

A Multienumerate Package

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Abstract

The `multienum.sty` package allows the user to produce an enumerated array of multiple columns, each vertically aligned on the counter. An optional argument provides for consecutive numbering of the array items, or an even-only or odd-only numbering scheme.

Introduction

Typesetting the solutions manual for a text usually involves creating an enumerated list involving many short answers. Typically these are set with several items per line, with no attempt made to vertically align the exercise numbers. This article describes a package, `multienum.sty`, which provides an environment, `multienumerate`, that produces an enumerated array in which columns are vertically aligned on the counter. If the user wishes, the enumeration counter can be changed to give a list of even-only numbers or odd-only numbers.

1. Not	2. Linear	3. Not	
4. Quadratic	5. Not	6. Linear	
7. No; if $x = 3$, then $y = -2$.	8. $x = 2$		
9. $(x_1, x_2) = (2 + \frac{1}{3}t, t)$ or $(s, 3s - 6)$			
10. $y = 7$	11. $x + y = 3$ and $z = 1$		
12. $(2, -1, 3)$	13. None	14. $(2, 1, 0, 1)$	
15. 2	16. 3	17. 4	18. 5
19. $(0, 0)$ and $(0, 1)$	20. If $x = 1$, $y = -2$.		
21. $(10, 11, 0, 0)$	22. $(0, -1, 0, -5)$		

Table 1: An enumerated array of solutions

What the package does

Table 1 shows a typical enumerated array. The second entry in the third row is left blank since we want the first item to expand into its space. To get the vertical alignment of the counter in column 3, we set row 3 as three entries, but left the second entry blank thus giving more space for the first entry. To produce this array, we typed the following:

```
\begin{multienumerate}
\mitemxxx{Not}{Linear}{Not}
\mitemxxx{Quadratic}{Not}{Linear}
\mitemxox{No; if  $x=3$ ,
  then  $y=-2$ .}{ $x=2$ }
\mitemx{ $(x_1, x_2) = (2 + \frac{1}{3}t, t)$ }
   $(s, 3s - 6)$ }
\mitemxox{ $y=7$ }{ $x+y=3$  and  $z=1$ }
\mitemxxx{ $(2, -1, 3)$ }{None}{ $(2, 1, 0, 1)$ }
\mitemxxxx{2}{3}{4}{5}
\mitemxx{ $(0, 0)$  and  $(0, 1)$ }{If  $x=1$ ,
   $y=-2$ .}
\mitemxx{ $(10, 11, 0, 0)$ }{ $(0, -1, 0, -5)$ }
\end{multienumerate}
```

The environment `multienumerate` has an optional argument¹ for enumerating even-only or odd-only arrays.

- `\begin{multienumerate} ...`
`\end{multienumerate}`
produces a consecutively enumerated array
- `\begin{multienumerate}[evenlist] ...`
`\end{multienumerate}`
produces an enumerated array using only even numbers
- `\begin{multienumerate}[oddlist] ...`
`\end{multienumerate}`
produces an enumerated array using only odd numbers

Using the package

Each row of the enumerated array is set using one of nine commands:

¹ The optional argument works only with L^AT_EX2_ε.

<code>\mitemx</code>	A single item in the row.
<code>\mitemxx</code>	Two items in the row.
<code>\mitemxxx</code>	Three items in the row.
<code>\mitemxox</code>	Three items in the row with the center item left blank so the first item can extend into its space.
<code>\mitemxxo</code>	Three items in the row, the last item left blank so the second item can extend into its space.
<code>\mitemxxxx</code>	Four items in the row.
<code>\mitemxoxx</code>	Four items in the row, the second space left blank so the first item can extend into its space.
<code>\mitemxxox</code>	Four items in the row, the third space left blank so the second item can extend into its space.
<code>\mitemxxxxo</code>	Four items in the row, the last space left blank so the third item can extend into its space.

For example, `\mitemxxx{a}{b}{c}` sets the entries *a*, *b*, and *c* equally spaced across the row, while `\mitemxox{a}{c}` sets the two items, *a* and *c*, across the row *as if* there were three items, leaving the second entry blank so that the first entry can extend into its space; and `\mitemxxo{a}{b}` sets the two items, *a* and *b*, *as if* there were three items, but leaves the space for the third item blank, allowing the second entry to extend into its space.

A convenient way to use the multienumerate package is with a two column layout using multicols. Figure 2 at the end of the article illustrates several possibilities.

A disadvantage of the package is that the user must choose how to typeset each line in the array rather than letting TeX decide how to do it. This creates a lot of overhead in the macro since separate commands are needed for each possibility. It is not difficult to write a macro that will let TeX decide how many items to set on each line. While this approach is more efficient, especially if one changes the entries, it does not always give the visual appearance the user may want.

How the package works

We describe how the package typesets a line containing two items. The other situations are similar.

Figure 1 shows two items on a line, each consisting of a label box of width $lw=\text{\labelwidth}$, a label separation of width $ls=\text{\labelsep}$, and a box containing the entry itself (set `\raggedright`) of width $.5rxx=.5\text{\remainxx}$. The length `\remainxx` is the total space remaining after two label widths

and two label separations have been removed; thus, it is the amount of space available for typesetting the two entries, each in a box whose width is one-half `\remainxx`. Since the total width of the line is `\hsize`, it follows that

$$\underbrace{2\text{\labelwidth} + 2\text{\labelsep} + \text{\remainxx}}_{\text{\usedxx}} = \text{\hsize}$$

and therefore

$$\text{\remainxx} = \text{\hsize} - \text{\usedxx}$$

In this way the the width of the box is calculated when two items are typeset on the line.

The macro

A somewhat trimmed copy of the package follows (`\newlength` and `\newcounter` declarations, higher levels of multienumerate list nesting, and four-across items are omitted). The full source of the package may be obtained by anonymous ftp from CTAN macros/latex/contrib/other/misc/multienum.sty, or by email from the author.

```
%Create multiple item styles
\newcommand{\labelname}{%
  \csname labelenum\romannumeral
  \themultienumdepth\endcsname}
\newcommand{\itemx}[1]{\parbox[t]{%
  {\labelwidth}{\hfill{\labelname}}%
  \hskip\labelsep%
  \parbox[t]{\remainx}{\raggedright #1}%
  \smallskip}
\newcommand{\itemxx}[2]{\parbox[t]{%
  {\labelwidth}{\hfill{\labelname}}%
  \hskip\labelsep\parbox[t]{%
  {.5\remainxx}{\raggedright #1}
  \hfill\parbox[t]{%
  {\labelwidth}{\hfill{\labelname}}%
  \hskip\labelsep\parbox[t]{%
  {0.5\remainxx}{\raggedright #2}
  \smallskip}
\newcommand{\itemxxx}[3]{\parbox[t]{%
  {\labelwidth}{\hfill{\labelname}}%
  \hskip\labelsep\parbox[t]{%
  {.3333\remainxxx}{\raggedright #1}
  \hfill\parbox[t]{%
```

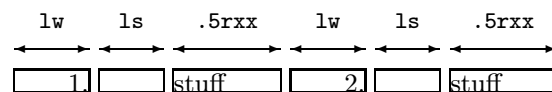


Figure 1: One line containing two items

```

{\labelwidth}{\hfill {\labelname}}
\hskip\labelsep\parbox[t]{%
  {0.3333\remainxxx}{\raggedright #2}
\hfill\parbox[t]{%
  {\labelwidth}{\hfill{\labelname}}
\hskip\labelsep\parbox[t]{%
  {0.3333\remainxxx}{\raggedright #3}
\smallskip}
\newcommand{\itemxox}[2]{\parbox[t]{%
  {\labelwidth}{\hfill{\labelname}}
\hskip\labelsep\parbox[t]{%
  {\remainxox}{\raggedright #1}
\hfill\parbox[t]{%
  {\labelwidth}{\hfill{\labelname}}
\hskip\labelsep\parbox[t]{%
  {0.3333\remainxxx}{\raggedright #2}
\smallskip}
\newcommand{\itemxox}[2]{\parbox[t]{%
  {\labelwidth}{\hfill{\labelname}}
\hskip\labelsep\parbox[t]{%
  {0.3333\remainxxx}{\raggedright #1}
\hfill\parbox[t]{%
  {\labelwidth}{\hfill{\labelname}}
\hskip\labelsep\parbox[t]{%
  {\remainxox}{\raggedright #2}
\smallskip}
%Define counter options
\newcommand{\oddlisti}{%
  \setcounter{multienumi}{-1}%
  \renewcommand{\labelenumi}{%
    {\ifodd\value{multienumi}%
      \addtocounter{multienumi}{2}%
      \themultienumi.\else
      \addtocounter{multienumi}{1}%
      \themultienumi.%
      \addtocounter{multienumi}{-2}\fi}}
\newcommand{\evenlisti}{%
  \setcounter{multienumi}{0}
  \renewcommand{\labelenumi}{%
    {\ifodd\value{multienumi}%
      \addtocounter{multienumi}{1}%
      \themultienumi.%
      \addtocounter{multienumi}{-2}\else
      \addtocounter{multienumi}{2}%
      \themultienumi.\fi}}
\newcommand{\regularlisti}{%
  \setcounter{multienumi}{0}%
  \renewcommand{\labelenumi}{%
    {\addtocounter{multienumi}{1}%
      \arabic{multienumi}.}}
\newcommand{\listtype}[1]{#1}
\newcommand{\mitemx}[1]{%
  \item[] \itemx{#1}}
\newcommand{\mitemxx}[2]{%
  \item[] \itemxx{#1}{#2}}
\newcommand{\mitemxxx}[3]{%
  \item[] \itemxxx{#1}{#2}{#3}}
\newcommand{\mitemxox}[2]{%
  \item[] \itemxox{#1}{#2}}
\newcommand{\mitemxox}[2]{%
  \item[] \itemxox{#1}{#2}}
%Define the multienumerate environment
\newenvironment{multienumerate}%
  [1][regularlist]{%
  \ifnum \themultienumdepth > 3
  \@toodeep\else
  \addtocounter{multienumdepth}{1}
  \edef\@multienumctr{%
    multienum\romannumeral%
    \themultienumdepth}
  {\csname label\@multienumctr%
    \endcsname}{%
    \usecounter{\@multienumctr}}%
  \listtype{\csname#1\romannumeral
    \themultienumdepth\endcsname}\fi
\begin{list}}{-%
  \ifnum\themultienumdepth=2
  \setlength{\leftmargin}{23pt} \else
  \setlength{\leftmargin}{0pt} \fi%
  \setlength{\labelwidth}{18pt}%
  \setlength{\labelsep}{5pt}%
  \setlength{\usedx}{\labelwidth}%
  \addtolength{\usedx}{\labelsep}%
  \addtolength{\usedx}{\leftmargin}%
  \setlength{\remainx}{\hspace}%
  \addtolength{\remainx}{-\usedx}%
  \setlength{\usedxx}{2\labelwidth}%
  \addtolength{\usedxx}{2\labelsep}%
  \addtolength{\usedxx}{\leftmargin}%
  \setlength{\remainxx}{\hspace}%
  \addtolength{\remainxx}{-\usedxx}%
  \setlength{\usedxxx}{3\labelwidth}%
  \addtolength{\usedxxx}{3\labelsep}%
  \addtolength{\usedxxx}{\leftmargin}%
  \setlength{\remainxxx}{\hspace}%
  \setlength{\remainxox}{.666\remainxxx}%
  \addtolength{\remainxox}{\labelwidth}%
  \addtolength{\remainxox}{\labelsep}%
  \setlength{\itemindent}{0pt}}{-%
  \addtocounter{multienumdepth}{-1}%
\end{list}}

```

Answers to Even Exercises**Chapter 1****Section 1**

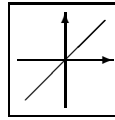
- | | | |
|------------------------|--------------|-------------|
| 2. 2 | 4. 5 | 6. -4 |
| 8. $x = 1$ | 10. $y = -7$ | 12. $z = 3$ |
| 14. $x^2 - 3x + 7 = 0$ | | 16. Yes |
| 18. 2 | 20. 5 | 22. -4 |
| 24. $x = 1$ | 26. $y = -7$ | 28. $z = 3$ |
| 30. $x^2 - 3x + 7 = 0$ | | 32. Yes |
| 34. 2 | 36. 5 | 38. -4 |
| 40. $x = 1$ | 42. $y = -7$ | 44. $z = 3$ |
| 46. $x^2 - 3x + 7 = 0$ | | 48. Yes |
| 50. 2 | 52. 5 | 54. -4 |
| 56. $x = 1$ | 58. $y = -7$ | 60. $z = 3$ |
| 62. 2 | 64. 5 | 66. -4 |
| 68. $x = 1$ | 70. $y = -7$ | 72. $z = 3$ |
| 74. 2 | 76. 5 | 78. -4 |

Section 2

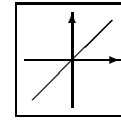
- | | |
|--|--------------------------|
| 2. Yes | 4. $3x^2 + x = -2$ |
| 6. If $x = 1$, the only solution is $y = 3$. | |
| 8. $x = 1$ | 10. $y = -7$ 12. $z = 3$ |
| 14. Yes | 16. No 18. No |
| 20. 2 | 22. 5 24. -4 |
| 26. $x^2 - 3x + 7 = 0$ | 28. Yes |

- | | | |
|------------------------|--------------|-------------|
| 30. 2 | 32. 5 | 34. -4 |
| 36. $x = 1$ | 38. $y = -7$ | 40. $z = 3$ |
| 42. $x^2 - 3x + 7 = 0$ | | 44. Yes |
| 46. 2 | 48. 5 | 50. -4 |

52.



54.



56. Billy should sell 3 red marbles, buy 2 white marbles, and keep the rest.
58. Sarah should buy 2 pounds of squash, 3 pounds of potatoes, and 4 pounds of fish.

Answers to Odd Exercises**Chapter 2****Section 1**

- | | | | |
|-------------------|--------------------|-----------------------|-------------|
| 1. Yes | 3. No | 5. No | 7. 3 |
| 9. 5 | 11. 2 | 13. -8 | 15. 7 |
| 17. $2x - 3y = 6$ | | 19. 1 | 21. -2 |
| 23. 2 | 25. 5 | 27. $3x^2 - 2y^2 = 1$ | |
| 29. $y = 3$ | 31. -5 | 33. $x = 9$ | 35. $y = 1$ |
| 37. 7 | 39. $2x + 3y = -5$ | 41. 6 | |
| 43. 7 | 45. 3 | 47. 1 | 49. 6 |

Quiz #1. Circle the correct answer.

- Which of the following numbers is a solution of the equation $2x + 5 = 9$:
a. 0 b. 1 c. 2 d. 3
- Which of the following numbers is a solution of the equation $x^2 + 5 = 9$:
a. 0 b. -1 c. -2 d. -3
- Which of the following expressions is equal to $x^2 - y^2$:
a. $(x - y)^2$ b. $(x + y)^2$
c. $(x - y)(x + y)$ d. 0
- The graph of the equation $3x^2 - 2y = 0$ is a:
a. circle b. parabola
c. ellipse d. line
- If $x = 2$, then the value of $x^3 - x + 3$ is:
a. 2 b. 6 c. None of these.
- Which of the following statements correctly expresses the meaning of the algebraic expression $2(x + y) = 6$:
a. twice the value of x added to twice the value of y is equal to 6 b. twice the sum of x and y is equal to 6
- Evaluate the expression $2 - [3 + (5 - 9)] + -3$.
a. 6 b. -1 c. 4 d. 0
- Evaluate the expression $5 + [3 - (1 + -2)]$.
a. 5 b. -1 c. 9 d. 1

Figure 2: Samples typeset using `multienum.sty`