

Package ‘parttree’

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Title Visualize Simple 2-D Decision Tree Partitions

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Description Visualize the partitions of simple decision trees, involving one or two predictors, on the scale of the original data. Provides an intuitive alternative to traditional tree diagrams, by visualizing how a decision tree divides the predictor space in a simple 2D plot alongside the original data. The 'parttree' package supports both classification and regression trees from 'rpart' and 'partykit', as well as trees produced by popular frontend systems like 'tidymodels' and 'mlr3'. Visualization methods are provided for both base R graphics and 'ggplot2'.

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URL <https://grantmcdermott.com/parttree/>

BugReports <https://github.com/grantmcdermott/parttree/issues>

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($\geq 0.3.0$)

Enhances ggplot2 ($\geq 3.4.0$)

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Contents

geom_parttree	2
parttree	6
plot.parttree	8

Index **11**

geom_parttree	<i>Visualize tree partitions with ggplot2</i>
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Description

geom_parttree() is a simple wrapper around [parttree\(\)](#) that takes a tree model object and then converts into an amenable data frame that ggplot2 knows how to plot. Please note that ggplot2 is not a hard dependency of parttree and must thus be installed separately on the user's system before calling geom_parttree.

Usage

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

Arguments

mapping	Set of aesthetic mappings created by aes() . If specified and inherit.aes = TRUE (the default), it is combined with the default mapping at the top level of the plot. You must supply mapping if there is no plot mapping.
data	An rpart::rpart.object or an object of compatible type (e.g. a decision tree constructed via the partykit, tidymodels, or mlr3 front-ends).

stat	<p>The statistical transformation to use on the data for this layer. When using a <code>geom_*()</code> function to construct a layer, the <code>stat</code> argument can be used to override the default coupling between geoms and stats. The <code>stat</code> argument accepts the following:</p> <ul style="list-style-type: none"> • A Stat ggproto subclass, for example <code>StatCount</code>. • A string naming the stat. To give the stat as a string, strip the function name of the <code>stat_</code> prefix. For example, to use <code>stat_count()</code>, give the stat as "count". • For more information and other ways to specify the stat, see the layer stat documentation.
position	<p>A position adjustment to use on the data for this layer. This can be used in various ways, including to prevent overplotting and improving the display. The <code>position</code> argument accepts the following:</p> <ul style="list-style-type: none"> • The result of calling a position function, such as <code>position_jitter()</code>. This method allows for passing extra arguments to the position. • A string naming the position adjustment. To give the position as a string, strip the function name of the <code>position_</code> prefix. For example, to use <code>position_jitter()</code>, give the position as "jitter". • For more information and other ways to specify the position, see the layer position documentation.
linejoin	Line join style (round, mitre, bevel).
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> .
flip	Logical. By default, the "x" and "y" axes variables for plotting are determined by the first split in the tree. This can cause plot orientation mismatches depending on how users specify the other layers of their plot. Setting to TRUE will flip the "x" and "y" variables for the <code>geom_parttree</code> layer.
...	<p>Other arguments passed on to <code>layer()</code>'s <code>params</code> argument. These arguments broadly fall into one of 4 categories below. Notably, further arguments to the <code>position</code> argument, or aesthetics that are required can <i>not</i> be passed through ... Unknown arguments that are not part of the 4 categories below are ignored.</p> <ul style="list-style-type: none"> • Static aesthetics that are not mapped to a scale, but are at a fixed value and apply to the layer as a whole. For example, <code>colour = "red"</code> or <code>linewidth = 3</code>. The geom's documentation has an Aesthetics section that lists the available options. The 'required' aesthetics cannot be passed on to the <code>params</code>. Please note that while passing unmapped aesthetics as vectors is technically possible, the order and required length is not guaranteed to be parallel to the input data.

- When constructing a layer using a `stat_*()` function, the `...` argument can be used to pass on parameters to the geom part of the layer. An example of this is `stat_density(geom = "area", outline.type = "both")`. The geom's documentation lists which parameters it can accept.
- Inversely, when constructing a layer using a `geom_*()` function, the `...` argument can be used to pass on parameters to the stat part of the layer. An example of this is `geom_area(stat = "density", adjust = 0.5)`. The stat's documentation lists which parameters it can accept.
- The `key_glyph` argument of `layer()` may also be passed on through `...`. This can be one of the functions described as [key glyphs](#), to change the display of the layer in the legend.

Details

Because of the way that ggplot2 validates inputs and assembles plot layers, note that the data input for `geom_parttree()` (i.e. decision tree object) must assigned in the layer itself; not in the initialising `ggplot2::ggplot()` call. See Examples.

Value

A [ggplot](#) layer.

Aesthetics

`geom_parttree()` aims to "work-out-of-the-box" with minimal input from the user's side, apart from specifying the data object. This includes taking care of the data transformation in a way that, generally, produces optimal corner coordinates for each partition (i.e. `xmin`, `xmax`, `ymin`, and `ymax`). However, it also understands the following aesthetics that users may choose to specify manually:

- `fill` (particularly encouraged, since this will provide a visual cue regarding the prediction in each partition region)
- `colour`
- `alpha`
- `linetype`
- `size`

See Also

[plot.parttree\(\)](#), which provides an alternative plotting method using base R graphics.

Examples

```
# install.packages("ggplot2")
library(ggplot2) # ggplot2 must be installed/loaded separately

library(parttree) # this package
library(rpart)    # decision trees

#
```

```
## Simple decision tree (max of two predictor variables)

iris_tree = rpart(Species ~ Petal.Length + Petal.Width, data=iris)

# Plot with original iris data only
p = ggplot(data = iris, aes(x = Petal.Length, y = Petal.Width)) +
  geom_point(aes(col = Species))

# Add tree partitions to the plot (borders only)
p + geom_parttree(data = iris_tree)

# Better to use fill and highlight predictions
p + geom_parttree(data = iris_tree, aes(fill = Species), alpha=0.1)

# To drop the black border lines (i.e. fill only)
p + geom_parttree(data = iris_tree, aes(fill = Species), col = NA, alpha = 0.1)

#
## Example with plot orientation mismatch

p2 = ggplot(iris, aes(x=Petal.Width, y=Petal.Length)) +
  geom_point(aes(col=Species))

# Oops
p2 + geom_parttree(data = iris_tree, aes(fill=Species), alpha = 0.1)

# Fix with 'flip = TRUE'
p2 + geom_parttree(data = iris_tree, aes(fill=Species), alpha = 0.1, flip = TRUE)

#
## Various front-end frameworks are also supported, e.g.:

# install.packages("parsnip")
library(parsnip)

iris_tree_parsnip = decision_tree() |>
  set_engine("rpart") |>
  set_mode("classification") |>
  fit(Species ~ Petal.Length + Petal.Width, data=iris)

p + geom_parttree(data = iris_tree_parsnip, aes(fill=Species), alpha = 0.1)

#
## Trees with continuous independent variables are also supported.

# Note: you may need to adjust (or switch off) the fill legend to match the
# original data, e.g.:

iris_tree_cont = rpart(Petal.Length ~ Sepal.Length + Petal.Width, data=iris)
p3 = ggplot(data = iris, aes(x = Petal.Width, y = Sepal.Length)) +
  geom_parttree(
    data = iris_tree_cont,
    aes(fill = Petal.Length), alpha=0.5
```

```

) +
geom_point(aes(col = Petal.Length)) +
theme_minimal()

# Legend scales don't quite match here:
p3

# Better to scale fill to the original data
p3 + scale_fill_continuous(limits = range(iris$Petal.Length))

```

parttree

Convert a decision tree into a data frame of partition coordinates

Description

Extracts the terminal leaf nodes of a decision tree that contains no more than two numeric predictor variables. These leaf nodes are then converted into a data frame, where each row represents a partition (or leaf or terminal node) that can easily be plotted in 2-D coordinate space.

Usage

```
parttree(tree, keep_as_dt = FALSE, flip = FALSE)
```

Arguments

tree	An rpart.object or alike. This includes compatible classes from the <code>mlr3</code> and <code>tidymodels</code> frontends, or the <code>constparty</code> class inheriting from <code>party</code> .
keep_as_dt	Logical. The function relies on <code>data.table</code> for internal data manipulation. But it will coerce the final return object into a regular data frame (default behavior) unless the user specifies <code>TRUE</code> .
flip	Logical. Should we flip the "x" and "y" variables in the return data frame? The default behaviour is for the first split variable in the tree to take the "y" slot, and any second split variable to take the "x" slot. Setting to <code>TRUE</code> switches these around. <i>Note:</i> This argument is primarily useful when it passed via geom_parttree to ensure correct axes orientation as part of a <code>ggplot2</code> visualization (see geom_parttree Examples). We do not expect users to call <code>parttree(..., flip = TRUE)</code> directly. Similarly, to switch axes orientation for the native (base graphics) plot.parttree method, we recommend calling <code>plot(..., flip = TRUE)</code> rather than flipping the underlying <code>parttree</code> object.

Value

A data frame comprising seven columns: the leaf node, its path, a set of rectangle limits (i.e., `xmin`, `xmax`, `ymin`, `ymax`), and a final column corresponding to the predicted value for that leaf.

See Also

[plot.parttree](#), [geom_parttree](#), [rpart](#), [ctree](#) [partykit::ctree](#).

Examples

```
library("parttree")

#
## rpart trees

library("rpart")
rp = rpart(Kyphosis ~ Start + Age, data = kyphosis)

# A parttree object is just a data frame with additional attributes
(rp_pt = parttree(rp))
attr(rp_pt, "parttree")

# simple plot
plot(rp_pt)

# removing the (recursive) partition borders helps to emphasise overall fit
plot(rp_pt, border = NA)

# customize further by passing extra options to (tiny)plot
plot(
  rp_pt,
  border = NA,                # no partition borders
  pch = 16,                  # filled points
  alpha = 0.6,               # point transparency
  grid = TRUE,               # background grid
  palette = "classic",       # new colour palette
  xlab = "Topmost vertebra operated on", # custom x title
  ylab = "Patient age (months)",      # custom y title
  main = "Tree predictions: Kyphosis recurrence" # custom title
)

#
## conditional inference trees from partyit

library("partykit")
ct = ctree(Species ~ Petal.Length + Petal.Width, data = iris)
ct_pt = parttree(ct)
plot(ct_pt, pch = 19, palette = "okabe", main = "ctree predictions: iris species")

## rpart via partykit
rp2 = as.party(rp)
parttree(rp2)

#
## various front-end frameworks are also supported, e.g.

# tidymodels
```

```

# install.packages("parsnip")
library(parsnip)

decision_tree() |>
  set_engine("rpart") |>
  set_mode("classification") |>
  fit(Species ~ Petal.Length + Petal.Width, data=iris) |>
  parttree() |>
  plot(main = "This time brought to you via parsnip...")

# mlr3 (NB: use `keep_model = TRUE` for mlr3 learners)

# install.packages("mlr3")
library(mlr3)

task_iris = TaskClassif$new("iris", iris, target = "Species")
task_iris$formula(rhs = "Petal.Length + Petal.Width")
fit_iris = lrn("classif.rpart", keep_model = TRUE) # NB!
fit_iris$train(task_iris)
plot(parttree(fit_iris), main = "... and now mlr3")

```

plot.parttree

Plot decision tree partitions

Description

Provides a plot method for parttree objects.

Usage

```

## S3 method for class 'parttree'
plot(
  x,
  raw = TRUE,
  border = "black",
  fill_alpha = 0.3,
  expand = TRUE,
  jitter = FALSE,
  add = FALSE,
  ...
)

```

Arguments

x	A parttree data frame.
raw	Logical. Should the raw (original) data points be plotted too? Default is TRUE.

border	Colour of the partition borders (edges). Default is "black". To remove the borders altogether, specify as NA.
fill_alpha	Numeric in the range $[0, 1]$. Alpha transparency of the filled partition rectangles. Default is 0.3.
expand	Logical. Should the partition limits be expanded to to meet the edge of the plot axes? Default is TRUE. If FALSE, then the partition limits will extend only until the range of the raw data.
jitter	Logical. Should the raw points be jittered? Default is FALSE. Only evaluated if raw = TRUE.
add	Logical. Add to an existing plot? Default is FALSE.
...	Additional arguments passed down to tinyplot .

Value

No return value, called for side effect of producing a plot.

No return value; called for its side effect of producing a plot.

Examples

```
library("parttree")

#
## rpart trees

library("rpart")
rp = rpart(Kyphosis ~ Start + Age, data = kyphosis)

# A parttree object is just a data frame with additional attributes
(rp_pt = parttree(rp))
attr(rp_pt, "parttree")

# simple plot
plot(rp_pt)

# removing the (recursive) partition borders helps to emphasise overall fit
plot(rp_pt, border = NA)

# customize further by passing extra options to (tiny)plot
plot(
  rp_pt,
  border = NA,                # no partition borders
  pch = 16,                   # filled points
  alpha = 0.6,                # point transparency
  grid = TRUE,                # background grid
  palette = "classic",        # new colour palette
  xlab = "Topmost vertebra operated on", # custom x title
  ylab = "Patient age (months)",     # custom y title
  main = "Tree predictions: Kyphosis recurrence" # custom title
)
```

```
#
## conditional inference trees from partyit

library("partykit")
ct = ctree(Species ~ Petal.Length + Petal.Width, data = iris)
ct_pt = parttree(ct)
plot(ct_pt, pch = 19, palette = "okabe", main = "ctree predictions: iris species")

## rpart via partykit
rp2 = as.party(rp)
parttree(rp2)

#
## various front-end frameworks are also supported, e.g.

# tidymodels

# install.packages("parsnip")
library(parsnip)

decision_tree() |>
  set_engine("rpart") |>
  set_mode("classification") |>
  fit(Species ~ Petal.Length + Petal.Width, data=iris) |>
  parttree() |>
  plot(main = "This time brought to you via parsnip...")

# mlr3 (NB: use `keep_model = TRUE` for mlr3 learners)

# install.packages("mlr3")
library(mlr3)

task_iris = TaskClassif$new("iris", iris, target = "Species")
task_iris$formula(rhs = "Petal.Length + Petal.Width")
fit_iris = lrn("classif.rpart", keep_model = TRUE) # NB!
fit_iris$train(task_iris)
plot(parttree(fit_iris), main = "... and now mlr3")
```

Index

`aes()`, 2

`borders()`, 3

`ctree`, 7

`geom_parttree`, 2, 6, 7

`ggplot`, 4

`ggplot2::ggplot()`, 4

key glyphs, 4

layer position, 3

layer stat, 3

`layer()`, 3, 4

`parttree`, 6, 8

`parttree()`, 2

`party`, 6

`partykit::ctree`, 7

`plot.parttree`, 6, 7, 8

`plot.parttree()`, 4

`rpart`, 7

`rpart.object`, 6

`rpart::rpart.object`, 2

`tinypplot`, 9