Package 'piecepackr'

October 23, 2026

Encoding UTF-8

Type Package

Title Board Game Graphics

Version 1.17.1

Description Functions to make board game graphics with the 'ggplot2', 'grid', 'rayrender', 'rayvertex', and 'rgl' packages. Specializes in game diagrams, animations, and ``Print & Play'' layouts for the 'piecepack' <https://www.ludism.org/ppwiki> but can make graphics for other board game systems. Includes configurations for several public domain game systems such as checkers, (double-18) dominoes, go, 'piecepack', playing cards, etc.

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URL https://trevorldavis.com/piecepackr/ (blog),
https://trevorldavis.com/R/piecepackr/ (pkgdown),
https://groups.google.com/forum/#!forum/piecepackr (forum)

BugReports https://github.com/piecepackr/piecepackr/issues

LazyData true

LazyLoad yes

Depends R (>= 4.1)

Imports affiner (>= 0.3.1), grid, gridGeometry, grImport2, grDevices, purrr, jpeg, png, R6, rlang, stringr, tibble, tools, utils

Suggests animation (>= 2.7), ggplot2, gifski, marquee, gridpattern, magick, pdftools, rayrender (>= 0.34.3), rayvertex (>= 0.10.4), readobj (>= 0.4.0), rgl (>= 0.106.8), scales (>= 0.5.0), svglite (>= 2.2.2), systemfonts, testthat, tweenr, vdiffr, xmpdf (>= 0.1.1), XML (>= 3.99-0.9)

Config/testthat/edition 3

Config/roxygen2/version 8.0.0

NeedsCompilation no

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<https://github.com/spdx/license-list-XML>),
Delapouite <https://delapouite.com/> [ill] (Meeple shape extracted from
``Meeple icon'' <https://game-icons.net/1x1/delapouite/meeple.html> /
``CC BY 3.0'' <https://creativecommons.org/licenses/by/3.0/>),
Creative Commons [ill] (`save_print_and_play()` uses ``license badges''
from Creative Commons to describe the generated print-and-play
file's license)

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Repository CRAN

Date/Publication 2026-10-23 09:10:20 UTC

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piecepackr-package *piecepackr: Board Game Graphics*

Description

Functions to make board game graphics with the 'ggplot2', 'grid', 'rayrender', 'rayvertex', and 'rgl' packages. Specializes in game diagrams, animations, and "Print & Play" layouts for the 'piecepack' https://www.ludism.org/ppwiki but can make graphics for other board game systems. Includes configurations for several public domain game systems such as checkers, (double-18) dominoes, go, 'piecepack', playing cards, etc.

Package options

The following piecepackr function arguments may be set globally via `base::options()`:

piecepackr.at.inform If `FALSE` turns off messages when affine transformation support not detected in active graphics device.

piecepackr.cfg Sets a new default for the `cfg` argument

piecepackr.check.cairo If `FALSE` don't check the version of cairo

piecepackr.default.units Sets a new default for the `default.units` argument

piecepackr.envir Sets a new default for the `envir` argument

piecepackr.fs.inform If `FALSE` turns off messages when stroking and filling path support not detected in active graphics device.

piecepackr.marquee.inform If `FALSE` turns off messages when `save_print_and_play()` omits its credits and instructions because `{marquee}` isn't installed or the graphics device doesn't support glyph rendering.

piecepackr.metadata.inform If `FALSE` turns off messages when support for embedding metadata not detected.

piecepackr.op_angle Sets a new default for the `op_angle` argument

piecepackr.op_scale Sets a new default for the `op_scale` argument

piecepackr.rgr.inform If `FALSE` turns off messages when radial gradient support not detected in active graphics device.

piecepackr.trans Sets a new default for the `trans` argument

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Other contributors:

- Linux Foundation (Uses some data from the "SPDX License List" <https://github.com/spdx/license-list-XML>) [data contributor]

- Delapouite <https://delapouite.com/> (Meeple shape extracted from "Meeple icon" <https://game-icons.net/1x1/delapouite/meeple.html> / "CC BY 3.0" <https://creativecommons.org/licenses/by/3.0/>) [illustrator]
- Creative Commons (‘save_print_and_play()‘ uses "license badges" from Creative Commons to describe the generated print-and-play file’s license) [illustrator]

See Also

Useful links:

- blog: https://trevorldavis.com/piecepackr/
- pkgdown: https://trevorldavis.com/R/piecepackr/
- forum: https://groups.google.com/forum/#!forum/piecepackr
- Report bugs: https://github.com/piecepackr/piecepackr/issues

---

`aabb_piece` *Calculate axis-aligned bounding box for set of game pieces*

Description

Calculate axis-aligned bounding box (AABB) for set of game pieces with and without an “oblique projection”.

Usage

```
aabb_piece(
  df,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  envir = getOption("piecepackr.envir"),
  op_scale = getOption("piecepackr.op_scale", 0),
  op_angle = getOption("piecepackr.op_angle", 45),
  ...
)
```

Arguments

`df`	A data frame of game piece information with (at least) the named columns “piece_side”, “x”, and “y”.
`cfg`	Piecepack configuration list or `pp_cfg` object, a list of `pp_cfg` objects, or a character vector referring to names in `envir` or a character vector referring to object names that can be retrieved by `base::dynGet()`.
`envir`	Environment (or named list) containing configuration list(s).
`op_scale`	How much to scale the depth of the piece in the oblique projection (viewed from the top of the board). `0` (the default) leads to an “orthographic” projection, `0.5` is the most common scale used in the “cabinet” projection, and `1.0` is the scale used in the “cavalier” projection.
`op_angle`	What is the angle of the oblique projection? Has no effect if `op_scale` is `0`.
`...`	Ignored

Details

The "oblique projection" of a set of (x, y, z) points onto the xy-plane is $(x + \lambda * z * cos(\alpha), y + \lambda * z * sin(\alpha))$ where λ is the scale factor and α is the angle.

Value

A named list of ranges with five named elements `x`, `y`, and `z` for the axis-aligned bounding cube in xyz-space plus `x_op` and `y_op` for the axis-aligned bounding box of the "oblique projection" onto the xy plane.

Examples

```
df_tiles <- data.frame(piece_side="tile_back", x=0.5+c(3,1,3,1), y=0.5+c(3,3,1,1),
                       suit=NA, angle=NA, z=NA, stringsAsFactors=FALSE)
df_coins <- data.frame(piece_side="coin_back", x=rep(4:1, 4), y=rep(4:1, each=4),
                       suit=1:16%%2+rep(c(1,3), each=8),
                       angle=rep(c(180,0), each=8), z=1/4+1/16, stringsAsFactors=FALSE)
df <- rbind(df_tiles, df_coins)

aabb_piece(df, op_scale = 0)
aabb_piece(df, op_scale = 1, op_angle = 45)
aabb_piece(df, op_scale = 1, op_angle = -90)
```

`AA_to_R` *Helper functions for making geometric calculations.*

Description

`to_x()`, `to_y()`, `to_r()`, `to_t()` convert between polar coordinates (in degrees) and Cartesian coordinates. `to_degrees()` and `to_radians()` converts between degrees and radians. `AA_to_R()` and `R_to_AA()` convert back and forth between (post-multiplied) rotation matrix and axis-angle representations of 3D rotations. `R_x()`, `R_y()`, and `R_z()` build (post-multiplied) rotation matrices for simple rotations around the x, y, and z axes.

Usage

```
AA_to_R(angle = 0, axis_x = 0, axis_y = 0, axis_z = NA, ...)

R_to_AA(R = diag(3))

R_x(angle = 0)

R_y(angle = 0)

R_z(angle = 0)

to_radians(t)
```

```
to_degrees(t)

to_x(t, r)

to_y(t, r)

to_r(x, y)

to_t(x, y)
```

Arguments

angle	Numeric vector in degrees (counter-clockwise) or an affiner::angle() vector.
axis_x	First coordinate of the axis unit vector.
axis_y	Second coordinate of the axis unit vector.
axis_z	Third coordinate of the axis unit vector (usually inferred).
...	Ignored
R	3D rotation matrix (post-multiplied)
t	Numeric vector in degrees (or radians for to_degrees()) or an affiner::angle() vector.
r	Radial distance
x	Cartesian x coordinate
y	Cartesian y coordinate

Details

pp_cfg() uses polar coordinates to determine where the "primary" and "directional" symbols are located on a game piece. They are also useful for drawing certain shapes and for making game diagrams on hex boards.

piecepackr and grid functions use angles in degrees but the base trigonometry functions usually use radians.

piecepackr's 3D graphics functions save_piece_obj(), piece(), piece3d(), and piece_mesh() use the axis-angle representation for 3D rotations. The axis-angle representation involves specifying a unit vector indicating the direction of an axis of rotation and an angle describing the (counter-clockwise) rotation around that axis. Because it is a unit vector one only needs to specify the first two elements, axis_x and axis_y, and we are able to infer the 3rd element axis_z. The default of axis = 0, axis_y = 0, and implied axis_z = 1 corresponds to a rotation around the z-axis which is reverse-compatible with the originally 2D angle interpretation in grid.piece(). In order to figure out the appropriate axis-angle representation parameters R_to_AA(), R_x(), R_y(), and R_z() allow one to first come up with an appropriate (post-multiplied) 3D rotation matrix by chaining simple rotations and then convert them to the corresponding axis-angle representation. Pieces are rotated as if their center was at the origin.

See Also

https://en.wikipedia.org/wiki/Axis-angle_representation for more details about the Axis-angle representation of 3D rotations. See Trig for R's built-in trigonometric functions.

Examples

```
to_x(90, 1)
to_y(180, 0.5)
to_t(0, -1)
to_r(0.5, 0)
all.equal(pi, to_radians(to_degrees(pi)))
# default axis-angle axis is equivalent to a rotation about the z-axis
all.equal(AA_to_R(angle=60), R_z(angle=60))
# axis-angle representation of 90 rotation about the x-axis
R_to_AA(R_x(90))
# find Axis-Angle representation of first rotating about x-axis 180 degrees
# and then rotating about z-axis 45 degrees
R_to_AA(R_x(180) %*% R_z(45))
```

`animate_piece` *Animate board game pieces*

Description

`animate_piece()` animates board game pieces.

Usage

```
animate_piece(
  dfs,
  file = "animation.gif",
  ...,
  .f = piecepackr::grid.piece,
  cfg = getOption("piecepackr.cfg", NULL),
  envir = getOption("piecepackr.envir"),
  width = NULL,
  height = NULL,
  ppi = NULL,
  annotate = TRUE,
  annotation_scale = NULL,
  open_device = TRUE,
  n_transitions = 0L,
  n_pauses = 1L,
  fps = n_transitions + n_pauses,
  xbreaks = NULL,
  ybreaks = NULL
)
```

Arguments

`dfs`	A list of data frames of game data to plot.

file	Filename to save animation unless NULL in which case it uses the current graphics device.
...	Arguments to pmap_piece()
.f	Low level graphics function to use e.g. grid.piece(), piece3d(), piece(), or piece_mesh().
cfg	A piecepackr configuration list. If NULL (the default) and envir is also NULL then the pieces are drawn with the "piecepack" configuration from game_systems().
envir	Environment (or named list) of piecepackr configuration lists. If NULL (the default) one is built from cfg and, when a cfg column names other configurations, game_systems().
width	Width of animation (in inches). Inferred by default.
height	Height of animation (in inches). Inferred by default.
ppi	Resolution of animation in pixels per inch. By default set so image max 600 pixels wide or tall.
annotate	If TRUE or "algebraic" annotate the plot with "algrebraic" coordinates, if FALSE or "none" don't annotate, if "cartesian" annotate the plot with "cartesian" coordinates.
annotation_scale	Multiplicative factor that scales (stretches) any annotation coordinates. By default uses attr(df, "scale_factor") %||% 1.
open_device	If TRUE open a new graphics device otherwise draw in the active graphics.
n_transitions	Integer, if over zero (the default) how many transition frames to add between moves.
n_pauses	Integer, how many paused frames per completed move.
fps	Double, frames per second.
xbreaks, ybreaks	Subset (of integers) to provide axis labels for if annotate is TRUE. If NULL infer a reasonable choice.

Value

Nothing, as a side effect creates an animation.

Examples

```
# Basic tic-tac-toe animation
dfs <- list()
d.frame <- function(piece_side = "bit_back", ..., rank = 1L) {
               data.frame(piece_side = piece_side, ..., rank = rank,
                          cfg = "checkers1", stringsAsFactors = FALSE)
}
df <- d.frame("board_back", suit = 2L, rank = 3L, x = 2, y = 2, id = "1")
dfs[[1L]] <- df
df <- rbind(df, d.frame(suit = 1L, x = 2, y = 2, id = "2"))
dfs[[2L]] <- df
df <- rbind(df, d.frame(suit = 2L, x = 1, y = 2, id = "3"))
```

```
  dfs[[3L]] <- df
  df <- rbind(df, d.frame(suit = 1L, x = 3, y = 1, id = "4"))
  dfs[[4L]] <- df
  df <- rbind(df, d.frame(suit = 2L, x = 1, y = 3, id = "5"))
  dfs[[5L]] <- df
  df <- rbind(df, d.frame(suit = 1L, x = 1, y = 1, id = "6"))
  dfs[[6L]] <- df
  df <- rbind(df, d.frame(suit = 2L, x = 3, y = 3, id = "7"))
  dfs[[7L]] <- df
  df <- rbind(df, d.frame(suit = 1L, x = 2, y = 1, id = "8"))
  dfs[[8L]] <- df

  ## Press enter to walk through moves in a "game" in new graphics device
  if (interactive()) {
      animate_piece(dfs, file = NULL)
  }

  ## Save GIF of game with animation transitions
  ## Not run: # May take more than 5 seconds on CRAN servers
  if ((requireNamespace("animation", quietly = TRUE) ||
       requireNamespace("gifski", quietly = TRUE)) &&
      requireNamespace("tweenr", quietly = TRUE)) {
      file <- tempfile("tic-tac-toe", fileext = ".gif")
      animate_piece(dfs, file = file,
                    n_transitions = 5L, n_pauses = 2L, fps = 9)
  }

## End(Not run)
```

---

basicPieceGrobs *Piece Grob Functions*

Description

basicPieceGrob() is the most common "grob" function that grid.piece() uses to create grid graphical grob objects. picturePieceGrobFn() is a function that returns a "grob" function that imports graphics from files found in its directory argument.

Usage

```
basicPieceGrob(piece_side, suit, rank, cfg = pp_cfg())

picturePieceGrobFn(directory, filename_fn = find_pp_file)

pyramidTopGrob(piece_side, suit, rank, cfg = pp_cfg())

previewLayoutGrob(piece_side, suit, rank, cfg = pp_cfg())
```

Arguments

piece_side	A string with piece and side separated by a underscore e.g. "coin_face"
suit	Number of suit (starting from 1).
rank	Number of rank (starting from 1)
cfg	Piecepack configuration list or pp_cfg() object.
directory	Directory that picturePieceGrobFn will look in for piece graphics.
filename_fn	Function that takes arguments directory, piece_side, suit, rank, and optionally cfg and returns the (full path) filename of the image that the function returned by picturePieceGrobFn should import.

Examples

```
if (requireNamespace("grid", quietly = TRUE) && piecepackr:::device_supports_unicode()) {
  cfg <- pp_cfg(list(grob_fn.tile=basicPieceGrob, invert_colors=TRUE))
  grid.piece("tile_face", suit=1, rank=3, cfg=cfg)
}

# May take more than 5 seconds on CRAN servers
try({
  if (requireNamespace("grid", quietly = TRUE) && capabilities(c("cairo"))) {
    cfg <- pp_cfg(list(grob_fn.tile=basicPieceGrob, invert_colors=TRUE))
    directory <- tempdir()
    save_piece_images(cfg, directory=directory, format="svg", angle=0)
    cfg2 <- pp_cfg(list(grob_fn=picturePieceGrobFn(directory)))

    grid::grid.newpage()
    grid.piece("coin_back", suit=3, rank=5, cfg=cfg2)
  }
})
```

---

font_utils *Font utility functions*

Description

get_embedded_font() returns which font is actually embedded by cairo_pdf() for a given character. has_font() tries to determine if a given font is available on the OS.

Usage

```
get_embedded_font(font, char)

has_font(font)
```

Arguments

font	A character vector of font(s).
char	A character vector of character(s) to be embedded by grid::grid.text()

Details

get_embedded_font() depends on the suggested pdftools package being installed and R being compiled with Cairo support. has_font() depends on either the suggested systemfonts (preferred) or pdftools packages being installed.

Value

get_embedded_font() returns character vector of fonts that were actually embedded by cairo_pdf(). NA's means no embedded font detected: this either means that no font was found or that a color emoji font was found and instead of a font an image was embedded.

Examples

```
if (requireNamespace("pdftools", quietly = TRUE) &&
    capabilities("cairo") &&
    !piecepackr:::is_cairo_maybe_buggy()) {
  chars <- c("a", "\u2666")
  fonts <- c("sans", "Sans Noto", "Noto Sans", "Noto Sans Symbols2")
  try(get_embedded_font(fonts, chars))
}

if (requireNamespace("systemfonts", quietly = TRUE) ||
    (requireNamespace("pdftools", quietly = TRUE) &&
     capabilities("cairo")) && !piecepackr:::is_cairo_maybe_buggy()) {
  try(has_font("Dejavu Sans"))
}
```

---

game_systems *Standard game systems*

Description

game_systems() returns a list of pp_cfg() objects representing several game systems and pieces. to_subpack() and to_hexpack() will attempt to generate matching (piecepack stackpack) subpack and (piecepack) hexpack pp_cfg() R6 objects respectively given a piecepack configuration.

Usage

```
game_systems(
  font = NULL,
  round = FALSE,
  pawn = "token",
  ...,
```

```
  shading = FALSE,
  border = TRUE,
  background_color = ifelse(border, "white", "burlywood"),
  edge_color = ifelse(border, "white", "black"),
  systems = NULL
)

to_hexpack(cfg = getOption("piecepackr.cfg", pp_cfg()))

to_subpack(cfg = getOption("piecepackr.cfg", pp_cfg()))
```

Arguments

font	If NULL (the default) uses suit glyphs from the default "sans" font. If "dejavu" it will use suit glyphs from the "DejaVu Sans" font (must be installed on the system).
round	If TRUE the "shape" of "tiles" and "cards" (and some boards) will be "roundrect" instead of "rect" (the default).
pawn	If "token" (default) the piecepack pawn will be a two-sided token in a "halma" outline, if "peg-doll" the piecepack pawn will be a "peg doll" style pawn, and if "joystick" the piecepack pawn will be a "joystick" style pawn. Note for the latter two pawn styles only pawn_top will work with grid.piece().
...	Must be empty
shading	If TRUE add a shading effect to marbles and stones when drawn with grid.piece().
border	If TRUE draw a black border line on piece edges. Should normally be TRUE when drawing with {grid} graphics and FALSE when drawing with 3D graphic systems.
background_color	Background color to use for certain pieces like boards and piecepack tiles.
edge_color	Edge color to use for certain pieces like boards and piecepack tiles.
systems	Character vector of the names of the game systems to build (see the list above). If NULL (the default) builds all of them, which takes tens of milliseconds.
cfg	List of configuration options

Details

Contains the following game systems:

alquerque Boards and pieces in nine color schemes for Alquerque

checkers1, checkers2 Checkers and checkered boards in nine color schemes. Checkers are represented by a piecepackr "bit". The "board" "face" is a checkered board and the "back" is a lined board. Color is controlled by suit and number of rows/columns by rank. checkers1 has one inch squares and checkers2 has two inch squares.

chess1, chess2 Chess pieces, boards, and dice in nine color schemes. Chess pieces are represented by a "bit" (face). The "board" "face" is a checkered board and the "back" is a lined board. Color is controlled by suit and number of rows/columns by rank. chess1 has one inch squares

and chess2 has two inch squares. Currently uses print-and-play style discs instead of 3D Staunton chess pieces.

cubes Cubes in six sizes and nine colors represented by a "bit". Color is controlled by suit and size of cube by rank. Sizes go from 8mm (rank 1) to 25mm (rank 6): 8mm, 10mm, 12mm, 15mm, 20mm, 25mm.

dice Traditional six-sided pipped dice in nine color schemes (color controlled by their suit).

dice_d4, dice_numeral, dice_d8, dice_d10, dice_d10_percentile, dice_d12, dice_d20 Polyhedral dice most commonly used to play wargames, roleplaying games, and trading card games:

- **dice_d4** Four-sided dice in nine color schemes (color controlled by their suit). Tetrahedrons with the rank as a numeral at the top point.
- **dice_numeral** Six-sided dice with numerals instead of pips in nine color schemes (color controlled by their suit).
- **dice_d8** Eight-sided dice in nine color schemes (color controlled by their suit). Octahedrons with the rank as a numeral at the top face.
- **dice_d10** Ten-sided dice in nine color schemes (color controlled by their suit). Pentagonal trapezohedrons with the rank as a numeral at the top face. The rank of ten is represented by a zero.
- **dice_d10_percentile** Ten-sided dice in nine color schemes (color controlled by their suit). Pentagonal trapezohedrons with the rank as a numeral followed by a zero at the top face. The rank of ten is represented by a zero.
- **dice_d12** Twelve-sided dice in nine color schemes (color controlled by their suit). Dodecahedrons with the rank as a numeral at the top face.
- **dice_d20** Twenty-sided dice in nine color schemes (color controlled by their suit). Icosahedrons with the rank as a numeral at the top face.

dice_fudge "Fudge" dice in nine color schemes (color controlled by their suit). "Fudge" dice have three ranks "+", " ", and "-" repeated twice.

dominoes, dominoes_black, dominoes_blue, dominoes_green, dominoes_red, dominoes_white, dominoes_yellow Traditional pipped dominoes in six color schemes (dominoes and dominoes_white are the same). In each color scheme the number of pips on the "top" of the domino is controlled by their "rank" and on the "bottom" by their "suit". Supports up to double-18 sets.

dominoes_chinese, dominoes_chinese_black dominoes_chinese has Asian-style six-sided pipped dice with white background and black and red pips. The "tile"'s are Chinese dominoes (1" x 2.5") whose number of pips are controlled by both their "rank" and their "suit". dominoes_chinese_black are like dominoes_chinese but the dice and dominoes have a black background and white and red pips.

go Go stones and lined boards in nine color schemes. Go stones are represented by a "bit" and the board is a "board". Color is controlled by suit and number of rows/columns by rank.

marbles Marbles in nine sizes and nine colors represented by a "bit". Color is controlled by suit and size of marble by rank. Sizes go from 1/2" (rank 1) to 1" (rank 9) in 1/16" increments. There are also square holed boards spaced for 1" marbles: their color is controlled by suit and number of holes per row/column by rank.

meeples Standard 16mm x 16mm x 10mm "meeples" in nine colors represented by a "bit".

morris Various morris aka mills aka merels games in nine colors. Color is controlled by suit and "size" of morris board is controlled by rank e.g. "Six men's morris" corresponds to a rank of 6 and "Nine men's morris" corresponds to a rank of 9. Game pieces are represented by stones.

piecepack, dual_piecepacks_expansion, playing_cards_expansion, hexpack, subpack, piecepack_inverted The piecepack is a public domain game system invented by James "Kyle" Droscha. See https://www.ludism.org/ppwiki for more info about the piecepack and its accessories/expansions.

- **piecepack** A standard piecepack. The configuration also contains the following piecepack accessories:
  - **piecepack dice cards** An accessory proposed by John Braley. See https://www.ludism.org/ppwiki/PiecepackDiceCards.
  - **piecepack matchsticks** A public domain accessory developed by Dan Burkey. See https://www.ludism.org/ppwiki/PiecepackMatchsticks.
  - **piecepack pyramids** A public domain accessory developed by Tim Schutz. See https://www.ludism.org/ppwiki/PiecepackPyramids.
  - **piecepack saucers** A public domain accessory developed by Karol M. Boyle at Mesomorph Games. See https://web.archive.org/web/20190719155827/http://www.piecepack.org/Accessories.html.
- **piecepack_inverted** The standard piecepack with its color scheme inverted. Intended to aid in highlighting special pieces in diagrams.
- **dual_piecepacks_expansion** A companion piecepack with a special suit scheme. See https://trevorldavis.com/piecepackr/dual-piecepacks-pnp.html.
- **playing_cards_expansion** A piecepack with the standard "French" playing card suits. See https://www.ludism.org/ppwiki/PlayingCardsExpansion.
- **hexpack** A hexagonal extrapolation of the piecepack designed by Nathan Morse and Daniel Wilcox. See https://boardgamegeek.com/boardgameexpansion/35424/hexpack.
- **subpack** A mini piecepack. Designed to be used with the `piecepack` to make piecepack "stackpack" diagrams. See https://www.ludism.org/ppwiki/StackPack.

playing_cards, playing_cards_colored, playing_cards_tarot Poker-sized "card" components for various playing card decks:

- **playing_cards** A traditional deck of playing cards with 4 suits and 13 ranks (A, 2-10, J, Q, K) plus a 14th "Joker" rank.
- **playing_cards_colored** Like `playing_cards` but with five colored suits: red hearts, black spades, green clubs, blue diamonds, and yellow stars.
- **playing_cards_tarot** A (French Bourgeois) deck of tarot playing cards: first four suits are hearts, spades, clubs, and diamonds with 14 ranks (ace through jack, knight, queen, king) plus a 15th "Joker" rank and a fifth "suit" of 22 trump cards (1-21 plus an "excuse").

reversi Boards and pieces for Reversi. "board_face" provides lined boards with colored backgrounds. "board_back" provides checkered boards. "bit_face" / "bit_back" provides circular game tokens with differently colored sides: red paired with green, black paired with white, and blue paired with yellow.

See Also

`pp_cfg()` for information about the `pp_cfg()` objects returned by `game_systems()`.

Examples

```
cfgs <- game_systems(pawn = "joystick")
names(cfgs)
```

```
# or just the ones you need
names(game_systems(systems = c("checkers1", "dice")))

# May take more than 5 seconds on CRAN servers
# standard dice, meeples, and joystick pawns
if (requireNamespace("grid", quietly = TRUE) && piecepackr:::device_supports_unicode()) {

   opt <- options(piecepackr.at.inform = FALSE)
   grid::grid.newpage()
   dice <-  c("d4", "numeral", "d8", "d10", "d12", "d20")
   cfg <- paste0("dice_", dice)
   grid.piece("die_face", suit = c(1:6, 1), rank = 1:6,
              cfg = cfg, envir = cfgs, x = 1:6, y = 1,
              default.units = "in", op_scale = 0.5)
   grid.piece("die_face", rank=1:6, suit=1:6,
              x=1:6, y=2, default.units="in",
              op_scale=0.5, cfg=cfgs$dice)
   grid.piece("bit_face", suit=1:6,
              x=1:6, y=3, default.units="in",
              op_scale=0.5, cfg=cfgs$meeple)
   grid.piece("pawn_top", suit=1:6,
              x=1:6, y=4, default.units="in",
              op_scale=0.5, cfg=cfgs$piecepack)
   options(opt)
}

# dominoes
if (requireNamespace("grid", quietly = TRUE)) {
   grid::grid.newpage()
   colors <- c("black", "red", "green", "blue", "yellow", "white")
   cfg <- paste0("dominoes_", rep(colors, 2))
   grid.piece("tile_face",  suit=1:12, rank=1:12+1,
              cfg=cfg, envir=cfgs,
              x=rep(6:1, 2), y=rep(2*2:1, each=6),
              default.units="in", op_scale=0.5)
}
# piecepack "playing card expansion"
if (requireNamespace("grid", quietly = TRUE) && piecepackr:::device_supports_unicode()) {
   grid::grid.newpage()
   df_tiles <- data.frame(piece_side="tile_back",
                          x=0.5+c(3,1,3,1), y=0.5+c(3,3,1,1),
                          suit=NA, angle=NA, z=1/8,
                          stringsAsFactors=FALSE)
   df_coins <- data.frame(piece_side="coin_back",
                          x=rep(4:1, 4), y=rep(4:1, each=4),
                          suit=c(1,4,1,4,4,1,4,1,2,3,2,3,3,2,3,2),
                          angle=rep(c(180,0), each=8), z=1/4+1/16,
                          stringsAsFactors=FALSE)
   df <- rbind(df_tiles, df_coins)
   pmap_piece(df, cfg = cfgs$playing_cards_expansion, op_scale=0.5,
              default.units="in")
}
```

geom_piece *Draw board game pieces with ggplot2*

Description

geom_piece() creates a ggplot2 geom. aes_piece() takes a data frame and generates an appropriate ggplot2::aes() mapping.

Usage

```
geom_piece(
  mapping = NULL,
  data = NULL,
  stat = "identity",
  position = "identity",
  ...,
  envir = getOption("piecepackr.envir", piecepackr::game_systems()),
  op_scale = getOption("piecepackr.op_scale", 0),
  op_angle = getOption("piecepackr.op_angle", 45),
  inherit.aes = TRUE
)

aes_piece(df)
```

Arguments

mapping	Set of aesthetic mappings created by aes(). If specified and inherit.aes = TRUE (the default), it is combined with the default mapping at the top level of the plot. You must supply mapping if there is no plot mapping.
data	The data to be displayed in this layer. There are three options: If NULL, the default, the data is inherited from the plot data as specified in the call to ggplot(). A data.frame, or other object, will override the plot data. All objects will be fortified to produce a data frame. See fortify() for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a data.frame, and will be used as the layer data. A function can be created from a formula (e.g. ~ head(.x, 10)).
stat	The statistical transformation to use on the data for this layer. When using a geom_*() function to construct a layer, the stat argument can be used to override the default coupling between geoms and stats. The stat argument accepts the following: • A Stat ggproto subclass, for example StatCount. • A string naming the stat. To give the stat as a string, strip the function name of the stat_ prefix. For example, to use stat_count(), give the stat as "count".

- For more information and other ways to specify the stat, see the layer stat documentation.

`position` A position adjustment to use on the data for this layer. This can be used in various ways, including to prevent overplotting and improving the display. The `position` argument accepts the following:

- The result of calling a position function, such as `position_jitter()`. This method allows for passing extra arguments to the position.
- A string naming the position adjustment. To give the position as a string, strip the function name of the `position_` prefix. For example, to use `position_jitter()`, give the position as `"jitter"`.
- For more information and other ways to specify the position, see the layer position documentation.

`...` Aesthetics, used to set an aesthetic to a fixed value.

`envir` Environment (or named list) containing configuration list(s).

`op_scale` How much to scale the depth of the piece in the oblique projection (viewed from the top of the board). `0` (the default) leads to an "orthographic" projection, `0.5` is the most common scale used in the "cabinet" projection, and `1.0` is the scale used in the "cavalier" projection.

`op_angle` What is the angle of the oblique projection? Has no effect if `op_scale` is `0`.

`inherit.aes` If `FALSE`, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. `annotation_borders()`.

`df` A data frame of game piece information with (at least) the named columns "piece_side", "x", and "y".

Details

`geom_piece()` requires a fixed scale coordinate system with an aspect ratio of 1 as provided by `ggplot2::coord_fixed()`. `geom_piece()` also requires that `cfg` is a character vector (and not a `pp_cfg()` object). In particular if using `op_transform()` one should set its argument `cfg_class = "character"` if intending for use with `geom_piece()`.

Aesthetics

`geom_piece()` understands the following aesthetics (required aesthetics are in bold). See `pieceGrob()` for more details.

- `x`
- `y`
- `z`
- `piece_side`
- `rank`
- `suit`
- `cfg`

- width
- height
- depth
- angle
- scale
- type

See Also

geom_piece() is a wrapper around pieceGrob(). scale_x_piece() and scale_y_piece() are wrappers around ggplot2::scale_x_continuous() and ggplot2::scale_y_continuous() with better defaults for board game diagrams.

Examples

```
if (require("ggplot2", quietly = TRUE) && require("tibble", quietly = TRUE)) {
  envir <- game_systems("sans")
  df_board <- tibble(piece_side = "board_face", suit = 3, rank = 8,
                x = 4.5, y = 4.5)
  df_w <- tibble(piece_side = "bit_back", suit = 6, rank = 1,
                x = rep(1:8, 2), y = rep(1:2, each=8))
  df_b <- tibble(piece_side = "bit_back", suit = 1, rank = 1,
                x = rep(1:8, 2), y = rep(7:8, each=8))
  df <- rbind(df_board, df_w, df_b)
  # 2D example
  # `cfg` must be a character vector for `geom_piece()`
  ggplot(df, aes_piece(df)) +
      geom_piece(cfg = "checkers1", envir = envir) +
      coord_fixed() +
      scale_x_piece() +
      scale_y_piece() +
      theme_minimal(28) +
      theme(panel.grid = element_blank())
}
if (require("ggplot2", quietly = TRUE) && require("tibble", quietly = TRUE)) {
  # 3D "oblique" projection example
  # `cfg_class` must be "character" when using with `geom_piece()`
  df3d <- op_transform(df, cfg = "checkers1", envir = envir,
                       op_angle = 45, cfg_class = "character")
  ggplot(df3d, aes_piece(df3d)) +
      geom_piece(cfg = "checkers1", envir = envir,
                 op_angle = 45, op_scale = 0.5) +
      coord_fixed() +
      theme_void()
}
```

grid.cropmark *Draw crop marks with grid*

Description

grid.cropmark() draws "crop marks" to the active graphics device. cropmarkGrob() is its grid grob counterpart. Intended for use in adding crop marks around game pieces in print-and-play layouts.

Usage

```
cropmarkGrob(
  ...,
  piece_side = "tile_back",
  suit = NA,
  rank = NA,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  x = unit(0.5, "npc"),
  y = unit(0.5, "npc"),
  angle = 0,
  width = NA,
  height = NA,
  scale = 1,
  default.units = "npc",
  envir = getOption("piecepackr.envir"),
  name = NULL,
  gp = gpar(),
  vp = NULL,
  bleed = unit(0.125, "in"),
  cm_select = "12345678",
  cm_width = unit(0.25, "mm"),
  cm_length = unit(0.125, "in")
)

grid.cropmark(..., draw = TRUE)
```

Arguments

...	cropmarkGrob() ignores; grid.cropmark() passes to cropmarkGrob().
piece_side	A string with piece and side separated by a underscore e.g. "coin_face"
suit	Number of suit (starting from 1).
rank	Number of rank (starting from 1)
cfg	Piecepack configuration list or pp_cfg object, a list of pp_cfg objects, or a character vector referring to names in envir or a character vector referring to object names that can be retrieved by base::dynGet().

x	Where to place piece on x axis of viewport
y	Where to place piece on y axis of viewport
angle	Angle (on xy plane) to draw piece at
width	Width of piece
height	Height of piece
scale	Multiplicative scaling factor to apply to width, height, and depth.
default.units	A string indicating the default units to use if 'x', 'y', 'width', and/or 'height' are only given as numeric vectors.
envir	Environment (or named list) containing configuration list(s).
name	A character identifier (for grid)
gp	An object of class "gpar".
vp	A grid viewport object (or NULL).
bleed	Bleed zone size to assume: • If bleed is a grid::unit() simply use it • If bleed is numeric then convert via grid::unit(bleed, default.units) • If bleed is TRUE assume 1/8 inch bleed zone size • If bleed is FALSE assume 0 inch bleed zone size
cm_select	A string of integers from "1" to "8" indicating which crop marks to draw. "1" represents the top right crop mark then we proceeding clockwise to "8" which represents the top left crop mark. Default "12345678" draws all eight crop marks.
cm_width	Width of crop mark.
cm_length	Length of crop mark.
draw	A logical value indicating whether graphics output should be produced.

Value

A grid grob.

Examples

```
if (requireNamespace("grid", quietly = TRUE) &&
    piecepackr:::device_supports_unicode()) {
  cfg <- pp_cfg(list(mat_color = "pink", mat_width=0.05, border_color=NA))
  grid::grid.newpage()
  df <- data.frame(piece_side = "tile_face", suit = 2, rank = 2,
                   x = 2, y = 2, angle = 0,
                   stringsAsFactors = FALSE)
  pmap_piece(df, grid.cropmark, cfg = cfg, default.units = "in")
  pmap_piece(df, grid.piece, cfg = cfg, default.units = "in", bleed=TRUE)
}
if (requireNamespace("grid", quietly = TRUE) &&
    piecepackr:::device_supports_unicode()) {
  grid::grid.newpage()
  df <- data.frame(piece_side = "coin_back", suit = 2, rank = 2,
```

```
                  x = 2, y = 2, angle = 0,
                  stringsAsFactors = FALSE)
  pmap_piece(df, grid.cropmark, cfg = cfg, default.units = "in", bleed=TRUE)
  pmap_piece(df, grid.piece, cfg = cfg, default.units = "in", bleed=TRUE)
}
```

`grid.crosshair` *Draw crosshairs with grid*

Description

`grid.crosshair()` draws crosshairs at the corners of a rectangular area. `crosshairGrob()` is its grid grob counterpart. They are intended for use in adding crosshairs at the corners of game pieces in print-and-play layouts. One can also use the lower level `circledSegmentsCrosshairGrob()`, `segmentsCrosshairGrob()`, `squaredSegmentsCrosshairGrob()`, and `squaresCrosshairGrob()` (which can be drawn with `grid::grid.draw()`) to add individual crosshairs to specified (x,y) locations (e.g. for use as registration marks).

Usage

```
crosshairGrob(
  ...,
  piece_side = "tile_back",
  suit = NA,
  rank = NA,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  x = unit(0.5, "npc"),
  y = unit(0.5, "npc"),
  angle = 0,
  width = NA,
  height = NA,
  scale = 1,
  default.units = "npc",
  envir = getOption("piecepackr.envir"),
  name = NULL,
  gp = gpar(),
  vp = NULL,
  ch_width = unit(1/6, "in"),
  ch_grob = squaresCrosshairGrob()
)

grid.crosshair(..., draw = TRUE)

segmentsCrosshairGrob(
  ...,
  x = unit(0.5, "npc"),
  y = unit(0.5, "npc"),
```

```
  width = unit(1, "snpc"),
  height = unit(1, "snpc"),
  default.units = "npc",
  name = NULL,
  gp = gpar(),
  vp = NULL
)

circledSegmentsCrosshairGrob(
  ...,
  x = unit(0.5, "npc"),
  y = unit(0.5, "npc"),
  width = unit(1, "snpc"),
  height = unit(1, "snpc"),
  default.units = "npc",
  name = NULL,
  gp = gpar(),
  vp = NULL
)

squaredSegmentsCrosshairGrob(
  ...,
  x = unit(0.5, "npc"),
  y = unit(0.5, "npc"),
  width = unit(1, "snpc"),
  height = unit(1, "snpc"),
  default.units = "npc",
  name = NULL,
  gp = gpar(),
  vp = NULL
)

squaresCrosshairGrob(
  ...,
  x = unit(0.5, "npc"),
  y = unit(0.5, "npc"),
  width = unit(1, "snpc"),
  height = unit(1, "snpc"),
  default.units = "npc",
  name = NULL,
  gp = gpar(),
  vp = NULL
)
```

Arguments

`...`	`crosshairGrob()` ignores; `grid.crosshair()` passes to `crosshairGrob()`.
`piece_side`	A string with piece and side separated by a underscore e.g. "coin_face"

suit	Number of suit (starting from 1).
rank	Number of rank (starting from 1)
cfg	Piecepack configuration list or pp_cfg object, a list of pp_cfg objects, or a character vector referring to names in envir or a character vector referring to object names that can be retrieved by base::dynGet().
x	Where to place piece on x axis of viewport
y	Where to place piece on y axis of viewport
angle	Angle (on xy plane) to draw piece at
width	Width of piece
height	Height of piece
scale	Multiplicative scaling factor to apply to width, height, and depth.
default.units	A string indicating the default units to use if 'x', 'y', 'width', and/or 'height' are only given as numeric vectors.
envir	Environment (or named list) containing configuration list(s).
name	A character identifier (for grid)
gp	An object of class "gpar".
vp	A grid viewport object (or NULL).
ch_width	Width/height of ch_grob's viewport.
ch_grob	Crosshair grob. Will be drawn in each corner of the piece in a viewport with ch_width width and ch_width height. segmentsCrosshairGrob() simply wraps grid::segmentsGrob(). circledSegmentsCrosshairGrob() wraps grid::segmentsGrob() and grid::circleGrob(). squaredSegmentsCrosshairGrob() wraps grid::segmentsGrob() and grid::rectGrob(). squaresCrosshairGrob() wraps grid::rectGrob() and alternates black/white squares for visibility on both light and dark backgrounds.
draw	A logical value indicating whether graphics output should be produced.

Value

A grid grob.

Examples

```
if (requireNamespace("grid", quietly = TRUE) &&
    piecepackr:::device_supports_unicode()) {
  cfg <- pp_cfg(list(border_color = NA))
  grid::grid.newpage()
  df <- data.frame(piece_side = "tile_face", suit = 2, rank = 2,
                   x = 2, y = 2, angle = 0,
                   stringsAsFactors = FALSE)
  pmap_piece(df, grid.piece, cfg = cfg, default.units = "in")
  pmap_piece(df, grid.crosshair, cfg = cfg, default.units = "in")
}
if (requireNamespace("grid", quietly = TRUE) &&
    piecepackr:::device_supports_unicode()) {
```

```
  grid::grid.newpage()
  pmap_piece(df, grid.piece, cfg = cfg, default.units = "in")
  pmap_piece(df, grid.crosshair, cfg = cfg, default.units = "in",
             ch_grob = segmentsCrosshairGrob())
}
if (requireNamespace("grid", quietly = TRUE)) {
  grid::grid.newpage()
  fns <- list(squaresCrosshairGrob, segmentsCrosshairGrob,
              circledSegmentsCrosshairGrob, squaredSegmentsCrosshairGrob)
  labels <- c("squaresCrosshairGrob()", "segmentsCrosshairGrob()",
              "circledSegmentsCrosshairGrob()", "squaredSegmentsCrosshairGrob()")
  xs <- c(0.25, 0.75, 0.25, 0.75)
  ys <- c(0.70, 0.70, 0.30, 0.30)
  label_ys <- c(0.55, 0.55, 0.15, 0.15)
  for (i in seq_along(fns)) {
    grid::grid.draw(fns[[i]](x = grid::unit(xs[i], "npc"),
                             y = grid::unit(ys[i], "npc"),
                             width = grid::unit(0.15, "npc"),
                             height = grid::unit(0.15, "npc")))
    grid::grid.text(labels[i], x = xs[i], y = label_ys[i], gp = grid::gpar(cex = 0.7))
  }
}
```

`grid.piece` *Draw board game pieces with grid*

Description

`grid.piece()` draws board game pieces onto the graphics device. `pieceGrob()` is its `grid` "grob" counterpart.

Usage

```
pieceGrob(
  piece_side = "tile_back",
  suit = NA,
  rank = NA,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  x = unit(0.5, "npc"),
  y = unit(0.5, "npc"),
  z = NA,
  angle = 0,
  ...,
  width = NA,
  height = NA,
  depth = NA,
  op_scale = getOption("piecepackr.op_scale", 0),
  op_angle = getOption("piecepackr.op_angle", 45),
  default.units = getOption("piecepackr.default.units", "npc"),
```

```
  envir = getOption("piecepackr.envir"),
  name = NULL,
  gp = NULL,
  vp = NULL,
  scale = 1,
  alpha = 1,
  type = "normal",
  bleed = FALSE
)

grid.piece(
  piece_side = "tile_back",
  suit = NA,
  rank = NA,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  x = unit(0.5, "npc"),
  y = unit(0.5, "npc"),
  z = NA,
  angle = 0,
  ...,
  width = NA,
  height = NA,
  depth = NA,
  op_scale = getOption("piecepackr.op_scale", 0),
  op_angle = getOption("piecepackr.op_angle", 45),
  default.units = getOption("piecepackr.default.units", "npc"),
  envir = getOption("piecepackr.envir"),
  name = NULL,
  gp = NULL,
  draw = TRUE,
  vp = NULL,
  scale = 1,
  alpha = 1,
  type = "normal",
  bleed = FALSE
)
```

Arguments

piece_side	A string with piece and side separated by a underscore e.g. "coin_face"
suit	Number of suit (starting from 1).
rank	Number of rank (starting from 1)
cfg	Piecepack configuration list or pp_cfg object, a list of pp_cfg objects, or a character vector referring to names in envir or a character vector referring to object names that can be retrieved by base::dynGet().
x	Where to place piece on x axis of viewport
y	Where to place piece on y axis of viewport

z	z-coordinate of the piece. Has no effect if op_scale is 0.
angle	Angle (on xy plane) to draw piece at
...	Ignored.
width	Width of piece
height	Height of piece
depth	Depth (thickness) of piece. Has no effect if op_scale is 0.
op_scale	How much to scale the depth of the piece in the oblique projection (viewed from the top of the board). 0 (the default) leads to an "orthographic" projection, 0.5 is the most common scale used in the "cabinet" projection, and 1.0 is the scale used in the "cavalier" projection.
op_angle	What is the angle of the oblique projection? Has no effect if op_scale is 0.
default.units	A string indicating the default units to use if 'x', 'y', 'width', and/or 'height' are only given as numeric vectors.
envir	Environment (or named list) containing configuration list(s).
name	A character identifier (for grid)
gp	An object of class "gpar".
vp	A grid viewport object (or NULL).
scale	Multiplicative scaling factor to apply to width, height, and depth.
alpha	Alpha channel for transparency.
type	Type of grid grob to use. Either "normal" (default), "picture", "raster", or "transformation". "picture" exports to (temporary) svg and re-imports as a grImport2::pictureGrob(). "raster" exports to (temporary) png and re-imports as a grid::rasterGrob(). "transformation" uses the affine transformation feature only supported in R 4.2+ within select graphic devices. The latter three can be useful if drawing pieces really big or small and don't want to mess with re-configuring fontsizes and linewidths.
bleed	If FALSE do not add a "bleed" zone around the piece, otherwise add a "bleed" zone around the piece: • If bleed is TRUE we will add 1/8 inch bleeds • If bleed is a grid::unit() we will use it as bleed size • If bleed is numeric we will convert to grid::unit() via grid::unit(bleed, default.units) A non-FALSE bleed is incompatible with op_scale > 0 (drawing in an "oblique projection").
draw	A logical value indicating whether graphics output should be produced.

Value

A grid grob object. If draw is TRUE then as a side effect grid.piece() will also draw it to the graphics device.

See Also

pmap_piece() which applies pieceGrob() over rows of a data frame.

Examples

```
if (requireNamespace("grid", quietly = TRUE) && piecepackr:::device_supports_unicode()) {
  opt <- options(piecepackr.at.inform = FALSE)

  draw_pp_diagram <- function(cfg=pp_cfg(), op_scale=0) {
      g.p <- function(...) {
          grid.piece(..., op_scale=op_scale, cfg=cfg, default.units="in")
      }
      g.p("tile_back", x=0.5+c(3,1,3,1), y=0.5+c(3,3,1,1))
      g.p("tile_back", x=0.5+3, y=0.5+1, z=1/4+1/8)
      g.p("tile_back", x=0.5+3, y=0.5+1, z=2/4+1/8)
      g.p("die_face", suit=3, rank=5, x=1, y=1, z=1/4+1/4)
      g.p("pawn_face", x=1, y=4, z=1/4+1/2, angle=90)
      g.p("coin_back", x=3, y=4, z=1/4+1/16, angle=180)
      g.p("coin_back", suit=4, x=3, y=4, z=1/4+1/8+1/16, angle=180)
      g.p("coin_back", suit=2, x=3, y=1, z=3/4+1/8, angle=90)
  }

  # default piecepack, orthogonal projection
  draw_pp_diagram(cfg=pp_cfg())

  options(opt) # Reset options
}
if (requireNamespace("grid", quietly = TRUE) && piecepackr:::device_supports_unicode()) {
  # custom configuration, orthogonal projection
  grid::grid.newpage()
  dark_colorscheme <- list(suit_color="darkred,black,darkgreen,darkblue,black",
                       invert_colors.suited=TRUE, border_color="black", border_lex=2)
  traditional_ranks <- list(use_suit_as_ace=TRUE, rank_text=",a,2,3,4,5")
  cfg <- c(dark_colorscheme, traditional_ranks)
  draw_pp_diagram(cfg=pp_cfg(cfg))
}
if (requireNamespace("grid", quietly = TRUE) && piecepackr:::device_supports_unicode()) {
  # custom configuration, oblique projection
  grid::grid.newpage()
  cfg3d <- list(width.pawn=0.75, height.pawn=0.75, depth.pawn=1,
                    dm_text.pawn="", shape.pawn="convex6", invert_colors.pawn=TRUE,
                    edge_color.coin="tan", edge_color.tile="tan")
  cfg <- pp_cfg(c(cfg, cfg3d))
  draw_pp_diagram(cfg=pp_cfg(cfg), op_scale=0.5)
}
```

`install_ppverse` *Install additional packages from the piecepackr universe*

Description

Uses `utils::install.packages()` to install additional R packages from the piecepackr universe https://piecepackr.r-universe.dev/builds. `pkgs_ppverse()` returns a character vector of R packages in the piecepackr universe.

Usage

```
install_ppverse(
  pkgs = pkgs_ppverse(free_libre_only),
  ...,
  dependencies = TRUE,
  free_libre_only = TRUE
)

pkgs_ppverse(free_libre_only = TRUE)
```

Arguments

pkgs	Packages to install. Passed to `utils::install.packages()`.
...	Passed to `utils::install.packages()`.
dependencies	Logical indicating whether to install dependencies of pkgs. Passed to `utils::install.packages()`.
free_libre_only	Flag to only include packages that are Free/Libre Open Source.

Examples

```
pkgs_ppverse()
## Not run: # Installs non-CRAN packages from the piecepackr universe
  install_ppverse()

## End(Not run)
```

---

op_transform *Oblique projection helper function*

Description

`op_transform()` guesses `z` coordinates and sorting order to more easily make 3D graphics with `pmap_piece()`. `marbles_transform()` is a wrapper around `op_transform()` that handles the special case of stacking 1" marbles in a pyramid with a square base on a holed board.

Usage

```
op_transform(
  df,
  ...,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  envir = getOption("piecepackr.envir"),
  op_angle = getOption("piecepackr.op_angle", 45),
  pt_thickness = 0.01,
  as_top = character(0),
  cfg_class = "list"
```

```
)

marbles_transform(df, ...)
```

Arguments

df	A data frame with coordinates and dimensions in inches
...	Ignored by op_transform(). marbles_transform() passes to op_transform().
cfg	Piecepack configuration list or pp_cfg() object, a list of pp_cfg() objects, or a character vector of the names of pp_cfg() objects contained in envir.
envir	Environment (or named list) containing configuration list(s).
op_angle	Intended oblique projection angle (used for re-sorting)
pt_thickness	Thickness of pyramid tip i.e. value to add to the z-value of a pyramid top if it is a (weakly) smaller ranked pyramid (top) placed on top of a larger ranked pyramid (top).
as_top	Character vector of components whose "side" should be converted to "top" e.g. "pawn_face".
cfg_class	Either "list" (default) or "character". Desired class of the cfg column in the returned tibble. "list" is more efficient for use with pmap_piece() but geom_piece() needs "character".

Details

The heuristics used to generate guesses for z coordinates and sorting order aren't guaranteed to work in every case. In some cases you may get better sorting results by changing the op_angle or the dimensions of pieces.

Value

A tibble with extra columns added and re-sorted rows

See Also

https://trevorldavis.com/piecepackr/3d-projections.html for more details and examples of oblique projections in piecepackr.

Examples

```
df <- tibble::tibble(piece_side="tile_back",
                     x=c(2,2,2,4,6,6,4,2,5),
                     y=c(4,4,4,4,4,2,2,2,3))
cfg <- game_systems()$piecepack
pmap_piece(df, op_angle=135, trans=op_transform,
           op_scale=0.5, default.units="in", cfg=cfg)
```

piece *Create rayrender board game piece objects*

Description

`piece()` creates 3d board game piece objects for use with the rayrender package.

Usage

```
piece(
  piece_side = "tile_back",
  suit = NA,
  rank = NA,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  x = 0,
  y = 0,
  z = NA,
  angle = 0,
  axis_x = 0,
  axis_y = 0,
  width = NA,
  height = NA,
  depth = NA,
  envir = getOption("piecepackr.envir"),
  ...,
  scale = 1,
  res = 72
)
```

Arguments

`piece_side`	A string with piece and side separated by a underscore e.g. "coin_face"
`suit`	Number of suit (starting from 1).
`rank`	Number of rank (starting from 1)
`cfg`	Piecepack configuration list or `pp_cfg` object, a list of `pp_cfg` objects, or a character vector referring to names in `envir` or a character vector referring to object names that can be retrieved by `base::dynGet()`.
`x`	Where to place piece on x axis of viewport
`y`	Where to place piece on y axis of viewport
`z`	z-coordinate of the piece. Has no effect if `op_scale` is `0`.
`angle`	Angle (on xy plane) to draw piece at
`axis_x`	First coordinate of the axis unit vector.
`axis_y`	Second coordinate of the axis unit vector.
`width`	Width of piece

height	Height of piece
depth	Depth (thickness) of piece. Has no effect if op_scale is 0.
envir	Environment (or named list) containing configuration list(s).
...	Ignored.
scale	Multiplicative scaling factor to apply to width, height, and depth.
res	Resolution of the faces.

Value

A rayrender object.

See Also

See https://www.rayrender.net for more information about the rayrender package. See geometry_utils for a discussion of the 3D rotation parameterization.

Examples

```
opt <- options(cores = getOption("Ncpus"))
cfg <- game_systems("sans", border = FALSE)$piecepack
should_run_piece_example <- piecepackr:::donttest() &&
  requireNamespace("rayrender", quietly = TRUE) &&
  all(capabilities(c("cairo", "png")))
if (should_run_piece_example) {
  scene <- piece("tile_face", suit = 3, rank = 3, cfg = cfg)
  rayrender::render_scene(scene)
}
if (should_run_piece_example) {
  scene <- piece("coin_back", suit = 4, rank = 2, cfg = cfg)
  rayrender::render_scene(scene)
}
if (should_run_piece_example) {
  scene <- piece("pawn_face", suit = 2, cfg = cfg)
  rayrender::render_scene(scene)
}
options(opt)
```

---

piece3d *Render board game pieces with rgl*

Description

piece3d() draws board games pieces using the rgl package.

Usage

```
piece3d(
  piece_side = "tile_back",
  suit = NA,
  rank = NA,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  x = 0,
  y = 0,
  z = NA,
  angle = 0,
  axis_x = 0,
  axis_y = 0,
  width = NA,
  height = NA,
  depth = NA,
  envir = getOption("piecepackr.envir"),
  ...,
  scale = 1,
  res = 72,
  alpha = 1,
  lit = FALSE,
  shininess = 50,
  textype = NA
)
```

Arguments

piece_side	A string with piece and side separated by a underscore e.g. "coin_face"
suit	Number of suit (starting from 1).
rank	Number of rank (starting from 1)
cfg	Piecepack configuration list or pp_cfg object, a list of pp_cfg objects, or a character vector referring to names in envir or a character vector referring to object names that can be retrieved by base::dynGet().
x	Where to place piece on x axis of viewport
y	Where to place piece on y axis of viewport
z	z-coordinate of the piece. Has no effect if op_scale is 0.
angle	Angle (on xy plane) to draw piece at
axis_x	First coordinate of the axis unit vector.
axis_y	Second coordinate of the axis unit vector.
width	Width of piece
height	Height of piece
depth	Depth (thickness) of piece. Has no effect if op_scale is 0.
envir	Environment (or named list) containing configuration list(s).
...	Ignored.

scale	Multiplicative scaling factor to apply to width, height, and depth.
res	Resolution of the faces.
alpha	Alpha channel for transparency.
lit	logical, specifying if rgl lighting calculation should take place.
shininess	Properties for rgl lighting calculation.
textype	Use "rgba" when sure texture will have alpha transparency. Use "rgb" when sure texture will not have alpha transparency (in particular rgl's WebGL export will likely work better). If NA we will read the texture and figure out a reasonable value.

Value

A numeric vector of rgl object IDs.

See Also

See rgl-package for more information about the rgl package. See rgl::material3d() for more info about setting rgl material properties. See geometry_utils for a discussion of the 3D rotation parameterization.

Examples

```
if (requireNamespace("rgl", quietly = TRUE) && all(capabilities(c("cairo", "png")))) {
  rgl::open3d()
  cfg <- game_systems("sans", border = FALSE)$piecepack
  piece3d("tile_back", suit = 3, rank = 3, cfg = cfg, x = 0, y = 0, z = 0)
  piece3d("coin_back", suit = 4, rank = 2, cfg = cfg, x = 0.5, y = 0.5, z = 0.25)
  piece3d("pawn_top", suit = 1, cfg = cfg, x = -0.5, y = 0.5, z = 0.6)
  piece3d("die_face", suit = 3, cfg = cfg, x = -0.5, y = -0.5, z = 0.375)
  piece3d("pyramid_top", suit = 2, rank = 3, cfg = cfg, x = 1.5, y = 0.0, z = 0.31875)
  invisible(NULL)
}
```

---

piecepackr-defunct *Defunct functions*

Description

These functions are Defunct and have been removed from piecepackr.

Usage

```
halmaGrob(...)

kiteGrob(...)

pyramidGrob(...)
```

```
convexGrobFn(...)

concaveGrobFn(...)

gridlinesGrob(...)

matGrob(...)

checkersGrob(...)

hexlinesGrob(...)

get_shape_grob_fn(...)
```

Arguments

...	Ignored

Details

1. For `get_shape_grob_fn` use `pp_shape()$shape` instead.
2. For `gridlinesGrob()` use `pp_shape()$gridlines()` instead.
3. For `matGrob()` use `pp_shape()$mat()` instead.
4. For `checkersGrob()()` use `pp_shape()$checkers()` instead.
5. For `hexlinesGrob()` use `pp_shape()$hexlines()` instead.
6. For `halmaGrob()` use `pp_shape("halma")$shape()` instead.
7. For `kiteGrob()` use `pp_shape("kite")$shape()` instead.
8. For `pyramidGrob()` use `pp_shape("pyramid")$shape()` instead.
9. For `convexGrobFn(n, t)` use `pp_shape(paste0("convex", n), t)$shape` instead.
10. For `concaveGrobFn(n, t, r)` use `pp_shape(paste0("concave", n), t, r)$shape` instead.

`piece_mesh` *Create rayvertex board game piece objects*

Description

`piece_mesh()` creates 3d board game piece objects for use with the rayvertex package.

Usage

```
piece_mesh(
  piece_side = "tile_back",
  suit = NA,
  rank = NA,
  cfg = pp_cfg(),
  x = 0,
  y = 0,
  z = NA,
  angle = 0,
  axis_x = 0,
  axis_y = 0,
  width = NA,
  height = NA,
  depth = NA,
  envir = NULL,
  ...,
  scale = 1,
  res = 72
)
```

Arguments

piece_side	A string with piece and side separated by a underscore e.g. "coin_face"
suit	Number of suit (starting from 1).
rank	Number of rank (starting from 1)
cfg	Piecepack configuration list or pp_cfg object, a list of pp_cfg objects, or a character vector referring to names in envir or a character vector referring to object names that can be retrieved by base::dynGet().
x	Where to place piece on x axis of viewport
y	Where to place piece on y axis of viewport
z	z-coordinate of the piece. Has no effect if op_scale is 0.
angle	Angle (on xy plane) to draw piece at
axis_x	First coordinate of the axis unit vector.
axis_y	Second coordinate of the axis unit vector.
width	Width of piece
height	Height of piece
depth	Depth (thickness) of piece. Has no effect if op_scale is 0.
envir	Environment (or named list) containing configuration list(s).
...	Ignored.
scale	Multiplicative scaling factor to apply to width, height, and depth.
res	Resolution of the faces.

Value

A rayvertex object.

See Also

See https://www.rayvertex.com for more information about the rayvertex package. See geometry_utils for a discussion of the 3D rotation parameterization.

Examples

```
cfg <- game_systems("sans", border = FALSE)$piecepack
rasterize_mesh <- function(mesh) {
  opt <- options(cores = getOption("Ncpus"))
  light <- rayvertex::directional_light(c(0, 0, 1))
  lookat <- c(0, 0, 0)
  rayvertex::rasterize_scene(mesh, light_info = light, lookat = lookat)
  invisible(options(opt))
}
should_run_piece_mesh_example <- piecepackr:::donttest() &&
  requireNamespace("rayvertex", quietly = TRUE) &&
  all(capabilities(c("cairo", "png")))
if (should_run_piece_mesh_example) {
  mesh <- piece_mesh("tile_face", suit = 3, rank = 3, cfg = cfg)
  rasterize_mesh(mesh)
}
if (should_run_piece_mesh_example) {
  mesh <- piece_mesh("coin_back", suit = 4, rank = 2, cfg = cfg)
  rasterize_mesh(mesh)
}
if (should_run_piece_mesh_example) {
  mesh <- piece_mesh("pawn_face", suit = 1, cfg = cfg)
  rasterize_mesh(mesh)
}
```

---

pmap_piece *Create graphics using data frame input*

Description

pmap_piece() operates on the rows of a data frame applying .f to each row (usually grid.piece).

Usage

```
pmap_piece(
  .l,
  .f = pieceGrob,
  ...,
  cfg = getOption("piecepackr.cfg"),
  envir = getOption("piecepackr.envir"),
```

```
  trans = getOption("piecepackr.trans"),
  draw = TRUE,
  name = NULL,
  gp = NULL,
  vp = NULL
)
```

Arguments

`.l`	A list of vectors, such as a data frame. The length of `.l` determines the number of arguments that `.f` will be called with. List names will be used if present.
`.f`	Function to be applied to `.l` after adjustments to `cfg` and `envir` and the application of `trans`. Usually `grid.piece()`, `pieceGrob()`, `piece3d()`, or `piece()`.
`...`	Extra arguments to pass to `.f`.
`cfg`	Piecepack configuration list or `pp_cfg` object, a list of `pp_cfg` objects, or a character vector referring to names in `envir` or a character vector referring to object names that can be retrieved by `base::dynGet()`.
`envir`	Environment (or named list) containing configuration list(s).
`trans`	Function to modify `.l` before drawing. Default (`NULL`) is to not modify `.l`. `op_transform` can help with using an oblique projection (i.e. `op_scale` over 0).
`draw`	A logical value indicating whether graphics output should be produced.
`name`	A character identifier (for grid)
`gp`	An object of class "gpar".
`vp`	A `grid` viewport object (or `NULL`).

Details

`pmap_piece()` differs from `purrr::pmap()` in a few ways:

1. If `cfg` and/or `envir` are missing attempts to set reasonable defaults. A missing `envir` holds `cfg` (if given) under the name `"piecepack"` plus just the game systems from `game_systems()` that a `cfg` column of `.l` names.
2. If not `NULL` will first apply function `trans` to `.l`.
3. If the output of `.f` is a grid grob object then `pmap_piece` will return a `gTree` object with specified `name`, `gp`, and `vp` values and if `draw` is true draw it.
4. If `.l` lacks a `name` column or if `name` column is non-unique attempts to generate a reasonable new default `name` column and use that to name the return `gTree` children or `list` values.

See Also

`render_piece()` is a higher-level function that wraps this function.

Examples

```
if (requireNamespace("grid", quietly = TRUE) && piecepackr:::device_supports_unicode()) {
     dark_colorscheme <- list(suit_color="darkred,black,darkgreen,darkblue,black",
                       invert_colors.suited=TRUE, border_color="black", border_lex=2)
     traditional_ranks <- list(use_suit_as_ace=TRUE, rank_text=",a,2,3,4,5")
     cfg3d <- list(width.pawn=0.75, height.pawn=0.75, depth.pawn=1,
                     dm_text.pawn="", shape.pawn="convex6", invert_colors.pawn=TRUE,
                      edge_color.coin="tan", edge_color.tile="tan")
     cfg <- pp_cfg(c(dark_colorscheme, traditional_ranks, cfg3d))
     grid::grid.newpage()
     df_tiles <- data.frame(piece_side="tile_back", x=0.5+c(3,1,3,1), y=0.5+c(3,3,1,1),
                            suit=NA, angle=NA, z=NA, stringsAsFactors=FALSE)
     df_coins <- data.frame(piece_side="coin_back", x=rep(4:1, 4), y=rep(4:1, each=4),
                            suit=1:16%%2+rep(c(1,3), each=8),
                          angle=rep(c(180,0), each=8), z=1/4+1/16, stringsAsFactors=FALSE)
     df <- rbind(df_tiles, df_coins)
     pmap_piece(df, cfg=cfg, op_scale=0.5, default.units="in")
 }
```

---

pp_cfg *Configuration list R6 object*

Description

pp_cfg() and as_pp_cfg() create piecepack configuration list R6 objects. is_pp_cfg() returns TRUE if object is a piecepack configuration list R6 object. as.list() will convert it into a list.

Usage

```
pp_cfg(cfg = list())

is_pp_cfg(cfg)

as_pp_cfg(cfg = list())
```

Arguments

cfg	List of configuration options

Details

pp_cfg R6 class objects serve the following purposes:

- Customize the appearance of pieces drawn by grid.piece().
- Speed up the drawing of graphics through use of caching.
- Allow the setting and querying of information about the board game components that maybe of use to developers:
  - Number of suits

- Number of ranks
- Suit colors
- Which types of components are included and/or properly supported
- What would be a good color to use when adding annotations on top of these components.
- Title, Description, Copyright, License, and Credit metadata

pp_cfg R6 Class Method Arguments

`piece_side` A string with piece and side separated by a underscore e.g. "coin_face".

`suit` Number of suit (starting from 1).

`rank` Number of rank (starting from 1).

`type` Which type of grob to return, either `"normal"`, `"picture"`, `"raster"`, or `"transformation"`.

`scale` "scale" factor

`alpha` "alpha" value

pp_cfg R6 Class Methods

`get_grob()` Returns a `grid` "grob" for drawing the piece.

`get_piece_opt()` Returns a list with info useful for drawing the piece.

`get_suit_color()` Returns the suit colors.

`get_width()`, `get_height()`, `get_depth()` Dimensions (of the bounding cube) of the piece in inches

pp_cfg R6 Class Fields and Active Bindings

`annotation_color` Suggestion of a good color to annotate with

`cache` Cache object which stores intermediate graphical calculations. Default is a memory-cache that does not prune. This can be replaced by another cache that implements the cache API used by the `cachem` package

`cache_grob` Whether we should cache (2D) grobs

`cache_grob_with_bleed_fn` Whether we should cache the grob with bleed functions

`cache_piece_opt` Whether we should cache piece opt information

`cache_op_fn` Whether we should cache the oblique projection functions

`cache_obj_fn` Whether we should cache any 3D rendering functions

`copyright` Design copyright information

`credit` Design credits (markdown) shown by `save_print_and_play()`

`description` Design description

`fontfamily` Main font family

`has_bits` Whether we should assume this supports "bit" pieces

`has_boards` Whether we should assume this supports "board" pieces

`has_cards` Whether we should assume this supports "card" pieces

`has_coins` Whether we should assume this supports "coin" pieces

has_dice Whether we should assume this supports "die" pieces

has_matchsticks Whether we should assume this supports "matchstick" pieces

has_pawns Whether we should assume this supports "pawn" pieces

has_piecepack Binding which simultaneously checks/sets has_coins, has_tiles, has_pawns, has_dice

has_pyramids Whether we should assume this supports "pyramid" pieces

has_saucers Whether we should assume this supports "saucer" pieces

has_tiles Whether we should assume this supports "tile" pieces

spdx_id SPDX Identifier for graphical design license. See https://spdx.org/licenses/ for full list.

title Design title

Defunct pp_cfg R6 Class attributes which have been removed

cache_shadow Use cache_op_fn instead

i_unsuit Instead add 1L to n_suits

get_pictureGrob() Use get_grob(..., type = "picture") instead

get_shadow_fn get_op_grob() returns complete oblique projection grob

See Also

game_systems() for functions that return configuration list objects for several game systems. https://trevorldavis.com/piecepackr/configuration-lists.html for more details about piecepackr configuration lists.

Examples

```
cfg <- pp_cfg(list(invert_colors=TRUE))
as.list(cfg)
is_pp_cfg(cfg)
as_pp_cfg(list(suit_color="darkred,black,darkgreen,darkblue,grey"))
cfg$get_suit_color(suit=3)
cfg$annotation_color
cfg$has_matchsticks
cfg$has_matchsticks <- TRUE
cfg$has_matchsticks
cfg$get_width("tile_back")
cfg$get_height("die_face")
cfg$get_depth("coin_face")
# May take more than 5 seconds on CRAN servers
# `pp_cfg()` objects use a cache to speed up repeated drawing
pdf(tempfile(fileext = ".pdf"))
cfg <- list()
system.time(replicate(100, grid.piece("tile_back", 4, 4, cfg)))
cfg <- pp_cfg(list())
system.time(replicate(100, grid.piece("tile_back", 4, 4, cfg)))
invisible(dev.off())
```

pp_shape *Shape object for generating various grobs*

Description

`pp_shape()` creates an R6 object with methods for creating various shape based grobs.

Usage

```
pp_shape(
  label = "rect",
  theta = 90,
  radius = 0.2,
  back = FALSE,
  ...,
  width = 1,
  height = 1
)
```

Arguments

`label`	Label of the shape. One of **"circle"** Circle. **"convexN"** An `N`-sided convex polygon. `theta` controls which direction the first vertex is drawn. **"concaveN"** A "star" (concave) polygon with `N` "points". `theta` controls which direction the first point is drawn. `radius` controls the distance of the "inner" vertices from the center. **"halma"** A 2D outline of a "Halma pawn". **"kite"** "Kite" quadrilateral shape. **"meeple"** A 2D outline of a "meeple". **"oval"** Oval. **"pyramid"** An "Isosceles" triangle whose base is the bottom of the viewport. Typically used to help draw the face of the "pyramid" piece. **"rect"** Rectangle. **"roundrect"** "Rounded" rectangle. `radius` controls curvature of corners.
`theta`	`convex` and `concave` polygon shapes use this to determine where the first point is drawn.
`radius`	`concave` polygon and `roundrect` use this to control appearance of the shape.
`back`	Whether the shape should be reflected across a vertical line in the middle of the viewport.
`...`	Should be empty
`width, height`	Width and height of the piece.

Details

pp_shape objects serve the following purposes:

1. Make it easier for developers to customize game piece appearances either through a "grob_fn" or "op_grob_fn" styles in pp_cfg() or manipulate a piece post drawing via functions like grid::grid.edit().
2. Used internally to generate piecepackr's built-in game piece grobs.

pp_shape R6 Class Method Arguments

mat_width Numeric vector of mat widths.

clip "clip grob" to perform polyclip operation with. See gridGeometry::grid.polyclip() for more info.

op Polyclip operation to perform. See gridGeometry::grid.polyclip() for more info.

pattern Pattern to fill in shape with. See gridpattern::patternGrob() for more info.

... Passed to gridpattern::patternGrob().

name Grid grob name value.

gp Grid gpar list. See grid::gpar() for more info.

vp Grid viewport or NULL.

pp_shape R6 Class Methods

checkers(name = NULL, gp = gpar(), vp = NULL) Returns a grob of checkers for that shape.

gridlines(name = NULL, gp = gpar(), vp = NULL) Returns a grob of gridlines for that shape.

hexlines(name = NULL, gp = gpar(), vp = NULL) Returns a grob of hexlines for that shape.

mat(mat_width = 0, name = NULL, gp = gpar(), vp = NULL) Returns a grob for a matting "mat" for that shape.

pattern(pattern = "stripe", ..., name = NULL, gp = gpar(), vp = NULL) Fills in the shape's npc_coords with a pattern. See gridpattern::patternGrob() for more information.

polyclip(clip, op = "intersection", name = NULL, gp = gpar(), vp = NULL) Returns a grob that is an "intersection", "minus", "union", or "xor" of another grob. Note unlike gridGeometry::polyclipGrob it can directly work with a pieceGrob "clip grob" argument.

shape(name = NULL, gp = gpar(), vp = NULL) Returns a grob of the shape.

pp_shape R6 Class Active Bindings

label The shape's label.

theta The shape's theta.

radius The shape's radius.

back A boolean of whether this is the shape's "back" side.

npc_coords A named list of "npc" coordinates along the perimeter of the shape.

Examples

```
if (require("grid", quietly = TRUE)) {
    gp <- gpar(col="black", fill="yellow")
    rect <- pp_shape(label="rect")
    convex6 <- pp_shape(label="convex6")
    circle <- pp_shape(label="circle")

    pushViewport(viewport(x=0.25, y=0.75, width=1/2, height=1/2))
    grid.draw(rect$shape(gp=gp))
    grid.draw(rect$gridlines(gp=gpar(col="blue", lex=4)))
    grid.draw(rect$hexlines(gp=gpar(col="green")))
    popViewport()

    pushViewport(viewport(x=0.75, y=0.75, width=1/2, height=1/2))
    grid.draw(convex6$shape(gp=gp))
    grid.draw(convex6$checkers(gp=gpar(fill="blue")))
    popViewport()

    pushViewport(viewport(x=0.25, y=0.25, width=1/2, height=1/2))
    grid.draw(circle$shape(gp=gp))
    grid.draw(circle$mat(mat_width=0.2, gp=gpar(fill="blue")))
    popViewport()

    pushViewport(viewport(x=0.75, y=0.25, width=1/2, height=1/2))
    grid.draw(rect$shape(gp=gp))
    grid.draw(rect$mat(mat_width=c(0.2, 0.1, 0.3, 0.4), gp=gpar(fill="blue")))
    popViewport()
}
if (require("grid", quietly = TRUE)) {
    grid.newpage()
    gp <- gpar(col="black", fill="yellow")

    vp <- viewport(x=1/4, y=1/4, width=1/2, height=1/2)
    grid.draw(pp_shape("halma")$shape(gp=gp, vp=vp))
    vp <- viewport(x=3/4, y=1/4, width=1/2, height=1/2)
    grid.draw(pp_shape("pyramid")$shape(gp=gp, vp=vp))
    vp <- viewport(x=3/4, y=3/4, width=1/2, height=1/2)
    grid.draw(pp_shape("kite")$shape(gp=gp, vp=vp))
    vp <- viewport(x=1/4, y=3/4, width=1/2, height=1/2)
    grid.draw(pp_shape("meeple")$shape(gp=gp, vp=vp))
}
if (require("grid", quietly = TRUE)) {
    grid.newpage()
    vp <- viewport(x=1/4, y=1/4, width=1/2, height=1/2)
    grid.draw(pp_shape("convex3", 0)$shape(gp=gp, vp=vp))
    vp <- viewport(x=3/4, y=1/4, width=1/2, height=1/2)
    grid.draw(pp_shape("convex4", 90)$shape(gp=gp, vp=vp))
    vp <- viewport(x=3/4, y=3/4, width=1/2, height=1/2)
    grid.draw(pp_shape("convex5", 180)$shape(gp=gp, vp=vp))
    vp <- viewport(x=1/4, y=3/4, width=1/2, height=1/2)
    grid.draw(pp_shape("convex6", 270)$shape(gp=gp, vp=vp))
}
```

```
if (require("grid", quietly = TRUE)) {
    grid.newpage()
    vp <- viewport(x=1/4, y=1/4, width=1/2, height=1/2)
    grid.draw(pp_shape("concave3", 0, 0.1)$shape(gp=gp, vp=vp))
    vp <- viewport(x=3/4, y=1/4, width=1/2, height=1/2)
    grid.draw(pp_shape("concave4", 90, 0.2)$shape(gp=gp, vp=vp))
    vp <- viewport(x=3/4, y=3/4, width=1/2, height=1/2)
    grid.draw(pp_shape("concave5", 180, 0.3)$shape(gp=gp, vp=vp))
    vp <- viewport(x=1/4, y=3/4, width=1/2, height=1/2)
    grid.draw(pp_shape("concave6", 270)$shape(gp=gp, vp=vp))
}
if (require("grid", quietly = TRUE) &&
    requireNamespace("gridpattern", quietly = TRUE)) {
    grid.newpage()
    hex <- pp_shape("convex6")
    gp <- gpar(fill = c("blue", "yellow", "red"), col = "black")
    grid.draw(hex$pattern("polygon_tiling", gp = gp, spacing = 0.1,
                          type = "truncated_trihexagonal"))
    gp <- gpar(fill = "black", col = NA)
    grid.draw(hex$mat(mat_width = 0.025, gp = gp))
}
```

---

pp_utils *Miscellaneous* piecepackr *utility functions*

Description

cleave() converts a delimiter separated string into a vector. inch(x) is equivalent to grid::unit(x, "in"). is_color_invisible() tells whether the color is transparent (and hence need not be drawn).

Usage

```
is_color_invisible(col)

inch(inches)

cleave(s, sep = ",", float = FALSE, color = FALSE)

file2grob(file, distort = TRUE)
```

Arguments

col	Color
inches	Number representing number of inches
s	String to convert
sep	Delimiter (defaults to ",")
float	If TRUE cast to numeric

color	if TRUE convert empty strings to "transparent"
file	Filename of image
distort	Logical value of whether one should preserve the aspect ratio or distort to fit the area it is drawn in

Examples

```
cleave("0.5,0.2,0.4,0.5", float=TRUE)
cleave("black,darkred,#050EAA,,", color=TRUE)

is_color_invisible("transparent")
is_color_invisible(NA)
is_color_invisible("blue")
is_color_invisible("#05AE9C")

if (requireNamespace("grid", quietly = TRUE)) {
    identical(inch(1), grid::unit(1, "inch"))
}
```

---

render_piece *Render image of game pieces*

Description

render_piece() renders an image of game pieces to a file or graphics device. It is a wrapper around pmap_piece() that can auto-size files and graphic devices, apply axes offsets, annotate coordinates, and set up rayrender / rayvertex scenes.

Usage

```
render_piece(
  df,
  file = NULL,
  ...,
  .f = piecepackr::grid.piece,
  cfg = getOption("piecepackr.cfg", NULL),
  envir = getOption("piecepackr.envir"),
  width = NULL,
  height = NULL,
  ppi = 72,
  bg = "white",
  xoffset = NULL,
  yoffset = NULL,
  annotate = FALSE,
  annotation_scale = NULL,
  dev = NULL,
```

```
  dev.args = list(res = ppi, bg = bg, units = "in"),
  open_device = TRUE,
  close_device = open_device && (!is.null(file) || !is.null(dev)),
  image = c("NULL", "raster", "nativeRaster"),
  xbreaks = NULL,
  ybreaks = NULL
)
```

Arguments

df	A data frame of game piece information with (at least) the named columns "piece_side", "x", and "y".
file	Filename to save image to unless NULL in which case it either uses the current graphics device or opens a new device (depending on open_device argument).
...	Arguments to pmap_piece()
.f	Low level graphics function to use e.g. grid.piece(), piece3d(), piece_mesh(), or piece().
cfg	A piecepackr configuration list. If NULL (the default) and envir is also NULL then the pieces are drawn with the "piecepack" configuration from game_systems().
envir	Environment (or named list) of piecepackr configuration lists. If NULL (the default) one is built from cfg and, when a cfg column names other configurations, game_systems().
width	Width of image (in inches). Inferred by default.
height	Height of image (in inches). Inferred by default.
ppi	Resolution of image in pixels per inch.
bg	Background color (use "transparent" for transparent)
xoffset	Number to add to the x column in df. Inferred by default.
yoffset	Number to add to the y column in df. Inferred by default.
annotate	If TRUE or "algebraic" annotate the plot with "algebraic" coordinates, if FALSE or "none" don't annotate, if "cartesian" annotate the plot with "cartesian" coordinates.
annotation_scale	Multiplicative factor that scales (stretches) any annotation coordinates. By default uses attr(df, "scale_factor") %||% 1.
dev	Graphics device function to use if open_device is FALSE. If NULL infer a reasonable choice from file.
dev.args	Additional arguments to pass to dev (besides filename, width, and height). Will filter out any names that aren't in formals(dev).
open_device	If TRUE open a new graphics device otherwise draw in the active graphics.
close_device	If TRUE close the graphics device (if open_device = TRUE close the newly opened device otherwise close the previously existing graphics device).
image	Class of image object to return in the "image" field of returned list. If "NULL" (the default) return NULL. If "raster" or "nativeRaster" try to return a raster object of the ima
xbreaks, ybreaks	Subset (of integers) to provide axis labels for if annotate is TRUE. If NULL infer a reasonable choice.

Value

An invisible list of the dimensions of the image and possibly an image object specified by `image`. As a side effect may save a file and/or open/close a graphics device.

See Also

This function is a wrapper around `pmap_piece()`.

Examples

```
df_board <- data.frame(piece_side = "board_face", suit = 3, rank = 5,
                       x = 3.0, y = 3.0, stringsAsFactors = FALSE)
df_w <- data.frame(piece_side = "bit_back", suit = 6, rank = 1,
                   x = rep(1:5, 2), y = rep(1:2, each=5),
                   stringsAsFactors = FALSE)
df_b <- data.frame(piece_side = "bit_back", suit = 1, rank = 1,
                   x = rep(1:5, 2), y = rep(4:5, each=5),
                   stringsAsFactors = FALSE)
df <- rbind(df_board, df_w, df_b)
df$cfg <- "checkers1"

if (requireNamespace("grid", quietly = TRUE)) {
  render_piece(df, open_device = FALSE)
}
if (requireNamespace("grid", quietly = TRUE)) {
  grid::grid.newpage()
  render_piece(df, open_device = FALSE,
               op_scale = 0.5, trans = op_transform,
               annotate = "algebraic")
}
## Not run: # May take more than 5 seconds on CRAN servers
if (require(rayvertex)) {
  envir3d <- game_systems("sans", border = FALSE)
  render_piece(df, .f = piece_mesh, envir = envir3d,
               open_device = FALSE,
               op_scale = 0.5, trans = op_transform)
}

## End(Not run)
```

---

save_ellipsoid_obj *Alternative Wavefront OBJ file generators*

Description

These are alternative Wavefront OBJ generators intended to be used as a `obj_fn` attribute in a `pp_cfg()` "configuration list". `save_ellipsoid_obj()` saves an ellipsoid with a color equal to that piece's `background_color`. `save_peg_doll_obj()` saves a "peg doll" style doll with a color equal to that piece's `edge_color` with a "pawn belt" around it's waste from that suit's and rank's `belt_face`.

Usage

```
save_ellipsoid_obj(
  piece_side = "bit_face",
  suit = 1,
  rank = 1,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  ...,
  x = 0,
  y = 0,
  z = 0,
  angle = 0,
  axis_x = 0,
  axis_y = 0,
  width = NA,
  height = NA,
  depth = NA,
  filename = tempfile(fileext = ".obj"),
  subdivide = 3
)

save_peg_doll_obj(
  piece_side = "pawn_top",
  suit = 1,
  rank = 1,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  ...,
  x = 0,
  y = 0,
  z = 0,
  angle = 0,
  axis_x = 0,
  axis_y = 0,
  width = NA,
  height = NA,
  depth = NA,
  filename = tempfile(fileext = ".obj"),
  res = 72
)
```

Arguments

piece_side	A string with piece and side separated by a underscore e.g. "coin_face"
suit	Number of suit (starting from 1).
rank	Number of rank (starting from 1)
cfg	Piecepack configuration list or pp_cfg object, a list of pp_cfg objects, or a character vector referring to names in envir or a character vector referring to object names that can be retrieved by base::dynGet().

...	Ignored.
x	Where to place piece on x axis of viewport
y	Where to place piece on y axis of viewport
z	z-coordinate of the piece. Has no effect if op_scale is 0.
angle	Angle (on xy plane) to draw piece at
axis_x	First coordinate of the axis unit vector.
axis_y	Second coordinate of the axis unit vector.
width	Width of piece
height	Height of piece
depth	Depth (thickness) of piece. Has no effect if op_scale is 0.
filename	Name of Wavefront OBJ object. By default tempfile(fileext = ".obj").
subdivide	Increasing this value makes for a smoother ellipsoid (and larger OBJ file and slower render). See rgl::ellipse3d().
res	Resolution of the faces.

See Also

See pp_cfg() for a discussion of "configuration lists". Wavefront OBJ file generators are used by save_piece_obj() and (by default) piece3d() (rgl wrapper), piece() (rayrender wrapper), and piece_mesh() (rayvertex wrapper).

---

save_piece_images *Save piecepack images*

Description

Saves images of all individual piecepack pieces.

Usage

```
save_piece_images(
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  directory = tempdir(),
  format = "svg",
  angle = 0
)
```

Arguments

cfg	Piecepack configuration list
directory	Directory where to place images
format	Character vector of formats to save images in
angle	Numeric vector of angles to rotate images (in degrees)

Examples

```
# May take more than 5 seconds on CRAN server
if (all(capabilities(c("cairo", "png")))) {
    cfg <- pp_cfg(list(suit_color="darkred,black,darkgreen,darkblue,grey"))
    save_piece_images(cfg, directory=tempdir(), format="svg", angle=0)
    save_piece_images(cfg, directory=tempdir(), format="png", angle=90)
}
```

`save_piece_obj` *Save Wavefront OBJ files of board game pieces*

Description

`save_piece_obj()` saves Wavefront OBJ files (including associated MTL and texture image) of board game pieces.

Usage

```
save_piece_obj(
  piece_side = "tile_face",
  suit = 1,
  rank = 1,
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  ...,
  x = 0,
  y = 0,
  z = 0,
  angle = 0,
  axis_x = 0,
  axis_y = 0,
  width = NA,
  height = NA,
  depth = NA,
  envir = getOption("piecepackr.envir"),
  filename = tempfile(fileext = "%03d.obj"),
  scale = 1,
  res = 72
)
```

Arguments

`piece_side`	A string with piece and side separated by a underscore e.g. "coin_face"
`suit`	Number of suit (starting from 1).
`rank`	Number of rank (starting from 1)

cfg	Piecepack configuration list or pp_cfg object, a list of pp_cfg objects, or a character vector referring to names in envir or a character vector referring to object names that can be retrieved by base::dynGet().
...	Ignored.
x	Where to place piece on x axis of viewport
y	Where to place piece on y axis of viewport
z	z-coordinate of the piece. Has no effect if op_scale is 0.
angle	Angle (on xy plane) to draw piece at
axis_x	First coordinate of the axis unit vector.
axis_y	Second coordinate of the axis unit vector.
width	Width of piece
height	Height of piece
depth	Depth (thickness) of piece. Has no effect if op_scale is 0.
envir	Environment (or named list) containing configuration list(s).
filename	Name of Wavefront OBJ object. By default tempfile(fileext = ".obj").
scale	Multiplicative scaling factor to apply to width, height, and depth.
res	Resolution of the faces.

Value

A data frame with named elements "obj", "mtl", "png" with the created filenames.

See Also

See geometry_utils for a discussion of the 3D rotation parameterization.

Examples

```
if (all(capabilities(c("cairo", "png")))) {
  cfg <- game_systems("sans", border = FALSE)$dominoes
  files <- save_piece_obj("tile_face", suit = 3+1, rank=6+1, cfg = cfg)
  print(files)
}
```

---

save_print_and_play *Save piecepack print-and-play (PnP) file*

Description

Save piecepack print-and-play (PnP) file

Usage

```
save_print_and_play(
  cfg = getOption("piecepackr.cfg", pp_cfg()),
  output_filename = "piecepack.pdf",
  size = c("letter", "A4", "A5", "4x6"),
  pieces = NULL,
  arrangement = c("single-sided", "double-sided"),
  dev = NULL,
 dev.args = list(family = cfg$fontfamily, onefile = TRUE, units = "in", bg = "white",
    res = 300),
  quietly = FALSE,
  ...,
  bleed = FALSE,
  size_bleed = NULL
)
```

Arguments

cfg	Piecepack configuration list or pp_cfg object
output_filename	Filename for print-and-play file
size	PnP output size (currently supports either "letter", "A4", or "A5"). This is the targeted "trim" size of the print-and-play file (size_bleed can be used to make the print-and-play file larger than this). "A5" is in "portrait" mode whereas the other sizes are in "landscape" mode.
pieces	Character vector of desired PnP pieces. Supports "piecepack", "matchsticks", "pyramids", "subpack", or "all". If NULL and combination of size / bleed values supports "matchsticks" and "pyramids" then defaults to c("piecepack", "pyramids", "matchsticks") else just "piecepack".
arrangement	Either "single-sided" or "double-sided".
dev	Graphics device function to use if open_device is FALSE. If NULL infer a reasonable choice from file.
dev.args	Additional arguments to pass to dev (besides filename, width, and height). Will filter out any names that aren't in formals(dev).
quietly	Whether to hide messages about missing metadata in the provided configuration.
...	Currently ignored.
bleed	Controls bleed zones and crop marks around game pieces. FALSE or "none" produces a compact layout with no bleed. TRUE or "individual" gives each piece its own 1/8" bleed zone and crop marks. "grouped" gives same-type pieces a shared 1/8" bleed zone: adjacent tiles share a cut line while coins and dice keep a gap so each can be punched out or cut to size. "individual" currently only supports pieces = "piecepack" and doesn't support size = "4x6". "grouped" only supports pieces = "piecepack" and arrangement = "single-sided", and doesn't support size = "4x6" or size = "A5".

size_bleed A list with names "top", "right", "bottom", "left" containing numeric values indicating the inches "bleed" to add to the size of the print-and-play layout. The default NULL means no such bleed added to "letter", "A4", and "A5" layouts. NB. multiply millimeters by 0.0393700787 to convert to inches. We currently don't support an asymmetric left/right bleed combined with arrangement = "double-sided".

Examples

```
# May take more than 5 seconds on CRAN servers
if (capabilities("cairo")) {
  cfg <- pp_cfg(list(invert_colors.suited=TRUE))
  cfg$description <- 'Piecepack with an "inverted" color scheme.'
  cfg$title <- '"Inverted" piecepack'
  cfg$copyright <- "\u00a9 2022 Trevor L Davis.  Some Right Reserved."
  cfg$spdx_id <- "CC-BY-4.0"
  cfg$credit <- ""

  file <- tempfile("my_pnp_file", fileext = ".pdf")
  file_ds <- tempfile("my_pnp_file_ds", fileext = ".pdf")
  file_a4 <- tempfile("my_pnp_file_a4", fileext = ".pdf")
  file_a5 <- tempfile("my_pnp_file_a5", fileext = ".pdf")

  save_print_and_play(cfg, file)
  save_print_and_play(cfg, file_ds, arrangement="double-sided")
  save_print_and_play(cfg, file_a4, size="A4", pieces="all")
  save_print_and_play(cfg, file_a5, size="A5")
}
```

---

scale_x_piece *ggplot2 game diagram scales*

Description

scale_x_piece() and scale_y_piece() are wrappers around ggplot2::scale_x_continuous() and ggplot2::scale_y_continuous() with "better" defaults for board game diagrams. label_letter() labels breaks with letters and label_counting() labels breaks with positive integers to more easily generate (i.e. chess) algebraic notation coordinates. breaks_counting() generates breaks of just the positive integers within the limits.

Usage

```
scale_x_piece(
  ...,
  name = NULL,
  breaks = breaks_counting(),
  minor_breaks = NULL,
  labels = label_letter()
```

```
)

scale_y_piece(
  ...,
  name = NULL,
  breaks = breaks_counting(),
  minor_breaks = NULL,
  labels = label_counting()
)

label_letter()

label_counting()

breaks_counting()
```

Arguments

`...`	Passed to `ggplot2::scale_x_continuous()` or `ggplot2::scale_y_continuous()`.
`name`	The name of the scale. Used as the axis or legend title. If `waiver()`, the default, the name of the scale is taken from the first mapping used for that aesthetic. If `NULL`, the legend title will be omitted.
`breaks`	One of: • `NULL` for no breaks • `waiver()` for the default breaks computed by the transformation object • A numeric vector of positions • A function that takes the limits as input and returns breaks as output (e.g., a function returned by `scales::extended_breaks()`). Note that for position scales, limits are provided after scale expansion. Also accepts rlang lambda function notation.
`minor_breaks`	One of: • `NULL` for no minor breaks • `waiver()` for the default breaks (none for discrete, one minor break between each major break for continuous) • A numeric vector of positions • A function that given the limits returns a vector of minor breaks. Also accepts rlang lambda function notation. When the function has two arguments, it will be given the limits and major break positions.
`labels`	One of the options below. Please note that when `labels` is a vector, it is highly recommended to also set the `breaks` argument as a vector to protect against unintended mismatches. • `NULL` for no labels • `waiver()` for the default labels computed by the transformation object • A character vector giving labels (must be same length as `breaks`) • An expression vector (must be the same length as breaks). See ?plotmath for details.

- A function that takes the breaks as input and returns labels as output. Also accepts rlang lambda function notation.

Value

`scale_x_piece()` and `scale_y_piece()` return ggplot2 scale objects. `label_letter()` and `label_counting()` return functions suitable for use with the `labels` scale argument. `breaks_counting()` returns a function suitable for use with the `breaks` scale argument.

Examples

```
if (require("ggplot2", quietly = TRUE) && require("tibble", quietly = TRUE)) {
  envir <- game_systems("sans")
  df_board <- tibble(piece_side = "board_face", suit = 3, rank = 8,
                 x = 4.5, y = 4.5)
  df_w <- tibble(piece_side = "bit_back", suit = 6, rank = 1,
                 x = rep(1:8, 2), y = rep(1:2, each=8))
  df_b <- tibble(piece_side = "bit_back", suit = 1, rank = 1,
                 x = rep(1:8, 2), y = rep(7:8, each=8))
  df <- rbind(df_board, df_w, df_b)

  # `cfg` must be a character vector for `geom_piece()`
  ggplot(df, aes_piece(df)) +
      geom_piece(cfg = "checkers1", envir = envir) +
      coord_fixed() +
      scale_x_piece() +
      scale_y_piece() +
      theme_minimal(28) +
      theme(panel.grid = element_blank())
}
```

---

spdx_license_list *SPDX License List data*

Description

`spdx_license_list` is a data frame of SPDX License List data.

Usage

```
spdx_license_list
```

Format

a data frame with eight variables:

id SPDX Identifier.

name Full name of license. For Creative Commons licenses these have been tweaked from the SPDX version to more closely match the full name used by Creative Commons Foundation.

url URL for copy of license located at `spdx.org`

fsf Is this license considered Free/Libre by the FSF?

osi Is this license OSI approved?

deprecated Has this SPDFX Identifier been deprecated by SPDX?

badge Filename of appropriate "button mark" badge (if any) located in `system.file("extdata/badges", package = "piecepackr")`.

url_alt Alternative URL for license. Manually created for a subset of Creative Commons licenses. Others taken from https://github.com/sindresorhus/spdx-license-list.

See Also

See https://spdx.org/licenses/ for more information.

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