The \texttt{ExSol} package

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1 Introduction

1.1 Package goal

The package \texttt{ExSol} provides macros to allow embedding exercises and solutions in the \LaTeX{} source of an instructional text (e.g., a book or a course text) while keeping the exercises and the solutions separately in the typeset result.

In \textit{global mode} (the default), this corresponds to generating the following separate documents:

\begin{itemize}
  \item your original text that only contains the exercises, and
  \item a solution book that only contains the solutions to the exercises (a package option exists to also copy the exercises themselves to the solution book).
\end{itemize}

The former is generated when running \LaTeX{} on your document. This run writes the solutions to a secondary file that can be included into a simple document harness, such that when running \LaTeX{} on the latter, you can generate a nice solution book.

In \textit{external mode} both the exercises and the solutions are written to secondary files that can be included in a simple document harness, such that when running \LaTeX{} on these, you can generate an exercise as well as a solution book.

In \textit{local mode} (invoked by specifying the package option 'local'), this corresponds to inserting the saved solutions in the current document at a later stage in the text.

In \textit{inline mode} (invoked by specifying the package option 'inline'), the solutions are inserted 'on the spot'.

This has been conveniently summarized in the table below:

\begin{center}
\begin{tabular}{|c|c|c|}
\hline
\textbf{mode} & \textbf{exercises} & \textbf{solutions} \\
\hline
-global & on the spot & in separate document \\
 external & in separate document & in separate document \\
 local & on the spot & later in the same document \\
 inline & on the spot & on the spot \\
\hline
\end{tabular}
\end{center}

*This document corresponds to exsol 1.6, dated 2024/01/07.
1.2 Why use ExSol?

- It allows to keep the \LaTeX source of your exercises and their solutions together in a single file, next to each other. Away with the nightmare to keep your solutions in sync with the exercises!
- It separates exercises and solutions, allowing you
  - to only release the solution book to the instructors of the course (using global mode);
  - to encourage students to first try solving the exercises without peeking into the list of solutions (or the solution book).

1.3 Credits

The code of the ExSol package was taken almost literally from \texttt{fancyvrb} [1]. Therefore, all credits go to the authors/maintainers of \texttt{fancyvrb}.

Thanks to Paul Levrie, Pieter Pareit, Pekka Pere, Benjamin Grinstein and Philippe Marti for signaling problems and making suggestions for the improvement of the package and the documentation.

1.4 Note

As of version 1.2, the package also contains facilities for generating a formula collection. The only limitation is that exercises and solutions cannot be part of the formula collection. Though this is a restriction, it is not a severe one in my opinion. Formula collections should be as concise as they can be.

Though generating formula collections goes beyond exercises and solutions, I chose not to change the package’s name ExSol. Einstein’s name was also not changed into Relativistic Einstein when he got to understand the theory of relativity.

2 Installation

Either you are a package manager and then you’ll know how to prepare an installation package for ExSol.

Either you are a normal user and then you have two options. First, check if there is a package that your favorite \TeX\ distributor has prepared for you. Second, grab the TDS package from CTAN [2] (exsol.tds.zip) and unzip it somewhere in your own TDS tree, regenerate your filename database and off you go. In any case, make sure that \TeX finds the \texttt{exsol.sty} file.

The ExSol package uses some auxiliary packages: \texttt{fancyvrb}, \texttt{ifthen}, \texttt{kvoptions} and, optionally, \texttt{babel}. Fetch them from CTAN [2] if your \TeX\ distributor does not provide them.
3 Usage

3.1 Preparing your document source

3.1.1 Loading the package

The macro package `exsol` can be loaded with:

\usepackage{babel} \usepackage{exsol}

Note before we start that you need to load the babel package before you load the `exsol` package! This is to allow you to load the appropriate languages for your text.

OK, now let's get started.

Your first choice to make is where you want your solutions to appear. The primary objective of the `exsol` package was 'global mode', i.e. separating your solutions from the exercises, gathering the solutions in a separate book. To this end, don’t specify the package option '\[local\]', or specify '\[local=false\]'.

A second mode of operation is 'local mode'. This allows grouping your exercises in series and including them later in your text. Gathering exercises in (numbered) series and 'loading' them locally in your text, allows for simplifying the individual exercise numbers (omitting their prefix containing, chapter number, section number, subsection number a.s.o.).

A third mode of operation is 'inline mode', in which the solution is inserted in the main text 'on the spot'. You can trigger this, by specifying the package option 'inline'.

3.1.2 Global mode - flat grouping exercises

Adding exercises together with their solutions in your document is easy. Just embed them in a `exercise` and a corresponding `solution` environment. Optionally, you may embed several of them in a `exercises` environment to make them stand out in your text.

\begin{exercises}[columns=2]
  \begin{exercise}
    Calculate $y = 5 + 7$
  \end{exercise}
  \begin{solution}
    $y = 12$
  \end{solution}
  \begin{exercise}
    Calculate $y = 7 - 12$
  \end{exercise}
\end{exercises}
The optional argument of the exercises environment allows specifying the typesetting in multiple columns.

On how to generate a solution book, take a look at the examples in section 3.2.1.

### 3.1.3 Local mode - grouping of exercises in series

One might also consider to keep the solutions in the same text, in local mode. In this case, we advise to gather the exercises in series (e.g. according to their degree of difficulty). This can be done by using the `exerciseseries` environment instead of the `exercises` environment. This environment takes and also takes a mandatory label argument. In addition it takes two optional arguments:

- `columns` to specify the amount of columns
- `exsubrule` to specify the creation of a horizontal rule below the exercise series.
- `solsubrule` to specify the creation of a horizontal rule below the solution series.
- `subrule` to specify the creation of a horizontal rule below the exercise and the solution series.

\begin{exerciseseries}[columns=2,subrule=\hrule]{Easy exercises}
\begin{exercise}
  Calculate $y = 5 + 7$
\end{exercise}
\begin{solution}
  $y = 12$
\end{solution}
\begin{exercise}
  Calculate $y = 7 - 12$
\end{exercise}
\begin{solution}
  $y = -5$
\end{solution}
\end{exerciseseries}

\begin{exerciseseries}{Difficult exercises}

\end{exerciseseries}
\begin{exercise}
Calculate \( y = 5 \cdot 7 \)
\end{exercise}
\begin{solution}
\( y = 35 \)
\end{solution}

\begin{exercise}
Calculate \( y = 8 / 4 \)
\end{exercise}
\begin{solution}
\( y = 2 \)
\end{solution}
\end{exerciseseries}

As an alternative, you can specify the 'inine' option to include the solutions on the spot where you specified them.

3.2 Examples

3.2.1 Global mode

Below, you can find an example of a file that contains a number of exercises and solutions, with the goal to generate a separate solution book. Note that referencing exercises works just as you would expect it.

%<example>
\documentclass[10pt]{article}
\usepackage{a4wide}
\usepackage[english]{babel}
\usepackage[copyexercisesinsolutions]{exsol}
\title{Global example, from the \textsf{ExSol} package}
\author{Walter Daems}
\setlength{\parindent}{0em}
\begin{document}
\maketitle
\section{Introduction}
In this text we explain how to solve second-order polynomial equations.
\section*{Solving second-order polynomial equations}
The roots of the following equation
\begin{equation}
ax^2 + bx + c = 0
\end{equation}
To make sure you master calculating the roots of second-order equation, please solve exercise \ref{ex:1}.

\begin{exercise}
\label{ex:1}
Solve the following equation for $x \in \mathbb{C}$, with $\mathbb{C}$ the set of complex numbers:
\begin{equation}
5 \, x^2 - 3 \, x = 5
\end{equation}
\end{exercise}

\begin{solution}
Let's start by rearranging the equation, a bit:
\begin{eqnarray}
5.7 \, x^2 - 3.1 \, x &=& 5.3 \\
5.7 \, x^2 - 3.1 \, x - 5.3 &=& 0
\end{eqnarray}
The equation is now in the standard form:
\begin{equation}
a \, x^2 + b \, x + c = 0
\end{equation}
For quadratic equations in the standard form, we know that two solutions exist:
\begin{equation}
x_{1,2} = \frac{-b \pm \sqrt{d}}{2a}
\end{equation}
with
\begin{equation}
d = b^2 - 4 \, a \, c
\end{equation}
If we apply this to our case, we obtain:
\begin{equation}
d = (-3.1)^2 - 4 \cdot 5.7 \cdot (-5.3) = 130.45
\end{equation}
and
\begin{eqnarray}
x_1 &\approx& \frac{-3.1 + \sqrt{130.45}}{11.4} = 1.27 \\
x_2 &\approx& \frac{-3.1 - \sqrt{130.45}}{11.4} = -0.73
\end{eqnarray}
The proposed values $x = x_1, x_2$ are solutions to the given equation.
\end{solution}

\begin{exercise}
\label{ex:2}
Consider a 2-dimensional vector space equipped with a Euclidean distance function. Given a right-angled triangle, with the sides $A$ and $B$ adjacent to the right angle having lengths, $3$ and $4$, calculate the length of the hypotenuse, labeled $C$.
\end{exercise}

\begin{solution}
This calls for application of Pythagoras' theorem, which tells us:
\begin{equation}
\end{equation}
\|A\|^2 + \|B\|^2 = \|C\|^2
\end{equation}
and therefore:
\begin{eqnarray}
\|C\| &=& \sqrt{\|A\|^2 + \|B\|^2} \\
&=& \sqrt{3^2 + 4^2} \\
&=& \sqrt{25} = 5
\end{eqnarray}
Therefore, the length of the hypotenuse equals $5$.
\end{solution}
\end{exercises}

And now, we can come to the conclusion.
\section{Conclusion}
Solving second-order polynomial equations is very easy.
\end{document}

The result in the original document, can be seen in the file example.pdf. As you can see, the formulacollection entry and the exercise appear. There's no trace of the solution.

The solution can be recovered by including the example.sol.tex file in an appropriate harness. This is explained in section 3.2.3.

3.2.2 external mode

Below, you can find an example of a file that contains a number of exercises and solutions, with the goal to generate a separate exercise and solution book.

\begin{document}
\maketitle
\section{Introduction}
In this text we explain how to solve second-order polynomial equations.
\section{Solving second-order polynomial equations}

\begin{equation}
ax^2 + bx + c = 0
\end{equation}

\begin{informulacollectiononly}
\section*{Solving second-order polynomial equations}
\end{informulacollectiononly}

\begin{informulacollection}
The roots of the following equation
\begin{equation}
a x^2 + bx + c = 0
\end{equation}
\end{informulacollection}

In this text we explain how to solve second-order polynomial equations.

\begin{informulacollectiononly}
\section*(Solving second-order polynomial equations)
\end{informulacollectiononly}

\begin{informulacollection}
The roots of the following equation
\begin{equation}
a x^2 + bx + c = 0
\end{equation}
\end{informulacollection}

\end{document}
\begin{equation}
\begin{align*}
x_{1,2} &= \frac{-b \pm \sqrt{b^2 - 4 a c}}{2 a}
\end{align*}
\end{equation}

\begin{exercises}[columns = 2]
\begin{exercise}
Solve the following equation for $x \in \mathbb{C}$, with $\mathbb{C}$ the set of complex numbers:
\begin{equation}
5 x^2 -3 x = 5
\end{equation}
\end{exercise}
\begin{solution}
Let's start by rearranging the equation, a bit:
\begin{eqnarray}
5.7 x^2 - 3.1 x &=& 5.3\\n5.7 x^2 - 3.1 x -5.3 &=& 0
\end{eqnarray}
The equation is now in the standard form:
\begin{equation}
a x^2 + b x + c = 0
\end{equation}
For quadratic equations in the standard form, we know that two solutions exist:
\begin{equation}
x_{1,2} = \frac{ -b \pm \sqrt{d}}{2a}
\end{equation}
with
\begin{equation}
d = b^2 - 4 a c
\end{equation}
If we apply this to our case, we obtain:
\begin{equation}
d = (-3.1)^2 - 4 \cdot 5.7 \cdot (-5.3) = 130.45
\end{equation}
and
\begin{eqnarray}
x_1 &=& \frac{3.1 + \sqrt{130.45}}{11.4} = 1.27\\nx_2 &=& \frac{3.1 - \sqrt{130.45}}{11.4} = -0.73
\end{eqnarray}
The proposed values $x = x_1, x_2 \in \mathbb{C}$ are solutions to the given equation.
\end{solution}
\begin{exercise}
Consider a 2-dimensional vector space equipped with a Euclidean distance function. Given a right-angled triangle, with the sides $A$ and $B$ adjacent to the right angle having lengths, $3$ and $4$, calculate the length of the hypotenuse, labeled $C$.
\end{exercise}
\begin{solution}
This calls for application of Pythagoras' theorem, which tells us:
\begin{equation}
\left\|A\right\|^2 + \left\|B\right\|^2 = \left\|C\right\|^2
\end{equation}
and therefore:
\begin{eqnarray}
\left\|C\right\| &=& \sqrt{\left\|A\right\|^2 + \left\|B\right\|^2}\n
8
\begin{eqnarray}
&=& \sqrt{3^2 + 4^2} \\
&=& \sqrt{25} = 5
\end{eqnarray}

Therefore, the length of the hypotenuse equals 5.

\begin{solution}
\end{solution}

\begin{exercises}
And now, we can come to conclusion.
\end{exercises}

\section{Conclusion}

Solving second-order polynomial equations is very easy.

The result in the original document, can be seen in the file example-external.pdf. As you can see, only the formula collection entry appears. There’s no trace of the exercises or the solutions.

3.2.3 Harnesses

When running \LaTeX{} on your document in global or external mode (e.g., the file example-external.tex as part of the exsol package, as a side effect files with the extension .sol.tex, .exc.tex and/or .fc.tex have been written to disk (in our case, the files example-external.sol.tex, example-external.exc.tex and example-external.fc.tex), containing all exercises, solutions and entries for the formula collection in sequence.

Generating an exercises/solution book is as simple as including the exercise/solution file into a simple \LaTeX{} harness, that allows you giving it a proper title page and to add other bells and whistles. As an example, you can find a harness for a solution book below.

\begin{example-sol}
\documentclass[a4paper,10pt]{article}
\usepackage{a4wide}
\usepackage[english]{babel}
\usepackage[exsol]
\setlength{\parindent}{0em}
\title{Solutions to the exercises, specified in the example of the \textsf{ExSol} package}
\author{Walter Daems}
\begin{document}
\maketitle
\input{example.sol.tex}
\end{document}
\end{example-sol}

Similar harnesses can be used for the exercise book and the formula collection.
3.2.4 Local mode

Below, you can find an example of a file that contains a number of exercises and solutions, with the goal to include them later in the same document. This is done by issuing the `loadSolutions` macro at the very end of the file. This macro can be called multiple times and will gobble up and include all solutions so far. As a consequence the solutions file is emptied and can be filled again by specifying new exercise/solution pairs.
Die Summe zweier Zahlen ist 17 und ihre Differenz 7. Bestimme die beiden Zahlen!

5 und 12


20 und 2

Berechne den Schnittpunkt von $y=3x+1$ und $y=3x-7$.

Es gibt keinen Schnittpunkt

Die Familie Meier fordert Offerten für eine Heizungsreparatur ein. Firma A berechnet für die Fahrtkosten Fr. 42.- und für jede Arbeitsstunde 76.-. Bei der Firma B sind die Fahrtkosten Fr. 35.- und jede Arbeitsstunde wird mit Fr. 80.- berechnet.

Welche Kosten entstehen für beide Firmen, wenn ein Monteur 3.5 Stunden für die Arbeit benötigt? Welche Firma ist in diesem Fall kostengünstiger?

Wie lauten die Gleichungen derjenigen zwei linearen Funktionen, die jeder Arbeitszeit $x$ (in Stunden) die
entstehenden Kosten $y$ (in Franken) zuordnet?
\begin{enumerate}
\item Berechne, bei welcher Arbeitszeit die Kosten bei beiden Firmen gleich sind.
\end{enumerate}
\begin{solution}
\begin{enumerate}[label=\alph*)]
\item Firma A: 308.- $|$ Firma B: 315.-
\item A: $y=76x+42$ $|$ B: $y=80x+35$
\item Bei $1 \frac{3}{4}$ Stunden
\end{enumerate}
\end{solution}
\section{Gleichungssysteme und Geraden}
Ein bisschen Theorie...
\begin{exerciseseries}
\begin{exercise}
Die Summe zweier Zahlen ist 17 und ihre Differenz 7. Bestimme die beiden Zahlen!
\end{exercise}
\begin{solution}
5 und 12
\end{solution}
\end{exerciseseries}
\subsection{Inline mode}
Below, you can find an example of a file that contains a number of exercises and solutions, with the goal to include the solutions on the spot.

20 und 2

Etwas mehr Theorie

\begin{exercise}
Berechne den Schnittpunkt von $y=3x+1$ und $y=3x-7$.
\end{exercise}

Es gibt keinen Schnittpunkt

\begin{exercise}
Die Familie Meier fordert Offerten für eine Heizungsreparatur ein. Firma A berechnet für die Fahrtkosten Fr. 42.- und für jede Arbeitsstunde 76.-. Bei der Firma B sind die Fahrtkosten Fr. 35.- und jede Arbeitsstunde wird mit Fr. 80.- berechnet.

\begin{enumerate}[label=\alph*)]
\item Welche Kosten entstehen für beide Firmen, wenn ein Monteur 3,5 Stunden für die Arbeit benötigt? Welche Firma ist in diesem Fall kostengünstiger?
\item Wie lauten die Gleichungen derjenigen zwei linearen Funktionen, die jeder Arbeitszeit $x$ (in Stunden) die entstehenden Kosten $y$ (in Franken) zuordnet?
\item Berechne, bei welcher Arbeitszeit die Kosten bei beiden Firmen gleich sind.
\end{enumerate}

\begin{enumerate}[label=\alph*)]
\item Firma A: 308.- $|$ Firma B: 315.-
\item A: $y=76x+42$ $|$ B: $y=80x+35$
\item Bei $1\frac{3}{4}$ Stunden
\end{enumerate}

\end{exercise}

3.3 Fiddling with the spacing

The default spacing provided by the ExSol package should be fine for most users. However, if you like to tweak, below you can find the controls.

As the formula collection generation is intended to interfere as little as possible with the flow of the main document, you will notice that it is impossible to control the extra spacing, as no extra spacing should originate from using the
informulacollection environment.

### 3.3.1 Spacing before and after the exercises environment

The lengths below control the spacing of the exercises environment:

- \texttt{exsolexerciseaboveskip}: rubber length controlling the vertical space after the top marker line of the environment
- \texttt{exsolexercisebelowskip}: rubber length controlling the vertical space before the bottom marker line of the environment

You can simply specify them like:

\begin{verbatim}
\setlength{\exsolexercisesaboveskip}{1ex plus 1pt minus 1pt}
\setlength{\exsolexercisesbelowskip}{1ex plus 1pt minus 1pt}
\end{verbatim}

The spacings specified here are the package defaults.

### 3.3.2 Spacing of the individual exercises

Caution: the spacing can only be tuned, when one invokes the \texttt{exerciseaslist} package option!

Then lengths below control the spacing of the exercise environment:

- \texttt{exercisetopbottomsep}: rubber length controlling the vertical space before and after individual exercises
- \texttt{exerciseleftmargin}: length controlling the horizontal space between the surrounding environment’s left margin (most often the page margin) and the left edge of the exercise environment
- \texttt{exerciseleftmargin}: length controlling the horizontal space between the surrounding environment’s right margin (most often the page margin) and the right edge of the exercise environment
- \texttt{exerciseitemindent}: length controlling the first-line indentation of the first paragraph in the exercise environment (actually, the label is set w.r.t. this position, that we will conveniently call position ‘x’)
- \texttt{exerciseeparindent}: length controlling the first-line indentation of the other paragraphs in the exercise environment.
- \texttt{exerciselabelsep}: length controlling the distance between the label and position ‘x’
- \texttt{exerciselabelwidth}: minimal width of the (internally right-alligned) box to use for the exercises label; if the box is not sufficiently big, position ‘x’ is shifted to the right
• **exerciseparsep**: internal paragraph separation (vertically)

You can simply specify them like:

\setlength{\exsolexercisetopbottomsep}{0pt plus 0pt minus 1pt}
\setlength{\exsolexerciseflleftmargin}{1em}
\setlength{\exsolexerciseflrightmargin}{1em}
\setlength{\exsolexerciseflindent}{0em}
\setlength{\exsolexercisefllabelsep}{0.5em}
\setlength{\exsolexercisefllabelwidth}{0pt}
\setlength{\exsolexerciseflitemindent}{0pt}
\setlength{\exsolexerciseflparsep}{\parskip}

The spacings specified here are the package defaults.

### 3.4 Tips and tricks

If you want to include the solutions all at the end of the current document in global mode, you need to explicitly close the solution stream before including it:

\closeout\solutionstream\input{\jobname.sol.tex}

If you want to avoid exercises being split by a page boundary, then provide the package option ‘minipage’. This causes the exercises to be wrapped in a minipage environment.
4 Implementation

1 ⟨∗package⟩

4.1 Auxiliary packages

The package uses some auxiliary packages:

2 \RequirePackage{ifmtarg}
3 \RequirePackage{fancyvrb}
4 \RequirePackage{ifthen}
5 \RequirePackage{kvoptions}
6 \RequirePackage{multicol}
7 \RequirePackage{varwidth}
8 \ifpackageloaded{babel}{\typeout{Good: you loaded babel first!}}{\PackageError{exsol}{You forgot to load the babel package before exsol}{}}

4.2 Package options

The package offers some options:

local This boolean option (true, false) allows setting the mode of the package into local, i.e. that the numbering of the exercises is not related to the position in the document, but uses its own local counter in combination with a exerciseseries counter.

10 \DeclareBoolOption[false]{local}

external This boolean option (true, false) allows setting the mode of the package into external, i.e. that the both exercises and solutions will be written to separate files.

11 \DeclareBoolOption[false]{external}

inline This boolean option (true, false) allows setting the mode of the package into inline, i.e. that the solutions will be included ‘on the spot’.

12 \DeclareBoolOption[false]{inline}

nolabels This boolean option (true, false) allows suppressing the ’Exercise’ and ’Solution’ label that normally appear before the exercise and solution number.

13 \DeclareBoolOption[false]{nolabels}

exercisesfontsize This option allows setting the font of the exercises environment. You may choose one of tiny, scriptsize, footnotesize, small, normalsize, large, etc.
E.g., \[exercisesfontsize=small\].

14 \DeclareStringOption[normalsize]{exercisesfontsize}
exerciseaslist This boolean option (true, false) allows setting the typesetting of the exercises in a list environment. This causes the exercises to be typeset in a more compact fashion, with indented left and right margin.

15 \DeclareBoolOption[false]{exerciseaslist}

copyexercisesinsolutions This boolean option (true, false) allows copying the exercises in the solutions file, to allow for making a complete stand-alone exercises bundle.

16 \DeclareBoolOption[false]{copyexercisesinsolutions}

minipage This boolean option (true, false) causes the exercises to be wrapped in minipages. This avoids them getting split by a page boundary.

17 \DeclareBoolOption[false]{minipage}

usesolutionserieslabels This boolean options (true, false) causes the exerciseseries label to be reused when inserting the corresponding solutionseries.

18 \DeclareBoolOption[false]{usesolutionserieslabels}

The options are processed using:

19 \ProcessKeyvalOptions*

The options are subsequently handled

20 \newcommand{\exercisesfontsize}{\csname \exsol@exercisesfontsize\endcsname \exsol@exercisesfontsize}

4.3 Customization of lengths

The commands below allow customizing many lengths that control the typesetting of the exercises.

First some lengths to control the spacing before and after exercises.

21 \newlength{\exsolexercisesaboveskip}
22 \setlength{\exsolexercisesaboveskip}{0ex plus 1pt minus 1pt}
23 \addtolength{\exsolexercisesaboveskip}{-2\baselineskip}
24 \newlength{\exsolexercisesbelowskip}
25 \setlength{\exsolexercisesbelowskip}{0ex plus 1pt minus 1pt}
26 \addtolength{\exsolexercisesbelowskip}{\baselineskip}

Then some lengths to control the spacing for a single exercise. These lengths only work when the exerciseaslist package option has been specified. Sensible defaults have been set.

27 \newlength{\exsolexercisetopbottomsep}
28 \setlength{\exsolexercisetopbottomsep}{0pt plus 0pt minus 1pt}
29 \newlength{\exsolexercisemargin}

17
At the beginning of your document, we start by opening a stream to a file that will be used to write the solutions to. At the end of your document, the package closes the stream.

\AtBeginDocument{
  \typeout{Writing solutions to solution file \jobname.sol.tex}
  \newwrite\solutionstream
  \immediate\openout\solutionstream=\jobname.sol.tex
  \ifexsol@external
    \typeout{Writing exercises to exercise file \jobname.exc.tex}
    \newwrite\exercisestream
    \immediate\openout\exercisestream=\jobname.exc.tex
  \else
    \typeout{Using intermediate exercise file \jobname.exc.tex}
    \newwrite\exercisestream
    \immediate\openout\exercisestream=\jobname.exc.tex
  \fi
  \typeout{Writing formulae to formula collection file \jobname.fc.tex}
  \newwrite\formulacollectionstream
  \immediate\openout\formulacollectionstream=\jobname.fc.tex
  \ifexsol
    \typeout{Using intermediate formula file \jobname.for.tex}
    \newwrite\formulastream
    \immediate\openout\formulastream=\jobname.for.tex
  \else
    \typeout{Using intermediate exercise file \jobname.exc.tex}
    \newwrite\exercisestream
  \fi
}\AtEndDocument{
  \immediate\closeout\formulacollectionstream
  \immediate\closeout\solutionstream
}\AtEndDocument{
  \immediate\closeout\formulacollectionstream
  \immediate\closeout\solutionstream}

In local mode we also want to close the solutionstream, read it and open it again:

\newcommand\loadSolutions{
  \immediate\closeout\solutionstream
  \input{\jobname.sol.tex}
  % \immediate\openout\solutionstream=\jobname.sol.tex
}\loadSolutions
4.5 Series counter

By providing an exerciseseries counter, proper numbering of the exercise series is provided. Note that separate series, render the numbering of the exercises from document-global, to series-local, therefore hindering the concordance of solutions to exercises.

\newcounter{exerciseseries}[subsubsection]
\setcounter{exerciseseries}{0}
\renewcommand{\theexerciseseries}{\arabic{exerciseseries}}

4.6 Exercise counter

By providing an exercise counter, proper numbering of the exercises is provided to allow for good cross referencing of the solutions to the exercises.

\newcounter{exercise}[exerciseseries]
\setcounter{exercise}{0}
\renewcommand{\theexercise}{\ifexsol@local\arabic{exerciseseries}.\arabic{exercise}\else\if0\arabic{chapter}\else\arabic{chapter}..\fi\if0\arabic{section}\else\arabic{section}\fi\if0\arabic{subsection}\else.\arabic{subsection}\fi\if0\arabic{subsubsection}\else.\arabic{subsubsection}\fi\if0\arabic{exercise}\else\@ifundefined{c@chapter}{}{\if0\arabic{section}\else-\fi-\arabic{exercise}\fi\fi}}

4.7 Detokenization in order to cope with utf8

Combining old-school \LaTeX{} (before X\LaTeX{} and Lua\LaTeX{}) and UTF-8 is a pain. Detokenization has been suggested by Geoffrey Poore to solve issues with UTF-8 characters messing up the fancyverb internals.

\newcommand{\GPES@write@detok}[1]{\immediate\write\exercisestream{\detokenize{#1}}}\newcommand{\GPSS@write@detok}[1]{\immediate\write\solutionstream{\detokenize{#1}}}\newcommand{\GPESS@write@detok}[1]{\GPES@write@detok{#1}\GPSS@write@detok{#1}}\newcommand{\GPFORCOL@write@detok}[1]{\immediate\write\formulacollectionstream{\detokenize{#1}}\immediate\write\formulastream{\detokenize{#1}}}
The user environments

exercise The exercise environment is used to typeset your exercises, provide them with a nice label and allow for copying the exercise to the solutions file (if the package option copyexercisesinsolution) is set. The label can be set by redefining the \exercisename macro, or by relying on the Babel provisions. The code is almost literally taken from the fancyvrb package.

\newcommand{\GP科尔ONLY@write@detok}[1]{% 
  \immediate\write\formulacollectionstream{\detokenize{#1}}}%

5 The user environments

exercise The exercise environment is used to typeset your exercises, provide them with a nice label and allow for copying the exercise to the solutions file (if the package option copyexercisesinsolution) is set. The label can be set by redefining the \exercisename macro, or by relying on the Babel provisions. The code is almost literally taken from the fancyvrb package.
The `exsol@exercise` environment is an internal macro used to typeset your exercises and provide them with a nice label and number. Do not use it directly. Use the proper environment `exercise` instead.

```latex
\newenvironment{exsol@exercise}[1][]{% 
  \ifthenelse{\boolean{exsol@minipage}}{% 
    \begin{minipage}[t]{\textwidth}% 
  \fi
  \ifthenelse{\boolean{exsol@exerciseaslist}}{% 
    \begin{list}{}{% 
      \setlength{\topsep}{\exsolexercisetopbottomsep}% 
      \setlength{\leftmargin}{\exsolexercisefullmargin}% 
      \setlength{\rightmargin}{\exsolexercisefullmargin}% 
      \setlength{\parindent}{\exsolexerciseparindent}% 
      \setlength{\itemindent}{\exsolexerciseitemindent}% 
      \setlength{\parsep}{\exsolexeseparlabel}% 
      \setlength{\labelsep}{\exsolexerciselabelsep}% 
      \setlength{\labelwidth}{\exsolexerciselabelwidth}}% 
    \item[\ifexsol@nolabels~#1:\else\exercisename{}~#1:\fi]% 
    \subparagraph{\exercisename{}~#1:}% 
  }{% 
    \ifexsol@nolabels #1:\else\subparagraph{\exercisename{}~#1:}}% 
  \end{list}% 
  \ifthenelse{\boolean{exsol@minipage}}{% 
    \end{minipage}% 
  }{% 
  \par}% 
\end{exsol@exercise}
```

The `solution` environment is used to typeset your solutions and provide them with a nice label and number that corresponds to the exercise that preceded this solution. Theno label can be set by redefining the `\solutionname` macro, or by relying on the `Babel` provisions. The code is almost literally taken from the `fancyvrb` package.

```latex
\def\solution{\FV@Environment{}{solution}}
\def\FVB@solution{% 
  % \typeout{Writing solution to \jobname.sol.tex}
  % WDSC
  \ifexsol@copyexercisesinsolutions
    \immediate\write\solutionstream{\string\begin{exsol@solution}{}\par}
  \else
    \ifexsol@inline
      \immediate\write\solutionstream{\string\begin{exsol@solution}{}\par}
    \else
      \immediate\write\solutionstream{\string\begin{exsol@solution}{\theexercise}\par}
    \fi
  \fi
  \ifthenelse{\boolean{exsol@exerciseaslist}}{% 
    \item[\ifexsol@nolabels #1:\else\exercisename{}~#1:\fi]% 
    \subparagraph{\exercisename{}~#1:}% 
  }{% 
    \ifthenelse{\boolean{exsol@nolabels}}{% 
      \immediate\write\solutionstream{\string\begin{exsol@solution}{}\par}
    }{% 
      \immediate\write\solutionstream{\string\begin{exsol@solution}{\theexercise}\par}
    }% 
  }\end{exsol@solution}
```
The `exsol@solution` environment is an internal macro used to typeset your solutions. Do not use it directly. Use the proper environment `solution` instead.
exercises  The exercises environment helps typesetting your exercises to stand out from the rest of the text. You may use it at the end of a chapter, or just to group some exercises in the text.

exerciseseries The exerciseseries environment helps typesetting your exercises in series.
solutionseries The \texttt{solutionseries} environment helps typesetting your solutions in series. You don’t need to use this function explicitly. The package does this for you.

\begin{verbatim}
\newenvironment{solutionseries}{\[3\]}{\]
{\newcommand\columncount{1} % default \newcommand\exsubrule{} % default \newcommand\solsubrule{} % default \setkeys{exercises}{#1}\% \paragraph{\seriesname~#3\ifexsol@usesolutionserieslabels: #2\fi}~\par \ifthenelse{\columncount > 1}{\begin{multicols}{\columncount}}{} }
{\ifthenelse{\columncount > 1}{\end{multicols}}{} \solsubrule\par}
\end{verbatim}

informulacollection The \texttt{informulacollection} environment is used to write its contents to the formula collection stream and load back into the main text for typesetting. The code is almost literally taken from the fancyvrb package.

\begin{verbatim}
\def\informulacollection{\FV@Environment{}{informulacollection}}
\def\FVB@informulacollection{\immediate\openout\formulastream=\jobname.for.tex}
\@bsphack \begingroup \FV@UseKeyValues \FV@DefineWhiteSpace \def\FV@Space{\space} \FV@DefineTabOut \let\FV@ProcessLine\GPFORCOL@write@detok \relax \let\FV@FontScanPrep\relax \let\@noligs\relax \FV@Scan \endgroup\@esphack \immediate\closeout\formulastream \input{\jobname.for.tex}
\end{verbatim}

informulacollectiononly The \texttt{informulacollectiononly} environment is used to write its contents to the formula collection stream without loading it back into the main text for typesetting.
The code is almost literally taken from the fancyvrb package.

5.1 Some Babel provisions

You may redefine these macros, but to help you out a little bit, we provide with some basic Babel auxiliaries. If you’re a true polyglot and are willing to help me out by providing translations for other languages, I’m very willing to incorporate them into the code.
Now the final hack overloads the basic sectioning commands to make sure that they are copied into your solution book.

```latex
\newif\ifnoexinchapter
\noexinchapterfalse
\ifexsol@local
\else
\let\exsol@@makechapterhead\@makechapterhead
\def\@makechapterhead#1{\par
\exsol@@makechapterhead{#1}
\ifnoexinchapter
\noexinchapterfalse
\else
\addtocounter{chapter}{-1}
\immediate\write\solutionstream{\string\setcounter{chapter}{\arabic{chapter}}%
\string\chapter{#1}}%
\ifexsol@external
\immediate\write\exercisestream{\string\setcounter{chapter}{\arabic{chapter}}%
\string\chapter{#1}}%
\fi
\addtocounter{chapter}{1}
\fi
\fi}
\ifdefined\frontmatter
\let\exsol@@frontmatter\frontmatter
\def\frontmatter{\immediate\write\solutionstream{\string\frontmatter}}%
\ifexsol@external
\immediate\write\exercisestream{\string\frontmatter}}%
\fi
\fi}
\let\exsol@external
```
\noexercisesinnextchapter If you have chapters without exercises, you may want to leave them out of your solution book. You can do this by putting the \noexercisesinnextchapter macro before your chapter mark.

\newcommand{\noexercisesinnextchapter}
{
\noexinchaptertrue
}

\noexercisesinnextchapter As an alternative you may just want to put this marker in your text to cause the printing of the sentence “No exercises in this chapter” in your solution book.

\newcommand{\noexercisesinchapter}
{
\immediate\write\solutionstream{No exercises in this chapter}
\ifexsol@external\immediate\write\exercisestream{No exercises in this chapter}\fi
\fi\"
References


Change History

v0.1
  General: Initial version ............. 1
  
  v0.2
  General: Minor bug fixes based on first use by Paul 1
  Added option exercisesfont ........ 16
  Fixed babel errors ............. 25
  Removed dash in counter when in document without sectioning commands ........ 19
  \texttt{exercises}: Attempted to fix MiKTeX formatting problems . 23
  \texttt{exsol@exercise}: Attempted to fix MiKTeX formatting problems . 21
  
  v0.3
  General: Minor bug fixes based on second use by Paul 1
  \texttt{exercises}: Added some extra whitespace below exercisesname .......... 23
  \texttt{exsol@exercise}: Fixed labelsep to avoid cluttered itemize environments .......... 21
  
  v0.4
  General: Allowed for non-list formatting of exercises (as default) ............. 1
  Added option exercisesinlist ........ 17
  Changed name of option to exercisesfontsize .......... 16
  \texttt{exsol@exercise}: Added option exercisesinlist such that default results in non list formatting of exercise ............. 21
  
  v0.5
  General: Added option to also send exercises to solutions file . 1
  Added option copyexercisesinsolutions .... 17
  Changed option exercisesinlist to exerciseaslist ............. 17
  \texttt{exsol@exercise}: Changed implementation to allow for copying the exercises to the solutions file. ............. 21
  
  v0.6
  General: Prepared for CTAN publication ............. 1
  
  v0.7
  General: Fixed UTF8 compatibility issues ............. 1
  Added detokenized writing ... 19
  Added Finnish language support 25
  
  v0.8
  General: Fixed missing babel tag and running out of write handles ............. 1
  moved newwrite of exercise stream to this spot to avoid consuming all handles ........ 18
  
  v0.9
  General: . Changed default behavior w.r.t. minipage-wrapping of exercises . 17
**v0.91**

General: Corrected minipage
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**v1.0**

General: First stable release ..... 1
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**v1.1**

General: Bugfix release ........ 1
Corrected congruence of
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document and chapter counter
of exercises document (taking
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**v1.2**

General: Implemented
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options (local, nolabels),
separate counter for
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**v1.3**

General: Correction of spacings
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**v1.4**

General: Implemented option to
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General: Added inline and
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**v1.6**

General: Added check to see if
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