

mathexercise 文档类使用手册*

Siyu Wu

sywumath@gmail.com

2023 年 2 月 22 日

目录

1 介绍	1	5 命令	3
2 文档类选项	1	5.1 无参数命令	3
3 导言区声明	2	5.2 有参数命令	3
4 环境	2	6 宏包依赖	4
	2	7 Source Code	4

1 介绍

mathexercise 文档类主要用于编写数学习题解.

2 文档类选项

mathexercise 文档类有下列选项:

withinchap (default) 此选项使得 **exercise** 环境的计数器随 chapter 自增, 当开始新的 chapter, 计数器的值重置为零.

withinsec 此选项使得 **exercise** 环境的计数器随 section 自增, 当开始新的 section, 计数器的值重置为零.

chinese 文档类默认不提供中文支持, 使用 **chinese** 选项后将调用 **ctex** 宏包并进行中文适配. 默认情况下建议使用 **pdflatex** 编译命令, 使用 **chinese** 选项后请使用 **xelatex** 或者 **lualatex** 编译命令.

*This document corresponds to **mathexercise** v1.1, dated 2023/02/22.

tikzcover 文档类默认情况下不使用 tikz 定制封面, 如果需要此功能, 请使用 **tikzcover** 选项.

3 导言区声明

文档类需要用户在导言区输入自定义信息, 如果使用了 **tikzcover** 选项, 需要输入类似于下列的信息:

```
\title{PDE Solutions}
\author{wsy}
\textbook{Partial Differential Equations}
\textbookauthor{Evans}
\textbookversion{Second Edition}
```

如果未使用 **tikzcover** 选项, 则只需要和标准文档类一样只输入 title 和 author 信息即可. 随后, 使用 **\maketitle** 命令便可以生成封面.

4 环境

exercise (*env.*) 文档类主要提供了下列环境:

proof (*env.*) **exercise** 此环境接受两个可选参数, 分别为 [*<integer>*] 和 *<<text>>*. 可选参数 [*<integer>*] 将当前题目的题号设置为 *<integer>*, 且后续题目的题号默认从 *<integer>*+1 开始增加. 使用可选参数 *<<text>>* 将会在题号后面以加粗字体显示 *<text>* 并以圆括号将其包裹.

proof 证明环境

solution 解答环境

theorem 定理环境

lemma 引理环境

example 例环境

remark 注环境

corollary 推论环境

proposition 命题环境

note 笔记环境

tasks 由 **tasks** 宏包提供, 具体使用方法参考其手册

注意: **proof**、**solution**、**theorem**、**lemma**、**example**、**remark**、**corollary**、**note** 环境的 Heading 受 **chinese** 选项影响.

5 命令

文档类定义了如下命令, 方便用户调用:

5.1 无参数命令

Command	Effect	Meaning
<code>\e</code>	e	Euler's number
<code>\T</code>	T	use for the transpose of matrix
<code>\upi</code>	i	imaginary unit
<code>\id</code>	id	identity map
<code>\diff</code>	d	differential operator
<code>\codim</code>	codim	codimension
<code>\conv</code>	conv	convex hull
<code>\diag</code>	diag	diagonal
<code>\diam</code>	diam	diameter
<code>\dist</code>	dist	distance
<code>\Int</code>	Int	interior of set
<code>\rank</code>	rank	rank
<code>\sgn</code>	sgn	sign
<code>\supp</code>	supp	support
<code>\lcm</code>	lcm	least common multiple
<code>\Span</code>	span	span
<code>\Re</code> (redefine)	Re	real part
<code>\Im</code> (redefine)	Im	imaginary part
<code>\weakconverge</code>	\rightharpoonup	weakly converge to

5.2 有参数命令

Command	Example	Effect	Meaning
<code>\closure</code>	<code>\closure{A}</code>	\overline{A}	closure of set
<code>\conjugate</code>	<code>\conjugate{z}</code>	\bar{z}	conjugate number
<code>\lrmangle</code>	<code>\lrmangle{g}</code>	$\langle g \rangle$	
<code>\innerp</code>	<code>\innerp{a}{b}</code>	$\langle a, b \rangle$	inner product
<code>\norm</code>	<code>\norm{v}</code>	$\ v\ $	norm

6 宏包依赖

mathexercise 文档类预加载了下列宏包用于提供各种常用功能:

- ctex (取决于 chinese 选项)
- indentfirst
- enumitem
- mathtools (mathtools 宏包预加载 amsmath 宏包, 本文档类依赖 mathtools 创建命令 \langle 、 \innerp 、 \norm)
- amssymb
- amsthm
- extarrows
- xcolor
- tcolorbox
- geometry
- tikz
- tasks
- hyperref
- fixdif (提供微分算符 d)

如果需要使用其它宏包, 直接在主文件导言区通过 `\usepackage{}` 命令添加即可.

7 Source Code

`\if@chinesesupport` 是否提供中文支持以及是否使用 TikZ 绘制封面。

```
\if@tikzcover 1 \newif\if@chinesesupport
               2 \newif\if@tikzcover
               3 \@chinesesupportfalse
               4 \@tikzcoverfalse
```

`withinchap` 声明选项, 处理选项。

```
withinsec 5 \DeclareOption{withinchap}{\def\exercounter@within{chapter}}
tikzcover 6 \DeclareOption{withinsec}{\def\exercounter@within{section}}
chinese 7 \DeclareOption{tikzcover}{\@tikzcovertrue}
         8 \DeclareOption{chinese}{\@chinesesupporttrue}
         9 \DeclareOption*{\PassOptionsToClass{\CurrentOption}{report}}
        10 \ExecuteOptions{withinchap}
        11 \ProcessOptions\relax
```

加载 report 文档类

```
12 \LoadClass{report}
```

加载所需宏包

```
13 \RequirePackage[indentfirst]
14 \RequirePackage[shortlabels]{enumitem}
15 \RequirePackage{mathtools}
16 \RequirePackage{amssymb}
17 \RequirePackage{amsthm}
18 \RequirePackage{fixdif}
19 \RequirePackage{extarrows}
20 \RequirePackage{xcolor}
21 \RequirePackage{tcolorbox}
22 \RequirePackage[width=14cm]{geometry}
23 \RequirePackage{tikz}
24 \usetikzlibrary{intersections,decorations.text}
```

定义颜色值。

```
25 \definecolor{c1}{RGB}{62, 97, 127}
26 \definecolor{c2}{RGB}{104, 182, 182}
27 \definecolor{c3}{RGB}{107, 190, 190}
28 \definecolor{c4}{RGB}{100, 172, 174}
29 \definecolor{c5}{RGB}{95, 162, 162}
```

根据 amsthm 宏包，新建定理风格。

```
30 \newtheoremstyle{mytheorem}{3pt}{3pt}{\rmfamily}{\parindent}{\bfseries}{\}%
31 { .5em}{\thmname{#1}\thmnumber{ #2}\thmnote{ (#3)}}
```

根据是否提供中文支持分别进行中西文设定。

```
32 \if@chinesesupport
33 \RequirePackage[heading=true, fontset = fandol]{ctex}
34 \ctexset {
35   chapter = {
36     beforeskip = 0pt,
37     fixskip = true,
38     format = \Huge\bfseries,
39     nameformat = \rule{\linewidth}{1bp}\par\bigskip\hfill\chapternamebox,
40     number = \arabic{chapter},
41     aftername = \par\medskip,
42     aftertitle = \par\bigskip\nointerlineskip\rule{\linewidth}{2bp}\par
43   }
44   \newcommand\chapternamebox[1]{%
45     \parbox{\ccwd}{\linespread{1}\selectfont\centering #1}}
46   \newcommand\solutionname{解}
47   %theorem environment
48   \theoremstyle{mytheorem}\newtheorem{theorem}{定理}
```

```

49 \theoremstyle{mytheorem}\newtheorem{lemma}{引理}
50 \theoremstyle{mytheorem}\newtheorem{example}{例}
51 \theoremstyle{mytheorem}\newtheorem*{remark}{注}
52 \theoremstyle{mytheorem}\newtheorem*{corollary}{推论}
53 \theoremstyle{mytheorem}\newtheorem{proposition}{命题}
54 \theoremstyle{mytheorem}\newtheorem{note}{笔记}
55 \newcommand{\authorname}{作者}
56 \newcommand{\textbookname}{教材}
57 \newcommand{\proofnamestyle}{\bfseries}
58 \newcommand{\proofpunct}{:}
59 \else
60 \newcommand{\solutionname}{Solution}
61 \theoremstyle{mytheorem}\newtheorem{theorem}{Theorem}
62 \theoremstyle{mytheorem}\newtheorem{lemma}{Lemma}
63 \theoremstyle{mytheorem}\newtheorem{example}{Example}
64 \theoremstyle{mytheorem}\newtheorem*{remark}{Remark}
65 \theoremstyle{mytheorem}\newtheorem*{corollary}{Corollary}
66 \theoremstyle{mytheorem}\newtheorem{proposition}{Proposition}
67 \theoremstyle{definition}\newtheorem{note}{Note}[chapter]
68 \newcommand{\authorname}{Author}
69 \newcommand{\textbookname}{Textbook}
70 \newcommand{\proofnamestyle}{\itshape}
71 \newcommand{\proofpunct}{.}
72 \fi

```

`\e` 罗马字体

```

\T 73 \newcommand{\e}{\mathrm{e}}
\upi 74 \newcommand{\T}{\mathrm{T}}
\id 75 \newcommand{\upi}{\mathrm{i}}
76 \newcommand{\id}{\mathrm{id}}

```

`\weakconverge` 弱收敛、闭包、共轭。

```

\closure 77 \newcommand{\weakconverge}{\rightharpoonup}
\conjugate 78 \newcommand{\closure}[1]{\overline{\#1}}
79 \newcommand{\conjugate}[1]{\overline{\#1}}

```

`\diff` 微分算符。

```
80 \newcommand{\diff}{\mathop{}\!\mathrm{d}}
```

使用 `\DeclareMathOperator` 定义算符。

```

81 \DeclareMathOperator{\codim}{codim}
82 \DeclareMathOperator{\conv}{conv}

```

```

83 \DeclareMathOperator{\diag}{diag}
84 \DeclareMathOperator{\diam}{diam}
85 \DeclareMathOperator{\dist}{dist}
86 \DeclareMathOperator{\Int}{Int}
87 \DeclareMathOperator{\lcm}{lcm}
88 \DeclareMathOperator{\rank}{rank}
89 \DeclareMathOperator{\sgn}{sgn}
90 \DeclareMathOperator{\sign}{sign}
91 \DeclareMathOperator{\spt}{spt}
92 \DeclareMathOperator{\supp}{supp}
93 \DeclareMathOperator{\Span}{span}
94 \DeclareMathOperator{\tr}{tr}

```

`\Rm` 重定义 `\Rm` 和 `\Im` 使其用于复数的实部和虚部。

```

\Im 95 \renewcommand{\Re}{\operatorname{Re}}
96 \renewcommand{\Im}{\operatorname{Im}}

```

`\innerp` 利用 `mathtools` 宏包构建宏。

```

\lrmangle 97 \DeclarePairedDelimiterX{\lrmangle}[1]{\langle}{\rangle}{#1}
\lrmangle 98 \DeclarePairedDelimiterX{\innerp}[2]{\langle}{\rangle}{#1,#2}
\lrmangle 99 \DeclarePairedDelimiterX{\norm}[1]{\lVert}{\rVert}{#1}

```

`\textbook` 三个用户宏分别用于输入教材名、教材作者以及教材版本。

```

\textbookauthor 100 \newcommand{\textbook}[1]{\gdef\@textbook{#1}}
\textbookversion 101 \newcommand{\textbookauthor}[1]{\gdef\@textbookauthor{#1}}
102 \newcommand{\textbookversion}[1]{\gdef\@textbookversion{#1}}

```

`proof (env.)` 重定义 `proof` 环境，新定义 `solution` 环境。

```

solution (env.) 103 \renewenvironment{proof}[1][\proofname]{\par
104   \pushQED{\qed}
105   \normalfont\topsep1\p@\@plus6\p@\relax
106   \trivlist\item\relax
107   {\hspace*{\parindent}{\proofnamestyle #1}\@addpunct{\proofpunct}}
108   \hspace\labelsep\ignorespaces
109 }{\%
110 \popQED\endtrivlist\@endpfalse
111 }
112
113 \newenvironment{solution}[1][\solutionname]{\par
114   \pushQED{\qed}%
115   \normalfont\topsep1\p@\@plus6\p@\relax
116   \trivlist\item\relax

```

```

117 {\hspace*{\parindent}{\proofnamestyle #1}\@addpunct{\proofpunct}}}%
118 \hspace\labelsep\ignorespaces
119 }{%
120 \popQED\endtrivlist\@endpefalse
121 }

```

`exercise (env.)` 定义 exercise 环境。

```

122 \newcounter{exercounter}
123 \counterwithin*{exercounter}{\exercounter@within}
124 \NewDocumentEnvironment{exercise}{o d< > +b}
125 {%
126   \IfNoValueTF{#1}
127     {\stepcounter{exercounter}}
128     {\setcounter{exercounter}{#1}}
129   \par\textbf{\theexercounter.}\hspace{.333em}%
130 \IfNoValueTF{#2}
131   {#3}
132   {\textbf{(#2)}\hspace{.333em}#3}
133 }
134 {\ignorespacesafterend}

```

`enumitem` 设定。

```

135 \setlist{nosep,left=\parindent}

```

`tasks` 宏包设置。

```

136 \RequirePackage{tasks}
137 \settasks{after-item-skip=0.5ex plus 0.5ex minus 1ex}

```

`hyperref` 宏包加载及设置。

```

138 \RequirePackage{hyperref}
139 \hypersetup{
140   colorlinks,%
141   linkcolor=red
142 }

```

`\maketitle` 封面设置。

```

143 \if@tikzcover
144 \renewcommand{\maketitle}{%
145   \thispagestyle{empty}
146   \begin{tikzpicture}[overlay,remember picture,font=\sffamily\bfseries]
147     \draw[ultra thick,c4,name path=big arc] ([xshift=-2mm]current page.north)
148     arc(150:285:11)
149     coordinate[pos=0.225] (x0);

```



```

150 \begin{scope}
151 \clip ([xshift=-2mm]current page.north) arc(150:285:11)
152 --(current page.northeast);
153 \fill[c4!50,opacity=0.25] ([xshift=4.55cm]x0) circle (4.55);
154 \fill[c4!50,opacity=0.25] ([xshift=3.4cm]x0) circle (3.4);
155 \fill[c4!50,opacity=0.25] ([xshift=2.25cm]x0) circle (2.25);
156 \draw[ultra thick,c4!50] (x0) arc(-90:30:6.5);
157 \draw[ultra thick,c4] (x0) arc(90:-30:8.75);
158 \draw[ultra thick,c4!50,name path=arc1] (x0) arc(90:-90:4.675);
159 \draw[ultra thick,c4!50] (x0) arc(90:-90:2.875);
160 \path[name intersections={of=big arc and arc1,by=x1}];
161 \draw[ultra thick,c4,name path=arc2] (x1) arc(135:-20:4.75);
162 \draw[ultra thick,c4!50] (x1) arc(135:-20:8.75);
163 \path[name intersections={of=big arc and arc2,by={aux,x2}}];
164 \draw[ultra thick,c4!50] (x2) arc(180:50:2.25);
165 \end{scope}
166 \path[decoration={text along path,text color=c4,
167 raise = -2.8ex,
168 text along path,
169 text = {\sffamily\bfseries\@date},
170 text align = center,
171 },
172 decorate
173 ] ([xshift=-2mm]current page.north) arc(150:245:11);
174 %
175 \begin{scope}
176 \path[clip,postaction={fill=c3}]
177 ([xshift=2cm,yshift=-8cm]current page.center) rectangle ++ (4.2,7.7);
178 \draw[c5,ultra thick,fill=c2] ([xshift=0.5cm,yshift=-8cm]current page.center)
179 ([xshift=0.5cm,yshift=-8cm]current page.center) arc(180:60:2)
180 |- ++ (-3,6) --cycle;
181 \draw[ultra thick,c5] ([xshift=-1.5cm,yshift=-8cm]current page.center)
182 arc(180:0:2);
183 \draw[ultra thick,c5] ([xshift=0.5cm,yshift=-8cm]current page.center)
184 arc(180:0:2);
185 \draw[ultra thick,c5] ([xshift=2.5cm,yshift=-8cm]current page.center)
186 arc(180:0:2);
187 \draw[ultra thick,c5] ([xshift=4.5cm,yshift=-8cm]current page.center)
188 arc(180:0:2);
189 \fill[red] ([xshift=2.5cm,yshift=-8cm]current page.center) +(60:2)
190 circle(1.5mm) node[above right=2mm,text=c5!80!black]
191 {\$\rho:=\dfrac{1+\sqrt{-3}}{2}$};

```

```

192     \end{scope}
193     %
194     \fill[c1] ([xshift=2cm,yshift=-8cm]current page.center)
195         rectangle ++ (-12.7,7.7);
196     \node[text=white,anchor=west,scale=3,inner sep=0pt] at
197         ([xshift=-9.5cm,yshift=-3.25cm]current page.center) {\@title};
198     \node[text=white,anchor=west,scale=1.5,inner sep=0pt] at
199         ([xshift=-9.5cm,yshift=-6cm]current page.center) {\authorname:\ \@author};
200     \node[text=white,anchor=west,scale=1.5,inner sep=0pt] at
201         ([xshift=-9.5cm,yshift=-6.75cm]current page.center)%
202         {\textbookname:\ \@textbook\ (\@textbookauthor\ \@textbookversion)};
203     %
204     % \draw[gray,line width=5mm]
205     % ([xshift=2mm,yshift=-1mm]current page.south west)
206     rectangle ([xshift=-2mm,yshift=1mm]current
207         % page.north east);
208     \end{tikzpicture}
209     \clearpage\thispagestyle{empty}
210     \begin{center}
211         \Large\bfseries Declaration
212     \end{center}
213     The class file \texttt{mathexercise.cls} for this document
214     is available at my github repository
215     \href{https://github.com/SwitWu/MathExercise}{MathExercise}.
216     Please report any issues you find in this document to me
217     through email or github issues. Fork and pull requests are welcome.
218     \clearpage
219 }
220 \else\fi

```

Change History

v1.0		v1.1
General: initial version 1	General: 调用 fixdif 包 4

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.

Symbols	proof 2 , 103	\norm 97
\! 80	solution 2 , 103	\normalfont 105 , 115
\@addpunct 107 , 117	theorem 2	
\@author 199	exercise (env.) 2 , 122	O
\@chinesesupportfalse .. 3	\exercounter@within ..	\operatorname 95 , 96
\@chinesesupporttrue .. 8 5 , 6 , 123	\overline 78 , 79
\@date 169		
\@endpfalse 110 , 120	H	P
\@plus 105 , 115	\Huge 38	\p@ 105 , 115
\@textbook 100 , 202	I	\par 39 , 41 , 42 , 103 , 113 , 129
\@textbookauthor . 101 , 202	\id 73	\parbox 45
\@textbookversion 102 , 202	\if@chinesesupport . 1 , 32	\parindent 30 , 107 , 117 , 135
\@tikzcoverfalse 4	\if@tikzcover 1 , 143	\PassOptionsToClass ... 9
\@tikzcovertrue 7	\IfNoValueTF 126 , 130	\path 160 , 163 , 166 , 176
\@title 197	\ignorespaces 108 , 118	\popQED 110 , 120
_ 199 , 202	\ignorespacesafterend 134	\ProcessOptions 11
	\Im 95	proof (env.) 2 , 103
A	\innerp 97	\proofname 103
\authorname ... 55 , 68 , 199	\Int 86	\proofnamestyle
	 57 , 70 , 107 , 117
C	L	\proofpunct 58 , 71 , 107 , 117
\chapternamebox ... 39 , 44	\langle 97 , 98	\pushQED 104 , 114
\chinese 5	\Large 211	
\clip 151	\lcm 87	Q
\closure 77	\lrmangle 97	\qed 104 , 114
\codim 81	\lVert 99	
\conjugate 77	M	R
\conv 82	\maketitle 143	\rangle 97 , 98
D	N	\rank 88
\DeclarePairedDelimiterX	\NewDocumentEnvironment	\Re 95
..... 97 , 98 , 99 124	\relax 11 , 105 , 106 , 115 , 116
\diag 83	\newenvironment 113	\renewcommand .. 95 , 96 , 144
\diam 84	\newif 1 , 2	\renewenvironment ... 103
\diff 80	\newtheorem 48 , 49 , 50 ,	\RequirePackage
\dist 85	51 , 52 , 53 , 54 , 61 , 13 , 14 , 15 ,
	62 , 63 , 64 , 65 , 66 , 67	16 , 17 , 18 , 19 , 20 ,
E	\newtheoremstyle 30	21 , 22 , 23 , 33 , 136 , 138
\e 73	\node 196 , 198 , 200	\rho 191
environments:	\nointerlineskip 42	\rightharpoonup 77
exercise 2 , 122		\Rm 95
		\rmfamily 30

<code>\rule</code>	39, 42	<code>\stepcounter</code>	127	<code>\thispagestyle</code> ...	145, 209
<code>\rVert</code>	99	<code>\supp</code>	92	<code>\thmname</code>	31
S		T		<code>\thmnote</code>	31
<code>\selectfont</code>	45	<code>\T</code>	73	<code>\thmnumber</code>	31
<code>\setcounter</code>	128	<code>\textbf</code>	129, 132	<code>\tikzcover</code>	5
<code>\setlist</code>	135	<code>\textbook</code>	100	<code>\topsep</code>	105, 115
<code>\settasks</code>	137	<code>\textbookauthor</code>	100	<code>\tr</code>	94
<code>\sffamily</code>	146, 169	<code>\textbookname</code> ..	56, 69, 202	<code>\trivlist</code>	106, 116
<code>\sgn</code>	89	<code>\textbookversion</code>	100	U	
<code>\sign</code>	90	<code>\texttt</code>	213	<code>\upi</code>	73
<code>solution (env.)</code>	2, 103	<code>\theexercounter</code>	129	<code>\usetikzlibrary</code>	24
<code>\solutionname</code> ..	46, 60, 113	<code>theorem (env.)</code>	2	W	
<code>\Span</code>	93	<code>\theoremstyle</code> 48, 49, 50,		<code>\weakconverge</code>	77
<code>\spt</code>	91	51, 52, 53, 54, 61,		<code>\withinchap</code>	5
<code>\sqrt</code>	191	62, 63, 64, 65, 66, 67		<code>\withinsec</code>	5