suanpan-l3—算盘 (Abacus) 排版宏包 ⟹ English Version

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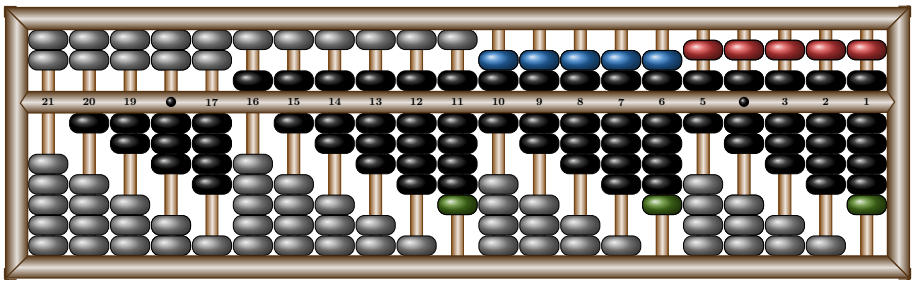
摘要

suanpan-l3 是一个基于 l3draw 和 TikZ 绘图宏包 (shading 高光)，用 Expl3 开发的中国传统 7 珠圆珠算盘排版宏包，它能够实现使用普通上珠、下珠和底珠、顶珠及悬珠的算盘排版。该宏包提供了唯一的一个 suanpan 算盘排版环境及仅在该环境中使用的 \rod、\rods、\bead、\beads、\rodmark和\mkframe绘制档杆、算珠着色、横梁标记和边框排版命令。同时，该宏包还提供了\suanpanset命令用于对算盘外观进行设置。



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*https://gitee.com/nwafu_nan/suan-pan

1 引言

suanpan-l3 宏包是一个基于 l3draw 和 TikZ 绘图宏包 (shading 高光)，用 Expl3 开发的中国传统 7 珠圆珠算盘排版宏包，它利用 l3draw 宏包，通过 l3coffin 容器的平移变换及拼接组装，将使用 TikZ 宏包绘制的算珠、档杆、边框等基本图元组装成算盘，从而实现算盘的排版。

由于正常的算珠是通过圆角矩形添加高光实现的，因此当算珠数量较多时，绘制耗时较长，其编译速度较慢。

注意: 该说明书中的所有颜色名称均来自 ninecolors 宏包。

2 用户接口

2.1 suanpan 算盘排版环境

suanpan `\begin{suanpan}[⟨外观选项⟩]`

New: 2024-08-20

Updated: 2026-08-12

```
.....
\end{suanpan}
```

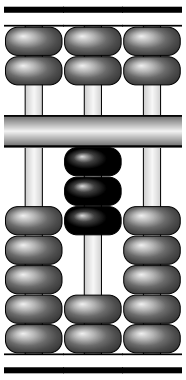
按 [⟨外观选项⟩] 设置的参数实现算盘排版。

在 suanpan 环境中，可以通过专用命令\rod(排版算盘的一个档位)，\rods(排版一组档位，支持区间语法)，\bead(指定算珠颜色)，\beads(指定内/外珠颜色)，\rodmark(为档位添加标记)，\mkframe(排版边框) 按需实现算盘排版。

在 [⟨外观选项⟩] 中可以通过 key-value 的方式设置线宽、颜色、缩放比例等外观属性。

通过 [⟨外观选项⟩] 设置的外观参数仅对 suanpan 环境局部有效。

注意: suanpan 环境中**不可以出现空行**。



```
\centering
% 为便排版，进行缩放
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rod{1}{0}
  \rod{2}{3}
  \rod{3}{0}
\end{suanpan}
```

2.2 suanpan 环境中的专用命令

2.2.1 \rod单一档位排版命令

\rod `\rod {⟨档位编号⟩} {⟨档位数字⟩}`

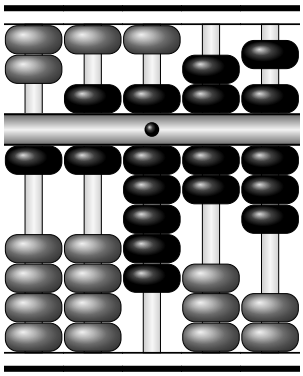
New: 2024-08-20

Updated: 2024-09-04

用于排版 {⟨档位编号⟩}(基于 1，从左向右进行编号) 参数指定的算盘档位，本档的计数值由 {⟨档位数字⟩} 参数指定。

{⟨档位数字⟩} 支持 [0, 20] 内的数字，其中 [0, 9] 内的数字采用常规 4 个下珠结合 1 个上珠的方法进行表示，[10, 15] 内的数字则需要额外使用“底珠”和“顶珠”进行表示，[16, 20] 内的数字则需要再额外使用“悬珠”进行表示。

宏包还同时提供了\rod*星号命令用于排版在横梁上带有计位点 (圆点) 的档位。



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rod{1}{1}   % 常规档位
  \rod{2}{6}
  \rod*{3}{10} % 计位点，使用底珠
  \rod{4}{12}  % 使用顶珠
  \rod{5}{18}  % 使用悬珠
\end{suanpan}
```

2.2.2 \rods一组档位排版命令

\rods　　\rods {⟨数字列表⟩}[⟨计位点标记⟩]

New: 2024-08-20

Updated: 2026-08-11

用于排版在 {⟨数字列表⟩} 中用逗号分隔的一组数字指定的档位，各档位编号基于 1，从左向右进行自动编号。

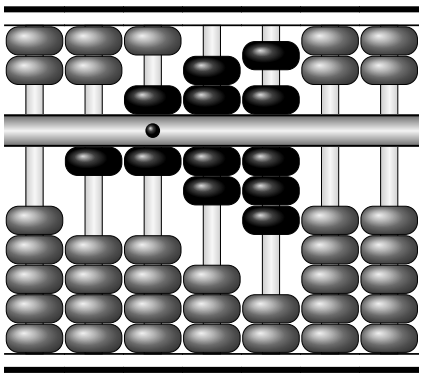
{⟨数字列表⟩} 中的各档位数字支持 [0, 20] 内的数字，其中 [0, 9] 内的数字采用常规 4 个下珠结合 1 个上珠的方法进行表示，[10, 15] 内的数字则需要额外使用“底珠”和“顶珠”进行表示，[16, 20] 内的数字则需要再额外使用“悬珠”进行表示。

{⟨数字列表⟩} 支持区间语法：start-end 表示步长为 1 的连续区间（如 4-7 表示 4,5,6,7），start-end-step 表示等步长区间（如 4-7-2 表示 4, 6）。

{⟨数字列表⟩} 也支持重复语法，格式为 value[count] （如，5[3] 表示 5，5，5）。

[⟨计位点标记⟩] 用于在指定的档位绘制计位点，其中，每个字符对应一个档位，用 “*” 星号表示有计位点，其它非空白字符表示无计位点。当 [⟨计位点标记⟩] 长度大于档数时，多余标记会被忽略；当 [⟨计位点标记⟩] 长度小于档数时，剩余档位不添加计位点。

注意: [⟨计位点标记⟩] 中的空白字符会被**自动忽略**。



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
    \rods{0-1, 6-18-6, 0[2]}[x.*-]
\end{suanpan}
```

2.2.3 \bead算珠着色命令

\bead　　\bead {⟨档位编号⟩}{⟨位置列表⟩}{⟨填充颜色⟩}[⟨绘制颜色⟩]

New: 2024-08-20

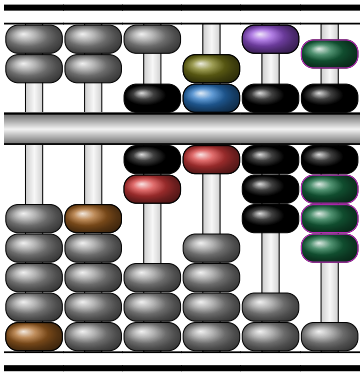
Updated: 2026-08-11

用于将 {⟨档位编号⟩} 指定的档位中，用逗号分隔的 {⟨位置列表⟩} 中指定的所有算珠的填充色设置为 {⟨填充颜色⟩} 指定的颜色，将其绘制颜色设置为可选项 [⟨绘制颜色⟩](默认为内珠绘制颜色)。

一个档位中的 {⟨算珠位置⟩} 自下向上，按“$1, 2, \cdots, 11$”的顺序进行编号。其中下珠占“$1, 2, \cdots, 7$”的位置，上珠占“$8, 9, 10$”的位置，悬珠占“11”的位置。

{⟨位置列表⟩} 支持 start-end 步长为 1 的连续区间语法（如 4-7 表示 4,5,6,7)。

注意: 该类型的算珠称为**浮珠**，浮珠是指通过 \bead 或 \beads 命令动态指定颜色的算珠，它独立于内珠和外珠的默认颜色设置。



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 0, 7, 11, 8, 19}
  \bead{1}{1}{brown5}
  \bead{2}{5}{brown5}
  \bead{3}{6}{red5}
  \bead{4}{7}{red5}
  \bead{4}{8}{azure5}
  \bead{4}{9}{yellow5}
  \bead{5}{10}{violet5}
  \bead{6}{4-6,11}{teal4}[magenta5]
\end{suanpan}
```

2.2.4 \beads内珠或外珠着色命令

\beads　　\beads {⟨档位编号⟩}{⟨档位数字⟩}{⟨填充颜色⟩}

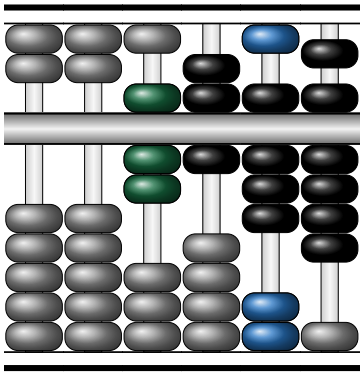
New: 2024-08-20

Updated: 2024-09-01

用于将 {⟨档位编号⟩} 指定的档位中，所有 {⟨档位数字⟩} 的内珠设置为 {⟨填充颜色⟩} 指定的颜色。同时，该命令还将算珠绘制颜色设置内珠绘制颜色 (innerdrawcolor)。

宏包还为\beads命令同时提供了\beads*星号命令用于设置该档所有外珠的颜色。此时，算珠绘制颜色设置外珠绘制颜色 (outerdrawcolor)。

注意: 该命令仅能选择内珠或外珠进行着色，不能同时选择内珠和外珠。这些算珠同样属于**浮珠**。



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 0, 7, 11, 8, 19}
  \beads{3}{7}{teal4}
  \beads*{5}{8}{azure5}
\end{suanpan}
```

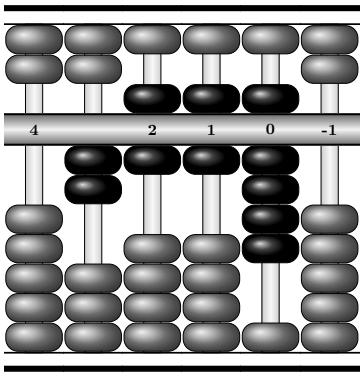
2.2.5 \rodmark档位标记命令

\rodmark　\rodmark [⟨起始档位⟩]{⟨标记列表⟩}

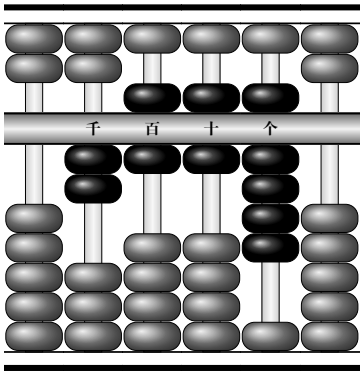
New: 2024-09-04

用于从 [⟨起始档位⟩] 可选项指定的档位开始，用 {⟨标记列表⟩} 中逗号分隔的标记在算盘横梁上为各档位添加标记。

注意: 如果 {⟨标记列表⟩} 中的标记数量超出从 [⟨起始档位⟩] 开始的档位数，多余的标记将被忽略。在 {⟨标记列表⟩} 中，可以用一对 “{}” 分组符号表示空白标记。




```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 2, 6, 6, 9, 0}
  \rodmark{4,{},2,1,0,-1,-2}
\end{suanpan}
```




```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 2, 6, 6, 9, 0}
  \rodmark[2]{千, 百, 十, 个}
\end{suanpan}
```

2.2.6 \mkframe边框排版命令

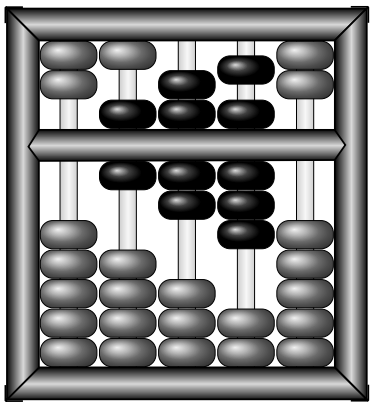
\mkframe `\mkframe`

New: 2024-08-20

Updated: 2026-08-11

用于排版算盘的边框。

注意: 由于档杆组件采用了静态缓存技术，因此可能会造成边框颜色与档杆组件不一致问题，此果，请重新设置档杆颜色。



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 6, 12, 18, 0}
  \mkframe
\end{suanpan}
```

2.3 \suanpanset选项设置命令

\suanpanset `\suanpanset {⟨外观选项⟩}`

New: 2024-08-20

通过 {⟨外观选项⟩} 的 key-value 选项设置算盘的算珠、边框等元素的绘制颜色、填充颜色、线条宽度；各档位之间的间距、算珠之间的间距；算盘整体的缩放比例等外观属性。

通过 \suanpanset{⟨外观选项⟩} 设置的外观属性对后续所有算盘排版操作有效。

注意: 由于 suanpan-l3 宏包涉及大量绘图操作，因此建议尽量减少在每个 suanpan 排版环境的可选项中使用 [⟨外观选项⟩] 设置，以节约编译时间。如需要更改算盘外观，可以在引用宏包时，通过为宏包添加选项实现，也可以执行\suanpanset命令进行必要的全局设置或在一定范围内进行统一设置。

另外，为了提高编译速度，宏包采用组件缓存机制，将已绘制的算珠、档杆等组件缓存以供复用，从而避免重复绘制。因此，部分选项（如颜色、尺寸等）的设置会影响后续所有使用该缓存的绘制操作。

3 宏包选项

在 suanpan-l3 宏包中，算盘颜色、线条宽度、档位及算珠间距等算盘外观属性可以在引入宏包时通过 [⟨宏包选项⟩] 进行设置，也可以在 suanpan 环境的 [⟨外观选项⟩] 中进行局部设置，还可以通过 \suanpanset 命令进行全局或局部设置。

强烈建议在引用宏包时通过 [⟨宏包选项⟩] 为一个文档统一全局设置算盘外观属性，以节约编译时间。应避免频繁 suanpan 环境中使用 [⟨宏包选项⟩] 或使用 \suanpanset 命令设置算盘外观属性。

suanpan-l3 宏包选项是一个英文逗号分隔的选项列表，其选项是 {⟨*key*⟩}={⟨*value*⟩} 形式。部分选项的 {⟨*value*⟩} 可以省略。对于同一选项，后续设置会覆盖以前设置。

suanpan-l3 宏包采用 LaTeX3 风格的键值设置，支持不同类型以及多种层次的选项设定。键值列表中，“=” 左右的空格不影响设置。但需注意，参数列表中**不可以出现空行**。

布尔型的参数 {⟨选项⟩}=true 中的 “=true” 可以省略。

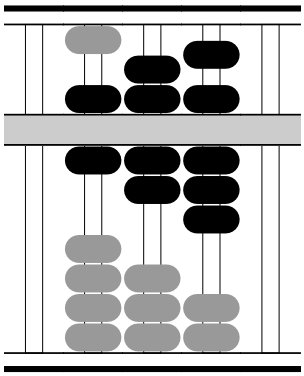
3.1 草稿模式

draft = ⟨草稿模式⟩ (init: false)

设置草稿模式。

[⟨*draft*⟩] 选项会将算珠用圆角线帽直线实现绘制，取消所有高光效果，从而加快编译速度。同时，[⟨*draft*⟩] 选项还会将空档算珠绘制选项 [⟨*empty*⟩] 设置为 false，也就是不绘制空档上的算珠。

注意: 在草稿模式下算盘排版会与期望的排版结果有出入。



```
% \usepackage[draft]{suanpan}
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}[draft]
  \rods{0, 6, 12, 18, 0}
\end{suanpan}
```

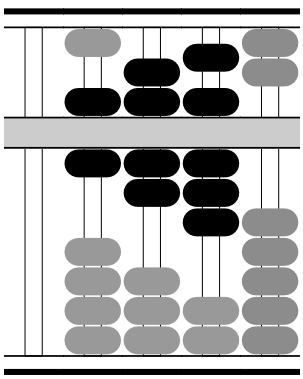
3.2 是否绘制空档算珠

empty = ⟨空档⟩ (init: true)

设置是否绘制空档算珠。

[⟨*empty*⟩] 选项用于选择是否绘制空档上的算珠，如果不绘制，在一定程度上可以加快编译速度。

注意: 如有需要，可以使用\bead或\beads*命令为空档绘制算珠。



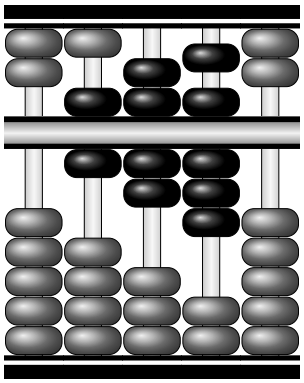
```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}[draft, empty = false]
  \rods{0, 6, 12, 18, 0}
  \beads*{5}{0}{gray6}
\end{suanpan}
```

3.3 线宽

linewd = ⟨线宽⟩ (init: 1pt)

设置算盘绘制中的线宽。

[⟨*linewd*⟩] 选项用于设置算盘边框内线线宽，同时会将边框外线设置为 linewd 的 3.5 倍，将档杆和算珠线宽设置为 linewd 的 0.1 倍。

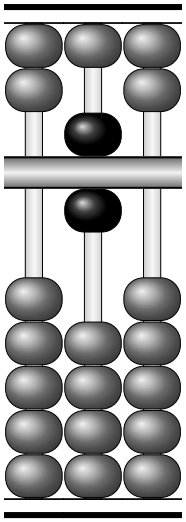


```
\centering
\suanpanset{scale = 0.65, linewd = 3pt}
\begin{suanpan}
  \rods{0, 6, 12, 18, 0}
\end{suanpan}
```

3.4 算珠高度

beadh = ⟨算珠高度⟩ (init: 6mm)

设置算珠高度。

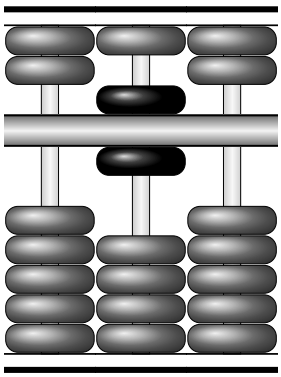


```
\centering
\suanpanset{scale = 0.65, beadh = 9mm}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.5 算珠直径

beadd = ⟨算珠直径⟩ (init: 11.5mm)

设置算珠直径。



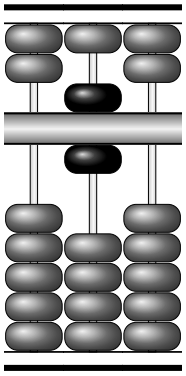
```
\centering
\suanpanset{scale = 0.65, beadd = 18mm}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.6 档杆直径

rodd = ⟨档杆直径⟩ (init: 3.5mm)

设置档杆直径。

注意: 档杆直径 rodd 应该小于算珠直径 beadd。

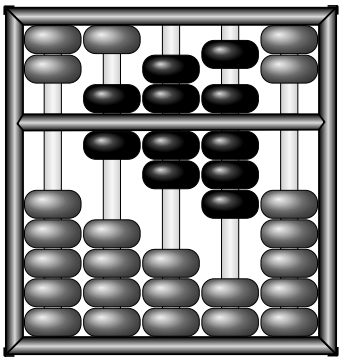


```
\centering
\suanpanset{scale = 0.65, rodd = 1.5mm}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.7 边框宽度

framew = ⟨边框宽度⟩ (init: 6.5mm)

设置边框宽度。

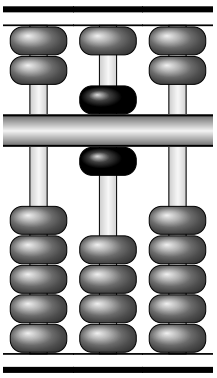


```
\centering
\suanpanset{scale = 0.65, framew = 3.5mm}
\begin{suanpan}
  \rods{0, 6, 12, 18, 0}
  \mkframe
\end{suanpan}
```

3.8 档位间距

rodsep = ⟨档位间距⟩ (init: 1.5pt)

设置算盘各档间的间距。



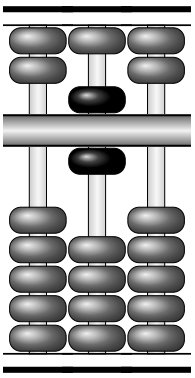
```
\centering
\suanpanset{scale = 0.65, rodsep = 7.5pt}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

注意: 修改档位间距会改变算盘排版的宽度。

3.9 算珠间距

beadsep = ⟨算珠间距⟩ (init: 0.9pt)

设置算珠间的间距。



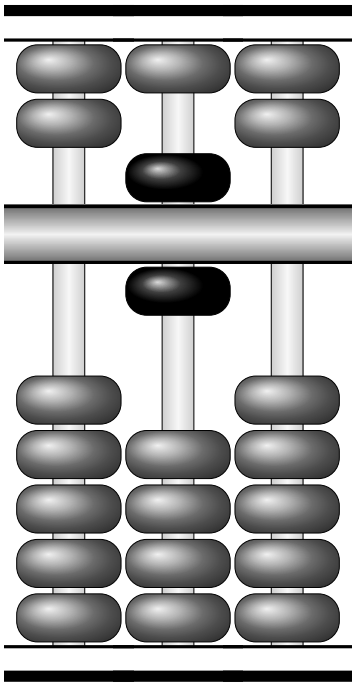
```
\centering
\suanpanset{scale = 0.65, beadsep = 2pt}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

注意: 修改算珠间距不会改变算盘的尺寸，但算珠高度会发生变化。另外，过小的算珠高度会造成算珠圆角的畸变。

3.10 缩放比例

scale = ⟨缩放比例⟩ (init: 1.0)

设置算盘输出结果的整体缩放比例。

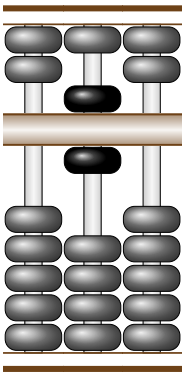


```
\centering
\suanpanset{scale = 1.20}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.11 边框颜色

framedraw = ⟨边框颜色⟩ (init: black)

设置算盘边框颜色。



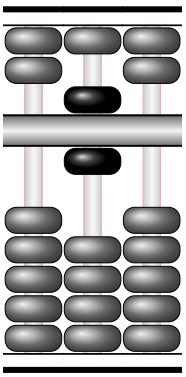
```
\centering
\suanpanset{scale = 0.65, framedraw = brown3}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

注意: 边框颜色包括内外边框和横梁颜色。

3.12 档杆绘制颜色

roddraw = ⟨档杆绘制颜色⟩ (init: black)

设置档杆绘制颜色。

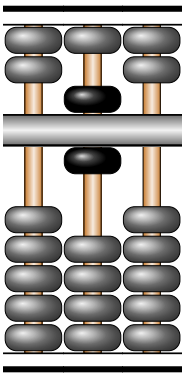


```
\centering
\suanpanset{scale = 0.65, roddraw = red8}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.13 档杆填充颜色

`rodfill` = ⟨档杆填充颜色⟩ (init: white)

设置档杆填充颜色。

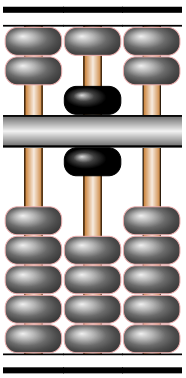


```
\centering
\suanpanset{scale = 0.65, rodfill = brown6}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.14 外珠绘制颜色

`outerdraw` = ⟨外珠绘制颜色⟩ (init: black)

设置档杆上外珠[1]绘制颜色。



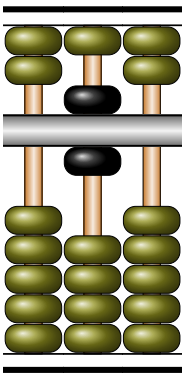
```
\centering
\suanpanset{scale = 0.65, outerdraw = red8}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.15 外珠填充颜色

`outerfill` = ⟨外珠填充颜色⟩ (init: black!40)

设置外珠填充颜色。

[1] 外珠是指离梁不记数的算珠。

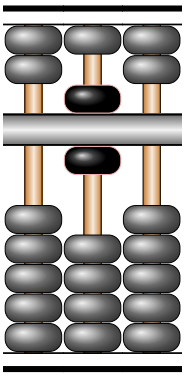


```
\centering
\suanpanset{scale = 0.65, outerfill = yellow6}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.16 内珠绘制颜色

innerdraw = ⟨内珠绘制颜色⟩ (init: black)

设置档杆上内珠[2]绘制颜色。

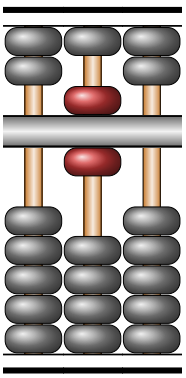


```
\centering
\suanpanset{scale = 0.65, innerdraw = red8}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.17 内珠填充颜色

innerfill = ⟨内珠填充颜色⟩ (init: black)

设置内珠填充颜色。



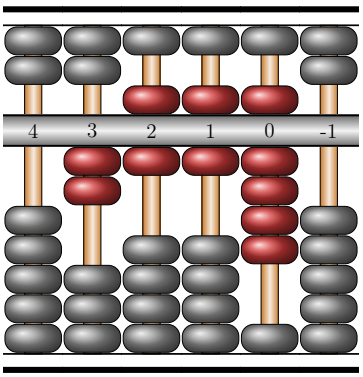
```
\centering
\suanpanset{scale = 0.65, innerfill = red5}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

3.18 标记字体

font = ⟨标记字体⟩ (init: \bfseries\small)

设置标记字体。

[2]内珠是指靠梁记数的算珠。

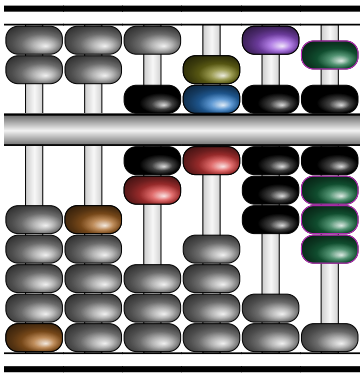



```
\centering
\suanpanset{scale = 0.65,
            font=\rmfamily\large}
\begin{suanpan}
  \rods{0, 2, 6, 6, 9, 0}
  \rodmark{4,3,2,1,0,-1}
\end{suanpan}
```

3.19 高光位置（角度）

beadspot = ⟨高光位置⟩ (init: 0)

设置算珠高光点的位置，用整数角度表示，逆时针为正。



```
\centering
\suanpanset{scale = 0.65, beadspot = 180}
\begin{suanpan}
  \rods{0, 0, 7, 11, 8, 19}
  \bead{1}{1}{brown5}
  \bead{2}{5}{brown5}
  \bead{3}{6}{red5}
  \bead{4}{7}{red5}
  \bead{4}{8}{azure5}
  \bead{4}{9}{yellow5}
  \bead{5}{10}{violet5}
  \bead{6}{4-6,11}{teal4}[magenta5]
\end{suanpan}
```

suanpan-l3 package for traditional Chinese 7-beads suanpan(abacus)

⟹ 中文版本

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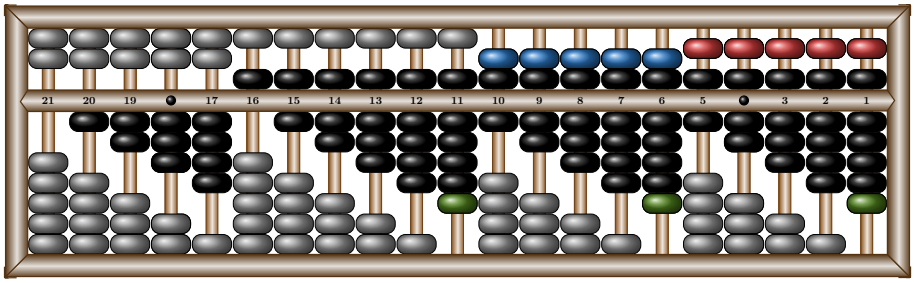
4 Introduction

suanpan-l3 is a traditional Chinese 7-beads suanpan drawing package utilizes l3draw and TikZ, and is developed with Expl3. It can effectively manage both upper and lower beads, while also considering bottom bead, top bead, and hanging bead.

This package offers a unique environment for drawing suanpan, denoted as `suanpan`. Within this environment, 8 specialized macros are available for the creation of suanpan. The `\rod` macro is used to lay out a single rod, while the `\rod*` macro draws a counting point on this rod' s beam. The `\rods` macro is capable of laying out a set of rods. The `\bead` macro colors the specified bead. The `\beads` macro colors all inner beads that are near the beam, while the `\beads*` macro colors all outer beads that are far from the beam. The `\rodmark` macro marks all rods on beam. Lastly, the `\mkframe` macro is used to lay out the left and right frames of an abacus.

At the same time, the package offers customization options for suanpan, including line width, draw color, fill color, bead space, rod space, etc. These can be configured through package options, `suanpan` environment options, or the `\suanpanset` macro.



NOTE: The color names appearing throughout this documentation are defined in the ninecolors package.

5 Interface

5.1 suanpan environment

suanpan

New: 2024-08-20

Updated: 2026-08-12

```
\begin{suanpan}[⟨options⟩]
.....
\end{suanpan}
```

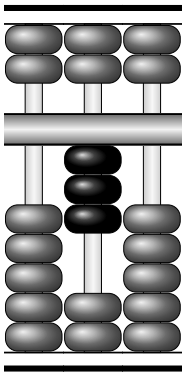
Typesetting 7-beads Chinese suanpan with `[⟨options⟩]`.

Within the `suanpan` environment, `\rod`, `\rod*`, `\rods`, `\bead`, `\beads`, `\beads*`, `\rodmark` and `\mkframe` 8 specialized macros are available for the creation of suanpan.

`[⟨options⟩]` is a key-value list for line width, draw color, fill color, bead space, rod space, etc.

`[⟨options⟩]` is environment's local setting.

NOTE: You should remove all blank lines in `suanpan` environment.



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rod{1}{0}
  \rod{2}{3}
  \rod{3}{0}
\end{suanpan}
```

5.2 suanpan's specialized macros

5.2.1 `\rod`—single rod

\rod

New: 2024-08-20

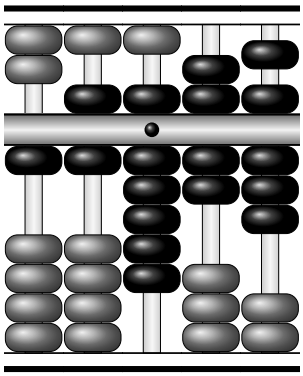
Updated: 2024-09-04

```
\rod {⟨num⟩} {⟨val⟩}
```

The `\rod` macro is used to lay out a single rod.

The `{⟨num⟩}` argument numbers the rods from left to right. The `{⟨val⟩}` is the number to be represented on the rod from 0 to 20. For number within [0, 9], it is represented using 4 lower deck beads and 1 upper deck bead. Numbers within [10, 15] are represented additionally using bottom bead and top bead. For numbers within [16, 20], hanging bead is also required for representation.

The starred version `\rod*` will draw a counting point on this rod's beam.



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rod{1}{1}   % normal rod
  \rod{2}{6}
  \rod*{3}{10} % counting point and
               % bottom bead
  \rod{4}{12}  % top bead
  \rod{5}{18}  % hanging bead
\end{suanpan}
```

5.2.2 \rods—a set of rods

\rods `\rods {⟨val list⟩}[⟨counting point string⟩]`

New: 2024-08-20

Updated: 2026-08-11

The **\rods** macro is used to lay out a set of rods.

The {⟨*val list*⟩} is a value list of each rod separated by commas. Each rod number is automatically numbered from left to right.

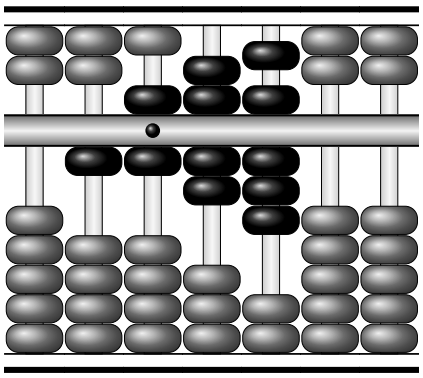
Each value in {⟨*val list*⟩} is the number to be represented on the rod from 0 to 20. For number within [0, 9], it is represented using 4 lower deck beads and 1 upper deck bead. Numbers within [10, 15] are represented additionally using bottom bead and top bead. For numbers within [16, 20], hanging bead is also required for representation.

The {⟨*val list*⟩} supports range syntax: 'start-end' for a continuous range with step size 1 (e.g., '4-7' → '4,5,6,7'), and 'start-end-step' for an arithmetic progression (e.g., '4-7-2' → '4,6').

The {⟨*val list*⟩} also supports repetition syntax in the form 'value[count]' (e.g., '5[3]' expands to '5,5,5').

The [⟨*counting point string*⟩] is used to indicate the rods where counting points should be drawn. Each character corresponds to a rod, and "*" indicates that the rod has a counting point, while other characters indicate no counting point. When the length of the mark string is greater than the number of rods, the excess marks are ignored; when it is shorter, the remaining rods will have no counting point.

NOTE: All spaces in the [⟨*counting point marks*⟩] will be ignored.



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0-1, 6-18-6, 0[2]}[x.*-]
\end{suanpan}
```

5.2.3 \bead—color bead

\bead `\bead {⟨num⟩}{⟨pos list⟩}{⟨fill color⟩}[⟨draw color⟩]`

New: 2024-08-20

Updated: 2026-08-11

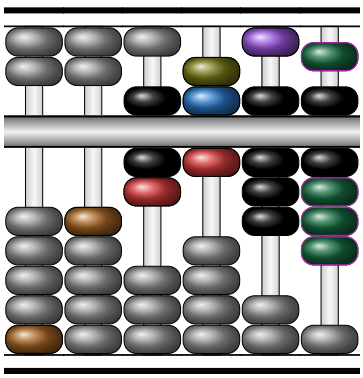
The `\bead` macro fills the specified bead.

The `{⟨num⟩}` is the same as for `\rod`; the `{⟨fill color⟩}` argument defines the fill color and the comma-separated `{⟨pos list⟩}` argument tells which bead has to be colored in `{⟨num⟩}` rod. The `[⟨draw color⟩]` option gives the draw color (default is inner bead draw color).

The `{⟨pos⟩}` in a rod is numbered from the bottom up in the order $1, 2, \cdots, 11$. The lower deck beads occupies position $1, 2, \cdots, 7$, the upper deck beads occupies position $8, 9, 10$, and the hanging bead occupies position 11 between 9 and 10 .

The `{⟨pos list⟩}` supports range syntax with a step of 1: 'start-end' denotes a continuous range (e.g., '4-7' expands to '4,5,6,7').

NOTE: This type of bead is called a float bead, which refers to beads whose colors are dynamically specified by the `\bead` or `\beads` command, independent of the default color settings for inner and outer beads.



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 0, 7, 11, 8, 19}
  \bead{1}{1}{brown5}
  \bead{2}{5}{brown5}
  \bead{3}{6}{red5}
  \bead{4}{7}{red5}
  \bead{4}{8}{azure5}
  \bead{4}{9}{yellow5}
  \bead{5}{10}{violet5}
  \bead{6}{4-6,11}{teal4}[magenta5]
\end{suanpan}
```

5.2.4 \beads—color inner/outer beads

\beads `\beads {⟨num⟩}{⟨val⟩}{⟨color⟩}`

New: 2024-08-20

Updated: 2024-09-01

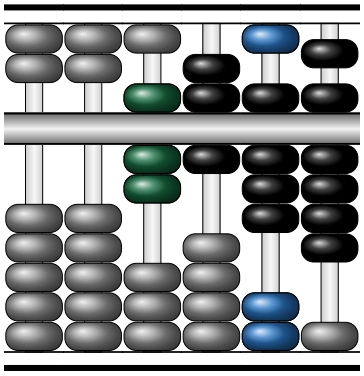
The `\beads` macro fills all inner beads that are near the beam.

`{⟨num⟩}` and `{⟨color⟩}` are the same as for `\bead`; the `{⟨val⟩}` argument is the same as for `\rod`.

The `{⟨color⟩}` is fill color for inner beads. it also sets `innerdrawcolor` to be used for inner beads drawing color.

The starred version `\beads*` is used to color outer beads of `{⟨num⟩}` rod. it also sets `outerdrawcolor` to be used for inner beads drawing color.

NOTE: This macro can only select the inner beads or the outer beads for coloring, you can't select both the inner and outer beads at the same time.



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 0, 7, 11, 8, 19}
  \beads{3}{7}{teal4}
  \beads*{5}{8}{azure5}
\end{suanpan}
```

5.2.5 \rodmark rod(s) marking on beam

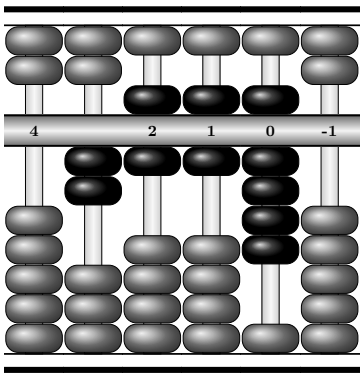
\rodmark `\rodmark [⟨st⟩]{⟨marker list⟩}`

New: 2024-09-04

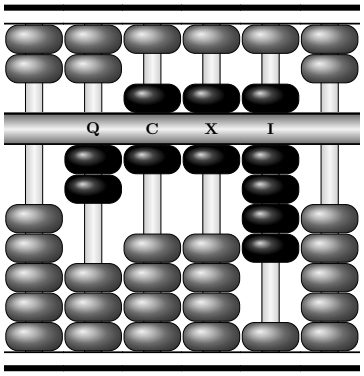
The `\rodmark` macro marks the rod(s) on the beam.

The `[⟨st⟩]` argument is the start rod and `{⟨marker list⟩}` is the marker list.

NOTE: If the number of `{⟨marker list⟩}` exceeds the number of rods from `[⟨st⟩]`, the excess markers will be ignored. In the `{⟨marker list⟩}`, it is possible to use a pair of "{}" grouping to indicate blank marker.




```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 2, 6, 6, 9, 0}
  \rodmark{4,{},2,1,0,-1,-2}
\end{suanpan}
```




```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 2, 6, 6, 9, 0}
  \rodmark[2]{Q,C,X,I}
\end{suanpan}
```

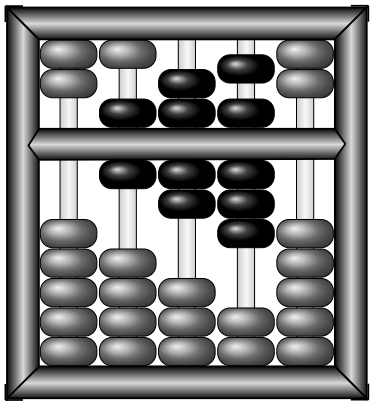
5.2.6 \mkframe—layout frame

\mkframe `\mkframe`

New: 2024-08-20

Updated: 2026-08-11

The `\mkframe` macro is used to lay out the frames of a suanpan.



```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}
  \rods{0, 6, 12, 18, 0}
  \mkframe
\end{suanpan}
```

5.3 \suanpanset

\suanpanset `\suanpanset {`⟨*options*⟩`}`

New: 2024-08-20

The `\suanpanset` macro offers customization options for suanpan, including line width, draw color, fill color, bead space, rod space, etc.

The {⟨*options*⟩} is a key-value list.

The options set by the `\suanpanset` are valid for all subsequent `suanpan` environments. This is useful for global style settings that apply to multiple suanpan drawings in a document.

6 options

The suanpan-l3 package offers customization options for abacus, including line width, draw color, fill color, bead space, rod space, etc. These can be configured through package [⟨*options*⟩], `suanpan` environment [⟨*options*⟩], or the `\suanpanset` macro.

It is strongly recommended that suanpan options be set globally for a document uniformly via [⟨*options*⟩] of packages to save compilation time. Frequent use of [⟨*options*⟩] in `suanpan` environments or use of the `\suanpanset` command to set suanpan options should be avoided.

The [⟨*options*⟩] is a comma-separated list of options in the form {⟨*key*⟩}={⟨*value*⟩}. The {⟨*value*⟩} can be omitted for some options. For the same option, subsequent settings will override the previous one.

The suanpan-l3 package uses LaTeX3 style key settings, supporting different types and levels of options. In the key list, spaces around "=" do not affect the settings. However, it is important to note that blank lines are not allowed in the list.

The "`=true`" in the {⟨*option*⟩}`=true` for Boolean types can be omitted.

Furthermore, to enhance compilation speed, the package utilizes a component caching mechanism that reuses previously drawn components such as beads and rods, thereby avoiding repeated rendering. Consequently, changes to certain options (e.g., colors, dimensions) will affect all subsequent drawing operations that rely on these cached components.

6.1 draft

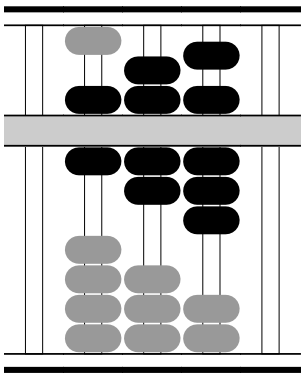
`draft` = ⟨*draft*⟩ `(init: false)`

Draft mode.

The [⟨*draft*⟩] option speeds up compilation by drawing beads using round cap line, at same time it will remove all highlight of bead(s), rod(s) and frame.

At the same time [⟨*draft*⟩] option will set the [⟨*empty*⟩] option to `false` to remove all beads on empty rod.

NOTE: Suanpan layout in draft mode may differ from the desired layout.



```
% \usepackage[draft]{suanpan}
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}[draft]
  \rods{0, 6, 12, 18, 0}
\end{suanpan}
```

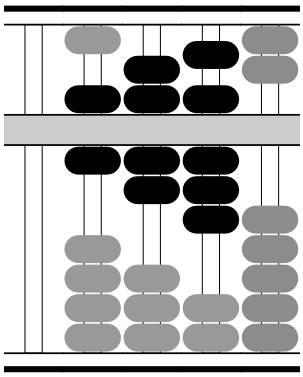
6.2 empty

`empty` = ⟨*empty*⟩ (init: true)

Remove beads on empty rod or not.

The [⟨*empty*⟩] option will remove all beads on empty rod.

NOTE: If necessary, you can use the `\bead` or `\beads*` macro to draw bead(s) for the empty rod.



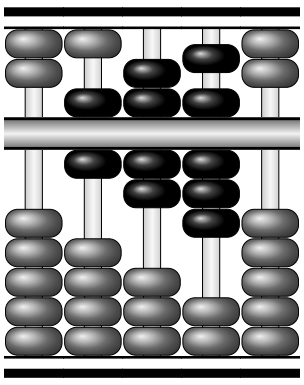
```
\centering
\suanpanset{scale = 0.65}
\begin{suanpan}[draft, empty=false]
  \rods{0, 6, 12, 18, 0}
  \beads*{5}{0}{gray6}
\end{suanpan}
```

6.3 line width

`linewd` = ⟨*linewd*⟩ (init: 1pt)

Drawing line width.

The [⟨*linewd*⟩] is used to set the line width of the frame inner, and will also set the line width the frame outer to 3.5 times linewd, and the rod and bead line widths to 0.1 times linewd.

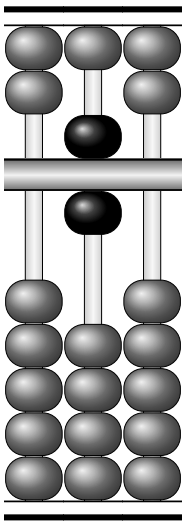


```
\centering
\suanpanset{scale = 0.65, linewd = 1.5pt}
\begin{suanpan}
  \rods{0, 6, 12, 18, 0}
\end{suanpan}
```

6.4 bead height

beadh = ⟨*beadh*⟩ (init: 6mm)

The height of bead.

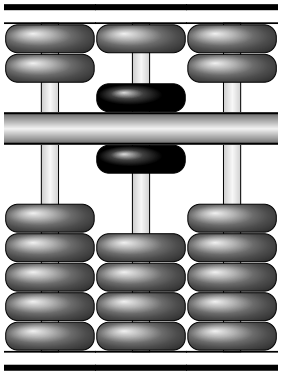


```
\centering
\suanpanset{scale = 0.65, beadh = 9mm}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.5 bead diameter

beadd = ⟨*beadd*⟩ (init: 11.5mm)

The diameter of bead.



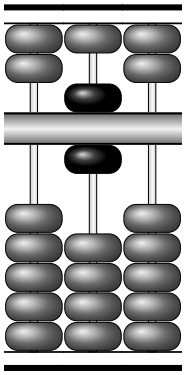
```
\centering
\suanpanset{scale = 0.65, beadd = 18mm}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.6 rod diameter

rodd = ⟨*rodd*⟩ (init: 3.5mm)

The diameter of rod.

NOTE: The rodd should be smaller than the beadd.

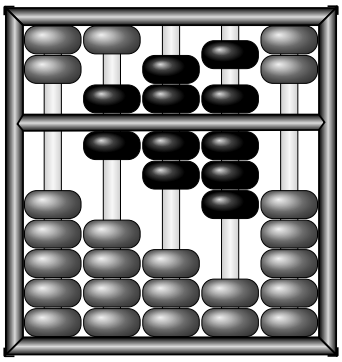


```
\centering
\suanpanset{scale = 0.65, rodd = 1.5mm}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.7 frame width

framew = ⟨*framew*⟩ (init: 6.5mm)

The width of frame.

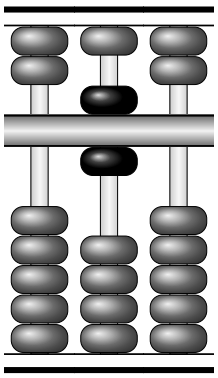


```
\centering
\suanpanset{scale = 0.65, framew = 3.5mm}
\begin{suanpan}
  \rods{0, 6, 12, 18, 0}
  \mkframe
\end{suanpan}
```

6.8 rod spacing

rodsep = ⟨*rodsep*⟩ (init: 1.5pt)

The spacing between suanpan rods.



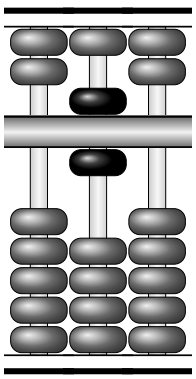
```
\centering
\suanpanset{scale = 0.65, rodsep = 7.5pt}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

NOTE: The [⟨*rodsep*⟩] will change the width of the suanpan.

6.9 bead spacing

beadsep = ⟨*beadsep*⟩ (init: 0.9pt)

The spacing between suanpan beads.



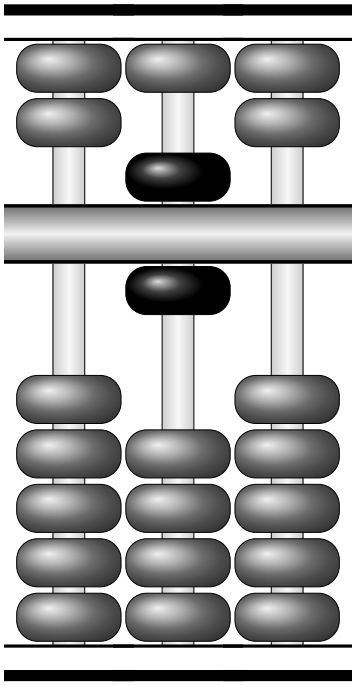
```
\centering
\suanpanset{scale = 0.65, beadsep = 2pt}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

NOTE: The [⟨*beadsep*⟩] does not change the size of the suanpan. But the height of each bead will be changed. In addition, too small a bead height will cause distortion of the rounded corners of the bead.

6.10 scale

scale = ⟨*scale*⟩ (init: 1.0)

Scaling factor of whole suanpan.

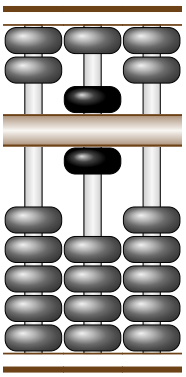


```
\centering
\suanpanset{scale = 1.20}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.11 frame color

framedraw = ⟨*framedraw*⟩ (init: black)

Frame drawing color.



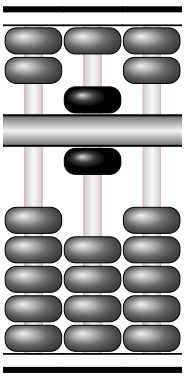
```
\centering
\suanpanset{scale = 0.65, framedraw = brown3}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

NOTE: Frame colors include inner and outer of frame and beam colors.

6.12 rod drawing color

roddraw = ⟨*roddraw*⟩ (init: black)

Rod drawing color.

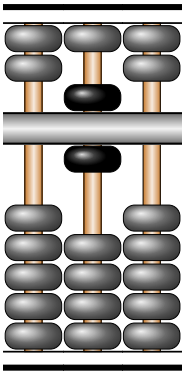


```
\centering
\suanpanset{scale = 0.65, roddraw = red8}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.13 rod filling color

`rodfill` = ⟨*rodfill*⟩ (init: white)

Rod filling color.

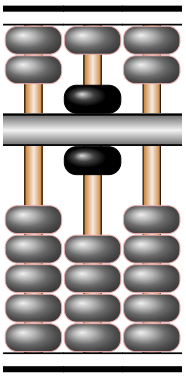


```
\centering
\suanpanset{scale = 0.65, rodfill = brown6}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.14 outer beads drawing color

`outerdraw` = ⟨*outerdraw*⟩ (init: black)

The outer beads[1]drawing color.



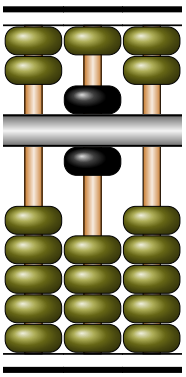
```
\centering
\suanpanset{scale = 0.65, outerdraw = red8}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.15 outer beads filling color

`outerfill` = ⟨*outerfill*⟩ (init: black!40)

The outer beads filling color。

[1]The outer bead is that is not counted away from the beam.

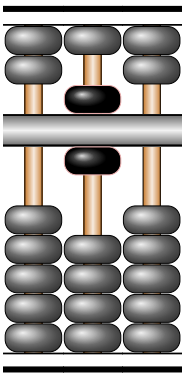


```
\centering
\suanpanset{scale = 0.65, outerfill = yellow6}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.16 inner beads drawing color

`innerdraw` = ⟨*innerdraw*⟩ (init: black)

The inner beads[2]drawing color.

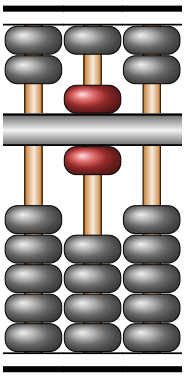


```
\centering
\suanpanset{scale = 0.65, innerdraw = red8}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.17 inner beads filling color

`innerfill` = ⟨*innerfill*⟩ (init: black)

The inner beads filling color.



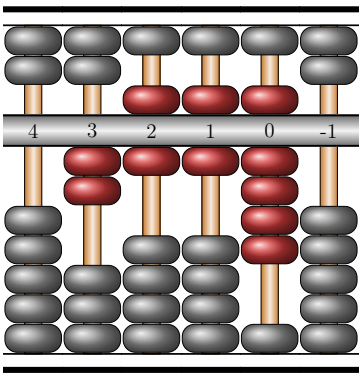
```
\centering
\suanpanset{scale = 0.65, innerfill = red5}
\begin{suanpan}
  \rods{0, 6, 0}
\end{suanpan}
```

6.18 mark font

`font` = ⟨*font*⟩ (init: \bfseries\small)

The font of mark(s).

[2]The inner bead is that is counted near to the beam.

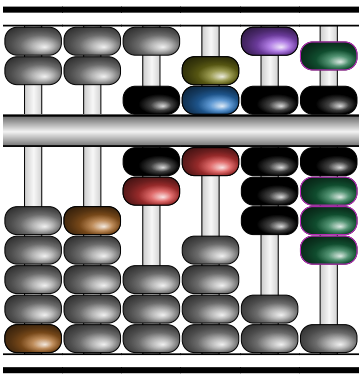



```
\centering
\suanpanset{scale = 0.65,
            font=\rmfamily\large}
\begin{suanpan}
  \rods{0, 2, 6, 6, 9, 0}
  \rodmark{4,3,2,1,0,-1}
\end{suanpan}
```

6.19 highlight pos/angle

beadspot = ⟨*beadspot*⟩ (init: 0)

The bead's highlight angle(int deg.).



```
\centering
\suanpanset{scale = 0.65, beadspot = 180}
\begin{suanpan}
  \rods{0, 0, 7, 11, 8, 19}
  \bead{1}{1}{brown5}
  \bead{2}{5}{brown5}
  \bead{3}{6}{red5}
  \bead{4}{7}{red5}
  \bead{4}{8}{azure5}
  \bead{4}{9}{yellow5}
  \bead{5}{10}{violet5}
  \bead{6}{4-6,11}{teal4}[magenta5]
\end{suanpan}
```

Change History

Index

The italic numbers denote the pages where the corresponding entry is described, numbers underlined point to the definition, all others indicate the places where it is used.