The ExSol package*

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1 Introduction

1.1 Package goal

The package 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 apart in the typeset result.

In *global mode* (the default), this corresponds to generating the following separate documents:

- your original text that only contains the exercises, and
- 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).

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 *local mode* (invoked by specifying the package option 'local'), this corresponds to reading in the saved solutions in the current document at a later stage in the text.

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 that you provide with the solutions separated from the exercises to first try solving the exercises without peeking into the list of solutions (or the solution book).

*This document corresponds to exsol 1.2, dated 2016/05/05.

1.3 Credits

The code of the ExSol package was taken almost literally from fancyvrb [1]. Therefore, all credits go to the authors/maintainers of 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 LaTeX 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 LaTeX finds the `exsol.sty` file.

The ExSol package uses some auxiliary packages: fancyvrb, ifthen, kvoptions and, optionally, 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{exsol}
```

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.).

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{exercises}
  \begin{solution}
    $y = 12$
  \end{solution}

  \begin{exercise}
    Calculate $y = 7 - 12$
  \end{exercises}
  \begin{solution}
    $y = -5$
  \end{solution}

\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 clumns

- `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{exercises}
  \begin{solution}
    $y = 12$
  \end{solution}

  \begin{exercise}
    Calculate $y = 7 - 12$
  \end{exercises}
  \begin{solution}
    $y = -5$
  \end{solution}

\end{exerciseseries}

\begin{exerciseseries}{Difficult exercises}

  \begin{exercise}
    Calculate $y = 5 \cdot 7$
  \end{exercises}
  \begin{solution}
    $y = 35$
  \end{solution}

  \begin{exercise}
    Calculate $y = 8 / 4$
  \end{exercises}
  \begin{solution}
    $y = 2$
  \end{solution}

\end{exerciseseries}
```

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.

```
%<*example>
\documentclass[a4paper,10pt]{article}

\usepackage{a4wide}
\usepackage[english]{babel}
\usepackage[copyexercisesinsolutions]{exsol}

\title{Gobal example, from the \textsf{ExSol} package}
\author{Walter Daems}
\setlength{\parindent}{0em}
\begin{document}
\maketitle

\section{Introduction}

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

\section{Solving 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}
  can be determined as:
  \begin{equation}
    x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4 a c}}{2 a}
  \end{equation}
\end{informulacollection}

\begin{exercises}[columns = 2]

  \begin{exercise}
    Solve the following equation for $x \in C$, with $C$ 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 &=& \frac{3.1 + \sqrt{130.45}}{11.4} = 1.27\\
      x_2 &=& \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}
    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}\\
      &=& \sqrt{3^2 + 4^2}\\
      &=& \sqrt{25} = 5
    \end{eqnarray}
    Therefore, the length of the hypotenuse equals $5$.
  \end{solution}

\end{exercises}

\end{document}
%</example>
```

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.

When running LaTeX on your document (e.g., the file example.tex as part of the exsol package, as a side effect files with the extension `.sol.tex` and `.fc.tex` have been written to disk (in our case, the files `example.sol.tex` and `example.fc.tex`), containing all solutions and entries for the formula collection in sequence.

Generating a solution book is as simple as including the solution file into a simple LaTeX harness, that allows you giving it a proper title page and to add other bells and whistles. This can be seen below:

```
%<*examplesol>
\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}
%</examplesol>
```

Generating a formula collection is as simple as including the formula collectoin file into a simple LaTeX harness, that allows you giving it a proper title page and to add other bells and whistles. This can be seen below:

```
%<*examplefor>
\documentclass[a4paper,10pt]{article}

\usepackage{a4wide}
\usepackage[english]{babel}
\usepackage{exsol}

\setlength{\parindent}{0em}

\title{Formula collection, specified in the example of the
  \textsf{ExSol} package}
\author{Walter Daems}

\begin{document}

\maketitle

\input{example.fc.tex}

\end{document}
%</examplefor>
```

3.2.2 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.

```
%<*example-local>
\documentclass[a4paper,10pt]{article}

\usepackage{a4wide}
\usepackage[german]{babel}
\usepackage[local,nolabels,exerciseaslist]{exsol}
\usepackage{enumitem}
```

```
\setlength{\exsolexercisetopbottomsep}{0pt plus 0pt minus 1pt}
\setlength{\exsolexerciseleftmargin}{2em}
\setlength{\exsolexerciserightmargin}{1em}
\setlength{\exsolexerciseparindent}{0em}
\setlength{\exsolexerciselabelsep}{1ex}
\setlength{\exsolexerciselabelwidth}{30pt}
\setlength{\exsolexerciseitemindent}{0pt}
\setlength{\exsolexerciseparsep}{\parskip}

\title{Local example, from the \textsf{ExSol} package}
\author{Philippe Marti}
\setlength{\parindent}{0em}
\begin{document}
\maketitle

\section{\exercisesname}

\begin{exerciseseries}[columns=2,solsubrule=\hrule]{Gleichungen $|$ Gleichungssysteme}

  \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}

  \begin{exercise}
    Die Differenz einer Zahl und dem Dreifachen einer zweiten Zahl ist
    14. Bestimme die beiden Zahlen, falls die zweite Zahl ein Zehntel
    der ersten ist.
  \end{exercise}
  \begin{solution}
    20 und 2
  \end{solution}

\end{exerciseseries}

\begin{exerciseseries}[columns=2]{Geraden}
  \begin{exercise}
    Berechne den Schnittpunkt von \mbox{$y=3x+1$} und \mbox{$y=3x-7$}.
  \end{exercise}
  \begin{solution}
    Es gibt keinen Schnittpunkt
  \end{solution}

  \begin{exercise}
    Die Familie Meier fordert Offerten f\"ur eine Heizungsreparatur
    ein. Firma A berechnet f\"ur die Fahrtkosten Fr. 42.- und f\"ur
    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 f\"ur beide Firmen, wenn ein Monteur
      3.5 Stunden
      f\"ur die Arbeit bentigt? Welche Firma ist in diesem Fall
      kostengnstiger?

    \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}
  \end{exercise}
  \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}
\end{exerciseseries}

\section{\solutionsname}
\loadSolutions

\end{document}
%</example-local>
```

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:

- `exsolexerciseaboveskip`: rubber length controlling the vertical space after the top marker line of the environment
- `exsolexercisebelowskip`: rubber length controlling the vertical space before the bottom marker line of the environment

You can simply specify them like:

```
\setlength{\exsolexercisesaboveskip}{1ex plus 1pt minus 1pt}
\setlength{\exsolexercisesbelowskip}{1ex plus 1pt minus 1pt}
```

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 `exerciseaslist` package option!

Then lengths below control the spacing of the `exercise` environment:

- `exercisetopbottomsep`: rubber length controlling the vertical space before and after individual exercises
- `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
- `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
- `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')
- `exerciseparindent`: length controlling the first-line indentation of the other paragraphs in the exercise environment.
- `exerciselabelsep`: length controlling the distance between the label and position 'x'
- `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{\exsolexerciseleftmargin}{1em}
\setlength{\exsolexerciserightmargin}{1em}
\setlength{\exsolexerciseparindent}{0em}
\setlength{\exsolexerciselabelsep}{0.5em}
\setlength{\exsolexerciselabelwidth}{0pt}
\setlength{\exsolexerciseitemindent}{0pt}
\setlength{\exsolexerciseparsep}{\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}
```

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 it's own local counter in combination with a exerciseseries counter.

```
7 \DeclareBoolOption[false]{local}
```

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

```
8 \DeclareBoolOption[false]{nolabels}
```

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

```
9 \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.

```
10 \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.

```
11 \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.

```
\DeclareBoolOption[false]{minipage}
```

The options are processed using:

```
\ProcessKeyvalOptions*
```

The options are subsequently handled

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

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`.

```
\newlength{\exsolexercisesaboveskip}
\setlength{\exsolexercisesaboveskip}{0ex plus 1pt minus 1pt}
\newlength{\exsolexercisesbelowskip}
\setlength{\exsolexercisesbelowskip}{0ex plus 1pt minus 1pt}
```

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.

```
\newlength{\exsolexercisetopbottomsep}
\setlength{\exsolexercisetopbottomsep}{0pt plus 0pt minus 1pt}
\newlength{\exsolexerciseleftmargin}
\setlength{\exsolexerciseleftmargin}{1em}
\newlength{\exsolexerciserightmargin}
\setlength{\exsolexerciserightmargin}{1em}
\newlength{\exsolexerciseparindent}
\setlength{\exsolexerciseparindent}{0em}
\newlength{\exsolexerciselabelsep}
\setlength{\exsolexerciselabelsep}{0.5em}
\newlength{\exsolexerciselabelwidth}
\setlength{\exsolexerciselabelwidth}{0pt}
\newlength{\exsolexerciseitemindent}
\setlength{\exsolexerciseitemindent}{0pt}
\newlength{\exsolexerciseparsep}
\setlength{\exsolexerciseparsep}{\parskip}
```

4.4 Con- and destruction of the auxiliary streams

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
  \typeout{Using intermediate exercise file \jobname.exc.tex}
  \newwrite\exercisestream
  \typeout{Writing formulae to formula collection file \jobname.fc.tex}
  \newwrite\formulacollectionstream
  \immediate\openout\formulacollectionstream=\jobname.fc.tex
  \typeout{Using intermediate formula file \jobname.for.tex}
  \newwrite\formulastream
}
\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
}
```

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
  \@ifundefined{c@chapter}{}{\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 XeTeX and LuaTeX) and UTF-8 is a pain. Detokenization has been suggested by Geoffrey Poore to solve issues with UTF-8 characters messing up the `fancyvrb` 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}}}%
\newcommand{\GPFORCOLONLY@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 litteraly taken from the fancyvrb package.

```
\def\exercise{\FV@Environment{}{exercise}}
\def\FVB@exercise{%
  \refstepcounter{exercise}%
  \immediate\openout\exercisestream=\jobname.exc.tex
  \ifexsol@local
%  \immediate\write\solutionstream{}
  \else
%  \immediate\write\solutionstream{\string\vspace*\string{2ex\string}%
%    \string\quad\string\newline}
  \fi
  \ifexsol@copyexercisesinsolutions
  % WDSC tofix
  % \typeout{Writing exercise to \jobname.sol.tex}
  \immediate\write\solutionstream{\string\begin{exsol@exercise}{\theexercise}}
  \fi
  \immediate\write\exercisestream{\string\begin{exsol@exercise}{\theexercise}}
```

```
  \@bsphack
  \begingroup
    \FV@UseKeyValues
    \FV@DefineWhiteSpace
    \def\FV@Space{\space}%
    \FV@DefineTabOut
    \ifexsol@copyexercisesinsolutions
      \let\FV@ProcessLine\GPESS@write@detok %
    \else
      \let\FV@ProcessLine\GPES@write@detok %
    \fi
    \relax
    \let\FV@FontScanPrep\relax
    \let\@noligs\relax
    \FV@Scan
  }
\def\FVE@exercise{
  \endgroup\@esphack
  \immediate\write\exercisestream{\string\end{exsol@exercise}}
  \ifexsol@copyexercisesinsolutions
    \immediate\write\solutionstream{\string\end{exsol@exercise}}
  \fi
  \immediate\closeout\exercisestream
  \input{\jobname.exc.tex}
}
\DefineVerbatimEnvironment{exercise}{exercise}{}
```

exsol@exercise

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.

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

```
  \ifthenelse{\boolean{exsol@exerciseaslist}}%
             {\end{list}}{}%
  \ifthenelse{\boolean{exsol@minipage}}{\end{minipage}}{\par}%
}
```

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

```
\def\solution{\FV@Environment{}{solution}}
\def\FVB@solution{%
  %\typeout{Writing solution to \jobname.sol.tex}
  \ifexsol@copyexercisesinsolutions
  \immediate\write\solutionstream{\string\begin{exsol@solution}{}}
  \else
  \immediate\write\solutionstream{\string\begin{exsol@solution}{\theexercise}}
  \fi
  \@bsphack
  \begingroup
    \FV@UseKeyValues
    \FV@DefineWhiteSpace
    \def\FV@Space{\space}%
    \FV@DefineTabOut
    \let\FV@ProcessLine\GPSS@write@detok %
    \relax
    \let\FV@FontScanPrep\relax
    \let\@noligs\relax
    \FV@Scan
  }
\def\FVE@solution{
  \endgroup\@esphack
  \immediate\write\solutionstream{\string\end{exsol@solution}}
}
\DefineVerbatimEnvironment{solution}{solution}{}
```

`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.

```
\newenvironment{exsol@solution}[1]
{%
  \ifthenelse{\boolean{exsol@minipage}}{\begin{minipage}[t]{\textwidth}}{}%
    \ifthenelse{\boolean{exsol@exerciseaslist}}
    {\begin{list}%
        {%
        }%
        {%
          \setlength{\topsep}{\exsolexercisetopbottomsep}%
          \setlength{\leftmargin}{\exsolexerciseleftmargin}%
          \setlength{\rightmargin}{\exsolexerciserightmargin}%
          \setlength{\listparindent}{\exsolexerciseparindent}%
```

```
          \setlength{\itemindent}{\exsolexerciseitemindent}%
          \setlength{\parsep}{\exsolexerciseparsep}
          \setlength{\labelsep}{\exsolexerciselabelsep}
          \setlength{\labelwidth}{\exsolexerciselabelwidth}}
      \item[\ifexsol@nolabels #1:\else%
        \subparagraph{\solutionname{}\@ifmtarg{#1}{}{~}#1:}\fi]
      }%
      {\ifexsol@nolabels #1:\else%
        \subparagraph{\solutionname{}\@ifmtarg{#1}{}{~}#1:}\fi}
    }
    {%
      \ifthenelse{\boolean{exsol@exerciseaslist}}%
      {\end{list}}{}%
    \ifthenelse{\boolean{exsol@minipage}}{\end{minipage}}{\par}%
}
```

`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.

```
\define@key{exercises}{columns}{\renewcommand\columncount{#1}}
\define@key{exercises}{exsubrule}{\renewcommand\exsubrule{#1}}
\define@key{exercises}{solsubrule}{\renewcommand\solsubrule{#1}}
\define@key{exercises}{subrule}{\renewcommand\exsubrule{#1}\renewcommand\solsubrule{#1}}
\newenvironment{exercises}[1][]
{
  \newcommand\columncount{1} % default
  \newcommand\exsubrule{} % default
  \newcommand\solsubrule{} % default
  \setkeys{exercises}{#1}
  \par\exercisesfontsize\rule{.25\linewidth}{0.15mm}%
  \vspace*{\exsolexercisesaboveskip}%
  \paragraph{\exercisesname}~\par
  \ifthenelse{\columncount > 1}{\begin{multicols}{\columncount}}{}
  }
  {
  \ifthenelse{\columncount > 1}{\end{multicols}}{}\relax
  \vspace*{-\baselineskip}\vspace*{\exsolexercisesbelowskip}%
  %\rule{.25\linewidth}{0.15mm}
  \exsubrule\par}
```

`exerciseseries` The `exerciseseries` environment helps typesetting your exercises in series.

```
\define@key{exerciseseries}{columns}{\renewcommand\columncount{#1}}
\define@key{exerciseseries}{exsubrule}{\renewcommand\exsubrule{#1}}
\define@key{exerciseseries}{solsubrule}{\renewcommand\solsubrule{#1}}
\define@key{exerciseseries}{subrule}{\renewcommand\exsubrule{#1}\renewcommand\solsubrule{#1}}
\newenvironment{exerciseseries}[2][]
{
  \refstepcounter{exerciseseries}%
  \newcommand\columncount{1} % default
  \newcommand\exsubrule{} % default
  \newcommand\solsubrule{} % default
```

```
  \setkeys{exerciseseries}{#1}
  \paragraph{\seriesname~\theexerciseseries:~#2}~\par
  \ifthenelse{\columncount > 1}{\begin{multicols}{\columncount}}{}
    \immediate\write\solutionstream{\string\begin\string{solutionseries\string}%
        \string[#1\string]\string{#2\string}\string{\theexerciseseries\string}}
    }
    {
      \ifthenelse{\columncount > 1}{\end{multicols}}{}\relax
    \exsubrule\par
    \immediate\write\solutionstream{\string\end\string{solutionseries\string}}
}
\newenvironment{solutionseries}[3][]
{
  \newcommand\columncount{1} % default
  \newcommand\exsubrule{} % default
  \newcommand\solsubrule{} % default
  \setkeys{exercises}{#1}
  \paragraph{\seriesname~#3}~\par
  \ifthenelse{\columncount > 1}{\begin{multicols}{\columncount}}{}
  }
  {
    \ifthenelse{\columncount > 1}{\end{multicols}}{}
  \solsubrule\par
}
```

`informulacollection` The `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 litteraly taken from the fancyvrb package.

```
\def\informulacollection{\FV@Environment{}{informulacollection}}
\def\FVB@informulacollection{%
  \immediate\openout\formulastream=\jobname.for.tex
  %\typeout{Writing formula to \jobname.for.tex and \jobname.fc.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
  }
\def\FVE@informulacollection{
  \endgroup\@esphack
  \immediate\closeout\formulastream
  \input{\jobname.for.tex}
}
\DefineVerbatimEnvironment{informulacollection}{informulacollection}{}
```

`informulacollectiononly` The `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 litteraly taken from the fancyvrb package.

```
\def\informulacollectiononly{\FV@Environment{}{informulacollectiononly}}
\def\FVB@informulacollectiononly{%
  %\typeout{Writing special to \jobname.fc.tex}
  \@bsphack
  \begingroup
    \FV@UseKeyValues
    \FV@DefineWhiteSpace
    \def\FV@Space{\space}%
    \FV@DefineTabOut
    \let\FV@ProcessLine\GPFORCOLONLY@write@detok %
    \relax
    \let\FV@FontScanPrep\relax
    \let\@noligs\relax
    \FV@Scan
  }
\def\FVE@informulacollectiononly{
  \endgroup\@esphack
}
\DefineVerbatimEnvironment{informulacollectiononly}{informulacollectiononly}{}
```

5.1 Some Babel provisions

```
\newcommand{\exercisename}{Exercise}
\newcommand{\exercisesname}{Exercises}
\newcommand{\solutionname}{Solution}
\newcommand{\solutionsname}{Solutions}
\newcommand{\seriesname}{Series}
```

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.

```
\addto\captionsdutch{%
  \renewcommand{\exercisename}{Oefening}%
  \renewcommand{\exercisesname}{Oefeningen}%
  \renewcommand{\solutionname}{Oplossing}%
  \renewcommand{\solutionsname}{Oplossingen}%
  \renewcommand{\seriesname}{Reeks}%
}
\addto\captionsgerman{%
  \renewcommand{\exercisename}{Aufgabe}%
  \renewcommand{\exercisesname}{Aufgaben}%
  \renewcommand{\solutionname}{L\"osung}%
  \renewcommand{\solutionsname}{L\"osungen}%
  \renewcommand{\seriesname}{Serie}%
}
\addto\captionsngerman{%
  \renewcommand{\exercisename}{Aufgabe}%
  \renewcommand{\exercisesname}{Aufgaben}%
```

```
  \renewcommand{\solutionname}{L\"osung}%
  \renewcommand{\solutionsname}{L\"osungen}%
  \renewcommand{\seriesname}{Serie}%
}
\addto\captionsfrench{%
  \renewcommand{\exercisename}{Exercice}%
  \renewcommand{\exercisesname}{Exercices}%
  \renewcommand{\solutionname}{Solution}%
  \renewcommand{\solutionsname}{Solutions}%
  \renewcommand{\seriesname}{Serie}%
}
\addto\captionsfinnish{
  \renewcommand{\exercisename}{Teht\"av\"a}%
  \renewcommand{\exercisesname}{Teht\"avi\"a}%
  \renewcommand{\solutionname}{Ratkaisu}%
  \renewcommand{\solutionsname}{Ratkaisut}%
  \renewcommand{\seriesname}{Sarja}
}
\addto\captionsspanish{%
  \renewcommand{\exercisename}{Ejercicio}%
  \renewcommand{\exercisesname}{Ejercicios}%
  \renewcommand{\solutionname}{Soluci\'on}%
  \renewcommand{\solutionsname}{Soluciones}%
  \renewcommand{\seriesname}{Serie}%
}
```

Now the final hack overloads the basic sectioning commands to make sure that they are copied into your solution book.

```
\ifexsol@local
\else
\let\exsol@@makechapterhead\@makechapterhead
\def\@makechapterhead#1{%
  \exsol@@makechapterhead{#1}
  \immediate\write\solutionstream{\string\setcounter{chapter}{\arabic{chapter}}%
    \string\chapter{#1}}%
}
\ifdefined\frontmatter
  \let\exsol@@frontmatter\frontmatter
  \def\frontmatter{%
    \immediate\write\solutionstream{\string\frontmatter}%
    \exsol@@frontmatter
  }
\fi
\ifdefined\frontmatter
  \let\exsol@@mainmatter\mainmatter
  \def\mainmatter{%
    \immediate\write\solutionstream{\string\mainmatter}%
    \exsol@@mainmatter
  }
\fi
\ifdefined\backmatter
  \let\exsol@@backmatter\backmatter
  \def\backmatter{%
```

```
    \immediate\write\solutionstream{\string\backmatter}%
    \exsol@@backmatter
  }
\fi
\ifdefined\appendix
  \let\exsol@@appendix\appendix
  \def\appendix{%
    \immediate\write\solutionstream{\string\appendix}%
    \exsol@@appendix
  }
\fi
\fi
```

`\noexercisesinchapter` If you have chapters without exercises, you may want to indicate this clearly into your source. Otherwise empty chapters may appear in your solution book.

```
\newcommand{\noexercisesinchapter}
{
  \immediate\write\solutionstream{No exercises in this chapter}
}
```

⟨/package⟩

References

[1] Timothy Van Zandt, Herbert Voß, Denis Girou, Sebastian Rahtz, Niall Mansfield The `fancyvrb` package. `http://ctan.org/pkg/fancyvrb`. online, accessed in January 2012.

[2] The Comprehensive TeX Archive Network. `http://www.ctan.org`. online, accessed in January 2012.

Change History

v0.1

General: Initial version 1

v0.2

General: Minor bug fixes based on first use by Paul Levrie 1

Added option exercisesfont . . . 11

Fixed babel errors 19

Removed dash in counter when in document without sectioning commands 13

`exercises`: Attempted to fix MiKTeX formatting problems . . . 17

`exsol@exercise`: Attempted to fix MiKTeX formatting problems 15

v0.3

General: Minor bug fixes based on second use by Paul 1

`exercises`: Added some extra whitespace below exercises-name 17

`exsol@exercise`: Fixed labelsep to avoid cluttered itemize environments 15

v0.4

General: Allowed for non-list formatting of exercises (as default) 1

Added option exercisesinlist . . 11

Changed name of option to exer-

cisesfontsize 11
exsol@exercise: Added option exercisesinlist such that default results in non list formatting of exercise 15
v0.5
General: Added option to also send exercises to solutions file 1
Added option copyexercisesinsolutions 11
Changed option exercisesinlist to exerciseaslist 11
exsol@exercise: Changed implementation to allow for copying the exercises to the solutions file. 15
v0.6
General: Prepared for CTAN publication 1
v0.7
General: Fixed UTF8 compatibility issues 1
Added detokenized writing . . . 14
Added Finnish language support 19
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 12
v0.9
General: . Changed default behavior w.r.t. minipage-wraping of exercises 11
Changed default behavior w.r.t. minipage-wrapping of exercises 1
v0.91
General: Corrected minipage dependence, made 1
added user-accessible lengths . 12
v1.0
General: First stable release 1
Added congruence of chaptercounter of main document and chapter counter of exercises document 20
Added detokenized writing of formula and formula collection stream 14
v1.1
General: Bugfix release 1
Corrected congruence of chaptercounter of main document and chapter counter of exercises document (taking intou account alphanumbered chapters 20
v1.2
General: Implemented multicolumn option for exercises, introduced new options (local, nolabels), separate counter for exerciseseries (only for use local mode), introduced local mode . 1
Added exerciseseries environment 17
Added option local 11
Added option nolabels 11
Added series counter 13
Added Spanish language support 19
Completed German language support (i.e. new spelling ngerman) support 19
exercises: Added multicolumn feature 17

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