

# Package ‘shades’

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**Title** Simple Colour Manipulation

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**Description**

Functions for easily manipulating colours, creating colour scales and calculating colour distances.

**Suggests** testthat, covr, ggplot2

**Enhances** colorspace

**Encoding** UTF-8

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addmix	<i>Colour mixtures</i>
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### Description

These functions allow colours to be mixed in any colour space, either additively (like light) or subtractively (like paint). The infix form `%.)%` is an alternative for `addmix`, and `%_/%` for `submix`, with the mixing amount being fixed to 1 in these cases.

### Usage

```
addmix(base, mixer, amount = 1, space = NULL)
```

```
submix(base, mixer, amount = 1, space = NULL)
```

```
X %.)% Y
```

```
X %_/% Y
```

### Arguments

base, X	A vector of base colours, or a palette function or scale.
mixer, Y	A vector of colours to mix in.
amount	The amount of each colour to mix in, relative to the amount of the base. This will be recycled to the length of mixer.
space	A string giving the space in which to perform the mixing, or NULL. In the latter case, the space of base will be used.

### Value

New colours of class "shade", or a new palette function.

### Author(s)

Jon Clayden <code@clayden.org>

### Examples

```
addmix(c("red", "green", "blue"), "red")
submix(c("cyan", "magenta", "yellow"), "cyan")
```

---

complement	<i>Complementary colours</i>
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---

**Description**

This function returns the complement of its argument, the "opposite" colours in the specified space.

**Usage**

```
complement(shades, space = NULL)
```

**Arguments**

shades	One or more colours, in any suitable form (see <a href="#">shade</a> ), or a palette function or scale.
space	The space in which to take the complement.

**Value**

New colours of class "shade", or a new palette function.

**Examples**

```
complement("cyan")
complement("cyan", space="HSV")
complement("cyan", space="Lab")
```

---

coords	<i>Retrieve the coordinates of a colour vector</i>
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**Description**

This function retrieves the coordinates of a colour vector's elements, within whatever space it is currently defined.

**Usage**

```
coords(x, ...)
```

**Arguments**

x	An R object.
...	Additional arguments to methods.

**Value**

A matrix giving colour coordinates in the relevant space, one colour per row. Columns are typically named.

**Author(s)**

Jon Clayden <code@clayden.org>

**Examples**

```
coords("red")
```

---

dichromat

*Simulate colour appearance for dichromats*

---

**Description**

This functions manipulates colours to simulate the effects of different kinds of colour blindness, and specifically dichromacy, in which only two of the usual three types of photoreceptors are present. There are three types, corresponding to the loss of red, green or blue photoreceptors.

**Usage**

```
dichromat(shades, type = c("protanopic", "deuteranopic", "tritanopic",  
"none"))
```

**Arguments**

shades	One or more colours, in any suitable form (see <a href="#">shade</a> ).
type	The type of colour vision deficiency to simulate: protanopia (red blindness), deuteranopia (green blindness) or tritanopia (blue blindness). The latter is the rarest in the population. "none" is also available, as a pass-through option. Abbreviations, such as the first letter, may be used, and multiple values are acceptable.

**Value**

New colours of class "shade" in LMS space, representing projections of the original shades onto a submanifold appropriate to the type of dichromacy being simulated.

**Author(s)**

Jon Clayden <code@clayden.org>

**References**

Brettel, H., Viénot, F. and Mollon, J.D. (1997). Computerized simulation of color appearance for dichromats. *Journal of the Optical Society of America A* 14(10):2647-2655.

**Examples**

```
dichromat(c("red", "green", "blue"))
```

---

distance	<i>Colour distance</i>
----------	------------------------

---

**Description**

This function calculates a distance measure that aims to quantify the perceptual difference between a vector of colours and a reference colour. The measure in question is the CIE Delta E (2000), which is calculated based on colour coordinates in Lab space.

**Usage**

```
distance(shades, reference)
```

**Arguments**

shades	One or more colours, in any suitable form (see <a href="#">shade</a> ).
reference	A single reference colour.

**Value**

A numeric vector of distances.

**Author(s)**

Jon Clayden <[code@clayden.org](mailto:code@clayden.org)>

**References**

[http://www.bruce.lindbloom.com/index.html?Eqn\\_DeltaE\\_CIE2000.html](http://www.bruce.lindbloom.com/index.html?Eqn_DeltaE_CIE2000.html)

**Examples**

```
distance(c("red", "green", "blue"), "red")
```

---

 gradient

*Colour gradients*


---

### Description

This function returns a set of colours interpolating between the specified key colours, equally separated in the specified space.

### Usage

```
gradient(shades, steps = NULL, space = NULL)
```

### Arguments

shades	Two or more colours, in any suitable form (see <a href="#">shade</a> ), or a named colour map such as "viridis".
steps	An integer giving the number of shades required in the palette. If NULL, a function will instead be returned that takes this argument.
space	The colour space to traverse. Defaults to the current space of shades, or "Lab" for the matplotlib colour maps, or "sRGB" otherwise.

### Details

The key colours may be specified explicitly, or else a built-in colour map may be used. The maps available are currently those developed for Python's matplotlib 2.0, namely "magma", "inferno", "plasma" and "viridis", and certain ColorBrewer palettes, namely "Blues", "Reds", "YlOrRd" (yellow-orange-red) and "RdBu" (red-grey-blue, a balanced diverging scale).

### Value

A character vector of class "shade" containing the gradient elements in the specified space, or a palette function.

### Author(s)

Jon Clayden <code@clayden.org>

### References

<http://bids.github.io/colormap/> for the matplotlib colour maps; <http://colorbrewer2.org> for the ColorBrewer ones.

### Examples

```
gradient(c("red", "blue"), 5)
gradient(c("red", "blue"), 5, space="Lab")
gradient("viridis", 5)
```

---

saturation	<i>Query or change colour properties</i>
------------	--

---

### Description

These functions obtain the value of a colour property, or modify it. They will convert between colour spaces as required, but the RGB representation will be appropriately updated in the result.

### Usage

```
saturation(shades, values = NULL)
```

```
brightness(shades, values = NULL)
```

```
lightness(shades, values = NULL)
```

```
chroma(shades, values = NULL)
```

```
hue(shades, values = NULL)
```

```
opacity(shades, values = NULL)
```

```
delta(...)
```

```
scalefac(...)
```

```
recycle(...)
```

### Arguments

shades	One or more colours, in any suitable form (see <a href="#">shade</a> ), or a palette function or scale.
values	New values for the property in question. If NULL, the current value(s) will be returned. May also be a function computing new values from old ones, such as <code>delta</code> , which adds its argument, or <code>scalefac</code> , which multiplies it.
...	Arguments to replacement functions <code>delta</code> , <code>scalefac</code> and <code>recycle</code> , which will be concatenated.

### Details

Brightness and lightness differ technically, in the sense that one is absolute and the other is relative. Intuitively, a grey square on white paper is brighter under bright sunlight than in a dark room, but its lightness (relative to the white around it) is constant between conditions. In these functions, brightness is “value” in HSV space and is between 0 and 1, while lightness is defined in Lab space and is between 0 and 100. Saturation and chroma are also related. Hue is defined in HSV space, with red at 0° (and 360°), which is generally the most familiar parameterisation.

**Value**

Current colour property values, or new colours of class "shade". If shades is a function, the result will be a new function that wraps the old one and modifies its return value accordingly.

**Note**

The colour property functions are vectorised over both of their arguments, such that the dimensions of the result will be `c(length(values), dim(shades))`. However, the `recycle` function can be used to suppress the usual dimensional expansion, and instead follow R's standard recycling rule.

**Author(s)**

Jon Clayden <code@clayden.org>

**Examples**

```
saturation(c("papayawhip", "lavenderblush", "olivedrab"))

saturation("papayawhip", 0.7)
saturation("papayawhip", delta(0.2))
saturation("papayawhip", scalefac(1.5))

saturation(c("red", "green"), c(0.4, 0.6))
saturation(c("red", "green"), recycle(0.4, 0.6))
```

---

shade

*The shade class*

---

**Description**

Objects of class "shade" are simply standard R character vectors representing one or more 8-bit (s)RGB colours in CSS-like hex format, but with extra attributes giving the current colour space and coordinates.

**Usage**

```
shade(x, ...)

## S3 method for class 'shade'
shade(x, ...)

## S3 method for class 'color'
shade(x, ...)

## S3 method for class 'matrix'
shade(x, space = "sRGB", alpha = NULL, ...)

## S3 method for class 'character'
```



```

shade(x, ...)

## Default S3 method:
shade(x, ...)

## S3 method for class 'shade'
print(x, ...)

## S3 method for class 'shade'
x[i]

## S3 replacement method for class 'shade'
x[i] <- value

## S3 method for class 'shade'
c(...)

## S3 method for class 'shade'
rep(x, ...)

## S3 method for class 'shade'
rev(x)

## S3 method for class 'shade'
x == y

## S3 method for class 'shade'
x != y

## S3 method for class 'equal.shade'
all(target, current, hexonly = FALSE, ...)

```

### Arguments

x, y	R objects, or "shade" objects for methods.
...	Additional parameters to methods. For c, any number of colours in any acceptable form.
space	For a matrix, the space in which coordinates are being provided.
alpha	For a matrix, an associated vector of opacity values between 0 and 1, if required.
i	An index vector.
value	A vector of replacement colours.
target, current	Shade vectors to compare.
hexonly	If TRUE, compare only on the basis of the hex strings. Otherwise test for equal coordinates.

**Details**

Comparison between "shade" objects  $x$  and  $y$  is achieved by converting  $y$  (the second argument) into the colour space of  $x$  and then comparing coordinates, after any clipping.

**Value**

A character vector of class "shade", with additional attributes as follows.

space	A string naming a color space.
coords	A matrix giving colour coordinates in the relevant space, one colour per row.

**Note**

When concatenating, shades that are all from the same space will remain in that space, but shades from different spaces will be warped to "XYZ" space.

**Author(s)**

Jon Clayden <code@clayden.org>

**Examples**

```
s <- shade(c("red", "green", "blue"))
s[1]
s[1] <- "pink"
```

---

space

*Retrieve the space of a colour vector*

---

**Description**

This function retrieves the colour space in which its argument is currently defined.

**Usage**

```
space(x, ...)
```

**Arguments**

$x$	An R object.
$\dots$	Additional arguments to methods.

**Value**

A string naming a colour space.

**Author(s)**

Jon Clayden <code@clayden.org>

**Examples**

```
space("red")
```

---

swatch

*Simple colour swatches*

---

**Description**

This function provides a simple visualisation of a colour series as a series of boxes against the specified background colour. If the input has more than one dimension then the boxes will be arranged in a grid (flattening further dimensions after the second).

**Usage**

```
swatch(x, bg = "white", ...)
```

**Arguments**

x	One or more colours, in any suitable form (see <a href="#">shade</a> ).
bg	A background colour.
...	Additional arguments (currently unused).

**Author(s)**

Jon Clayden <code@clayden.org>

**Examples**

```
swatch(c("red", "green", "blue"))
```

---

warp

*Shift colours between spaces*

---

### Description

This function shifts the current colour space of its arguments to the specified space, returning a new object of class "shade".

### Usage

```
warp(x, space)
```

### Arguments

x	An R object which can be coerced to class "shade".
space	A string naming the new space.

### Details

Valid names for spaces are currently those supported by the [convertColor](#) function, namely "sRGB", "Apple RGB", "CIE RGB", "XYZ", "Lab" and "Luv"; plus "RGB" (which is treated as an alias for "sRGB"), "HSV", "LCh" and "LMS". Case is not significant.

### Value

A new object of class "shade".

### Note

LMS space, used for chromatic adaptation and simulating colour blindness, is not uniquely defined. Here we use the (linearised) Bradford transform, obtained by Lam (1985) and used widely in ICC colour profiles and elsewhere, to transform to and from CIE XYZ space.

R uses the D65 standard illuminant as the reference white for the "Lab" and "Luv" spaces.

### Author(s)

Jon Clayden <[code@clayden.org](mailto:code@clayden.org)>

### References

Lam, K.M. (1985). Metamerism and colour constancy. PhD thesis, University of Bradford.

### See Also

[convertColor](#)

### Examples

```
warp("red", "HSV")
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