

# Package ‘Cairo’

July 7, 2020

**Version** 1.5-12.2

**Title** R Graphics Device using Cairo Graphics Library for Creating High-Quality Bitmap (PNG, JPEG, TIFF), Vector (PDF, SVG, PostScript) and Display (X11 and Win32) Output

**Author** Simon Urbanek <Simon.Urbanek@r-project.org>, Jeffrey Horner <jeff.horner@vanderbilt.edu>

**Maintainer** Simon Urbanek <Simon.Urbanek@r-project.org>

**Depends** R (>= 2.4.0)

**Imports** grDevices, graphics

**Suggests** png

**Enhances** FastRWeb

**Description** R graphics device using cairographics library that can be used to create high-quality vector (PDF, PostScript and SVG) and bitmap output (PNG, JPEG, TIFF), and high-quality rendering in displays (X11 and Win32). Since it uses the same back-end for all output, copying across formats is WYSIWYG. Files are created without the dependence on X11 or other external programs. This device supports alpha channel (semi-transparent drawing) and resulting images can contain transparent and semi-transparent regions. It is ideal for use in server environments (file output) and as a replacement for other devices that don't have Cairo's capabilities such as alpha support or anti-aliasing. Backends are modular such that any subset of backends is supported.

**License** GPL-2

**SystemRequirements** cairo (>= 1.2 <http://www.cairographics.org/>)

**URL** <http://www.rforge.net/Cairo/>

**NeedsCompilation** yes

**Repository** CRAN

**Date/Publication** 2020-07-07 06:11:04 UTC

## R topics documented:

Cairo	2
Cairo.capabilities	5

Cairo.capture . . . . .	6
Cairo.onSave . . . . .	7
Cairo.serial . . . . .	8
CairoFonMatch . . . . .	8
CairoFonts . . . . .	10

<b>Index</b>	<b>12</b>
--------------	-----------

---

Cairo	<i>Create a new Cairo-based graphics device</i>
-------	---

---

## Description

Cairo initializes a new graphics device that uses the cairo graphics library for rendering. The current implementation produces high-quality PNG, JPEG, TIFF bitmap files, high resolution PDF files with embedded fonts, SVG graphics and PostScript files. It also provides X11 and Windows interactive graphics devices. Unlike other devices it supports all graphics features including alpha blending, anti-aliasing etc.

CairoX11, CairoPNG, CairoPDF, CairoPS and CairoSVG are convenience wrappers of Cairo that take the same arguments as the corresponding device it replaces such as X11, png, pdf, etc. Use of the Cairo function is encouraged as it is more flexible than the wrappers.

## Usage

```
Cairo(width = 640, height = 480, file="", type="png", pointsize=12,
      bg = "transparent", canvas = "white", units = "px", dpi = "auto",
      ...)
```

```
CairoX11(display=Sys.getenv("DISPLAY"), width = 7, height = 7,
         pointsize = 12, gamma = getOption("gamma"), bg = "transparent",
         canvas = "white", xpos = NA, ypos = NA, ...)
```

```
CairoPNG(filename = "Rplot%03d.png", width = 480, height = 480,
         pointsize = 12, bg = "white", res = NA, ...)
```

```
CairoJPEG(filename = "Rplot%03d.jpeg", width = 480, height = 480,
         pointsize = 12, quality = 75, bg = "white", res = NA, ...)
```

```
CairoTIFF(filename = "Rplot%03d.tiff", width = 480, height = 480,
         pointsize = 12, bg = "white", res = NA, ...)
```

```
CairoPDF(file = ifelse(onefile, "Rplots.pdf", "Rplot%03d.pdf"),
        width = 6, height = 6, onefile = TRUE, family = "Helvetica",
        title = "R Graphics Output", fonts = NULL, version = "1.1",
        paper = "special", encoding, bg, fg, pointsize, pagecentre)
```

```
CairoSVG(file = ifelse(onefile, "Rplots.svg", "Rplot%03d.svg"),
        width = 6, height = 6, onefile = TRUE, bg = "transparent",
        pointsize = 12, ...)
```

```
CairoWin(width = 7, height = 7, pointsize = 12,
        record = getOption("graphics.record"),
        rescale = c("R", "fit", "fixed"), xpinch, ypinch, bg =
        "transparent", canvas = "white", gamma = getOption("gamma"),
```

```

xpos = NA, ypos = NA, buffered = getOption("windowsBuffered"),
restoreConsole = FALSE, ...)
CairoPS(file = ifelse(onefile, "Rplots.ps", "Rplot%03d.ps"),
onefile = TRUE, family, title = "R Graphics Output", fonts = NULL,
encoding, bg, fg, width, height, horizontal, pointsize, paper,
pagecentre, print.it, command, colormodel)

```

## Arguments

width	width of the plot area (also see units).
height	height of the plot area (also see units).
file	name of the file to be created or connection to write to. Only PDF, PS and PNG types support connections. For X11 type file specifies the display name. If NULL or "" a reasonable default will be chosen which is "plot.type" for file-oriented types and value of the DISPLAY environment variable for X11. For image types the file name can contain printf-style formatting expecting one integer parameter which is the page number, such as "Rplot%03d.png". The page numbers start at one. The filename is expanded using <a href="#">path.expand</a> .
type	output type. This version of Cairo supports "png", "jpeg" and "tiff" bitmaps (png/tiff with transparent background), "pdf" PDF-file with embedded fonts, "svg" SVG-file, "ps" PostScript-file, "x11" X11 interactive window and "win" Windows graphics. A special type "raster" creates an image back-end that produces no actual output file but can be used in conjunction with any of <code>dev.capture()</code> , <code>grid.cap()</code> or <code>Cairo:::image()</code> to create in-memory images. Depending on the support of various backends in cairo graphics some of the options may not be available for your system. See <a href="#">Cairo.capabilities</a> function.
pointsize	initial text size (in points).
canvas	canvas color (must be opaque). The canvas is only used by devices that display graphics on a screen and the canvas is only visible only if bg is transparent.
bg	plot background color (can include alpha-component or be transparent altogether).
units	units for of the width and height specifications. It can be any of "px" (pixels), "in" (inches), "pt" (points), "cm" (centimeters) or "mm" (millimeters).
dpi	DPI used for the conversion of units to pixels. If set to "auto" the DPI resolution will be determined by the back-end.
...	additional backend specific parameters (e.g. quality setting for JPEG (0..100), compression for TIFF (0,1=none, 5=LZW (default), 7=JPEG, 8=Adobe Deflate), locator for a custom locator function in image back-ends) All parameters listed below are defined by the other devices are used by the wrappers to make it easier replace other devices by Cairo. They are described in detail in the documentation corresponding to the device that is being replaced.
display	X11 display, see <a href="#">X11</a>
gamma	gamma correction
xpos	see <a href="#">X11</a>
ypos	see <a href="#">X11</a>

filename	same as file in Cairo
res	resolution in ppi, see <a href="#">png</a> , will override dpi in Cairo if set to anything other than NA or NULL. Note that cairographics does not support tagging PNG output files with DPI so the raster image will be produced with the dpi setting, but readers may render it at some default dpi setting.
quality	quality of the jpeg, see <a href="#">jpeg</a>
onefile	logical: if true (the default) allow multiple figures in one file (see <a href="#">pdf</a> ). false is currently not supported by vector devices
family	font family, see <a href="#">pdf</a>
title	see <a href="#">pdf</a> (ignored)
fonts	see <a href="#">pdf</a> , ignored, Cairo automatically detects and embeds fonts
version	PDF version, see <a href="#">pdf</a> (ignored)
paper	see <a href="#">pdf</a> (ignored, Cairo uses device dimensions)
encoding	see <a href="#">pdf</a> (ignored, Cairo uses native encoding except for symbols)
fg	see <a href="#">pdf</a> (ignored)
pagecentre	see <a href="#">pdf</a> (ignored, Cairo uses device dimensions and thus it is irrelevant)
record	Windows-specific, ignored on unix
rescale	Windows-specific, ignored on unix
xpinch	Windows-specific, ignored on unix
ypinch	Windows-specific, ignored on unix
buffered	Windows-specific, ignored on unix
restoreConsole	Windows-specific, ignored on unix
horizontal	see <a href="#">postscript</a> (ignored)
print.it	see <a href="#">postscript</a> (ignored)
command	see <a href="#">postscript</a> (ignored)
colormodel	see <a href="#">postscript</a> (ignored, Cairo always uses RGB or ARGB)

### Value

The (invisible) return value is NULL if the device couldn't be created or a Cairo object if successful. The value of the object is the device number.

### Known issues

- The X11 backend is quite slow. The reason is the cairographics implementation of the backend, so we can't do much about it. It should be possible to drop cairographics' Xlib backend entirely and use image backend copied into an X11 window instead. We may try that in future releases.
- TrueType (and OpenType) fonts are supported when this package is compiled against a cairo graphics library configured with FreeType and Fontconfig support. Therefore make sure have a cairo graphics library with all bells and whistles to get a good result.
- R math symbols are supported, but require a TrueType "Symbol" font accessible to Cairo under that name.

**See Also**[CairoFonts](#)**Examples**

```
# very simple KDE
Cairo(600, 600, file="plot.png", type="png", bg="white")
plot(rnorm(4000),rnorm(4000),col="#ff000018",pch=19,cex=2) # semi-transparent red
dev.off() # creates a file "plot.png" with the above plot

# you can use any Cairo backend and get the same result
# vector, bitmap or on-screen
CairoPDF("plot.pdf", 6, 6, bg="transparent")
data(iris)
attach(iris)
plot(Petal.Length, rep(-0.03,length(Species)), xlim=c(1,7),
      ylim=c(0,1.7), xlab="Petal.Length", ylab="Density",
      pch=21, cex=1.5, col="#00000001", main = "Iris (yet again)",
      bg=c("#ff000020","#00ff0020","#0000ff20")[unclass(Species)])
for (i in 1:3)
  polygon(density(Petal.Length[unclass(Species)==i],bw=0.2),
          col=c("#ff000040","#00ff0040","#0000ff40")[i])
dev.off()

## remove the example files if not in an interactive session
if (!interactive()) unlink(c("plot.png","plot.pdf"))
```

---

Cairo.capabilities      *Reports which output types are supported by this Cairo build*

---

**Description**

Cairo.capabilities returns a logical vector describing the capabilities of this particular Cairo build.

**Usage**

```
Cairo.capabilities()
```

**Details**

The Cairo package provides multiple back-ends, such as images (PNG, JPEG, TIFF), vector graphics (PDF, PostScript, SVG) or displays (X11, Windows). However, not all systems support all back-ends. The Cairo.capabilities function returns a logical vector showing which capabilities are supported in this particular Cairo build.

Note that the capabilities depend both on the libraries available in the system as well as the compiled-in modules in cairo graphics.

**See Also**

[Cairo](#)

---

Cairo.capture

*Capture contents of an image backend or a display list snapshot.*

---

**Description**

Cairo.capture is essentially the same as dev.capture(native=TRUE) with the exception that it works where dev.capture doesn't such as onSave callbacks.

Cairo.snapshot is very similar to recordPlot except it also allows to retrieve the last snapshot.

**Usage**

```
Cairo.capture(device = dev.cur())  
Cairo.snapshot(device = dev.cur(), last=FALSE)
```

**Arguments**

device	device number or an object of the class Cairo (as obtained from the <a href="#">Cairo</a> function).
last	logical, if FALSE then a new snapshot is created (exactly the same as recordPlot()), if TRUE then the last known snapshot is retrieved, if NA then a snapshot is created first, but if the display list is empty last snapshot is retrieved instead.

**Value**

Cairo.capture: object of the class nativeRaster.

Cairo.snapshot: object of the class recordedplot.

**Author(s)**

Simon Urbanek

---

Cairo.onSave                      *Cairo callbacks*

---

### Description

Cairo.onSave set the onSave callback which allows R code to be run when Cairo finalizes a page (either due to a new page being created or by the device being closed). The callback expects `function(device,page)` where `device` will be the device number and `page` is the currently finished page number (starting at 1).

### Usage

```
Cairo.onSave(device = dev.cur(), onSave)
```

### Arguments

<code>device</code>	device number or Cairo object (as returned by the <a href="#">Cairo</a> function)
<code>onSave</code>	function that will replace the current callback or NULL to remove the current callback

### Value

The old callback being replaced or NULL if there was none.

### Note

The function `onSave` will be evaluated in the global environment and no error checking is done, so you must make sure to catch errors, otherwise the behavior is undefined (and may included crashing R or other bad things).

### Author(s)

Simon Urbanek

### See Also

[Cairo](#)

### Examples

```
if (require(png, quietly=TRUE)) {  
  dev <- Cairo(800, 600, type='raster')  
  Cairo.onSave(dev, function(dev, page)  
    .GlobalEnv$png <- writePNG(Cairo.capture(dev))  
  )  
  plot(1:10, col=2)  
  dev.off()  
  str(png)  
}
```

Cairo.serial

*Check for changes in the graphics state of Cairo devices.*

---

**Description**

Cairo.serial returns an integer that is increased with every plotting operation on the device. This allows user code to determine whether any new content has been added to the device since it was last checked.

**Usage**

```
Cairo.serial(device = dev.cur())
```

**Arguments**

device            device number or an object of the class Cairo (as obtained from the [Cairo](#) function).

**Value**

Integer value.

**Note**

The integer value overflows to 0 at  $2^{31}$ . Typically only equality should be checked and for such it is extremely unlikely that the state has changed yet the serial value is the same due to overflow.

**Author(s)**

Simon Urbanek

---

CairoFonMatch*Find installed fonts with a fontconfig pattern*

---

**Description**

CairoFontMatch searches for fonts based on a fontconfig pattern.

**Usage**

```
CairoFontMatch(fontpattern="Helvetica", sort=FALSE, verbose=FALSE)
```

**Arguments**

fontpattern	character; a fontconfig pattern.
sort	logical; if 'FALSE', display only the best matching font for the pattern. If 'TRUE', display a sorted list of best matching fonts.
verbose	logical; if 'FALSE', display the family, style, and file property for the pattern. if 'TRUE', display the canonical font pattern for each match.

**Details**

This function displays a list of one or more fonts matching the supplied fontconfig pattern. `sort='FALSE'` displays the font that Cairo will use for the supplied pattern, while `sort='TRUE'` displays a sorted list of best matching fonts. The simplest fontconfig pattern matching all installed fonts is `":"`. Here's what `CairoFontMatch(":")` displays on this system:

```
1. family: "Bitstream Vera Sans", style: "Roman", file: "/usr/share/fonts/truetype/ttf-bitstream-vera/
```

`verbose='FALSE'` displays the font properties 'family', 'style', and 'file', while `verbose='TRUE'` will display the canonical font pattern, displaying all properties known for the font (output of `CairoFontMatch(":",verbose=TRUE)`):

```
1. family: "Bitstream Vera Sans", style: "Roman", file: "/usr/share/fonts/truetype/ttf-bitstream-vera/
   "Bitstream Vera Sans-12:familylang=en:style=Roman:stylelang=en:slant=0:weight=80:width=100:pixelsi
```

A simple approach to selecting a font starts with calling `CairoFontMatch(":",sort=TRUE)` to list all available fonts. Next, the user will choose a font from the list and call `CairoFontMatch("FamilyName:style=PreferredStyle",sort=TRUE)`, substituting "FamilyName" and "PreferredStyle" with the desired values. If only one font is found, then the user has found the fontconfig pattern that will select the desired font. Otherwise, the user will call `CairoFontMatch` with `verbose=TRUE` to determine other properties to add to the pattern to attain the desired font, for instance the fontformat.

The following excerpt is from the fontconfig user's manual (<http://fontconfig.org/>) and better describes the fontconfig pattern definition:

"Fontconfig provides a textual representation for patterns that the library can both accept and generate. The representation is in three parts, first a list of family names, second a list of point sizes and finally a list of additional properties:

```
<families>-<point sizes>:<name1>=<values1>:<name2>=<values2>...
```

Values in a list are separated with commas. The name needn't include either families or point sizes; they can be elided. In addition, there are symbolic constants that simultaneously indicate both a name and a value. Here are some examples:

Font Pattern	Meaning
Times-12	12 point Times Roman
Times-12:bold	12 point Times Bold
Courier:italic	Courier Italic in the default size
Monospace:matrix=1 .1 0 1	The users preferred monospace font with artificial obliquing

The '\', '-:', '::' and ',,' characters in family names must be preceded by a '\' character to avoid having them misinterpreted. Similarly, values containing '\', '=, \'\_ ', '::' and ',,' must also have them preceded by a '\' character. The '\' characters are stripped out of the family name and values as the font name is read."

### Known issues

- This function is only available when the Cairo graphics library is configured with FreeType and Fontconfig support.

### See Also

[CairoFonts](#), [Cairo](#)

---

CairoFonts

*Set the fonts used for all Cairo graphics devices.*

---

### Description

CairoFonts initializes the fonts used for Cairo graphics devices.

### Usage

```
CairoFonts(
regular="Helvetica:style=Regular",
bold="Helvetica:style=Bold",
italic="Helvetica:style=Italic",
bolditalic="Helvetica:style=Bold Italic,BoldItalic",
symbol="Symbol"
)
```

### Arguments

regular	character; fontconfig pattern for the 'plain text' font.
bold	character; fontconfig pattern for the 'bold face' font.
italic	character; fontconfig pattern for the 'italic' font.
bolditalic	character; fontconfig pattern for the 'bold italic' font.
symbol	character; fontconfig pattern for the 'symbol' font.

### Details

This function sets the fonts for Cairo graphics devices globally; previously opened Cairo graphics devices will also use these fonts. The argument names correspond to the five values of the graphical parameter 'font', i.e. regular is 1, bold is 2, italic is 3, etc.

For an explanation of fontconfig patterns, see [CairoFontMatch](#).

**Known issues**

- This function is only available when the cairo graphics library is configured with FreeType and Fontconfig support.
- R math symbols are supported, but require a "Symbol" font with the Adobe symbol encoding. At the time of this release the authors are unaware of a free version of this font, however they do exist on Windows and Mac OS X.

**See Also**

[CairoFontMatch](#), [Cairo](#), [par](#),

**Examples**

```
## Not run:
#
# The following fontconfig patterns define the free truetype fonts
# available in the debian package 'ttf-freefont'.
#
# Freesans is very similar to Helvetica
CairoFonts(
  regular="FreeSans:style=Medium",
  bold="FreeSans:style=Bold",
  italic="FreeSans:style=Oblique",
  bolditalic="FreeSans:style=BoldOblique"
)

## End(Not run)
```

# Index

## \* device

- Cairo, [2](#)
- Cairo.capabilities, [5](#)
- Cairo.capture, [6](#)
- Cairo.onSave, [7](#)
- Cairo.serial, [8](#)
- CairoFonMatch, [8](#)
- CairoFonts, [10](#)

- Cairo, [2](#), [6–8](#), [10](#), [11](#)
- Cairo.capabilities, [3](#), [5](#)
- Cairo.capture, [6](#)
- Cairo.onSave, [7](#)
- Cairo.serial, [8](#)
- Cairo.snapshot (Cairo.capture), [6](#)
- CairoFonMatch, [8](#)
- CairoFontMatch, [10](#), [11](#)
- CairoFontMatch (CairoFonMatch), [8](#)
- CairoFonts, [5](#), [10](#), [10](#)
- CairoJPEG (Cairo), [2](#)
- CairoPDF (Cairo), [2](#)
- CairoPNG (Cairo), [2](#)
- CairoPS (Cairo), [2](#)
- CairoSVG (Cairo), [2](#)
- CairoTIFF (Cairo), [2](#)
- CairoWin (Cairo), [2](#)
- CairoX11 (Cairo), [2](#)

jpeg, [4](#)

- par, [11](#)
- path.expand, [3](#)
- pdf, [4](#)
- png, [4](#)
- postscript, [4](#)

X11, [3](#)