The `smstut` Package: Create Problem Sheets and Exams with Solutions

Daniel Daners
School of Mathematics and Statistics
University of Sydney, NSW 2006, Australia
D.Daners@maths.usyd.edu.au

File version v2.0, dated 2014/04/22

Abstract

The tools provided allow to typeset questions and solutions to problem sheets and exams within one document with the possibility of switching solutions on and off as required. Included are four files, two LaTeX packages `question` and `solution`, and twp document classes, `smstut` and `smsexam`. The tools are entirely based on widely available LaTeX classes and packages, and therefore should be working with future versions of LaTeX. To make applications more flexible, the packages can be used independently of the classes.

Contents

1 Introduction

The present documentation describes the LaTeX package `smstut` which allows to typeset problems sheets with questions and solutions in one file. Then either only questions or questions and solutions can be printed as required. Keeping the questions with the solutions in one file makes it easy to rearrange questions, replace parts etc.

To make the application of the features provided as flexible as possible the package includes four files: there are two document classes and two package files. If you only want to switch on and off solutions and keep control over all the rest like layout, numbering etc, you should only load the `solution` package. If you want to have automatic numbering of problems and cross referencing you load the `question` package. You can also load the `solution` package if you want to typeset solutions within the same document.

Finally, the document classes `smstut` and `smsexam` automatically load the two packages. The classes change the margins to fill the page better and produces a heading for the problem sheet which changes automatically depending on whether solutions are printed or not. Also, an environment is provided to print parts of problems in several columns on the problem sheet, but then automatically revert to one column when solutions are printed. The `smsexam` class produces exams conforming to the guidelines of the Examination office of the The University of Sydney(at least at the time the package was written).

2 User guide

2.1 The `smstut` document class

We mainly discuss the features of the `smstut` document class as this provides the most convenient way to use the LaTeXpackage. We only briefly mention what is available if the `question` or `solution` packages are loaded separately.

Always `latex` the file *twice*. Then page numbers only appear if the problem sheet has more than one page.

2.1.1 The preamble

We first load the `smstut` class with options, for instance with 12pt print. By default, the paper size is A4, so you do not need to put `a4paper`, but you can specify another paper size if needed. Then load all packages you require, for instance `amsmath`, `amsfonts` and `pstricks`. After that, you put some private definitions and then start the document. Hence the preamble of your document may look as follows:

```
\documentclass[12pt]{smstut}
%Load packages required.
\usepackage{amsmath,amsfonts}
\usepackage{pstricks}

%Quote out the following line if solutions are not required.
\printsolutions
```

```
%Some definitions
\newcommand{\R}{\mathbb R}

\begin{document}
```

\printsolutions The macro \printsolutions indicates that solutions will be printed. It will change some head elements as described in Section 2.1.2 below.

Customisation The text area should be as large as possible. For this reason
\margin the margins on all four sides of the page have been set to 1 inch. If you want to have a smaller or larger page margin, you can achieve that by using the \margin macro. To produce 2cm margins for instance put

```
\margin{2cm}
```

into the preamble. The minimal "reasonable" margin seems to be about 1.5cm.

2.1.2 The heading

\Heading After the \begin{document} we put the head elements like unit of study code
\UnitCode and name, lecturer, web page etc. For all this to be printed type \MakeHeading
\UnitName (as you type \maketitle in the standard LaTeX classes).
\Semester
\Lecturer
\WebPage
\MakeHeading

```
\Heading{Tutorial 1}
\UnitCode{MATH2961}
\UnitName{Vector calculus and complex variables (advanced)}
\Semester{Semester 1, 2013}
\Lecturer{Daniel Daners}
\WebPage{www.sydney.edu.au/science/maths/u/UG/IM/MATH2901/}
\MakeHeading
```

You can leave any elements undefined. In particular, you do not need to define \Lecturer or \WebPage. Also, there is no obligation to use the given mechanism to produce the heading. You can use your own, but *Solutions to* is not put in front of the heading automatically if you print solutions.

\University There are some predefined head elements, \University and \Department. By
\Department default they are set to *The University of Sydney* and *School of Mathematics and Statistics*, but they can be redefined by setting for instance:

```
\University{University of the North Pole}
\Department{Department of Polar Bear Hunting}
```

\copyrightnotice There is also a copyright notice on the bottom of the first page. By default, it is set to the year followed by what is specified in \University. You can change this by for instance \copyrightnotice{⟨*2004 your name*⟩}. If you want no such notice you put \copyrightnotice{}.

\printsolutions To print questions and solutions you need to put \printsolutions into the preamble. If you do that, then *Solutions to* is put in front of the heading. In the above example *Tutorial 1* will be replaced by *Solutions to Tutorial 1* automatically. See below how to customise the words *Solutions to*.

Customisation Some elements in the heading can be customised. In particular, you can customise the words introducing the lecturer, the Web page and the words *Solutions to* when solutions are printed.

For instance if there are multiple lecturers you can redefine the relevant heading
`\lecturerheading` by putting

```
\renewcommand{\lecturerheading}{Lecturers:}
```

into the preamble. Likewise, you can replace the default heading *Web Page:* by
`\wwwheading` for instance *Internet:* by putting

```
\renewcommand{\wwwheading}{Internet:}
```

into the preamble. Finally, you can replace the words *Solutions to* by something
`\solutionto` else, for instance *Solutions:* by putting

```
\renewcommand{\solutionto}{Solutions: }
```

into the preamble.

2.1.3 Assigning marks to questions

For setting assignments or quizzes it may be useful to be able to allocate marks to questions. This can be done as described in Section 2.4.3.

2.2 The `question` package

In a first subsection we describe the macros to typeset questions. They are available when loading the `question` package or by using the `smstut` or `smsexam` document classes. In the second subsection we discuss cross referencing, and in the last a possibility to print questions in several columns and revert to one column if solutions are printed. The feature is only available with the two document classes `smstut` and `smsexam`.

2.2.1 Environments for questions and starred questions

`question` After the heading you type the main body of your problem sheet. Questions are typed between `\begin{question}` and `\end{question}`. There is no special command for parts of questions. Instead the `question` environment works similar to the standard `enumerate` environment and can be nested. Depending on the nesting level, the numbering style will be different. There are four nesting levels. You can put arbitrary text between questions at any level. Here is an example using three nesting levels.

```
\begin{question}
  Some text
  \begin{question}
     First part
     \begin{question}
       First subpart
     \end{question}
     \begin{question}
       Second subpart
```

```
    \end{question}
    Some more text
    \begin{question}
      Third subpart
    \end{question}
  \end{question}
  \begin{question}
    Second part
  \end{question}
\end{question}
```

(The `solution` environment will be described below). This will produce something like

1. Some text

(a) First part

(i) First subpart

(ii) Second subpart

Some more text

(iii) Third subpart

(b) Second part

`question*` There is an alternative environment `question*` which allows questions to be starred. This can be used for instance to identify questions which are particularly hard or questions that students are expected to work through themselves during the tutorial.

```
\begin{question}
  Some text
  \begin{question*}
    First part
  \end{question*}
  \begin{question}
    Second part
  \end{question}
  \begin{question*}
    Third part
  \end{question*}
\end{question}
```

produces something like

2. Some text

*(a) First part

(b) Second part

*(c) Third part

`\starsymbol` **Customisation** It is possible to change the symbol used to "star" questions. To change the * to $^+$ set

```
\starsymbol{$^+$}
```

One can also use this to define an environment `question**` to produce double starred questions by putting

```
\newenvironment{question**}
  {\starsymbol{**}\begin{question*}\starsymbol{*}}
  {\end{question*}}
```

into the preamble.

2.2.2 Cross referencing

As other numbered objects in LaTeX, questions can be labelled, and referred to by using the `\ref` mechanism. For instance, if you type

```
\begin{question}
  Some text
  \begin{question}
  \label{q:xxx}
     First part
  \end{question}
  \begin{question}
     Second part
  \end{question}
\end{question}
```

you get

3. Some text
   (a) First part
   (b) Second part

and you can refer to Question 3(a) by typing `Question~\ref{q:xxx}(\ref{q:yyy})`.

2.2.3 Questions in multiple colums: The `mcols` environment

Sometimes questions, or in particular parts of questions are very short, and it takes too much space to print them on separate lines. There is an environment `mcols` which allows to have several parts on one line. The solutions are generally not so short. for this reason, if solutions are printed, the parts (with the solutions) are printed in one column only. Note that the `mcols` environment only works if you use the `smstut` or `smsexam` document class!

`mcols` The environment takes the number of columns as an optional argument. The default is two columns. The syntax is as follows

`\begin{mcols}[`⟨*number of columns*⟩`]` ... questions ... `\end{mcols}`

For instance, to print three columns type

```
\begin{question}
  Some text
  \begin{mcols}[3]
```

```
\begin{question}
  First part
  \begin{solution}
    Solution to first part
  \end{solution}
\end{question}
\begin{question}
  Second part
  \begin{solution}
    Solution to second part
  \end{solution}
\end{question}
\begin{question}
  Third part
  \begin{solution}
    Solution to third part
  \end{solution}
\end{question}
\end{mcols}
\end{question}
```

If solutions are not printed this yields

4. Some text

(a) First part (b) Second part (c) Third part

If solutions are printed the text looks like

4. Some text

(a) First part

Solution: Solution to first part

(b) Second part

Solution: Solution to second part

(c) Third part

Solution: Solution to third part

`multicols` If the solutions are very short (for instance just a number), and you want to print them in several columns as well, then you need to replace the `mcols` environment by `multicols`. The syntax is similar as before:

`\begin{multicols}{`⟨*number of columns*⟩`}` ... questions ... `\end{multicols}`

Note however, that here the number of columns is a *mandatory* argument! The `multicols` environment is defined in the `multicol` package. The documentation of that package gives a more comprehensive description of the `multicols` environment.

2.3 The `solution` package

This section describes the three environments provided by the `solution` package. They work independently of the `question` package, except of course that the `question` environment is undefined. Everything can be used with the `smstut` document class.

2.3.1 Environments for solutions

There are three environments for controlling what is printed and what is not, depending on whether solutions are switched on or off.

`solution` Solutions are typeset between `\begin{solution}` and `\end{solution}`. It is suggested you keep the solution with each part of a question (even though this is not compulsory). This makes it easy to rearrange parts of questions or make separate questions from parts as the solution is moved with the part. The suggested syntax is as follows:

```
\begin{question}
  Some text
  \begin{question}
     First part
     \begin{question}
       First subpart
       \begin{solution}
         Solution to first subpart
       \end{solution}
     \end{question}
     \begin{question}
       Second subpart
       \begin{solution}
         Solution to second subpart
       \end{solution}
     \end{question}
  \end{question}
  \begin{question}
     Second part
       \begin{solution}
         Solution to second part
       \end{solution}
  \end{question}
\end{question}
```

If `\printsolutions` appears in the preamble then the above looks like

5. Some text

(a) First part

(i) First subpart

Solution: Solution to first subpart

(ii) Second subpart

Solution: Solution to second subpart

(b) Second part

Solution: Solution to second part

The `solution` environment prints a heading (by default ***Solution:***) and controls the space before and after the solution. See below how to change this.

`solutionsonly` There is a second environment `solutionsonly`. Its content is only printed if solutions are printed. The difference to the `solution` environment is that it does not produce a heading or any spacing before and after it. It can be used to print information only relevant for the solutions and not the problem sheet. For instance you could include

```
\begin{solutionsonly}
  \newpage
\end{solutionsonly}
```

to produce a page break on solutions only.

`sheetonly` The contents of the third environment, `sheetonly`, is only printed if solutions are not printed. It can be used to print information only relevant for the problem sheet and not the solutions. For instance on an assignment sheet you could include

```
\begin{sheetonly}
  The assignment is due on 17 May by 5pm
  \par
  I confirm that this is my onwn work:
  \par
  Name:\hfill SID\hfill Signature:\hfill
\end{sheetonly}
```

`\thesolution` **Customisation** You can change the default heading ***Solution:*** for solutions by redefining `\thesolution`. For instance, to print **Solution.** with a line break afterwards, you can put

```
\renewcommand{\thesolution}{\textbf{Solution.}\newline}
```

in the preamble.

2.4 The `smsexam` document class

The `smsexam` document class works almost the same as the `smstut` class. We point out the differences.

2.4.1 The preamble

As with `smstut` we first load the `smsexam` class with options, for instance with 12pt. All options the `article.cls` class accepts can be used. There are two extra options:

- `confidential` to be used for confidential exams. It marks the exam as confidential, and puts a box for student number, names and seat number on the front page.
- `booklet` to be used for exam booklets where the students write there responses into the booklet.

The options can be used together, or separately. We can put

```
\documentclass[12pt]{smsexam}
```

at the start for a non-confidential exam, or

```
\documentclass[12pt,confidential]{smsexam}
```

for a confidential exam. We could use

```
\documentclass[booklet]{smsexam}
```

or

```
\documentclass[11pt,confidential,booklet]{smsexam}
```

\printsolutions

for instance. The rest is identical to the `smstut` document class. If solutions are activated using `\printsolutions`, then **SOLUTIONS** will be printed on the bottom of each page.

2.4.2 The exam cover page

\PaperCode
\UnitCode
\UnitName
\Semester
\Lecturer
\Duration
\MakeHeading
instructions

After the `\begin{document}` we put the head elements like unit of study code and name, lecturer. Here `\Heading` and `\WebPage` are not available, but instead `\PaperCode` and `\Duration`.

Finally, there is an environment `instructions` where specific instructions can be typeset. As an optional argument, the environment takes the width of the text. The default width is 80% of the `\textwidth`. The instructions are enclosed in a "shadowbox." Note that the `instructions` environment must appear before the `\MakeHeading`.

```
\PaperCode{80/36}
\Semester{Semester 1, 2002}
\UnitCode{MATH2901}
\UnitName{Vector calculus and complex variables (advanced)}
\Lecturer{D. Daners}
\Duration{2 Hours}
\begin{instructions}[.5\textwidth]
  \begin{itemize}
  \item All work must be shown
  \item University calculators only
  \end{itemize}
\end{instructions}
\MakeHeading
```

You can leave any elements undefined, but the result may be poor. Again, there is no obligation to use that mechanism. `\PaperCode` and `\Semester` are not used by `\MakeHeading`, but by the page style, so they should *always* be declared, even if the `\MakeHeading` mechanism is not being used. For supplementary exams not having a paper code I suggest to set `\PaperCode{Supplementary Exam}`.

\University
\Faculty
\Department

There are some predefined head elements. As in the `smstut` class we have `\University` and `\Department`, set to *The University of Sydney* and *School of Mathematics and Statistics*, respectively. There is also `\Faculty`, set to *Faculties of Arts, Economics, Education, Engineering and Science* by default. They can all be redefined by setting for instance:

```
\University{University of the North Pole}
\Faculty{Faculty of Science}
\Department{Department of Polar Bear Hunting}
```

Of course, these settings must appear before the `\MakeHeading`. After that everything works identical to the `smstut` document class.

2.4.3 Assigning marks to questions

`\markvalue` For setting exams or assignments it may be useful to allocate marks to a question and/or subquestions. The macro `\markvalue{<marks>}` provides a mechanism for that. Typically this could be

```
\begin{question}
  Some text
  \begin{question}\markvalue{2}
     First part
  \end{question}
  \begin{question}\markvalue{3}
     Second part
  \end{question}
\end{question}
```

`\TotalMarks` The total number of marks can be accessed by the macro `\TotalMarks`. For instance, one could write:

```
The total marks available in the exam paper are \TotalMarks.
```