Trabajando con gráficos vectoriales en C++ (Cairo-Graphics 2-D)

Ivan Cruz Aceves
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¿Qué es Cairo?
https://www.cairographics.org/

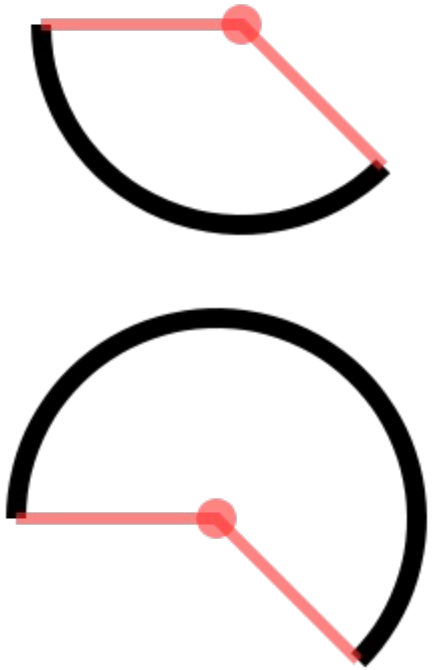
- Cairo es una libreria para generar gráficos vectoriales en 2-D
- Free Software (GNU LGPL)
- Es multiplataforma
- Múltiples dispositivos de salida
- Image buffers, Postscript, PDF, SVG
- Puede ser embebido en ambientes gráficos como wxWidgets
- Es utilizada por Gnome, Firefox, Dia, entre otros...

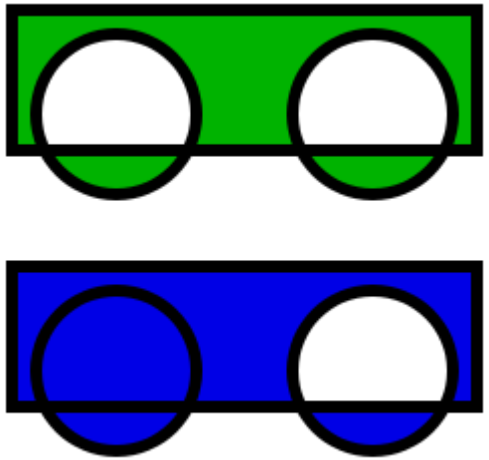
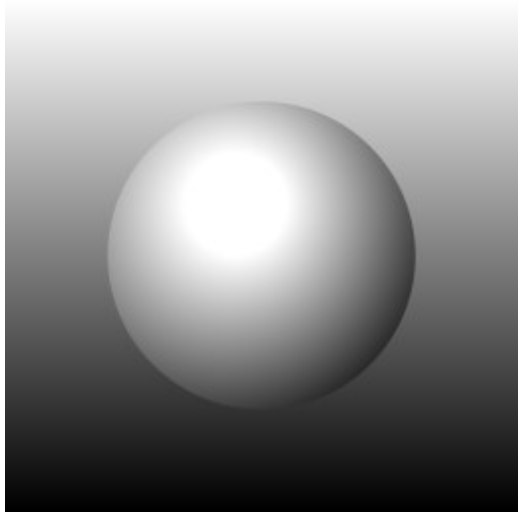
¿Qué es Cairo?
https://www.cairographics.org/

- Con Cairo es posible la creación de diversos gráficos como:
  - Gráficas de barras
  - Gráficas circulares
  - Boxplot
  - Gráficas de dispersión
  - Gráficas de lineas y puntos
  - Diagramas de todo tipo
  - Manipulación de imágenes

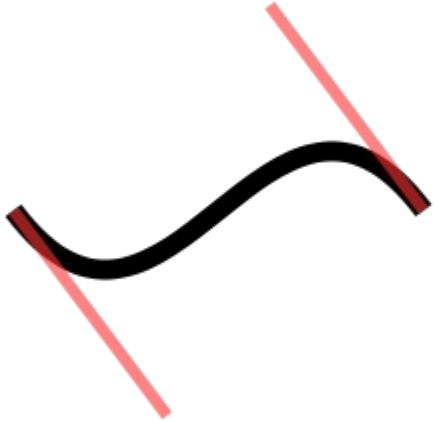
¿Qué es Cairo?

https://www.cairographics.org/samples/



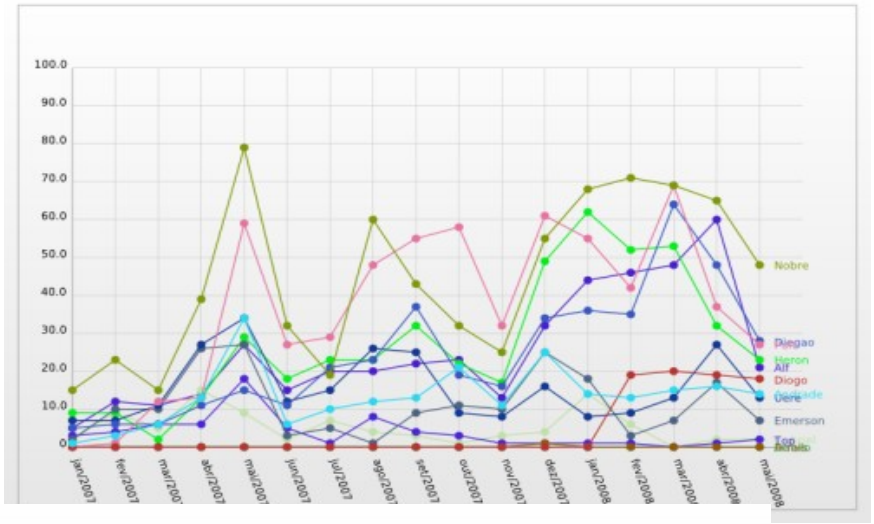


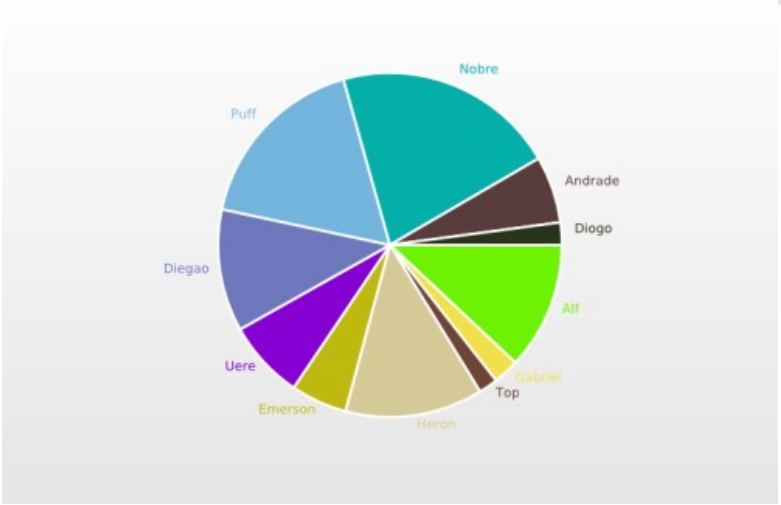



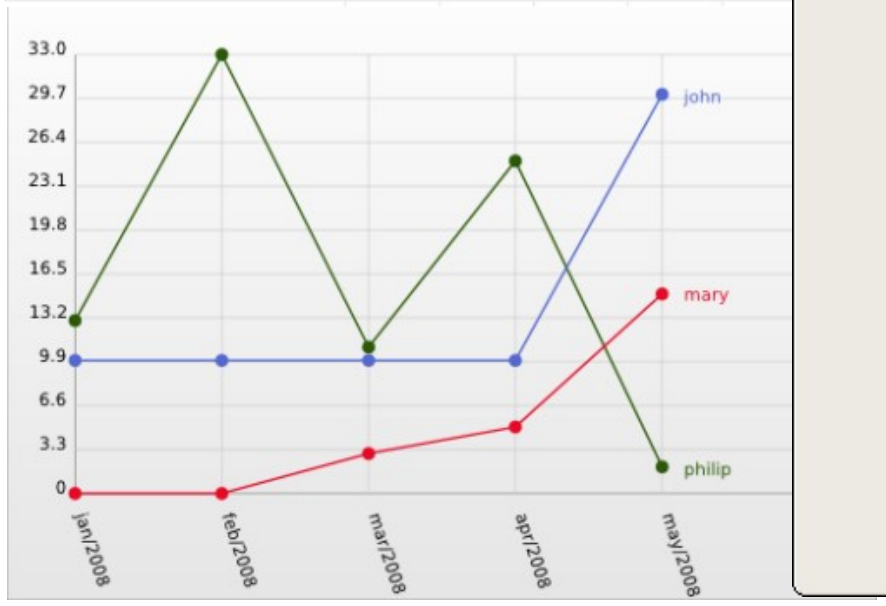
Ejemplos de uso con python (pycairo)

https://linil.wordpress.com/2008/06/14/cairoplot-plotting-graphics-using-python-and-cairo/

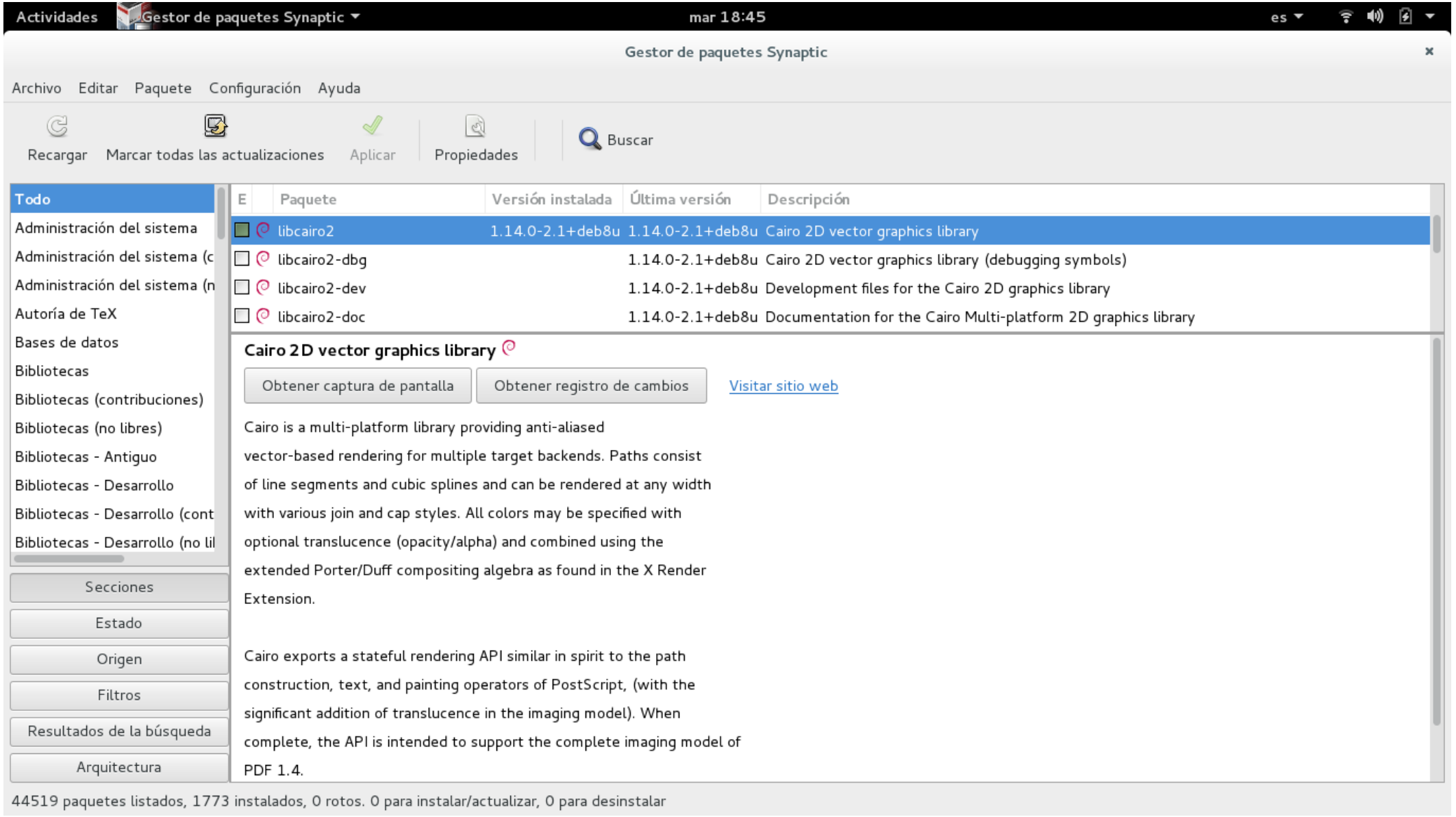
https://setanta.wordpress.com/2007/02/17/aventuras-no-cairo/



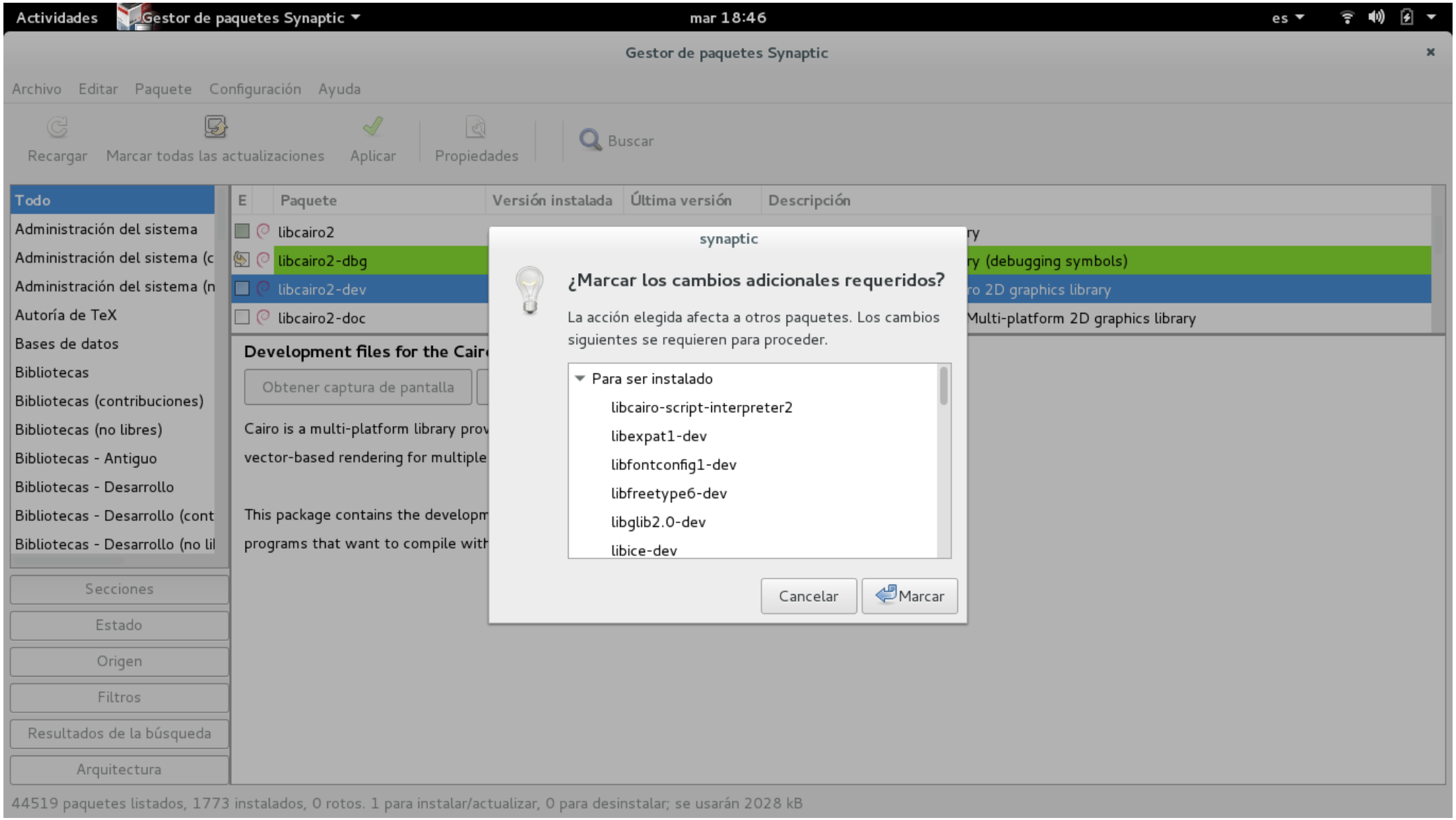




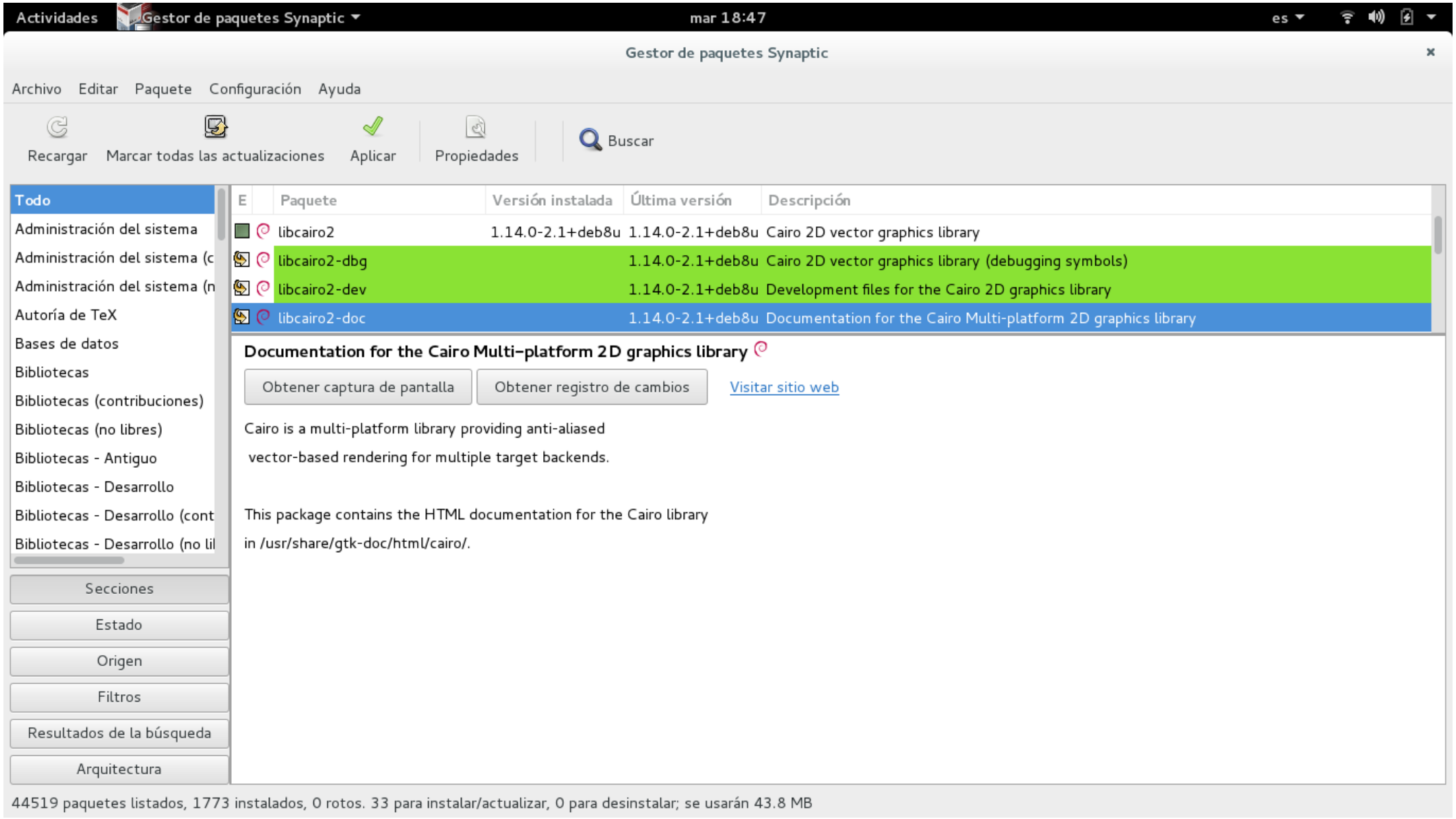
Instalación de cairo en Sistemas Linux



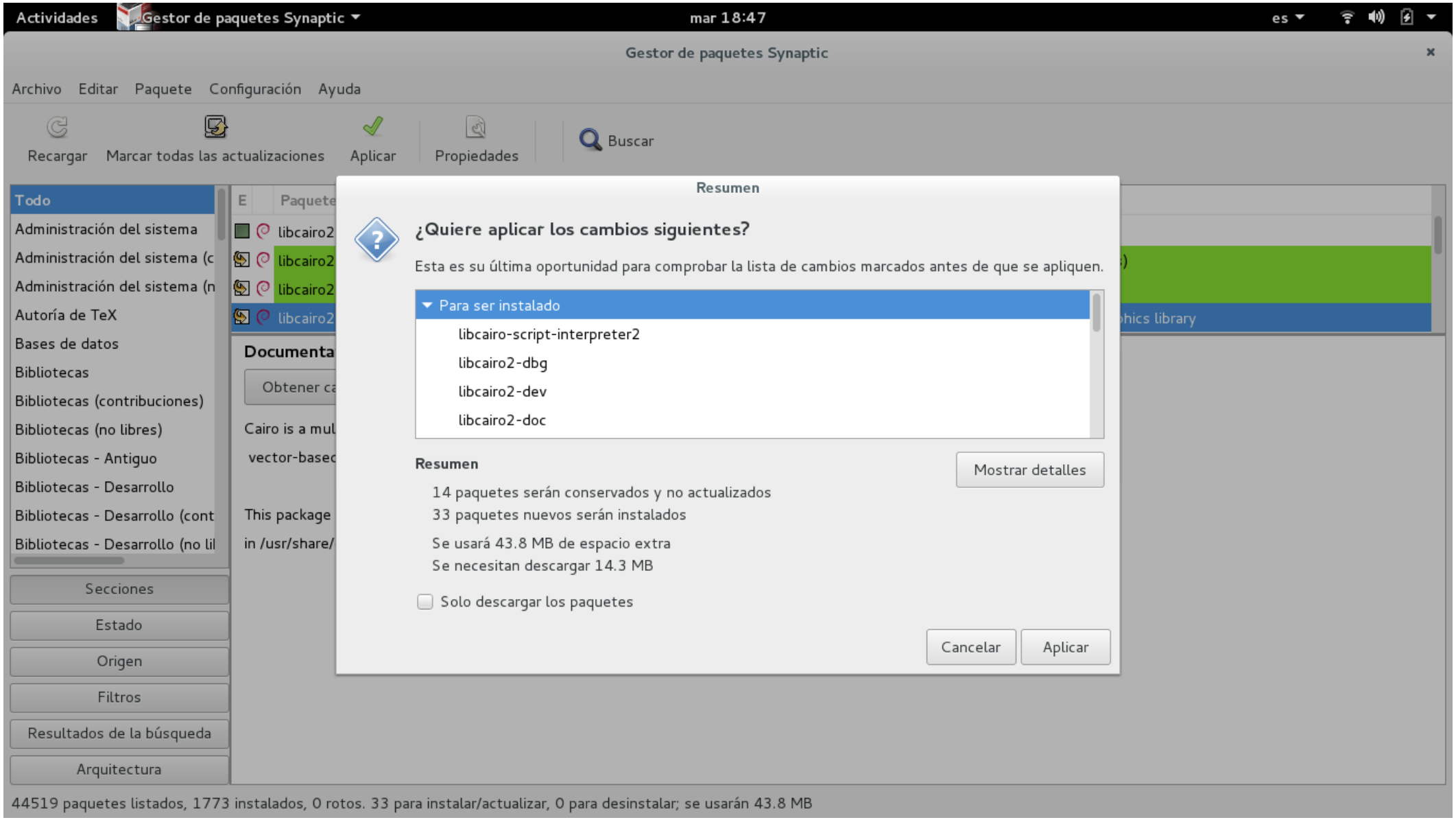
Instalación de cairo en Sistemas Linux



Instalación de cairo en Sistemas Linux



Instalación de cairo en Sistemas Linux



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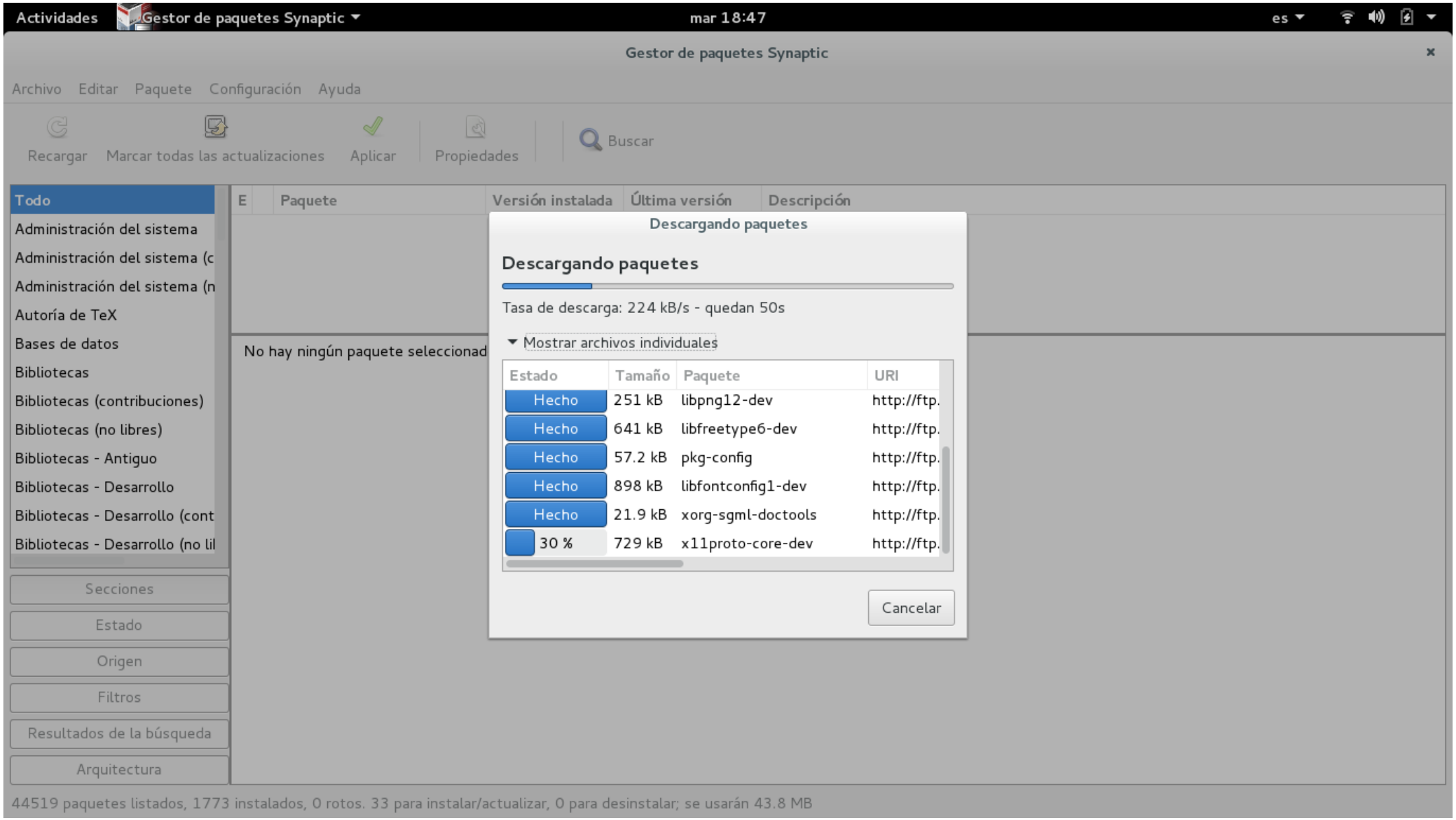
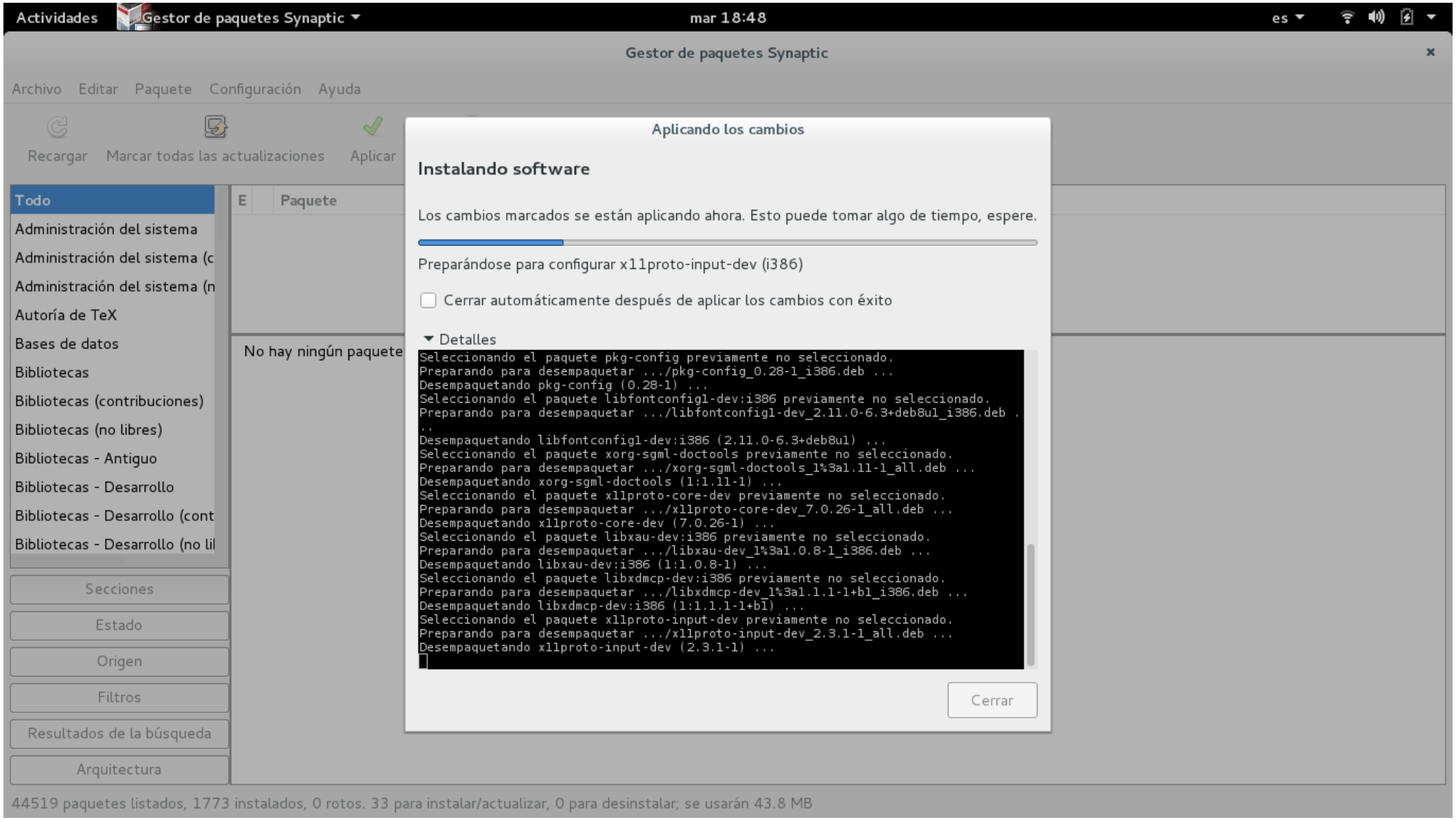
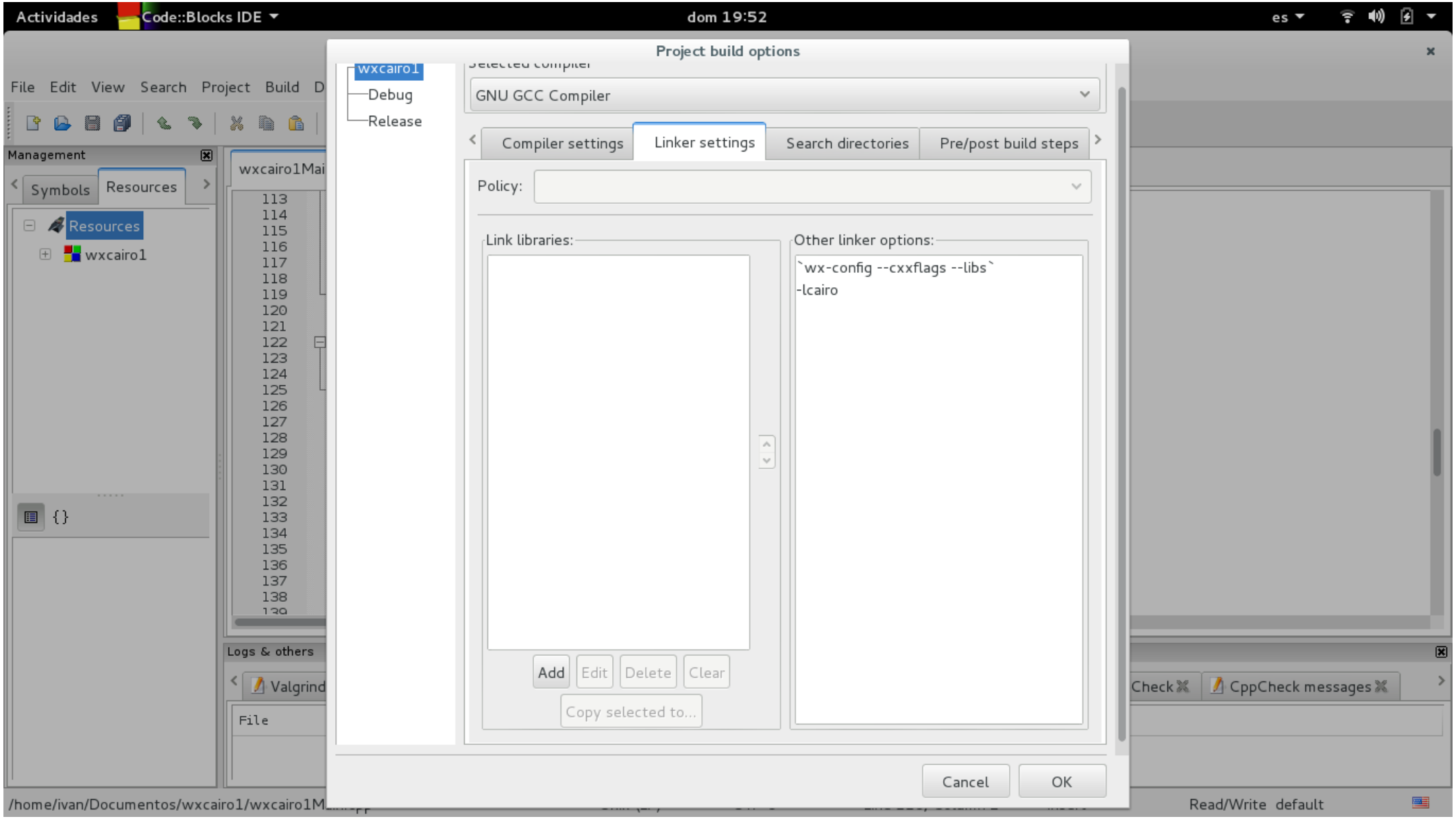


Instalación de cairo en Sistemas Linux



Trabajando cairo en CodeBlocks #include <cairo/cairo.h>



Instalando Cairo-graphics en C++ con CodeBlocks en MSW

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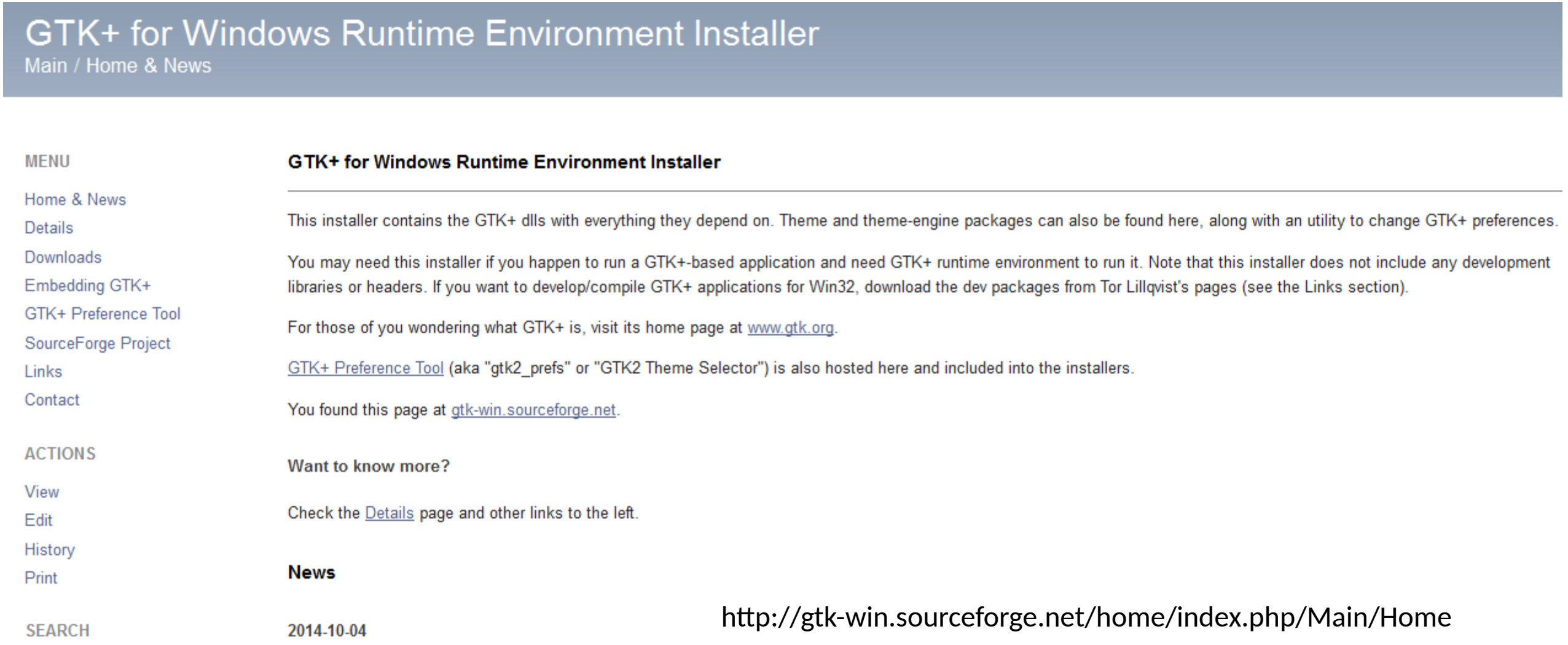
Instalación de cairo sobre MS-Windows

1. Descargar GTK para windows
2. Configuración de Codeblocks para trabajar con Cairo-graphics
3. Linker/ Compiler
4. Ejemplo basado en la pagina de Cairo

Instalación de cairo sobre Windows

https://www.gtk.org/

Instalación de cairo sobre Windows



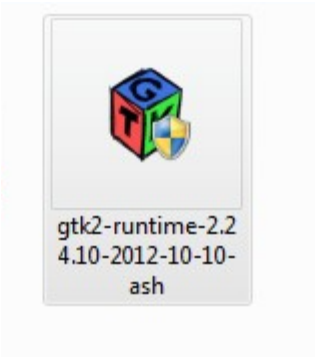
http://gtk-win.sourceforge.net/home/index.php/Main/Home

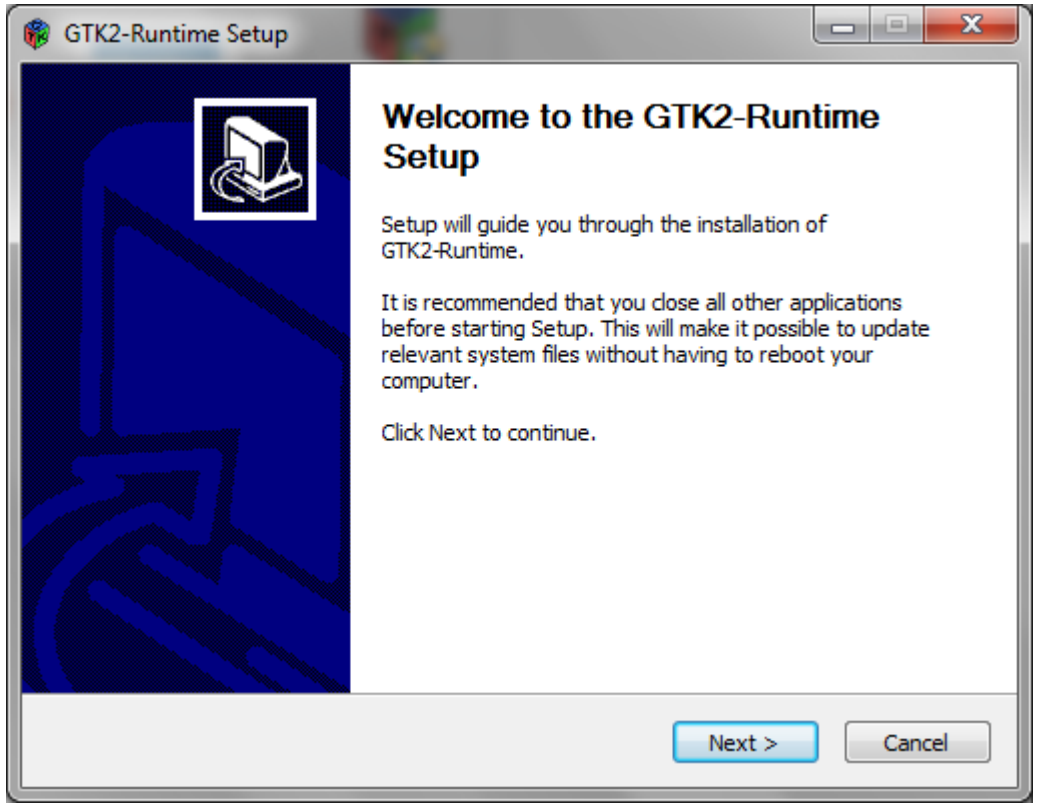
Instalación de cairo sobre Windows

https://sourceforge.net/projects/gtk-win/

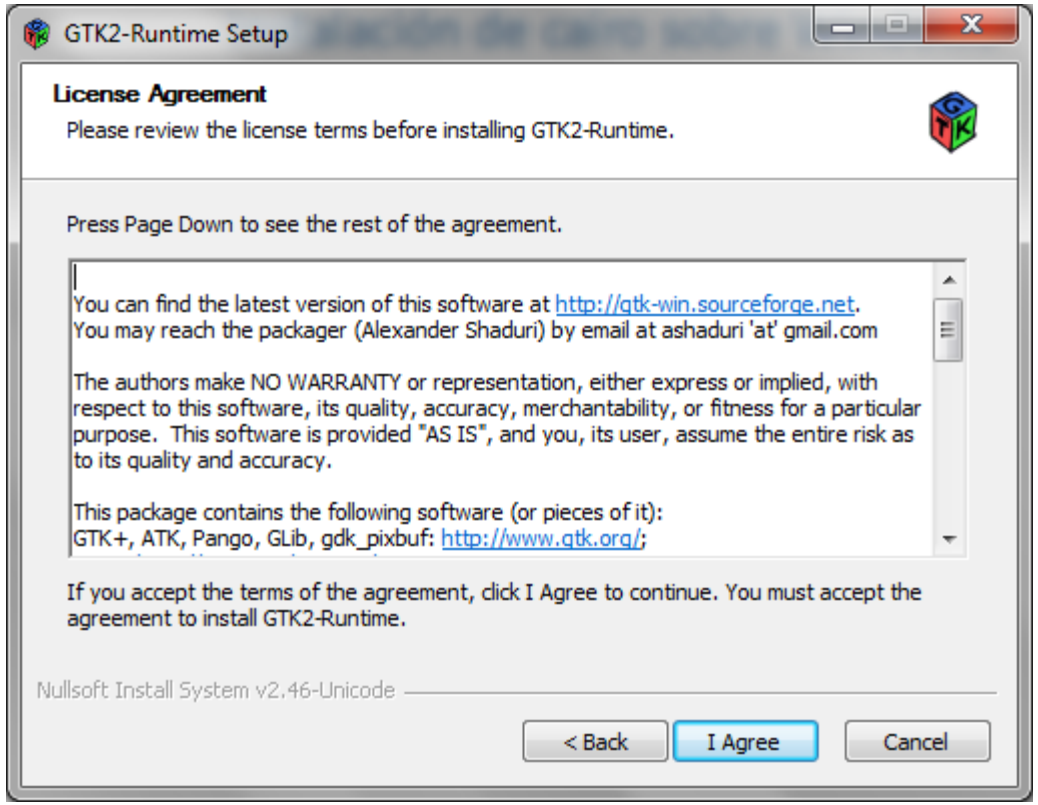
Instalación de cairo sobre Windows

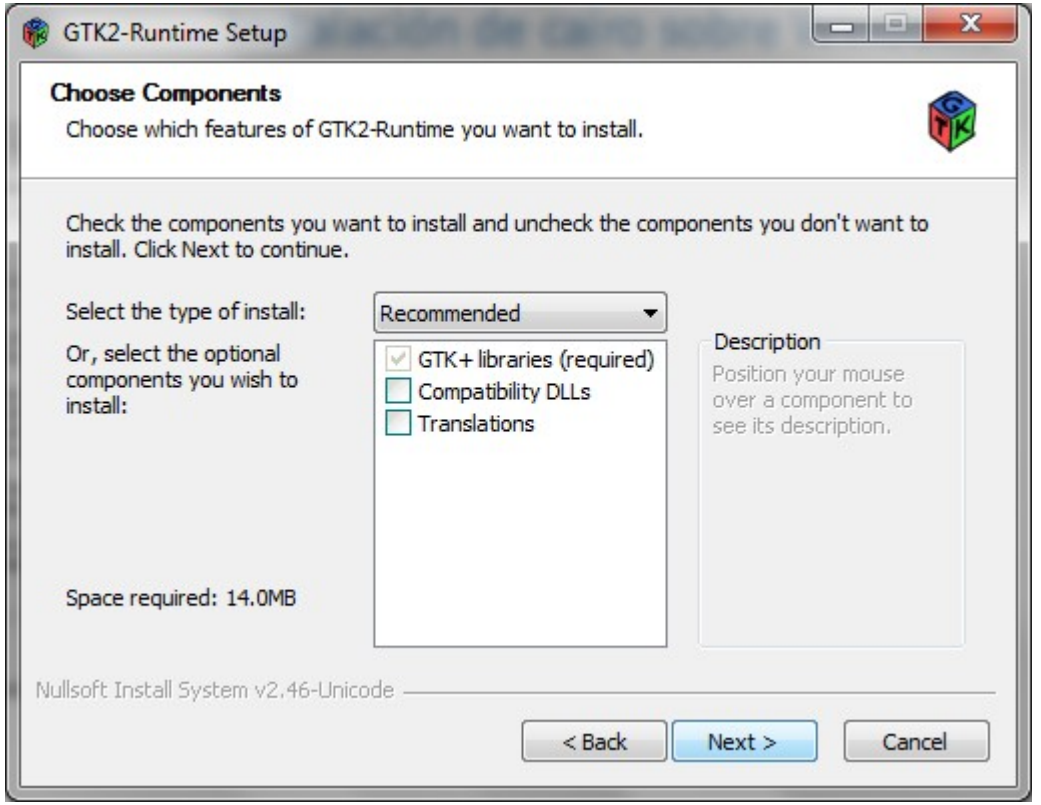
gtk2-runtime-2.24.10-2012-10-10-ash



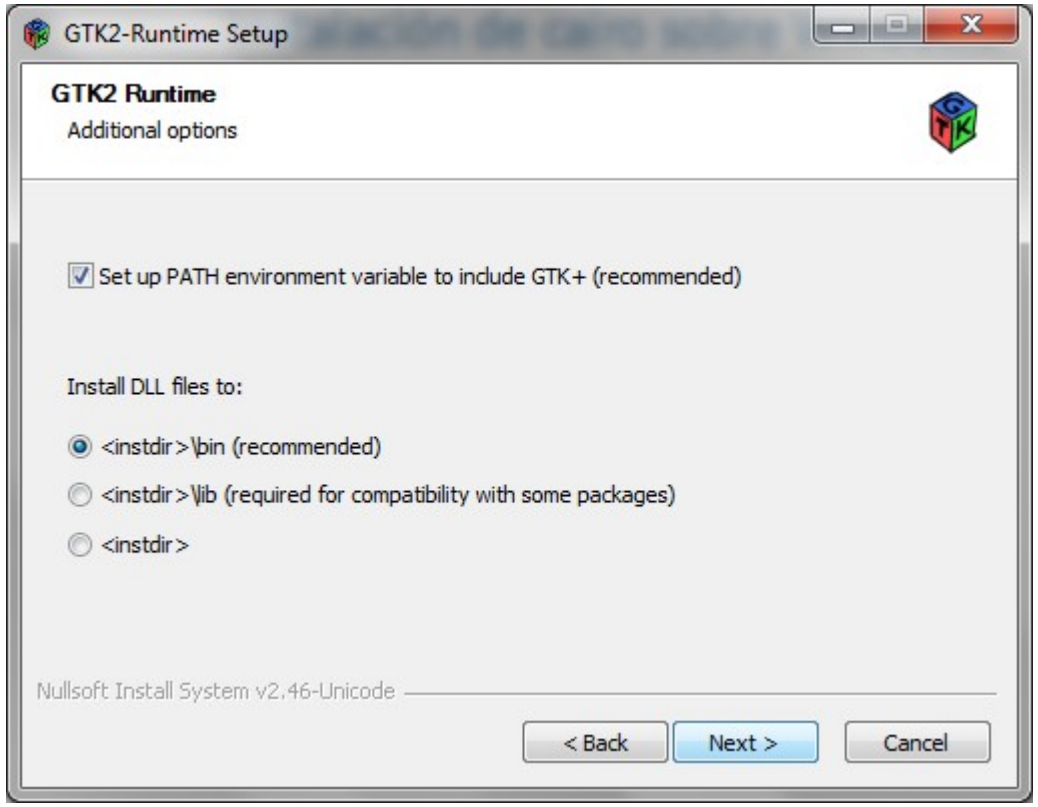


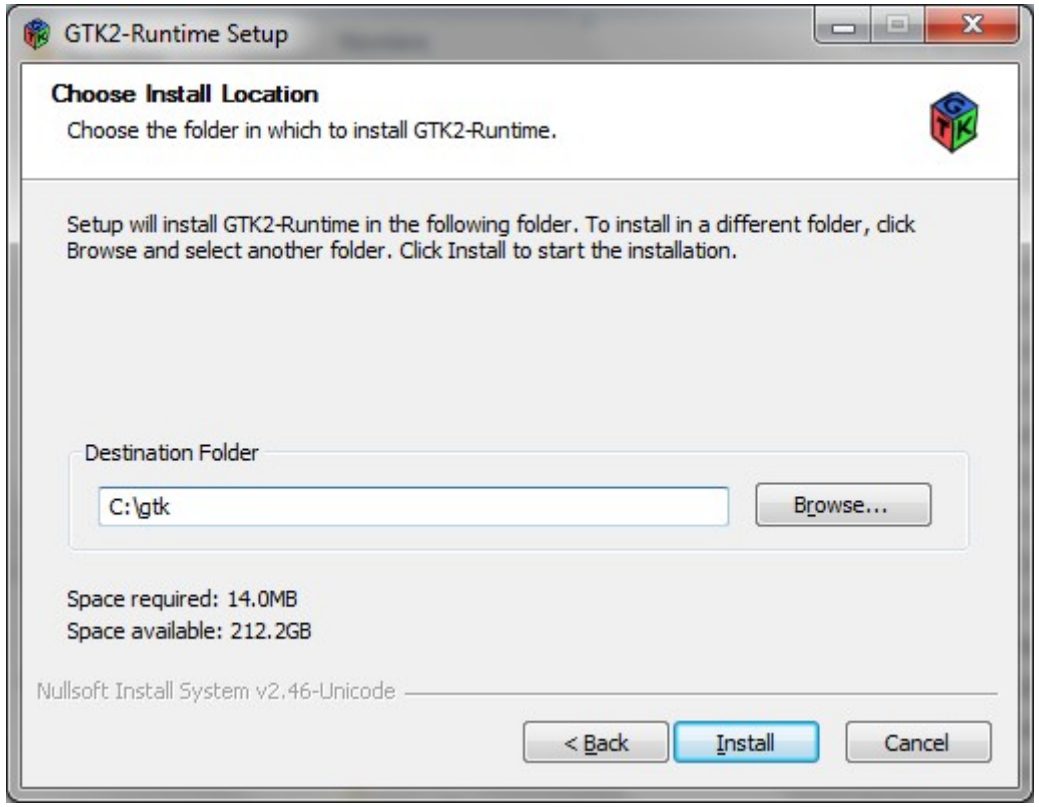
Instalación de cairo sobre Windows



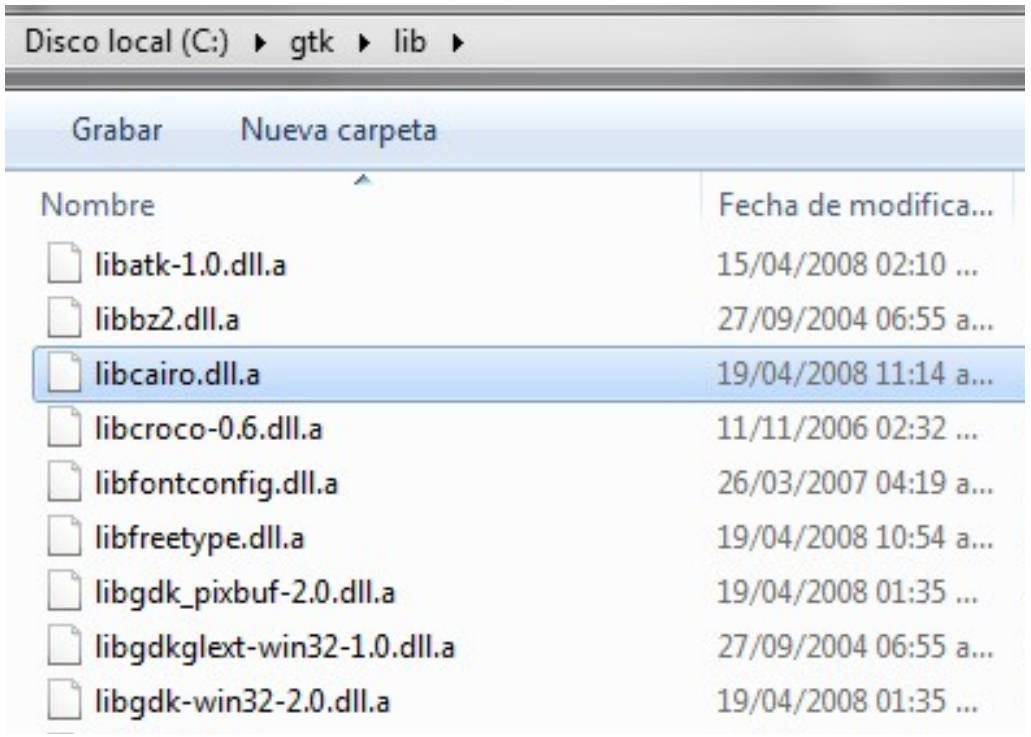


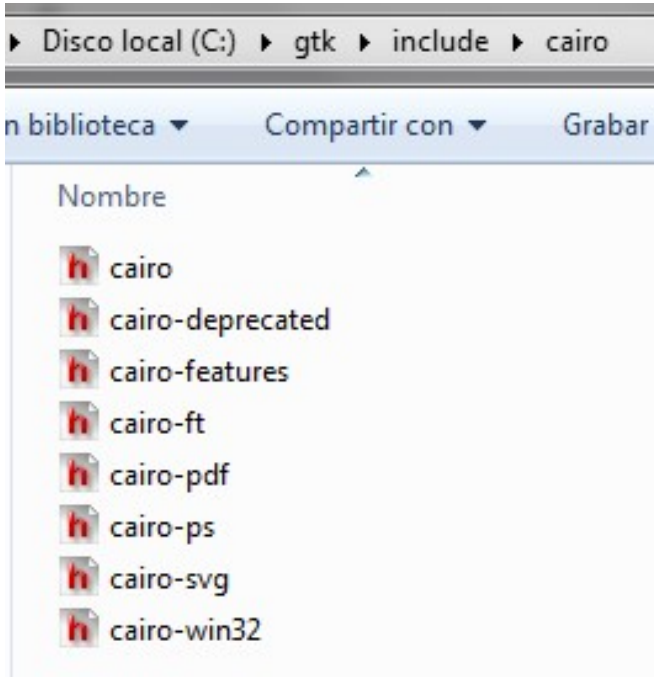
Instalación de cairo sobre Windows

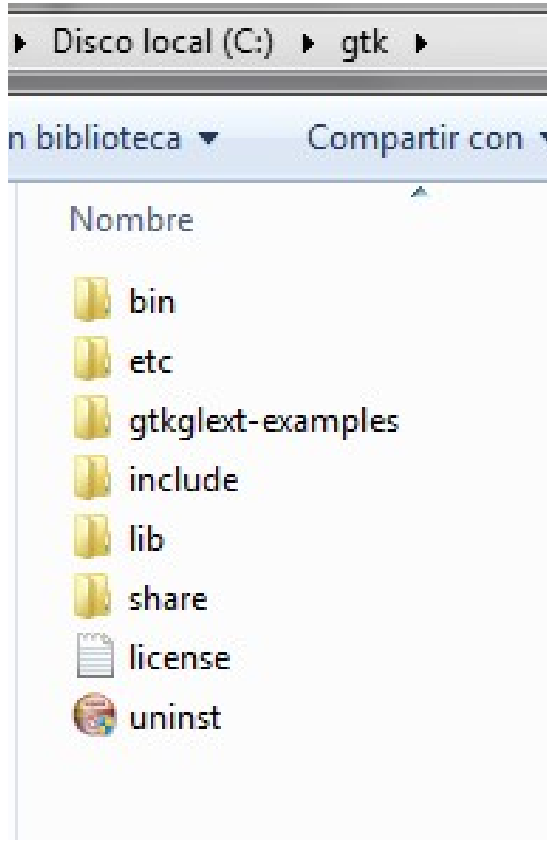




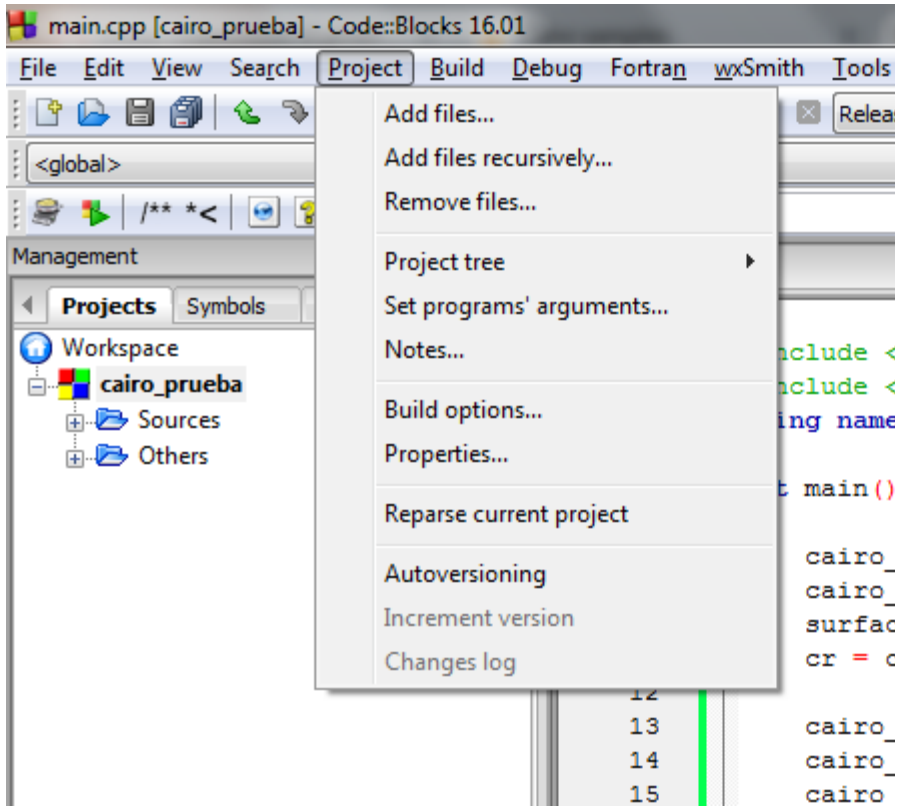
Instalación de cairo sobre Windows

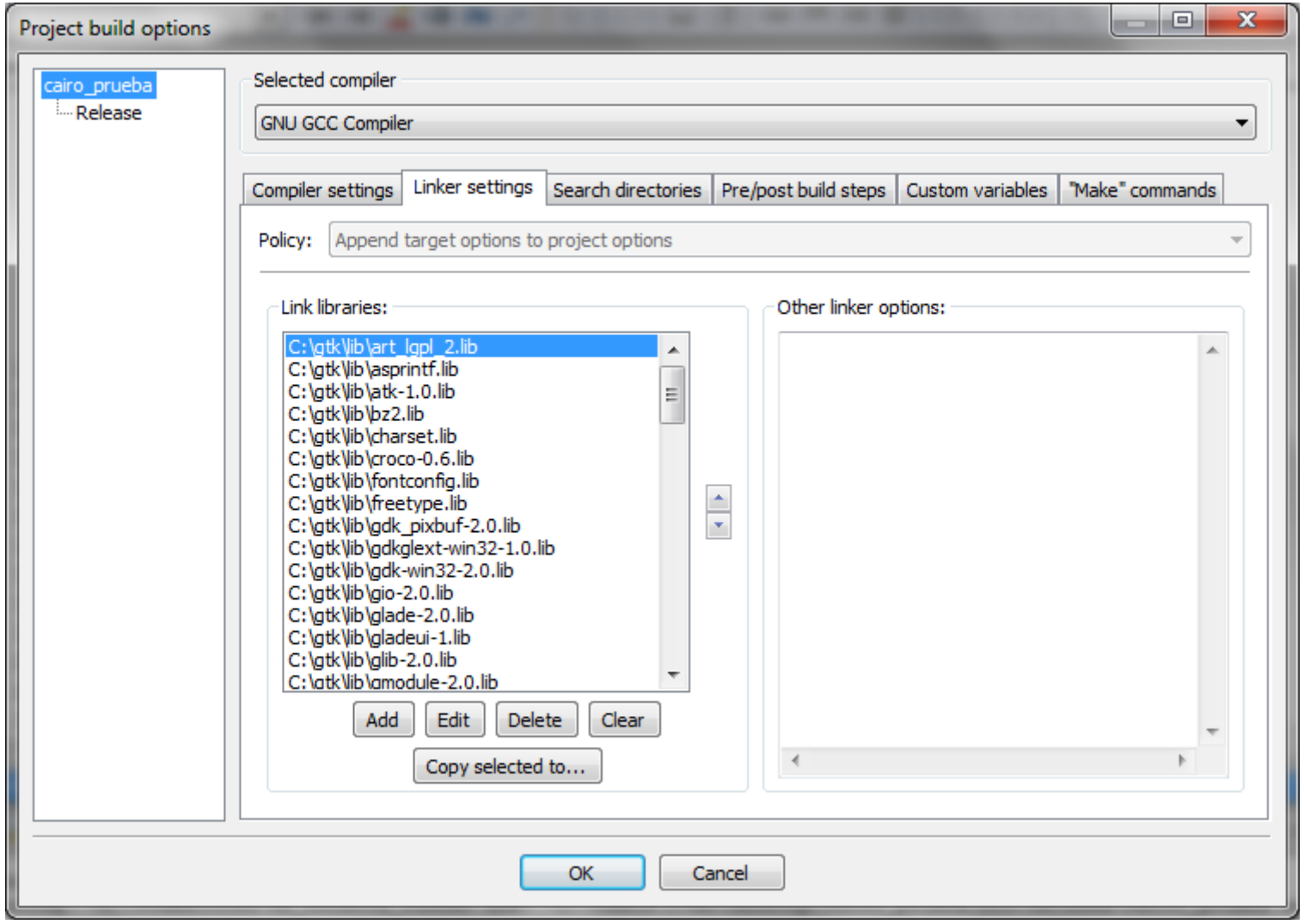






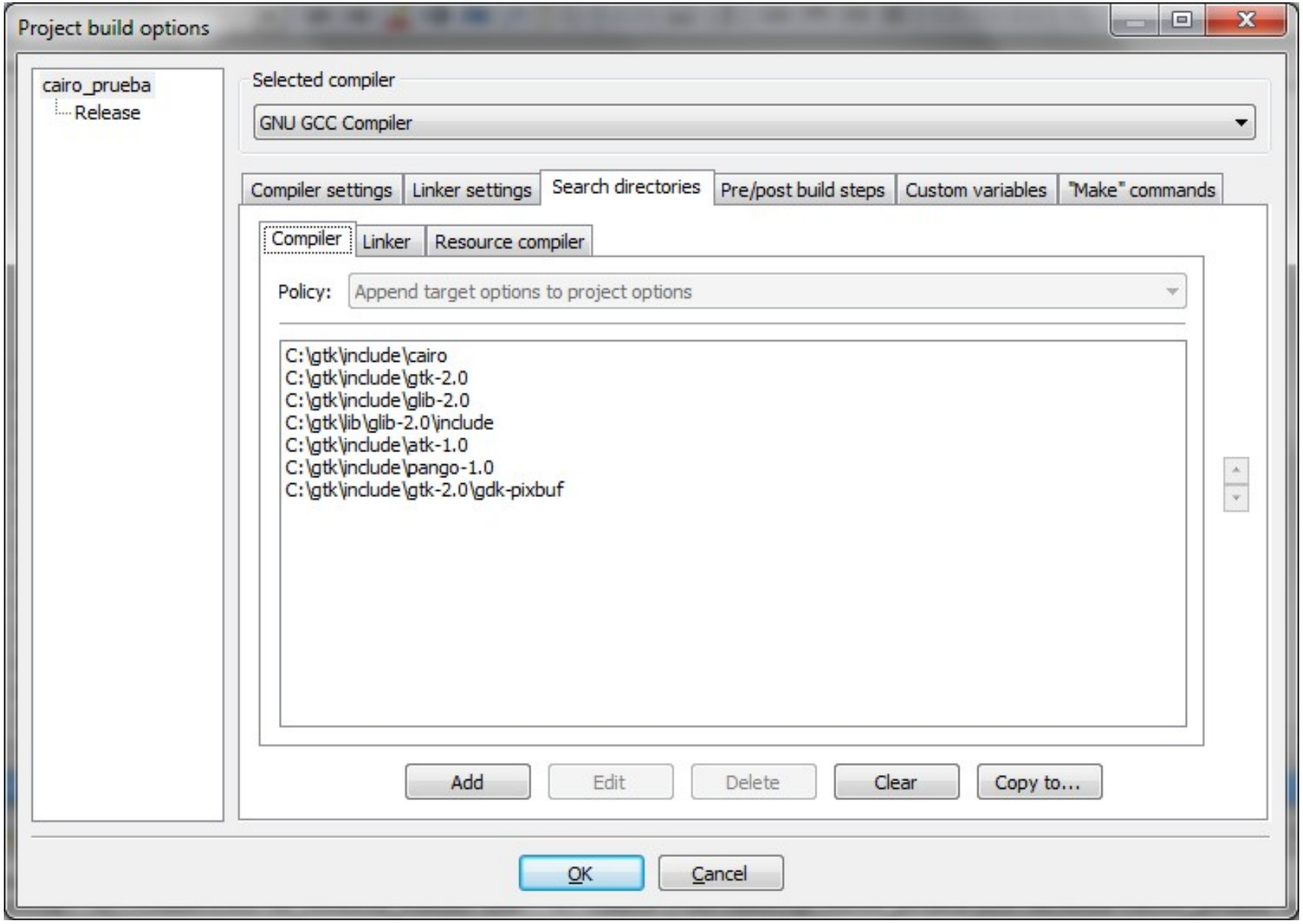
Configurando CodeBlocks para usar cairo sobre Windows





Copiar todas las librerias de-> C:\gtk\lib

Configurando CodeBlocks para usar cairo sobre Windows



Traza al Compilar aplicación en CodeBlocks / cairo

Logs & others

Search results | Cccc | Build log | Build messages | CppCheck | CppCheck messages | Cscope | Debugger | DoxyBlocks

```
-------------- Build: Release in cairo_prueba (compiler: GNU GCC Compiler)---------------

mingw32-g++.exe -Wall -fexceptions -O2 -IC:\gtk\include\cairo -IC:\gtk\include\gtk-2.0 -IC:\gtk\include\glib-2.0 -IC:\gtk\lib\glib-2.0\include -IC:\gtk
\include\atk-1.0 -IC:\gtk\include\pango-1.0 -IC:\gtk\include\gtk-2.0\gdk-pixbuf -IC:\gtk\include\cairo -IC:\gtk\include\gtk-2.0 -IC:\gtk\include\glib-
2.0 -IC:\gtk\lib\glib-2.0\include -IC:\gtk\include\atk-1.0 -IC:\gtk\include\pango-1.0 -IC:\gtk\include\gtk-2.0\gdk-pixbuf -c C:\Users\Ivan\Desktop
\cairo_prueba\main.cpp -o obj\Release\main.o
mingw32-g++.exe  -o bin\Release\cairo_prueba.exe obj\Release\main.o  -s  C:\gtk\lib\art_lgpl_2.lib C:\gtk\lib\asprintf.lib C:\gtk\lib\atk-1.0.lib C:\gtk
\lib\bz2.lib C:\gtk\lib\charset.lib C:\gtk\lib\croco-0.6.lib C:\gtk\lib\fontconfig.lib C:\gtk\lib\freetype.lib C:\gtk\lib\gdk_pixbuf-2.0.lib C:\gtk\lib
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0.6.dll.a C:\gtk\lib\libfontconfig.dll.a C:\gtk\lib\libfreetype.dll.a C:\gtk\lib\libgdk_pixbuf-2.0.dll.a C:\gtk\lib\libgdkglext-win32-1.0.dll.a C:\gtk
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C:\gtk\lib\libz.dll.a C:\gtk\lib\pango-1.0.lib C:\gtk\lib\pangocairo-1.0.lib C:\gtk\lib\pangoft2-1.0.lib C:\gtk\lib\pangowin32-1.0.lib C:\gtk\lib
\png.lib C:\gtk\lib\popt.lib C:\gtk\lib\rsvg-2.lib C:\gtk\lib\tiff.lib C:\gtk\lib\xml2.lib C:\gtk\lib\z.lib
Output file is bin\Release\cairo_prueba.exe with size 543.00 KB
Process terminated with status 0 (0 minute(s), 0 second(s))
0 error(s), 0 warning(s) (0 minute(s), 0 second(s))
```

Funciones para utilizar en Cairo
https://www.cairographics.org/manual/

cairo_surface_t	Clase base para generacion de superficies
cairo_t	Tipo de dato definido para generar un contexto
cairo_image_surface_create	Crea un espacio de almacenamiento (formato,tamaño)
cairo_create	Asignacion de surface al contexto definido
cairo_select_font_face	Seleccion del tipo de fuente
cairo_set_font_size	Seleccion del tamaño de fuente
cairo_set_source_rgb	Asignación del color
cairo_move_to	Posicionamiento del puntero sobre la surface
cairo_show_text	Desplegado de texto
cairo_destroy	Liberación de memoria para contexto
cairo_surface_write_to_png	Salida del gráfico como imagen tipo "png"
cairo_surface_destroy	Liberación de memoria para Surface
cairo_stroke	Liberación de lienzo de un objeto pintado

Ejemplo de Cairo en C++

```
#include <iostream>
#include <cairo.h>
using namespace std;

int main()
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32,500,200);
    cr = cairo_create (surface);

    cairo_set_source_rgb (cr,0,1,0);
    cairo_rectangle(cr,20,20,120,80);
    cairo_fill(cr);

    cairo_surface_write_to_png(surface,"Cuadro.png");
    cairo_destroy(cr);
    cairo_surface_destroy(surface);
    return 0;
}
```

Inicialización de:
- Superficie de pintado
- Lienzo a pintar

Ejemplo de Cairo en C++

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    cairo_rectangle(cr,20,20,120,80);
    cairo_fill(cr);

    cairo_surface_write_to_png(surface,"Cuadro.png");
    cairo_destroy(cr);
    cairo_surface_destroy(surface);
    return 0;
}
```

Inicialización de:
- Superficie de pintado
- Lienzo a pintar

- Escritura de objeto gráfico
- Liberación de memoria

Ejemplo de Cairo en C++

```
#include <iostream>
#include <cairo.h>
using namespace std;

int main()
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32,500,200);
    cr = cairo_create (surface);

    cairo_set_source_rgb (cr,0,1,0);
    cairo_rectangle(cr,20,20,120,80);
    cairo_fill(cr);

    cairo_surface_write_to_png(surface,"Cuadro.png");
    cairo_destroy(cr);
    cairo_surface_destroy(surface);
    return 0;
}
```

Inicialización de:
- Superficie de pintado
- Lienzo a pintar

- Declaramos color verde (0-1-0)
- Creamos un rectángulo (x,y,L,W)
- Coloreamos rectángulo

- Escritura de objeto gráfico
- Liberación de memoria

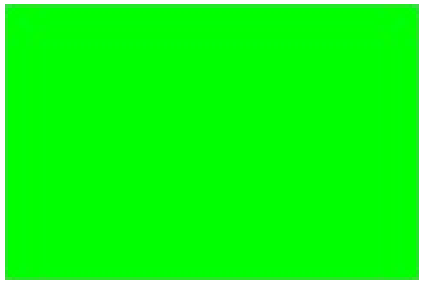
Ejemplo de Cairo en C++

```
#include <iostream>
#include <cairo.h>
using namespace std;

int main()
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32,500,200);
    cr = cairo_create (surface);

    cairo_set_source_rgb (cr,0,1,0);
    cairo_rectangle(cr,20,20,120,80);
    cairo_fill(cr);

    cairo_surface_write_to_png(surface,"Cuadro.png");
    cairo_destroy(cr);
    cairo_surface_destroy(surface);
    return 0;
}
```



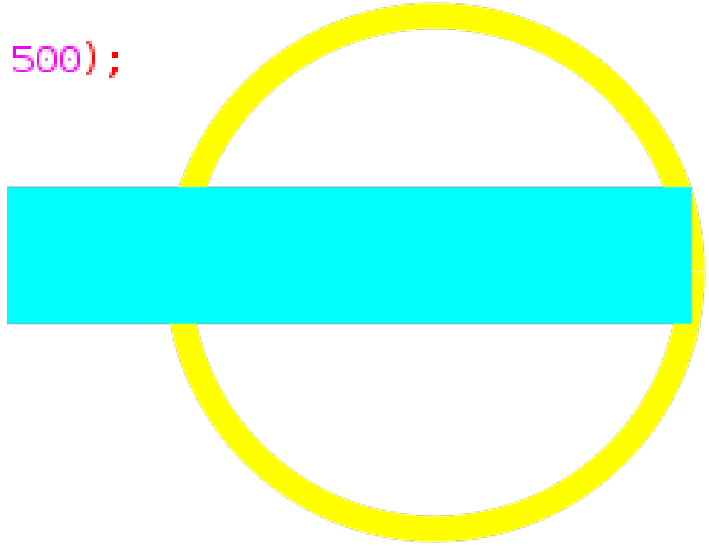
Trabajando cairo

```
void wxcairo1Frame::OnAbout(wxCommandEvent& event)
{
    cairo_surface_t *surface;
    cairo_t *cr;

    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32, 500, 500);
    cr = cairo_create (surface);

    cairo_set_source_rgb (cr, 1.0, 1.0, 0.0);
    cairo_set_line_width(cr,15);
    cairo_arc(cr,250,250,150,0,6.28);
    cairo_stroke(cr);
    cairo_set_source_rgb (cr, 0.0, 1.0, 1.0);
    cairo_rectangle(cr,0,200,400,80);
    cairo_fill(cr);
    cairo_surface_write_to_png (surface, "Anuncio.png");
    cairo_destroy (cr);
    cairo_surface_destroy (surface);


}
```



Trabajando cairo

```
void wxcairo1Frame::OnAbout(wxCommandEvent& event)
{
    cairo_surface_t *surface;
    cairo_t *cr;

    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32, 250, 100);
    cr = cairo_create (surface);

    cairo_select_font_face (cr, "serif", CAIRO_FONT_SLANT_NORMAL, CAIRO_FONT_WEIGHT_BOLD);
    cairo_set_font_size (cr, 12.0);
    cairo_set_source_rgb (cr, 0.5, 0.1, 1.0);
    cairo_move_to (cr, 10.0, 10.0);
    cairo_show_text (cr, "Programando en Cairo");
    cairo_destroy (cr);
    cairo_surface_write_to_png (surface, "Imagen1.png");
    cairo_surface_destroy (surface);


}
```

Trabajando cairo

```
void wxcairo1Frame::OnAbout(wxCommandEvent& event)
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32, 500, 500);
    cr = cairo_create (surface);
    cairo_fill(cr);
    cairo_set_source_rgb (cr, 0.0, 1.0, 0.0);
    cairo_set_line_width(cr,25);
    cairo_arc(cr,200,200,100,0,6.28);
    cairo_stroke(cr);
    cairo_set_source_rgb (cr, 0.0, 1.0, 1.0);
    cairo_rectangle(cr,0,160,400,50);
    cairo_fill(cr);
    cairo_select_font_face (cr, "sans", CAIRO_FONT_SLANT_NORMAL, CAIRO_FONT_WEIGHT_NORMAL);
    cairo_set_font_size (cr, 24.0);
    cairo_set_source_rgb (cr, 0.5, 0.1, 1.0);
    cairo_move_to (cr, 200.0, 180.0);
    cairo_show_text (cr, "Cairo");
    cairo_surface_write_to_png (surface, "Anuncio1.png");
    cairo_destroy (cr);
    cairo_surface_destroy (surface);


}
```

Trabajando cairo

```
void wxcairo1Frame::OnAbout(wxCommandEvent& event)
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32, 500, 200);
    cr = cairo_create (surface);

    cairo_move_to (cr, 20, 20);
    cairo_curve_to(cr,320,200,330,110,450,40);
    cairo_stroke(cr);

    cairo_surface_write_to_png (surface, "Bezier.png");
    cairo_destroy (cr);
    cairo_surface_destroy (surface);


}
```

http://zetcode.com/gfx/pycairo/basicdrawing/

Trabajando cairo

```
void wxcairolFrame::OnAbout(wxCommandEvent& event)
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32, 500, 200);
    cr = cairo_create (surface);

    cairo_set_source_rgb (cr, 0.0, 1.0, 0.0);
    cairo_rectangle(cr,20, 20, 120, 80);
    cairo_rectangle(cr,180, 20, 80, 80);
    cairo_fill(cr);

    cairo_surface_write_to_png (surface, "Path.png");
    cairo_destroy (cr);
    cairo_surface_destroy (surface);
}
```

Trabajando cairo

```
void wxcairo1Frame::OnAbout(wxCommandEvent& event)
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32, 500, 200);
    cr = cairo_create (surface);

    cairo_set_source_rgb (cr, 0.0, 1.0, 0.0);
    cairo_rectangle(cr,20, 20, 120, 80);
    cairo_rectangle(cr,180, 20, 80, 80);
    cairo_fill(cr);
    cairo_arc(cr,350, 70, 30, 0, 2* 3.1416);
    cairo_fill(cr);

    cairo_surface_write_to_png (surface, "Path.png");
    cairo_destroy (cr);
    cairo_surface_destroy (surface);
}
```

Trabajando cairo

```
void wxcairo1Frame::OnAbout(wxCommandEvent& event)
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32, 300, 300);
    cr = cairo_create (surface);

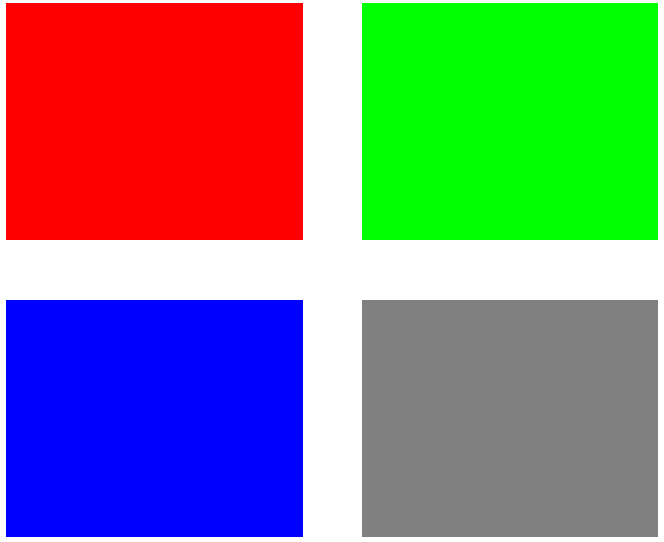
    cairo_set_source_rgb (cr, 1.0, 0.0, 0.0);
    cairo_rectangle(cr,20, 30, 100, 80);
    cairo_fill(cr);

    cairo_set_source_rgb (cr, 0.0, 1.0, 0.0);
    cairo_rectangle(cr,140, 30, 100, 80);
    cairo_fill(cr);

    cairo_set_source_rgb (cr, 0.0, 0.0, 1.0);
    cairo_rectangle(cr,20, 130, 100, 80);
    cairo_fill(cr);

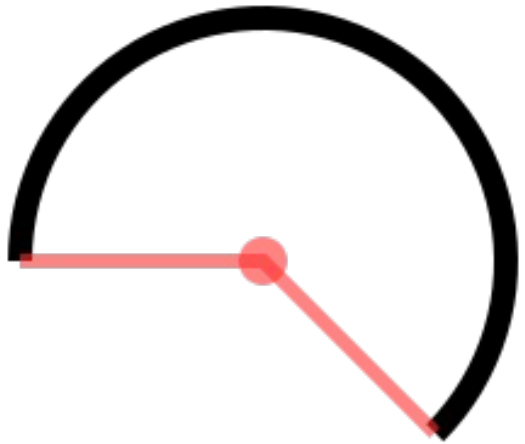
    cairo_set_source_rgb (cr, 0.5, 0.5, 0.5);
    cairo_rectangle(cr,140, 130, 100, 80);
    cairo_fill(cr);

    cairo_surface_write_to_png (surface, "Recs.png");
    cairo_destroy (cr);
    cairo_surface_destroy (surface);
}
```



Trabajando cairo

```
void wxcairo1Frame::OnAbout(wxCommandEvent& event)
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32, 300, 300);
    cr = cairo_create (surface);
    double xc = 128.0;
    double yc = 128.0;
    double radius = 100.0;
    double angle1 = 45.0  * (M_PI/180.0);  /* angles are specified */
    double angle2 = 180.0 * (M_PI/180.0);  /* in radians           */
    cairo_set_line_width (cr, 10.0);
    cairo_arc_negative (cr, xc, yc, radius, angle1, angle2);
    cairo_stroke (cr);
    /* draw helping lines */
    cairo_set_source_rgba (cr, 1, 0.2, 0.2, 0.6);
    cairo_set_line_width (cr, 6.0);
    cairo_arc (cr, xc, yc, 10.0, 0, 2*M_PI);
    cairo_fill (cr);
    cairo_arc (cr, xc, yc, radius, angle1, angle1);
    cairo_line_to (cr, xc, yc);
    cairo_arc (cr, xc, yc, radius, angle2, angle2);
    cairo_line_to (cr, xc, yc);
    cairo_stroke (cr);
    cairo_surface_write_to_png (surface, "CairoEjemplo.png");
    cairo_destroy (cr);
    cairo_surface_destroy (surface);
}
```



https://www.cairographics.org/samples/

Trabajando cairo

```
void wxcairo1Frame::OnAbout(wxCommandEvent& event)
{
    cairo_surface_t *surface;
    cairo_t *cr;
    surface = cairo_image_surface_create (CAIRO_FORMAT_ARGB32, 300, 300);
    cr = cairo_create (surface);

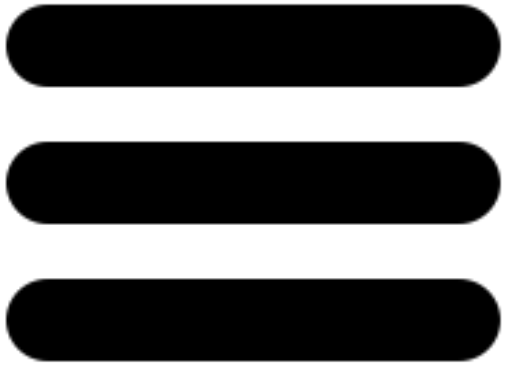
    cairo_move_to (cr, 50.0, 75.0);
    cairo_line_to (cr, 200.0, 75.0);

    cairo_move_to (cr, 50.0, 125.0);
    cairo_line_to (cr, 200.0, 125.0);

    cairo_move_to (cr, 50.0, 175.0);
    cairo_line_to (cr, 200.0, 175.0);

    cairo_set_line_width (cr, 30.0);
    cairo_set_line_cap (cr, CAIRO_LINE_CAP_ROUND);
    cairo_stroke (cr);

    cairo_surface_write_to_png (surface, "Lines.png");
    cairo_destroy (cr);
    cairo_surface_destroy (surface);
}
```



https://www.cairographics.org/samples/

Trabajando cairo

```
void wxcairo1Frame::OnAbout(wxCommandEvent& event)
{
    int w, h;
    cairo_surface_t *image;

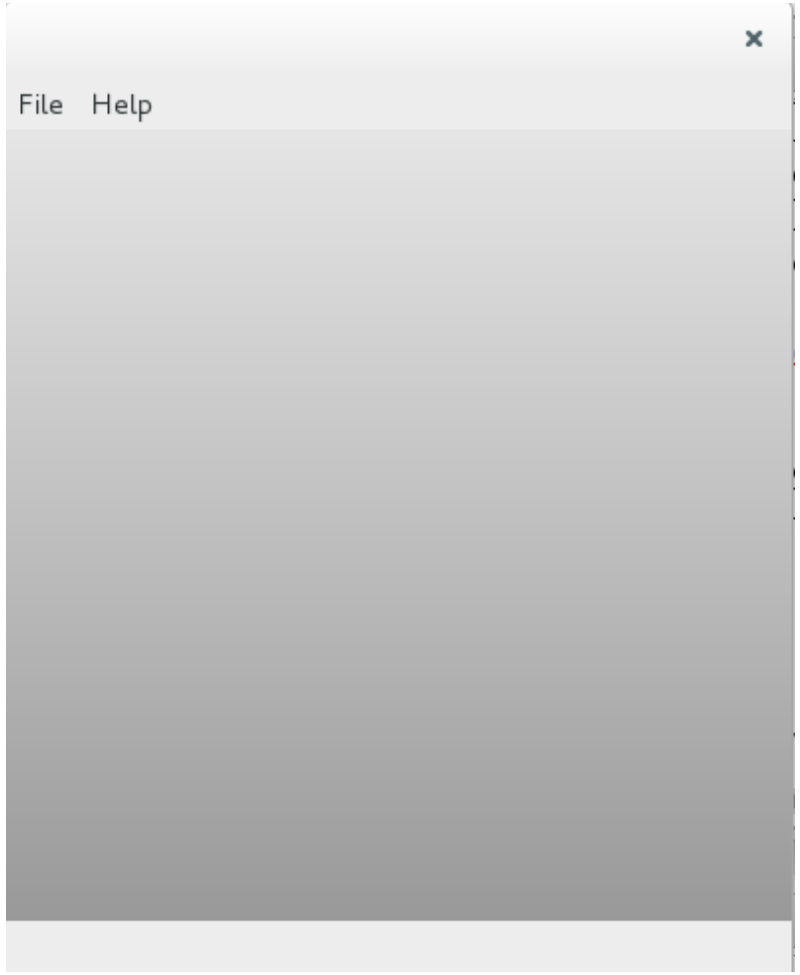
    image = cairo_image_surface_create_from_png ("lobo.png");
    w = cairo_image_surface_get_width (image);
    h = cairo_image_surface_get_height (image);

    cairo_surface_write_to_png (image, "lobo_cairo.png");
    cairo_surface_destroy (image);
}
```

Generando un Sistema Cartesiano

Generando un graficador 2-D (Fondo)

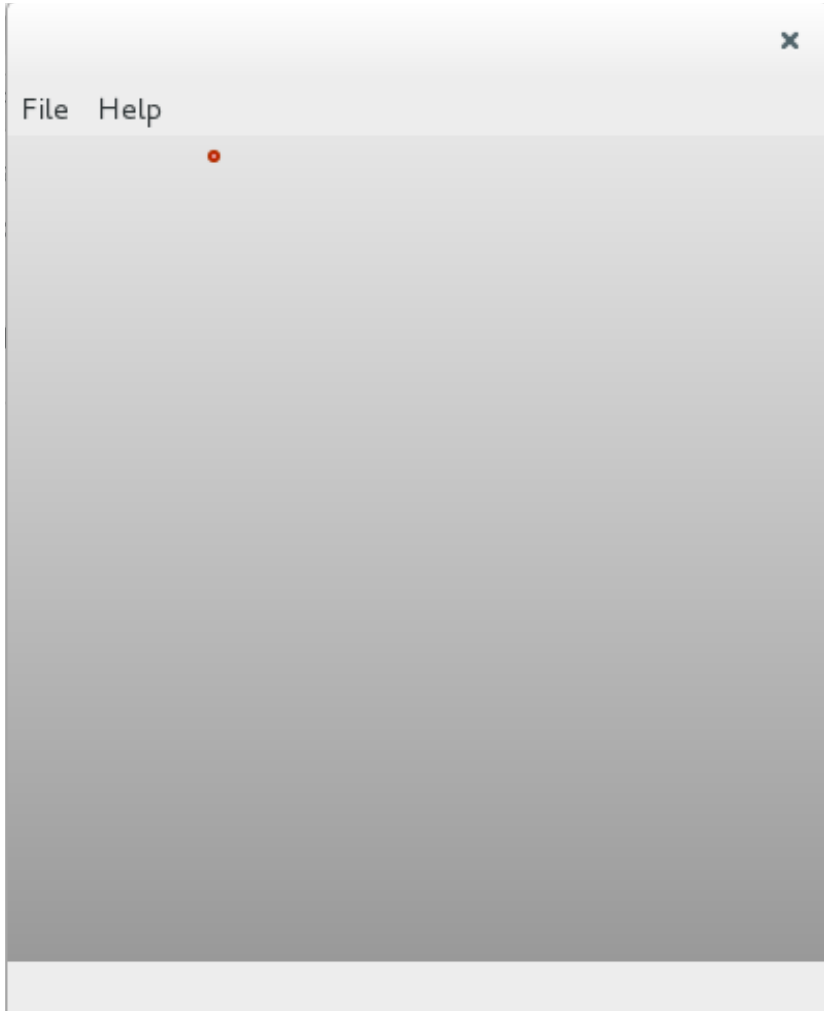
```
cairo_pattern_t *pat;
pat = cairo_pattern_create_linear (width/2, 0.0,  width/2, height);
cairo_pattern_add_color_stop_rgb (pat, 0.0, 0.9, 0.9, 0.9);
cairo_pattern_add_color_stop_rgb (pat, 1.0, 0.6, 0.6, 0.6);
cairo_rectangle (cr, 0, 0, width, height);
cairo_set_source (cr, pat);
cairo_fill (cr);
```



Generando un graficador 2-D (Data Points)

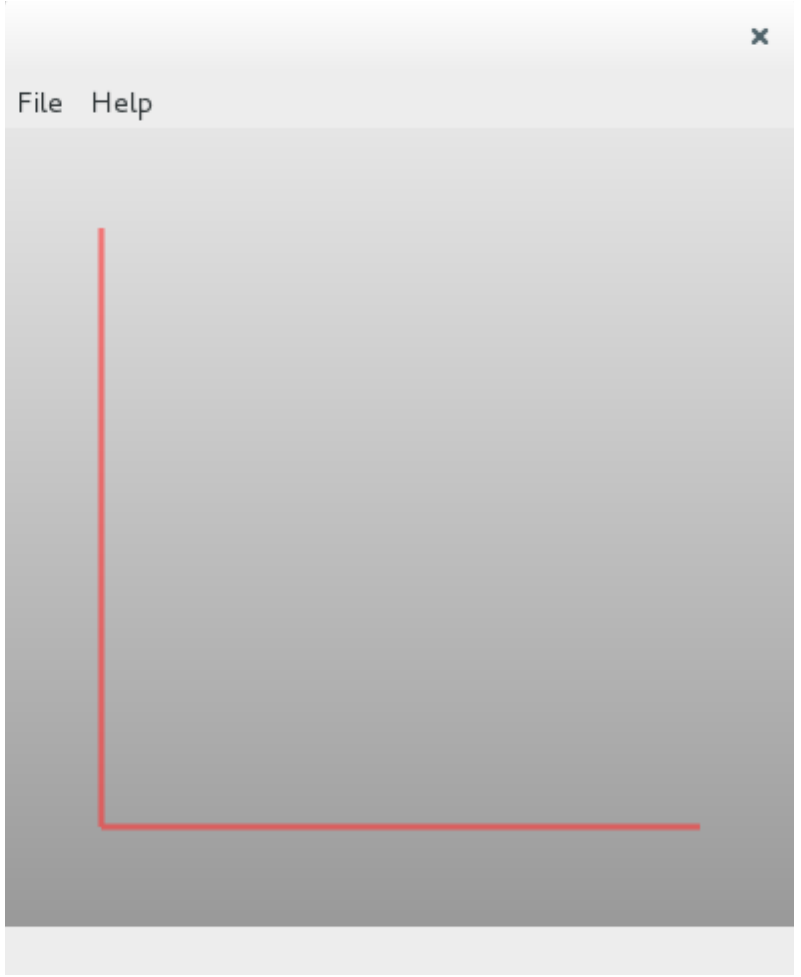
```
cairo_set_source_rgb(cr, 0.69, 0.19, 0);
cairo_arc(cr, 100, 10,2.1, 0, 2 * M_PI);
cairo_stroke_preserve(cr);
cairo_set_source_rgba(cr, 0.9, 0.0, 0.0,0.3);
cairo_fill(cr);
```

Contexto
Pos_x
Pos_y
Radio
[0,2pi]



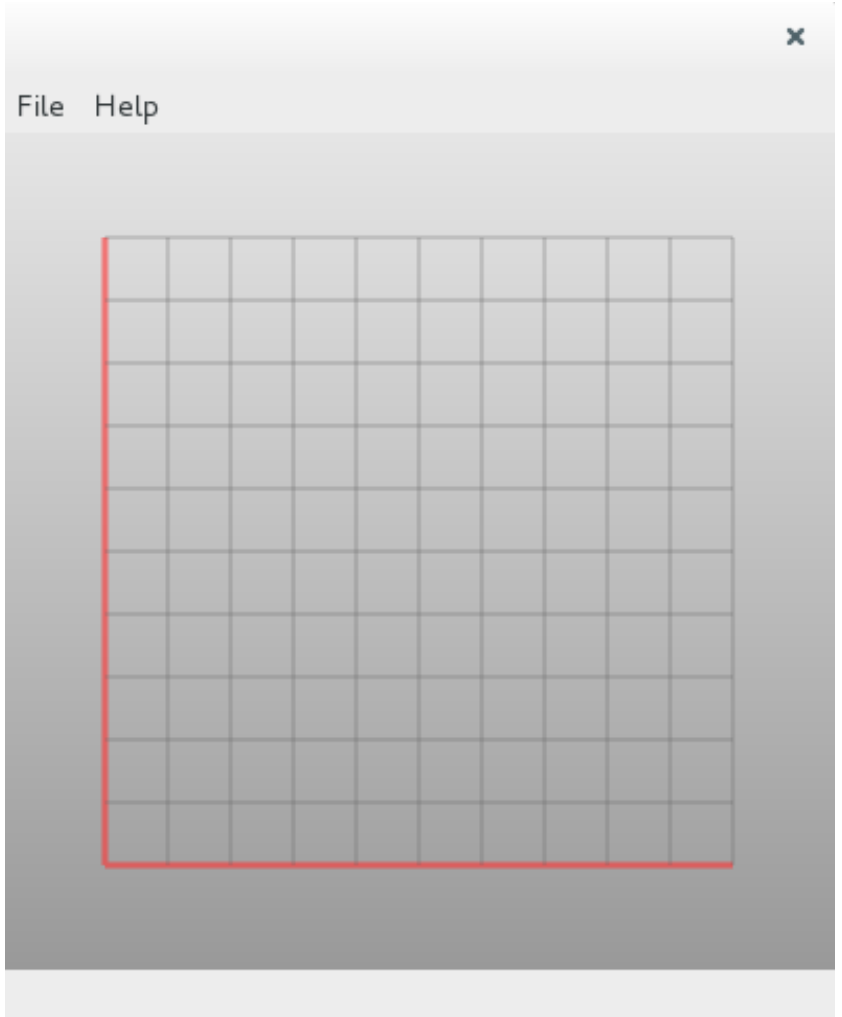
Generando un graficador 2-D (Eje)

```
//1.- Obtener el max y min de (x,y)
double xmax = Max(vectorx,tam);double xmin = Min(vectorx,tam);
double ymax = Max(vectory,tam);double ymin = Min(vectory,tam);
//2.-Ubicar el plano cartesiano a) origen b) eje x c) eje y
double ejex = width - (width/8);//proporcion del 1/8 sobre el canvas
double ejey = height/8;//proporcion del 1/8 sobre el canvas
double origenx = width/8;//proporcion del 1/8 sobre el canvas
double origeny = height - (height/8);//proporcion del 1/8 sobre el canvas
//pintado de los ejes x,y
cairo_set_source_rgba (cr, 1, 0.2, 0.2, 0.6);
cairo_set_line_width (cr, 3.0);
cairo_move_to (cr,origenx,origeny); cairo_line_to (cr,ejex,origeny);//eje x
cairo_move_to (cr,origenx,origeny); cairo_line_to (cr,origenx,ejey);//eje y
```



Generando un graficador 2-D (Grid)

```
//pintado del grid
double metrica_ejex = (ejex - origenx)/10.0;//proporcion de longit
double metrica_ejey = (origeny - ejey)/10.0;//proporcion de longit
for (int indice=1; indice < 11; indice++)
{
    cairo_set_source_rgb (cr,0.4, 0.4, 0.4);
    cairo_set_line_width (cr, 0.5);
    //vertical(solo cambia la posicion en x)
    cairo_move_to (cr,(origenx+(metrica_ejex*indice)),origeny);
    cairo_line_to (cr,(origenx+(metrica_ejex*indice)),ejey);
    //horizontal(solo cambia la posicion en x)
    cairo_move_to (cr,origenx,(ejey+(metrica_ejey*(indice-1))));
    cairo_line_to (cr,ejex,   (ejey+(metrica_ejey*(indice-1))));
    cairo_stroke(cr);
}
```

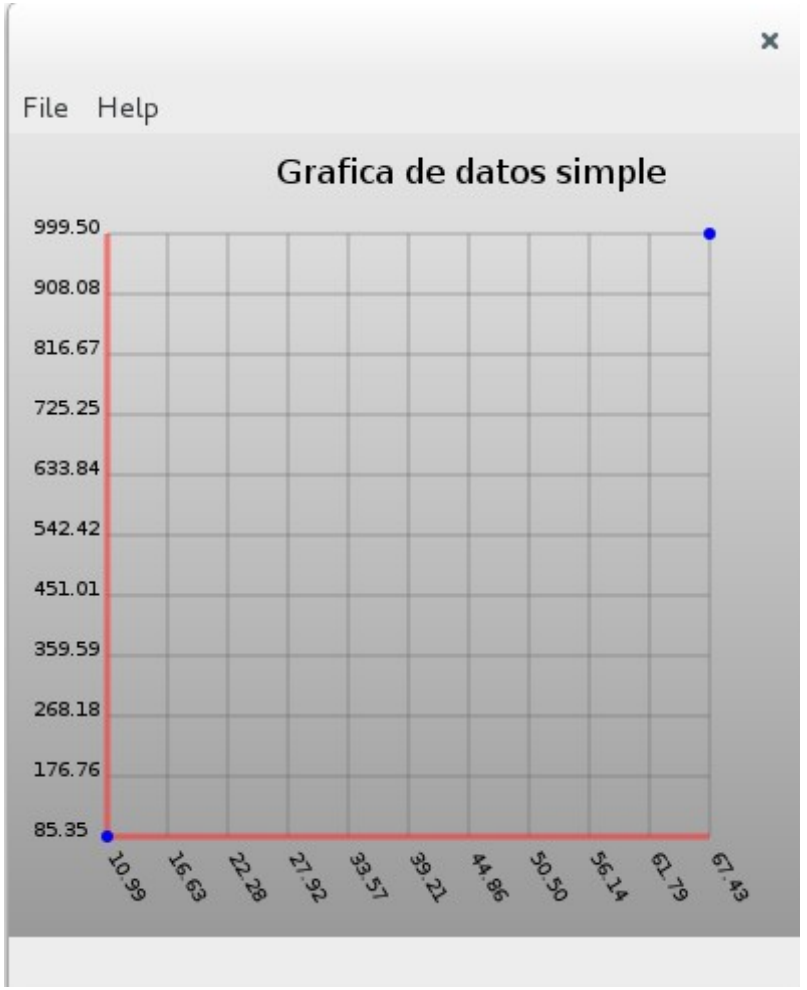


Generando un graficador 2-D (Labels)

```
//1.-Labels horizontales falta
for (int i=0; i < 11; i++)
{
    cairo_set_source_rgb(cr, 0.0, 0.0, 0.0);
    cairo_select_font_face (cr, "Sans",CAIRO_FONT_SLANT_NORMAL,C
    cairo_set_font_size (cr, 10.0);
    cairo_move_to (cr,(origenx+(metrica_ejex*i)),(origeny+10));
    cairo_save(cr);
    cairo_rotate(cr,45.0);
    cairo_show_text (cr,metricax[i]);
    cairo_restore(cr);
}
//2.- Nombre de grafica
cairo_set_source_rgb(cr, 0.0, 0.0, 0.0);
cairo_select_font_face (cr, "Sans", CAIRO_FONT_SLANT_NORMAL,CAIR
cairo_set_font_size (cr, (ejey/3.0));
cairo_move_to (cr, width/3.0,ejey/2.0);
cairo_show_text (cr, nombre);
```

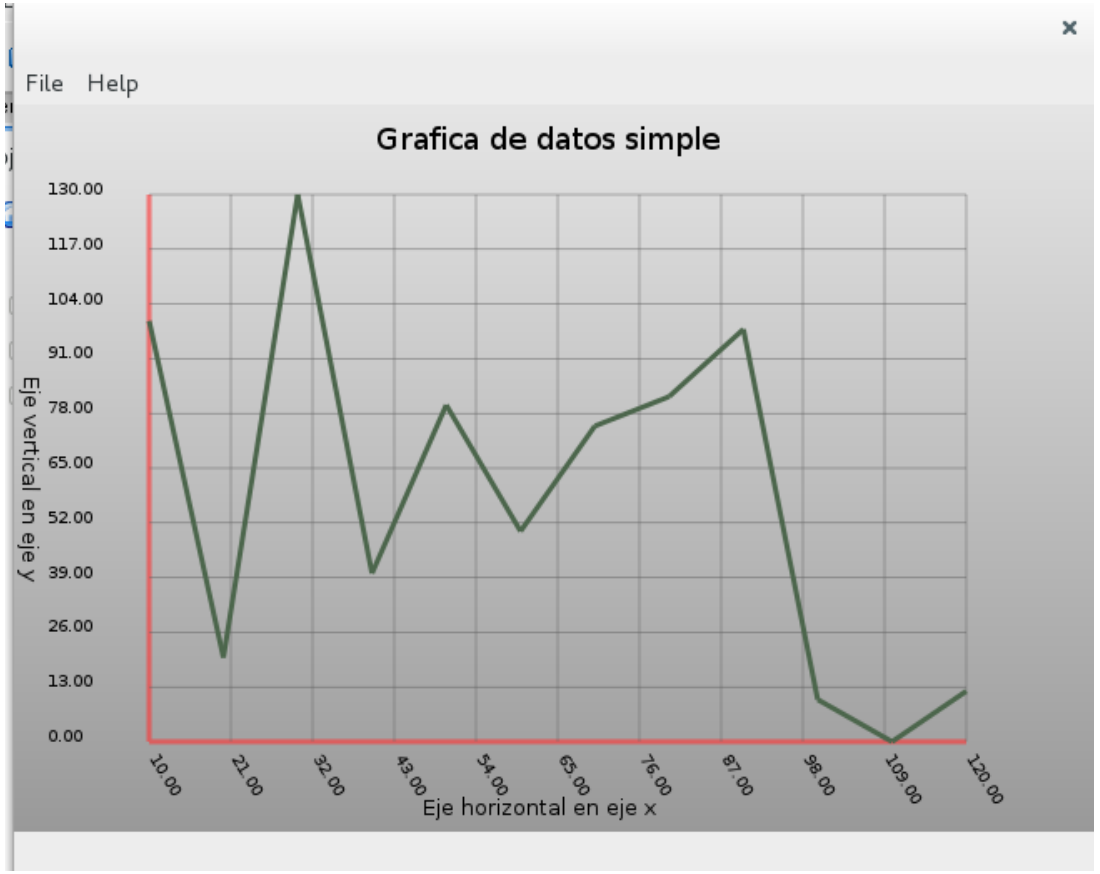
Generando un graficador 2-D (Scatter Plot)

```
//pintado de los datapoints
    for(int i=0;i<tam;i++)
    {
        double valx = Ecuacion_recta(ejex,origenx,xmax,xmin,vectorx[i]);
        double valy = Ecuacion_recta(ejey,origeny,ymax,ymin,vectory[i]);
        cairo_set_source_rgb(cr, 0.0, 0.0, 1.0);
        cairo_arc(cr, valx, valy,3,0,2*M_PI);
        cairo_fill(cr);
        cairo_stroke(cr);
    }
```

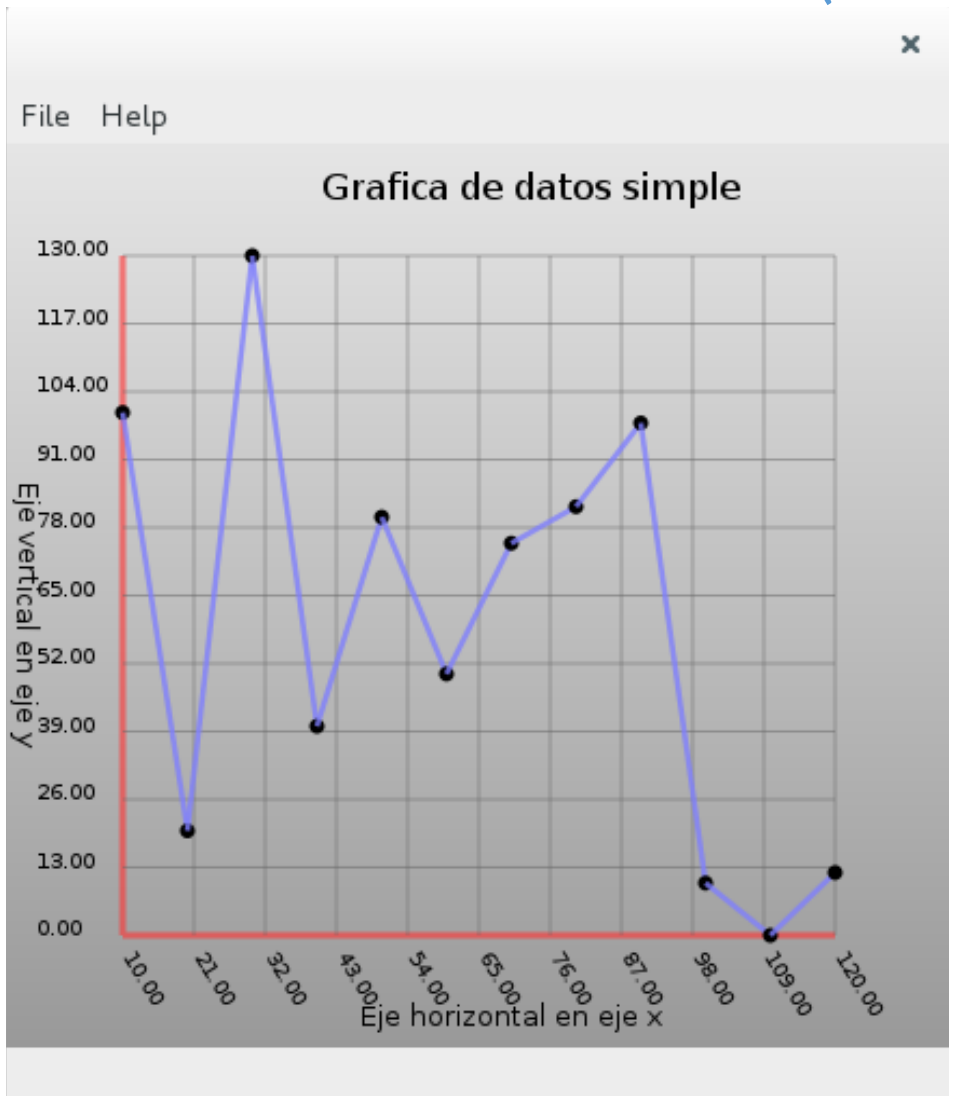


Generando un graficador 2-D (Gráfica lineal)

```
for(int i=0;i<tam;i++)
{
    double valx = Ecuacion_recta(ejex,origenx,xmax,xmin,vectorx[i]);
    double valy = Ecuacion_recta(ejey,origeny,ymax,ymin,vectory[i]);
    if(i >= 1)
    {
        cairo_set_source_rgba (cr,0.3, 0.4, 0.3, 1.0);
        cairo_set_line_width (cr, 3);
        cairo_move_to (cr,xaux,yaux);
        cairo_line_to (cr,valx,valy);
        cairo_stroke(cr);
    }
    xaux = valx;
    yaux = valy;
}
```

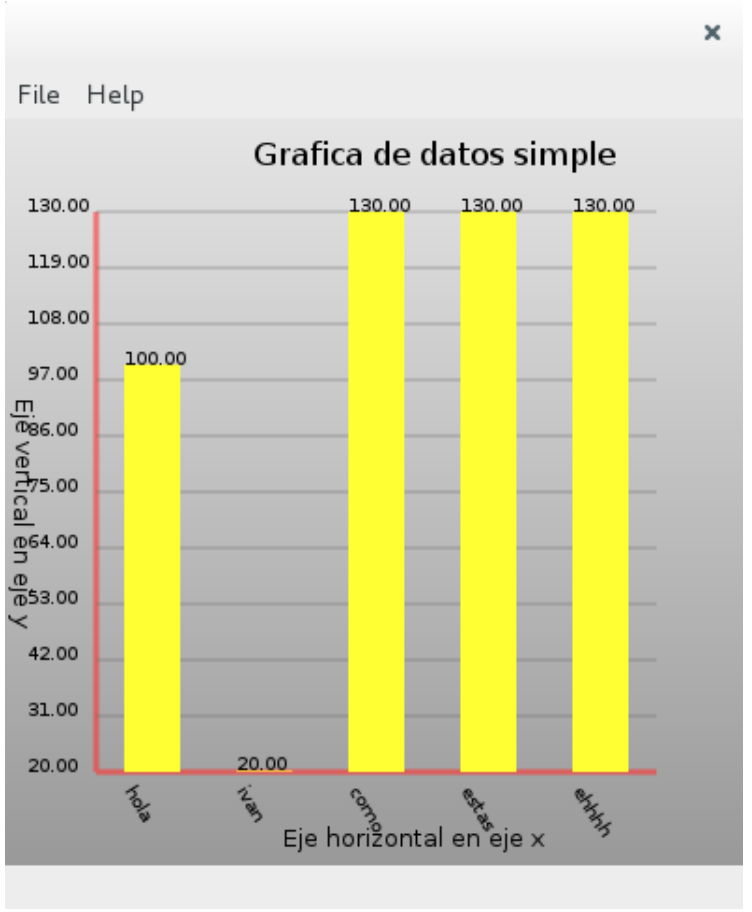


Generando un graficador 2-D
(Otras gráficas)



Generando un graficador 2-D (Bar plot)

```
if (corners == false)
{
    for(int i=0;i<tam;i++)
    {
        double valy = Ecuacion_recta(ejey,origeny,ymax,ymin,vec_vals[i]);
        cairo_set_source_rgba (cr,1.0, 1.0, 0.2, 1.0);
        if (valy == origeny)
            valy -=((origeny-ejey)/500.0);
        cairo_rectangle(cr,(origenx+(metrica_ejex*i)+15),valy,(metrica_ejex/2.0),(origeny-valy)
        cairo_fill(cr);
        cairo_stroke(cr);
        cairo_set_source_rgb(cr, 0.0, 0.0, 0.0);
        cairo_select_font_face (cr, "Sans",CAIRO_FONT_SLANT_NORMAL,CAIRO_FONT_WEIGHT_NORMAL);
        cairo_set_font_size (cr, 10.0);
```



Generando un graficador 2-D (Bar plots)