Package 'ggtern'

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Title An Extension to 'ggplot2', for the Creation of Ternary Diagrams

Description Extends the functionality of 'ggplot2', providing the capability to plot ternary diagrams for (subset of) the 'ggplot2' geometries. Additionally, 'ggtern' has implemented several NEW geometries which are unavailable to the standard 'ggplot2' release. For further examples and documentation, please proceed to the 'ggtern' website.

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Depends R (>= 2.10), ggplot2 (>= 3.0.0)

Imports compositions (>= 1.40-2), grid, gridExtra, gtable (>= 0.1.2), latex2exp (>= 0.4), MASS, plyr (>= 1.8.3), scales (>= 0.3.0), stats, proto, utils, lattice

Enhances sp

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URL http://www.ggtern.com

Collate 'ggtern-package.R' 'aes.R' 'coord-tern.R' 'calc-tern-tlr2xy.R' 'calc-mahalanobis-distance.R' 'calc-kde2d-weighted.R' 'doc-data.R' 'doc-theme-convenience.R' 'depreciated.R' 'labels-new.R' 'labels-percent.R' 'legend-draw-tern.R' 'ggtern-constructor.R' 'gg-internal.R' 'modifications-gridExtra.R' 'onLoad.R' 'plot.R' 'plot-build.R' 'plot-construction.R' 'position-.R' 'position-nudge-tern.R' 'position-jitter-tern.R' 'save.R' 'scales-tern.R' 'strip-unapproved.R' 'tern-limits.R' 'theme.R' 'theme-arrowlength.R' 'theme-clockwise.R' 'theme-defaults.R' 'theme-elements.R' 'theme-gridsontop.R' 'theme-bordersontop.R' 'theme-legend-position.R' 'theme-latex.R' 'theme-mesh.R' 'theme-noarrows.R' 'theme-nomask.R' 'theme-novar-tern.R' 'theme-rotate.R' 'theme-showgrid.R' 'theme-showlabels.R' 'theme-ticks.R' 'theme-showtitles.R' 'theme-ticksoutside.R'

'theme-zoom.R' 'utilities.R' 'utilities-help.R'
'geom-density-tern.R' 'stat-density-tern.R' 'geom-mask.R'
'geom-Xline.R' 'geom-Xisoprop.R' 'geom-confidence-tern.R'
'stat-confidence-tern.R' 'geom-errorbarX.R'
'geom-smooth-tern.R' 'stat-smooth-tern.R' 'geom-mean-ellipse.R'
'stat-mean-ellipse.R' 'geom-interpolate-tern.R'
'stat-interpolate-tern.R' 'stat-interpolate-methods.R'
'geom-crosshair-tern.R' 'geom-point-swap.R' 'geom-hex-tern.R'
'stat-hex-tern.R' 'annotation-tern.R'
'annotation-raster-tern.R' 'geom-text-viewport.R'
'geom-label-viewport.R' 'geom-polygon-closed.R'
'geom-tri-tern.R' 'stat-tri-tern.R'

NeedsCompilation no

Repository CRAN

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R topics documented:

+.gg *Plot Construction*

Description

"+.gg" is a local copy of the ggplot2 add function, no change other than exporting from the ggtern namespace

Usage

```
## S3 method for class 'gg'
e1 + e2

e1 %+% e2
```

Arguments

e1	first object
e2	second object

Author(s)

Nicholas Hamilton

aes *Modified Aesthetic Mappings*

Description

Modified Aesthetic Mappings

Usage

```
aes(x, y, z, ...)
```

Arguments

x	x value
y	y value
z	z value
...	other arguments as per aes

Details

An extension to the base aes functin from ggplot2, this is modified to handle a default z mapping for application in ternary phase diagrams. Does not alter the standard behaviour.

See Also

Parent aes function.

---

annotate *Create an annotation layer (ggtern version).*

Description

This function adds geoms to a plot. Unlike typical a geom function, the properties of the geoms are not mapped from variables of a data frame, but are instead passed in as vectors. This is useful for adding small annotations (such as text labels) or if you have your data in vectors, and for some reason don't want to put them in a data frame.

Usage

```
annotate(geom, x = NULL, y = NULL, z = NULL, xmin = NULL, xmax = NULL,
  ymin = NULL, ymax = NULL, zmin = NULL, zmax = NULL, xend = NULL,
  yend = NULL, zend = NULL, ..., na.rm = FALSE)
```

Arguments

geom	name of geom to use for annotation
x, y, z, xmin, ymin, zmin, xmax, ymax, zmax, xend, yend, zend	positioning aesthetics - you must specify at least one of these.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.

Details

Note that all position aesthetics are scaled (i.e. they will expand the limits of the plot so they are visible), but all other aesthetics are set. This means that layers created with this function will never affect the legend.

Author(s)

Nicholas Hamilton

See Also

annotate

Examples

```
ggtern() +
annotate(geom  = 'text',
             x     = c(0.5,1/3,0.0),
             y     = c(0.5,1/3,0.0),
             z     = c(0.0,1/3,1.0),
             angle = c(0,30,60),
             vjust = c(1.5,0.5,-0.5),
             label = paste("Point",c("A","B","C")),
             color = c("green","red",'blue')) +
  theme_dark() +
  theme_nomask()
```

`annotation_raster_tern` *Annotation: High-performance rectangular tiling (ggtern version)*

Description

This is a special version of `geom_raster` optimised for static annotations that are the same in every panel. These annotations will not affect scales (i.e. the x and y axes will not grow to cover the range of the raster, and the raster must already have its own colours).

Usage

```
annotation_raster_tern(raster, xmin = 0, xmax = 1, ymin = 0, ymax = 1,
  interpolate = FALSE)
```

Arguments

`raster`	raster object to display
`xmin, xmax`	x location (in npc coordinates) giving horizontal location of raster
`ymin, ymax`	y location (in npc coordinates) giving vertical location of raster
`interpolate`	If `TRUE` interpolate linearly, if `FALSE` (the default) don't interpolate.

Details

Most useful for adding bitmap images.

Author(s)

Nicholas Hamilton

Examples

```
data(Feldspar)
data(FeldsparRaster)
ggtern(Feldspar,aes(Ab,An,Or)) +
theme_rgbw() +
annotation_raster_tern(FeldsparRaster,xmin=0,xmax=1,ymin=0,ymax=1) +
geom_mask() +
geom_point(size=5,aes(shape=Feldspar,fill=Feldspar),color='black') +
scale_shape_manual(values=c(21,24)) +
labs(title="Demonstration of Raster Annotation")
```

---

approved_layers *Approved Geoms, Stats and Positions*

Description

ggtern is a specialist extension to ggplot2 for rendering ternary diagrams, as such, many stats and geoms which come packaged with ggplot2 are either not relevant or will not work, as such, ggtern regulates during the plot construction process, which geoms and stats are able to be applied when using the coord_tern coordinate system. Attempting to apply non-approved geometries or stats (ie geometries / stats not in the below list), will result in the respective layers being stripped from the final plot.

Approved Geometries

The following geoms have been approved so far, including a combination of existing geoms and newly created geoms for the ggtern package APPROVED geoms in ggtern are as follows:

- geom_point
- geom_path
- geom_line
- geom_label
- geom_text
- geom_jitter
- geom_Tline
- geom_Rline
- geom_Lline
- geom_polygon
- geom_segment
- geom_count
- geom_errorbarT
- geom_errorbarL
- geom_errorbarR

- geom_density_tern
- geom_confidence
- geom_curve
- geom_mask
- geom_smooth_tern
- geom_blank
- geom_jitter
- geom_Tisoprop
- geom_Lisoprop
- geom_Risoprop
- geom_interpolate_tern
- geom_crosshair_tern
- geom_Tmark
- geom_Lmark
- geom_Rmark
- geom_point_swap
- geom_rect
- geom_polygon_closed
- geom_hex_tern
- geom_tri_tern
- geom_mean_ellipse
- geom_text_viewport
- geom_label_viewport

Approved Stats

The following stats have been approved so far, including a combination of existing stats and newly created stats for the ggtern package APPROVED stats in ggtern are as follows:

- stat_identity
- stat_confidence
- stat_density_tern
- stat_smooth_tern
- stat_sum
- stat_unique
- stat_interpolate_tern
- stat_mean_ellipse
- stat_hex_tern
- stat_tri_tern

Approved Positions

The following positions have been approved so far, including a combination of existing positions and newly created positions for the ggtern package APPROVED positions in `ggtern` are as follows:

- `position_identity`
- `position_nudge_tern`
- `position_jitter_tern`

The balance of the available stats, geometries or positions within ggplot2 are either invalid or remain work in progress with regards to the `ggtern` package.

Author(s)

Nicholas Hamilton

`arrangeGrob` *Arrange multiple grobs on a page (ggtern version)*

Description

A very slight modification to the original function, removing the explicit direction to use the ggplotGrob function from the ggplot2 namespace

Usage

```
arrangeGrob(..., grobs = list(...), layout_matrix, vp = NULL,
  name = "arrange", as.table = TRUE, respect = FALSE, clip = "off",
  nrow = NULL, ncol = NULL, widths = NULL, heights = NULL, top = NULL,
  bottom = NULL, left = NULL, right = NULL, padding = unit(0.5, "line"))

grid.arrange(..., newpage = TRUE)
```

Arguments

`...`	grobs, gtables, ggplot or trellis objects
`grobs`	list of grobs
`layout_matrix`	optional layout
`vp`	viewport
`name`	argument of gtable
`as.table`	logical: bottom-left to top-right (TRUE) or top-left to bottom-right (FALSE)
`respect`	argument of gtable
`clip`	argument of gtable
`nrow`	argument of gtable
`ncol`	argument of gtable

widths	argument of gtable
heights	argument of gtable
top	optional string, or grob
bottom	optional string, or grob
left	optional string, or grob
right	optional string, or grob
padding	unit of length one, margin around annotations
newpage	open a new page

Author(s)

Nicholas Hamilton

`breaks_tern` *Generate Axis Breaks*

Description

Calculates the Breaks for Major or Minor Gridlines based on the input limits.

Usage

```
breaks_tern(limits = c(0, 1), isMajor = TRUE, n = 5)
```

Arguments

limits	the scale limits
isMajor	major or minor grids
n	number of breaks

Examples

```
breaks_tern()
breaks_tern(limits = c(0,.5),FALSE,10)
```

coord_tern *Ternary Coordinate System*

Description

coord_tern is a function which creates a transformation mechanism between the ternary system, and, the cartesian system. It inherits from the fixed coordinate system, employing fixed ratio between x and y axes once transformed.

Usage

```
coord_tern(Tlim = NULL, Llim = NULL, Rlim = NULL, expand = TRUE)
```

Arguments

Tlim	the range of T in the ternary space
Llim	the range of L in the ternary space
Rlim	the range of R in the ternary space
expand	If TRUE, the default, adds a small expansion factor to the limits to ensure that data and axes don't overlap. If FALSE, limits are taken exactly from the data or xlim/ylim.

Value

coord_tern returns a CoordTern ggproto

Aesthetics (Required in Each Layer)

coord_tern understands the following aesthetics (required aesthetics are in bold):

- **x**
- **y**
- **z**

Abovementioned limitations include the types of geometries which can be used (ie approved geometries), or modifications to required aesthetic mappings. One such essential patch is, for approved geometries previously requiring x and y coordinates, now require an additional z coordinate, and, geom_segment goes one step further in that it requires both an additional z and zend coordinate mappings.

In essence, the required aesthetics are the product between what is required of each 'layer' and what is required of the 'coordinate system'.

Author(s)

Nicholas Hamilton

`data_Feldspar` *Elkin and Groves Feldspar Data*

Description

Data relating to Elkins and Groves Feldspar Data, the following datasets include the experimental data and sample raster data from one of the images in the referenced paper. `Feldspar` - Experimental Data `FeldsparRaster` - Raster Data for Fig. 6.

Usage

```
#Experimental Data
data(Feldspar)

#Raster data
data(FeldsparRaster)
```

Format

`Feldsdpar` - One (1) row per Feldspar composition, `FeldsdparRaster` - Raster Matrix

Author(s)

Nicholas Hamilton

References

Elkins, L. T. & Grove, T. L. Ternary Feldspar Experiments and Thermodynamic Models American Mineralogist, Mineral Soc America, 1990, 75, 544-559

See Also

Data

Examples

```
#Summarize the Feldspar Data
data(Feldspar)
summary(Feldspar)

#Plot Felspar Data
ggtern(data=Feldspar,aes(x=An,y=Ab,z=Or)) +
    geom_point()

# Plot Feldspar data and Underlying Raster Image
data(FeldsparRaster)
ggtern(Feldspar,aes(Ab,An,Or)) +
    theme_rgbw() +
    annotation_raster_tern(FeldsparRaster,xmin=0,xmax=1,ymin=0,ymax=1) +
```

```
geom_point(size=5,aes(shape=Feldspar,fill=Feldspar),color='black') +
scale_shape_manual(values=c(21,24)) +
labs(title = "Demonstration of Raster Annotation")
```

`data_Fragments` *Grantham and Valbel Rock Fragment Data*

Description

ABSTRACT: Chemical weathering influences the detrital composition of sand-size sediment derived from source areas subject to different amounts of precipitation in the Coweeta Basin, North Carolina. Of the grain types studied, rock fragments are most sensitive to chemical degradation; therefore, their abundance is the best indicator of cumulative weathering effects. Destruction of sand-size rock fragments by chemical weathering is a function of both the intensity and duration of chemical weathering experienced by grains in regoliths of the source area. In the Coweeta Basin, the intensity of chemical weathering is directly related to the climate via effective precipitation in individual subbasins, whereas the duration of chemical weathering is inversely related to the relief ratio of the watershe . Therefore, soils in watersheds with low-relief ratios and high discharge per unit area experience the most extensive chemical weathering, and sediments derived from these watersheds contain the lowest percentage of rock fragments. The effects of climate alone cannot explain the systematic variation of rock fragment abundance in sediments from the Coweeta Basin. The compositional imprint left on these sediments by chemical weathering is a function of both climate and topographic slope in the sediment source area.

Usage

```
data(Fragments)
```

Format

1row per point, Each point contains data on the following:

1. **Watershed**: By id: 2, 10, 34, 41, 13, 27, 32 or 37,
2. **Position**: By name: Tallulah or Coweeta,
3. **CCWI**: The Cumulative Chemical Weathering Index: numeric
4. **Precipitation**: Average Annual Precipitation, numeric
5. **Discharge**: Annual Average Discharge, numeric
6. **Relief**: Relief Ratio, numeric
7. **GrainSize**: Coarse Medium or Fine,
8. **Sample**: Field Sampling, A, B or C
9. **Points**: The number of points measured for each sample
10. **Qm**: Multicrystalline Quarts Amount, percentage
11. **Qp**: Polycrystalline Quarts Amount, percentage
12. **Rf**: Rock Fragments Amount, percentage
13. **M**: Mica Amount, percentage

Author(s)

Jeremy Hummon Grantham and Michael Anthony Velbel

References

Grantham, Jeremy Hummon, and Michael Anthony Velbel. "The influence of climate and topography on rock-fragment abundance in modern fluvial sands of the southern Blue Ridge Mountains, North Carolina." Journal of Sedimentary Research 58.2 (1988).

Examples

```
data(Fragments)
ggtern(Fragments,aes(Qm+Qp,Rf,M,colour=Sample)) +
  geom_density_tern(h=2,aes(fill=..level..),
  expand=0.75,alpha=0.5,bins=5) +
  geom_point(aes(shape=Position,size=Relief)) +
  theme_bw(base_size=8) +
  theme_showarrows() +
  custom_percent('%') +
  labs(title = "Grantham and Valbel Rock Fragment Data",
       x = "Q_{m+p}", xarrow = "Quartz (Multi + Poly)",
       y = "R_f",     yarrow = "Rock Fragments",
       z = "M",       zarrow = "Mica") +
  theme_latex() +
  facet_wrap(~Sample,nrow=2)
```

---

data_SkyeLava *Aichisons Skye Lavas*

Description

AFM compositions of 23 aphyric Skye lavas.

Format

1 row per point, 23 points in total, Each point contains data on the following:

1. **No**: ID, S1 to S23
2. **A**: Percent Na2O+K2O ,
3. **F**: Percent Fe2O3
4. **F**: Percent MgO

Author(s)

J. Aitchison

References

Aitchison, J. The statistical analysis of compositional data Chapman and Hall London, 1986, pp360

Examples

```
# Emulate & Enhance plot produced in Fig. 3, pg 7 of:
# Martin-Fernandez, J.; Chacon-Duran, J. & Mateu-Figueras, G.
# Updating on the kernel density estimation for compositional data
# Proceedings of 17th Conference IASC-ERSS, Compstat, Roma,(Italy), 2006, 713-720

data(SkyeLava)
breaks  = c(.01,.05,.10,.25,.5,.75,.9,.95,.99)
ggtern(SkyeLava,aes(F,A,M)) +
theme_bw() +
theme_showarrows() +
theme_latex() +
theme(tern.panel.grid.minor = element_blank(),
      tern.panel.grid.major = element_line(linetype='dotted',color='darkgray'),
      tern.axis.text        = element_text(size=8)) +
      geom_density_tern() +
      geom_point() +
      limit_tern(breaks = breaks,
                 labels = sprintf("%.2f",breaks)) +
labs(title    = "Aphyric Skye Lavas",
     subtitle = "AFM Compositions of 23 samples",
     Tarrow = "A = Na_2O + K_2O",
     Larrow = "F = Fe_2O_3",
     Rarrow = "M = MgO")
```

---

data_USDA *USDA Textural Classification Data*

Description

This dataset was issued by the United States Department of Agriculture (USDA) in the form of a ternary diagram, this original ternary diagram has been converted to numerical data and included here.

Usage

```
data(USDA)
```

Format

1row per point, many points per classification representing the extremes of the area.

Author(s)

United States Department of Agriculture (USDA)

Nicholas Hamilton

Source

Soil Mechanics Level 1, Module 3, USDA Textural Classification Study Guide

See Also

ggtern datasets

Examples

```
#Load the Libraries
library(ggtern)
library(plyr)

#Load the Data.
data(USDA)

#Put tile labels at the midpoint of each tile.
USDA.LAB <- ddply(USDA,"Label",function(df){
  apply(df[,1:3],2,mean)
})

#Tweak
USDA.LAB$Angle = sapply(as.character(USDA.LAB$Label),function(x){
    switch(x,"Loamy Sand"=-35,0)
})

#Construct the plot.
ggtern(data=USDA,aes(Sand,Clay,Silt,color=Label,fill=Label)) +
  geom_polygon(alpha=0.75,size=0.5,color="black") +
  geom_mask() +
  geom_text(data=USDA.LAB,aes(label=Label,angle=Angle),color="black",size=3.5) +
  theme_rgbw() +
  theme_showsecondary() +
  theme_showarrows() +
  weight_percent() +
  guides(fill='none') +
  theme_legend_position("topleft") +
  labs(title = "USDA Textural Classification Chart",
       fill  = "Textural Class",
       color = "Textural Class")
```

data_WhiteCells *Aichisons White Cells*

Description

White-cell compositions of 30 blood cells by two different methods

Format

1 row per point, 60 points in total, 2 experiments x 30 points each, Each point contains data on the following:

1. **No**: ID, S1 to S30
2. **Experiment**: MicroscopicInspection or ImageAnalysis
3. **G**: Fraction Granulocytes
4. **L**: Fraction Lymphocytes
5. **M**: Fraction Monocytes

Author(s)

J. Aitchison

References

Aitchison, J. The statistical analysis of compositional data Chapman and Hall London, 1986, pp366

Examples

```
data(WhiteCells)
   ggtern(WhiteCells,aes(G,L,M)) +
   geom_density_tern(aes(color=Experiment)) +
   geom_point(aes(shape=Experiment)) +
   facet_wrap(~Experiment,nrow=2)
```

draw_key_tern *Key drawing functions*

Description

Each Geom has an associated function that draws the key when the geom needs to be displayed in a legend. These are the options built into ggplot2.

Usage

```
draw_key_crosshair_tern(data, params, size)

draw_key_Tmark(data, params, size)

draw_key_Lmark(data, params, size)

draw_key_Rmark(data, params, size)

draw_key_Tline(data, params, size)

draw_key_Lline(data, params, size)

draw_key_Rline(data, params, size)

draw_key_Tiso(data, params, size)

draw_key_Liso(data, params, size)

draw_key_Riso(data, params, size)

draw_key_point_swap(data, params, size)
```

Arguments

data	A single row data frame containing the scaled aesthetics to display in this key
params	A list of additional parameters supplied to the geom.
size	Width and height of key in mm.

Value

A grid grob.

Author(s)

Nicholas Hamilton

`geom_confidence_tern` *Confidence Interval*

Description

Calculates the confidence intervals, via the Mahalnobis Distance and use of the `Log-Ratio` Transformation

Statistic

Usage

```
geom_confidence_tern(mapping = NULL, data = NULL, stat = "ConfidenceTern",
  position = "identity", ..., lineend = "butt", linejoin = "round",
  linemitre = 1, na.rm = FALSE, show.legend = NA, inherit.aes = TRUE)

stat_confidence_tern(mapping = NULL, data = NULL, geom = "ConfidenceTern",
  position = "identity", ..., contour = TRUE, n = 100, h = NULL,
  na.rm = FALSE, breaks = c(0.5, 0.9, 0.95), show.legend = NA,
  inherit.aes = TRUE)
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
stat	Use to override the default connection between geom_smooth and stat_smooth.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
lineend	Line end style (round, butt, square).
linejoin	Line join style (round, mitre, bevel).
linemitre	Line mitre limit (number greater than 1).
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().
geom	Use to override the default connection between geom_smooth and stat_smooth.
contour	If TRUE, contour the results of the 2d density estimation
n	number of grid points in each direction
h	Bandwidth (vector of length two). If NULL, estimated using bandwidth.nrd.
breaks	the confidence intervals, default to 50, 90 and 95 percent.

Aesthetics

geom_ConfidenceTern understands the following aesthetics (required aesthetics are in bold):

- **x**
- **y**
- alpha
- colour
- linetype
- size

Computed variables

Same as stat_contour

Author(s)

Nicholas Hamilton

Examples

```
data(Feldspar)
ggtern(data=Feldspar,aes(An,Ab,Or)) +
  geom_point() +
  geom_confidence_tern()
```

---

geom_crosshair_tern *Ternary Crosshairs*

Description

A new geometry, geom_crosshair_tern is one that that marks on the respective axes, the values of each data point. We also include additional geometries geom_Tmark, geom_Rmark and geom_Lmark – to render only the respective axis component of the abovementioned crosshair.

Usage

```
geom_crosshair_tern(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", ..., arrow = NULL, lineend = "butt",
  na.rm = FALSE, show.legend = NA, inherit.aes = TRUE)

geom_Tmark(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", arrow = NULL, lineend = "butt", na.rm = FALSE,
  show.legend = NA, inherit.aes = TRUE, ...)

geom_Lmark(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", arrow = NULL, lineend = "butt", na.rm = FALSE,
```

```
  show.legend = NA, inherit.aes = TRUE, ...)

geom_Rmark(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", arrow = NULL, lineend = "butt", na.rm = FALSE,
  show.legend = NA, inherit.aes = TRUE, ...)
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
stat	The statistical transformation to use on the data for this layer, as a string.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
arrow	specification for arrow heads, as created by arrow().
lineend	Line end style (round, butt, square).
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().

Aesthetics

geom_crosshair_tern understands the following aesthetics (required aesthetics are in bold):

- **x**
- **y**
- **z**
- alpha
- colour
- linetype
- size

Author(s)

Nicholas Hamilton

Examples

```
set.seed(1)
df = data.frame(x=runif(10),y=runif(10),z=runif(10))
base = ggtern(df,aes(x,y,z)) + geom_point()
base + geom_crosshair_tern()
base + geom_Tmark()
base + geom_Rmark()
base + geom_Lmark()
```

---

geom_density_tern *Density Estimate (ggtern version)*

Description

Perform a 2D kernel density estimatation using kde2d and display the results with contours. This can be useful for dealing with overplotting. Additional weight aesthetic (see aesthetic section below) permits better weighting if desired

Usage

```
geom_density_tern(mapping = NULL, data = NULL, stat = "DensityTern",
  position = "identity", ..., lineend = "butt", linejoin = "round",
  linemitre = 1, na.rm = FALSE, show.legend = NA, inherit.aes = TRUE)

stat_density_tern(mapping = NULL, data = NULL, geom = "density_tern",
  position = "identity", ..., contour = TRUE, n = 100, h = NULL,
  bdl = 0, bdl.val = NA, na.rm = FALSE, show.legend = NA,
  inherit.aes = TRUE, weight = 1, base = "ilr", expand = c(0.5, 0.5))
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.

stat	The statistical transformation to use on the data for this layer, as a string.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
lineend	Line end style (round, butt, square).
linejoin	Line join style (round, mitre, bevel).
linemitre	Line mitre limit (number greater than 1).
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().
geom	Use to override the default connection between geom_density_2d and stat_density_2d.
contour	If TRUE, contour the results of the 2d density estimation
n	number of grid points in each direction
h	Bandwidth (vector of length two) as a multiple of the best estimate, estimated using bandwidth.nrd.
bdl	the threshold for detection limit. This is applied against the output of acomp function, so it is expected as a fraction in the range [0,1]
bdl.val	compositions which have components that are below the detection limit, will have these components replaced by this val. If it is NA then these items will be discarded. If the value is something other than 'NA', then all values less than bdl will be replaced and therefore included in the final density estimate.
weight	weighting for weighted kde2d esimate, default's to 1, which is non-weighted and equivalent to the usual kde2d calculation
base	the base transformation of the data, options include 'identity' (ie direct on the cartesian space), or 'ilr' which means to use the isometric log ratio transformation.
expand	Calculate on a mesh which extends beyond the grid of the plot region by this amount If NULL, estimated using bandwidth.nrd.

Aesthetics

geom_density_tern understands the following aesthetics (required aesthetics are in bold):

- **x**
- **y**
- alpha

- colour
- linetype
- size
- weight

Author(s)

Nicholas Hamilton

Nicholas Hamilton

Examples

```
#Plot Density Estimate, on isometric log ratio transformation of original data
data('Feldspar')
ggtern(Feldspar,aes(Ab,An,Or)) +
 geom_density_tern(aes(color=..level..),bins=5) +
 geom_point()

#Plot Density Estimate w/ Polygon Geometry
data('Feldspar')
ggtern(data=Feldspar,aes(Ab,An,Or)) +
    stat_density_tern(
        geom='polygon',
        aes(fill=..level..),
        bins=5,
        color='grey') +
    geom_point()
```

---

geom_errorbarX *Ternary Error Bars*

Description

geom_errorbarT, geom_errorbarL and geom_errorbarR are geometries to render error bars for the top, left and right apex species respectively, analogous to geom_errorbar and/or geom_errorbarh as provided in the base ggplot2 package.

Usage

```
geom_errorbarT(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", ..., arrow = NULL, lineend = "butt",
  na.rm = FALSE, show.legend = NA, inherit.aes = TRUE)

geom_errorbarL(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", arrow = NULL, lineend = "butt", na.rm = FALSE,
  show.legend = NA, inherit.aes = TRUE, ...)
```

```
geom_errorbarR(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", arrow = NULL, lineend = "butt", na.rm = FALSE,
  show.legend = NA, inherit.aes = TRUE, ...)
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
stat	The statistical transformation to use on the data for this layer, as a string.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
arrow	specification for arrow heads, as created by arrow().
lineend	Line end style (round, butt, square).
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().

Aesthetics (geom_errorbarT)

geom_errorbart understands the following aesthetics (required aesthetics are in bold):

- **Tmax**
- **Tmin**
- **x**
- **y**
- **z**

- alpha
- colour
- linetype
- size

Aesthetics (geom_errorbarL)

`geom_errorbarl` understands the following aesthetics (required aesthetics are in bold):

- **Lmax**
- **Lmin**
- **x**
- **y**
- **z**
- alpha
- colour
- linetype
- size

Aesthetics (geom_errorbarR)

`geom_errorbarr` understands the following aesthetics (required aesthetics are in bold):

- **Rmax**
- **Rmin**
- **x**
- **y**
- **z**
- alpha
- colour
- linetype
- size

Author(s)

Nicholas Hamilton

Examples

```
#Example with Dummy Data.
tmp <- data.frame(x=1/3,
y=1/3,
z=1/3,
Min=1/3-1/6,
Max=1/3+1/6)
ggtern(data=tmp,aes(x,y,z)) +
  geom_point() +
  geom_errorbarT(aes(Tmin=Min,Tmax=Max),colour='red')+
  geom_errorbarL(aes(Lmin=Min,Lmax=Max),colour='green')+
  geom_errorbarR(aes(Rmin=Min,Rmax=Max),colour='blue')
```

---

geom_hex_tern *Hexbin (ggtern version).*

Description

Divides the plane into regular hexagons, counts the number of cases in each hexagon, and then (by default) maps the number of cases to the hexagon fill. Hexagon bins avoid the visual artefacts sometimes generated by the very regular alignment of [geom_bin2d()].

Usage

```
geom_hex_tern(mapping = NULL, data = NULL, stat = "hex_tern",
  position = "identity", ..., fun = sum, na.rm = FALSE,
  show.legend = NA, inherit.aes = TRUE)

stat_hex_tern(mapping = NULL, data = NULL, geom = "hex_tern",
  position = "identity", ..., bins = 30, fun = sum, binwidth = NULL,
  na.rm = FALSE, show.legend = NA, inherit.aes = TRUE)
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.

...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
fun	the scalar function to use for the statistic
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().
geom, stat	Override the default connection between 'geom_hex_tern' and 'stat_hex_tern'
bins	numeric vector giving number of bins in both vertical and horizontal directions. Set to 30 by default.
binwidth	Numeric vector giving bin width in both vertical and horizontal directions. Overrides bins if both set.

Details

This geometry is loosely based on the base ggplot2 geom_hex, with a few subtle (but advantageous differences). The user can control the border thickness of the hexagonal polygons using the size aesthetic. The user can also control the particular statistic to use, by defining the fun argument (sum by default), which by default is applied over a value of 1 per point, however, this can also be mapped to a data variable via the 'value' mapping.

Aesthetics

@section Aesthetics: geom_hex() understands the following aesthetics (required aesthetics are in bold):

- x
- y
- alpha
- colour
- fill
- group
- linetype
- size

Learn more about setting these aesthetics in vignette("ggplot2-specs").

Examples

```
set.seed(1)
n  = 1000
df = data.frame(x  = runif(n),
                y  = runif(n),
                z  = runif(n),
                wt = runif(n))

#Equivalent of Hexbin
ggtern(df,aes(x,y,z)) +
    geom_hex_tern(binwidth=0.1)

#Calculate Mean of variable wt
ggtern(df,aes(x,y,z)) +
     geom_hex_tern(binwidth=0.05,
                   aes(value=wt),
                   fun=mean)

#Custom functions, for ex. discrete output...
myfun = function(x) sample(LETTERS,1)
ggtern(df,aes(x,y,z)) +
     geom_hex_tern(binwidth=0.05,
                   fun=myfun)
```

---

geom_interpolate_tern *Ternary Interpolation*

Description

This is the heavily requested geometry for interpolating between ternary values, results being rendered using contours on a ternary mesh.

Usage

```
geom_interpolate_tern(mapping = NULL, data = NULL,
  stat = "InterpolateTern", position = "identity", ..., method = "auto",
  formula = value ~ poly(x, y, degree = 1), lineend = "butt",
  linejoin = "round", linemitre = 1, na.rm = FALSE, show.legend = NA,
  inherit.aes = TRUE)

stat_interpolate_tern(mapping = NULL, data = NULL,
  geom = "interpolate_tern", position = "identity", ..., method = "auto",
  na.rm = FALSE, show.legend = NA, inherit.aes = TRUE, n = 80,
  formula = value ~ poly(x, y, degree = 1), base = "ilr")
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
stat	Use to override the default connection between geom_smooth and stat_smooth.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
method	Smoothing method (function) to use, eg. lm, glm, gam, loess, MASS::rlm. For method = "auto" the smoothing method is chosen based on the size of the largest group (across all panels). loess() is used for less than 1,000 observations; otherwise mgcv::gam() is used with formula = y ~ s(x, bs = "cs"). Somewhat anecdotally, loess gives a better appearance, but is O(n^2) in memory, so does not work for larger datasets. If you have fewer than 1,000 observations but want to use the same gam model that method = "auto" would use then set method = "gam", formula = y ~ s(x, bs = "cs").
formula	Formula to use in smoothing function, eg. y ~ x, y ~ poly(x, 2), y ~ log(x)
lineend	Line end style (round, butt, square).
linejoin	Line join style (round, mitre, bevel).
linemitre	Line mitre limit (number greater than 1).
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().
geom	Use to override the default connection between geom_smooth and stat_smooth.
n	number of grid points in each direction
base	the base transformation of the data, options include 'identity' (ie direct on the cartesian space), or 'ilr' which means to use the isometric log ratio transformation.

Aesthetics

geom_InterpolateTern understands the following aesthetics (required aesthetics are in bold):

- **x**
- **y**
- alpha
- colour
- linetype
- size

Author(s)

Nicholas Hamilton

Examples

```
data(Feldspar)
ggtern(Feldspar,aes(Ab,An,Or,value=T.C)) +
stat_interpolate_tern(geom="polygon",
                      formula=value~x+y,
                      method=lm,n=100,
                      breaks=seq(0,1000,by=100),
                      aes(fill=..level..),expand=1) +
                      geom_point()
```

---

geom_label_viewport *Draw Label at Relative Position on Viewport*

Description

Since it is sometimes counter intuitive for working with ternary or other non-cartesian coordinates in the event that the the user wishes to place a label-geometry based on visual inspection, this geometry positions such text item at a fraction from x=[0,1] and y=[0,1] of the viewport in x and y cartesian coordinates.

Usage

```
geom_label_viewport(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", ..., hjust = "inward", vjust = "inward",
  parse = FALSE, label.padding = unit(0.25, "lines"), label.r = unit(0.15,
  "lines"), label.size = 0.25, na.rm = FALSE, show.legend = NA,
  inherit.aes = TRUE)
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
stat	The statistical transformation to use on the data for this layer, as a string.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
hjust	horizontal justification
vjust	vertical justification
parse	If TRUE, the labels will be parsed into expressions and displayed as described in ?plotmath
label.padding	Amount of padding around label. Defaults to 0.25 lines.
label.r	Radius of rounded corners. Defaults to 0.15 lines.
label.size	Size of label border, in mm.
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().

Aesthetics

geom_Label understands the following aesthetics (required aesthetics are in bold):

- **label**
- **x**
- **y**
- alpha
- angle

- colour
- family
- fill
- fontface
- hjust
- lineheight
- size
- vjust

Author(s)

Nicholas Hamilton

See Also

geom_label

Examples

```
library(ggplot2)
data(Feldspar)
base = ggtern(data=Feldspar,aes(Ab,An,Or)) +
  geom_mask() +
  geom_point() +
  geom_label_viewport(x=0.5,y=0.5,label="Middle",color='red') +
  geom_label_viewport(x=1.0,y=1.0,label="Top Right",color='blue') +
  geom_label_viewport(x=0.0,y=0.0,label="Bottom Left",color='green') +
  geom_label_viewport(x=0.0,y=1.0,label="Top Left",color='orange') +
  geom_label_viewport(x=1.0,y=0.0,label="Bottom Right",color='magenta')
base

base +
  geom_label_viewport(x=0.9,y=0.5,label="Clipping Turned Off",color='purple',hjust=0,clip='on')

base +
  geom_label_viewport(x=0.9,y=0.5,label="Clipping Turned Off",color='purple',hjust=0,clip='off')
```

---

geom_mask *Apply Manual Clipping Mask*

Description

This function creates a manual clipping mask, which in turn suppresses the standard clipping mask that would otherwise be rendered in the foregound rendering procedure, giving the user control over the exact placement with respect to other layers. For example, the user may wish to have the clipping mask placed after the `geom_point(...)` layer, but before the `geom_label(...)` layer, this situation has been demonstrated in the example below. In the event that the user wishes to suppress the mask altogether, then a convenience function has been provided, `theme_nomask()`.

Usage

```
geom_mask()
```

Author(s)

Nicholas Hamilton

Examples

```
data(Feldspar)
x = ggtern(Feldspar,aes(Ab,An,Or,label=Experiment)) + geom_point()

#Default Behaviour
x + geom_label()

#Insert manual mask before the labels, to prevent them being truncated
x + geom_point(size=6) + geom_mask() + geom_label()
```

---

geom_mean_ellipse *Mean Ellipse*

Description

Produce ellipses from a mean and a variance of ternary compositional data, based off the function included in the compositions package.

Mean Ellipses

Usage

```
geom_mean_ellipse(mapping = NULL, data = NULL, stat = "MeanEllipse",
  position = "identity", ..., lineend = "butt", linejoin = "round",
  linemitre = 1, na.rm = FALSE, show.legend = NA, inherit.aes = TRUE)

stat_mean_ellipse(mapping = NULL, data = NULL, geom = "MeanEllipse",
  position = "identity", ..., steps = 72, r = 1, na.rm = FALSE,
  show.legend = NA, inherit.aes = TRUE)
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
stat	Use to override the default connection between geom_smooth and stat_smooth.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
lineend	Line end style (round, butt, square).
linejoin	Line join style (round, mitre, bevel).
linemitre	Line mitre limit (number greater than 1).
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().
geom	Use to override the default connection between geom_smooth and stat_smooth.
steps	the number of discretisation points to draw the ellipses
r	a scaling of the half-diameters

Aesthetics

geom_MeanEllipse understands the following aesthetics (required aesthetics are in bold):

- **x**
- **y**
- alpha
- colour
- linetype
- size

Computed variables

Same as stat_contour

Author(s)

Nicholas Hamilton & Ashton Drew

Examples

```
  data(Feldspar)
  ggtern(data=Feldspar,aes(An,Ab,Or)) +
    geom_point() +
    geom_mean_ellipse()
data(Feldspar)
ggtern(data=Feldspar,aes(Ab,An,Or)) +
  theme_bw() +
  stat_mean_ellipse(geom='polygon',steps=500,fill='red',color='black') +
  geom_point()
```

---

geom_point_swap *Points (Colour and Fill Swapped), as for a scatterplot*

Description

The geom_point_swap geometry is used to create scatterplots, however, this version swaps the colour and the fill mappings. Useful if the fill mapping is already occupied (say with existing polygon geometry), this geometry will allow points of shape 21-25 to use colour mapping for the center colour, and fill mapping for the border.

Usage

```
geom_point_swap(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", ..., na.rm = FALSE, show.legend = NA,
  inherit.aes = TRUE)
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
stat	The statistical transformation to use on the data for this layer, as a string.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.

na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().

Author(s)

Nicholas Hamilton

Examples

```
data(Feldspar)
ggtern(Feldspar,aes(Ab,An,Or)) +
stat_confidence_tern(geom='polygon',aes(fill=..level..),color='white') +
geom_mask() +
geom_point_swap(aes(colour=T.C,shape=Feldspar),fill='black',size=5) +
scale_shape_manual(values=c(21,24)) +
scale_color_gradient(low='green',high='red') +
labs(title="Feldspar",color="Temperature",fill='Confidence')
```

---

geom_polygon_closed *Closed Polygons*

Description

A little like geom_area, in the sense that polygons are either upper or lower closed based on the starting and finishing points index.

Usage

```
geom_polygon_closed(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", ..., na.rm = FALSE, show.legend = NA,
  inherit.aes = TRUE, closure = "none")
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
stat	The statistical transformation to use on the data for this layer, as a string.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().
closure	one of 'none','upper' or 'lower'

Author(s)

Nicholas Hamilton

---

geom_smooth_tern *Add a Smoothed Conditional Mean.*

Description

Aids the eye in seeing patterns in the presence of overplotting. geom_smooth_tern and stat_smooth_tern are effectively aliases: they both use the same arguments. Use geom_smooth_tern unless you want to display the results with a non-standard geom.

Usage

```
geom_smooth_tern(mapping = NULL, data = NULL, position = "identity", ...,
  method = "auto", formula = y ~ x, se = TRUE, na.rm = FALSE,
  show.legend = NA, inherit.aes = TRUE, expand = c(0.5, 0.5))

stat_smooth_tern(mapping = NULL, data = NULL, position = "identity", ...,
  method = "auto", formula = y ~ x, se = TRUE, n = 80, span = 0.75,
  fullrange = FALSE, level = 0.95, method.args = list(), na.rm = FALSE,
  show.legend = NA, inherit.aes = TRUE, expand = c(0.5, 0.5))
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
method	Smoothing method (function) to use, eg. lm, glm, gam, loess, MASS::rlm. For method = "auto" the smoothing method is chosen based on the size of the largest group (across all panels). loess() is used for less than 1,000 observations; otherwise mgcv::gam() is used with formula = y ~ s(x, bs = "cs"). Somewhat anecdotally, loess gives a better appearance, but is O(n^2) in memory, so does not work for larger datasets. If you have fewer than 1,000 observations but want to use the same gam model that method = "auto" would use then set method = "gam", formula = y ~ s(x, bs = "cs").
formula	Formula to use in smoothing function, eg. y ~ x, y ~ poly(x, 2), y ~ log(x)
se	Display confidence interval around smooth? (TRUE by default, see level to control.)
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().
expand	expand the range of values by this much (vector of length 2) when fullrange is set to TRUE
n	Number of points at which to evaluate smoother.
span	Controls the amount of smoothing for the default loess smoother. Smaller numbers produce wigglier lines, larger numbers produce smoother lines.
fullrange	Should the fit span the full range of the plot, or just the data?
level	Level of confidence interval to use (0.95 by default).
method.args	List of additional arguments passed on to the modelling function defined by method.

Author(s)

Nicholas Hamilton

Examples

```
data(Feldspar)
ggtern(data=Feldspar,aes(Ab,An,Or,group=Feldspar)) +
  geom_smooth_tern(method=lm,fullrange=TRUE,colour='red') +
  geom_point() +
  labs(title="Example Smoothing")
```

---

geom_text_viewport *Draw Text at Relative Position on Viewport*

Description

Since it is sometimes counter intuitive for working with ternary or other non-cartesian coordinates in the event that the the user wishes to place a text-geometry based on visual inspection, this geometry positions such text item at a fraction from x=[0,1] and y=[0,1] of the viewport in x and y cartesian coordinates.

Usage

```
geom_text_viewport(mapping = NULL, data = NULL, stat = "identity",
  position = "identity", ..., hjust = "inward", vjust = "inward",
  parse = FALSE, check_overlap = FALSE, na.rm = FALSE, show.legend = NA,
  inherit.aes = TRUE)
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
stat	The statistical transformation to use on the data for this layer, as a string.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.

...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
hjust	horizontal justification
vjust	vertical justification
parse	If TRUE, the labels will be parsed into expressions and displayed as described in ?plotmath
check_overlap	If TRUE, text that overlaps previous text in the same layer will not be plotted.
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().

Aesthetics

geom_Text understands the following aesthetics (required aesthetics are in bold):

- **label**
- **x**
- **y**
- alpha
- angle
- colour
- family
- fontface
- hjust
- lineheight
- size
- vjust

Author(s)

Nicholas Hamilton

See Also

geom_text

Examples

```
library(ggplot2)
data(Feldspar)
base = ggtern(data=Feldspar,aes(Ab,An,Or)) +
  geom_mask() +
  geom_point() +
  geom_text_viewport(x=0.5,y=0.5,label="Middle",color='red') +
  geom_text_viewport(x=1.0,y=1.0,label="Top Right",color='blue') +
  geom_text_viewport(x=0.0,y=0.0,label="Bottom Left",color='green') +
  geom_text_viewport(x=0.0,y=1.0,label="Top Left",color='orange') +
  geom_text_viewport(x=1.0,y=0.0,label="Bottom Right",color='magenta')
base

base +
 geom_text_viewport(x=0.9,y=0.5,label="Clipping Turned Off",color='purple',hjust=0,clip='on')

base +
 geom_text_viewport(x=0.9,y=0.5,label="Clipping Turned Off",color='purple',hjust=0,clip='off')
```

---

geom_tri_tern *Tribin (ggtern version).*

Description

Divides the plane into regular triangles, counts the number of cases in each triangles, and then (by default) maps the number of cases to the triangle fill.

Usage

```
geom_tri_tern(mapping = NULL, data = NULL, stat = "tri_tern",
  position = "identity", ..., fun = sum, na.rm = FALSE,
  show.legend = NA, inherit.aes = TRUE)

stat_tri_tern(mapping = NULL, data = NULL, geom = "tri_tern",
  position = "identity", ..., bins = 30, fun = sum, centroid = FALSE,
  na.rm = FALSE, show.legend = NA, inherit.aes = TRUE)
```

Arguments

mapping	Set of aesthetic mappings created by aes() or 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.
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
fun	the scalar function to use for the statistic
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.
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. borders().
geom, stat	Override the default connection between 'geom_hex_tern' and 'stat_hex_tern'
bins	numeric vector giving number of bins in both vertical and horizontal directions. Set to 30 by default.
centroid	logical to return the centroid of the polygon, rather than the complete polygon

Aesthetics

@section Aesthetics: geom_hex() understands the following aesthetics (required aesthetics are in bold):

- x
- y
- alpha
- colour
- fill
- group
- linetype
- size

Learn more about setting these aesthetics in vignette("ggplot2-specs").

Examples

```
set.seed(1)
n  = 1000
df = data.frame(x  = runif(n),
                y  = runif(n),
                z  = runif(n),
                wt = runif(n))
#Equivalent of Hexbin
ggtern(df,aes(x,y,z)) +
   geom_tri_tern(bins=10,aes(fill=..count..)) +
   geom_point(size=0.25)

#Custom Function, Mean
ggtern(df,aes(x,y,z)) +
   geom_tri_tern(bins=5,aes(fill=..stat..,value=wt),fun=mean) +
   geom_point(size=0.25)
```

---

geom_Xisoprop *Fixed Value Isoproportion Lines*

Description

Create fixed isoproportion lines for each of the ternary axes, `geom_Xisoprop(...)`, `(X = T, L, R)` will draw an isoproportion line projecting from the T, L and R apex respectively.

Usage

```
geom_Tisoprop(mapping = NULL, data = NULL, ..., value, na.rm = FALSE,
  show.legend = NA)

geom_Lisoprop(mapping = NULL, data = NULL, ..., value, na.rm = FALSE,
  show.legend = NA)

geom_Risoprop(mapping = NULL, data = NULL, ..., value, na.rm = FALSE,
  show.legend = NA)
```

Arguments

`mapping`	Set of aesthetic mappings created by `aes()` or `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.
...	Other arguments passed on to layer(). These are often aesthetics, used to set an aesthetic to a fixed value, like color = "red" or size = 3. They may also be parameters to the paired geom/stat.
value,	the isoproportion ratio to draw
na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.

Aesthetics

geom_Tisoprop understands the following aesthetics (required aesthetics are in bold):

- **value**
- alpha
- arrow
- colour
- linetype
- size

Author(s)

Nicholas Hamilton

Examples

```
data(Feldspar)
ggtern(data=Feldspar,aes(Ab,An,Or)) +
geom_Tisoprop(value=0.5) +
geom_Lisoprop(value=0.5) +
geom_Risoprop(value=0.5) +
geom_point()
```

---

geom_Xline *Fixed Value Lines*

Description

Plot fixed value lines, for the top, left and right axis, analagous to the geom_hline and geom_vline geometries in ggplot2

Usage

```
geom_Tline(mapping = NULL, data = NULL, ..., Tintercept, na.rm = FALSE,
  show.legend = NA)

Tline(mapping = NULL, data = NULL, ..., Tintercept, na.rm = FALSE,
  show.legend = NA)

tline(mapping = NULL, data = NULL, ..., Tintercept, na.rm = FALSE,
  show.legend = NA)

geom_Lline(mapping = NULL, data = NULL, ..., Lintercept, na.rm = FALSE,
  show.legend = NA)

Lline(mapping = NULL, data = NULL, ..., Lintercept, na.rm = FALSE,
  show.legend = NA)

lline(mapping = NULL, data = NULL, ..., Lintercept, na.rm = FALSE,
  show.legend = NA)

geom_Rline(mapping = NULL, data = NULL, ..., Rintercept, na.rm = FALSE,
  show.legend = NA)

Rline(mapping = NULL, data = NULL, ..., Rintercept, na.rm = FALSE,
  show.legend = NA)

rline(mapping = NULL, data = NULL, ..., Rintercept, na.rm = FALSE,
  show.legend = NA)
```

Arguments

`mapping`	Set of aesthetic mappings created by `aes()` or `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.
`...`	Other arguments passed on to `layer()`. These are often aesthetics, used to set an aesthetic to a fixed value, like `color = "red"` or `size = 3`. They may also be parameters to the paired geom/stat.
`Tintercept, Lintercept, Rintercept`	the intercepts for the T, L and R axis respectively

na.rm	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display.

Author(s)

Nicholas Hamilton

Examples

```
ggtern() +
geom_Tline(Tintercept=.5,arrow=arrow(), colour='red') +
geom_Lline(Lintercept=.2, colour='green') +
geom_Rline(Rintercept=.1, colour='blue')
```

---

ggplot *Create a new ggplot plot.*

Description

ggplot() initializes a ggplot object. It can be used to declare the input data frame for a graphic and to specify the set of plot aesthetics intended to be common throughout all subsequent layers unless specifically overridden.

Draw plot on current graphics device.

Usage

```
ggplot(data = NULL, mapping = aes(), ..., environment = parent.frame())

## S3 method for class 'ggplot'
print(x, newpage = is.null(vp), vp = NULL, ...)

## S3 method for class 'ggplot'
plot(x, newpage = is.null(vp), vp = NULL, ...)
```

Arguments

data	Default dataset to use for plot. If not already a data.frame, will be converted to one by fortify(). If not specified, must be supplied in each layer added to the plot.
mapping	Default list of aesthetic mappings to use for plot. If not specified, must be supplied in each layer added to the plot.
...	other arguments not used by this method
environment	DEPRECATED. Used prior to tidy evaluation.

x	plot to display
newpage	draw new (empty) page first?
vp	viewport to draw plot in

Details

ggplot() is typically used to construct a plot incrementally, using the + operator to add layers to the existing ggplot object. This is advantageous in that the code is explicit about which layers are added and the order in which they are added. For complex graphics with multiple layers, initialization with ggplot is recommended.

There are three common ways to invoke ggplot:

- ggplot(df, aes(x, y, <other aesthetics>))
- ggplot(df)
- ggplot()

The first method is recommended if all layers use the same data and the same set of aesthetics, although this method can also be used to add a layer using data from another data frame. See the first example below. The second method specifies the default data frame to use for the plot, but no aesthetics are defined up front. This is useful when one data frame is used predominantly as layers are added, but the aesthetics may vary from one layer to another. The third method initializes a skeleton ggplot object which is fleshed out as layers are added. This method is useful when multiple data frames are used to produce different layers, as is often the case in complex graphics.

Value

Invisibly returns the result of ggplot_build, which is a list with components that contain the plot itself, the data, information about the scales, panels etc.

Author(s)

Nicholas Hamilton

---

ggsave *Save a ggplot (or other grid object) with sensible defaults (ggtern version)*

Description

ggsave() is a convenient function for saving a plot. It defaults to saving the last plot that you displayed, using the size of the current graphics device. It also guesses the type of graphics device from the extension.

Usage

```
ggsave(filename, plot = last_plot(), device = NULL, path = NULL,
  scale = 1, width = NA, height = NA, units = c("in", "cm", "mm"),
  dpi = 300, limitsize = TRUE, ...)
```

Arguments

filename	File name to create on disk.
plot	Plot to save, defaults to last plot displayed.
device	Device to use (function or any of the recognized extensions, e.g. "pdf"). By default, extracted from filename extension. ggsave currently recognises eps/ps, tex (pictex), pdf, jpeg, tiff, png, bmp, svg and wmf (windows only).
path	Path to save plot to (combined with filename).
scale	Multiplicative scaling factor.
width, height	Plot dimensions, defaults to size of current graphics device.
units	Units for width and height when specified explicitly (in, cm, or mm)
dpi	Resolution used for raster outputs.
limitsize	When TRUE (the default), ggsave will not save images larger than 50x50 inches, to prevent the common error of specifying dimensions in pixels.
...	Other arguments passed on to graphics device

Author(s)

Nicholas Hamilton

Examples

```
## Not run:
data(Feldspar)
base = ggtern(Feldspar,aes(Ab,An,Or)) + geom_point()
ggsave("./output.pdf",base,width=10,height=10)

## End(Not run)
```

---

ggtern *ggtern Constructor*

Description

Plots in ggtern are instigated via the default constructor: ggtern(...), which is essentially a convenience wrapper for the following: ggplot{...} + coord_tern(), indeed, if one wishes to use ggplot{...} + coord_tern() then this is quite satisfactory.

Usage

```
ggtern(data = NULL, mapping = aes(), ..., environment = parent.frame())
```

Arguments

data	Default dataset to use for plot. If not already a data.frame, will be converted to one by fortify(). If not specified, must be supplied in each layer added to the plot.
mapping	Default list of aesthetic mappings to use for plot. If not specified, must be supplied in each layer added to the plot.
...	additional arguments passed through to ggplot
environment	DEPRECATED. Used prior to tidy evaluation.

Value

ggtern(...) returns an object of class ggplot.

Author(s)

Nicholas Hamilton

See Also

For an introduction to the ggtern package, (including many examples), click HERE.

Examples

```
ggtern(data=data.frame(x=1,y=1,z=1),aes(x,y,z)) + geom_point()
```

---

ggtern_labels *Change Axis labels and legend titles*

Description

New label modification functions, equivalent to the original functions in ggplot2 (xlab and ylab) however for the new axes used in the ggtern package

Tlab modifies the label of the TOP apex species

Llab modifies the label of the LHS apex species

Rlab modifies the label of the RHS apex species

Wlab modifies the label of the arrow suffix

Usage

```
Tlab(label, labelarrow = label)

Llab(label, labelarrow = label)

Rlab(label, labelarrow = label)
```

```
Wlab(label)

zlab(label)

Tarrowlab(label)

Larrowlab(label)

Rarrowlab(label)
```

Arguments

label	the desired label
labelarrow	the desired label, if different to label, for the markers along the procession arrows

Details

Tlab and xlab are equivalent (when T='x' in the coord_tern definition), as is Llab and ylab (when L='y') , and Rlab and zlab (when R='z'), for other assignments when coord_tern is defined, the equivalence is not the case, however, if T='XXX', then Tlab will be the same as XXXlab (where XXX can be substituted for 'x', 'y' or 'z', and likewise for Llab and Rlab).

zlab is new to ggtern, but is intended to be an analogous to xlab and ylab as per the definitions in ggplot2.

Arrow Label

Tarrowlab, Larrowlab and Rarrowlab permits setting a different label to the apex labels.

Arrow Label Suffix

Wlab changes the ternary arrow suffix (ie atomic percent, weight percent etc) when the ternary arrows are enabled (see theme_showarrows and weight_percent)

Precedence

AAAlab takes precedence over BBBlab (where AAA represents T, L or R and BBB represents x, y or z)

Use of Expressions

Expressions can be used in the labels, in the event that the user wishes to render formula, subscripts or superscripts, see the last example below.

Creation of Aliasses

Aliasses exist for Tlab, Llab, Rlab and Wlab, which are tlab, llab, rlab and wlab. These aliasses produce an identical result, and are there for convenience (as opposed to having an error thrown) in the event that the user forgets to use an upper-case letter.

Arguments for these functions can be provided as a character or expression, although other values can be inputed (such as, for example, scalar numeric or logical). ggtern also imports the latex2exp package, and these formats can be parsed too.

Author(s)

Nicholas Hamilton

See Also

ggplot2 labs

Examples

```
data(Feldspar)
plot <- ggtern(data=Feldspar,aes(Ab,An,Or)) +  geom_point() +
        xlab("ABC") + ylab("DEF") + zlab("GHI")

#Alternatives, and Arrow Label
plot + Tlab("TOP") + Llab("LHS") + Rlab("RHS") +
  Tarrowlab("Top Arrow Label") + Larrowlab("Left Arrow Label") + Rarrowlab("Right Arrow Label") +
   theme_showarrows() + Wlab("WEIGHT")

#Demonstrate the use of the latex2exp integration, and seperate arrow labels.
ggtern(data=Feldspar,aes(x=Ab,y=An,z=Or)) +
labs( x       = "NaAlSi_3O_8",
      xarrow  = "Albite, NaAlSi_3O_8",
      y       = "(Na,K)AlSi_3O_8",
      yarrow  = "Anorthite (Na,K)AlSi_3O_8",
      z       = "KAlSi_3O_8",
      zarrow  = "Orthoclase KAlSi_3O_8") +
theme_latex(TRUE) +
geom_point() +
theme_showarrows() +
theme_clockwise() +
weight_percent()
```

---

ggtern_labels_arrow_suffix

Atomic, Weight or Custom Percentage Suffix

Description

By default there are no suffixes behind the arrow label marker (the arrow up next to the ternary axes), and these functions appends to the set of arrow labels, a value to indicate the nature of the scale.

`percent_weight` adds 'Wt. %' to the arrow marker label as a suffix

`weight_percent` is an alias for `percent_weight()`

`percent_atomic` adds 'At. %' to the arrow marker label as a suffix

`atomic_percent` is an alias for `percent_atomic()`

`percent_custom` adds a custom suffix to the arrow label marker.

`custom_percent` is an alias for `percent_custom()`

Usage

```
percent_weight()

weight_percent()

percent_atomic()

atomic_percent()

percent_custom(x)

custom_percent(x)
```

Arguments

x	the custom suffix

Details

These are convenience wrappers to `labs(W="XYZ")`.

Author(s)

Nicholas Hamilton

See Also

Convenience functions for `T, L, R, W labels`

`ggtern_package` *Ternary Diagrams in R*

Description

Ternary diagrams are used frequently in a number of disciplines to graph compositional features for mixtures of three different elements or compounds. It is possible to represent a coordinate system having three (3) degrees of freedom, in 2D space, since the third dimention is linear and depends only on the other two.

The `ggtern` package is based on (extends) the very popular `ggplot2` package, which is an implementation of Wilkinsons "The Grammar of Graphics", and, makes provision for a highly methodical construction process for the development of meaningful (graphical) data representations. Of course,

the above book by Wilkinson outlines the *theory*, whilst Hadley Wickhams ggplot2 implementation is where much of the magic happens, and, an ideal base-platform for the ggtern package.

In this document, some of the main features are highlighted, however, current examples (and corresponding outputs) can be viewed at http://ggtern.com

ggtern Constructor

Plots in ggtern are instigated via the default constructor: ggtern(...), for additional information, click HERE:

ggtern Ternary Coordinate System

The foundation of this package, is the ternary coordinate system, which can be produced with the coord_tern(...) command and added to an existing ggplot object. The ggtern(...) constructor adds the coord_tern(...) coordinate system by default. For further information on the coord_tern(...) coordinate system, click HERE.

ggtern Valid Geometries

ggplot2, using the grid and proto architectures, makes provision for a many number of geometries to be added progressively in *'layers'* to a given base plot. Due to the nature of the ternary coordinate system, some of the geometries which are available in ggplot2, are **not relevant** (or won't function) with ternary plots and as such, a limited number of 'approved' geometries can be used. Click HERE for the full list of approved geometries.

Notably, ggtern includes novel geometries not available to ggplot2 which include:

1. Confidence Intervals via the Mahalnobis Distance
2. Ternary Errorbars
3. Ternary Constant-Lines

ggtern Handling Non-Approved Geometries

If a geometric layer is added that is **NOT** contained in the approved list, **IT WILL BE STRIPPED / IGNORED** from the ternary diagram when rendering takes place (notifying the user to such effect). The reason for this is that subtle 'patches' have been applied, which are mainly to do with the transformation procedures when incorporating a 'third' dimention. **NB:** In the future, others may be made available once patched.

ggtern New Theme Elements and Heirarchies

ggtern implements many new theme elements and heirarchies which can be tailored on a case-by-case basis. The full list of new elements can is provided HERE.

ggtern Theme Element Convenience Functions

ggtern has made available a number of convenience functions, for rapid tweaking of common theme elements, for a comprehensive list, see HERE.

ggtern Modification to Required Aesthetics

Each geometry has a pre-determined set of **required** aesthetics. These have been modifid such that where x and y were previously required, now an additional z aesthetic is required (geom_segment now requires z and zend). This is made possible without affecting the standard ggplot2 behaviour because ggtern distinuishes between ggplot2 and ggtern objects, distinguished by the presence of the coord_tern(...) coordinate system.

ggtern Provided Datasets

ggtern ships with a number of datasets, including:

1. Elkin and Groves Feldspar Data
2. USDA Textural Classification Data
3. Grantham and Valbel Rock Fragment Data

Author(s)

Nicholas Hamilton

Examples

```
##-----------------------------------------------
## Basic Usage
##-----------------------------------------------
df = data.frame(x = runif(50),
                y = runif(50),
                z = runif(50),
                Value = runif(50,1,10),
                Group = as.factor(round(runif(50,1,2))))
ggtern(data=df,aes(x,y,z,color=Group)) +
  theme_rgbw() +
  geom_point() + geom_path() +
  labs(x="X",y="Y",z="Z",title="Title")
```

---

ggtern_themes *ggtern themes*

Description

Themes set the general aspect of the plot such as the colour of the background, gridlines, the size and colour of fonts.

Usage

```
theme_ggtern(base_size = 11, base_family = "")

theme_gray(base_size = 11, base_family = "")

theme_bw(base_size = 12, base_family = "")

theme_linedraw(base_size = 12, base_family = "")

theme_light(base_size = 12, base_family = "")

theme_minimal(base_size = 12, base_family = "")

theme_classic(base_size = 12, base_family = "")

theme_dark(base_size = 12, base_family = "")

theme_void(base_size = 12, base_family = "")

theme_darker(base_size = 12, base_family = "")

theme_custom(base_size = 12, base_family = "",
  tern.plot.background = NULL, tern.panel.background = NULL,
  col.T = "black", col.L = "black", col.R = "black",
  col.grid.minor = "white")

theme_rgbw(base_size = 12, base_family = "")

theme_rgbg(base_size = 12, base_family = "")

theme_matrix(base_size = 12, base_family = "")

theme_tropical(base_size = 12, base_family = "")

theme_bluedark(base_size = 12, base_family = "")

theme_bluelight(base_size = 12, base_family = "")

theme_bvbw(base_size = 12, base_family = "")

theme_bvbg(base_size = 12, base_family = "")
```

Arguments

base_size	base font size
base_family	base font family
tern.plot.background	colour of background colour to plot area

`tern.panel.background` colour of panel background of plot area

`col.T` colour of top axis, ticks labels and major gridlines

`col.L` colour of left axis, ticks, labels and major gridlines

`col.R` colour of right axis, ticks, labels and major gridlines

`col.grid.minor` the colour of the minor grid `theme_custom` is a convenience function to allow the user to control the basic theme colours very easily.

Details

`theme_gray` The signature ggplot2 theme with a grey background and white gridlines, designed to put the data forward yet make comparisons easy.

`theme_bw` The classic dark-on-light ggplot2 theme. May work better for presentations displayed with a projector.

`theme_linedraw` A theme with only black lines of various widths on white backgrounds, reminiscent of a line drawings. Serves a purpose similar to `theme_bw`. Note that this theme has some very thin lines (« 1 pt) which some journals may refuse.

`theme_light` A theme similar to `theme_linedraw` but with light grey lines and axes, to direct more attention towards the data.

`theme_dark` The dark cousin of `theme_light`, with similar line sizes but a dark background. Useful to make thin coloured lines pop out.

`theme_darker` A darker cousing to `theme_dark`, with a dark panel background.

`theme_minimal` A minimalistic theme with no background annotations.

`theme_classic` A classic-looking theme, with x and y axis lines and no gridlines.

`theme_rgbw` A theme with white background, red, green and blue axes and gridlines

`theme_rgbg` A theme with grey background, red, green and blue axes and gridlines

`theme_void` A completely empty theme.

`theme_custom` Theme with custom basic colours

`theme_matrix` Theme with very dark background and bright green features

`theme_tropical` Theme with tropical colours

`theme_bluelight` A blue theme with light background and dark features

`theme_bluedark` A blue theme with dark background and light features

`theme_bvbw` A black/vermillion/blue theme with white background, for colorblind sensitive readers, see references.

`theme_bvbg` A black/vermillion/blue theme with grey background, for colorblind sensitive readers, see references.

Author(s)

Nicholas Hamilton

References

Okabe, Masataka, and Kei Ito. "How to make figures and presentations that are friendly to color blind people." University of Tokyo (2002). http://jfly.iam.u-tokyo.ac.jp/color/

Examples

```
#Create a list of the theme suffixes
themesOrg = c('gray','bw','linedraw','light',
              'dark','minimal','classic','void')
themesNew = c('custom','darker','rgbw','rgbg','tropical',
              'matrix','bluelight','bluedark','bvbw','bvbg')

#Iterate over all the suffixes, creating a list of plots
plotThemes = function(themes){
   grobs = lapply(themes,function(x){
     thmName = sprintf("theme_%s",x)
     thm = do.call(thmName,args=list(base_size=9))
     df  = data.frame(label=thmName)
     ggtern(df) + facet_wrap(~label) + thm
   })
   grobs
}

#Arrange the Original Themes
grid.arrange(grobs=plotThemes(themesOrg),top = "Collection of Themes (Original)")

#Arrange the New Themes
grid.arrange(grobs=plotThemes(themesNew),top = "Collection of Themes (New Themes)")
```

`labels_tern` *Generate Axis Labels*

Description

Calculates the Labels for Major or Minor Gridlines based on the input limits.

Usage

```
labels_tern(limits = c(0, 1), breaks = breaks_tern(limits),
  format = "%g", factor = 100)
```

Arguments

`limits`	the scale limits
`breaks`	numeric denoting the breaks to produce corresponding labels
`format`	the formatting string to be passed through to the `sprintf` function
`factor`	the multiplicative factor

Author(s)

Nicholas Hamilton

Examples

```
labels_tern()
labels_tern(limits = c(0,.5))
```

---

label_formatter *label_formatter is a function that formats / parses labels for use in the grid.*

Description

label_formatter is a function that formats / parses labels for use in the grid.

Usage

```
label_formatter(label, ...)
```

Arguments

label	character label
...	additional arguments

---

mahalanobis_distance *Mahalanobis Distance*

Description

Modified version of the code provided in the drawMahal package

Usage

```
mahalanobis_distance(x, x.mean, x.cov, whichlines = c(0.975, 0.9, 0.75),
  m = 360)
```

Arguments

x	data
x.mean	mean value
x.cov	coveriance value
whichlines	the confidence values
m	the number of values to return for each line

Value

list containing mdX and mdY values.

Author(s)

Nicholas Hamilton

`position_jitter_tern` *Jitter Ternary Points*

Description

Jitter ternary points to avoid overplotting.

Usage

```
position_jitter_tern(x = NULL, y = NULL, z = NULL)
```

Arguments

`x, y, z`	amount of positional jitter

Author(s)

Nicholas Hamilton

See Also

Other position adjustments: `position_nudge_tern`

`position_nudge_tern` *Nudge Ternary Points.*

Description

This is useful if you want to nudge labels a little ways from their points, input data will normalised to sum to unity before applying the particular nudge, so the nudge variables should be as a fraction ie (0,1)

Usage

```
position_nudge_tern(x = 0, y = 0, z = 0)
```

Arguments

`x, y, z`	Amount of compositions to nudge

Author(s)

Nicholas Hamilton

See Also

Other position adjustments: position_jitter_tern

---

predictdf2d *Prediction data frame*

Description

Get predictions with standard errors into data frame

Usage

```
predictdf2d(model, xseq, yseq)
```

Arguments

model	the model to predict
xseq, yseq	the x and y values

---

scale_X_continuous *Ternary Position Scales*

Description

Define the ternary continuous position scales (T, L & R).

Usage

```
scale_T_continuous(name = waiver(), limits = NULL, breaks = waiver(),
  minor_breaks = waiver(), labels = waiver(), ...)

scale_L_continuous(name = waiver(), limits = NULL, breaks = waiver(),
  minor_breaks = waiver(), labels = waiver(), ...)

scale_R_continuous(name = waiver(), limits = NULL, breaks = waiver(),
  minor_breaks = waiver(), labels = waiver(), ...)
```

Arguments

name	The name of the scale. Used as 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.
limits	A numeric vector of length two providing limits of the scale. Use NA to refer to the existing minimum or maximum.
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
minor_breaks	One of: • NULL for no minor breaks • waiver() for the default breaks (one minor break between each major break) • A numeric vector of positions • A function that given the limits returns a vector of minor breaks.
labels	One of: • 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) • A function that takes the breaks as input and returns labels as output
...	not used

Author(s)

Nicholas Hamilton

---

strip_unapproved *Strip Unapproved Layers*

Description

strip_unapproved is an internal function which essentially 'deletes' layers from the current ternary plot in the event that such layers are not one of the approved layers. For a layer to be approved, it must use an approved geometry, and also an approved stat. Refer to approved_layers for the current list of approved geometries and stats

Usage

```
strip_unapproved(layers)
```

Arguments

layers	list of the layers to strip unnaproved layers from.

Value

strip_unapproved returns a list of approved layers (may be empty if none are approved).

---

ternary_transformation

Ternary / Cartesian Transformation

Description

Functions to transform data from the ternary to cartesian spaces and vice-versa.

Usage

```
tlr2xy(data, coord, ..., inverse = FALSE, scale = TRUE, drop = FALSE)

xy2tlr(data, coord, ..., inverse = FALSE, scale = TRUE)
```

Arguments

data	data.frame containing columns as required by the coordinate system. Data will be scaled so that the rows sum to unity, in the event that the user has provided data that does not.
coord	Coordinate system object, inheriting the CoordTern class, error will be thrown if a different coordinate system is sent to this method
...	not used
inverse	logical if we are doing a forward (FALSE) or reverse (TRUE) transformation
scale	logical as to whether the transformed coordinates are scaled (or reverse scaled in the case of inverse transformation) according to the training routine defined in the coordinate system.
drop	drop all non columns which are not involved in the transformation

Details

tlr2xy transforms from the ternary to cartesian spaces, an inverse transformation transforms between cartesian to ternary spaces

xy2tlr transforms from the cartesian to ternary spaces, an inverse transformation transforms between ternary to cartesian spaces, it is the reciprocal to tlr2xy, therefore an inverse transformation in xy2tlr function is the same as the forward transformation in tlr2xy

Author(s)

Nicholas Hamilton

Examples

```
data(Feldspar)
dfm = plyr::rename(Feldspar,c("Ab"="x","An"="y","Or"="z"))
crd = coord_tern()
fwd = tlr2xy(dfm,crd)
rev = tlr2xy(fwd,crd,inverse = TRUE)
```

---

tern_limits *Restrict Ternary Limits*

Description

`tern_limits` (or its aliasses) appends new `T`, `L` and `R` ternary continuous scales, where the maximum scale value is specified, and, where the minimums for each are solved.

Usage

```
tern_limit(T = 1, L = 1, R = 1, ...)

limit_tern(...)
```

Arguments

`T, L, R`	numeric value (scalar) of the maximum `T,L,R` species limit for each scale respectively
`...`	other arguments to pass to ALL of `scale_X_continuous` (`X = T, L, R`)

Details

The contra value (ie minimum value) for the `T`, `L` and `R` species is solved using linear equations, therefore, if the solution is degenerate, or, the solution results in a zero range in either of the proposed scales, then a warning message will be reported and an empty list returned. Note that `limits_tern(...)`, `limit_tern(...)` and `tern_limit(...)` are all aliasses for the main function, `tern_limits(...)` and can be used interchangeably.

Value

Either an empty list (when no solution can be found), or a list containing one of each of `scale_X_continuous` (`X = T, L, R`)

Author(s)

Nicholas Hamilton

See Also

`scale_T_continuous`, `scale_L_continuous` and `scale_R_continuous`

Examples

```
#Display a non-zoomed and zoomed plot side by side
data(Feldspar)
df.lims = data.frame(Ab = c(1,.25,.25),
                     An = c(0,.75,.00),
                     Or = c(0,.00,.75))
#Build the non-zoomed plot
A = ggtern(Feldspar,aes(Ab,An,Or)) +
 stat_density_tern(geom='polygon',aes(fill=..level..,alpha=..level..)) +
 geom_point() +
 geom_mask() +
 geom_polygon(data=df.lims,color='red',alpha=0,size=0.5) +
 guides(color='none',fill='none',alpha='none') +
 labs(title = "Non-Zoomed")

#Build the zoomed plot
B = A +
  tern_limits(T=max(df.lims$An), L=max(df.lims$Ab), R=max(df.lims$Or)) +
  labs(title = "Zoomed")

#Arrange the above plots side by side for illustration
grid.arrange(A,B,ncol=2,top="Demonstration of Limiting Region")
```

---

theme *Modify components of a theme (ggtern version)*

Description

Use ‘theme()‘ to modify individual components of a theme, allowing you to control the appearance of all non-data components of the plot. ‘theme()‘ only affects a single plot: see [theme_update()] if you want modify the active theme, to affect all subsequent plots.

Usage

```
theme(line, rect, text, title, aspect.ratio, axis.title, axis.title.x,
  axis.title.x.top, axis.title.y, axis.title.y.right, axis.text, axis.text.x,
  axis.text.x.top, axis.text.y, axis.text.y.right, axis.ticks, axis.ticks.x,
  axis.ticks.y, axis.ticks.length, axis.line, axis.line.x, axis.line.y,
  legend.background, legend.margin, legend.spacing, legend.spacing.x,
  legend.spacing.y, legend.key, legend.key.size, legend.key.height,
  legend.key.width, legend.text, legend.text.align, legend.title,
  legend.title.align, legend.position, legend.direction, legend.justification,
  legend.box, legend.box.just, legend.box.margin, legend.box.background,
  legend.box.spacing, panel.background, panel.border, panel.spacing,
  panel.spacing.x, panel.spacing.y, panel.grid, panel.grid.major,
  panel.grid.minor, panel.grid.major.x, panel.grid.major.y, panel.grid.minor.x,
  panel.grid.minor.y, panel.ontop, plot.background, plot.title, plot.subtitle,
  plot.caption, plot.margin, strip.background, strip.placement, strip.text,
```

```
strip.text.x, strip.text.y, strip.switch.pad.grid, strip.switch.pad.wrap,
tern.axis.arrow, tern.axis.arrow.T, tern.axis.arrow.L, tern.axis.arrow.R,
tern.axis.arrow.text, tern.axis.arrow.text.T, tern.axis.arrow.text.L,
tern.axis.arrow.text.R, tern.axis.arrow.start, tern.axis.arrow.finish,
tern.axis.arrow.sep, tern.axis.arrow.show, tern.axis.clockwise,
tern.axis.vshift, tern.axis.hshift, tern.axis.line.ontop, tern.axis.line,
tern.axis.line.T, tern.axis.line.L, tern.axis.line.R, tern.axis.text,
tern.axis.text.T, tern.axis.text.L, tern.axis.text.R, tern.axis.text.show,
tern.axis.ticks, tern.axis.ticks.length.major, tern.axis.ticks.length.minor,
tern.axis.ticks.major, tern.axis.ticks.major.T, tern.axis.ticks.major.L,
tern.axis.ticks.major.R, tern.axis.ticks.minor, tern.axis.ticks.minor.T,
tern.axis.ticks.minor.L, tern.axis.ticks.minor.R, tern.axis.ticks.outside,
tern.axis.ticks.primary.show, tern.axis.ticks.secondary.show, tern.axis.title,
tern.axis.title.T, tern.axis.title.L, tern.axis.title.R, tern.axis.title.show,
tern.panel.background, tern.panel.expand, tern.panel.grid.major,
tern.panel.grid.major.T, tern.panel.grid.major.L, tern.panel.grid.major.R,
tern.panel.grid.major.show, tern.panel.grid.minor, tern.panel.grid.minor.T,
tern.panel.grid.minor.L, tern.panel.grid.minor.R, tern.panel.grid.minor.show,
tern.panel.grid.ontop, tern.panel.mask.show, tern.panel.rotate,
tern.plot.background, tern.plot.latex, ..., complete = FALSE,
validate = TRUE)
```

Arguments

line	all line elements (element_line)
rect	all rectangular elements (element_rect)
text	all text elements (element_text)
title	all title elements: plot, axes, legends (element_text; inherits from text)
aspect.ratio	aspect ratio of the panel
axis.title	label of axes (element_text; inherits from text)
axis.title.x	x axis label (element_text; inherits from axis.title)
axis.title.x.top	x axis label on top axis (element_text; inherits from axis.title.x)
axis.title.y	y axis label (element_text; inherits from axis.title)
axis.title.y.right	y axis label on right axis (element_text; inherits from axis.title.y)
axis.text	tick labels along axes (element_text; inherits from text)
axis.text.x	x axis tick labels (element_text; inherits from axis.text)
axis.text.x.top	x axis tick labels on top axis (element_text; inherits from axis.text.x)
axis.text.y	y axis tick labels (element_text; inherits from axis.text)
axis.text.y.right	y axis tick labels on right axis (element_text; inherits from axis.text.y)
axis.ticks	tick marks along axes (element_line; inherits from line)

`axis.ticks.x` x axis tick marks (`element_line`; inherits from `axis.ticks`)

`axis.ticks.y` y axis tick marks (`element_line`; inherits from `axis.ticks`)

`axis.ticks.length`
length of tick marks (`unit`)

`axis.line` lines along axes (`element_line`; inherits from `line`)

`axis.line.x` line along x axis (`element_line`; inherits from `axis.line`)

`axis.line.y` line along y axis (`element_line`; inherits from `axis.line`)

`legend.background`
background of legend (`element_rect`; inherits from `rect`)

`legend.margin` the margin around each legend (`margin`)

`legend.spacing` the spacing between legends (`unit`)

`legend.spacing.x`
the horizontal spacing between legends (`unit`); inherits from `legend.spacing`

`legend.spacing.y`
the horizontal spacing between legends (`unit`); inherits from `legend.spacing`

`legend.key` background underneath legend keys (`element_rect`; inherits from `rect`)

`legend.key.size`
size of legend keys (`unit`)

`legend.key.height`
key background height (`unit`; inherits from `legend.key.size`)

`legend.key.width`
key background width (`unit`; inherits from `legend.key.size`)

`legend.text` legend item labels (`element_text`; inherits from `text`)

`legend.text.align`
alignment of legend labels (number from 0 (left) to 1 (right))

`legend.title` title of legend (`element_text`; inherits from `title`)

`legend.title.align`
alignment of legend title (number from 0 (left) to 1 (right))

`legend.position`
the position of legends ("none", "left", "right", "bottom", "top", or two-element numeric vector)

`legend.direction`
layout of items in legends ("horizontal" or "vertical")

`legend.justification`
anchor point for positioning legend inside plot ("center" or two-element numeric vector) or the justification according to the plot area when positioned outside the plot

`legend.box` arrangement of multiple legends ("horizontal" or "vertical")

`legend.box.just`
justification of each legend within the overall bounding box, when there are multiple legends ("top", "bottom", "left", or "right")

`legend.box.margin`
margins around the full legend area, as specified using `margin()`

`legend.box.background`
: background of legend area (`element_rect`; inherits from `rect`)

`legend.box.spacing`
: The spacing between the plotting area and the legend box (`unit`)

`panel.background`
: background of plotting area, drawn underneath plot (`element_rect`; inherits from `rect`)

`panel.border`
: border around plotting area, drawn on top of plot so that it covers tick marks and grid lines. This should be used with `fill=NA` (`element_rect`; inherits from `rect`)

`panel.spacing`
: spacing between facet panels (`unit`)

`panel.spacing.x`
: horizontal spacing between facet panels (`unit`; inherits from `panel.spacing`)

`panel.spacing.y`
: vertical spacing between facet panels (`unit`; inherits from `panel.spacing`)

`panel.grid`
: grid lines (`element_line`; inherits from `line`)

`panel.grid.major`
: major grid lines (`element_line`; inherits from `panel.grid`)

`panel.grid.minor`
: minor grid lines (`element_line`; inherits from `panel.grid`)

`panel.grid.major.x`
: vertical major grid lines (`element_line`; inherits from `panel.grid.major`)

`panel.grid.major.y`
: horizontal major grid lines (`element_line`; inherits from `panel.grid.major`)

`panel.grid.minor.x`
: vertical minor grid lines (`element_line`; inherits from `panel.grid.minor`)

`panel.grid.minor.y`
: horizontal minor grid lines (`element_line`; inherits from `panel.grid.minor`)

`panel.ontop`
: option to place the panel (background, gridlines) over the data layers. Usually used with a transparent or blank `panel.background`. (`logical`)

`plot.background`
: background of the entire plot (`element_rect`; inherits from `rect`)

`plot.title`
: plot title (text appearance) (`element_text`; inherits from `title`) left-aligned by default

`plot.subtitle`
: plot subtitle (text appearance) (`element_text`; inherits from `title`) left-aligned by default

`plot.caption`
: caption below the plot (text appearance) (`element_text`; inherits from `title`) right-aligned by default

`plot.margin`
: margin around entire plot (`unit` with the sizes of the top, right, bottom, and left margins)

`strip.background`
: background of facet labels (`element_rect`; inherits from `rect`)

`strip.placement`
: placement of strip with respect to axes, either "inside" or "outside". Only important when axes and strips are on the same side of the plot.

`strip.text` facet labels (`element_text`; inherits from `text`)

`strip.text.x` facet labels along horizontal direction (`element_text`; inherits from `strip.text`)

`strip.text.y` facet labels along vertical direction (`element_text`; inherits from `strip.text`)

`strip.switch.pad.grid`
space between strips and axes when strips are switched (`unit`)

`strip.switch.pad.wrap`
space between strips and axes when strips are switched (`unit`)

`tern.axis.arrow`
Base Arrow Line (‘element_line‘; inherits from ‘axis.line‘)

`tern.axis.arrow.T`
Arrow Line for TOP Axis (‘element_line‘; inherits from ‘tern.axis.arrow‘)

`tern.axis.arrow.L`
Arrow Line for LHS Axis (‘element_line‘; inherits from ‘tern.axis.arrow‘)

`tern.axis.arrow.R`
Arrow Line for RHS Axis (‘element_line‘; inherits from ‘tern.axis.arrow‘)

`tern.axis.arrow.text`
Base Arrow Label (‘element_text‘; inherits from ‘tern.axis.text‘)

`tern.axis.arrow.text.T`
Arrow Label on TOP Axis (‘element_text‘; inherits from ‘tern.axis.arrow.text‘)

`tern.axis.arrow.text.L`
Arrow Label on LHS Axis (‘element_text‘; inherits from ‘tern.axis.arrow.text‘)

`tern.axis.arrow.text.R`
Arrow Label on RHS Axis (‘element_text‘; inherits from ‘tern.axis.arrow.text‘)

`tern.axis.arrow.start`
Proportion of Axis when Arrow Starts (‘numeric‘)

`tern.axis.arrow.finish`
Proportion of Axis when Arrow Finishes (‘numeric‘)

`tern.axis.arrow.sep`
Arrows Seperation from Axis (‘numeric‘)

`tern.axis.arrow.show`
Arrows Show or Hide (‘logical‘)

`tern.axis.clockwise`
Clockwise or Anticlockwise Precession (‘logical‘)

`tern.axis.vshift`
Amount to nudge the plot vertically (‘numeric‘)

`tern.axis.hshift`
Amount to nudge the plot horizontally (‘numeric‘)

`tern.axis.line.ontop`
Bring Axis Borders on Top of Everything (Depreciated) (‘logical‘)

`tern.axis.line` Base Line (‘element_line‘; inherits from ‘axis.line‘)

`tern.axis.line.T`
Line for TOP Axis (‘element_line‘; inherits from ‘tern.axis.line‘)

`tern.axis.line.L`
Line for LHS Axis (‘element_line‘; inherits from ‘tern.axis.line‘)

`tern.axis.line.R`
: Line for RHS Axis (‘element_line‘; inherits from ‘tern.axis.line‘)

`tern.axis.text` Base Text (‘element_text‘; inherits from ‘axis.text‘)

`tern.axis.text.T`
: Text for TOP Axis (‘element_text‘; inherits from ‘tern.axis.text‘)

`tern.axis.text.L`
: Text for LHS Axis (‘element_text‘; inherits from ‘tern.axis.text‘)

`tern.axis.text.R`
: Text for RHS Axis (‘element_text‘; inherits from ‘tern.axis.text‘)

`tern.axis.text.show`
: Axis Labels Show or Hide (‘logical‘)

`tern.axis.ticks`
: Base Ticks (‘element_line‘; inherits from ‘axis.ticks‘)

`tern.axis.ticks.length.major`
: Ticks Major Ticklength (‘unit‘)

`tern.axis.ticks.length.minor`
: Ticks Minor Ticklength (‘unit‘)

`tern.axis.ticks.major`
: Base Major Ticks (‘element_line‘; inherits from ‘tern.axis.ticks‘)

`tern.axis.ticks.major.T`
: Base Major Ticks for TOP Axis (‘element_line‘; inherits from ‘tern.axis.ticks.major‘)

`tern.axis.ticks.major.L`
: Base Major Ticks for LHS Axis (‘element_line‘; inherits from ‘tern.axis.ticks.major‘)

`tern.axis.ticks.major.R`
: Base Major Ticks for RHS Axis (‘element_line‘; inherits from ‘tern.axis.ticks.major‘)

`tern.axis.ticks.minor`
: Base Minor Ticks (‘element_line‘; inherits from ‘tern.axis.ticks‘)

`tern.axis.ticks.minor.T`
: Base Minor Ticks for TOP Axis (‘element_line‘; inherits from ‘tern.axis.ticks.minor‘)

`tern.axis.ticks.minor.L`
: Base Minor Ticks for LHS Axis (‘element_line‘; inherits from ‘tern.axis.ticks.minor‘)

`tern.axis.ticks.minor.R`
: Base Minor Ticks for RHS Axis (‘element_line‘; inherits from ‘tern.axis.ticks.minor‘)

`tern.axis.ticks.outside`
: Ticks Outside or Inside (‘logical‘)

`tern.axis.ticks.primary.show`
: Ticks Show Primary (‘logical‘)

`tern.axis.ticks.secondary.show`
: Ticks Show Secondary (‘logical‘)

`tern.axis.title`
: Base Apex Title (‘element_text‘; inherits from ‘axis.title‘)

`tern.axis.title.T`
: Apex Title for TOP Axis (‘element_text‘; inherits from ‘tern.axis.title‘)

`tern.axis.title.L`
: Apex Title for LHS Axis (‘element_text‘; inherits from ‘tern.axis.title‘)

tern.axis.title.R
: Apex Title for RHS Axis ('element_text'; inherits from 'tern.axis.title')

tern.axis.title.show
: Apex Titles Show or Hide ('logical')

tern.panel.background
: Background of Ternary Plot Area** ('element_rect'; inherits from 'panel.background')

tern.panel.expand
: The amount to expand the ternary plotting panel, in ratio to npc units ('numeric')

tern.panel.grid.major
: Base Major Gridline ('element_line'; inherits from 'panel.grid.major')

tern.panel.grid.major.T
: Major Gridline for TOP Axis ('element_line'; inherits from 'tern.panel.grid.major')

tern.panel.grid.major.L
: Major Gridline for LHS Axis ('element_line'; inherits from 'tern.panel.grid.major')

tern.panel.grid.major.R
: Major Gridline for RHS Axis ('element_line'; inherits from 'tern.panel.grid.major')

tern.panel.grid.major.show
: Show or Hide Major Gridline ('logical')

tern.panel.grid.minor
: Base Minor Gridline ('element_line'; inherits from 'panel.grid.minor')

tern.panel.grid.minor.T
: Minor Gridline for TOP Axis ('element_line'; inherits from 'tern.panel.grid.minor')

tern.panel.grid.minor.L
: Minor Gridline for LHS Axis ('element_line'; inherits from 'tern.panel.grid.minor')

tern.panel.grid.minor.R
: Minor Gridline for RHS Axis ('element_line'; inherits from 'tern.panel.grid.minor')

tern.panel.grid.minor.show
: Show or Hide Minor Gridline ('logical')

tern.panel.grid.ontop
: Bring grids, axis and axis labels on top of everything else ('logical')

tern.panel.mask.show
: Show or Hide the Clipping Mask ('logical')

tern.panel.rotate
: The amount to rotate the ternary diagram in degrees ('numeric')

tern.plot.background
: Background of Ternary Clipping Area** ('element_rect'; inherits from 'plot.background')

tern.plot.latex
: Whether to parse characters as latex commands ('logical')

... : additional element specifications not part of base ggplot2. If supplied `validate` needs to be set to `FALSE`.

complete : set this to TRUE if this is a complete theme, such as the one returned by `theme_grey()`. Complete themes behave differently when added to a ggplot object. Also, when setting `complete = TRUE` all elements will be set to inherit from blank elements.

validate : `TRUE` to run validate_element, `FALSE` to bypass checks.

Theme inheritance

Theme elements inherit properties from other theme elements. For example, ‘axis.title.x‘ inherits from ‘axis.title‘, which in turn inherits from ‘text‘. All text elements inherit directly or indirectly from ‘text‘; all lines inherit from ‘line‘, and all rectangular objects inherit from ‘rect‘. This means that you can modify the appearance of multiple elements by setting a single high-level component.

Author(s)

Nicholas Hamilton

---

theme_arrowlength *Change the Length of the Ternary Arrows*

Description

A set of convenience functions to rapidly change the length of the ternary arrows, the convenience functions include presets (short, normal, long), or makes provision for the user to specify custom fractional starting and ending values relative to the size of the ternary axis. In the event that the user elects to specify the values via the `theme_arrowcustomlength` (or its aliasses), then the user can specify a single scalar value which apply to all three (3) arrows, or, alternatively, can provide a numeric vector of length three (3), one for each arrow respectively.

Usage

```
theme_arrowcustomlength(start = getOption("tern.arrow.start"),
  finish = getOption("tern.arrow.finish"))

theme_arrowlength(start = getOption("tern.arrow.start"),
  finish = getOption("tern.arrow.finish"))

theme_arrowsmall()

theme_arrowshort()

theme_arrownormal()

theme_arrowdefault()

theme_arrowlarge()

theme_arrowlong()
```

Arguments

`start`	a numeric scalar, or numeric vector of length three (3), representing the fractional [0,1] position along the axis where the arrow/s should START.
`finish`	a numeric scalar, or numeric vector of length three (3), representing the fractional [0,1] position along the axis where the arrow/s should FINISH.

Details

If the ternary arrows are switched OFF (via the theme_hidearrows command, or the theme(tern.axis.arrow.show=FALSE theme element), then under such circumstance, these convenience functions will turn ON the ternary arrows, essentially running theme_showarrows or theme(tern.axis.arrow.show=TRUE)

If for some reason, the start and finish arguments are identical, then the ternary arrows will be switched OFF, tantamount to running the theme_hidearrows convenience function.

Custom Length

theme_arrowcustomlength or theme_arrowlength (alias) sets the ternary arrow lengths to values as specified by the user, occupying a length between the values as specified by the start and finish arguments (fractions) relative to the length of the ternary axis.

Short Arrow Length

theme_arrowsmall or theme_arrowshort(alias) reduces the ternary arrows to short arrows, occupying a length between **0.4** and **0.6** of the length of the ternary axis

Normal/Default Arrow Length

theme_arrownormal or theme_arrowdefault(alias) reduces the ternary arrows to normally sized arrows, occupying a length between getOption("tern.arrow.start") and getOption("tern.arrow.finish") global option values, whatever they may be.

Long Arrow Length

theme_arrowlarge or theme_arrowlong(alias) increases the ternary arrows to long arrows occupying a length between **0.2** and **0.8** of the length of the ternary axis

Author(s)

Nicholas Hamilton

See Also

theme_arrowbaseline and theme(tern.axis.arrow.sep=X) for methods to adjust the separation distance of the ternary arrows from the ternary axes.

Examples

```
#Create base plot
plot <- ggtern(data=data.frame(x=1,y=1,z=1),aes(x,y,z)) + geom_point()

#Pre-Specified Values
plot + theme_arrowsmall()

## Alternatives, Uncomment lines below
plot + theme_arrownormal()
plot + theme_arrowlarge()
plot + theme_arrowcustomlength(.1,.8)
```

```
plot + theme_arrowlength(start=c(.1,.25,.4),finish=c(.9,.75,.6))
```

---

theme_bordersontop *Render Borders on Top*

Description

Convenience functions to render the axis border lines on top (or bottom) of the other layers. By default the borders are rendered in the background (bottom)

Usage

```
theme_bordersontop()

theme_bordersonbottom()
```

Author(s)

Nicholas Hamilton

---

theme_clockwise *Direction of Ternary Rotation*

Description

`theme_clockwise`, `theme_anticlockwise` (or their aliasses) are function that instructs the axes precession to be clockwise or anticlockwise respectively.

Usage

```
theme_clockwise()

theme_anticlockwise()

theme_counterclockwise()
```

Details

If the `tern.axis.arrow.show` value is `FALSE`, these functions will set it to `TRUE`.

Author(s)

Nicholas Hamilton

theme_complete *List of Available Themes*

Description

ggtern ships with a number of complete themes, summarized as follows. These themes combine the base themes available to ggplot2 and a number of NEW themes, which are unique to ggtern.

- Black and White Theme: theme_bw(...)
- Minimal Theme: theme_minimal(...)
- Classic Theme: theme_classic(...)
- Gray and White Theme: theme_gray(...)
- Red, Green, Blue and White Theme: theme_rgbw(...)
- Red, Green, Blue and Gray Theme: theme_rgbg(...)
- Dark Theme: theme_dark(...)
- Darker Theme: theme_darker(...)
- Light Theme: theme_light(...)
- Theme with Only Black Lines: theme_linedraw(...)
- Matrix Theme: theme_matrix(...)
- Tropical Theme: theme_tropical(...)
- BlueLight Theme: theme_bluelight(...)
- BlueDark Theme: theme_bluedark(...)
- Black Vermillion Blue Theme (White Background): theme_bvbw(...)
- Black Vermillion Blue Theme (Grey Background): theme_bvbg(...)

Author(s)

Nicholas Hamilton

See Also

ggtern_themes

`theme_convenience_functions` *Theme Convenience Functions*

Description

ggtern has made available a number of convenience functions for rapid tweaking of the various theme elements, for a full list of the available theme elements which can be manually modified, see HERE.

Convenience Functions

Some of the Convenience functions that ship with ggtern, to assist in the rapid modification of key theme elements:

- Show/Hide Axis Titles
- Show/Hide Arrows
- Show/Hide Grids
- Show/Hide Axis Ticklabels
- Show/Hide Primary/Secondary Ticks
- Ticks Inside or Outside of the Main Plot Area
- Set Length of arrows
- Clockwise/Anticlockwise Axis Precession
- Rotate the plot by X degrees or radians
- Create a mesh of 'n' Major/Minor gridlines
- Enable/Disable parsing of labels according to latex markup
- Turn off the clipping mask
- Atomic or Weight Percent Arrow Label Suffix.

Manual Modification

For manual modification on a per-element basis:

- Ternary Theme Elements

Default Themes

Default (complete) themes which ship with ggtern:

- Complete Themes

Examples

```
#Load data and create the base plot.
plot <- ggtern() + theme_bw() +
 theme(tern.axis.ticks.length.major=unit(3.0,'mm'),
       tern.axis.ticks.length.minor=unit(1.5,'mm'))
plot

#Show Arrows
last_plot() + theme_showarrows()

#Major/Minor Grids?
last_plot() + theme_nogrid_minor()
last_plot() + theme_nogrid_major()
last_plot() + theme_showgrid()

#Clockwise/Anticlockwise Precession
last_plot() + theme_clockwise()

#Ticks Inside or Outside
last_plot() + theme_ticksinside()

#Show/Hide BOTH Primary and Secondary Ticks
last_plot() + theme_showticks()
last_plot() + theme_hideticks()

#Show/Hide EITHER Primary OR Secondary Ticks.
last_plot() + theme_showprimary() + theme_hidesecondary()
last_plot() + theme_hideprimary() + theme_showsecondary()

#Atomic / Weight Percent
last_plot() + theme_showarrows() + atomic_percent() #+weight_percent()
last_plot() + theme_showarrows() + custom_percent("Atomic Percent")

#Rotation
last_plot() + theme_rotate(60)
```

---

theme_elements *New Theme Elements*

Description

ggtern creates many new theme elements and inheritances, the following is an outline:

Details

Theme elements can inherit properties from other theme elements. For example, axis.title.x inherits from axis.title, which in turn inherits from text. All text elements inherit directly or indirectly from text; all lines inherit from line, and all rectangular objects inherit from rect.

Modifying the newly created items requires the same procedures as introduced in the ggplot2 theme documentation. Some convenience functions have been also newly created, proceed to theme_convenience_functions for additional information.

New/Additional Inheritance Structures

Based on the ggplot2 existing structure (theme), the **NEW** individual theme elements for the ternary plot are as follows:

NAME	OBJECT/(INHERITS)	DESCRIPTION
tern.panel.background	element_rect/(panel.background)	Background of Ternary Plot Area**
tern.plot.background	element_rect/(plot.background)	Background of Ternary Clipping Area**
tern.plot.latex	logical	Whether to parse characters as latex comma
tern.axis.hshift	numeric	Amount to nudge the plot horizontally
tern.axis.vshift	numeric	Amount to nudge the plot vertically
tern.axis.clockwise	logical	Clockwise or Anticlockwise Precession
tern.axis.line	element_line/(axis.line)	Base Line
tern.axis.line.T	element_line/(tern.axis.line)	Line for TOP Axis
tern.axis.line.L	element_line/(tern.axis.line)	Line for LHS Axis
tern.axis.line.R	element_line/(tern.axis.line)	Line for RHS Axis
tern.axis.line.ontop	logical	Bring Axis Borders on Top of Everything (D
tern.axis.text	element_text/(axis.text)	Base Text
tern.axis.text.T	element_text/(tern.axis.text)	Text for TOP Axis
tern.axis.text.L	element_text/(tern.axis.text)	Text for LHS Axis
tern.axis.text.R	element_text/(tern.axis.text)	Text for RHS Axis
tern.axis.text.show	logical	Axis Labels Show or Hide
tern.axis.title	element_text/(axis.title)	Base Apex Title
tern.axis.title.T	element_text/(tern.axis.title)	Apex Title for TOP Axis
tern.axis.title.L	element_text/(tern.axis.title)	Apex Title for LHS Axis
tern.axis.title.R	element_text/(tern.axis.title)	Apex Title for RHS Axis
tern.axis.title.show	logical	Apex Titles Show or Hide
tern.axis.arrow	element_line/(axis.line)	Base Arrow Line
tern.axis.arrow.T	element_line/(tern.axis.arrow)	Arrow Line for TOP Axis
tern.axis.arrow.L	element_line/(tern.axis.arrow)	Arrow Line for LHS Axis
tern.axis.arrow.R	element_line/(tern.axis.arrow)	Arrow Line for RHS Axis
tern.axis.arrow.text	element_text/(tern.axis.text)	Base Arrow Label
tern.axis.arrow.text.T	element_text/(tern.axis.arrow.text)	Arrow Label on TOP Axis
tern.axis.arrow.text.L	element_text/(tern.axis.arrow.text)	Arrow Label on LHS Axis
tern.axis.arrow.text.R	element_text/(tern.axis.arrow.text)	Arrow Label on RHS Axis
tern.axis.arrow.show	logical	Arrows Show or Hide
tern.axis.arrow.sep	numeric	Arrows Seperation from Axis
tern.axis.arrow.start	numeric	Proportion of Axis when Arrow Starts
tern.axis.arrow.finish	numeric	Proportion of Axis when Arrow Finishes
tern.axis.ticks	element_line/(axis.ticks)	Base Ticks
tern.axis.ticks.major	element_line/(tern.axis.ticks)	Base Major Ticks
tern.axis.ticks.major.T	element_line/(tern.axis.ticks.major)	Base Major Ticks for TOP Axis
tern.axis.ticks.major.L	element_line/(tern.axis.ticks.major)	Base Major Ticks for LHS Axis
tern.axis.ticks.major.R	element_line/(tern.axis.ticks.major)	Base Major Ticks for RHS Axis
tern.axis.ticks.length.major	unit	Ticks Major Ticklength

tern.axis.ticks.length.minor	unit	Ticks Minor Ticklength
tern.axis.ticks.outside	logical	Ticks Outside or Inside
tern.axis.ticks.primary.show	logical	Ticks Show Primary
tern.axis.ticks.secondary.show	logical	Ticks Show Secondary
tern.axis.ticks.minor	element_line/(tern.axis.ticks)	Base Minor Ticks
tern.axis.ticks.minor.T	element_line/(tern.axis.ticks.minor)	Base Minor Ticks for TOP Axis
tern.axis.ticks.minor.L	element_line/(tern.axis.ticks.minor)	Base Minor Ticks for LHS Axis
tern.axis.ticks.minor.R	element_line/(tern.axis.ticks.minor)	Base Minor Ticks for RHS Axis
tern.panel.grid.major	element_line/(panel.grid.major)	Base Major Gridline
tern.panel.grid.major.T	element_line/(tern.panel.grid.major)	Major Gridline for TOP Axis
tern.panel.grid.major.L	element_line/(tern.panel.grid.major)	Major Gridline for LHS Axis
tern.panel.grid.major.R	element_line/(tern.panel.grid.major)	Major Gridline for RHS Axis
tern.panel.grid.major.show	logical	Show or Hide Major Gridline
tern.panel.grid.minor	element_line/(panel.grid.minor)	Base Minor Gridline
tern.panel.grid.minor.T	element_line/(tern.panel.grid.minor)	Minor Gridline for TOP Axis
tern.panel.grid.minor.L	element_line/(tern.panel.grid.minor)	Minor Gridline for LHS Axis
tern.panel.grid.minor.R	element_line/(tern.panel.grid.minor)	Minor Gridline for RHS Axis
tern.panel.grid.minor.show	logical	Show or Hide Minor Gridline
tern.panel.grid.ontop	logical	Bring grids, axis and axis labels on top of ev
tern.panel.mask.show	logical	Show or Hide the Clipping Mask
tern.panel.expand	numeric	The amount to expand the ternary plotting p
tern.panel.rotate	numeric	The amount to rotate the ternary diagram in

** **NB:** tern.panel.background, whilst the ternary area is 'triangular' per-se, element_rect has been used, as it actually holds NO information regarding the geometry (width, height), only fill, color, size and linetype border (ie the style of how it will be rendered).

Author(s)

Nicholas Hamilton

---

theme_gridsontop *Render Grids on Top*

Description

Convenience function to render the major and minor grids on top (or bottom) of the other layers. By default the grids are rendered in the background (bottom)

Usage

```
theme_gridsontop()

theme_gridsonbottom()
```

Author(s)

Nicholas Hamilton

theme_latex *Parse Labels w Latex Markup*

Description

A series of convenience functions that either enable or disable the use of the latex2exp package for parsing the various text elements using the TeX method. In many cases, by turning the latex parsing on, this prevents confusing use of expressions to obtain greeks, superscripts, subscripts etc... Note that when latex parsing is enabled, this can override specific formatting directives from the element tree, see the third and fourth example below.

Usage

```
theme_latex(value = TRUE)

theme_showlatex()

theme_nolatex()

theme_hidelatex()
```

Arguments

value	logical as to whether to enable latex parsing or not

Author(s)

Nicholas Hamilton

See Also

TeX

Examples

```
#Demonstrate  without latex parsing
ggtern() +
 theme_latex(FALSE) +
 labs(title = '\\textit{Plot Title}')

#Same as before, but turn on the latex parsing
last_plot() +
 theme_latex(TRUE)

#Demonstrate latex overriding the bold face
ggtern() +
 labs(title = '\\textit{Plot Title}') +
 theme_latex(TRUE) +
```

```
 theme('plot.title' = element_text(face='bold'))

#Turn off latex parsing, bold title revealed
last_plot() +
 theme_latex(FALSE)
```

`theme_legend_position` *Position Legend in Convenient Locations*

Description

A convenience function to position the legend at various internal positions

Usage

```
theme_legend_position(x = "topleft")
```

Arguments

x	the position, valid values are topleft, middleleft, bottomleft, topright, middleright and bottomright, or the shortened versions respecitvely, tl, ml, bl, tr, mr, br

Author(s)

Nicholas Hamilton

`theme_mesh` *Create Grid Mesh*

Description

Convenience function for creation of a grid mesh of an ideal number of 'n' major breaks. Note that the value of 'n' is the target number of breaks, and due to the use of the `pretty` function within `breaks_tern` convenience function, may not be strictly adhered or reflected.

Usage

```
theme_mesh(n = 5, ...)
```

Arguments

n	the 'target' number of major breaks
...	additional arguments to be passed through to `tern_limits`

Author(s)

Nicholas Hamilton

Examples

```
#Default example of a target n=10 mesh
ggtern() +
 theme_mesh(10)

#Default example, of a target n=5 mesh, with limiting region
ggtern() +
 theme_mesh(5,T=.5,L=.5,R=.5)
```

---

theme_noarrows *Show or Hide the Ternary Arrows*

Description

`theme_noarrows` is a function that appends to the current theme a flag to switch OFF the ternary arrows

`theme_hidearrows` is an alias for `theme_noarrows`

`theme_showarrows` is a function that appends to the current theme a flag to switch ON the ternary arrows

Usage

```
theme_noarrows()

theme_hidearrows()

theme_showarrows()
```

Author(s)

Nicholas Hamilton

theme_nomask *Show or Hide the Clipping Mask*

Description

Convenience Function to Show or Hide the Clipping Mask, `theme_showmask` is a function that appends to the current theme a flag to switch ON the clipping mask, whilst, `theme_nomask` (or `theme_hidemask`) is a function that appends to the current theme a flag to switch OFF the clipping mask

Usage

```
theme_nomask()

theme_hidemask()

theme_showmask()
```

Author(s)

Nicholas Hamilton

theme_novar_tern *Blank one variable's annotations in ternary plot*

Description

This function blanks the grid and axis elements for one variable in a ternary plot.

Usage

```
theme_novar_tern(species, ...)
```

Arguments

`species`	A character giving the species. Choices are "T", "L" and "R", but is not case sensitive
`...`	Further arguments, including additional selections otherwise used in species

Details

This function takes a user-specified character corresponding to one of the three ternary variables, and constructs a `theme` function which adds blank elements for that variable's grid elements and axis elements chosen from the **ggtern** package. This new function is then executed which "adds" this theme to the open ternary plot.

The logic of the species selection is pretty transparent so it may be possible to customize this function to add further affected elements as desired. However the computing on the language which drives this function has not been thoroughly tested. Neither has this function been tested with non-ternary plots available in the **ggplot2** framework.

Value

This function is called for the side effect of adding a theme which actually blanks the grid and axis elements for the chosen ternary species.

Author(s)

Nicholas Hamilton, John Szumiloski

Examples

```
base = ggtern() + theme_rgbg()
base + theme_novar_tern("L")
base + theme_novar_tern(c("T","L"))
base + theme_novar_tern('L',R)
```

`theme_rotate` *Rotate Ternary Diagram*

Description

Convenience function to rotate the diagram by an angle in degrees or radians.

Usage

```
theme_rotate(degrees = 60, radians = degrees * pi/180)
```

Arguments

`degrees, radians`
: specify the angle to rotate the plot by in either degrees or radians. If both `degrees` and `radians` are specified, then precedence is given to the `radians` argument. If no value is specified, the plot will rotate by 60 degrees

Author(s)

Nicholas Hamilton

Examples

```
x = ggtern(data.frame(x=1,y=1,z=1),aes(x,y,z))
for(a in seq(0,60,by=15))
print(x + theme_rotate(a))
```

`theme_showgrid` *Show or Hide Grid*

Description

A set of convenience functions to enable or disable the use of major or minor (or both) gridlines.

Usage

```
theme_showgrid()

theme_hidegrid()

theme_nogrid()

theme_tern_nogrid()

theme_showgrid_major()

theme_hidegrid_major()

theme_nogrid_major()

theme_tern_nogrid_major()

theme_showgrid_minor()

theme_hidegrid_minor()
```

Details

These flags operate at the 'rendering' level, and, supercede the presence of theme elements, therefore,

`theme_hidegrid(...)` or its aliases will PREVENT rendering of grid elements, irrespective of whether those grid elements are valid (renderable). From the counter perspective,

`theme_showgrid(...)` or its aliases will ALLOW rendering of grid elements, subject to those grid elements being valid (renderable, ie say `element_line` as opposed to `element_blank`).

`theme_hidegrid` or `theme_nogrid` (alias) is a function which **disables** both MAJOR and MINOR gridlines.

`theme_showgrid_major` is a function which **enables** MAJOR gridlines.

`theme_hidegrid_major` or `theme_nogrid_major` (alias) is a function which **disables** MAJOR gridlines.

`theme_showgrid_major` is a function which **enables** MINOR gridlines.

`theme_hidegrid_minor` or `theme_nogrid_minor` (alias) is a function which **disables** MINOR gridlines.

`theme_showgrid` is a function which **enables** both MAJOR and MINOR gridlines.

Author(s)

Nicholas Hamilton

Examples

```
#Load data
data(Feldspar)
plot <- ggtern(data=Feldspar,aes(Ab,An,Or)) +
        geom_point()   + #Layer
        theme_bw()       #For clarity
plot
plot = plot + theme_hidegrid(); plot
plot + theme_showgrid()
```

`theme_showlabels` *Show or Hide Axis Ticklabels*

Description

Convenience functions to enable or disable the axis ticklabels

Usage

```
theme_showlabels()

theme_hidelabels()

theme_nolabels()
```

Details

`theme_showlabels` is a function that apends to the current theme a flag to switch ON the axis ticklabels, whilst `theme_hidelabels` or `theme_nolabels` (Alias) are functions that apends to the current theme a flag to switch OFF the axis ticklabels

Author(s)

Nicholas Hamilton

theme_showprimary *Show or Hide the Primary/Secondary Ticks*

Description

Convenience functions to enable or disable the axis primary or secondary ticks.

Usage

```
theme_noprimary()

theme_hideprimary()

theme_showprimary()

theme_nosecondary()

theme_hidesecondary()

theme_showsecondary()

theme_showticks()

theme_hideticks()

theme_noticks()
```

Details

In ggtern, the primary ticks are deemed as being the ticks along the binary axis increasing to the apex species, primary ticks can consist of both major and minor ticks (major ticks have labels, and are generally longer and bolder). Therefore, there are three (3) sets of major primary ticks, and, three (3) sets of minor primary ticks.

These convenience functions introduce the concept of secondary ticks, which, are the same items however on the 'opposing' binary axis.

For example, considering the TOP apex species, in a plot with 'clockwise' axis precession, the primary ticks would run along the LHS, whilst, the secondary ticks, woudl run along the RHS. By default, the primary ticks are switched ON, whilst the secondary ticks are switched OFF and are controlled by the tern.axis.ticks.primary.show and tern.axis.ticks.secondary.show theme elements respectively.

theme_showsecondary is a function that apends to the current theme a flag to switch ON the secondary ticks theme_showticks(), themehideticks(), theme_noticks() are functions that switch ON or OFF BOTH the primary or secondary ticks. theme_nosecondary or theme_hidesecondary (Alias) are functions that apends to the current theme a flag to switch OFF the secondary ticks theme_showprimary is a function that apends to the current theme a flag to switch ON the primary ticks theme_noprimary or theme_hideprimary (Alias) are functions that apends to the current theme a flag to switch OFF the primary ticks

Author(s)

Nicholas Hamilton

Examples

```
data(Feldspar)
plot <- ggtern(data=Feldspar,aes(Ab,An,Or)) + geom_point() +
  theme_showsecondary()
```

---

theme_showtitles *Show or Hide the Axis (Apex) Titles*

Description

Convenience functions to SHOW or HIDE the apex labels.

`theme_showtitles` is a function that apends to the current theme a flag to switch ON the apex titles.

`theme_hidetitles` or `theme_notitles` (alias) is a function that apends to the current theme a flag to switch OFF the apex titles.

Usage

```
theme_showtitles()

theme_hidetitles()

theme_notitles()
```

Author(s)

Nicholas Hamilton

Examples

```
#Load data
data(Feldspar)
ggtern(data=Feldspar,aes(An,Ab,Or)) + geom_point() + theme_bw() + theme_hidetitles()
```

theme_ticklength *Modify the Ticklengths*

Description

Convenience Function for changing the major and/or minor ticklengths.

Usage

```
theme_ticklength(major = NULL, minor = NULL)

theme_ticklength_major(major)

theme_ticklength_minor(minor)
```

Arguments

major, minor	lenth of major and minor ticklengths respectively. Must be a unit object, or will be ignored.

Author(s)

Nicholas Hamilton

Examples

```
ggtern() +
  theme_ticklength(major = unit(5.0,'mm'),
                   minor = unit(2.5,'mm'))
```

theme_ticksoutside *Place Ticks Inside or Outside*

Description

theme_ticksoutside is a function that ensures the ticks are placed OUTSIDE of the plot area, whereas, theme_ticksinside is a function that ensures the ticks are placed INSIDE of the plot area (opposite to theme_ticksoutside)

Usage

```
theme_ticksoutside()

theme_ticksinside()
```

Author(s)

Nicholas Hamilton

theme_zoom_X *Zoom on Plot Region*

Description

A series of convenience functions for the zooming in on the middle or apex regions to various degrees. In these convenience functions, a single value of x is expected, which defines the values of the apex limits other than the point of reference, for example, theme_zoom_T will fix the T limit at 1, and will adjust the balancing limits according to the argument x. Equivalent are also possible for the L and R apexes, via the theme_zoom_L and theme_zoom_R functions respectively. Finally, the theme_zoom_center function will adjust all three apex limits, serving, as the name suggests, to act as a centred zoom. The examples below are fairly self explanatory.

Usage

```
theme_zoom_T(x = 1, ...)

theme_zoom_L(x = 1, ...)

theme_zoom_R(x = 1, ...)

theme_zoom_center(x = 1, ...)
```

Arguments

x	numeric scalar
...	additional arguments to be passed through to limit_tern

Author(s)

Nicholas Hamilton

Examples

```
#Default Plot
data(Feldspar)
base = ggtern(Feldspar,aes(Ab,An,Or)) +
       theme_bw(8) +
       geom_density_tern() +
       geom_point() +
       labs(title="Original")

#Zoom on Left Region
A = base + theme_zoom_L(0.5) + labs(title="theme_zoom_L")

#Zoom on Right Region
B = base + theme_zoom_R(0.5) + labs(title="theme_zoom_R")
```

```
#Zoom on Top Region
C = base + theme_zoom_T(0.5) + labs(title="theme_zoom_T")

#Zoom on Center Region
D = base + theme_zoom_center(0.5) + labs(title="theme_zoom_center")

#Put all together for comparisons sake
grid.arrange(arrangeGrob(base),
             arrangeGrob(A,B,nrow=1),
             arrangeGrob(C,D,nrow=1),
             ncol=1, heights=c(2,1,1),
             top = "Comparison of Zooming Functions")
```

`zzz-depreciated` *Depreciated Functions*

Description

The following is a list of functions which were once used in previous versions of ggtern, however, have now been depreciated

DEPRECIATED: `tern_stop(...)` Internal Function, checks if the most recent coordinate system is ternary, and, if not, stops the current procedure, with a common message format

DEPRECIATED: `clipPolygons(...)` Using the using the PolyClip Package, This clips input polygons for use in the density and contour geometries.

DEPRECIATED: `theme_arrowbaseline(...)` The ternary arrows can have an offset unit value (see `tern.axis.arrow.sep`), however, it is convenient to set this relative to either the axis, ticks or axis ticklabels (since the latter two can be hidden / removed.). This function permits this to be set

DEPRECIATED: `element_ternary(...)` Replaced by individual theme elements:

1. `tern.axis.arrow.show`
2. `tern.axis.padding`
3. `tern.axis.arrow.sep`
4. `tern.axis.arrow.start`
5. `tern.axis.arrow.finish`
6. `tern.axis.vshift`
7. `tern.axis.hshift`
8. `tern.axis.ticks.length.major`
9. `tern.axis.ticks.length.minor`

DEPRECIATED: `ggtern.multi` is a function which permits the arrangement of muliple `ggtern` or `ggplot2` objects, plots can be provided to the elipsis argument, or, as a list and at the simplest case, the number of columns can be specified. For more advanced usage, consider the layout argument.

DEPRECIATED: The `point.in.sequence` function takes numeric input vectors `x` and `y` or a `data.frame` object, and orders the values in such way that they are correctly sequenced by the angle subtended between each point, and, the centroid of the total set. If the data is provided in the format of a `data.frame`, then it must containing columns named `x` and `y`, else an error will be thrown.

Usage

```
tern_stop(src = "target")

clipPolygons(df, coord, plyon = c("level", "piece", "group"),
  op = "intersection")

theme_arrowbaseline(label = "labels")

element_ternary(showarrows, padding, arrowsep, arrowstart, arrowfinish, vshift,
  hshift, ticklength.major, ticklength.minor)

ggtern.multi(..., plotlist = NULL, cols = 1, layout = NULL)

point.in.sequence(x, y, ..., df = data.frame(x = x, y = y), close = FALSE)
```

Arguments

`src`	character name of current procedure
`df`	a data frame
`coord`	a ternary coordinate system
`plyon`	items in the data frame to pass to ddply argument
`op`	operation method to clip, intersection, union, minus or xor
`label`	a character ('axis','ticks' or 'labels') or numeric (rounded to 0, 1 or 2) value to determine the relative location (labels is default) if a character is provided, and it is not one of the above, an error will be thrown.
`showarrows`	logical whether to show the axis directional arrows DEPRECIATED
`padding`	the padding around the plot area to make provision for axis labels, ticks and arrows, relative to the cartesian plane. DEPRECIATED
`arrowsep`	the distance between ternary axis and ternary arrows DEPRECIATED
`arrowstart`	the proportion along the ternary axis to start the directional arrow DEPRECIATED
`arrowfinish`	the proportion along the ternary axis to stop the directional arrow DEPRECIATED
`vshift`	shift the plot area vertically DEPRECIATED
`hshift`	shift the plot area horizontally DEPRECIATED
`ticklength.major`	the length of the major ternary ticks as an euclidean distance relative to the x and y limits of the cartesian plot area. DEPRECIATED

ticklength.minor	the length of the minor ternary ticks as an euclidean distance relative to the x and y limits of the cartesian plot area. DEPRECIATED
...	additional arguments, multiple plot objects
plotlist	alternative to the ... argument, provide a list of ggplot or grob objects, objects which do not inherit the ggplot or grob classes will be stripped.
cols	number of columns if the layout parameter is not provided.
layout	override number of cols, and provide a matrix specifying the layout
x	vector of numeric x values
y	vector of numeric y values
close	logical value (default FALSE), as to whether the set should be closed by adding (duplicating) the first row (after ordering) to the end of the set.

Details

Used to define the layout of some of the ggtern plot features which are unique to the ternary diagrams , and hence, this package.

By default, 1 column is specified, which means that the plots will be stacked on top of each other in a single column, however, if say 4 plots are provided to the ellipsis or plotlist, with cols equal to 2, then this will produce a 2 x 2 arrangement.

In regards to the layout argument (which overrides the cols argument), if it is something like matrix(c(1,2,3,3), nrow=2, byrow=TRUE), then plot number 1 will go in the upper left, 2 will go in the upper right, and 3 will go all the way across the bottom - see the last example below.

The arguments x and y represent cartesian coordinates. This is useful if a path is sought that passes through each point in the ordered set, however, no two lines in the total path cross over each other. Uses the atan2 function to determine the angle (theta) between each point (x,y) and the centroid of the data, it then orders based on increasing values of theta.

Value

data.frame object containing the re-ordered input set.

Author(s)

Nicholas Hamilton

Source

http://www.cookbook-r.com/Graphs/Multiple_graphs_on_one_page_(ggplot2)/

Index