

The `exercise`* package

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1 User guide

The `exercise` package allows you to typeset exercises and keep the answers together with the questions in your source (so they don't get lost) but typeset them all together at the end of your document.

1.1 Exercises and answers

`exercise` Exercises are typeset in an `exercise` environment. This takes no arguments. There's a counter for exercises, named `exercise`, and you can cross-reference exercises in the usual way.

`\answer` If you want to include an answer for your exercise, just say `\answer` followed by your answer. The rest of the text up to the end of the `exercise` environment is considered to be the answer, and is stored away until asked for. This material can contain anything you like. It *isn't* a moving argument.

`\skipanswer` The `\skipanswer` command is similar, but just skips over the answer rather than writing it to the output file. It does nothing at all with counters – it's as if there was no answer given at all.

It's OK to use commands like `\answer` and `\skipanswer` in your own macros as long as they're the *last* token. You can therefore say something like

```
\newcommand{\evenanswer}{%}
```

*The `exercise` package is currently at version 1.1, dated 25 August 2003.

Exercise 1 Show that if $F: \{0, 1\}^k \times \{0, 1\}^* \rightarrow \{0, 1\}^L$ is a $(t, q + 1, \varepsilon)$ -secure PRF, then F is also a $(t, q, \varepsilon + 2^{-L})$ -secure MAC.

```
\begin{exercise}
Show that if  $F: \{0, 1\}^k \times \{0, 1\}^* \rightarrow \{0, 1\}^L$ 
is a  $(t, q + 1, \varepsilon)$ -secure PRF, then  $F$  is also a
 $(t, q, \varepsilon + 2^{-L})$ -secure MAC.
\answer
Let  $A$  be an adversary attacking  $F$  as a MAC. Consider the
adversary  $B$  \ldots
\end{exercise}
```

```
\ifthenelse%
{\isodd{\value{exercise}}}%
{\answer}%
{\skipanswer}%
}
```

to get just the answers to the odd-numbered problems. (If you don't like `\ifthen` then you'll need to play with `\expandafter` for a bit.)

1.2 The answers file

`\answrite` Answers are accumulated into a file, to be read later. Additional material can be added to the file using the `\answrite` macro, which just writes its argument. Note that this is a *moving* argument, so fragile commands need `\protecting`.

`\exctrcheck` It's common to divide up the answers by section. You can tell the package to check a collection of counters and perform actions if they've changed since last time, giving you a chance to write the correct decorations to the answers file. This is done by saying `\exctrcheck{\langle counter \rangle}{\langle action \rangle}`. Then, each `\answer` command checks to see if $\langle counter \rangle$ has changed since last time, and if it has, it does $\langle action \rangle$. For example,

```
\exctrcheck{section}
{\answrite{\protect\subsection*{Section \thesection}}}
```

starts a new (unnumbered) subsection in the answers for each section in the main document.

1.3 Style tweaks

The exercise environment is very simple, and can be easily rewritten to fit in with your style preferences. If you like exercises to look like theorems, the easiest thing to do is say something like

```
\newtheorem{doexercise}[exercise]{\exercisename}
\renewenvironment{exercise}{\exfix\doexercise}{\enddoexercise}
```

This makes the environment use the existing exercise counter. If you don't want that, say

```
\newtheorem{doexercise}[othercounter]{\exercisename}
\renewenvironment{exercise}{\exfix\doexercise}{\enddoexercise}
\let\theexercise\theothercounter
```

and all will be well.

doanswer Answers are typeset in a **doanswer** environment, which is given one argument: the exercise number (as set by **\theexercise**). This can be modified to do whatever you like.

\exfix The **\exfix** is a convenient hook which is run both in the **exercise** and **doanswer** environments by default. The current implementation just skips a level of enumerate depth, which usually means that **enumerate** lists will go (a), (b), (c), ... rather than 1, 2, 3, ...

1.4 Lists in paragraphs

parenum Answers to subparts tend to be compressed together into a single paragraph. It's nice, when you do this, not to have to worry about losing your numbering of subparts. The **parenum** environment provides an enumerated list in a paragraph. So, for example, you can say something like this.

Example of **parenum**

Exercise 2 A PRG $g: \{0, 1\}^k \rightarrow \{0, 1\}^L$ is *trivial* if $k \geq L$.

- (a) Show that trivial PRGs exist.
- (b) Show that a non-trivial (t, ε) -secure PRG is a $(t, \varepsilon + 2^{k-L})$ -secure one-way function.

```
\begin{exercise}
A PRG  $g$  colon  $\{0, 1\}^k$  to  $\{0, 1\}^L$  is \emph{trivial} if
 $k \geq L$ .
\begin{enumerate}
\item Show that trivial PRGs exist.
\item Show that a non-trivial  $(t, \varepsilon)$ -secure PRG is a
 $(t, \varepsilon + 2^{k-L})$ -secure one-way function.
\end{enumerate}
\answer
\begin{parenum}
\item The identity function is a trivial PRG: the real and random
games are identically distributed.
\item Let  $A$  be an adversary attempting to invert  $g$ : then we
can construct a distinguisher  $B$  as follows \ldots
\end{parenum}
\end{exercise}
```

1.5 And finally

\answers In order to extract your answers, say **\answers**.

Answers

1 Let A be an adversary attacking F as a MAC. Consider the adversary $B \dots$

2 (a) The identity function is a trivial PRG: the real and random games are identically distributed. (b) Let A be an adversary attempting to invert g : then we can construct a distinguisher B as follows \dots

```
\section*{Answers}
\answers
```

The `\answers` command has an optional argument, which is the file to read in. This allows you to make ‘answer booklet’ documents, by saying something like

```
\answers[otherdoc]
```

If you don’t give a file extension, then `.ans` is appended automatically.

2 Implementation

```
1 < *package>
```

2.1 Initialization

The `within` option is handled by the `mdwkey` package.

```
2 \RequirePackage{mdwkey}
```

`\ex@within` When the `within` option is seen, we set a command `\ex@within` to the correct code, to be executed later when we’ve made our minds up.

```
3 \let\ex@within\relax
4 \mkdef{exercise:opts}{within}{%
5   \def\ex@within{%
6     \@addtoreset{exercise}{#1}%
7     \toks@\expandafter{\csname the#1\expandafter\endcsname%
8       \expandafter.\theexercise}%
9     \edef\theexercise{\the\toks@}%
10  }%
11 }
```

`\ex@opts` The `\ex@opts` macro just runs the `mdwkey` kit to parse an option string.

```
12 \def\ex@opts{\mkparse{exercise:opts}}
```

Now do the options thing.

```
13 \DeclareOption*{\expandafter\ex@opts\expandafter{\CurrentOption}}
14 \ProcessOptions*
```

Set up the `exercise` counter, and number it within some other sort of counter as appropriate.

```
15 \newcounter{exercise}\ex@within
```

We also need the `sverb` package in order to do the delaying of the answers.

```
16 \RequirePackage{sverb}
```

2.2 Checking for counter changes

`\ex@ctrcheck` The counter checking state is stored here. It's initially empty.

```
17 \def\ex@ctrcheck{}
```

`\exctrcheck` Adding a counter to the check list is relatively easy. We expand the current list into a token register, add the new material to the end, and put the list back in our macro using `\edef`. The 'last' value of the counter is set to `\relax`, to force out the change on the next `\answer`.

```
18 \def\exctrcheck#1#2{%
19   \toks@\expandafter{\ex@ctrcheck\ex@ctrdo{#1}{#2}}%
20   \edef\ex@ctrcheck{\the\toks@}%
21   \global\expandafter\let\csname ex@ctrlast@#1\endcsname\relax%
22 }
```

`\ex@ctrdo` Here we actually check to see whether a counter has changed and execute the appropriate code.

```
23 \def\ex@ctrdo#1#2{%
24   \edef\@tempa{\csname the#1\endcsname}%
25   \expandafter\ifx\csname ex@ctrlast@#1\endcsname\@tempa\else%
26     #2%
27     \global\expandafter\let\csname ex@ctrlast@#1\endcsname\@tempa%
28   \fi%
29 }
```

2.3 The exercise environment

`\exercisename` We store the string to print for each exercise in `\exercisename` as a half-hearted attempt at internationalization.

```
30 \providecommand\exercisename{Exercise}
```

`\exfix` This is a dumping ground for style fixing common to both exercises and answers. Here, we bump on the `enum depth` counter, so that it skips labelling with digits.

```
31 \def\exfix{\advance\@enumdepth\@ne}
```

`exercise` This is pretty simple. The environment is list-based, with the number set in bold in a label.

```
32 \def\exercise{%
33   \refstepcounter{exercise}%
34   \exfix%
35   \trivlist\advance\itemindent\labelsep%
36   \item[\textbf{\exercisename\ \theexercise}]{%
37 }
38 \let\endexercise\endtrivlist
```

2.4 Answers

We need a file in which to store our answers.

```
39 \newwrite\ex@ansfile
```

`\ex@ansfilename` In case anyone has a better idea for a filename than our default, we provide a hook.

```
40 \def\ex@ansfilename{\jobname.ans}
```

We open the file at the end of the preamble, to give the user a chance to say `\nofiles`, or change `\ex@ansfilename`.

```
41 \AtBeginDocument{%
42   \if@files%
43     \immediate\openout\ex@ansfile=\ex@ansfilename\relax%
44     \answrite\relax%
45   \fi%
46 }
```

`\answrite` This writes stuff to the answers file. We make sure that it's appropriately protected, so that you can insert section headings and so on.

```
47 \def\answrite#1{%
48   \if@files%
49     \begingroup%
50     \let\protect\@unexpandable@protect%
51     \immediate\write\ex@ansfile{#1}%
52     \endgroup%
53   \fi%
54 }
```

`\answer` The `\answer` macro needs to read until the end of the enclosing exercise environment (or whatever).

```
55 \def\answer{\sv@readenv\ex@answer}
```

Now for the main guts.

```
56 \def\ex@answer#1#2{%
57   \begingroup%
58   \@bsphack%
```

First of all, check to see whether any counters have changed.

```
59   \ex@ctrcheck%
```

Start a `doanswer` environment in the file.

```
60   \answrite{\noexpand\begin{doanswer}{\theexercise}}%
```

Set catcodes to be strange, and read lines one-at-a-time, writing them to the file. When finished, continue at `\ex@endanswer`.

```
61   \let\do\@makeother\dospecials%
62   \sv@safespc%
63   \sv@read{#1}\answrite{\ex@endanswer#2}%
64 }
```

When that's done, we wind up here.

```
65 \def\ex@endanswer{%
66   \@esphack%
67   \answrite{\noexpand\end{doanswer}}}%
68   \endgroup%
69 }
```

`\skipanswer` This is much simpler.

```
70 \let\skipanswer\ignore
```

`\answers` The `\answers` macro closes the file, makes sure that future exercises with answers cause an error, and reads in the file.

```
71 \def\answers{%
72   \@ifnextchar[{\answers@i\input}{\answers@i\input[\ex@ansfilename]]}%
73 }
74 \def\answers@i#1[#2]{%
75   \immediate\closeout\ex@ansfile%
76   \global\let\answrite\exerr@toolate%
77   \ex@withtext{#1}{#2}{ans}%
78 }
79 \def\q@delim{\q@delim}
80 \def\ex@withtext#1#2#3{%
81   \edef\next@##1{\noexpand\ex@ext@i{##1}{#2}{#3}#2.\noexpand\q@delim}%
82   \next@{#1}%
83 }
84 \def\ex@ext@i#1#2#3#4.#5\q@delim{%
85   \ifx\q@delim#5\q@delim\def\next@{#1{#2.#3}}}%
86   \else\def\next@{#1{#2}}\fi%
87   \next@%
88 }
```

`doanswer` A very simple environment. We set the exercise number in bold and then just write the text.

```
89 \def\doanswer#1{%
90   \exfix%
91   \trivlist\advance\itemindent\labelsep%
92   \item[\textbf{#1}]%
93 }
94 \let\enddoanswer\endtrivlist
```

2.5 Lists inside paragraphs

`parlist` The `parlist` environment is a trimmed-down version of a normal list. We todge the `\item` command, make `\list` and `\trivlist` make errors, and do various normal list things.

```
95 \def\parlist#1#2{%
96   \let\@trivlist\exerr@parlist%
97   \def\@itemlabel{#1}%
98   \let\makelabel\relax%
99   \@nmbrlistfalse%
100   #2%
101   \let\item\pl@item%
```

```

102 \ignorespaces%
103 }

\pl@item This is the implementation of \item within a parlist. The main interesting point
is the game with boxes, which has the objective of extracting the text of the item,
together with any style changes set by \makelabel, but without any stupid bits
of glue, or \llap or anything like that.

104 \def\pl@item{\@ifnextchar[\pl@item@i{\pl@item@i[\@itemlabel]}}
105 \def\pl@item@i[#1]{%
106   \if@nmbbrlist\refstepcounter{\@listctr}\fi%
107   \setbox\z@\hbox{\makelabel{\global\setbox\@ne\hbox{#1}}}%
108   \ifvmode\leavevmode\else\unskip\hskip1em\fi\box\@ne~\ignorespaces%
109 }

\useparlist We just set the list environment to use parlist.

110 \def\useparlist{\let\list\parlist\let\endlist\relax}

parenum Very simple, this. Note that we don't run \endenumerate, because that's \let to
\endlist.

111 \def\parenum{\useparlist\enumerate}
112 \let\endparenum\endparlist

```

2.6 Errors

```

113 \def\exerr@toolate{%
114   \PackageError{exercise}{Too late now for \string\answrite}{%
115     You can't write answers after you've read the file in. I've^^J%
116     ignored the text you attempted to write. This is why answers^^J%
117     go at the end of a book!%
118   }%
119 }
120 \def\exerr@parlist{%
121   \PackageError{exercise}{You can't nest a 'list' inside a 'parlist'.}{%
122     I've found a 'list' or 'trivlist' environment nested inside^^J%
123     a 'parlist'. This isn't allowed. You're probably doomed now.%
124   }%
125 }
126 \end{package}

```

Done.

Mark Wooding, 25 August 2003

Appendix

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Version 2, June 1991

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Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

Gnomovision version 69, Copyright (C) yyyy name of author
Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type ‘show w’.
This is free software, and you are welcome to redistribute it under certain conditions; type ‘show c’ for details.

The hypothetical commands **show w** and **show c** should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than **show w** and **show c**; they could even be mouse-clicks or menu items—whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a “copyright disclaimer” for the program, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the program ‘Gnomovision’ (which makes passes at compilers) written by James Hacker.

signature of Ty Coon, 1 April 1989
Ty Coon, President of Vice

This General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Library General Public License instead of this License.

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