mathexercise 文档类使用手册*

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目录

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.*)
proof (*env.*)
solution (*env.*)
theorem (*env.*)

文档类主要提供了下列环境:

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

5.2 有参数命令

Command	Example	Effect	Meaning
`\closure`	`\closure{A}`	$\overline{A}$	closure of set
`\conjugate`	`\conjugate{z}`	$\overline{z}$	conjugate number
`\lrangle`	`\lrangle{g}`	$\langle g \rangle$	
`\innerp`	`\innerp{a}{b}`	$\langle a, b \rangle$	inner product
`\norm`	`\norm{v}`	$\|v\|$	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 `\lrangle`、`\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`

```
\newif\if@chinesesupport
\newif\if@tikzcover
\@chinesesupportfalse
\@tikzcoverfalse
```

`withinchap` 声明选项，处理选项。

`withinsec`

`tikzcover`

`chinese`

```
\DeclareOption{withinchap}{\def\exercounter@within{chapter}}
\DeclareOption{withinsec}{\def\exercounter@within{section}}
\DeclareOption{tikzcover}{\@tikzcovertrue}
\DeclareOption{chinese}{\@chinesesupporttrue}
\DeclareOption*{\PassOptionsToClass{\CurrentOption}{report}}
\ExecuteOptions{withinchap}
\ProcessOptions\relax
```

加载 report 文档类

```
\LoadClass{report}
```

加载所需宏包

```
\RequirePackage{indentfirst}
\RequirePackage[shortlabels]{enumitem}
\RequirePackage{mathtools}
\RequirePackage{amssymb}
\RequirePackage{amsthm}
\RequirePackage{fixdif}
\RequirePackage{extarrows}
\RequirePackage{xcolor}
\RequirePackage{tcolorbox}
\RequirePackage[width=14cm]{geometry}
\RequirePackage{tikz}
\usetikzlibrary{intersections,decorations.text}
```

定义颜色值。

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

根据 amsthm 宏包，新建定理风格。

```
\newtheoremstyle{mytheorem}{3pt}{3pt}{\rmfamily}{\parindent}{\bfseries}{}%
  {.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。

```
\if@chinesesupport
  \RequirePackage[heading=true, fontset = fandol]{ctex}
  \ctexset {
    chapter = {
      beforeskip = 0pt,
      fixskip = true,
      format = \Huge\bfseries,
      nameformat = \rule{\linewidth}{1bp}\par\bigskip\hfill\chapternamebox,
      number = \arabic{chapter},
      aftername = \par\medskip,
      aftertitle = \par\bigskip\nointerlineskip\rule{\linewidth}{2bp}\par}
  }
  \newcommand\chapternamebox[1]{%
  \parbox{\ccwd}{\linespread{1}\selectfont\centering #1}}
  \newcommand{\solutionname}{解}
  %theorem environment
  \theoremstyle{mytheorem}\newtheorem{theorem}{定理}
```

```
  \theoremstyle{mytheorem}\newtheorem{lemma}{引理}
  \theoremstyle{mytheorem}\newtheorem{example}{例}
  \theoremstyle{mytheorem}\newtheorem*{remark}{注}
  \theoremstyle{mytheorem}\newtheorem*{corollary}{推论}
  \theoremstyle{mytheorem}\newtheorem{proposition}{命题}
  \theoremstyle{mytheorem}\newtheorem{note}{笔记}
  \newcommand{\authorname}{作者}
  \newcommand{\textbookname}{教材}
  \newcommand{\proofnamestyle}{\bfseries}
  \newcommand{\proofpunct}{:}
\else
  \newcommand{\solutionname}{Solution}
  \theoremstyle{mytheorem}\newtheorem{theorem}{Theorem}
  \theoremstyle{mytheorem}\newtheorem{lemma}{Lemma}
  \theoremstyle{mytheorem}\newtheorem{example}{Example}
  \theoremstyle{mytheorem}\newtheorem*{remark}{Remark}
  \theoremstyle{mytheorem}\newtheorem*{corollary}{Corollary}
  \theoremstyle{mytheorem}\newtheorem{proposition}{Proposition}
  \theoremstyle{definition}\newtheorem{note}{Note}[chapter]
  \newcommand{\authorname}{Author}
  \newcommand{\textbookname}{Textbook}
  \newcommand{\proofnamestyle}{\itshape}
  \newcommand{\proofpunct}{.}
\fi
```

`\e` 罗马字体

`\T`
`\upi`
`\id`

```
\newcommand{\e}{\mathrm{e}}
\newcommand{\T}{\mathrm{T}}
\newcommand{\upi}{\mathrm{i}}
\newcommand{\id}{\mathrm{id}}
```

`\weakconverge` 弱收敛、闭包、共轭。

`\closure`
`\conjugate`

```
\newcommand{\weakconverge}{\rightharpoonup}
\newcommand{\closure}[1]{\overline{#1}}
\newcommand{\conjugate}[1]{\overline{#1}}
```

`\diff` 微分算符。

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

使用 `\DeclareMathOperator` 定义算符。

```
\DeclareMathOperator{\codim}{codim}
\DeclareMathOperator{\conv}{conv}
```

```
\DeclareMathOperator{\diag}{diag}
\DeclareMathOperator{\diam}{diam}
\DeclareMathOperator{\dist}{dist}
\DeclareMathOperator{\Int}{Int}
\DeclareMathOperator{\lcm}{lcm}
\DeclareMathOperator{\rank}{rank}
\DeclareMathOperator{\sgn}{sgn}
\DeclareMathOperator{\sign}{sign}
\DeclareMathOperator{\spt}{spt}
\DeclareMathOperator{\supp}{supp}
\DeclareMathOperator{\Span}{span}
\DeclareMathOperator{\tr}{tr}
```

`\Rm` 重定义 `\Rm` 和 `\Im` 使其用于复数的实部和虚部。

`\Im`

```
\renewcommand{\Re}{\operatorname{Re}}
\renewcommand{\Im}{\operatorname{Im}}
```

`\innerp` 利用 mathtools 宏包构建宏。

`\lrangle`

`\norm`

```
\DeclarePairedDelimiterX{\lrangle}[1]{\langle}{\rangle}{#1}
\DeclarePairedDelimiterX{\innerp}[2]{\langle}{\rangle}{#1,#2}
\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`

`\textbookversion`

```
\newcommand{\textbook}[1]{\gdef\@textbook{#1}}
\newcommand{\textbookauthor}[1]{\gdef\@textbookauthor{#1}}
\newcommand{\textbookversion}[1]{\gdef\@textbookversion{#1}}
```

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

`solution` (*env.*)

```
\renewenvironment{proof}[1][\proofname]{\par
  \pushQED{\qed}
  \normalfont\topsep1\p@\@plus6\p@\relax
  \trivlist\item\relax
{\hspace*{\parindent}{\proofnamestyle #1}\@addpunct{\proofpunct}}
  \hspace\labelsep\ignorespaces
}{%
\popQED\endtrivlist\@endpefalse
}

\newenvironment{solution}[1][\solutionname]{\par
\pushQED{\qed}%
  \normalfont\topsep1\p@\@plus6\p@\relax
  \trivlist\item\relax
```

```
{\hspace*{\parindent}{\proofnamestyle #1}\@addpunct{\proofpunct}}%
  \hspace\labelsep\ignorespaces
}{%
\popQED\endtrivlist\@endpefalse
}
```

exercise (*env.*) 定义 exercise 环境。

```
\newcounter{exercounter}
\counterwithin*{exercounter}{\exercounter@within}
\NewDocumentEnvironment{exercise}{o d<> +b}
  {%
    \IfNoValueTF{#1}
      {\stepcounter{exercounter}}
      {\setcounter{exercounter}{#1}}
    \par\textbf{\theexercounter.}\hspace{.333em}%
\IfNoValueTF{#2}
    {#3}
    {\textbf{(#2)}\hspace{.333em}#3}
  }
  {\ignorespacesafterend}
```

enumitem 设定。

```
\setlist{nosep,left=\parindent}
```

tasks 宏包设置。

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

hyperref 宏包加载及设置。

```
\RequirePackage{hyperref}
\hypersetup{
  colorlinks,%
  linkcolor=red
}
```

\maketitle 封面设置。

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

```
\begin{scope}
\clip ([xshift=-2mm]current page.north) arc(150:285:11)
  --(current page.northeast);
\fill[c4!50,opacity=0.25] ([xshift=4.55cm]x0) circle (4.55);
\fill[c4!50,opacity=0.25] ([xshift=3.4cm]x0) circle (3.4);
\fill[c4!50,opacity=0.25] ([xshift=2.25cm]x0) circle (2.25);
\draw[ultra thick,c4!50] (x0) arc(-90:30:6.5);
\draw[ultra thick,c4] (x0) arc(90:-30:8.75);
\draw[ultra thick,c4!50,name path=arc1] (x0) arc(90:-90:4.675);
\draw[ultra thick,c4!50] (x0) arc(90:-90:2.875);
\path[name intersections={of=big arc and arc1,by=x1}];
\draw[ultra thick,c4,name path=arc2] (x1) arc(135:-20:4.75);
\draw[ultra thick,c4!50] (x1) arc(135:-20:8.75);
\path[name intersections={of=big arc and arc2,by={aux,x2}}];
\draw[ultra thick,c4!50] (x2) arc(180:50:2.25);
\end{scope}
\path[decoration={text along path,text color=c4,
        raise = -2.8ex,
        text  along path,
        text = {|\sffamily\bfseries|\@date},
        text align = center,
      },
      decorate
    ] ([xshift=-2mm]current page.north) arc(150:245:11);
%
\begin{scope}
\path[clip,postaction={fill=c3}]
([xshift=2cm,yshift=-8cm]current page.center) rectangle ++ (4.2,7.7);
\draw[c5,ultra thick,fill=c2] ([xshift=0.5cm,yshift=-8cm]current page.center)
  ([xshift=0.5cm,yshift=-8cm]current page.center)  arc(180:60:2)
  |- ++ (-3,6) --cycle;
\draw[ultra thick,c5] ([xshift=-1.5cm,yshift=-8cm]current page.center)
arc(180:0:2);
\draw[ultra thick,c5] ([xshift=0.5cm,yshift=-8cm]current page.center)
arc(180:0:2);
\draw[ultra thick,c5] ([xshift=2.5cm,yshift=-8cm]current page.center)
arc(180:0:2);
\draw[ultra thick,c5] ([xshift=4.5cm,yshift=-8cm]current page.center)
arc(180:0:2);
\fill[red] ([xshift=2.5cm,yshift=-8cm]current page.center) +(60:2)
  circle(1.5mm) node[above right=2mm,text=c5!80!black]
  {$\rho:=\dfrac{1+\sqrt{-3}}{2}$};
```

```
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

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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.

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