

Applied informatics

Overview of the advanced modification techniques, conversion, compression and insertion of graphic objects

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Overview of the advanced modification techniques, conversion, compression and insertion of graphic objects

- 1. Graphical files and formats**
- 2. Advanced modifications and conversions of graphic files**
- 3. Compression and use of graphic objects in applications**



Aims of the lecture

1. Explain the importance of graphic objects
2. Characterize advanced modifications, conversions and compression of graphic objects
3. Give recommendations for the use of graphic SW in document modifications

Graphics

- ☐ The art to write in the broadest sense, including painting and drawing
- ☐ Working with lines – drawing, surface, colors
- ☐ Printed image or script

„More than half of the information one receives using the eye and an image is a very effective means of communication.“ [4]

Computer graphics

The term computer graphics first appeared in 1960, when Boeing workers have begun this term to indicate the design and implementation of technical drawings using a computer. [1]

Can be divided into:

- 2D graphics (surface),
- 3D graphics (space).

Graphical data collection

- ☐ Starting from scratch in a program
- ☐ Scan (press, own graphics, photos, ..)
- ☐ Digital photos, video
- ☐ Screenshots
- ☐ Generation in a SW program or by own code

„When using graphic objects of other entities respect the copyright law.“

Graphic format

- ❑ graphic way of organizing data that describes a graphic template, in the form of a graphic file;
- ❑ Most graphics programs implicitly store graphic data into their proprietary format, but many allow to export into standard formats.

Graphic file

- file in a particular graphic format
- includes graphic data to store, convert, process or display graphic data

Graphic files

- Include:
 - graphic data,
 - metadata.
- To work with graphic files you need graphic SW:
 - That is compatible with the file format and is able to decode and process the file

Graphic file formats

- **Basic**

- Bitmap
- Vector
- Metafiles
 - Combination of bitmap, vector, ...

- **Other**

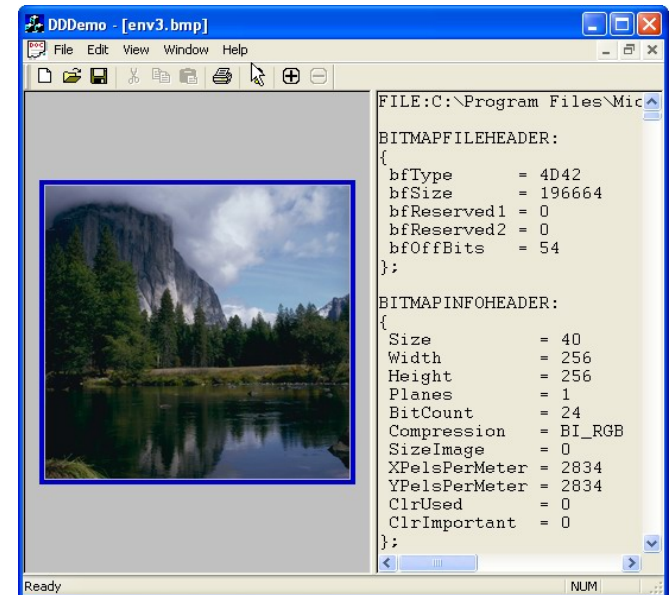
- animation
- video
- multimedia

Examples of graphic formats

Bitmap	Vector	Metafile	Animation	Video
BMP	CDR	WMF	GIF	MPEG 1, 2 a 4
GIF	DXF	PDF	FLI	WMV
JPEG	DXB	EPS		AVI
PNG	ZMF	SVG		
TIFF				

Bitmap graphic files

- Basically the structure is the same
- Structure:
 - header,
 - Bitmap data,
 - other
(color palette).



Bitmap graphic files

Bitmap data

- Occupy most of the data in the file
- In most format are placed directly after the header.
- Organized into pixel values.
- **Pixels** are usually organized into rows of the displayed surface.

Other information

- Other data structures that help to process the data

Pixel

The image is decomposed into image elements so called pixels organized into a map

Physical pixel **Number of pixels = $n \times m$**

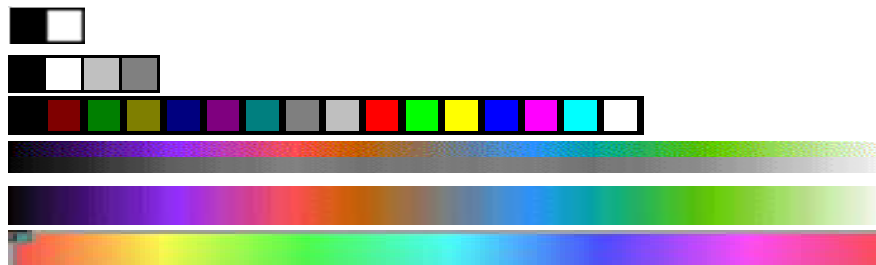
- ❑ point which is used by the output display device (size);
- ❑ Directly controlled by the HW of the output device;
- ❑ Usually composed of a few smaller elements.

Logical pixel

- ❑ mathematical point that specifies the position (the coordinates)

The color depth of pixels

- ❑ Color depth = number of bits storing the color of the pixel
- ❑ Implies the number of colors representable by the format



Bitmap graphic data

Advantages:

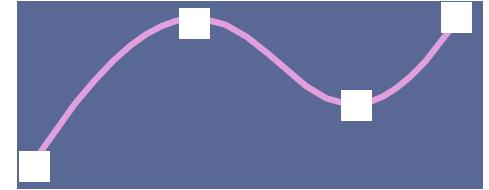
- (+) device independent (monitors, printers, ...)
- (+) easy to create,
- (+) easy to modify.

Disadvantages:

- (-) large files (in particular at high color depths)
- (-) compression can reduce quality,
- (-) scaling can distort the image.

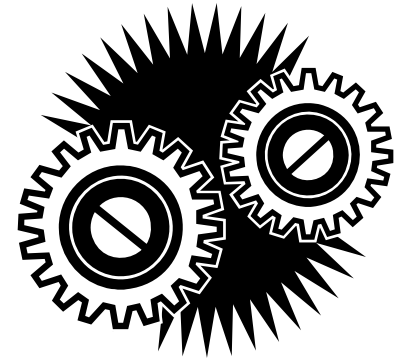
Vector graphic data

- ❑ Image is composed from objects – so called vectors, which are organized to layers.
- ❑ Mathematical description of vector properties (position, shape, color, width, fill).
- ❑ Each vector is independent (move, modification, grouping)
- ❑ Line elements are defined by color, starting point, direction and length – straight lines and curves.



Vector graphic files

- Vary significantly.
- Most of file follow the structure:
 - header,
 - color palette,
 - vector data.
- Some of the are simpler in structure than bitmap files.



Vector graphic files

Advantages

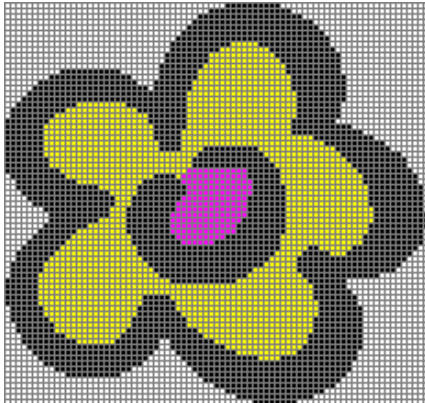
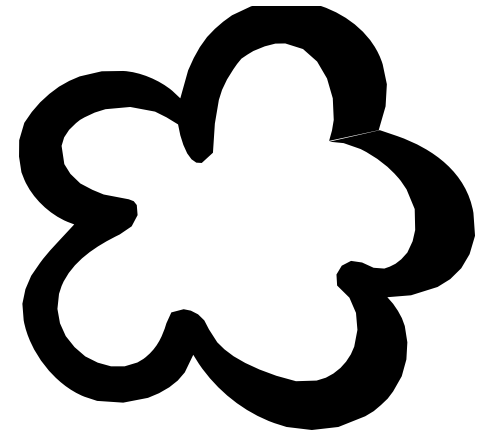
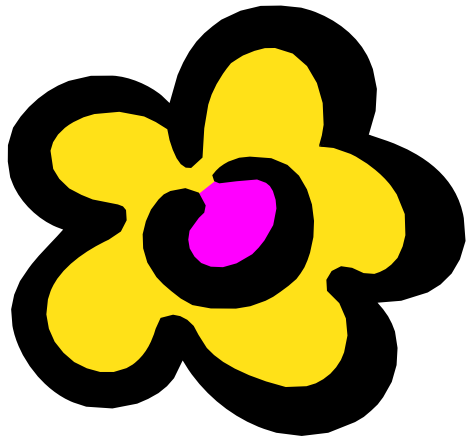
- ❑ Vector files are useful when processing data originating as a collection of line objects.
- ❑ ***Simple scaling*** (and adaptation for the output device).
- ❑ ***Easy to export vector data to bitmap data.***

Vector graphic files

Disadvantages

- ***Not suitable for very complex images*** (e.g. photographs).
- The look of vector data is dependent on the output device and the processing SW application.
- ***Best results (output)*** can be achieved by using vector output devices (plotters). When using bitmap output devices, the resolution should be high.
- ***The reconstruction*** of vector data (to display, process, etc.) can be time consuming.

Comparison



Bitmap graphic data

Vector graphic data

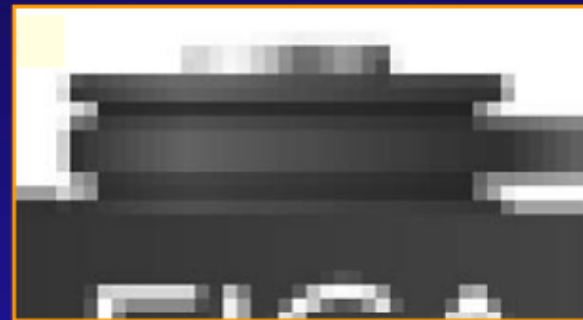
Scaling



originální vektorový obrázek



zvětšeno 8x jako vektorový
obrázek



zvětšeno 8x jako rastrový
obrázek

Graphic SW

- **Bitmap graphic:** Paint.Net, Zoner Photo Studio, FastStone Image, Picpick, Gimp, Corel PhotoPaint, Adobe Photoshop, MS Paint, Aicon,...
- **Vector graphic:** OpenOffice Draw , Inkscape, Corel Draw, Adobe Illustrator, clker.com SVG Edit,...
- **Animation:** GIF Animator, Pencil, Flash Develop, Adobe Flash, Synfig Studio,...
- **CAD and 3D modeling:** Archicad 14, Autocad 12, Google SketchUp, Rhino 3D, Autodesk 3D Studio Max, Room Aranger,...
- **Presentations:** OpenOffice Impress, MS Powerpoint, iWork Keynote,...
- **Press:** Adobe Indesign, Scribus, Quark Xpress, TEX,...

Advanced modifications

- Change of individual parameters.
- To remove faults/imperfections in images, to enhance some properties, etc.
- **Conversion** – change of format for the use of the data in other environment.
- **Compression** – reduction of file size
 - Lossy (JPG)
 - Lossless (TIFF)

Conversions

- Change of data format (e.g. from map.bmp to map.png)
- Can lead to:
 - reduction of data quality,
 - data loss (reduction of color depth,..),
- Not always can be done.

Conversions

☐ **Reasons:**

- ☐ to print,
- ☐ to open in another SW,
- ☐ size, ...

☐ **SW**

- ☐ conversion,
- ☐ general
(export and import).



Conversion

bitmap → vector
metafile → vector

- 🙄 The most difficult, we hardly ever get reasonable results.
- 🙄 Conversion algorithms must detect lines and create vector equivalents (the detection is error prone).
- 🙄 Loss of color information.

Conversion

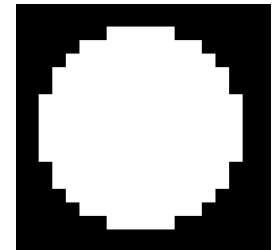


👍😊 Mostly very easy.

👍😊 Vectors are expressed as pixels.

😞👎 The resulting quality depends on the resolution of the bitmap and the complexity of the vector data.

😞👎 Aliasing problems. (e.g. circle must be represented as square pixels.)



Conversion

bitmap → **bitmap**



Best results.



Data transformed pixel by pixel.



Change of color depth (e.g. 24b vs. 4b).



Change of size.



24 b



4 b

Conversion

vector  **vector**

 Usually easy

 Very different sets of basic elements in different vector formats.

 Problems with inosculation and ending of the curves.

 Difficult precise positioning.

Compression of graphic data

Reduction in size

Compression ratio = original size / compressed size

Compression:

- **Lossless**

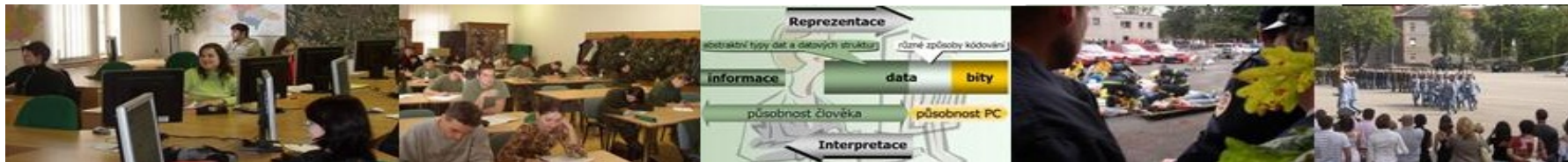
More effective encoding. Original entropy maintained.

- **Lossy**

Reduction of quality.

Compression algorithms

Algorithm		Note
RLE	Lossless compressi on	Byte stream coding
LZW		Dictionary based. Most common method.
Huffman coding		Bitstrings of different length. More frequent usage in data file leads to shorter representation.
JPEG	Lossy	Quality loss can be configured.
MPEG 1,2 a 4		Video compression algorithms



Questions & assignments



What is the use of graphic objects

What color modes are used for monitors and printers?

Discuss the problem of graphic data conversion

Assignment: prepare the structure of your presentation

Resources:

- [1] BARTONĚK, D. *Počítačová grafika I: Teorie grafických formátů*. 2005. vyd. VUT Brno, 2005, 120 s. Dostupné z:
http://fast.darmy.net/opory-G2/GE09-Pocitacova_grafika_I--M01-Teorie_grafickych_formatu.pdf
- [2] SOBOTA, B., MILIÁN, J. *Grafické formáty*. České Budějovice: Koop. 1996, 157 s.
- [3] HASHIMOTO, A. *Velká kniha digitální grafiky a designu*. Vyd. 1. Brno: Computer Press, 2008, 384 s. ISBN 978-80-251-2166-5.
- [4] MURRAY, J. D. van RYPER, W. *Encyklopedie grafických formátů*. 2. vyd. Praha: Computer Press, 1997, 922 s. ISBN 80-722-6033-2.
- [5] DPI. *Wikipedie: Otevřená encyklopedie* [online]. 9. 3. 2013 [cit. 2013-10-18]. Dostupné z:<http://cs.wikipedia.org/wiki/DPI>