

Package ‘ggtern’

August 22, 2018

Version 3.0.0

Date 2018-8-22

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.

Author Nicholas Hamilton [aut, cre]

Maintainer Nicholas Hamilton <nick@ggtern.com>

Depends 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' 'deprecated.R'
'labels-new.R' 'labels-percent.R' 'legend-draw-tern.R'
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 'stat-mean-ellipse.R' 'geom-interpolate-tern.R'
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 '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

RoxygenNote 6.0.1

Date/Publication 2018-08-22 17:10:07 UTC

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`+.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

<code>e1</code>	first object
<code>e2</code>	second object

Author(s)

Nicholas Hamilton

`aes`*Modified Aesthetic Mappings*

Description

Modified Aesthetic Mappings

Usage

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

Arguments

<code>x</code>	x value
<code>y</code>	y value
<code>z</code>	z value
<code>...</code>	other arguments as per aes

Details

An extension to the base `aes` function 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 <code>color = "red"</code> or <code>size = 3</code> . 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

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

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	<i>Ternary Coordinate System</i>
------------	----------------------------------

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

Feldspar - One (1) row per Feldspar composition, FeldsparRaster - 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 watershed. 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

1 row 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 = Na20 + K20",
      Larrow = "F = Fe20_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	<i>Aichisons White Cells</i>
-----------------	------------------------------

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	<i>Key drawing functions</i>
---------------	------------------------------

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 Mahalanobis 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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame</code> , and will be used as the layer data.
stat	Use to override the default connection between <code>geom_smooth</code> and <code>stat_smooth</code> .
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired <code>geom/stat</code> .
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 <code>FALSE</code> , the default, missing values are removed with a warning. If <code>TRUE</code> , missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? <code>NA</code> , the default, includes if any aesthetics are mapped. <code>FALSE</code> never includes, and <code>TRUE</code> always includes. It can also be a named logical vector to finely select the aesthetics to display.
inherit.aes	If <code>FALSE</code> , 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. <code>borders()</code> .
geom	Use to override the default connection between <code>geom_smooth</code> and <code>stat_smooth</code> .
contour	If <code>TRUE</code> , contour the results of the 2d density estimation
n	number of grid points in each direction
h	Bandwidth (vector of length two). If <code>NULL</code> , estimated using <code>bandwidth.nrd</code> .
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 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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame</code> , 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 <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired <code>geom/stat</code> .
arrow	specification for arrow heads, as created by <code>arrow()</code> .
lineend	Line end style (round, butt, square).
na.rm	If <code>FALSE</code> , the default, missing values are removed with a warning. If <code>TRUE</code> , missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? <code>NA</code> , the default, includes if any aesthetics are mapped. <code>FALSE</code> never includes, and <code>TRUE</code> always includes. It can also be a named logical vector to finely select the aesthetics to display.
inherit.aes	If <code>FALSE</code> , 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. <code>borders()</code> .

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 estimation 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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame</code> , 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 <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . 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. <code>borders()</code> .
geom	Use to override the default connection between <code>geom_density_2d</code> and <code>stat_density_2d</code> .
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 <code>bandwidth.nrd</code> .
bd1	the threshold for detection limit. This is applied against the output of <code>acomp</code> function, so it is expected as a fraction in the range [0,1]
bd1.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 bd1 will be replaced and therefore included in the final density estimate.
weight	weighting for weighted kde2d estimate, 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 <code>bandwidth.nrd</code> .

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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame</code> , 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 <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired geom/stat.
arrow	specification for arrow heads, as created by <code>arrow()</code> .
lineend	Line end style (round, butt, square).
na.rm	If <code>FALSE</code> , the default, missing values are removed with a warning. If <code>TRUE</code> , missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? <code>NA</code> , the default, includes if any aesthetics are mapped. <code>FALSE</code> never includes, and <code>TRUE</code> always includes. It can also be a named logical vector to finely select the aesthetics to display.
inherit.aes	If <code>FALSE</code> , 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. <code>borders()</code> .

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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame.</code> , 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 <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired geom/stat.
<code>fun</code>	the scalar function to use for the statistic
<code>na.rm</code>	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
<code>show.legend</code>	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.
<code>inherit.aes</code>	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. <code>borders()</code> .
<code>geom, stat</code>	Override the default connection between 'geom_hex_tern' and 'stat_hex_tern'
<code>bins</code>	numeric vector giving number of bins in both vertical and horizontal directions. Set to 30 by default.
<code>binwidth</code>	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`
- `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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame</code> , and will be used as the layer data.
stat	Use to override the default connection between <code>geom_smooth</code> and <code>stat_smooth</code> .
position	Position adjustment, either as a string, or the result of a call to a position adjustment function.
...	Other arguments passed on to <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired <code>geom/stat</code> .
method	Smoothing method (function) to use, eg. <code>lm</code> , <code>glm</code> , <code>gam</code> , <code>loess</code> , <code>MASS::rlm</code> . For <code>method = "auto"</code> the smoothing method is chosen based on the size of the largest group (across all panels). <code>loess()</code> is used for less than 1,000 observations; otherwise <code>mgcv::gam()</code> is used with <code>formula = y ~ s(x, bs = "cs")</code> . Somewhat anecdotally, <code>loess</code> 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 <code>gam</code> model that <code>method = "auto"</code> would use then set <code>method = "gam"</code> , <code>formula = y ~ s(x, bs = "cs")</code> .
formula	Formula to use in smoothing function, eg. <code>y ~ x</code> , <code>y ~ poly(x, 2)</code> , <code>y ~ log(x)</code>
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 <code>FALSE</code> , the default, missing values are removed with a warning. If <code>TRUE</code> , missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? <code>NA</code> , the default, includes if any aesthetics are mapped. <code>FALSE</code> never includes, and <code>TRUE</code> always includes. It can also be a named logical vector to finely select the aesthetics to display.
inherit.aes	If <code>FALSE</code> , 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. <code>borders()</code> .
geom	Use to override the default connection between <code>geom_smooth</code> and <code>stat_smooth</code> .
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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame</code> , 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 <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired geom/stat.
hjust	horizontal justification
vjust	vertical justification
parse	If <code>TRUE</code> , the labels will be parsed into expressions and displayed as described in <code>?plotmath</code>
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 <code>FALSE</code> , the default, missing values are removed with a warning. If <code>TRUE</code> , missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? <code>NA</code> , the default, includes if any aesthetics are mapped. <code>FALSE</code> never includes, and <code>TRUE</code> always includes. It can also be a named logical vector to finely select the aesthetics to display.
inherit.aes	If <code>FALSE</code> , 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. <code>borders()</code> .

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 foreground 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 <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , 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.

<code>stat</code>	Use to override the default connection between <code>geom_smooth</code> and <code>stat_smooth</code> .
<code>position</code>	Position adjustment, either as a string, or the result of a call to a position adjustment function.
<code>...</code>	Other arguments passed on to <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired geom/stat.
<code>lineend</code>	Line end style (round, butt, square).
<code>linejoin</code>	Line join style (round, mitre, bevel).
<code>linemitre</code>	Line mitre limit (number greater than 1).
<code>na.rm</code>	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
<code>show.legend</code>	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.
<code>inherit.aes</code>	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. <code>borders()</code> .
<code>geom</code>	Use to override the default connection between <code>geom_smooth</code> and <code>stat_smooth</code> .
<code>steps</code>	the number of discretisation points to draw the ellipses
<code>r</code>	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	<i>Points (Colour and Fill Swapped), as for a scatterplot</i>
-----------------	---

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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame</code> , 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 <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired <code>geom/stat</code> .

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. <code>borders()</code> .

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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>ggplot()</code> .

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.

<code>stat</code>	The statistical transformation to use on the data for this layer, as a string.
<code>position</code>	Position adjustment, either as a string, or the result of a call to a position adjustment function.
<code>...</code>	Other arguments passed on to <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired geom/stat.
<code>na.rm</code>	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
<code>show.legend</code>	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.
<code>inherit.aes</code>	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. <code>borders()</code> .
<code>closure</code>	one of 'none', 'upper' or 'lower'

Author(s)

Nicholas Hamilton

<code>geom_smooth_tern</code>	<i>Add a Smoothed Conditional Mean.</i>
-------------------------------	---

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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame</code> , 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 <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired geom/stat.
method	Smoothing method (function) to use, eg. <code>lm</code> , <code>glm</code> , <code>gam</code> , <code>loess</code> , <code>MASS::rlm</code> . For <code>method = "auto"</code> the smoothing method is chosen based on the size of the largest group (across all panels). <code>loess()</code> is used for less than 1,000 observations; otherwise <code>mgcv::gam()</code> is used with <code>formula = y ~ s(x, bs = "cs")</code> . Somewhat anecdotally, <code>loess</code> 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 <code>gam</code> model that <code>method = "auto"</code> would use then set <code>method = "gam"</code> , <code>formula = y ~ s(x, bs = "cs")</code> .
formula	Formula to use in smoothing function, eg. <code>y ~ x</code> , <code>y ~ poly(x, 2)</code> , <code>y ~ log(x)</code>
se	Display confidence interval around smooth? (<code>TRUE</code> by default, see <code>level</code> to control.)
na.rm	If <code>FALSE</code> , the default, missing values are removed with a warning. If <code>TRUE</code> , missing values are silently removed.
show.legend	logical. Should this layer be included in the legends? <code>NA</code> , the default, includes if any aesthetics are mapped. <code>FALSE</code> never includes, and <code>TRUE</code> always includes. It can also be a named logical vector to finely select the aesthetics to display.
inherit.aes	If <code>FALSE</code> , 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. <code>borders()</code> .
expand	expand the range of values by this much (vector of length 2) when <code>fullrange</code> is set to <code>TRUE</code>
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 <code>method</code> .

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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame.</code> , 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 <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired geom/stat.
<code>hjust</code>	horizontal justification
<code>vjust</code>	vertical justification
<code>parse</code>	If TRUE, the labels will be parsed into expressions and displayed as described in <code>?plotmath</code>
<code>check_overlap</code>	If TRUE, text that overlaps previous text in the same layer will not be plotted.
<code>na.rm</code>	If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.
<code>show.legend</code>	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.
<code>inherit.aes</code>	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. <code>borders()</code> .

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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> .

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 <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . 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. <code>borders()</code> .
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
- 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 <code>aes()</code> or <code>aes_()</code> . If specified and <code>inherit.aes = TRUE</code> (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 <code>NULL</code> , the default, the data is inherited from the plot data as specified in the call to <code>ggplot()</code> . A <code>data.frame</code> , or other object, will override the plot data. All objects will be fortified to produce a data frame. See <code>fortify()</code> for which variables will be created. A function will be called with a single argument, the plot data. The return value must be a <code>data.frame.</code> , and will be used as the layer data.
...	Other arguments passed on to <code>layer()</code> . These are often aesthetics, used to set an aesthetic to a fixed value, like <code>color = "red"</code> or <code>size = 3</code> . They may also be parameters to the paired <code>geom/stat</code> .

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	<i>Create a new ggplot plot.</i>
--------	----------------------------------

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 <code>fortify()</code> . 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	<i>Save a ggplot (or other grid object) with sensible defaults (ggtern version)</i>
--------	---

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 <code>fortify()</code> . 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 <code>ggplot</code>
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	<i>Change Axis labels and legend titles</i>
---------------	---

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 inputted (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_30_8",
      xarrow = "Albite, NaAlSi_30_8",
      y      = "(Na,K)AlSi_30_8",
      yarrow = "Anorthite (Na,K)AlSi_30_8",
      z      = "KAlSi_30_8",
      zarrow = "Orthoclase KAlSi_30_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 dimension 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 Wilkinson's "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 Mahalanobis 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' dimension. **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 modified 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 distinguishes 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

<code>base_size</code>	base font size
<code>base_family</code>	base font family
<code>tern.plot.background</code>	colour of background colour to plot area

<code>tern.panel.background</code>	colour of panel background of plot area
<code>col.T</code>	colour of top axis, ticks labels and major gridlines
<code>col.L</code>	colour of left axis, ticks, labels and major gridlines
<code>col.R</code>	colour of right axis, ticks, labels and major gridlines
<code>col.grid.minor</code>	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

<code>theme_gray</code>	The signature ggplot2 theme with a grey background and white gridlines, designed to put the data forward yet make comparisons easy.
<code>theme_bw</code>	The classic dark-on-light ggplot2 theme. May work better for presentations displayed with a projector.
<code>theme_linedraw</code>	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 ($\ll 1$ pt) which some journals may refuse.
<code>theme_light</code>	A theme similar to theme_linedraw but with light grey lines and axes, to direct more attention towards the data.
<code>theme_dark</code>	The dark cousin of theme_light, with similar line sizes but a dark background. Useful to make thin coloured lines pop out.
<code>theme_darker</code>	A darker cousin to theme_dark, with a dark panel background.
<code>theme_minimal</code>	A minimalistic theme with no background annotations.
<code>theme_classic</code>	A classic-looking theme, with x and y axis lines and no gridlines.
<code>theme_rgbw</code>	A theme with white background, red, green and blue axes and gridlines
<code>theme_rgbg</code>	A theme with grey background, red, green and blue axes and gridlines
<code>theme_void</code>	A completely empty theme.
<code>theme_custom</code>	Theme with custom basic colours
<code>theme_matrix</code>	Theme with very dark background and bright green features
<code>theme_tropical</code>	Theme with tropical colours
<code>theme_bluelight</code>	A blue theme with light background and dark features
<code>theme_bluedark</code>	A blue theme with dark background and light features
<code>theme_bvbw</code>	A black/vermillion/blue theme with white background, for colorblind sensitive readers, see references.
<code>theme_bvbg</code>	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 <code>sprintf</code> 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	<i>Mahalanobis Distance</i>
----------------------	-----------------------------

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	<i>Prediction data frame</i>
-------------	------------------------------

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	<i>Ternary Position Scales</i>
--------------------	--------------------------------

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 <code>waiver()</code> , the default, the name of the scale is taken from the first mapping used for that aesthetic. If <code>NULL</code> , the legend title will be omitted.
limits	A numeric vector of length two providing limits of the scale. Use <code>NA</code> to refer to the existing minimum or maximum.
breaks	One of: <ul style="list-style-type: none"> • <code>NULL</code> for no breaks • <code>waiver()</code> 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: <ul style="list-style-type: none"> • <code>NULL</code> for no minor breaks • <code>waiver()</code> 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: <ul style="list-style-type: none"> • <code>NULL</code> for no labels • <code>waiver()</code> 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 unapproved 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 aliases) 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 aliases 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

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

<code>axis.ticks.x</code>	x axis tick marks (<code>element_line</code> ; inherits from <code>axis.ticks</code>)
<code>axis.ticks.y</code>	y axis tick marks (<code>element_line</code> ; inherits from <code>axis.ticks</code>)
<code>axis.ticks.length</code>	length of tick marks (unit)
<code>axis.line</code>	lines along axes (<code>element_line</code> ; inherits from <code>line</code>)
<code>axis.line.x</code>	line along x axis (<code>element_line</code> ; inherits from <code>axis.line</code>)
<code>axis.line.y</code>	line along y axis (<code>element_line</code> ; inherits from <code>axis.line</code>)
<code>legend.background</code>	background of legend (<code>element_rect</code> ; inherits from <code>rect</code>)
<code>legend.margin</code>	the margin around each legend (margin)
<code>legend.spacing</code>	the spacing between legends (unit)
<code>legend.spacing.x</code>	the horizontal spacing between legends (unit); inherits from <code>legend.spacing</code>
<code>legend.spacing.y</code>	the horizontal spacing between legends (unit); inherits from <code>legend.spacing</code>
<code>legend.key</code>	background underneath legend keys (<code>element_rect</code> ; inherits from <code>rect</code>)
<code>legend.key.size</code>	size of legend keys (unit)
<code>legend.key.height</code>	key background height (unit; inherits from <code>legend.key.size</code>)
<code>legend.key.width</code>	key background width (unit; inherits from <code>legend.key.size</code>)
<code>legend.text</code>	legend item labels (<code>element_text</code> ; inherits from <code>text</code>)
<code>legend.text.align</code>	alignment of legend labels (number from 0 (left) to 1 (right))
<code>legend.title</code>	title of legend (<code>element_text</code> ; inherits from <code>title</code>)
<code>legend.title.align</code>	alignment of legend title (number from 0 (left) to 1 (right))
<code>legend.position</code>	the position of legends ("none", "left", "right", "bottom", "top", or two-element numeric vector)
<code>legend.direction</code>	layout of items in legends ("horizontal" or "vertical")
<code>legend.justification</code>	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
<code>legend.box</code>	arrangement of multiple legends ("horizontal" or "vertical")
<code>legend.box.just</code>	justification of each legend within the overall bounding box, when there are multiple legends ("top", "bottom", "left", or "right")
<code>legend.box.margin</code>	margins around the full legend area, as specified using <code>margin()</code>

<code>legend.box.background</code>	background of legend area (<code>element_rect</code> ; inherits from <code>rect</code>)
<code>legend.box.spacing</code>	The spacing between the plotting area and the legend box (<code>unit</code>)
<code>panel.background</code>	background of plotting area, drawn underneath plot (<code>element_rect</code> ; inherits from <code>rect</code>)
<code>panel.border</code>	border around plotting area, drawn on top of plot so that it covers tick marks and grid lines. This should be used with <code>fill=NA</code> (<code>element_rect</code> ; inherits from <code>rect</code>)
<code>panel.spacing</code>	spacing between facet panels (<code>unit</code>)
<code>panel.spacing.x</code>	horizontal spacing between facet panels (<code>unit</code> ; inherits from <code>panel.spacing</code>)
<code>panel.spacing.y</code>	vertical spacing between facet panels (<code>unit</code> ; inherits from <code>panel.spacing</code>)
<code>panel.grid</code>	grid lines (<code>element_line</code> ; inherits from <code>line</code>)
<code>panel.grid.major</code>	major grid lines (<code>element_line</code> ; inherits from <code>panel.grid</code>)
<code>panel.grid.minor</code>	minor grid lines (<code>element_line</code> ; inherits from <code>panel.grid</code>)
<code>panel.grid.major.x</code>	vertical major grid lines (<code>element_line</code> ; inherits from <code>panel.grid.major</code>)
<code>panel.grid.major.y</code>	horizontal major grid lines (<code>element_line</code> ; inherits from <code>panel.grid.major</code>)
<code>panel.grid.minor.x</code>	vertical minor grid lines (<code>element_line</code> ; inherits from <code>panel.grid.minor</code>)
<code>panel.grid.minor.y</code>	horizontal minor grid lines (<code>element_line</code> ; inherits from <code>panel.grid.minor</code>)
<code>panel.ontop</code>	option to place the panel (background, gridlines) over the data layers. Usually used with a transparent or blank <code>panel.background</code> . (logical)
<code>plot.background</code>	background of the entire plot (<code>element_rect</code> ; inherits from <code>rect</code>)
<code>plot.title</code>	plot title (text appearance) (<code>element_text</code> ; inherits from <code>title</code>) left-aligned by default
<code>plot.subtitle</code>	plot subtitle (text appearance) (<code>element_text</code> ; inherits from <code>title</code>) left-aligned by default
<code>plot.caption</code>	caption below the plot (text appearance) (<code>element_text</code> ; inherits from <code>title</code>) right-aligned by default
<code>plot.margin</code>	margin around entire plot (<code>unit</code> with the sizes of the top, right, bottom, and left margins)
<code>strip.background</code>	background of facet labels (<code>element_rect</code> ; inherits from <code>rect</code>)
<code>strip.placement</code>	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.

<code>strip.text</code>	facet labels (element_text; inherits from text)
<code>strip.text.x</code>	facet labels along horizontal direction (element_text; inherits from strip.text)
<code>strip.text.y</code>	facet labels along vertical direction (element_text; inherits from strip.text)
<code>strip.switch.pad.grid</code>	space between strips and axes when strips are switched (unit)
<code>strip.switch.pad.wrap</code>	space between strips and axes when strips are switched (unit)
<code>tern.axis.arrow</code>	Base Arrow Line ('element_line'; inherits from 'axis.line')
<code>tern.axis.arrow.T</code>	Arrow Line for TOP Axis ('element_line'; inherits from 'tern.axis.arrow')
<code>tern.axis.arrow.L</code>	Arrow Line for LHS Axis ('element_line'; inherits from 'tern.axis.arrow')
<code>tern.axis.arrow.R</code>	Arrow Line for RHS Axis ('element_line'; inherits from 'tern.axis.arrow')
<code>tern.axis.arrow.text</code>	Base Arrow Label ('element_text'; inherits from 'tern.axis.text')
<code>tern.axis.arrow.text.T</code>	Arrow Label on TOP Axis ('element_text'; inherits from 'tern.axis.arrow.text')
<code>tern.axis.arrow.text.L</code>	Arrow Label on LHS Axis ('element_text'; inherits from 'tern.axis.arrow.text')
<code>tern.axis.arrow.text.R</code>	Arrow Label on RHS Axis ('element_text'; inherits from 'tern.axis.arrow.text')
<code>tern.axis.arrow.start</code>	Proportion of Axis when Arrow Starts ('numeric')
<code>tern.axis.arrow.finish</code>	Proportion of Axis when Arrow Finishes ('numeric')
<code>tern.axis.arrow.sep</code>	Arrows Separation from Axis ('numeric')
<code>tern.axis.arrow.show</code>	Arrows Show or Hide ('logical')
<code>tern.axis.clockwise</code>	Clockwise or Anticlockwise Precession ('logical')
<code>tern.axis.vshift</code>	Amount to nudge the plot vertically ('numeric')
<code>tern.axis.hshift</code>	Amount to nudge the plot horizontally ('numeric')
<code>tern.axis.line.ontop</code>	Bring Axis Borders on Top of Everything (Deprecated) ('logical')
<code>tern.axis.line</code>	Base Line ('element_line'; inherits from 'axis.line')
<code>tern.axis.line.T</code>	Line for TOP Axis ('element_line'; inherits from 'tern.axis.line')
<code>tern.axis.line.L</code>	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')

```

<code>tern.axis.title.R</code>	Apex Title for RHS Axis ('element_text'; inherits from 'tern.axis.title')
<code>tern.axis.title.show</code>	Apex Titles Show or Hide ('logical')
<code>tern.panel.background</code>	Background of Ternary Plot Area** ('element_rect'; inherits from 'panel.background')
<code>tern.panel.expand</code>	The amount to expand the ternary plotting panel, in ratio to npc units ('numeric')
<code>tern.panel.grid.major</code>	Base Major Gridline ('element_line'; inherits from 'panel.grid.major')
<code>tern.panel.grid.major.T</code>	Major Gridline for TOP Axis ('element_line'; inherits from 'tern.panel.grid.major')
<code>tern.panel.grid.major.L</code>	Major Gridline for LHS Axis ('element_line'; inherits from 'tern.panel.grid.major')
<code>tern.panel.grid.major.R</code>	Major Gridline for RHS Axis ('element_line'; inherits from 'tern.panel.grid.major')
<code>tern.panel.grid.major.show</code>	Show or Hide Major Gridline ('logical')
<code>tern.panel.grid.minor</code>	Base Minor Gridline ('element_line'; inherits from 'panel.grid.minor')
<code>tern.panel.grid.minor.T</code>	Minor Gridline for TOP Axis ('element_line'; inherits from 'tern.panel.grid.minor')
<code>tern.panel.grid.minor.L</code>	Minor Gridline for LHS Axis ('element_line'; inherits from 'tern.panel.grid.minor')
<code>tern.panel.grid.minor.R</code>	Minor Gridline for RHS Axis ('element_line'; inherits from 'tern.panel.grid.minor')
<code>tern.panel.grid.minor.show</code>	Show or Hide Minor Gridline ('logical')
<code>tern.panel.grid.ontop</code>	Bring grids, axis and axis labels on top of everything else ('logical')
<code>tern.panel.mask.show</code>	Show or Hide the Clipping Mask ('logical')
<code>tern.panel.rotate</code>	The amount to rotate the ternary diagram in degrees ('numeric')
<code>tern.plot.background</code>	Background of Ternary Clipping Area** ('element_rect'; inherits from 'plot.background')
<code>tern.plot.latex</code>	Whether to parse characters as latex commands ('logical')
<code>...</code>	additional element specifications not part of base ggplot2. If supplied <code>validate</code> needs to be set to <code>FALSE</code> .
<code>complete</code>	set this to <code>TRUE</code> if this is a complete theme, such as the one returned by <code>theme_grey()</code> . Complete themes behave differently when added to a ggplot object. Also, when setting <code>complete = TRUE</code> all elements will be set to inherit from blank elements.
<code>validate</code>	<code>TRUE</code> to run <code>validate_element</code> , <code>FALSE</code> 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	<i>Change the Length of the Ternary Arrows</i>
-------------------	--

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 aliases), 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 aliases) 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

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

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_gridson_top()
```

```
theme_gridson_bottom()
```

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 greys, 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_nolatemx()

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 respectively, 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	<i>Show or Hide the Clipping Mask</i>
--------------	---------------------------------------

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	<i>Blank one variable's annotations in ternary plot</i>
------------------	---

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	<i>Show or Hide Grid</i>
----------------	--------------------------

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 appends to the current theme a flag to switch ON the axis ticklabels, whilst theme_hidelabels or theme_nolabels (Alias) are functions that appends to the current theme a flag to switch OFF the axis ticklabels

Author(s)

Nicholas Hamilton

theme_showprimary	<i>Show or Hide the Primary/Secondary Ticks</i>
-------------------	---

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, would 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 appends 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 appends to the current theme a flag to switch OFF the secondary ticks theme_showprimary is a function that appends to the current theme a flag to switch ON the primary ticks theme_noprimary or theme_hideprimary (Alias) are functions that appends 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 appends to the current theme a flag to switch ON the apex titles.

theme_hidetitles or theme_notitles (alias) is a function that appends 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	<i>Modify the Ticklengths</i>
------------------	-------------------------------

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	<i>Place Ticks Inside or Outside</i>
--------------------	--------------------------------------

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	<i>Zoom on Plot Region</i>
--------------	----------------------------

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

<code>x</code>	numeric scalar
<code>...</code>	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

*Deprecated Functions***Description**

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

DEPRECATED: `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

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

DEPRECATED: `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

DEPRECATED: `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`

DEPRECATED: `ggtern.multi` is a function which permits the arrangement of multiple `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.

DEPRECATED: 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

<code>src</code>	character name of current procedure
<code>df</code>	a data frame
<code>coord</code>	a ternary coordinate system
<code>plyon</code>	items in the data frame to pass to <code>ddply</code> argument
<code>op</code>	operation method to clip, intersection, union, minus or xor
<code>label</code>	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.
<code>showarrows</code>	logical whether to show the axis directional arrows DEPRECATED
<code>padding</code>	the padding around the plot area to make provision for axis labels, ticks and arrows, relative to the cartesian plane. DEPRECATED
<code>arrowsep</code>	the distance between ternary axis and ternary arrows DEPRECATED
<code>arrowstart</code>	the proportion along the ternary axis to start the directional arrow DEPRECATED
<code>arrowfinish</code>	the proportion along the ternary axis to stop the directional arrow DEPRECATED
<code>vshift</code>	shift the plot area vertically DEPRECATED
<code>hshift</code>	shift the plot area horizontally DEPRECATED
<code>ticklength.major</code>	the length of the major ternary ticks as an euclidean distance relative to the x and y limits of the cartesian plot area. DEPRECATED

<code>ticklength.minor</code>	the length of the minor ternary ticks as an euclidean distance relative to the x and y limits of the cartesian plot area. DEPRECIATED
<code>...</code>	additional arguments, multiple plot objects
<code>plotlist</code>	alternative to the <code>...</code> argument, provide a list of ggplot or grob objects, objects which do not inherit the ggplot or grob classes will be stripped.
<code>cols</code>	number of columns if the layout parameter is not provided.
<code>layout</code>	override number of cols, and provide a matrix specifying the layout
<code>x</code>	vector of numeric x values
<code>y</code>	vector of numeric y values
<code>close</code>	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_\(ggplot2\)/](http://www.cookbook-r.com/Graphs/Multiple_graphs_on_one_page_(ggplot2)/)

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