

The `ytableau` package*

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For Greta

1 Y tableau?

At the time this package was first written, there there existed two packages with which one can draw Young tableaux: `young` and `youngtab`. As the latter is explicitly an alternative to the former, they do not overlap very much except in what they eventually produce. Between them, they define the following three basic constructions of Young tableaux:

- An environment with array-style syntax;
- A short-form macro;
- An even shorter-form macro for drawing Young diagrams (having nothing inside the boxes).

In this package we also implement these methods. However, we aim to take them as far as possible so that the conceivable needs of a mathematician making serious use of Young tableaux can be met with as little effort as possible on their part (and, thus, great effort on the part of this author). In writing this package we pursued the following major goals:

- The syntax should be as convenient as possible. The `young` package makes unfortunate use of the `\cr` delimiter for lines in an array, which is nowhere to be seen in modern \LaTeX and is likely unfamiliar to casual, young writers. The `youngtab` package requires the author to define individual, separate macros to draw items requiring more than one token to represent in \TeX . That is, if a cell of a tableau is to contain the expression $n + 1$, then one must place it into an auxiliary macro. Also, the same command, `\young`, delimits its contents with parentheses `(...)` rather than braces `{...}`.
- The package should make no assumptions about the intentions of the user. In particular, esoteric constructions such as skew tableaux and disconnected tableaux are not in principle any more difficult to draw, and should be no more difficult to write.
- Tableaux should support totally arbitrary decoration. We took this to mean that they should be easily colored; this possibility allows the depiction of tableaux within tableaux, an application which was specifically requested of the author (and was the original reason for writing this package).
- Configuration should be easy and plentiful. The `young` package has none, while `youngtab` package uses a strange syntax. Now that `keyval` is available there is no excuse for not providing a keyword-driven user interface to options controlling all aspects of the appearance of tableaux.

- Interoperability with all the common environments. In particular, since this is a mathematics package, it should work properly in the AMS environments, and since it is an array-based package it should work properly in array environments.

We believe the package achieves all these things. There should be nothing that one would want to do with Young tableaux that cannot be accomplished in the obvious way using the commands given below.

Requirements

This package is quite self-contained and I have tried to avoid pulling in very large prerequisites. It includes `pgfkeys`, `pgfplots`, and `xcolor`, and specifically requires version 2 (2011/06/02) of `pgfplots`; this is enforced in the code.

2 User commands

We provide three commands for drawing Young tableaux and diagrams. Each one is convenient for slightly different purposes and each supports various operations more or less easily than the others.

2.1 The `ytableau` environment

`ytableau` The `ytableau` environment is the core drawing engine for this package. It may be called as follows (similarly to `young`):

```
\begin{ytableau}[\langle general formatting \rangle]
  \langle entry \rangle & *(\langle color name \rangle) \langle entry \rangle & \dots \ \backslash
  \dots
\end{ytableau}
```

The result is an array of boxes separated by lines of width `0.4pt` (not tunable, and not affected by outside influences), each containing the entries specified in the environment.

Each `\langle entry \rangle` is typeset in math mode (by default, but text mode is possible) and the entries are horizontally and (mostly) vertically centered in their box. In fact, the entries are treated as though they consist of a single line of text, and the baselines of all the entries in a row are aligned with each other for a consistent appearance (but see the options).

The environment may appear in or out of math mode without any ill effect (and without any effect on the contents). However, it *is* affected by the ambient font size: in `\Huge` text the entire tableau is correspondingly Huge, at least as long as you are careful to specify the box size in `em` or `ex` units, rather than invariant ones like `pt`.

`\none` An entry may be omitted by writing `\none`, which prevents the drawing of a frame but places an invisible box of the correct dimension inside the entry. Thus, one may create a tableau “starting” at an offset or even a “tableau” consisting of several disconnected regions. One can actually get things into these “empty” boxes by passing an optional argument to `\none`.

The $\langle color\ name \rangle$ can be any color name familiar to the package `xcolor`, or (of course) user-defined. The background of this box will be drawn in that color; by default, if no color is given the background is *transparent*, which probably means white, unless the tableau is somehow overlaid on something else (see 2.4).

The $\langle general\ formatting \rangle$ is simply \TeX material which is placed in front of each $\langle entry \rangle$. It can also contain a $\langle color\ name \rangle$, which is overridden by those specified individually.

2.2 The `ytableaushort` command

`\ytableaushort` This command (however ironically named) allows inline specification of a tableau:

```
\ytableaushort [ $\langle general\ formatting \rangle$ ] { $\langle line \rangle$ , $\langle line \rangle$ ,...}
```

where $\langle general\ formatting \rangle$ is as before, and each $\langle line \rangle$ is a sequence of tokens representing entries in the tableau, similarly to `youngtab`. However, it is possible to include complex entries by surrounding them in `{...}`. This command internally reduces its functioning to `ytableau`, so the entries may contain colors and in general behave exactly as described above.

2.3 The `ydiagram` command

`\ydiagram` This command draws Young diagrams somewhat in the manner of `youngtab`:

```
\ydiagram [ $\langle general\ formatting \rangle$ ] { [ $\langle offset \rangle$  +] $\langle number \rangle$ ,...}
```

producing an array of *identical* boxes (empty by default), each row having $\langle number \rangle$ in it with $\langle offset \rangle$ blank boxes preceding ($\langle offset \rangle$ is optional but, when provided, is not written with `[...]`). Thus, a typical invocation might be

```
\ydiagram{2 + 1, 3, 1}.
```

Both $\langle offset \rangle$ and $\langle number \rangle$ may be any \TeX expressions evaluating to the textual representation of a number, including zero (e.g. `6` or `\thecountername`, but not just `\countername`). The boxes can be colored or filled with a single expression by means of $\langle general\ formatting \rangle$.

2.4 Chaining

The coloring facility for `\ydiagram` is not very interesting as-is. Thus, the package allows for the augmentation of several diagrams in the following manner:

`\ydiagram` $\langle arguments \rangle * \langle arguments \rangle * \dots$

produces a *single* Young diagram obtained by layering the ones specified by the various $\langle arguments \rangle$ from left (on top) to right (at the bottom). In fact, one can even write

`\ytableaushort` $\langle tableau arguments \rangle * \langle diagram arguments \rangle * \dots$

where first a Young tableau is constructed according to the initial set of arguments, then all subsequent arguments are passed to `\ydiagram`, with the result layered from left to right. This allows the construction of arbitrary color patterns with arbitrary contents.

This operation is not possible with `\begin{ytableau}... \end{ytableau}` since the `\end` command obscures the following text from the internally-called `\endytableau` command. If you want to chain a `ytableau`, instead write it in the T_EX style `\ytableau... \endytableau`. Unfortunately it is not possible to work around this.

3 Package options

The package accepts the following options:

- | | |
|--|---|
| <code>boxsize</code> | <ul style="list-style-type: none"> • <code>boxsize=</code>$\langle dimension \rangle$. This manually sets the height (and width, which is the same) of boxes in all tableaux to $\langle dimension \rangle$. If you change the size and want to get back to the default (1.5em), just say <code>boxsize = normal</code>. |
| <code>boxframe</code> | <ul style="list-style-type: none"> • <code>boxframe=</code>$\langle dimension \rangle$. Like <code>boxsize</code>, but sets the width of the lines of the frame around the boxes of the tableau to $\langle dimension \rangle$. If you change the size and want to get back to the default (0.04em) just say <code>boxframe = normal</code>. |
| <code>smalltableaux</code>
<code>nosmalltableaux</code> | <ul style="list-style-type: none"> • <code>smalltableaux/nosmalltableaux</code>. The first option makes the box size quite small; indeed, just small enough to fit a $\\$($\\$ precisely. It also passes <code>\scriptstyle</code> to each box, which as usual can be overridden if you wish (but you don't). The second option returns things to how they were, as do <code>smalltableaux=false</code> and <code>smalltableaux=off</code>. |
| <code>aligntableaux</code>
<code>centertableaux</code>
<code>nocentertableaux</code> | <ul style="list-style-type: none"> • <code>aligntableaux=</code>$\langle alignment \rangle$/<code>centertableaux/nocentertableaux</code>. The first argument allows any of <code>top</code>, <code>center</code>, or <code>bottom</code>. With <code>top</code>, the tableaux are all aligned on the baseline of their top row, with <code>bottom</code> they are aligned on the baseline of their bottom row, and <code>center</code> centers them (they correspond to <code>\vtop</code>, <code>\vbox</code>, and <code>\vcenter</code>). The other two arguments are semantically pleasing shorthand for <code>aligntableaux = center</code> and <code>aligntableaux = top</code>. |
| <code>textmode</code>
<code>mathmode</code> | <ul style="list-style-type: none"> • <code>textmode/mathmode</code>. The former sets all the boxes in text mode, and the latter returns to math mode (the default). |

- `baseline` • `baseline/nobaseline/centerboxes`. The former, which is the default, aligns the entries of each box so that they share a common baseline, like normal text (but are otherwise centered). The latter (which are synonyms) center them vertically and independently of each other. Use `nobaseline` for tableaux with numbers, but `baseline` for anything else, particularly anything with some depth.
- `tabloids` • `tabloids/notabloids`. The former switches off drawing the vertical edges in a tableau, producing a “tabloid”; the latter (the default) switches them back on. Syntax such as `tabloids = off` or `tabloids = true` is allowed.

It may not be useful to set these options globally, so we provide a macro for changing each of these parameters “on the fly”:

`\ytableausetup` Takes all of the above options and acts on them, setting parameters for all subsequent tableaux. The assignments are global with respect to $\text{T}_{\text{E}}\text{X}$ nestings.

4 Samples

Note that the option settings are persistent.

4.1 Standard Young tableaux

a	d	f
b	e	g
c		

```
\ytableausetup{centertableaux}
\begin{ytableau}
a & d & f \\
b & e & g \\
c
\end{ytableau}
```

a	d	f
b	e	g
c		

```
\ytableausetup{textmode, boxframe=0.1em}
\begin{ytableau}
a & d & f \\
b & e & g \\
c
\end{ytableau}
```

1	2	3	...	$2n-1$	$2n$
2	3	4	...	$2n$	
\vdots	\vdots	\vdots			
$2n-1$	$2n$				
$2n$					

```
\ytableausetup
{mathmode, boxframe=normal, boxsize=2em}
\begin{ytableau}
1 & 2 & 3 & \none[\dots]
& \scriptstyle 2n - 1 & 2n \\
2 & 3 & 4 & \none[\dots]
& 2n \\
\none[\vdots] & \none[\vdots]
& \none[\vdots] \\
\scriptstyle 2n - 1 & 2n \\
2n
\end{ytableau}
```

1	2	3
4	5	
6		

1	3
4	5
6	

```

\ytableaushort{
  {boxsize=normal,tablods}
\ytableaushort{
  123, 45, 6
}
\hfill
\ytableaushort{
  \none 23, 45, 6
}

```

4.2 Skew tableaux

		1	2
	1	2	
1	2		
2			

```

\ytableaushort{notablods}
\begin{ytableau}
  \none & \none & 1 & 2 \\
  \none & 1 & 2 \\
  1 & 2 \\
  2
\end{ytableau}

```

	1	2
	1	2
1	2	
2		

	1	2
	1	2
1	2	
2		

```

\ytableaushort{smalltableaux}
\ytableaushort{
  \none\none12, \none12, 12, 2}
\ytableaushort{nobaseline}
\ytableaushort{
  \none\none12, \none12, 12, 2}

```



```

\ydiagram{2+2, 1+2, 2, 1}
\ydiagram{2+2, 0, 0+2, 1}

```

4.3 Color and chaining

1	3	5
2	4	
6		

```

\ytableaushort{nosmalltableaux}
\begin{ytableau}
  *(red) 1 & *(red) 3 & *(red) 5 \\
  *(blue) 2 & *(blue) 4 \\
  *(blue) 6
\end{ytableau}

```

x_1	x_3	x_5
x_2	x_4	
x_6		

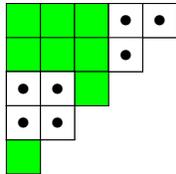
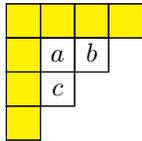
x_1	x_3	x_5
x_2	x_4	
x_6		

```

\ytableaushort{baseline}
\ytableaushort[* (green) x_]
  {135, {*(white)2}4, 6}
{\Large
\ytableaushort[* (green) x_]
  {135, {*(white)2}4, 6}
}

```

$$\begin{array}{|c|c|c|} \hline x_1 & x_3 & x_5 \\ \hline x_2 & x_4 & \\ \hline x_6 & & \\ \hline \end{array} + \begin{array}{|c|c|c|c|} \hline \color{red} & \color{red} & \color{red} & \color{red} \\ \hline \end{array} + \begin{array}{|c|c|c|} \hline \color{blue} & \color{blue} & \color{blue} \\ \hline \color{blue} & & \\ \hline \color{blue} & & \\ \hline \end{array} = \begin{array}{|c|c|c|} \hline \color{red} & \color{red} & \color{red} \\ \hline \color{blue} & \color{blue} & \\ \hline \color{blue} & & \\ \hline \end{array} \quad (1)$$



```

\begin{multline}
\ytableaushort{
  \boxsize=1.25em}
\ytableaushort{
  \aligntableaux=top}
\ytableaushort[x_]{135,24,6}
+ \ydiagram[*\color{red}]{3} \backslash
+ \ydiagram[*\color{blue}]{3,2,1}
= \ytableaushort[x_]{135,24,6}
*[*\color{red}]{3} *[*\color{blue}]{3,2,1}
\end{multline}

```

```

\ytableaushort{centertableaux}
\ytableaushort{
  {\none,\none ab, \none c}
* {4,3,2,1}
* [*\color{yellow}]{4,1,1,1}

```

```

\ydiagram[*\color{white} \bullet]
{3+2,3+1,2,2}
*[*\color{green}]{5,4,3,2,1}

```

5 The Code

5.1 Global definitions

Here are all the registers set and “variables” used.

5.1.1 Box registers

- `\tableaux@YT` When chaining, collects the successive tableaux.
- `\thistableau@YT` When chaining, stores the current tableau in the chain. Used in `\endytableau`.
- ```
1 \newbox\tableaux@YT
2 \newbox\thistableau@YT
```
- `\thisbox@YT` Stores the box currently being constructed. We define it as an alias because it is local to the construction of `\thistableau@YT` and, afterwards, irrelevant. Used in `\startbox@@YT` and `\endbox@YT`.
- ```
3 \let\thisbox@YT=\thistableau@YT
```
- `\refhtdp@YT` Box that holds the reference-height and -depth character, which should be a math-mode parenthesis. This is set in `\ytableau` and used in option `smalltableaux` and in `\endbox@YT`.
- ```
4 \newbox\refhtdp@YT
```

#### 5.1.2 Token registers

- `\toks@YT` Accumulates what will be put in the `ytableau` environment. Used in `\ydiagram`, `\getnumbers@YT`, `\getentries@@YT`, `\loop@YT`, and `\ytableaushort`.
- ```
5 \newtoks\toks@YT
```
- `\opttoksa@YT` Store the optional arguments (minus color specifications) when processing each entry of the tableau. Also used as temporary token registers. Used in `\startbox@YT`, `\getline@YT`.
- ```
6 \newtoks\opttoksa@YT
7 \newtoks\opttoksb@YT
```

#### 5.1.3 Dimension registers

- `\boxdim@YT` The size of the boxes in a tableau. Used in `\ytableau`, `\startbox@@YT`, `\endbox@YT`.
- ```
8 \newdimen\boxdim@YT
```
- `\tableauwd@YT` Save the total width of a tableau for supporting the “chaining” operation. Used in `\endytableau`.
- ```
9 \newdimen\tableauwd@YT
```

#### 5.1.4 Count registers

`\count@YT` Just a counter for looping. Used in `\loop@YT`, `\fullexpand@YT`.  
10 `\newcount\count@YT`

#### 5.1.5 Macros

`\ifstar@YT` Fix a bug with `amsmath` where `\@ifnextchar` (used in `\@ifstar`) doesn't ignore spaces.

```
11 \def\ifstar@YT#1{\kernel@ifnextchar *{\@firstoftwo{#1}}}
```

`\expandonce@YT` This is a substitute for using all of `etoolbox`. It operates on one token.

```
12 \def\expandonce@YT#1{%
13 \expandafter\unexpanded\expandafter{#1}%
14 }
```

`\nil@YT` A useful marker; it is equal to itself both as text and as a macro.

```
15 \def\nil@YT{\nil@YT}
```

`\boxframe@YT` The font-independent "normal" width of the frame in a tableau. Used in option `boxframe`.

```
16 \def\boxframe@normal@YT{0.04em}
17 \edef\boxframe@YT{\boxframe@normal@YT}
```

`\boxdim@normal@YT` Respectively, the font-independent "normal" box size and the previously used size when using the option pair `smalltableaux`, `nosmalltableaux`. Used in options `boxsize`, `smalltableaux`, `nosmalltableaux`.

`\boxdim@save@YT`

```
18 \def\boxdim@normal@YT{1.5em}
19 \let\boxdim@save@YT = \boxdim@normal@YT
```

`\macro@boxdim@YT` The font-independent dimension of a tableau box. Sometimes is a `\dimexpr`. Used in options `boxsize`, `smalltableaux`, `nosmalltableaux`, and in `\ytableau`.

```
20 \edef\macro@boxdim@YT{\boxdim@normal@YT}
```

`\hrule@normal@YT` `\hrule` and `\vrule` for drawing the frames around tableau cells. The vertical ones are a little shorter to produce a small overlap that eliminates gaps at the corners without producing anti-gaps in the hinting at the edges. I am basically copying the idea from `xcolor`'s `\boxframe`.

`\vrule@normal@YT`

```
21 \def\hrule@normal@YT{%
22 \hrule width \dimexpr \boxdim@YT + \fboxrule * 2\relax
23 height \fboxrule
24 }
25 \def\vrule@normal@YT{%
26 \vrule height \dimexpr \boxdim@YT + \fboxrule\relax
27 width \fboxrule
28 }
```

`\hrule@none@YT` Fake rules for `\none` to give the correct spacing.

```

\vrule@none@YT 29 \def\hrule@none@YT{\kern\fbboxrule}
 30 \def\vrule@none@YT{%
 31 \vrule width Opt
 32 height \dimexpr \boxdim@YT + \fbboxrule\relax
 33 \kern\fbboxrule
 34 }

```

`\font@YT` This is the font style of everything in a tableau box. By default, it is normal. Used in option `smalltableaux`.

```

 35 \def\font@YT{}

```

`\skipin@YT` Stores the delimiter for text mode or math mode which absorbs spaces around the contents of a box.

`\skipout@YT`

`\smallfont@YT` The font style for the `smalltableaux` option. It depends on math or text mode.

`\set@mathmode@YT` This sets up the tableau boxes to typeset in math mode.

```

 36 \def\set@mathmode@YT{%
 37 \gdef\skipin@YT{$}%
 38 \gdef\skipout@YT{$}%
 39 \def\smallfont@YT{\scriptstyle}%
 40 }

```

`\set@textmode@YT` This sets up the tableau boxes to typeset in text mode. In text mode, the `skipout` macro has to `\unskip` prior spaces, while the `skipin` macro has to ignore following ones.

```

 41 \def\set@textmode@YT{%
 42 \gdef\skipin@YT{\ignorespaces}%
 43 \gdef\skipout@YT{\unskip}%
 44 \def\smallfont@YT{\scriptsize}%
 45 }

```

The default is math mode.

```

 46 \set@mathmode@YT

```

`\thisboxcolor@YT` Stores the color of the current box in a tableau. The color `clear` is not recognized by `xcolor` but denotes for us a transparent box. Used in `\getcolor@YT` and `\endbox@YT`.

```

 47 \def\thisboxcolor@YT{clear}

```

`\centering@YT` What kind of vertical alignment our tableaux will have. Used in `\ytableau` and options `aligntableaux`, `centertableaux`, `nocentertableaux`.

```

 48 \def\centering@YT{top}

```

`\compare@YT` Compares two strings. Neither of them should be hidden in macros; i.e. it compares exactly what is given. Used in options `boxsize` and `aligntableaux` as well as in `\getline@YT`, `\getentries@YT`, `\loop@YT`, and `\getnumbers@YT`.

`\compare@YT` Compares two strings, where the first is hidden in one layer of macros. Used in `\endytableau`, `\fcolorbox@YT`.

```
\ifeq@YT Tests the result of \compare@YT(@).
49 \def\compare@YT#1#2{%
50 \def\tmpa@YT{#1}\def\tmpb@YT{#2}%
51 \ifx\tmpa@YT\tmpb@YT
52 \global\eq@YTtrue
53 \else
54 \global\eq@YTfalse
55 \fi
56 }
57 \def\compare@@YT#1#2{%
58 \def\tmpb@YT{#2}%
59 \ifx#1\tmpb@YT
60 \global\eq@YTtrue
61 \else
62 \global\eq@YTfalse
63 \fi
64 }
65 \newif\ifeq@YT
```

## 5.2 Options

We include `pgfkeys` to support various options.

```
66 \RequirePackage{pgfkeys}
67 \pgfkeys{/ytableau/options/.is family}
```

`\ytableausetup` The user interface to options once the document is in progress.

```
68 \newcommand{\ytableausetup}[1]{\pgfkeys{/ytableau/options,#1}}
69 \pgfkeys{/ytableau/options,
```

`boxsize` Box size. Takes a dimension or `normal`.

```
70 boxsize/.value required,
71 boxsize/.code = {%
```

Make tableaux un-small before changing the box size, even if the user wants to go smaller, because there is also the issue of `\font@YT` being set, and it is only ever changed in that option.

```
72 \pgfkeysalso{nosmalltableaux}%
73 \compare@YT{#1}{normal}%
74 \ifeq@YT
75 \xdef\macro@boxdim@YT{\expandonce@YT\boxdim@normal@YT}%
76 \else
77 \xdef\macro@boxdim@YT{#1}%
78 \fi
79 }
80 }
81 \pgfkeys{/ytableau/options,
```

`boxframe` Box frame width. Takes a dimension or `normal`.

```
82 boxframe/.value required,
83 boxframe/.code = {%
84 \compare@YT{#1}{normal}%
85 \ifeq@YT
86 \xdef\boxframe@YT{\expandonce@YT\boxframe@normal@YT}%
87 \else
88 \xdef\boxframe@YT{#1}%
89 \fi
90 }
91 }
92 \pgfkeys{/ytableau/options,
```

`aligntableaux` Most general alignment option, can be any of `top`, `center`, or `bottom`.

```
93 aligntableaux/.value required,
94 aligntableaux/.is choice,
95 aligntableaux/top/.code = {\gdef\centering@YT{top}},
96 aligntableaux/center/.code = {\gdef\centering@YT{center}},
97 aligntableaux/bottom/.code = {\gdef\centering@YT{bottom}},
```

`centertableaux` `centertableaux` is `aligntableaux = center`.

```
98 centertableaux/.value forbidden,
99 centertableaux/.style = {aligntableaux/center},
```

`nocentertableaux` `nocentertableaux` is `aligntableaux = top`.

```
100 nocentertableaux/.value forbidden,
101 nocentertableaux/.style = {aligntableaux/top}
102 }
```

`\ifsmalltableaux@YT` This conditional tracks whether we are operating under the option `smalltableaux`.

```
103 \newif\ifsmalltableaux@YT
104 \pgfkeys{/ytableau/options,
```

`smalltableaux` Small tableaux: reduce the box size and the text size.

```
105 smalltableaux/.default = true,
106 smalltableaux/.is choice,
107 smalltableaux/true/.code = {%
```

We check whether we are “in” small tableaux; this prevents double-calling the option. Even if the user is not so malicious, this can (does) happen in the `amsmath` display environments.

```
108 \ifsmalltableaux@YT\else
109 \global\smalltableaux@YTtrue
110 \gdef\font@YT{\smallfont@YT}%
```

We expand once here and later so that `\macro@boxdim@YT` can be evaluated lazily.

```
111 \xdef\boxdim@save@YT{\expandonce@YT\macro@boxdim@YT}%
```

This one must be a `\def` rather than an `\edef` because `\refhtdp@YT` is not set until later.

```

112 \gdef\macro@boxdim@YT{%
113 \dimexpr \ht\refhtdp@YT + \dp\refhtdp@YT + 0.1em\relax
114 }
115 \fi
116 },
117 smalltableaux/false/.code = {%
118 \ifsmalltableaux@YT
119 \global\smalltableaux@YTfalse
120 \gdef\font@YT{%
121 \xdef\macro@boxdim@YT{\expandonce@YT\boxdim@save@YT}%
122 \fi
123 },
124 smalltableaux/on/.style = {smalltableaux/true},
125 smalltableaux/off/.style = {smalltableaux/false},

```

`nosmalltableaux` `nosmalltableaux` resets everything to the way it was before `smalltableaux` was passed.

```

126 nosmalltableaux/.value forbidden,
127 nosmalltableaux/.style = {smalltableaux/false}

128 }
129 \pgfkeys{/ytableau/options,

```

`textmode` Requests that the boxes in tableaux be typeset in text mode rather than the default math mode.

```

130 textmode/.value forbidden,
131 textmode/.code = \set@textmode@YT,

```

`mathmode` The inverse of `textmode`.

```

132 mathmode/.value forbidden,
133 mathmode/.code = \set@mathmode@YT,
134 }

```

`\ifbaseline@YT` Whether or not to create a baseline in the tableau boxes.

```

135 \newif\ifbaseline@YT

136 \pgfkeys{/ytableau/options,

```

`baseline` Switches whether the cells of the tableau should have their sizes normalized (and thus establish a common baseline in each row). Enabling it (the default) improves the appearance of text and symbols.

```

137 baseline/.is if = baseline@YT,
138 baseline/.default = true,

```

`nobaseline` Synonymous with `baseline = false`. Improves the appearance of tableaux with numbers in their cells.

```

139 nobaseline/.style = {baseline = false},

```

`centerboxes` Synonymous with `baseline = false`.

```
140 centerboxes/.style = {baseline = false},
141 }
142 \pgfkeys{/ytableau/options,
```

`tabloids` Causes the vertical lines of a tableau to be omitted.

```
143 tabloids/.default = true,
144 tabloids/.is choice,
145 tabloids/true/.code = {%
146 \global\let\vrule@YT=\vrule@none@YT
147 \global\let\hrule@YT=\hrule@normal@YT
148 },
149 tabloids/false/.code = {%
150 \global\let\vrule@YT=\vrule@normal@YT
151 \global\let\hrule@YT=\hrule@normal@YT
152 },
153 tabloids/on/.style = {tabloids/true},
154 tabloids/off/.style = {tabloids/false},
155 notabloids/.style = {tabloids/false},
156 }
```

Process the options now. Then we load `xcolor`.

```
157 \ytableausetup{nosmalltableaux,mathmode,baseline,notabloids}
158 \RequirePackage{pgfopts}[2011/06/02]
159 \ProcessPgfPackageOptions{/ytableau/options}
160 \RequirePackage{xcolor}
```

### 5.3 `ytableau` environment

`ytableau` The core tableau-drawing environment. The first argument, which is optional, is just “formatting” pasted on to each entry. The contents are an `\halign`-style array; if an entry begins with `*(\color)`, then the background of that box is colored.

```
161 \newenvironment{ytableau}[1] []
162 {%
```

Despite the alignment requirements, we set the tableau top-aligned so that it can be easily chained. This will get fixed before we print it, though.

The point of the mysterious `\iffalse` is to produce a syntactically balanced pair of braces `{}` which semantically is equivalent to just an open brace `{`. This is required to support tableaux nested inside other alignments because `\halign` does not recognize `\bgroup...\egroup` as designating a nesting! (We will use this fact later, actually.) But we can’t just write `{` and (in `\endytableau`) `}` either.

```
163 \global\setbox\thistableau@YT=\vtop{\iffalse}\fi
```

`\none` This one is for omitting entries but leaving their space. We also allow something to be placed in the empty space (e.g. `\dots`), but don’t allow color (that would defeat the purpose of omitting the box). To support the optional argument without screwing up the `\omit`, we have to go in two steps.

```
164 \def\none{\omit\none@YT}
```

Now we set all the dimensions that depend on the font.

```
165 \setbox\refhtdp@YT=\hbox{\skipin@YT\font@YT (\skipout@YT)%
166 \boxdim@YT=\macro@boxdim@YT\relax
167 \fboxrule=\boxframe@YT\relax
168 \fboxsep=0pt %
```

I hate `\cr`, let's use the L<sup>A</sup>T<sub>E</sub>X convention.

```
169 \let\=\cr@YT
```

Lines and columns should abut, accounting for the fact that each entry is framed. The first entry should not have any skip, since the first rule is not doubled.

```
170 \tabskip=0pt %
171 \offinterlineskip
172 \openup-\fboxrule
```

We have to make sure `\everycr` is empty or else strange things could happen (like in the `amsmath` environment `gather`). Thanks to Harald Hanche-Olsen for telling me about this.

```
173 \everycr={}%
```

Now we begin the `\halign`. Each entry is passed as an argument to our box-building function, but we can't just write something like `\box@YT{##}` because of the following complication:

When TeX sees `\box@YT{`, it absorbs tokens up until the next unmatched `}` without interpreting them and then feeds that to the macro as `#1`. Unfortunately, we would like it to be possible to omit `\` on the last line (as people are used to this, and Knuth provided for it with `\crr`). But since `ytableau` is an environment, the ending of `\halign` is hidden in the macro `\endytableau` (or `\end{ytableau}`) which is *not expanded by* `\halign` while reading for `##` in the proposed code.

The workaround is to pretend that `##` is not an argument to a macro until we get deep inside `\startbox@YT`, where (after some processing) it is fed to an `\hbox` inside math mode. `\hbox` is not really a macro (it's a builtin) and it does interpret its contents as it reads them, and since we have finally set up the desired typesetting environment we can let it read `##` properly. Since we are *still* inside an `\halign`, eventually it will expand `\endytableau` and `##` will terminate properly. Whew.

```
174 \halign\bgroup&\tabskip=-\fboxrule
175 \startbox@YT{\font@YT}{#1}##\endbox@YT\cr
176 }
177 {%
```

The `\crr` supports the omission of `\` in the last row. That's a pretty modest goal for all the work that went into thinking up this crazy scheme.

```
178 \crr\egroup
179 \iffalse{\fi}%
```

Support for chaining. We allow `\endytableau` to be followed by `*[...]{...}`, which is fed to `\ydiagram` as-is. This only works in the short forms `\ytableaushort`

and `\ydiagram`, since in `\end{ytableau}` there is extra code intervening before the following characters and no way to insert things in it.

```
180 \ifnum\wd\thistableau@YT>\wd\tableaux@YT
181 \tableauwd@YT=\wd\thistableau@YT
```

This prevents the last rule from being ignored, as it is not doubled.

```
182 \advance\tableauwd@YT by \fboxrule
183 \wd\thistableau@YT = \tableauwd@YT
184 \advance\tableauwd@YT by -\wd\tableaux@YT
185 \else
186 \tableauwd@YT = Opt %
187 \fi
```

We have saved the larger width, but now `\thistableau@YT` must have width zero so that it can be overlaid with the existing `tableaux`.

```
188 \wd\thistableau@YT=Opt %
189 \setbox\tableaux@YT
190 =\hbox{\box\thistableau@YT\unhbox\tableaux@YT
191 \kern\tableauwd@YT}%
192 \ifstar@YT
193 {\ydiagram}%
194 {%
```

We adjust the vertical alignment finally and print the boxes. `\leavevmode` ensures that the tableau is treated in horizontal mode. You are on your own if you put this inside of another box.

```
195 \leavevmode
196 \compare@YT{\centering@YT}{center}%
197 \ifeq@YT
198 \hbox{\vcenter{\box\tableaux@YT}}%
199 \else\compare@YT{\centering@YT}{bottom}%
200 \ifeq@YT
201 \hbox{\raise\dp\tableaux@YT\box\tableaux@YT}%
202 \fi
203 \box\tableaux@YT
204 \fi
205 }%
206 }
```

`\cr@YT` Annoying to have to do this, but nested `halign` chokes when `\cr` appears inside the definition.

```
207 \def\cr@YT{\cr}
```

`\none@YT` This finds the optional argument to `\none` and makes the box itself. We draw an invisible frame by replacing the actual frame with the frame separation. We use `\nullfont` after the box so as to forbid any "out of alignment" characters, which would appear between columns. Anything outside of the optional argument is simply ignored to the end of the cell.

```
208 \newcommand{\none@YT}[1] [] {%
```

```

209 \def\thisboxcolor@YT{clear}%
210 \let\hrule@YT=\hrule@none@YT
211 \let\vrule@YT=\vrule@none@YT
212 \startbox@YT#1\endbox@YT
213 \nullfont
214 }

\startbox@YT #1 = font style, #2 = optional material. We want to extract the colors from each
and then pass the whole thing on to \startbox@@YT.
215 \def\startbox@YT#1#2{%
We get the colors and then put the rest into temporary token registers.
216 \getcolor@YT{\save@YT{\opttoksa@YT}}#1\nil@YT
217 \getcolor@YT{\save@YT{\opttoksb@YT}}#2\nil@YT
Now we get the color from the entry and proceed.
218 \getcolor@YT
219 {\startbox@@YT\the\opttoksa@YT\the\opttoksb@YT}%
220 }

\save@YT Stick the following text into the token register in #1. Note that we use \nil@YT as
an end-marker; it is not actually defined, so hopefully we never expand it!
221 \def\save@YT#1#2\nil@YT#{#1=#2}}

\getcolor@YT #1 is pasted in front of what remains after removing the color. Basically, it's a "do
next".
222 \def\getcolor@YT#1{\ifstar@YT{\getcolor@@YT{#1}}{#1}}

\getcolor@@YT Save the (optional) color argument and pass the rest to \startbox@@YT.
223 \def\getcolor@@YT#1(#2){%
224 \def\thisboxcolor@YT{#2}%
225 #1%
226 }

\startbox@@YT Start collecting the current entry into a horizontally-centered hbox, but save the
result.
227 \def\startbox@@YT{%
Use a \bgroup...\egroup so as not to introduce nesting that would block & or \cr.
228 \setbox\thisbox@YT=\hbox to \boxdim@YT\bgroup
229 \hss
230 \skipin@YT
231 }

Since we are now in the intended typesetting context (i.e. an hbox with math mode
on) we can let \halign expand tokens in the rest of the entry until it finds a & or
\cr (= \)

```

`\endbox@YT` Now we can finish the box and set it.

```
232 \def\endbox@YT{%
233 \skipout@YT
234 \hss
235 \egroup
```

We want all the boxes to have a consistent baseline, so we normalize them to the same size. Multiple text lines will be aligned with the baseline of the last line at the center, so this really only works well for single lines of text.

```
236 \ifbaseline@YT
237 \ht\thisbox@YT=\ht\refhtdp@YT
238 \dp\thisbox@YT=\dp\refhtdp@YT
239 \fi
```

The extra `\fboxrule` is to account for the margin on the vertical edges of the frame.

```
240 \fcolorbox@YT{\thisboxcolor@YT}{%
241 \vbox to \dimexpr\boxdim@YT + \fboxrule\relax{\vss\box\thisbox@YT\vss}%
242 }%
243 }
```

`\fcolorbox@YT` We need a wrapper around `\colorbox` since it produces an opaque box, and sometimes, we want `clear`. We also have to draw the frame carefully. Note the order of the `\vbox` and the `\hbox`: it has to be that way, else `\none` gives a strange gap at the right edge in tabloids since the inner set of rules is shorter, and `\colorbox` does odd things inside a `\vbox`.

#1 = color, #2 = contents

```
244 \def\fcolorbox@YT#1#2{%
```

This idea is again from `xcolor`.

```
245 \lower\fboxrule\vbox{%
246 \ifodd\fboxrule\kern1sp \fi
247 \kern0.5\fboxrule
248 \hbox{%
249 \kern\fboxrule
250 \compare@YT{#1}{clear}%
251 \ifeq@YT
```

Clear background; don't draw anything.

```
252 #2%
253 \else
```

Colored background; pass it to `\colorbox`.

```
254 \colorbox{#1}{#2}%
255 \fi
256 \rules@YT{v}%
257 }%
258 \kern-0.5\fboxrule
259 \rules@YT{h}%
260 }%
261 }
```

`\rules@YT` Draws `\boxdim@YT`-spaced rules either horizontally or vertically. This is so that the entire frame can be drawn after the contents of a box. It is drawn *before* the current location.

```
262 \def\rules@YT#1{%
263 \expandafter\let\expandafter\rule@YT\csname #1rule@YT\endcsname
264 \kern-\dimexpr\boxdim@YT + \fboxrule\relax
265 \rule@YT
266 \kern\boxdim@YT
267 \rule@YT
268 }
```

## 5.4 ytableaushort command

`\ytableaushort` The short form of `ytableau`. It takes a comma-separated list of lines, each one a string of entries given as individual tokens. `{...}` is allowed (and encouraged) for complex entries, and color is possible. All sorts of redundancies in the syntax are allowed.

```
269 \newcommand{\ytableaushort}[2] [] {%
\endytableau has to be right at the end, so we can't use scope to reset \toks@YT.
270 \toks@YT={}%
271 \getentries@YT{\getentries@YT}{#2,\nil@YT
272 \ytableau[#1]\the\toks@YT\endytableau
273 }
```

`\getentries@YT` Split the CSV into rows. This is really a job for `etoolbox:\docsvlist` but whatever. We put a `.` in front of the string so that a line may be enclosed entirely in `{...}` Otherwise, `\def\cs#1,{etc}` would make `#1 = ...` and not `#1 = {...}` as we want.

```
274 \def\getentries@YT#1#2{\getline@YT{#1}{#2}.}
```

`\getline@YT` Grab the first *<line>*, in the string and remove the initial `.`

```
275 \def\getline@YT#1#2#3,{%
276 \opttoksa@YT=\expandafter{\@gobble#3}%
277 \opttoksb@YT={\getline@YT{#1}{#2}}%
```

We pass `#3` back as an *argument* to `\getline@YT`, thus avoiding the braces issue.

```
278 \edef\next@YT{\the\opttoksb@YT{\the\opttoksa@YT}}%
```

We use `\futurelet` to check whether the next token is `\nil@YT` without breaking brace groups.

```
279 \futurelet\tmpa@YT\next@YT
280 }
```

`\getline@YT` `#1` = the macro to process each row, `#2` = the junk to put after each row (followed by `\nil@YT`), `#3` = everything before the first comma. If this is not the last row, we have to recurse down the list. Otherwise, just process the current row. Multiple commas are ignored.

```
281 \def\getline@YT#1#2#3{%
```

```

282 \ifx\tmpa@YT\nil@YT
283 \compare@YT{#3}{}%
284 \ifeq@YT
285 \def\next@YT{\@gobble}%
286 \else
287 \def\next@YT{#1#3#2}%
288 \fi
289 \else
290 \compare@YT{#3}{}%
291 \ifeq@YT
292 \def\next@YT{\getline@YT{#1}{#2}.}%
293 \else
294 \def\next@YT{#1#3#2\nil@YT\getentries@YT{#1}{#2}}%
295 \fi
296 \fi
297 \next@YT
298 }

```

`\getentries@YT` Separates the entries in a line of `\ytableaushort` and reformats them for `\ytableau`. Takes two tokens and checks if the second is `\nil@YT`, which means the first is the last entry.

```
299 \def\getentries@YT#1#2{%
```

If this is not the last entry, we have to recurse down the line. Otherwise, we just print `\.`

```

300 \compare@YT{#2}{\nil@YT}%
301 \ifeq@YT
302 \toks@YT=\expandafter{\the\toks@YT#1\}%
303 \def\next@YT{}%
304 \else
305 \toks@YT=\expandafter{\the\toks@YT#1&}%
306 \def\next@YT{\getentries@YT{#2}}%
307 \fi
308 \next@YT
309 }

```

## 5.5 `ydiagram` command

`\ydiagram` Takes the same optional argument as the other macros. Its main argument `#2` is of the form

$[\langle offset \rangle + ]\langle number \rangle, \dots$

where both  $\langle offset \rangle$  and  $\langle number \rangle$  may be any expression evaluating to a textual number (e.g. `\the\count<n>` rather than `\count<n>`).

```
310 \newcommand\ydiagram[2] []{%
```

We need `\endytableau` to be right at the end, so we can't use scope to reset `\toks@YT`.

```

311 \toks@YT={}%
312 \getentries@YT{\getnumbers@YT}{+}#2,\nil@YT

```

```

313 \ytableau[#1]\the\toks@YT\endytableau
314 }

```

`\getnumbers@YT` Separates the entries in a line of `\ydiagram` and reformats them for `\ytableau`.

```

315 \def\getnumbers@YT#1+#2\nil@YT{%
If #2 = {}, then there is no offset and #1 is the row shape.
316 \compare@YT{#2}{}%
317 \ifeq@YT
318 \def\next@YT{%
319 \loop@YT{#1}{}%
320 }%
Else #1 is the offset and #2 is the shape.
321 \else
322 \def\next@YT{%
323 \loop@YT{#1}{\none}%
Now #2 looks like <number>+, so we feed it back in.
324 \getnumbers@YT#2\nil@YT
325 }%
326 \fi
327 \next@YT
328 }

```

`\loop@YT` Loops on the first argument, building a `\ytableau` line whose entries are the second argument. The results go in `\toks@YT`.

```

329 \def\loop@YT#1#2{%
330 \count@YT=#1\relax
331 \loop\ifnum\count@YT>1 %
332 \toks@YT=\expandafter{\the\toks@YT#2&}%
333 \advance\count@YT by -1 %
334 \repeat

```

The last entry in the list may not be the last entry in the line. If it's empty, it is (according to our usage), otherwise not.

```

335 \ifnum\count@YT=1 %
336 \compare@YT{#2}{}%
337 \ifeq@YT
338 \toks@YT=\expandafter{\the\toks@YT#2\}%
339 \else
340 \toks@YT=\expandafter{\the\toks@YT#2&}%
341 \fi
342 \else

```

This supports using 0 as a number: it inserts an empty line, but only if it is the +0 case, not the 0+ case.

```

343 \compare@YT{#2}{}%
344 \ifeq@YT
345 \toks@YT=\expandafter{\the\toks@YT\none\}%
346 \fi

```

347 \fi  
348 }

## 6 Change History

|      |                                                                                                                                                             |                                                                                                                                                     |    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----|
| v1.0 |                                                                                                                                                             | Fixed a bug where giving a line length of 0 in <code>\ydiagram</code> did not draw an empty row, but rather ignored the row. . . . .                | 21 |
|      | General: Initial version . . . . .                                                                                                                          |                                                                                                                                                     | 1  |
| v1.1 |                                                                                                                                                             | Fixed a bug where the prevailing font size was ignored or imperfectly obeyed. . . . .                                                               | 9  |
|      | General: Changed the namespace convention from <code>ytableau@...</code> to <code>...@YT</code> to make the index useful and the macros shorter. . . . .    |                                                                                                                                                     | 9  |
|      | Removed null initializations of temp macros <code>\tmp(a,b,c)@YT</code> . . . . .                                                                           |                                                                                                                                                     | 11 |
|      | <code>nosmalltableaux</code> : Correctly reassign a positive value to <code>\boxdim@save@YT</code> when exiting small tableaux. . . . .                     |                                                                                                                                                     | 14 |
|      | <code>\refhtdp@YT</code> : Put the reference letters into a single box and renamed it more semantically. . . . .                                            |                                                                                                                                                     | 9  |
|      | <code>\skipout@YT</code> : Split up the “skip in” and “skip out” macros. . . . .                                                                            |                                                                                                                                                     | 11 |
|      | <code>ytableau</code> : Added the <code>everycr</code> fix. . . . .                                                                                         |                                                                                                                                                     | 16 |
|      | Moved the <code>leavevmode</code> down to the output routine and simplified the alignment computations now that the <code>everycr</code> fix is in. . . . . |                                                                                                                                                     | 17 |
|      | Removed an unnecessary layer of boxes and moved the fake braces into the outer layer. . . . .                                                               |                                                                                                                                                     | 15 |
|      | Replaced explicit setting of the chained box width by a kern. . . . .                                                                                       |                                                                                                                                                     | 17 |
|      | Save the box width difference rather than the larger width. . . . .                                                                                         |                                                                                                                                                     | 16 |
|      | <code>\thisbox@YT</code> : Made <code>\thisbox@YT</code> an alias for <code>\thistableau@YT</code> . . . . .                                                |                                                                                                                                                     | 9  |
| v1.2 |                                                                                                                                                             | Fixed a bug where the widths of the outer rules of the tableau were ignored. . . . .                                                                | 15 |
|      | General: Added an option <code>baseline</code> to fix an irritating irregularity in some tableaux. . . . .                                                  |                                                                                                                                                     | 12 |
|      | Fixed a bug in <code>\none</code> where text outside the optional argument would be typeset off-grid. . . . .                                               |                                                                                                                                                     | 17 |
|      | Fixed a bug in <code>\ytableaushort</code> where <code>{,}</code> was treated as a comma at the beginning of a line. . . . .                                |                                                                                                                                                     | 20 |
|      | Fixed a bug in <code>textmode</code> and <code>smalltableaux</code> where <code>\scriptstyle</code> was used outside of math mode. . . . .                  |                                                                                                                                                     | 13 |
|      | No longer pass options to <code>xcolor</code> . . . . .                                                                                                     |                                                                                                                                                     | 15 |
|      | Removed <code>\fullexpand@YT</code> . . . . .                                                                                                               |                                                                                                                                                     | 21 |
|      | Removed a lot of pointless <code>endline-comments</code> after control sequences and added spaces after numbers. . . . .                                    |                                                                                                                                                     | 9  |
|      | Switched from using <code>xkeyval</code> to <code>pgfkeys</code> . . . . .                                                                                  |                                                                                                                                                     | 12 |
|      | <code>baseline</code> : Added option. . . . .                                                                                                               |                                                                                                                                                     | 14 |
|      | <code>\boxdim@normal@YT</code> : Made a macro. . . . .                                                                                                      |                                                                                                                                                     | 10 |
|      | <code>\boxdim@save@YT</code> : Made a macro. . . . .                                                                                                        |                                                                                                                                                     | 10 |
|      | <code>\boxframe@YT</code> : Made a macro. . . . .                                                                                                           |                                                                                                                                                     | 10 |
|      | <code>centerboxes</code> : Added option. . . . .                                                                                                            |                                                                                                                                                     | 14 |
|      | <code>\expandonce@YT</code> : Added. . . . .                                                                                                                |                                                                                                                                                     | 10 |
|      | <code>\font@YT</code> : Changed name from <code>\defarg@YT</code> . . . . .                                                                                 |                                                                                                                                                     | 11 |
|      | <code>\ifbaseline@YT</code> : Added. . . . .                                                                                                                |                                                                                                                                                     | 14 |
|      | <code>\ifsmalltableaux@YT</code> : Added. . . . .                                                                                                           |                                                                                                                                                     | 13 |
|      | <code>\macro@boxdim@YT</code> : Added. . . . .                                                                                                              |                                                                                                                                                     | 10 |
|      | <code>\nil@YT</code> : Added. . . . .                                                                                                                       |                                                                                                                                                     | 10 |
|      | <code>\none</code> : Moved definition inside <code>\ytableau</code> . . . . .                                                                               |                                                                                                                                                     | 15 |
|      | <code>nobaseline</code> : Added option. . . . .                                                                                                             |                                                                                                                                                     | 14 |
|      | <code>\refhtdp@YT</code> : Moved definition to <code>\ytableau</code> . . . . .                                                                             |                                                                                                                                                     | 9  |
|      | <code>\set@mathmode@YT</code> : Added. . . . .                                                                                                              |                                                                                                                                                     | 11 |
|      | <code>\set@textmode@YT</code> : Added. . . . .                                                                                                              |                                                                                                                                                     | 11 |
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