newcommand{\nosectionappendix}{
372
       \global\def\axp@sectitle{}%
373
374
```

\axp@writesection If \axp@sectitle is not empty, we create a new section in the appendix, referring to the main text section.

> Here, we wrap \ref{axp@si} into \axp@protectref@i, in order to protect the label name from wrongly being converted to uppercase, e.g., in fancyhdr with \pagestyle{fancy}.

This macro is defined both in the .aux file (in order to ensure availability when typesetting the \tableofcontents), and immediately before typesetting the appendix section (to ensure availability in the \section command).

```
375
     \newcommand\axp@writesection{%
376
       \ifx\axp@sectitle\@empty
377
       \else
378
         \edef\axp@tmp{%
379
            \noexpand\global\noexpand\def
            \expandonce{\csname axp@protectref@\roman{axp@seccounter}\endcsname}{%
380
              \noexpand\ref{axp@s\roman{axp@seccounter}}%
381
           }%
382
         }%
383
         \immediate\write\@auxout{\expandonce\axp@tmp}
384
         \immediate\write\axp@proofsfile{%
385
            \expandonce\axp@tmp^^J%
386
            \noexpand\axp@section{%
387
              \noexpand\appendixsectionformat{%
388
389
                \protect
390
                \expandonce{\csname axp@protectref@\roman{axp@seccounter}\endcsname}%
391
             }{\expandonce\axp@sectitle}%
           }%
392
         }%
393
394
          \nosectionappendix
395
       \fi
     }
396
```

Finally, in a somewhat ad hoc manner, we disable the whole section management for **\tableofcontents**, which may be typeset using a section heading, but for which automatic section management does not make sense.

\axp@oldtableofcontents \tableofcontents

```
397 \let\axp@oldtableofcontents\tableofcontents
398 \def\tableofcontents{{\let\section\axp@oldsection\axp@oldtableofcontents}}
```

7.5.6 Append Compilation Mode

399 \ifthenelse{\equal{\axp@appendix}{append}}{

\axp@oldbibliography \bibliography

Unless the bibliography option is set to common, we need to set the appendix bibliography source to be the same as that of the main text, thanks to bibunits's \defaultbibliography macro.

```
400 \ifthenelse{\equal{\axp@bibliography}{separate}}{
401 \let\axp@oldbibliography\bibliography
402 \renewcommand\bibliography[1]{%
403 \defaultbibliography{#1}%
404 \axp@oldbibliography{#1}%
405 }
406 }{}
```

After the end of the main text, we add the appendix (after the command \appendixprelim is issued) within a bibunit environment so as to typeset a separate bibliography for the appendix (unless the bibliography option is set to common). This is done using \pretocmd on \@enddocumenthook instead of \AtEndDocument because we want the code to be run before any code in the \@enddocumenthook that has been set in the document class, as in the amsart document class. There is an extra test to ensure an empty bibliography environment is not produced. The name of the bibliography is changed to \appendixrefname; in most document classes, it is called \refname but it is occasionally (scrartcl, scrreprt) called \bibname. An ad-hoc test is added to fix a conflict with the natbib package which redefines bibcite at the end of the document.

```
\pretocmd{\@enddocumenthook}{%
407
         \ifdefined\NAT@testdef
408
           \renewcommand\bibcite[2]{%
409
              \global\@namedef{b@#1\@extra@binfo}{#2}%
410
           }
411
         \fi
412
413
         \appendixprelim
         \appendix
414
         \ifthenelse{\equal{\axp@bibliography}{separate}}{
415
         \begin{bibunit}[\appendixbibliographystyle]
416
417
418
            \immediate\closeout\axp@proofsfile
419
            \input{\jobname.axp}
         \ifthenelse{\equal{\axp@bibliography}{separate}}{
420
            \ifdefined\refname
421
              \renewcommand{\refname}{\appendixrefname}
422
423
            \else\ifdefined\bibname
              \renewcommand{\bibname}{\appendixrefname}
425
            \let\axp@oldthebibliography\thebibliography
426
            \renewcommand\thebibliography[1]{%
427
              \ifx\relax#1\relax\else\axp@oldthebibliography{#1}\fi}
428
429
            \appendixbibliographyprelim
430
            \putbib
431
         \end{bibunit}
         \ifdefined\NAT@testdef
432
            \let\bibcite\NAT@testdef
433
         \fi
434
         }{}
435
436
       }{}{}
     }{}
437
```

7.5.7 Class-Specific Behavior

We conclude with some class-specific behavior.

ACM Document Classes (old versions, till 2017)

```
438 \ifdefined\@acmtitlebox
```

We first redefine the proofsketch environment, which is used differently in the base class.

439 \renewenvironment{proofsketch}{\begin{axp@oldproof}[sketch]}{\end{axp@oldproof}}

We adjust the styling of theorems for the needs of apxproof.

```
\newtheoremstyle{mystyle}
441
        {6pt}
442
        {6pt}
443
        {\itshape}
444
        {10pt}
445
        {\scshape}
        {.}
446
        {.5em}
447
448
        {}
     \theoremstyle{mystyle}
449
```

\thebibliography \refname \appendixrefname

The section title of the bibliography is in uppercase in these document classes. In addition, the \thebibliography macro hard-codes twice the section title, so we un-hardcode it so that it can be modified in the appendix.

```
450 \patchcmd{\thebibliography}{References}{\protect\refname}{}{\
451 \patchcmd{\thebibliography}{References}{\protect\refname}{}{}
452 \newcommand{\refname}{REFERENCES}
453 \renewcommand{\appendixrefname}{REFERENCES FOR THE APPENDIX}
454 \fi
```

lipcs

 $455 \qquad \verb|\ifdefined\lipics@opterrshort| \\$

 $\verb|\appendixbibliographyprelim| \\$

The default bibliography in the lipics document class formatting is not compatible with the alpha bibliography style. We fix this here.

```
456 \renewcommand{\appendixbibliographyprelim}{%
457 \global\let\@oldbiblabel\@biblabel
458 \def\@biblabel{\hspace*{-2em}\small\@oldbiblabel}%
459 }
460 \fi
461 }
```

Change History

```
v1.0.0 v1.0.1 General: Prevent empty General: Initial released version \dots 1 bibliography environment; fix
```

typos 1	in document classes that treat	
v1.0.2	theorems differently when they	
axp@newtheoremrep: Fix display of	have an empty note	15
repeated theorem counter in	Fix incorrect use of \noexpand	
some document classes 16	in optional argument of macro	
Fix missing space between		16
repeated theorem counter and	v1.1.0	
theorem note <u>16</u>	\FVE@axp@VerbatimOut: Make	
v1.0.3	apxproof compatible with	
\appendixbibliographyprelim:		14
Support for lipics-v2016 23	\appendixsectionformat: Fix	
General: Note on entire sections in	missing space in default	
appendix 2		11
proofsketch: Ignore spaces after		11
beginning of Proof sketch 11	\axp@proofsfile: Initialization	
v1.0.4	deferred to \AtBeginDocument	
\appendixprelim: Configurable	for compatibility with \dumped	
appendix style 11	precompiled preambles (K. D.	10
\axp@bibliography: bibliography	,	13
option	\axp@redefinelabels: Fix \label	
General: More faithful theorem	not being disabled in amsmath	
style for ACM templates 22	environments, where	
More robust coherent styling of	\label@in@display is used	11
proof sketches 22	,	11
Re-establish custom proof	\axp@repeqn: repeqn option	9
environments 8	\axp@unactivateeightbit: Fix	
Show options commented on in	compilation of non-ASCII	
margin and index 1	characters with	
v1.0.5	\usepackage[utf8]{inputenc}	
General: Ability to specify a		14
sectioning counter in	\arrowvert axp@writesection: Make	
newtheoremrep 2	\axp@tmp wrapper more robust.	
Fix compilation of proofsketch	Resolves issues from use of	
environment in inline mode 4	section title in fancyhdr, and in	
v1.0.6	\tableofcontents (K. D.	
\axp@newtheorem: Introduce	,	21
intermediary command for	\section: Fix handling of fragile	
theorem macro 10	macros within section headings.	
\axp@writesection: Fix	See #22	20
extraneous space after section	Rewrote definition of \section	
number in appendix titles 21	to enable optional argument.	
General: Better support of Springer	See #23. (K. D. Bauer)	20
document classes 12	\tableofcontents: Disable section	
Deal with document classes	management for table of	
where the bibliography is called	contents	21
\bibname 22	General: Added forward-link	
Support of new ACM document	mechanism (K. D. Bauer)	17
class (acmart.cls) 23	v1.2.0	
axp@newtheoremrep: Better	\axp@newtheoremrep: Fix	
handling of note-free theorems	formatting of theorems without	
<u> </u>	<u> </u>	

notes in some document classes	compatibility with xypic	
in inline mode $\dots 13$	package	14
\axp@newtheoremrep@definetheorem:	Fix compatibility with other uses	
Restore predefined theorem	of fancyvrb that set	
counters	\FV@CatCodesHook	14
\axp@redefinelabels: Fix extra	\appendixrefname: Fix	
spacing erroneously introduced	compatibility with memoir	
within the	document class	11
$\armonomname \armonomname \ar$	General: Ad hoc fix for natbib	
$\mbox{\mbox{\tt mainbodyrepeatedtheorem:}}$	package conflict	22
Configurable repeated theorem	v1.2.2	
command	\axp@section: Detect a section	
General: Do not load bibunits if	within an included file to avoid	
bibliography is set to common 10	produced useless sections 2	20
axp@newtheoremrep: Fix display of	General: Compatibility with AMS	
theorem notes $\dots 16$	document classes: do not use	
proofsketch: Fix proof sketches in	\AtEndDocument 2	22
inline compilation mode for	axp@newtheoremrep: Fix handling	
Springer document classes 12	of optional arguments of	
1.2.1	repeated theorems containing	
$\verb \FVE@axp@VerbatimOut: Fix \\$	optional arguments	15

\mathbf{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.

${f Symbols}$	\@oldbiblabel 457, 458
$\verb \@Caxp@newtheorem $	\@oparg 83, 86
\@@section 358	\@section
\@acmplainnotefont 233, 245, 246	\@thmcountersep 133
\@acmtitlebox 438	
\@auxout 384	25 44 50 04
$\ensuremath{\texttt{Qaxp@newtheorem}}$	\□
\@begintheorem 232	A
\@biblabel 457, 458	\advance 174
\@bsphack 178	\appendix
\@enddocumenthook 407	appendix (option) 5
\@esphack 191	\appendixbibliographyprelim
\@extra@binfo 410	5, 89, 429, 456
\@ifnextchar 348, 357	\appendixbibliographystyle $\frac{5}{89}$, $\frac{89}{416}$
\@ifpackageloaded 7	\appendixprelim 5, <u>89</u> , 413
\@ifstar 71, 359	\appendixproof 150, 329
\@namedef 410	appendixproof (environment) 2, 146, 311
\@ne 174	$\verb \appendixrefname . 5, 89, 422, 424, 450 $
\@noligs 186	\appendixsectionformat $5, 89, 388$

\apx@oldamsthmendproof 10, 17	\bibliography $\underline{400}$
$\verb \apx@oldamsthmproof \dots \dots 9, 15, 16 $	bibliography (option) 4
\AtBeginDocument 157, 161	\bibname 423, 424
\axp@@@section	\BODY 140, 142, 215, 219
\axp@@sectiontestinput 347	\boolfalse 284
\axp@@sectiontestsection $\underline{347}$	\booltrue 271
\axp@appendix $\underline{24}$,	
28, 30, 32, 35, 99, 135, 270, 399	C
\axp@bibliography	\CatchFileDef353
25, 38, 41, 44, 400, 415, 420	\catcode 172
\axp@equation $\underline{197}$	\clearpage 93
$\verb \axp@equationx \dots \dots \dots \underline{197}$	\closeout
\axp@forward <u>286</u>	\count@ 170, 172, 173, 174
\axp@forward@link 276 , 286	\csdef 275
\axp@forward@setup 203, <u>305</u>	\csedef 306
\axp@forward@target $256, \underline{298}$	\csletcs 273, 274, 282
\axp@newtheorem $\dots 62, \frac{71}{2}, 202$	D
\axp@newtheoremrep 86 , $\underline{136}$, $\underline{199}$, $\underline{199}$	\DeclareStringOption 24, 25, 26
$\verb \axp@newtheoremrep@definetheorem \\$	\defaultbibliography 403
	\DefineVerbatimEnvironment 176
\axp@newtheoremreptmp $\underline{82}$	(Delinevelbatimentvilonment 170
\axp@oldbibliography $\underline{400}$	${f E}$
\axp@oldlabel 100, 103, 104, 108, 111, 113	\endappendixproof 151, 336
\axp@oldlabel@in@display	\endaxp@oldproof 96, 165, 338, 342, 344
$\dots \dots $	\endaxp@VerbatimOut 194, 320
\axp@oldproof 95, 164, 331, 341, 343	\endinlineproof 147, 342
axp@oldproof (environment) 95	\endnestedproof 149, 344
\axp@oldsection $166, 357, 358, 398$	\endproof 10, 12, 17, 96, 147, 149, 151, 165
\axp@oldtableofcontents 397	environments:
$\arrowvert axp@oldthebibliography 426, 428$	appendixproof
$\ap@proofsfile \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	axp@oldproof 95
221, 223, 228, 263, 314, 321, 385, 418	axp@VerbatimOut 176
\axp@redefinelabels . $\underline{97}$, 140 , 142 , 257	inlineproof \dots 4 , 146 , 341
$\ap@repeqn 26, 47, 49, 52, 205, 222, 262$	nestedproof $\dots \dots \dots 6$, $\overline{146}$, $\overline{341}$
\axp@rpcounter <u>196</u>	$proof \ \ldots \ 3, \ \underline{161}, \ \underline{326}$
$\label{eq:axp@seccounter} $$ \axp@seccounter $$ $\frac{345}{2} $$$	proofsketch
$\label{eq:axp@section} $$\operatorname{axp@section} \ \dots \ \underline{347}, \ 387$$	toappendix
\axp@sectitle 346 , 363 , 373 , 376 , 391	\errmessage 35, 44, 52
$\verb \axp@seenreptheorem \underline{195}$	\expandonce 380, 384, 386, 390, 391
\axp@tmp 353, 355, 378, 384, 386	
\axp@tmptmp 354, 355	
	F
$\verb \axp@unactivateeightbit \underline{169}, 180$	F \FV@CatCodesHook
\axp@VerbatimOut 193, 317	\FV@DefineTabOut $\dots 183$
lem:lem:lem:lem:lem:lem:lem:lem:lem:lem:	\FV@DefineTabOut
$\begin{tabular}{lllllllllllllllllllllllllllllllllll$	\FV@DefineTabOut
lem:lem:lem:lem:lem:lem:lem:lem:lem:lem:	\FV@DefineTabOut 183 \FV@DefineWhiteSpace 181 \FV@FontScanPrep 185 \FV@ProcessLine 184
$\label{eq:local_problem} $$ \axp@VerbatimOut &$	\FV@DefineTabOut 183 \FV@DefineWhiteSpace 181 \FV@FontScanPrep 185 \FV@ProcessLine 184 \FV@Scan 188
$\label{eq:linear_power_power} $$ \axp@VerbatimOut (environment) \dots \frac{176}{269} $$ \axp@with@forward \dots 210, 212, \frac{269}{269} $$ \axp@writesection \dots 193, 220, 313, \frac{375}{269} $$ $$ B$	\FV@DefineTabOut 183 \FV@DefineWhiteSpace 181 \FV@FontScanPrep 185 \FV@ProcessLine 184 \FV@Scan 188 \FV@Space 182
$\label{eq:local_problem} $$ \axp@VerbatimOut &$	\FV@DefineTabOut 183 \FV@DefineWhiteSpace 181 \FV@FontScanPrep 185 \FV@ProcessLine 184 \FV@Scan 188

Н	P
\hspace 458	\pretocmd 201, 232, 407
\hyperlink 290	\ProcessLocalKeyvalOptions 27
\hypertarget 300	\proof . 9, 11, 16, 95, 146, 148, 150, 164
,,	proof (environment) 3, <u>161</u> , <u>326</u>
I	\proofsketch <u>132</u>
\ifblank 306	<pre>proofsketch (environment) 4, 88</pre>
\ifbool 288	\providecommand 90, 98
\ifcsdef 281, 289	\putbib 430
\ifcsname 57, 63, 299	
\ifcsundef	\mathbf{R}
\ifnum	\ref 241, 381
\inlineproof 146, 341	\refname $421, 422, \underline{450}$
inlineproof (environment) . 4, 146, 341	\repeat 175
\input	$\texttt{repeqn} \; (\text{option}) \dots \dots 6$
\itshape 121, 123, 126, 130, 443	
(105hape 121, 120, 120, 140	S
L	\scshape
\label 100, 102, 111, 113, 210, 212, 370	\section <u>161</u> , 357, <u>358</u> , 398
\label@in@display 98, 101, 106, 112, 114	\setcounter 206, 224, 225, 264
\lipics@opterrshort 455	\SetupKeyvalOptions 20
	\small
\loop 171	\spnewtheorem . 117, 121, 123, 126, 130
\mathbf{M}	Т
\mainbodyrepeatedtheorem 5 , 89 , 214	\tableofcontents <u>397</u>
	\tableofcontents
\mainbodyrepeatedtheorem $5, 89, 214$ \message $29, 31, 33, 40, 42, 48, 50$	\tableofcontents
\mainbodyrepeatedtheorem 5 , 89 , 214 \message 29 , 31 , 33 , 40 , 42 , 48 , 50	$\begin{tabular}{lllllllllllllllllllllllllllllllllll$
$\label{eq:mainbodyrepeatedtheorem} \begin{array}{llllllllllllllllllllllllllllllllllll$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
\mainbodyrepeatedtheorem 5, 89, 214 \message 29, 31, 33, 40, 42, 48, 50 N \NAT@testdef 408, 432, 433 \nestedproof 148, 343	\tableofcontents
$\label{eq:mainbodyrepeatedtheorem} \begin{array}{llllllllllllllllllllllllllllllllllll$	$\begin{array}{llllllllllllllllllllllllllllllllllll$
\mainbodyrepeatedtheorem 5, 89, 214 \message 29, 31, 33, 40, 42, 48, 50 N \NAT@testdef 408, 432, 433 \nestedproof 148, 343	\tableofcontents
$\begin{tabular}{lllllllllllllllllllllllllllllllllll$	\tableofcontents
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	\tableofcontents
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	\tableofcontents \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	\tableofcontents \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	\tableofcontents
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	\tableofcontents \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \

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A Proofs for Section 1 (Usage)

This content is in the appendix.	
<i>Proof.</i> This proof is in the appendix.	
Foobar 2. This foobar is repeated in the appendix.	
<i>Proof.</i> This is the proof of the repeated foobar.	
This is a citation in the appendix [Unk16].	

References for the Appendix

[Unk16] Unknown. Proofs are hard, 2016.