The smstut Package:
Create Problem Sheets and Exams with Solutions

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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 two 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.

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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 \LaTeX{} package. We only briefly mention what is available if the question or solution packages are loaded separately.

Always \texttt{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 \texttt{a4paper}, but you can specify another paper size if needed. Then load all packages you require, for instance \texttt{amsmath}, \texttt{amsfonts} and \texttt{pstricks}. After that, you put some private definitions and then start the document. Hence the preamble of your document may look as follows:

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

%Quote out the following line if solutions are not required.
\printsolutions
\end{verbatim}
\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.

\margin

Customisation The text area should be as large as possible. For this reason 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
\UnitCode
\UnitName
\Semester
\Lecturer
\WebPage
\MakeHeading

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

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.

There are some predefined head elements, \University and \Department. By 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 by putting

\renewcommand{\lecturerheading}{Lecturers:}

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

\renewcommand{\wwwheading}{Internet:}

into the preamble. Finally, you can replace the words Solutions to by something 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
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}
\end{question}
\begin{question}
Second subpart
\end{question}
\end{question}
Some more text

\begin{question}
Third subpart
\end{question}
\end{question}

(The \texttt{solution} environment will be described below). This will produce something like

\begin{enumerate}
\item Some text
\begin{enumerate}
\item First part
\begin{enumerate}
\item First subpart
\item Second subpart
Some more text
\item Third subpart
\end{enumerate}
\end{enumerate}
\item Second part
\end{enumerate}

\begin{question*}
First part
\end{question*}
\begin{question}
Second part
\end{question}
\begin{question*}
Third part
\end{question*}
\end{question}

produces something like

\begin{enumerate}
\item Some text
\begin{enumerate}
\item First part
\item Second part
\item Third part
\end{enumerate}
\end{enumerate}

There is an alternative environment \texttt{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{enumerate}
\item Some text
\begin{enumerate}
\item First part
\end{enumerate}
\item Second part
\begin{enumerate}
\item Third part
\end{enumerate}
\end{enumerate}

produces something like

\begin{enumerate}
\item Some text
\begin{enumerate}
\item First part
\item Second part
\item Third part
\end{enumerate}
\end{enumerate}

\texttt{Customisation} It is possible to change the symbol used to “star” questions. To change the \texttt{*} to \texttt{+} set
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 \texttt{\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 \texttt{Question\ref{q:xxx}(\ref{q:yyy})}.

2.2.3 Questions in multiple columns: The \texttt{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 \texttt{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 \texttt{mcols} environment only works if you use the \texttt{smstut} or \texttt{smsexam} document class!

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

\begin{mcols}\[\text{number of columns}\]...questions...
\end{mcols}

For instance, to print three columns type

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

\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

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.

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
         \textbf{Solution:} Solution to first subpart
      (ii) Second subpart
         \textbf{Solution:} Solution to second subpart

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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.

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.

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 own work:
\par
Name:\hspace{10pt} SID\hspace{10pt} Signature:\hspace{10pt}
\end{sheetonly}

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 their 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

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\Semester\UnitCode\UnitName\Lecturer\Duration\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}.

There are some predefined head elements. As in the smstut class we have

\University \Faculty \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:
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.