

Basics of Image Processing

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Agenda

- 1 Image
- 2 GIMP-Basics
- 3 Screenshots
- 4 Latex
- 5 Xfig
- 6 Xfig Demos
- 7 Inkscape
- 8 Inkscape Demo

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Image - definitions

Raster image (bitmap)

- In computer graphics, a raster graphics image or bitmap:
 - is a data structure representing a generally rectangular grid of pixels, or points of color, viewable via a monitor, paper, etc.
 - raster images are stored in image files with varying formats.

Vector image

- In computer graphics, a vector graphics:
 - is the use of geometrical primitives (points, lines, curves, and shapes or polygons), which are all based upon mathematical equations, to represent images

Images may be

- two-dimensional: a photograph, screen display,
- three-dimensional: such as a statue.

Bitmap Image - Characterization

Bitmap image is technically characterized

- by the width and height of the image in pixels giving the **resolution** of the image
 - VGA: 640x480 pixel
 - SGA: 800x600
 - XGA: 1024x768
 - UXGA: 1600x1200
 - WUXGA: 1920x1200
- by the the number of bits per pixel
 - meaning the color depth, which determines the number of colors it can represent.
- quality of raster image determined by resolution and color depth

Bitmap Image - Color

Color Spaces:

- RGB color space: Red, Green, Blue additive colors
 - color depth: defined by three bytes — one byte for each color.
 - standard for computer displays since 1995
- Monochrom space: an image with only black and white pixels
 - requires only a single bit for each pixel.
- others: sRGB, Adobe-RGB, CMYK (printers), etc.

Image Formats

- JPEG, TIFF, PNG, etc.
- RAW data by digital SLR cameras
 - lossless compression
 - 12, 14 bit color depth (!!)
 - image processing in RAW mode, image will be only after converted to JPG
- **always shot in RAW mode**

Image Processing Overview

Image Processing operations are among many other

- Geometric transformations: enlargement, reduction, and rotation
- Color corrections such as
 - brightness and contrast adjustments, quantization, or conversion to a different color space
- Image editing: increase the quality of a digital image
 - manipulate, enhance, and transform images
- HDR - High dynamic range imaging
 - Extending dynamic range by combining differently exposed images

Special Software needed for Digital Image Processing (DIP)

- DIP is done by special software to manipulate images in many ways
 - Adobe Photoshop line
 - GIMP - GNU Image Manipulation Program
 - DPP - Canon Digital Photo Professional for Canon DSLRs
 - ACDSee - more simple application

Image pixel size - Output device - output image size

relation of these terms

Pixel image - resolution

- image of any formats is stored in a file
- image resolution is given in pixel

Output devices - resolution

- computer display
 - has a size in inch (my display: 20,3 inch wide 12,8 inch high, gives 24 inch in diagonal)
- it has 1920 x 1200 pixel
- horizontal resolution is: $1920 / 20,3 = \text{about } 95 \text{ pixel/inch}$
- vertical resolution is: $1200 / 12,8 = 94 \text{ pixel/inch}$

Printer devices

- resolution in dpi, dot per inch
- variable, till max. 600 or 1200 dpi
- dpi not equal ppi. for simplicity we treat it equal

Image pixel size - Output device - output image size

relation of these terms

Image size on the display

- Example-1: image size 1200 x 800 pixel
 - display resolution is 95 pixel/inch
 - image width on display: $1200/95 = 12,6 \text{ inch} = 32 \text{ cm}$
- Example-2: image size 1200 x 800 pixel
 - Display is my big TV (1920x1080 pixel, 36,6 inch wide)
 - display resolution is 52,5 pixel/inch
 - image width on display: $1200/52,5 = 22,86 \text{ inch} = 80 \text{ cm}$
- Formula:
 - image size in cm on the display is = image size in pixel / output device resolution * 2.54

Image size on the printer

- depends on the resolution you set for printing the image either on the printer or in the software which prints the image

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GIMP - The Gnu Image Manipulation Program

Features - I

What is GIMP

- a free raster graphics editor
- to process digital graphics and photographs
 - image composition: creating graphics and logos
 - photo retouching: removing unwanted image features
 - resizing and cropping photos
 - converting between different image formats (very important use)
 - create basic animated images in GIF format
 - altering colors, combining multiple images
- free software replacement for Adobe Photoshop
 - it is not designed to be a Photoshop clone
- the project was started in 1995
- current version (2.6.10) works with numerous OS:
 - Linux, Microsoft Windows, Apple's Mac OS X, OpenSolaris, FreeBSD

GIMP - The Gnu Image Manipulation Program

Features - II

Effects and filters and formats

- GIMP has approximately 150 standard effects and filters
 - Drop Shadow, Blur, Motion blur and Noise.
 - operations can be automated with scripting languages
 - Scheme (LISP) interpreter named Script-Fu is built in
 - external Perl, Python, or Tcl can be used
- File formats (read and write)
 - BMP, JPEG, PNG, GIF, TIFF
 - Autodesk flic animations, Corel Paint Shop Pro images
 - Adobe Photoshop Documents, PostScript documents
- File formats (read only)
 - Adobe PDF documents
 - raw image formats used by many digital cameras

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Screenshot

General requirements

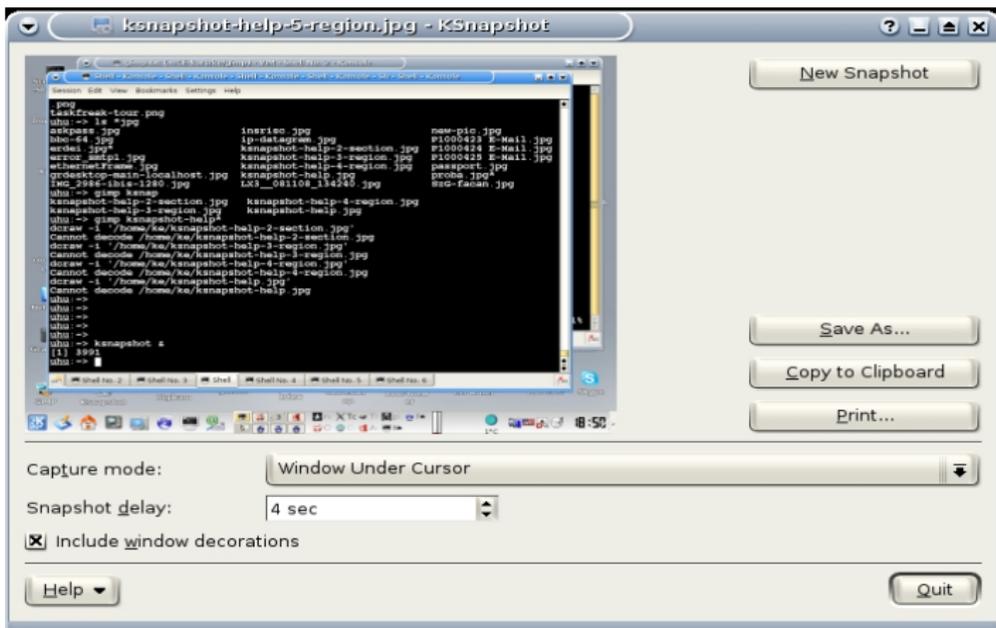
- make a snapshot from a window or from the full screen or from a region of the screen
- set a delay to prepare effects on the screen/window
- convert output to different formats

Software for generating screenshots

- ksnapshot
 - very professional, all requirements implemented
 - this is a screenshot generator only
- GIMP
 - very usable, all necessary functions available
 - DIP program !

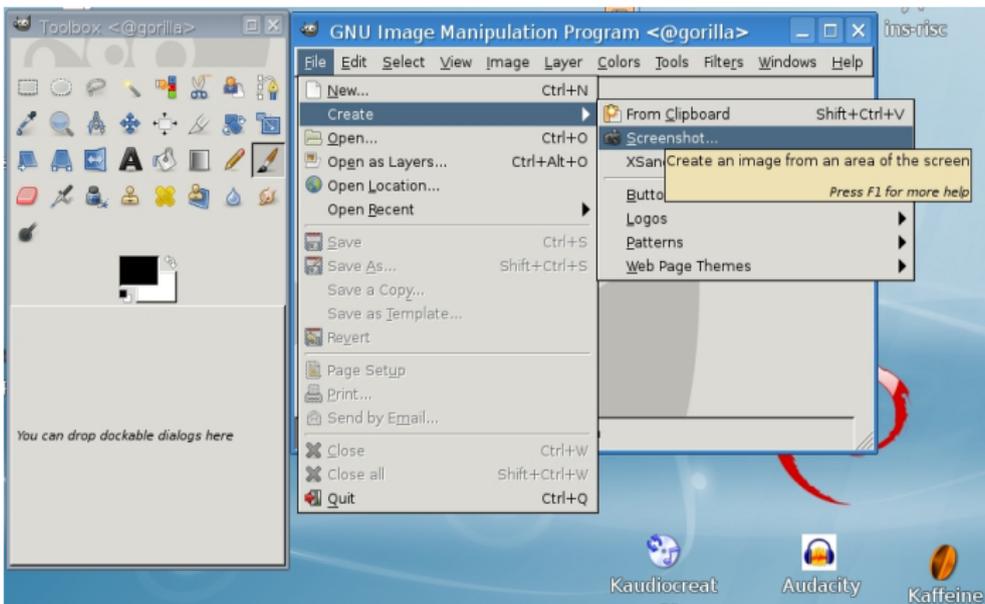
Screenshot with ksnapshot

Starting ksnapshot



Now an online demo with ksnapshot !

Screenshot with GIMP



Now an online demo with GIMP !

Cropping, scaling with GIMP

Now an online demo with GIMP !

- Cropping
- Scaling

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How to include graphics in Latex

Using Latex you can include only .eps graphics (example.tex)

```
\documentclass{article}
\usepackage{graphicx}
\includegraphics[height=4in]{graphic.eps}
\end{document}
```

- compile it by `latex example.tex`

Using PdfLatex you can include png, pdf, jpg, files (pdf-example.tex)

```
\documentclass{article}
\usepackage[pdftex]{graphicx}
\includegraphics[height=4in]{emtex.pdf}
\end{document}
```

- compile it by `pdflatex pdf-example.tex`

Includegraphics Details

The full command structure

Full command

```
\includegraphics [key=value,...]{file}
```

- the optional parameter accepts comma separated list of keys with associated values
- the keys can be used to change the width, height and rotation of the included graphics
- **file** is the graphics. The type may be .eps only using **latex**
- **file** is the graphics. The type may be: .png, .pdf, .jpg using **pdflatex**
- the most important keys:
 - **width**: scale graphics to the specified width
 - **height**: scale graphics to the specified height
 - **angle**: rotate graphics counterclockwise
 - **scale**: scale graphics

Includegraphics Examples

Parameters for includegraphics

```
\includegraphics{sample0_a.pdf}
```

- will use the graphics as it is

```
\includegraphics[scale=0.7]{sample0_a.pdf}
```

- scales the inserted PDF image by factor 0.7

```
\includegraphics[width=12.5cm]{sample0_a.pdf}
```

- will show the image transformed to width 12.5 cm

```
\includegraphics[height=4in]{sample0_a.pdf}
```

```
\includegraphics[width=0.4\textwidth]{sample0_a.pdf}
```

- textwidth is the width of a standard paragraph

```
\includegraphics[height=0.65\textwidth]{sample0_a.pdf}
```

```
\includegraphics[width=.9\columnwidth,bb=67 385 525 742]{cpu.eps}
```

```
\includegraphics[angle=90,width=\columnwidth]{arch.eps}
```

Includegraphics Details

File conversion and Compatibility

- programs to convert graphics formats:
 - epstopdf
 - GIMP
- For compatibility between latex and pdflatex:
 - do NOT use file extensions in the file parameter
 - create the appropriate versions of the graphics in the directory
 - latex will look for `.eps` files
 - pdflatex will look for `.png`, `.pdf`, `.jpg` files in this order !

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Xfig - main features

xfig - Facility for Interactive Generation of figures

Xfig features

- open source vector graphics editor
- runs under the X Window Systems on most UNIX-compatible platforms
- screen-oriented menu-driven tool
- saves figures in its native text-only fig format
- TransFig package is used when printing or exporting

Drawing figures

- using objects: circles, boxes, lines, polygons, text, etc.
- objects can be created, deleted, moved or modified
- for text, 35 fonts are available
- Attributes (e.g. colors, line styles) can be selected in various ways

Xfig - features

xfig - output, input, export

Xfig output

- print figures to a PostScript printer too
- convenient feature is the PSTEX or PDFTEX export format
 - allows integration of Xfig-generated images into LaTeX

Imports various files as images

- Raster formats: GIF, JPEG, PNG, TIFF, XBM, XPM, etc.
- Vector graphics formats: EPS, PostScript

Exports into various formats:

- Raster formats: GIF, JPEG, PNG, PPM, TIFF, etc.
- Vector graphics formats: EPS, SVG, PIC, MetaFont, EMF, Tk

Formats for printed documents:

- PostScript, PDF, HP-GL (printer control language HP plotters)

Xfig - menus, panels

main, drawing, editing, attributes, etc.

Main menue - general basic functions

- File: open, save file, print or export figures
- Edit: paste, search, settings
- View: portrait, lanscape, zoom in/out, show with options, etc.

Drawing Mode Panel:

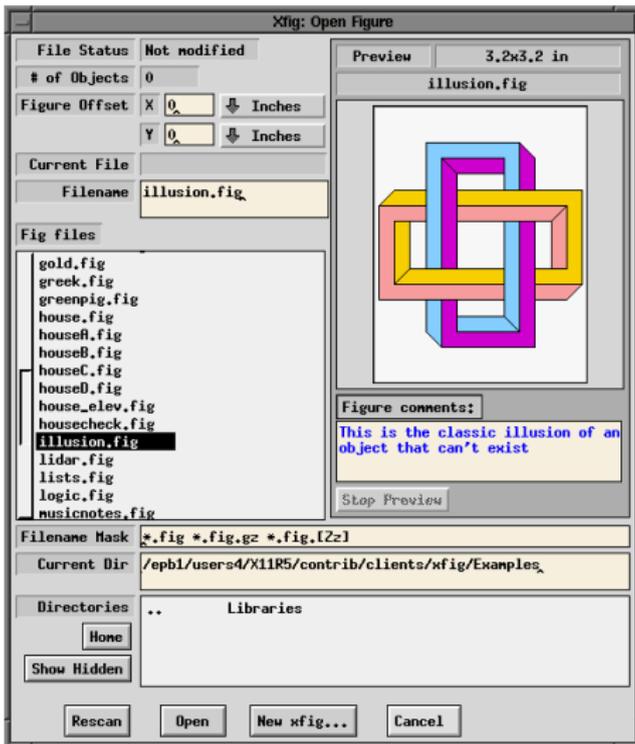
- buttons for drawing operations:
 - circle, box, polyline, text, etc.

Editing Mode Panel:

- buttons for editing operations;
 - move, copy, delete, scale, edit attributes, etc.

Xfig - Panels

Open file panel



Xfig

Linux packages

Linux packages:

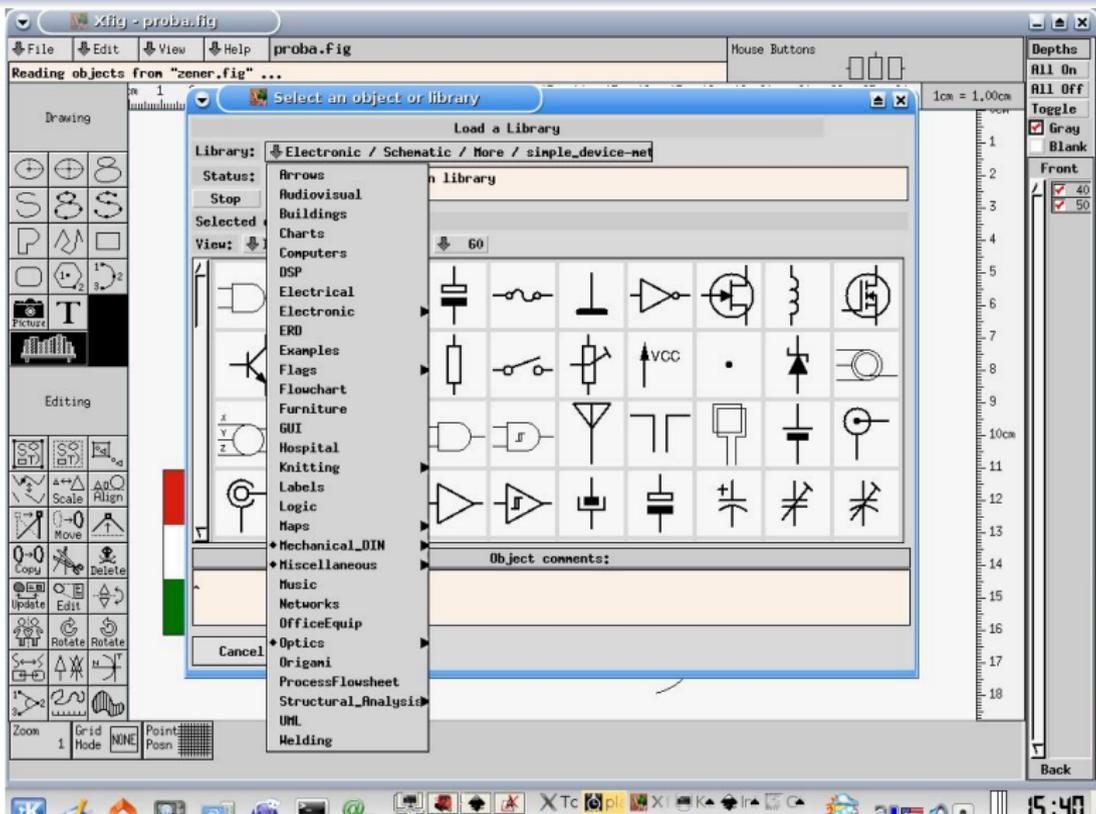
/	Name	Version	Description
+++-----			
ii	xfig	3.2.5-alpha5-9	Facility for Interactive Generation o
ii	xfig-doc	3.2.5-alpha5-9	XFig on-line documentation and exampl
ii	xfig-libs	3.2.5-alpha5-9	XFig image libraries and examples

Documentation

- /usr/share/doc/xfig/html/frm_introduction.html

Xfig - Libraries

xfig-libs package

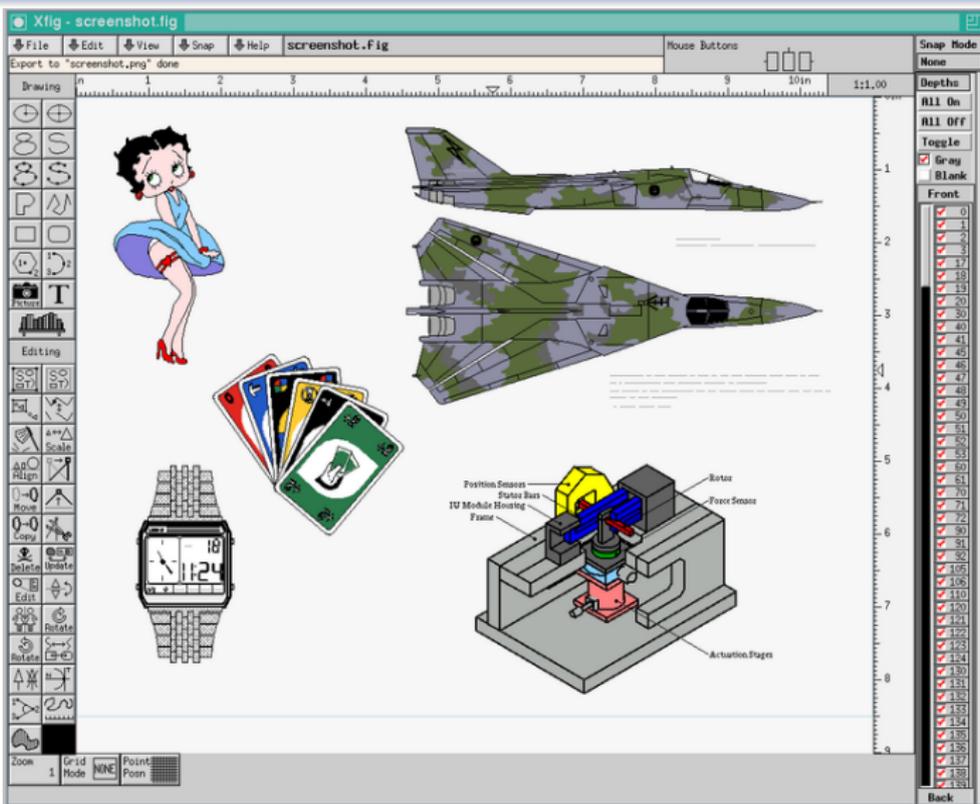


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Xfig - demo graphics

Full screen demo objects



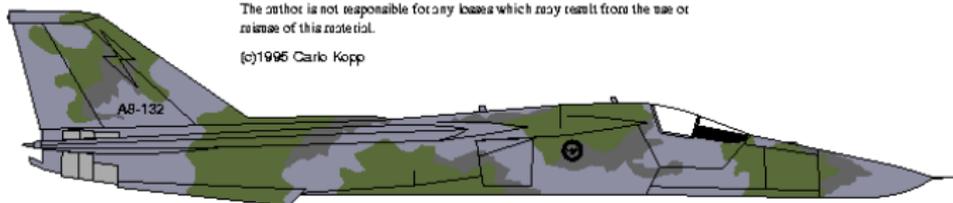
Xfig - demo graphics

Airplane

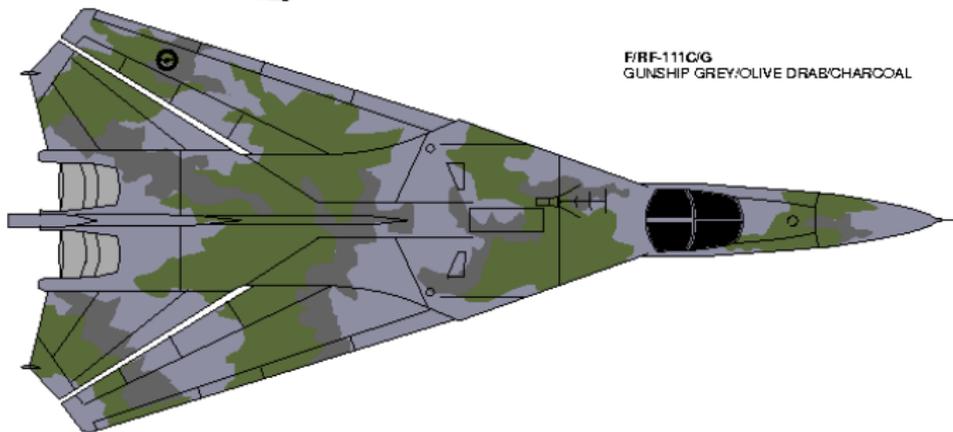
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F/R-111C/G
GUNSHIP GREY/OLIVE DRAB/CHARCOAL



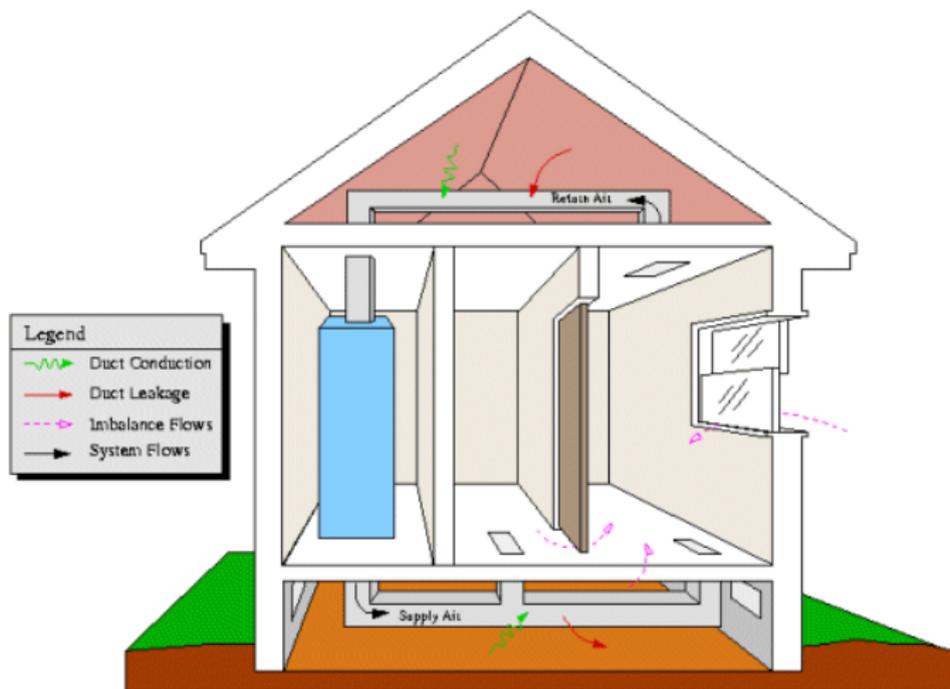
Xfig - demo graphics

Watch



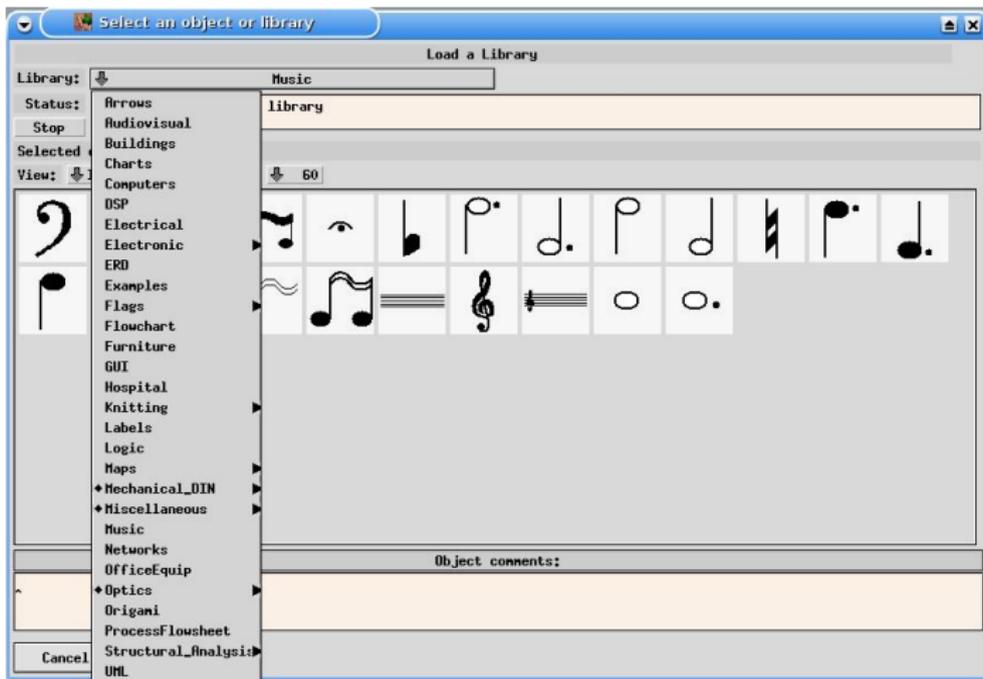
Xfig - demo graphics

3D-house



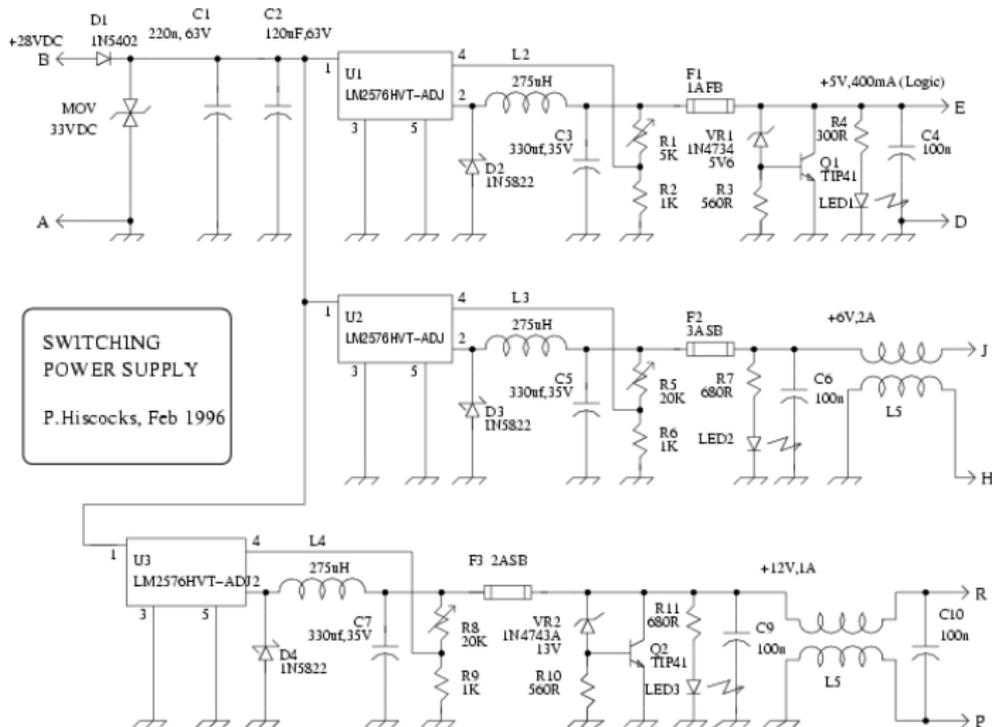
Xfig - demo graphics

Music symbols



Xfig - demo graphics

Power supply - from 1996



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Inkscape

Features

Basic characteristic

- is a vector graphics editor application,
 - similar to Adobe Illustrator, Corel Draw, Freehand
- it is a free software, licensed under the GNU GPL
- goal is to become a powerful graphics tool
 - fully compliant with the XML, SVG, and CSS standards
- is a cross-platform application, runs on:
 - Mac OS X (typically under X11)
 - Linux operating systems, Free-BSD operating system
 - Microsoft Windows
- implementation of SVG and CSS standards is incomplete
 - it does not yet support animation
- Inkscape has multi-lingual support
- As of 2010, Inkscape is under active development - with new features being added regularly.

Inkscape Objects

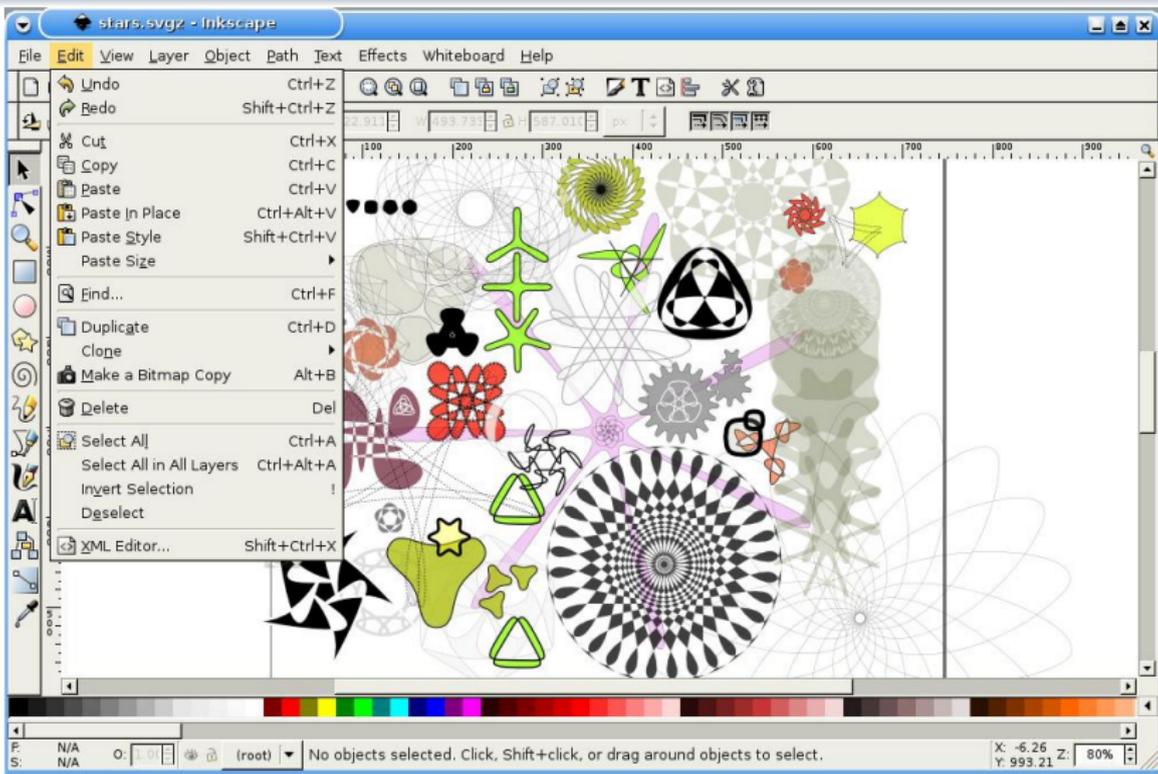
Basic object types

Object types

- Paths — made with the Pencil tool (allows freehand drawing)
- Splines - created by the the Pen tool (node by node)
- Rectangles — created using the Rectangle tool
 - Corners of rectangles can be rounded
- Ellipses — created using the Ellipse tool
 - Ellipses can be transformed into arcs and circle segments
- Stars/polygons — created using the Polygon tool
 - Multi-pointed stars can be used to emulate spirographs
- Text — created with the Text tool
 - text can use any of the system fonts
 - it can be easily converted to path
 - both regular and flowed text is supported
 - text objects can be arbitrarily transformed

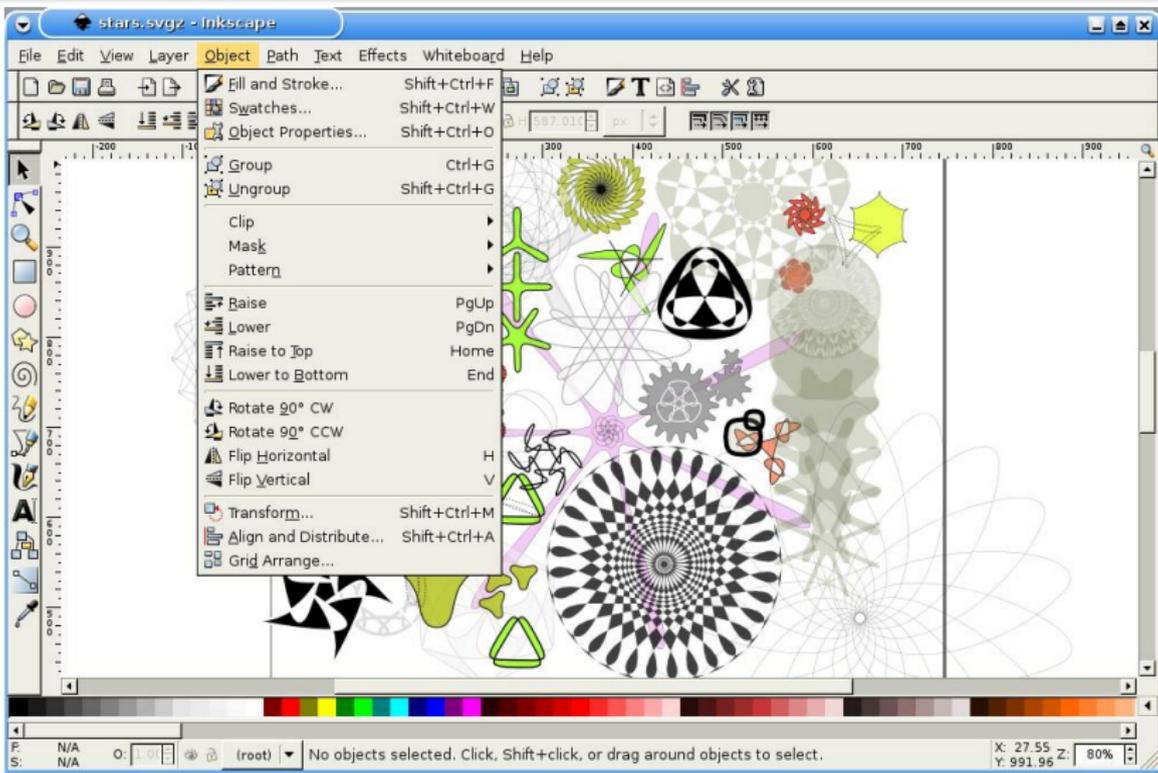
Inkscape - Edit

Edit menu



Inkscape - Object

Object menu



Inkscape Objects

Basic object types

Object types

- Raster/bitmap images (import/export)
 - images are linked by default, but they can be embedded into the SVG
 - supported are PNG, JPEG and BMP images
- Clones — created using the Clone operation on existing objects
 - are verbatim copies of other objects
 - can have different transformations applied than the original object
 - are updated live whenever the original object changes
 - deleting the original object causes the clone to be "unlinked", it becomes a separate object
 - it is also possible to create chained clones i.e. clones of a clone, to an arbitrary depth

Inkscape Objects

Special object types

Special objects

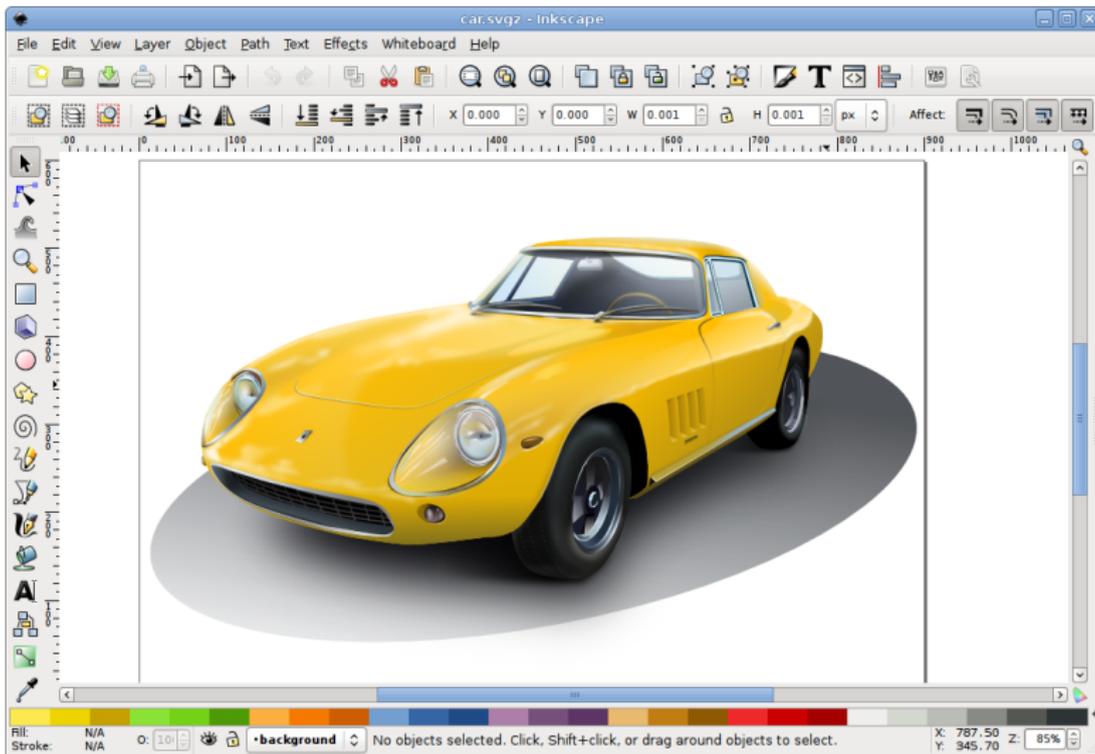
- Spirals — created using the Spiral tool
 - they have configurable number of turns and convergence
- 3D Boxes — created using the 3D Box tool
 - have adjustable perspective and a configurable number of vanishing points
- can be used to assist perspective drawings
- 3D boxes are in fact groups of paths

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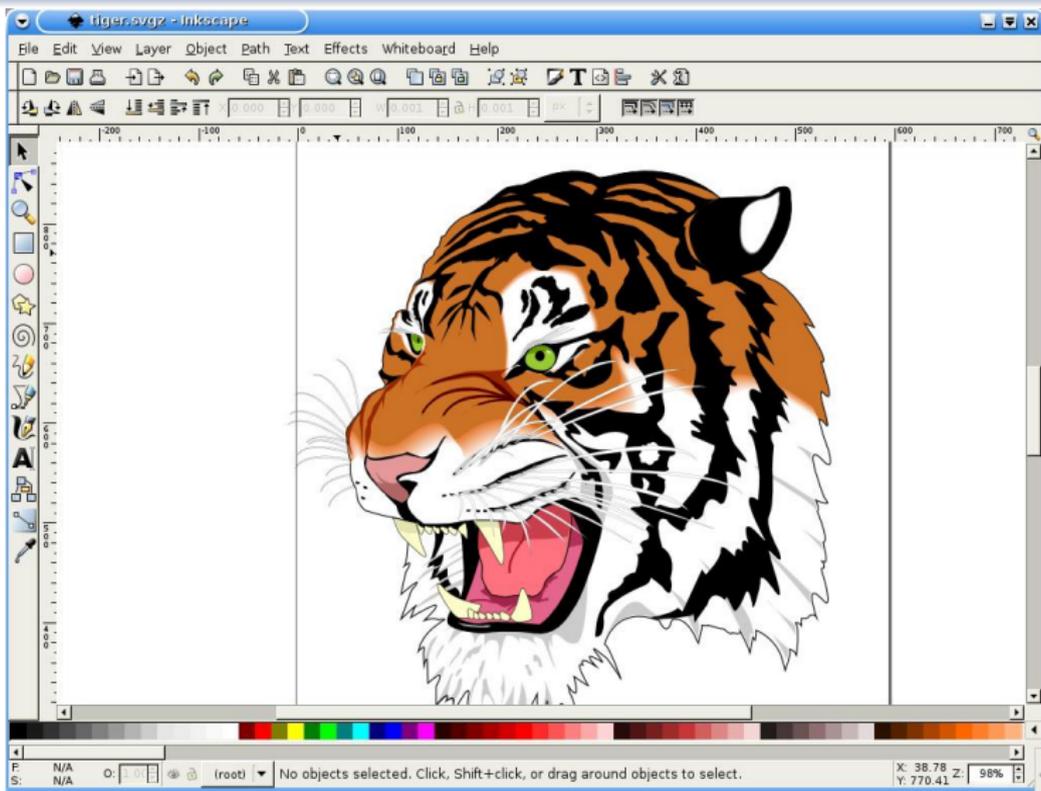
Inkscape - demo graphics

Car



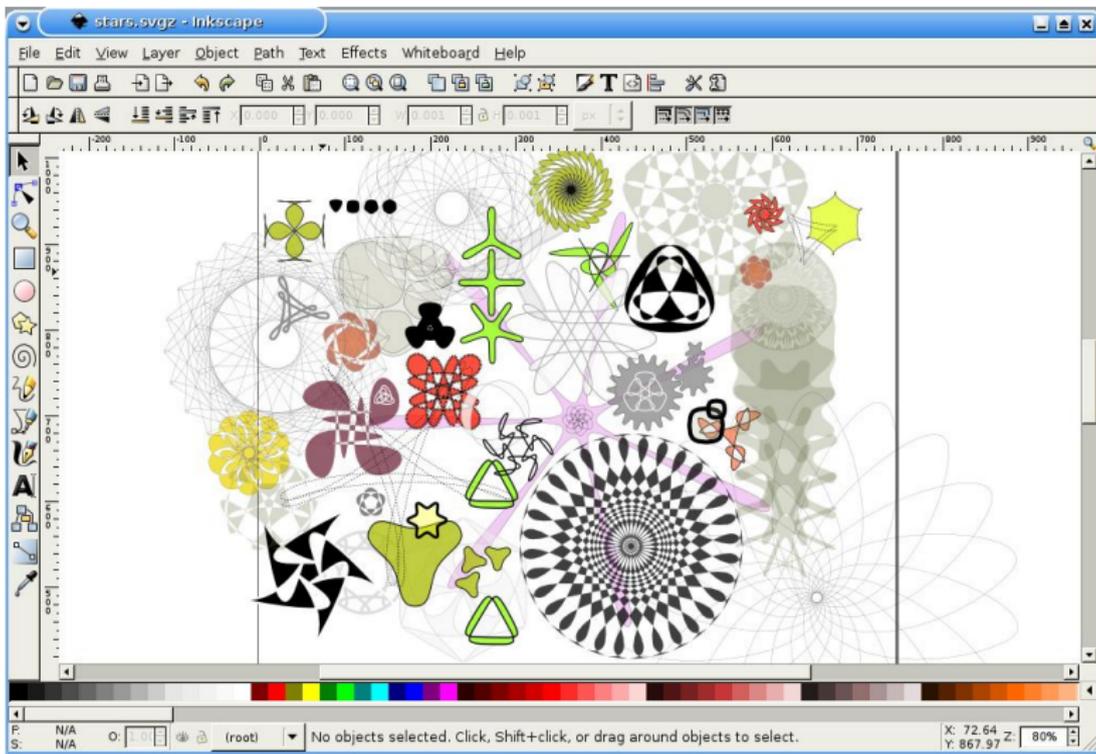
Inkscape - demo graphics

Tiger



Inkscape - demo graphics

Stars



Further information

Links

- For further information and details about the topic please check the listed links after the description of topic.

End of Basics of Image Processing and Drawing

Thanks for your attention !