`exercise.sty` : a package to typeset exercises

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Abstract

This package offers a simple environment to typeset exercises, and their questions, sub-questions, indications, answers and so on.

The layout of the exercises is fully customisable. Moreover, the answers of the exercise could be typeset immediately or later in the document.

1 Simple usage

This package defines two environments. The environment `Exercise` is used to typeset one exercise. For example, the following output:

Exercise 1 — Duhamel's Rule

Assume that the series $\sum x_n$ satisfies

$$\frac{x_{n+1}}{x_n} = 1 - \frac{b}{n} + \frac{\varepsilon(n)}{n}$$

where b is a real number and the function ε satisfies

$$\lim_{n\to+\infty} \varepsilon(n) = 0.$$

1. Show that if $b < 1$, then the series $\sum x_n$ is divergent.
2. Show that if $b > 1$, then the series $\sum x_n$ is convergent.
3. What happens to $\sum x_n$ if $b = 1$?

is obtained by the following code (the text has been cut to underscore the structure of the code):

```
\begin{Exercise}[title={Duhamel's Rule}]
   Assume...
   \Question Show that if $b < 1$...
   \Question Show that if $b > 1$...
   \Question What happens to if $b=1$?
\end{Exercise}
```

Up to three level of question are available, and a part level (between exercise and question) is implemented:

```
\begin{Exercise}[title={Example}]
    Assume...
    \ExePart
    \Question
      \subQuestion Show that...
      \subQuestion In this question...
        \subsubQuestion Show that...
        \subsubQuestion Conclude...
      \subQuestion Conclude.
    \Question Show that if $b > 1$...
    \ExePart
    \Question What happens to if $b=1$?
\end{Exercise}
```

The commands to typeset question, sub-question and sub-sub-question are `Question`, `subQuestion`, and `subsubQuestion`. The exercise is split in parts with the command `ExePart`.

The environment `Exercise` can be stared (no number is typeset). The options of these commands are described in section 3. The layout of exercises can be customised in many way: see section 4.

It is common to have a long list of exercise to typeset, and the usage of the `Exercise` environment could be cumbersome. Another environment is available: the `ExerciseList` environment.

Ex. 2 — Discuss the convergence or divergence of $\left[1+\sin\left(\frac{1}{an}\right)\right]^{bn}$ where a and b are two parameters.

Ex. 3 — Discuss the convergence or divergence of $n^{\frac{(-1)^n}{n}}-1$.

Ex. — Discuss the convergence or divergence of $\frac{(-1)^n}{n+(-1)^n}$.

Answer (ex. 2) — $\lim\limits_{n\to+\infty}\left[1+\sin\left(\dfrac{1}{an}\right)\right]^{bn}=\mathrm{e}^{\frac{b}{a}}$

```
\begin{ExerciseList}
    \Exercise[label={ex:two}] Discuss...
    \Exercise Discuss...
    \Exercise* Discuss...
    \Answer[ref={ex:two}] $...$
\end{ExerciseList}
```

This example show two new commands: `\Exercise*` (for an exercise without number) and `\Answer`. These commands are explained in detail later in this document.

Of course, the `\Question`, `\subQuestion`, and `\subsubQuestion` hierarchy is also available in `ExerciseList`:

```
\begin{ExerciseList}
    \Exercise Discuss...
    \Exercise Let $u$...
      \Question ...
        \subQuestion ...
      \Question
    \Exercise What...
\end{ExerciseList}
```

2 Options of the package

Here we list the options of the package `exercise.sty`:

`noexercise` hide all the exercises of a document.

`noanswer` hide all the answers of a document. The default behaviour is to show both the exercises and the answers.

`exerciseonly` is a synonym of `noanswer`.

`answeronly` is a synonym of `noexercise`.

`nothing` hide answers and exercises (synonym of `noanswer` and `noexercise`).

`answerdelayed` save the answers instead of typeset them. The answers can be included later in the document with the command `\shipoutAnswer`. More precisely, the answers are stored in a vertical box. When `\shipoutAnswer` is encountered, this box is emptied and its contents is placed in the main vertical list. The answers defined later are placed in this emptied vertical box. In this way, you can have many group of answers in the same document.

`exercisedelayed` saves the exercises instead of typeset them. The exercises can be included later with the command `\shipoutExercise`.

`lastexercise` if no references is given for an answer, then the answer is supposed to refer to the last exercise (see section 3.1).

3 Commands

3.1 Exercises and answers

`\begin{Exercise}` [⟨*key val list*⟩] ... `\end{Exercise}`
`\begin{Exercise*}` [⟨*key val list*⟩] ... `\end{Exercise*}`

`Exercise`
`Exercise*`

The `Exercise` environment is used to typeset just one exercise. We use the keyval package to give different informations about an exercise.

`label`={⟨*string*⟩}
`title`={⟨*string*⟩}
`difficulty`={⟨*number*⟩}
`origin`={⟨*string*⟩}
`name`={⟨*string*⟩}
`counter`={⟨*counter*⟩}
`number`={⟨*string*⟩}

All these keys define commands that will be available later to typeset the exercise. They are all optional.

`label` The label of the exercise. This label can be used later in cross-reference, or to link an answer to this exercise.

`title` The title of the exercise. It will be available later with the command `\ExerciseTitle`.

`difficulty` The difficulty of the exercise (a number). It will be available later with the counter `\ExerciseDifficulty`.

`origin` The origin of the exercise. It will be available later with the command `\ExerciseOrigin`.

`name` In document, exercises can have multiple denomination, like problem, exam, or even question. This key allows to change the denomination.

`counter` Use the given counter to number this exercise. Here, {⟨*counter*⟩} must be a pre-defined counter.

`number` Use the given number for the exercise. In fact, this number is a string, so you can number the exercise with letters.

As an example, with the default definitions, the following code:

```
\begin{Exercise}[title={Euler's constant}, difficulty=2,
                 origin={P.Paelw}]
\end{Exercise}
```

will give

**** Exercise 4 — Euler's constant** (*P.Paelw*)

`Problem` It is possible to define different type of exercise. For example, you can define a `Problem` environment with the two lines:

```
\newcounter{Problem}
\newenvironment{Problem}{\begin{Exercise}[name={Problem},
                                          counter={Problem}]}
                        {\end{Exercise}}
```

Anyway, all type of exercise will have the same layout in the document.

`\begin{Answer}` [⟨*key val list*⟩] ... `\end{Answer}`

`Answer` The `Answer` environment is used to typeset the answer of an exercise. To determine which the exercise this answer is attributed to, you can use the two following keys.

`ref`=⟨*string*⟩
`number`=⟨*string*⟩

This is the description of these keys:

`ref` a LaTeX reference. *Must* correspond to the `label` key of an exercise.

`number` if the answer refers to an exercise in another document, you can set the number of the exercise with this key. It is in fact a string.

If the package is loaded with the option `lastexercise` and if no `ref` and no `number` key is given, then the last exercise is taken as a reference for the answer.

If no `ref` and no `number` key is given and the option `lastexercise` is not activated, a Package Warning is displayed.

```
\begin{ExerciseList}
  \Exercise[⟨key val list⟩]
  \Answer[⟨key val list⟩]
\end{Exercise}
```

`ExerciseList` The `ExerciseList` environment is a convenience to typeset a list of small exercises. In `ExerciseList`, everything between two `\Exercise` or `\Answer` tags is interpreted as the body of an exercise (or an answer).

`\Exercise` `\Exercise*` `\Answer` The command `\Exercise` inside `ExerciseList` accepts the same keys than the `Exercise` environment. The command `\Answer` inside `ExerciseList` accepts the same keys than the `Answer` environment and behaves in the same way.

3.2 Parts and questions

`\ExePart`[⟨*key val list*⟩]
`\ExePart*`[⟨*key val list*⟩]

`\ExePart` `\ExePart*` It is common to split large exercise in parts: it is the purpose of the `\ExePart` command. The keys `title`, `name` and `difficulty` are available for this command.

For example, a non-numbered preliminary part is obtained with

```
\ExePart*[name={Preliminary}]
```

```
\Question[⟨key val list⟩]
\subQuestion[⟨key val list⟩]
\subsubQuestion[⟨key val list⟩]
```

\Question
\subQuestion
\subsubQuestion

These three commands define the hierarchy of questions. A \subsubQuestion cannot be preceded by a \Question or a \begin{Exercise}. A \subQuestion cannot be preceded by a \begin{Exercise}. If one of these cases is detected, a Package Error is displayed.

Two keys are available for these commands: title and difficulty.

```
\ExeText
```

\ExeText

The text following this command has the same status that the first indications of the exercise. So, the next level of the hierarchy must be a \ExePart or a \Question.

3.3 Extra stuff

\marker
\DifficultyMarker

The difficulty of an exercise is represented by a certain amount of stars. The command \marker is used to typeset the difficulty of an exercise.

```
\marker<symbol><counter>
```

displays <symbol> repeated <counter> times. For example \marker*2 gives **, and \marker+{14} gives +++++++++++++++

By default, the difficulty is symbolized by star. You can customise this by redefining the command \DifficultyMarker.

4 Customisation

4.1 Internationalisation

```
\ExerciseName
\ExerciseListName
\AnswerName
\AnswerListName
\ExePartName
```

\ExerciseName
\ExerciseListName
\AnswerName
\AnswerListName
\ExePartName
\ExePartListName

These commands store various hard-wired string. \ExerciseListName is used in the ExerciseList environment: it is possibly an abbreviation of the word "Exercise".

Exercise.sty automatically detects the usage of babel and translate these terms in the language loaded... if I (the author) know the translation! As my skills in foreign language are quite weak, only English and French are currently supported.

If you sent me the translations in your language, I will be happy to add them in the package. Anyway, you can redefine these commands (with a \renewcommand).

4.2 Layout

4.2.1 Exercises, answers and parts

For the layout of the exercises, two levels of customisation are available. First, you can customise the way the informations will be typeset, and then you can customise the way these pieces of informations are typeset together.

```
\ExerciseHeaderTitle
\ExerciseHeaderDifficulty
\ExerciseHeaderOrigin
\ExerciseHeaderNB
```

\ExerciseHeaderTitle
\ExerciseHeaderDifficulty
\ExerciseHeaderOrigin
\ExerciseHeaderNB

These commands are used to typeset the corresponding information: `\ExerciseHeaderTitle` corresponds to the `title` key, `\ExerciseHeaderDifficulty` to the `difficulty` key, `\ExerciseHeaderOrigin` to the `origin` key and `\ExerciseHeaderNB` to the number of the exercise.

In these commands, you specify the fonts to use, the space around the information, some symbols (like dash or dot) you want to put here, and so on. If the key is not present in the definition of the exercise, then the corresponding part of the header will be emptied by the package.

For example the default definition of `\ExerciseHeaderTitle` is

```
\newcommand{\ExerciseHeaderTitle}{\quad---\quad\ExerciseTitle}
```

If an exercise has a title, then this title will be displayed preceded by an emdash (as you can see in exercise 1 of this document). If an exercise doesn't have a title, then this command is set to nothing (precisely to `{}`) during the exercise.

These commands can be redefined with a `\renewcommand`. You don't have to worry about the "undefinition" mechanism: the package manages that by itself.

```
\ExerciseHeader
\ExerciseListHeader
```

\ExerciseHeader
\ExerciseListHeader

When the layout of all the elements has been fixed, they are collected in the `\ExerciseHeader` command (or in `\ExerciseListHeader`). Here, you specify the way the different elements are mixed together.

The default definition of `\ExerciseHeader` is

```
\newcommand{\ExerciseHeader}{\centerline{\textbf{\large
            \ExerciseName\ExerciseHeaderNB\ExerciseHeaderTitle
            \ExerciseHeaderOrigin\medskip}}}
```

which displays all the informations in a centered line, using a large bold default font.

```
\AnswerHeader
\AnswerListHeader
```

\AnswerHeader
\AnswerListHeader

The same mechanism is implemented for the answers. `\AnswerHeader` and

`\AnswerListHeader` specifies the way the header of answers are typeset. In the definition of these commands, you can use freely the informations of the related exercise. For example, this is the default definition of `\AnswerHeader`:

```
\newcommand{\AnswerHeader}{\medskip\centerline{\textbf{
            Answer of \ExerciseName\ \ExerciseHeaderNB}\smallskip}}
```

`\ExePartHeaderTitle`
`\ExePartHeaderDifficulty`
`\ExePartHeaderNB`
`\ExePartHeader`
`\ExePartListHeader`

`\ExePartHeaderTitle`
`\ExePartHeaderDifficulty`
`\ExePartHeaderNB`
`\ExePartHeader`
`\ExePartListHeader`

The same kind of customisation is available for the `\ExePart` command: `\ExePartHeaderTitle`, `\ExePartHeaderDifficulty` and `\ExePartHeaderNB` control the way the title (`\ExePartTitle`), the difficulty (`\ExePartdifficulty`) and the number (`\theExePart`) of the part are displayed.

These pieces are collected in the command `\ExePartHeader` or `\ExePartListHeader`.

4.2.2 Questions, sub-questions and sub-sub-questions

The layout of the questions is a little more rigid. Somehow, it can be customised.

`\QuestionHeaderTitle`
`\QuestionHeaderDifficulty`
`\QuestionHeaderNB`

`\QuestionHeaderTitle`
`\QuestionHeaderDifficulty`
`\QuestionHeaderNB`

These commands plays the same role that the corresponding command relating to exercises. But here, no `\QuestionHeader` is defined.

The `subQuestion` and `subsubQuestion` versions of these commands are also defined.

`\subQuestionHeaderTitle`
`\subQuestionHeaderDifficulty`
`\subQuestionHeaderNB`
`\subsubQuestionHeaderTitle`
`\subsubQuestionHeaderDifficulty`
`\subsubQuestionHeaderNB`

All of these commands can be changed using `\renewcommand`.

4.3 Lengths

`\Exesep`	`\Exetopsep`	`\Exeparsep`	`\Exepartopsep`
`\Exeleftmargin`	`\Exerightmargin`	`\Exelabelwidth`	`\Exelabelsep`

`Exesep`
`Exetopsep`
`Exeparsep`
`Exepartopsep`
`Exeleftmargin`
`Exerightmargin`
`Exelabelsep`

The `ExerciseList` environment is nothing more than a `list` environment. All the parameters of LaTeX's lists are available. Please consult your favourite source of information to have the exact definitions of these lengths.

`\QuestionBefore`	`\QuestionIndent`
`\subQuestionBefore`	`\subQuestionIndent`
`\subsubQuestionBefore`	`\subsubQuestionIndent`

QuestionBefore
QuestionIndent
subQuestionBefore
subQuestionIndent
subsubQuestionBefore
subsubQuestionIndent

Here, `\QuestionBefore` is the vertical space above `\Question`, and `\QuestionIndent` it the horizontal distance added to the margin in question. Same thing for `\subQuestion` and `\subsubQuestion`.

4.4 The `\renewcounter` command

In a document, you will probably want to customise the way the `Exercise` counter will reseted. Strangely, it is impossible to redefined counter with LaTeX. There is no equivalent of the `\renewcommand` command for the counters.

`\renewcounter`

We provide such an equivalent with the command `\renewcounter`.

`\newcounter{`⟨*foo*⟩`}[`⟨*counter*⟩`]`

The `\renewcounter` command defines a new counter named `foo`. The counter is initialized to zero.

The optional argument `[`⟨*counter*⟩`]` causes the counter `foo` to be reset whenever the counter named in the optional argument is incremented.

If the counter `foo` was not previously defined, an LaTeX error occurs.

5 Known problems

The commands `\Question`, `\subQuestion`, etc. are heavily based on `list` environment. These lists are hidden (I know it's bad!) to simplify the syntax of the source file (I think it's nice!).

In fact, every `\Question` is like the beginning of an environment, which is closed at the next `\Question` (the exact mechanism is a little bit more complicated).

Consequently it's dangerous to put questions inside environment. The following code will lead to an error:

```
\begin{Exercise}
    \begin{multicols}{2}
        \Question ...
        \Question ...
    \end{multicols}
\end{Exercise}
```

Of course, you can put entire exercise inside other environment (like `minipage`). The following code will work:

```
\begin{multicols}{2}
    \begin{Exercise}
        \Question ...
        \Question ...
    \end{Exercise}
\end{multicols}
```

```
\EndCurrentQuestion
\EndCurrentsubQuestion
\EndCurrentsubsubQuestion
```

\EndCurrentQuestion
\EndCurrentsubQuestion
\EndCurrentsubsubQuestion

If you really need to put some questions inside environment, you must use the command `\EndCurrentQuestion` just before ending the environment. This command ends the question's "environment". So, this code will work:

```
\begin{Exercise}
    \begin{multicols}{2}
        \Question ...
        \Question ...
        \EndCurrentQuestion
    \end{multicols}
\end{Exercise}
```

In `ExerciseList` environment, the command `\Exercise` shouldn't be followed by an empty line.

Change History

v1.0
General: Initial version 1
v1.01
General: Many typos corrected, improved index. 1
v1.1
General: Added the 'renewcounter' command. 9

6 Implementation

6.1 Package options

This part deals with the package options. Nothing more than an affair of boolean.

```
\newif\if@AnswerOutput          \@AnswerOutputtrue
\newif\if@AnswerDelay           \@AnswerDelayfalse
\newif\if@ExerciseOutput        \@ExerciseOutputtrue
\newif\if@ExerciseDelay         \@ExerciseDelayfalse
\newif\if@AswLastExe            \@AswLastExefalse

\DeclareOption{noanswer}      {\@AnswerOutputfalse}
\DeclareOption{answeronly}    {\@ExerciseOutputfalse}
\DeclareOption{noexercise}    {\@ExerciseOutputfalse}
\DeclareOption{exerciseonly} {\@AnswerOutputfalse}
\DeclareOption{outputnothing}{\@ExerciseOutputfalse\@AnswerOutputfalse}
\DeclareOption{exercisedelayed}{\@ExerciseDelaytrue}
\DeclareOption{answerdelayed}{\@AnswerDelaytrue}
\DeclareOption{lastexercise} {\@AswLastExetrue}
```

The following option, which displays the exercise label in margin, is not implemented yet.

```
\newif\if@ShowLabel               \@ShowLabelfalse
\DeclareOption{showlabel}       {\@ShowLabeltrue}

\ProcessOptions
```

The only required package are keyval and ifthen.

```
\RequirePackage{keyval, ifthen}
```

6.2 Customisation

6.2.1 Internationalisation

```
\def\ExerciseName{Exercise}%
\def\AnswerName{Answer}%
\def\ExerciseListName{Ex.}%
\def\AnswerListName{Answer}%
\def\ExePartName{Part}%
\@ifpackageloaded{babel}{
\addto{\captionsfrenchb}{
  \def\ExerciseName{Exercise}%
  \def\AnswerName{Solution}%
  \def\ExerciseListName{Ex.}%
  \def\AnswerListName{Sol.}%
  \def\ExePartName{Partie}%
}}
```

6.2.2 Layout

First a bunch of length definitions.

```
\newlength{\Exesep}
\setlength{\Exesep}{1\baselineskip}
\newlength{\Exetopsep}
\setlength{\Exetopsep}\z@
\newlength{\Exeparsep}
\setlength{\Exeparsep}\z@
\newlength{\Exepartopsep}
\setlength{\Exepartopsep}\z@
\newlength{\Exeleftmargin}
\setlength{\Exeleftmargin}\z@
\newlength{\Exerightmargin}
\setlength{\Exerightmargin}\z@
\newlength{\Exelabelwidth}
\setlength{\Exelabelwidth}\z@
\newlength{\Exelabelsep}
\setlength{\Exelabelsep}\z@
\newlength{\ExerciseBefore}
\setlength{\ExerciseBefore}{0em}
\newlength{\QuestionBefore}
\setlength{\QuestionBefore}{.25em}
\newlength{\subQuestionBefore}
\setlength{\subQuestionBefore}{0em}
```

```
\newlength{\subsubQuestionBefore}
\setlength{\subsubQuestionBefore}{0em}
\newlength{\QuestionIndent}
\setlength{\QuestionIndent}{3em}
\newlength{\subQuestionIndent}
\setlength{\subQuestionIndent}{2em}
\newlength{\subsubQuestionIndent}
\setlength{\subsubQuestionIndent}{1.5em}
```

Now the counters

```
\newcounter{Exercise}
\gdef\@ExerciseCounter{Exercise}          %default exercise counter
\newcounter{ExePart}[Exercise]
\newcounter{Question}[Exercise]
\newcounter{subQuestion}[Question]
\newcounter{subsubQuestion}[subQuestion]
```

Presentation of these labels in cross references

```
\renewcommand{\theExercise}{\arabic{\@ExerciseCounter}}
\renewcommand{\theExePart}{\Roman{ExePart}}
\renewcommand{\theQuestion}{\arabic{Question}}
\renewcommand{\thesubQuestion}{\alph{subQuestion}}
\renewcommand{\thesubsubQuestion}{\arabic{subsubQuestion}}
```

For internal purposes

```
\newcounter{savedQuestion}
\newcounter{savedsubQuestion}
\newcounter{savedsubsubQuestion}
```

The `\marker` command.

```
    \def\marker#1#2{\@tempcnta#2\whiledo{\@tempcnta>0}{#1\advance
            \@tempcnta by -1 }}
```

Symbol used to indicate the difficulty of an exercise or a question

```
\def\DifficultyMarker{*}
```

Presentation of informations in the header of exercises

```
\newcommand{\ExerciseHeaderTitle}{\quad --- \quad \ExerciseTitle}
\newcommand{\ExerciseHeaderDifficulty}{\theExerciseDifficulty\ }
\newcommand{\ExerciseHeaderOrigin}{%
\ ({\usefont{\encodingdefault}{\rmdefault}{m}{it}\ExerciseOrigin})}
\newcommand{\ExerciseHeaderNB}{\ \theExercise}
\newcommand{\ExerciseHeaderLabel}{\fbox{\textsc{\ExerciseLabel}}}
```

The header itself

```
\newcommand{\ExerciseHeader}{\centerline{%
\textbf{\large\ExerciseHeaderDifficulty\ExerciseName%
\ExerciseHeaderNB\ExerciseHeaderTitle\ExerciseHeaderOrigin}}\medskip}
```

The header of exercise in ExerciseList environment

```
\newcommand{\ExerciseListHeader}{\ExerciseHeaderDifficulty%
\textbf{\ExerciseListName\ExerciseHeaderNB%
\ --- \ \ExerciseHeaderTitle}%
\ExerciseHeaderOrigin\ignorespaces}
```

Presentation of informations in the header of ExePart

```
\newcommand{\ExePartHeaderNB}{\ \theExePart}
\newcommand{\ExePartHeaderTitle}{\quad --- \quad {\ExePartTitle}}
\newcommand{\ExePartHeaderDifficulty}{\theExePartDifficulty\ }
```

The header of `ExePart`

```
\newcommand{\ExePartHeader}{%
\medskip\centerline{\emph{\large\ExePartHeaderDifficulty\ExePartName%
\ExePartHeaderNB\ExePartHeaderTitle}}}
```

Presentation of Questions

```
\newcommand{\QuestionNB}{\arabic{Question}.\ }
\newcommand{\QuestionHeaderTitle}{\emph{(\QuestionTitle)}\ }
\newcommand{\QuestionHeaderDifficulty}{\theQuestionDifficulty\ }
\newcommand{\theQuestionDifficulty}{\marker{\DifficultyMarker}%
{\QuestionDifficulty}}
\newcommand{\subQuestionNB}{\alph{subQuestion})}
\newcommand{\subQuestionHeaderTitle}{\emph{(\subQuestionTitle)}\ }
\newcommand{\subQuestionHeaderDifficulty}{\thesubQuestionDifficulty\ }
\newcommand{\subQuestionHeader}{\subQuestionHeaderDifficulty%
    \subQuestionNB)\ \emph{\subQuestionHeaderTitle}}
\newcommand{\thesubQuestionDifficulty}{\marker{\DifficultyMarker}%
{\subQuestionDifficulty}}
\newcommand{\subsubQuestionNB}{\arabic{subsubQuestion} -- }
\newcommand{\subsubQuestionHeaderTitle}{\emph{(\subsubQuestionTitle)}\ }
\newcommand{\subsubQuestionHeaderDifficulty}{\thesubsubQuestionDifficulty\ }
\newcommand{\subsubQuestionHeader}{\subsubQuestionHeaderDifficulty%
    \subsubQuestionNB \emph{\subsubQuestionHeaderTitle} --}
\newcommand{\thesubsubQuestionDifficulty}{%
\marker{\DifficultyMarker}{\subsubQuestionDifficulty}}
```

6.3 Macros definition

```
\newcount\@QuestionLevel \@QuestionLevel=0
\newcommand{\the@QuestionLevel}{\number\@QuestionLevel}
\newbox\@Exercisebox
\newbox\all@Exercisebox
\newbox\temp@Exercisebox
\newbox\all@Answerbox
\newbox\temp@Answerbox
\newif\if@echapq \@echapqfalse
\newif\if@Answer                \@Answerfalse
\def\termineliste#1{\global\@echapqfalse%
\whiledo{\@QuestionLevel>#1}%
{\ifnum\@QuestionLevel=\colonnesLevel\end{multicols}\colonnesLevel=-10\fi%
\end{list}\advance\@QuestionLevel by -1}%
\ifnum\@QuestionLevel=\colonnesLevel\end{multicols}\colonnesLevel=-10\fi}
```

6.3.1 Definition of `Exercise`

The keyval package is used to specify various information about an exercise.

```
\newif\if@ExeTitle                          \@ExeTitlefalse
\newif\if@ExeReName                         \@ExeReNamefalse
\global\newcount\ExerciseDifficulty         \ExerciseDifficulty=0
\newif\if@ExeDifficulty                     \@ExeDifficultyfalse
\newif\if@ExeOrigin                         \@ExeOriginfalse
\newif\if@ExeLabel                          \@ExeLabelfalse
\newif\if@ExeNB                             \@ExeNBfalse
%
\def\theExerciseDifficulty{\marker{\DifficultyMarker}{\ExerciseDifficulty}}
%
\define@key{PPExercise}{title}%
{\global\@ExeTitletrue\gdef\ExerciseTitle{\string#1}}
\define@key{PPExercise}{difficulty}%
{\global\@ExeDifficultytrue\global\ExerciseDifficulty=\number#1}
\define@key{PPExercise}{name}%
{\global\@ExeReNametrue\gdef\@ExerciseName{\string#1}}
\define@key{PPExercise}{origin}%
{\global\@ExeOrigintrue\gdef\ExerciseOrigin{#1}}
\define@key{PPExercise}{counter}%
{\gdef\@ExerciseCounter{\string#1}}
\define@key{PPExercise}{label}%
{\global\@ExeLabeltrue\gdef\ExerciseLabel{\string#1}}
\define@key{PPExercise}{number}%
{\global\@ExeNBtrue\gdef\ExerciseLocalNB{\string#1}}
%
%% \define@key{PPExercise}{domain}{}
%% \define@key{PPExercise}{sdomain}{}
%% \define@key{PPExercise}{keyword}{}
%
\newif\if@ExeStared
\newif\if@staredpb
\newif\if@staredpart
\newif\if@renamepart
%
\@ExeStaredfalse
\@staredpbfalse
\@staredpartfalse
\@renamepartfalse
%
\def\@InitExe{\@savemathindent\global\@echapqfalse%
\gdef\ExerciseTitle{}%
\gdef\@ExerciseName{}%
\gdef\ExerciseOrigin{}%
\gdef\labelexe{}%
\global\ExerciseDifficulty=0%
\global\@ExeTitlefalse%
\global\@ExeReNamefalse%
\global\@ExeDifficultyfalse%
\global\@ExeOriginfalse%
\global\@ExeNBfalse%
```

```
\gdef\@ExerciseCounter{Exercise}%
\setcounter{Question}{0}%
\global\@ExeLabelfalse}
%
\def\@getExerciseInfo{%
\if@ExeReName\def\ExerciseName{\@ExerciseName}\fi%
\if@ExeTitle\else\def\ExerciseHeaderTitle{}\fi%
\if@ExeOrigin\else\def\ExerciseHeaderOrigin{}\fi%
\if@ExeLabel\else\def\ExerciseHeaderLabel{}\fi%
\if@ExeDifficulty\else\def\ExerciseHeaderDifficulty{}\fi%
\if@ExeStared\def\ExerciseHeaderNB{}\fi%
\if@ExeNB\def\theExercise{\ExerciseLocalNB}\fi%
\if@ExeLabel\label{\ExerciseLabel}\recordExerciseLabel{\ExerciseLabel}\fi%
}
%
\def\refstepExecounter{\if@ExeStared\else\if@ExeNB\else%
\refstepcounter{\@ExerciseCounter}\fi\fi}
%
\def\recordExerciseLabel#1{\@bsphack
  \protected@write\@auxout{}%
         {\string\newlabel{PP#1}{{\@AnswerHeaderRef}{\thepage}}}%
  \@esphack}
%
\def\@BeginExeBox{\global\setbox\@Exercisebox\vbox\bgroup}
\def\@EndExeBox{\egroup\if@Answer\if@AnswerOutput\@DelayAnswerBox\fi%
\else\if@ExerciseOutput\@DelayExerciseBox\fi\fi}
%
\def\@DelayAnswerBox{%
\if@AnswerDelay\global\setbox\temp@Answerbox%
\vbox{\unvbox\all@Answerbox\vskip12pt\unvbox\@Exercisebox\vskip\z@}%
\global\setbox\all@Answerbox\copy\temp@Answerbox%
\else\unvbox\@Exercisebox\fi}
%
\def\@DelayExerciseBox{\if@ExerciseDelay%
\global\setbox\temp@Exercisebox%
\vbox{\unvbox\all@Exercisebox\vskip12pt\unvbox\@Exercisebox\vskip\z@}%
\global\setbox\all@Exercisebox\copy\temp@Exercisebox%
\else\unvbox\@Exercisebox\fi}
%
\newcommand{\shipoutAnswer}{\if@AnswerOutput\unvbox\all@Answerbox\fi}
\newcommand{\shipoutExercise}{\if@ExerciseOutput\unvbox\all@Exercisebox\fi}
```

The commands for the `Exercise` environment.

```
\def\beginExerciseEnv{\@InitExe\@ifnextchar[\@@ExeEnv{\@@ExeEnv[]}}%]
%
\def\@@ExeEnv[#1]{\setkeys{PPExercise}{#1}%
\global\@Answerfalse\@BeginExeBox\@@@ExeEnv}
%
\newcommand{\@@@ExeEnv}{%
    \@QuestionLevel1
```

```
    \refstepExecounter
    \begingroup\@getExerciseInfo\ExerciseHeader\endgroup}
%
%
\def\endExerciseEnv{\termineliste{1}\@EndExeBox}
```

The commands for exercise within ¡ExerciseList¿ environment

```
\def\ExerciseCmd{\@InitExe\@ifstar{\global\@ExeStaredtrue\@ExeCmd}%
{\global\@ExeStaredfalse\@ExeCmd}}
%
\def\@ExeCmd{\@ifnextchar[\@@ExeCmd{\@@ExeCmd[]}}%] for emacs
%
\def\@@ExeCmd[#1]{\setkeys{PPExercise}{#1}\@@@ExeCmd}
%
\newcommand{\@@@ExeCmd}{%
    \ifnum\@QuestionLevel=0
      \advance \@QuestionLevel by 1
      \begin{list}{\@getExerciseInfo\ExerciseListHeader}%
{\partopsep\Exepartopsep \labelsep\Exelabelsep \itemsep \Exesep%
\parsep\Exeparsep \topsep\Exetopsep \labelwidth\Exelabelwidth%
\leftmargin\Exeleftmargin \rightmargin\Exerightmargin}
    \else
      \termineliste{1}\@EndExeBox
    \fi
    \global\@Answerfalse\@BeginExeBox\refstepExecounter%
    \item\ignorespaces
}
%
\def\defineExerciseEnv{%
    \renewenvironment{Exercise}{\global\@ExeStaredfalse\beginExerciseEnv}%
{\endExerciseEnv}
    \renewenvironment{Exercise*}{\global\@ExeStaredtrue\beginExerciseEnv}%
{\endExerciseEnv}
}
\newenvironment{Exercise}{}{}
\newenvironment{Exercise*}{}{}
%
\def\defineExerciseCmd{\def\Exercise{\ExerciseCmd}}
%
\renewcommand{\Exercise}{}
%
\defineExerciseEnv
%
\def\beginExerciseListEnv{\defineExerciseCmd\defineAnswerCmd}
%
\def\endExerciseListEnv{\termineliste{1}\@EndExeBox\termineliste{0}%
\defineExerciseEnv\defineAnswerEnv}
%
\newenvironment{ExerciseList}{\beginExerciseListEnv}{\endExerciseListEnv}
```

6.3.2 Definition of questions

```
\def\QuestionTitle{}
\newif\if@QuestionTitle               \@QuestionTitlefalse
\global\newcount\QuestionDifficulty   \QuestionDifficulty=0
\newif\if@QuestionDifficulty          \@QuestionDifficultyfalse
%
\define@key{PPQuestion}{title}{%
\gdef\QuestionTitle{\string#1}\@QuestionTitletrue}
\define@key{PPQuestion}{difficulty}{%
\@QuestionDifficultytrue\global\QuestionDifficulty=\number#1}
%
\def\@InitQuestion{\gdef\QuestionTitle{}%
\global\QuestionDifficulty=0%
\global\@QuestionTitlefalse%
\global\@QuestionDifficultyfalse}
%
\def\@getQuestionInfo{%
\if@QuestionTitle\else\def\QuestionHeaderTitle{}\fi
\if@QuestionDifficulty\else\def\QuestionHeaderDifficulty{}\fi
}
%
\def\EndCurrentQuestion{\termineliste{1}}
%
\def\Question{\@InitQuestion\@ifnextchar[\@@Question{\@@Question[]}%]
%
\def\@@Question[#1]{\setkeys{PPQuestion}{#1}\@@@Question}
%
\def\@QuestionHeader{\item[{\makebox[0cm][r]{\begingroup\@getQuestionInfo%
\QuestionHeaderDifficulty\QuestionNB\endgroup}}]%
\begingroup\@getQuestionInfo\QuestionHeaderTitle\endgroup\ignorespaces}
\newcommand{\@@@Question}{%
    \ifnum\@QuestionLevel=1
    \advance \@QuestionLevel by 1
    \begin{list}{}{\leftmargin \QuestionIndent
            \partopsep0pt \parsep0pt \topsep \QuestionBefore
            \itemsep \QuestionBefore \labelwidth 2em
            \usecounter{Question}}
        \if@echapq
          \setcounter{Question}{\value{savedQuestion}}\global\@echapqfalse
        \fi
        \refstepcounter{Question}
        \@restoremathindent
        \@decalemathindent{\QuestionIndent}
        \@QuestionHeader
   \else
     \ifnum\@QuestionLevel=2
          \refstepcounter{Question}
          \@QuestionHeader
     \else
```

```
    \ifnum\@QuestionLevel>2
      \termineliste{2}
      \refstepcounter{Question}
      \@QuestionHeader
    \else
    \PackageError{exercise}{You don't respect the hierarchy of
        questions}{Verify the Question}
    \fi
  \fi
\fi
}
```

6.3.3 Definition of sub-questions and sub-sub-questions

Here a good factorization is possible, but I prefer readibility over efficacity.

```
\def\subQuestionTitle{}
\newif\if@subQuestionTitle\@subQuestionTitlefalse
\global\newcount\subQuestionDifficulty\subQuestionDifficulty=0
\newif\if@subQuestionDifficulty\@subQuestionDifficultyfalse
%
\define@key{PPsubQuestion}{title}{%
\gdef\subQuestionTitle{\string#1}\@subQuestionTitletrue}
\define@key{PPsubQuestion}{difficulty}{%
\@subQuestionDifficultytrue\global\subQuestionDifficulty=\number#1}
%
\def\@InitsubQuestion{\gdef\subQuestionTitle{}%
\global\subQuestionDifficulty=0%
\global\@subQuestionTitlefalse%
\global\@subQuestionDifficultyfalse}
%
\def\@getsubQuestionInfo{%
\if@subQuestionTitle\else\def\subQuestionHeaderTitle{}\fi
\if@subQuestionDifficulty\else\def\subQuestionHeaderDifficulty{}\fi
}
%
\def\EndCurrentsubQuestion{\termineliste{2}}
%
\def\subQuestion{\@InitsubQuestion%
\@ifnextchar[\@@subQuestion{\@@subQuestion[]}%]
\def\@@subQuestion[#1]{\setkeys{PPsubQuestion}{#1}\@@@subQuestion}
%
\def\@subQuestionHeader{\item[{\makebox[0cm][r]%
{\begingroup\@getsubQuestionInfo\subQuestionHeaderDifficulty%
\subQuestionNB\endgroup}}]%
\begingroup\@getsubQuestionInfo\subQuestionHeaderTitle\endgroup%
\ignorespaces}
\newcommand{\@@@subQuestion}{%
    \ifnum\@QuestionLevel=2
    \advance \@QuestionLevel by 1
    \begin{list}{}{\leftmargin \subQuestionIndent
```

```
            \partopsep0pt \parsep0pt \topsep \subQuestionBefore
            \itemsep \subQuestionBefore \labelwidth 2em
            \usecounter{subQuestion}}
        \if@echapq
          \setcounter{subQuestion}{\value{savedsubQuestion}}%
          \global\@echapqfalse
        \fi
        \refstepcounter{subQuestion}
        \@restoremathindent
        \@decalemathindent{\subQuestionIndent}
        \@subQuestionHeader
   \else
     \ifnum\@QuestionLevel=3
          \refstepcounter{subQuestion}
          \@subQuestionHeader
     \else
     \ifnum\@QuestionLevel>3
       \termineliste{3}
       \refstepcounter{subQuestion}
       \@subQuestionHeader
     \else
     \PackageError{exercise}{You don't respect the hierarchy of
         subQuestion}{Verify the subQuestion}
     \fi
   \fi
 \fi
}
%
\def\subsubQuestionTitle{}
\newif\if@subsubQuestionTitle\@subsubQuestionTitlefalse
\global\newcount\subsubQuestionDifficulty\subsubQuestionDifficulty=0
\newif\if@subsubQuestionDifficulty\@subsubQuestionDifficultyfalse
%
\define@key{PPsubsubQuestion}{title}{%
\gdef\subsubQuestionTitle{\string#1}\@QuestionTitletrue}
\define@key{PPsubsubQuestion}{difficulty}{%
\@QuestionDifficultytrue\global\subsubQuestionDifficulty=\number#1}
%
\def\@InitsubsubQuestion{\gdef\subsubQuestionTitle{}%
\global\subsubQuestionDifficulty=0%
\global\@subsubQuestionTitlefalse%
\global\@subsubQuestionDifficultyfalse}
%
\def\@getsubsubQuestionInfo{%
\if@subsubQuestionTitle\else\def\subsubQuestionHeaderTitle{}\fi
\if@subsubQuestionDifficulty\else\def\subsubQuestionHeaderDifficulty{}\fi
}
%
\def\EndCurrentsubsubQuestion{\termineliste{3}}
\def\subsubQuestion{\@InitsubsubQuestion%
```

```
\@ifnextchar[\@@subsubQuestion{\@@subsubQuestion[]}%]
\def\@@subsubQuestion[#1]{\setkeys{PPsubsubQuestion}{#1}\@@@subsubQuestion}
%
\def\@subsubQuestionHeader{\item[{\makebox[0cm][r]%
{\begingroup\@getsubsubQuestionInfo\subsubQuestionHeaderDifficulty%
\subsubQuestionNB\endgroup}}]%
\begingroup\@getsubsubQuestionInfo\subsubQuestionHeaderTitle\endgroup%
\ignorespaces}
\newcommand{\@@@subsubQuestion}{%
    \ifnum\@QuestionLevel=3
    \advance \@QuestionLevel by 1
    \begin{list}{}{\leftmargin \subsubQuestionIndent
            \partopsep0pt \parsep0pt \topsep \subsubQuestionBefore
            \itemsep \subsubQuestionBefore \labelwidth 2em
            \usecounter{subsubQuestion}}
        \if@echapq
          \setcounter{subsubQuestion}{\value{savedsubsubQuestion}}%
          \global\@echapqfalse
        \fi
        \refstepcounter{subsubQuestion}
        \@restoremathindent
        \@decalemathindent{\subsubQuestionIndent}
        \@subsubQuestionHeader
   \else
     \ifnum\@QuestionLevel=4
          \refstepcounter{subsubQuestion}
          \@subsubQuestionHeader
     \else
     \ifnum\@QuestionLevel>4
       \termineliste{4}
       \refstepcounter{subsubQuestion}
       \@subsubQuestionHeader
     \else
     \PackageError{exercise}{You don't respect the hierarchy of
         subsubQuestion}{Verify the subsubQuestion}
     \fi
   \fi
 \fi
}
```

6.3.4 Presentation of part (within an exercise)

```
\newif\if@ExePartStared             \@ExePartStaredfalse
\newif\if@ExePartTitle              \@ExePartTitlefalse
\newif\if@ExePartReName             \@ExePartReNamefalse
\newif\if@ExePartDifficulty         \@ExePartDifficultyfalse
\global\newcount\ExePartDifficulty  \ExePartDifficulty=0
%
\def\theExePartDifficulty{\marker{\DifficultyMarker}{\ExePartDifficulty}}
%
```

```
\def\@InitExePart{\global\@echapqfalse%
\gdef\ExePartTitle{}%
\gdef\@ExePartName{}%
\global\ExePartDifficulty=0%
\global\@ExePartTitlefalse%
\global\@ExePartReNamefalse%
\global\@ExePartDifficultyfalse%
\setcounter{Question}{0}}
%
\define@key{PPExePart}{title}{\gdef\ExePartTitle{\string#1}\@ExePartTitletrue}
\define@key{PPExePart}{name}{\gdef\@ExePartName{\string#1}\@ExePartReNametrue}
\define@key{PPExePart}{difficulty}{\@ExePartDifficultytrue%
\global\ExePartDifficulty=\number#1}
%
\def\@getExePartInfo{%
\if@ExePartReName\def\ExePartName{\@ExePartName}\fi
\if@ExePartTitle\else\def\ExePartHeaderTitle{}\fi
\if@ExePartDifficulty\else\def\ExePartHeaderDifficulty{}\fi
\if@ExePartStared\def\ExePartHeaderNB{}\fi
}
%
\def\ExePart{\@InitExePart\@ifstar{\global\@ExePartStaredtrue\@ExePart}%
{\global\@ExePartStaredfalse\@ExePart}}
%
\def\@ExePart{\@ifnextchar[\@@ExePart{\@@ExePart[]}}%] for emacs
%
\def\@@ExePart[#1]{\setkeys{PPExePart}{#1}\@@@ExePart}
%
\newcommand{\@@@ExePart}{%
    \if@ExePartStared\else\refstepcounter{ExePart}\fi
    \begingroup\@getExePartInfo\ExePartHeader\endgroup}
%
```

6.3.5 Presentation of answers

```
\newbox\@Answerbox
%
%% \newcommand{\AnswerHeaderRef}{Answer of \ExerciseName\ \theExercise}
%% \newcommand{\AnswerListHeaderRef}{Answer (ex.\ \theExercise)\ ---\ }
%
\newcommand{\AnswerHeader}{\medskip\centerline{\textbf{Answer of
            \ExerciseName  \ExerciseHeaderNB}\smallskip}}
%
\newcommand{\AnswerListHeader}{\textbf{Answer (ex.\
        \ExerciseHeaderNB)\ ---\ }}
%
% The commands for <Exercise> environment
%
\def\@InitAnswer{\@savemathindent\global\@echapqfalse%
\gdef\AnswerRef{}%
\global\@AnswerReffalse%
```

```
\gdef\AnswerNB{}%
\global\@AnswerNBfalse%
\setcounter{Question}{0}}
%
\def\@getAnswerInfo{%
\if@AnswerRef%
\def\AnswerHeader{\ref{PP\AnswerRef}}%
\def\AnswerListHeader{\ref{PP\AnswerRef}}%
\else
\if@AnswerNB
\def\ExerciseTitle{}
\def\ExerciseName{}
\def\ExerciseOrigin{}
\ExerciseDifficulty=0
\def\theExercise{\AnswerNB}
\else
\if@AswLastExe
\else
\PackageWarning{Exercise}%
{A answer has no reference and no number}{}%
\def\AnswerHeaderRef{\AnswerName\ ???}%
\def\AnswerListHeaderRef{\AnswerName\ ???}%
\fi\fi\fi}
%
\newif\if@AnswerRef          \@AnswerReffalse
\newif\if@AnswerNB           \@AnswerNBfalse
%
\define@key{PPAnswer}{ref}{\global\@AnswerReftrue\gdef\AnswerRef{\string#1}}
\define@key{PPAnswer}{number}{\global\@AnswerNBtrue\gdef\AnswerNB{\string#1}}
%
\def\beginAnswerEnv{\@InitAnswer\@ifnextchar[\@@AnswerEnv{\@@AnswerEnv[]}}%]
%
\def\@@AnswerEnv[#1]{\setkeys{PPAnswer}{#1}%
\global\@Answertrue\@BeginExeBox\@@@AnswerEnv}
%
\newcommand{\@@@AnswerEnv}{%
    \@QuestionLevel1
    \begingroup\@getAnswerInfo\AnswerHeader\endgroup}
%
\def\endAnswerEnv{\termineliste{1}\@EndExeBox}
%
\newenvironment{Answer}{}{}
\def\defineAnswerEnv{
    \gdef\@AnswerHeaderRef{\AnswerHeader}
    \renewenvironment{Answer}{\beginAnswerEnv}{\endAnswerEnv}}
%
\defineAnswerEnv
%
\def\AnswerCmd{\@InitAnswer\@ifnextchar[\@@AnswerCmd{\@@AnswerCmd[]}}
%
```

```
\def\@@AnswerCmd[#1]{\setkeys{PPAnswer}{#1}\@@@AnswerCmd}
%
\newcommand{\@@@AnswerCmd}{%
    \ifnum\@QuestionLevel=0
      \advance \@QuestionLevel by 1
      \begin{list}{}{\partopsep\Exepartopsep \labelsep\Exelabelsep
                     \itemsep \Exesep \parsep\Exeparsep
                     \topsep\Exetopsep \labelwidth\Exelabelwidth
                     \leftmargin\Exeleftmargin
                     \rightmargin\Exerightmargin }
                \refstepExecounter
    \else
      \termineliste{1}\@EndExeBox
    \fi
    \global\@Answertrue\@BeginExeBox%
        \item[\bgroup\@getAnswerInfo\AnswerListHeader\egroup]\ignorespaces
}
%
\def\defineAnswerCmd{\gdef\@AnswerHeaderRef{\AnswerListHeader}%
\gdef\Answer{\AnswerCmd}}
```

6.3.6 Some extra stuff

```
\newcommand{\ExeText}{\setcounter{savedQuestion}{\value{Question}}%
\termineliste{1}\@echapqtrue}
```

6.3.7 Secret stuff

```
%
% Il est possible de présenter un niveau de sectionnement sur
% deux colonnes avec la commande \colonnesLevel
%
\newcount\colonnesLevel \colonnesLevel=-10
\newskip\tempskipa
\newskip\tempskipb
\def\deuxcolonnes{\tempskipa=\multicolsep\colonnesLevel=\@QuestionLevel
\ifcase\@QuestionLevel \multicolsep=\QuestionBefore %
\or
\multicolsep=\subQuestionBefore\or\multicolsep=\subsubQuestionBefore\fi%
\begin{multicols}{2}}
%
% Tenir compte de l'option fleqn
%
\@ifundefined{if@fleqn}{\newif\if@fleqn\@fleqnfalse}{}
%
\newcommand{\@savemathindent}{\relax}
\newcommand{\@decalemathindent}[1]{\relax}
\newcommand{\@restoremathindent}{\relax}
\if@fleqn %
  \renewcommand{\@savemathindent}{\setlength{\@savedmathindent}{\mathindent}}
  \renewcommand{\@decalemathindent}[1]{\addtolength{\mathindent}{#1}}
  \renewcommand{\@restoremathindent}{\setlength{\mathindent}{\@savedmathindent}}
```

```
\else
  \renewcommand{\@savemathindent}{\relax}
  \renewcommand{\@decalemathindent}[1]{\relax}
  \renewcommand{\@restoremathindent}{\relax}
\fi
```

6.4 The \renewcounter command

This commands is the equivalent of the well–known `\renewcommand`, but for counter. It allows you to redefine the `Exercise` counter, in order to reset it at each chapter (for example).

```
\def\renewcounter#1{%
    \@ifundefined{c@#1}
    {\@latex@error{counter #1 undefined}\@ehc}%
    \relax
    \let\@ifdefinable\@rc@ifdefinable
    \@ifnextchar[{\@newctr{#1}}{}}
```

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