

systeq - manual

Syntax

We can render a simple system (like `math.cases`) which is `inline` by default.

```
This is a simple 2x2 linear system:  
#render-systeq(systeq($5x - 4y = 8$, $2x + 5y = 1$))
```

$$\begin{cases} 5x - 4y = 8 \\ 2x + 5y = 1 \end{cases}$$

Simply put it between `$... $` to make it into a `block`:

```
This is a simple 2x2 linear system:  
$ #render-systeq(systeq($5x - 4y = 8$, $2x + 5y = 1$)) $
```

This is a simple 2x2 linear system:

$$\begin{cases} 5x - 4y = 8 \\ 2x + 5y = 1 \end{cases}$$

The function `sys` represents a system, which needs to be rendered via `render-sys`. Multiple systems can be rendered at once and will be rendered in a grid with default symbol `sep-symbol`: `$<=>$` and default column number `columns`: `4` (counting separators).

```
#render-systeq(  
    systeq($5x - 4y = 8$, $2x + 5y = 1$),  
    systeq($-10x + 8y = -16$, $10x + 25y = 5$),  
    systeq($2x + 5y = 1$, " " " 33y = -11$),  
    systeq($2x + 5y = 1$, " " " y = -1/3$),  
)
```

$$\begin{aligned} \begin{cases} 5x - 4y = 8 \\ 2x + 5y = 1 \end{cases} &\iff \begin{cases} -10x + 8y = -16 \\ 10x + 25y = 5 \end{cases} \\ \iff \begin{cases} 2x + 5y = 1 \\ 33y = -11 \end{cases} &\iff \begin{cases} 2x + 5y = 1 \\ y = -\frac{1}{3} \end{cases} \end{aligned}$$

Usual alignment operator `&` cannot be used in `sys`. You should use spaces to create the alignment points instead and empty strings `" "` to get empty placeholders.

Alignments

Alignments can be customized at different levels. First we can change the alignment inside the grid (default: `align: horizon`).

```
#render-systeq(
  align: center + horizon,
  systeq($5x - 4y = 8$, $2x + 5y = 1$),
  systeq($-10x + 8y = -16$, $10x + 25y = 5$),
  systeq($2x + 5y = 1$, " 33y = -11),
  systeq($2x + 5y = 1$, "  y = -1/3),
)
```

$$\begin{aligned} \left\{ \begin{array}{l} 5x - 4y = 8 \\ 2x + 5y = 1 \end{array} \right. &\iff \left\{ \begin{array}{l} -10x + 8y = -16 \\ 10x + 25y = 5 \end{array} \right. \\ \iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ 33y = -11 \end{array} \right. &\iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ y = -\frac{1}{3} \end{array} \right. \end{aligned}$$

You can also change the alignment inside the systems (default: `align: right`).

```
#render-systeq(
  sys-align: left,
  systeq($5x - 4y = 8$, $2x + 5y = 1$),
  systeq($-10x + 8y = -16$, $10x + 25y = 5$),
  systeq($2x + 5y = 1$, " 33y = -11),
  systeq($2x + 5y = 1$, "  y = -1/3),
)
```

$$\begin{aligned} \left\{ \begin{array}{l} 5x - 4y = 8 \\ 2x + 5y = 1 \end{array} \right. &\iff \left\{ \begin{array}{l} -10x + 8y = -16 \\ 10x + 25y = 5 \end{array} \right. \\ \iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ 33y = -11 \end{array} \right. &\iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ y = -\frac{1}{3} \end{array} \right. \end{aligned}$$

Spacing

You can customize the grid gutters with defaults `column-gutter: 2em` and `row-gutter: 2em`.

```
#render-systeq(
  column-gutter: 4em,
  systeq($5x - 4y = 8$, $2x + 5y = 1$),
  systeq($-10x + 8y = -16$, $10x + 25y = 5$),
  systeq($2x + 5y = 1$, " 33y = -11$),
  systeq($2x + 5y = 1$, "  y = -1/3$),
)
```

$$\begin{aligned} \left\{ \begin{array}{l} 5x - 4y = 8 \\ 2x + 5y = 1 \end{array} \right. &\iff \left\{ \begin{array}{l} -10x + 8y = -16 \\ 10x + 25y = 5 \end{array} \right. \\ \iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ 33y = -11 \end{array} \right. &\iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ y = -\frac{1}{3} \end{array} \right. \end{aligned}$$

You can customize the spacing inside the system with defaults `sys-col-gap: .4em` and `sys-row-gap: .4em`.

```
#render-systeq(
  sys-col-gap: 1em,
  systeq($5x - 4y = 8$, $2x + 5y = 1$),
  systeq($-10x + 8y = -16$, $10x + 25y = 5$),
  systeq($2x + 5y = 1$, " 33y = -11$),
  systeq($2x + 5y = 1$, "  y = -1/3$),
)
```

$$\begin{aligned} \left\{ \begin{array}{l} 5x - 4y = 8 \\ 2x + 5y = 1 \end{array} \right. &\iff \left\{ \begin{array}{l} -10x + 8y = -16 \\ 10x + 25y = 5 \end{array} \right. \\ \iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ 33y = -11 \end{array} \right. &\iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ y = -\frac{1}{3} \end{array} \right. \end{aligned}$$

Annotations

You can annotate each equation of a system using the `annot` parameter of `sys`.

```
#render-systeq(
    systeq($5x - 4y = 8$, $2x + 5y = 1$, annot: ($dot (-2)$, $dot 5$)),
    systeq($-10x + 8y = -16$, $10x + 25y = 5$),
    systeq($2x + 5y = 1$, "" "" 33y = -11, annot: ("",$div 33$)),
    systeq($2x + 5y = 1$, "" "" y = -1/3$),
)
```

$$\begin{array}{l} \left\{ \begin{array}{l} 5x - 4y = 8 \\ 2x + 5y = 1 \end{array} \right. \begin{array}{c} | \cdot (-2) \\ | \cdot 5 \end{array} \iff \left\{ \begin{array}{l} -10x + 8y = -16 \\ 10x + 25y = 5 \end{array} \right. \\ \iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ 33y = -11 \end{array} \right. \begin{array}{c} | \div 33 \end{array} \iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ y = -\frac{1}{3} \end{array} \right. \end{array}$$

The annotation color, size, offset and bar stroke can be changed with following defaults `annot-color: red`, `annot-size: 1em`, `annot-spacing: (left: 1em, right: .2em)` and `annot-bar: (paint: annot-color, thickness: .8pt, dash: "solid")`. The latter accepts any stroke as argument and the `annot-bar` is removed when set to `none`. Each of these parameters can be passed to `render-sys` to be applied to every underlying system and can individually be overridden by passing them to `sys`.

```
#render-systeq(
    annot-color: blue.darken(10%),
    annot-size: .9em,
    annot-spacing: (left: 2em, right: 0em),
    annot-bar: (dash: "dashed"),
    systeq($5x - 4y = 8$, $2x + 5y = 1$, annot: ($dot (-2)$, $dot 5$)),
    systeq($-10x + 8y = -16$, $10x + 25y = 5$),
    systeq($2x + 5y = 1$, "" "" 33y = -11, annot: ("",$div 33$), annot-bar: purple),
    systeq($2x + 5y = 1$, "" "" y = -1/3$),
)
```

$$\begin{array}{l} \left\{ \begin{array}{l} 5x - 4y = 8 \\ 2x + 5y = 1 \end{array} \right. \begin{array}{c} | \cdot (-2) \\ | \cdot 5 \end{array} \iff \left\{ \begin{array}{l} -10x + 8y = -16 \\ 10x + 25y = 5 \end{array} \right. \\ \iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ 33y = -11 \end{array} \right. \begin{array}{c} | \div 33 \end{array} \iff \left\{ \begin{array}{l} 2x + 5y = 1 \\ y = -\frac{1}{3} \end{array} \right. \end{array}$$

Addition and substractions modes

One last feature of the `systeq` package is to display addition or subtraction operations between equations of one system. This can be used by changing the systems mode with default mode: "normal" to mode: "add" or mode: "sub". This uses the last sys entry as result of the addition / subtraction and adds a + or - sign on the bottom left. In this case, it is not possible to annotate the system and the annot-bar style is applied to the horizontal bar. The result and sign colors and size are inherited from `annot-color` and `annot-size`.

```
#render-systeq(
  align: top,
  systeq($5x - 4y = 8$, $2x + 5y = 1$, annot: ($dot (-2$), $dot 5$)),
  systeq($-10x + 8y = -16$, $10x + 25y = 5$, $" $" 33y = -11, mode: "add",
  annot-color: blue)
)
```

$$\left\{ \begin{array}{l} 5x - 4y = 8 \\ 2x + 5y = 1 \end{array} \right. \quad \left| \begin{array}{c} \cdot (-2) \\ \cdot 5 \end{array} \right. \quad \Leftrightarrow \quad \begin{array}{r} \left\{ \begin{array}{l} -10x + 8y = -16 \\ 10x + 25y = 5 \end{array} \right. \\ \hline 33y = -11 \end{array}$$

Display

In "normal" mode, you can choose whether your math content is sized with display or not. This makes sense for example when fraction arise in your equations. For "add" and "sub" mode there is no display option. The default for normal mode is `display: true`. This parameter can be passed to `render-sys` or `sys`, the latter overriding the former.

```
#render-systeq(
  display: true, // default
  systeq($" $" y = x + 1$, $(x + 1) / 3 - y / 6 = 1$),
  systeq($" $" y = x + 1$, $(x + 1) / 3 - (x+1) / 6 = 1$, display: false)
) \
#render-systeq(
  display: false,
  systeq($" $" y = x + 1$, $(x + 1) / 3 - y / 6 = 1$),
  systeq($" $" y = x + 1$, $(x + 1) / 3 - (x+1) / 6 = 1$)
)
```

$$\left\{ \begin{array}{l} x + 1 = y \\ \frac{x+1}{3} - \frac{y}{6} = 1 \end{array} \right. \quad \Leftrightarrow \quad \left\{ \begin{array}{l} x + 1 = y \\ \frac{x+1}{3} - \frac{x+1}{6} = 1 \end{array} \right.$$

$$\left\{ \begin{array}{l} x + 1 = y \\ \frac{x+1}{3} - \frac{y}{6} = 1 \end{array} \right. \quad \Leftrightarrow \quad \left\{ \begin{array}{l} x + 1 = y \\ \frac{x+1}{3} - \frac{x+1}{6} = 1 \end{array} \right.$$

Further examples

ignore system alignment

```
#render-systeq(
  sys-align: left,
  systeq($5x-4y=8$, $2x=1$),
  systeq($10x+8y=-16$, $x=1/2$),
)
```

$$\begin{cases} 5x - 4y = 8 \\ 2x = 1 \end{cases} \iff \begin{cases} 10x + 8y = -16 \\ x = \frac{1}{2} \end{cases}$$

change number of system per line

```
#render-systeq(
  sys-align: left,
  columns: 8,
  column-gutter: 1.5em,
  systeq($5x-4y=8$, $2x=4$),
  systeq($10x+\textit{8dot } 2=-16$, $x=2$),
  systeq($10x=0$, $x=2$),
  systeq($x=0$, $x=2$),
)
```

$$\begin{cases} 5x - 4y = 8 \\ 2x = 4 \end{cases} \iff \begin{cases} 10x + 8 \cdot 2 = -16 \\ x = 2 \end{cases} \iff \begin{cases} 10x = 0 \\ x = 2 \end{cases} \iff \begin{cases} x = 0 \\ x = 2 \end{cases}$$

change separator

```
#render-systeq(
  sys-align: left,
  columns: 6,
  sep-symbol: $==>$,
  systeq($5x-4y=8$, $\sqrt{y-5}=4$),
  systeq($5x-4y=8$, $y-5=4$),
  systeq($5x-4y=8$, $y=9$),
)
```

$$\begin{cases} 5x - 4y = 8 \\ \sqrt{y-5} = 4 \end{cases} \Rightarrow \begin{cases} 5x - 4y = 8 \\ y - 5 = 4 \end{cases} \Rightarrow \begin{cases} 5x - 4y = 8 \\ y = 9 \end{cases}$$

3x3 system

```

$ #render-systeq(
  annot-color: red.darken(20%),
  annot-size: 10pt,
  row-gutter: 2.5em,
  align: left + horizon,
  systeq($2x + 3y - z = 24$, $4x - 2y + 3z = 6$, $6x - y + 2z = 22$, annot: ($dot 2$,)),
  systeq($4x - 2y + 3z = 6$, $4x + 6y - 2z = 48$, $6x - y + 2z = 22$, $10x + 5y "" "" = 70$, mode: "add"),
  systeq($4x - 2y + 3z = 6$, $4x + 6y - 2z = 48$, $10x + 5y "" "" = 70$, annot: ($dot 2$, $dot 3$)),
  systeq($10x + 5y "" "" = 70$, $12x + 18y - 6z = 144$, $8x - 4y + 6z = 12$, $20x + 14y "" "" = 168$, mode: "add"),
  systeq($8x - 4y + 6z = 12$, $10x + 5y "" "" = 70$, $20x + 14y "" "" = 168$, annot: ("", $dot 2$)),
  systeq($8x - 4y + 6z = 12$, $20x + 10y "" "" = 140$, $20x + 14y "" "" = 168$, $"" - 4y "" "" = 28$, mode: "sub")
),
systeq($8x - 4y + 6z = 12$, $20x + 10y "" "" = 140$, $" - 4y "" "" = 28$,
  annot: ($div 2#h(1.5em)$, $div 10#h(1em)$, $div (-4)$)
),
systeq($4x - 2y + 3z = 6$, $2x + y "" "" = 14$, $" "" y "" "" = 4$, annot: ($y -> 4$, $y -> 4$)),
systeq($4x - 8 + 3z = 6$, $2x + 4 "" "" = 14$, $" "" y "" "" = 4$,
  annot: ($+ thin 8 #h(3.5em)$,$-4 "and" div 2$)
),
systeq($4x "" "" + 3z = 14$, $x "" "" "" "" = 5$, $" "" y "" "" = 4$, annot: ($x -> 5$,)),
systeq($" "" "" "" 3z = -6$, $x "" "" "" "" = 5$, $" "" y "" "" = 4$),
systeq($z = -2$, $x = 5$, $y = 4$),
) $

```

$$\Leftrightarrow \left\{ \begin{array}{l} 8x - 4y + 6z = 12 \\ 20x + 10y = 140 \\ - 4y = 28 \end{array} \right| \begin{array}{l} \div 2 \\ \div 10 \\ \div (-4) \end{array} \Leftrightarrow \left\{ \begin{array}{l} 4x - 2y + 3z = 6 \\ 2x + y = 14 \\ y = 4 \end{array} \right| \begin{array}{l} y \rightarrow 4 \\ y \rightarrow 4 \end{array}$$

$$\Leftrightarrow \left\{ \begin{array}{l} 4x - 8 + 3z = 6 \\ 2x + 4 = 14 \\ y = 4 \end{array} \right| \begin{array}{l} +8 \\ -4 \text{ and } \div 2 \end{array} \Leftrightarrow \left\{ \begin{array}{l} 4x + 3z = 14 \\ x = 5 \\ y = 4 \end{array} \right| \textcolor{red}{x \rightarrow 5}$$

$$\Leftrightarrow \begin{cases} 3z = -6 \\ x = 5 \\ y = 4 \end{cases} \qquad \Leftrightarrow \qquad \begin{cases} z = -2 \\ x = 5 \\ y = 4 \end{cases}$$