

Requirements?

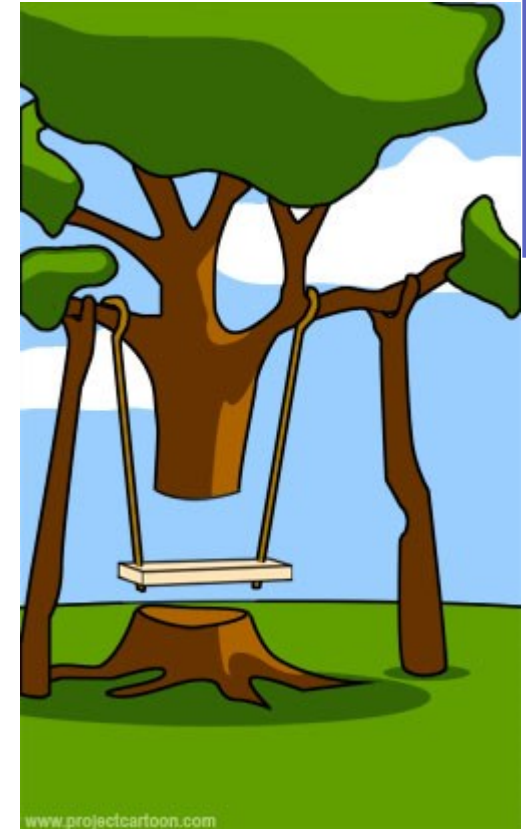
We really have a situation here...



How the customer explained it



How the project leader understood it

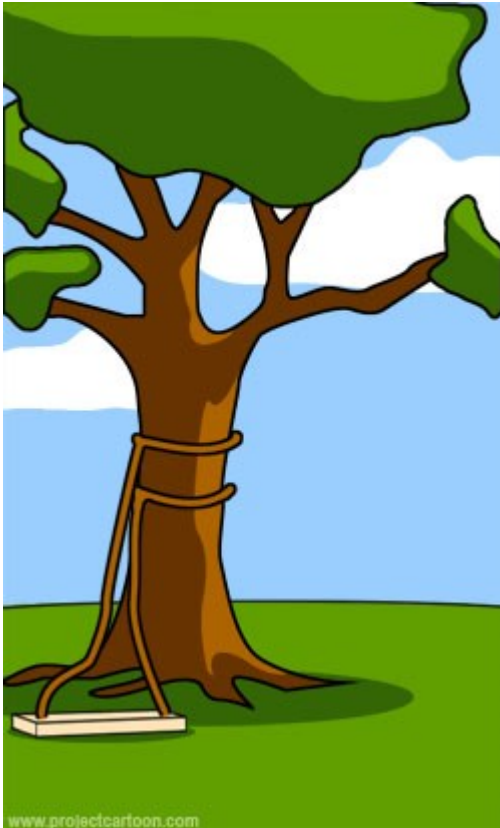


How the analyst designed it

Source: www.projectcartoon.com

Requirements?

We really have a situation here...



How the programmer
wrote it



What the beta testers
received

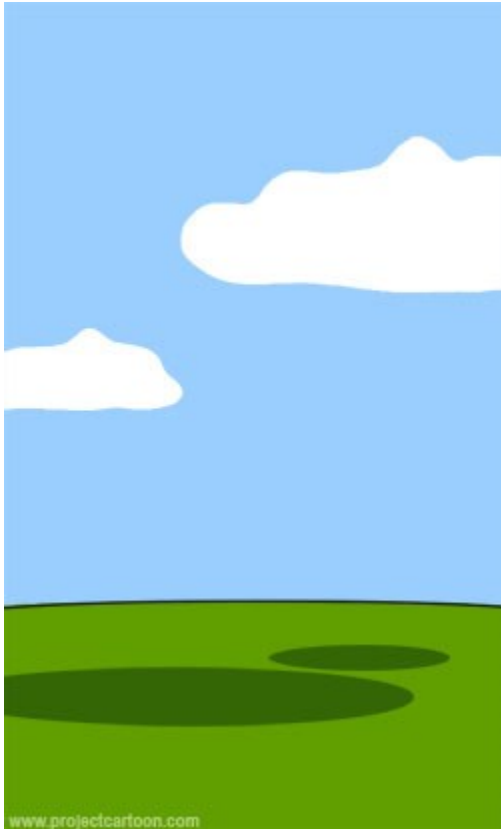


How the business
consultant described it

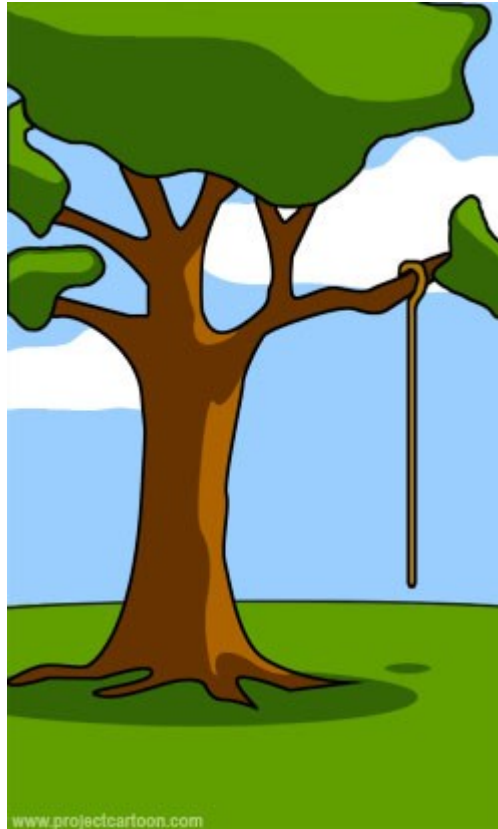
Source: www.projectcartoon.com

Requirements?

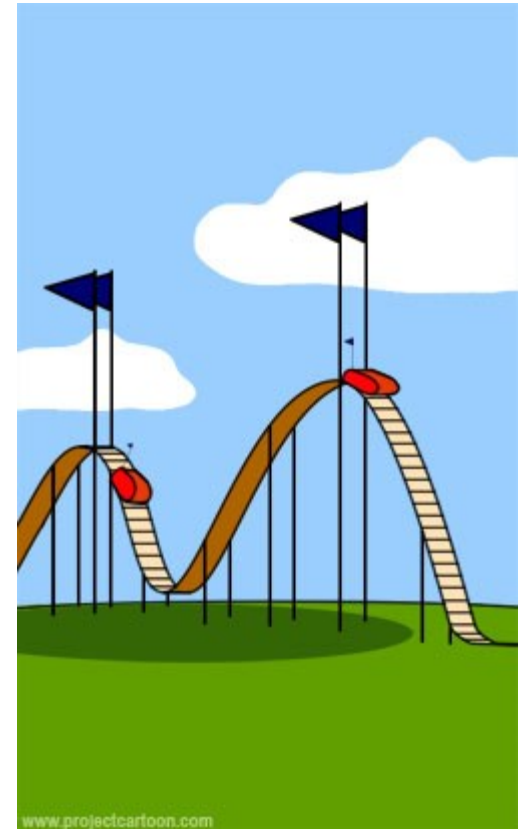
We really have a situation here...



How the project was documented



What operations installed

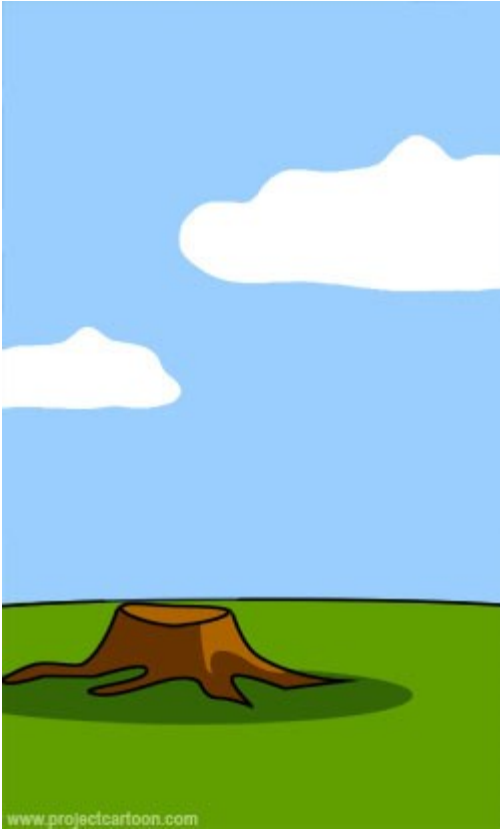


How the customer was billed

Source: www.projectcartoon.com

Requirements?

We really have a situation here...



How it was supported



What marketing advertised



What the customer
really needed

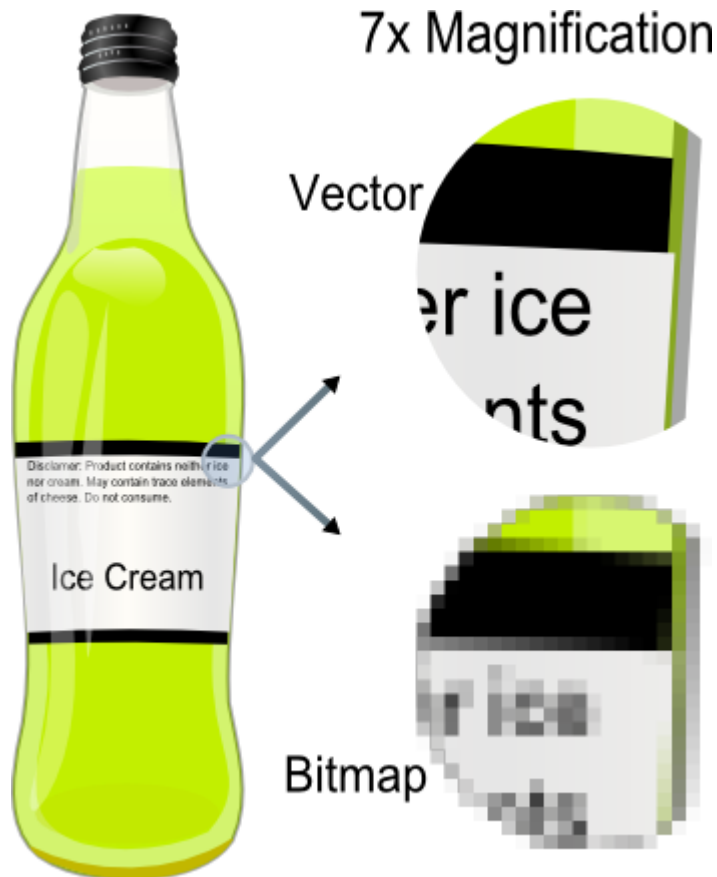
Source: www.projectcartoon.com

Nichtfunktionale Anforderungen

"Nichtfunktionale Anforderungen (nonfunctional requirements, kurz NFRs), auch Technische Anforderungen oder Quality of Service (QoS) genannt, beschreiben Aspekte, die typischerweise mehrere oder alle funktionale Anforderungen betreffen bzw. überschneiden (cross-cut). Zu den NFRs zählen u. a. Genauigkeit, Verfügbarkeit, Nebenläufigkeit, Konsumierbarkeit (eine Obermenge der Benutzbarkeit), Internationalisierung, Betriebseigenschaften, Zuverlässigkeit, Sicherheit, Service-Anforderungen, Support." [Balzert 2009], p. 463

- [Pohl07, S. 16 ff.] in [Balzert 2009, p. 463]: Nichtfunktionale Anforderungen sind entweder Qualitätsanforderungen oder unterspezifizierte funktionale Anforderungen
- "Eine **Qualitätsanforderung** legt eine qualitative und/oder quantitative Eigenschaft des Softwaresystems oder einer seiner Komponenten fest." [Balzert 2009], p. 463

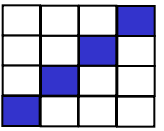
Images



Source: http://en.wikipedia.org/wiki/Vector_graphics

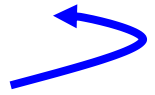
- Vector graphics are stored as a collection of vectors
- Small memory size
- Complex rendering
- Bitmap/Raster Graphics are stored as array of pixels
- Large memory size
- Simple rendering

Bitmap Graphics



- Modern graphics displays are raster based
- This just means that they display a grid of pixels, where each pixel color can be set independently
- Individual pixels are usually formed from smaller red, green, and blue (RGB) subpixels. If you look very closely at a TV screen or computer monitor, you will notice the pattern of subpixels
- Older style vector displays did not display a grid of pixels, but instead drew lines directly with an electron beam
- Can only be displayed by interpreting software/hardware

Vector Graphic Images

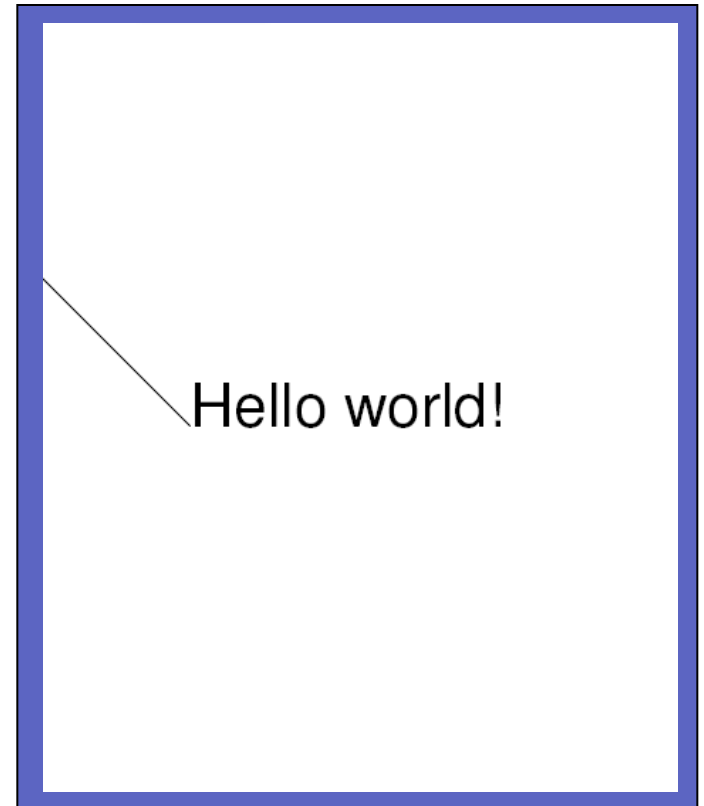
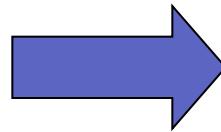


- A vector graphic file format is composed of analytical geometry formula representations for basic geometric shapes (e.g., line, rectangle, ellipse, etc.)
- Used primarily for storing graphics produced with technical drawing programs or "simple images"
- The graphic can be resized easily by simply changing the coefficients of the geometric
- Resizing does not effect quality

Postscript: Vector Graphics & Text

- A programming language developed in 1982 by Adobe Systems
- File Extension: *.PS
- Subset of Postscript is used by Adobe PDF
- Example:

```
%!PS
/Arial findfont
40 scalefont
setfont
100 500 moveto
(Hello world!) show
100 500 moveto
0 600 lineto stroke
showpage
```



24-Bit and 8-Bit Images

■ 24-Bit Bitmap Color Graphics

- Photographic quality
- Each pixel value is represented as three bytes (one for each primary RGB color). Thus 256 different shades of red, green and blue is possible for each pixel; 256^3 possible combined colors (16,777,216)
- A 640 X 480 24-bit color image would require 921.6KB of storage.

■ 8-Bit Bitmap Color Graphics

- Monitors are capable of displaying millions of colors.
- This requires 8-bit color images have color look-up tables (CLUT), stored with them to represent which 256 colors, out of the millions possible, are to be used in the image. A 640 X 480 8-bit color image would require 307.2KB of storage (the same as 8-bit grayscale).
- Acceptable color quality, but does not compare to 35mm photographic quality

Rock of Cashel, Ireland



Grayscale and Monochrome Images

- A grayscale image, usually requires that each pixel be stored as a value between 0 - 255 (byte). Where the value represents the shade of gray of the pixel.
A 640 X 480 grayscale image would require 307.2KB of storage.
- In a monochrome (black/white), image, (like the example at the right), each pixel is stored as a single 0 or 1 value (bit).
A 640 X 480 monochrome image would require 38.4KB of storage.

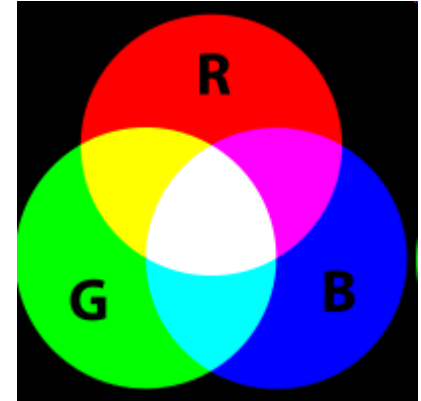


Color Models

- Define how colors are "synthesised"
- Apply to Images, Videos, Print Media, ...
- Can be grouped into
 - Additive Color Models
 - Subtractive Color Models

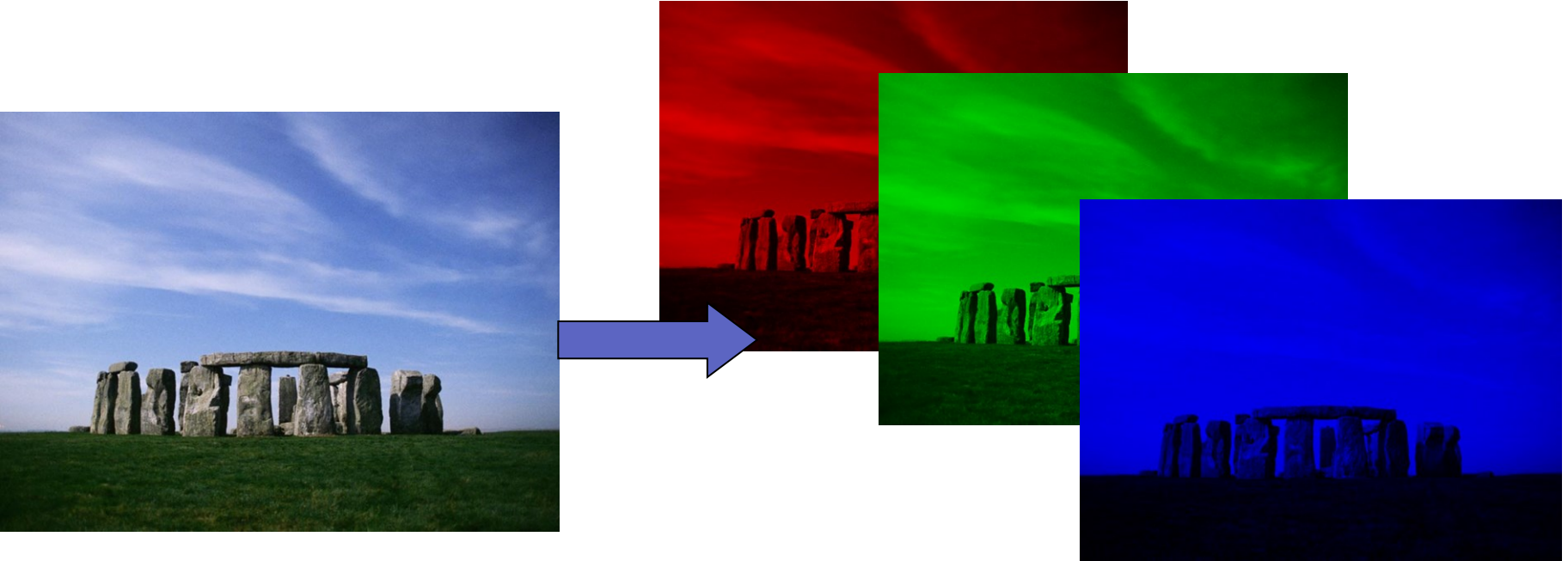
RGB Color Model

- RGB Model is an additive color model
- Colors within model: Red, Green, Blue
- Colors specified by levels of R, G, B, e.g., (255,255,255) -> WHITE, (0,0,0) -> BLACK
- All colors together spawn a Color Space
- RGB is device-independant, but synthesised color can differ across devices -> color management
- RGB is used, e.g., for computer monitors



Source: en.wikipedia.org

RGB: Splitting-Up Color Channels

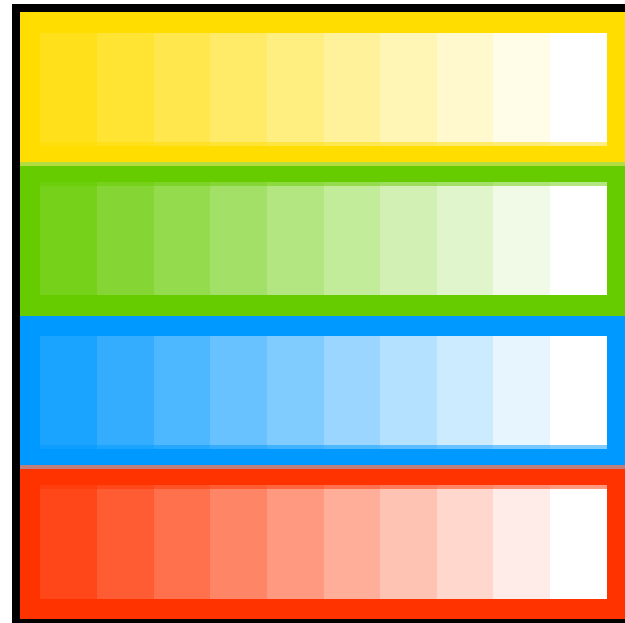


Example: $R + G =$



RGBA

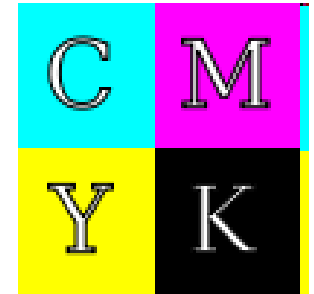
- RGBA = RGB + Alpha
- RGBA is used by CSS3
- Alpha channel specifies transparency
 - A: 0% -> fully transparent (invisible)
 - A: 100% -> fully opaque



Source: http://developer.mozilla.org/en/Canvas_tutorial/Applying_styles_and_colors

CMYK Color Model

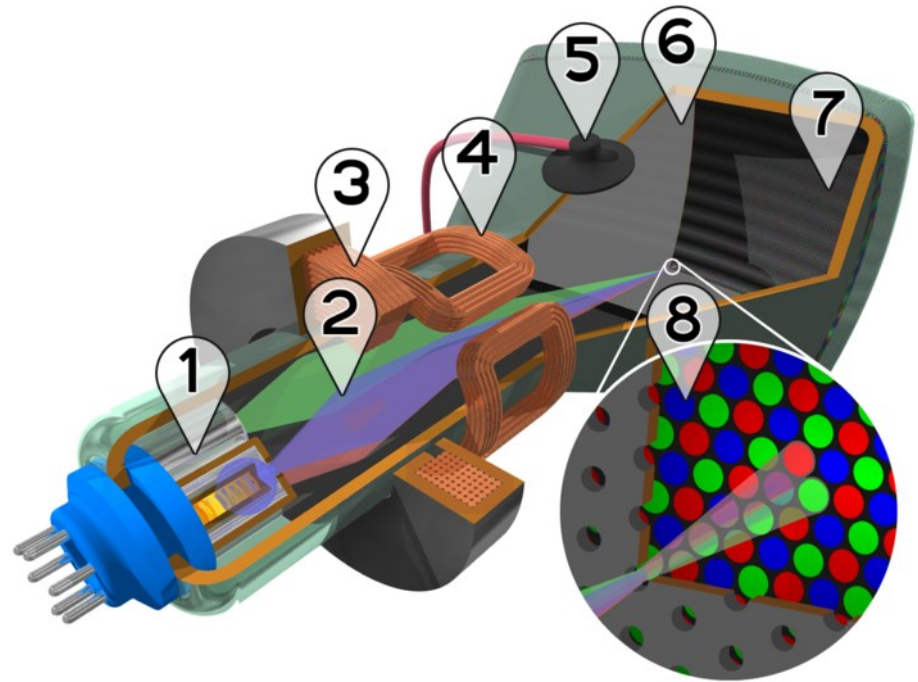
- CMYK is a subtractive color model
- Colors within model: cyan, magenta, yellow, and key (black)
- Colors specified by levels of CMYK
e.g., (255,255,255,255) -> BLACK,
(0,0,0,0) -> WHITE
- Conversion from RGB:
 - $R = 1.0 - (C + K)$
 - $G = 1.0 - (M + K)$
 - $B = 1.0 - (Y + K)$
- CMYK is used for printing (hint: compare the colors of your inkjet printer to CMYK)



Source: en.wikipedia.org

Display Technology

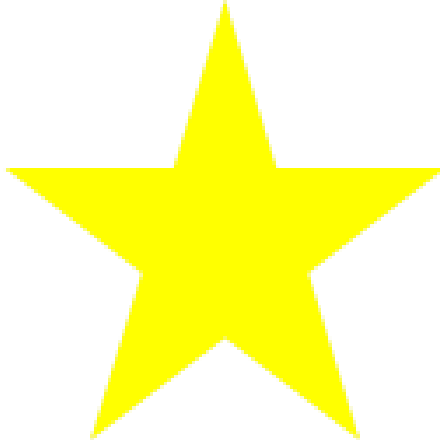
- CRT (cathode ray tube)
- LCD (liquid crystal display)
- TFT (thin film transistor)
- Plasma
- Film
- Print
- ...



Source: en.wikipedia.org

SVG – Scalable Vector Graphic Format

- XML-based vector format by W3C
- Rendering in Browser via Plug-In (IE) or native SVG support



```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE svg PUBLIC "-//W3C//DTD SVG 1.1//EN"
"http://www.w3.org/Graphics/SVG/1.1/DTD/svg11.dtd">
<svg version="1.1" viewBox="0 0 21000 29700"
preserveAspectRatio="xMidYMid" fill-rule="evenodd"
xmlns="http://www.w3.org/2000/svg"
xmlns:xlink="http://www.w3.org/1999/xlink"><g
visibility="visible"
id="Default"><desc>Master slide</desc></g><g
visibility="visible"
id="page1"><desc>Slide</desc><g><desc>Drawing</desc>
<g><g style="stroke:none;fill:rgb(255,255,0)"><path d="M
5249,1500 L 4491,3984 2000,3984 4023,5534 3263,8000
5249,6490
7237,8000 6477,5534 8500,3984 6009,3984 5249,1500
5249,1500 Z"/></g><g style="stroke:rgb(0,0,0);fill:none">
<path style="fill:none" d="M 5249,1500 L 4491,3984
2000,3984 4023,5534 3263,8000 5249,6490 7237,8000
6477,5534 8500,
3984 6009,3984 5249,1500"/></g><g></g></g></g></svg>
```

Compression

- Almost all graphic/video formats incorporate some variation of a *compression* technique due to the large storage size of image files. These can be classified into either **lossless** or **lossy** formats.
- **Lossless** formats compress all of the original captured/created data of the image/graphic using algorithms that allow the original data of the file to be recreated *without loss* of any data, hence the name.
- **Lossy** formats discard data when storing images. The data discarded is in most cases beyond the ability of the human vision system and thus there is no discernible difference between the original image and the compressed image.



Original Photo



Compressed Photo

Bitmap Graphic Format

GIF, JPG, PNG

■ GIF (Grafic Interchange Format)

- uses Lempel-Ziv-Welch (LZW) compression (dictionary-based approach)
- supports one transparent color
- lossless, compressed format
- can be interlaced (image becomes more detailed during loading)
- supports simple animations
- supports up to 256 different colors

■ JPG/JPEG (Joint Photographic Experts Group)

- supports 24-bit color (16,7 million colors)
- no transparency support
- lossy compression format (supports different compression algorithms)
- compression ration of 1:15 for "visually lossless" images

■ PNG (Portable Network Graphics)

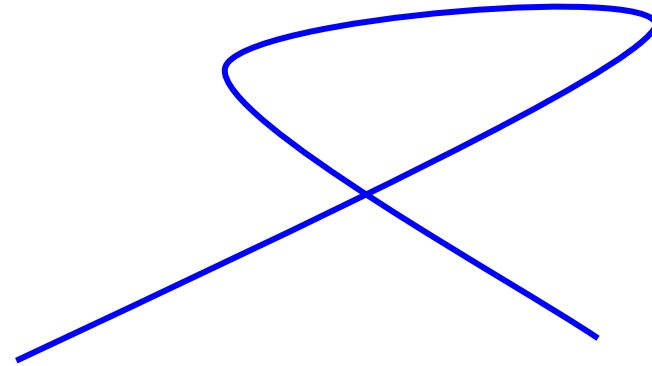
- supports 24-bit colors (16,7 million colors)
- supports transparency
- lossless compression scheme



Graphic Editor Software

■ Vector Graphic Editors

- Inkscape
- OpenOffice Draw
- Corel Draw
- Adobe Freehand
- ZCubes
- ...



■ Bitmap Graphic Editors

- Adobe Fireworks
- Adobe Photoshop
- Microsoft Paint
- GIMP
- Paint.NET
- ...

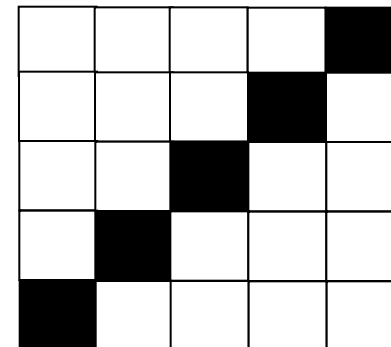
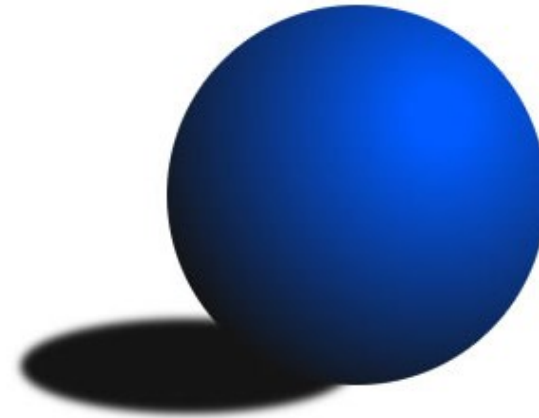
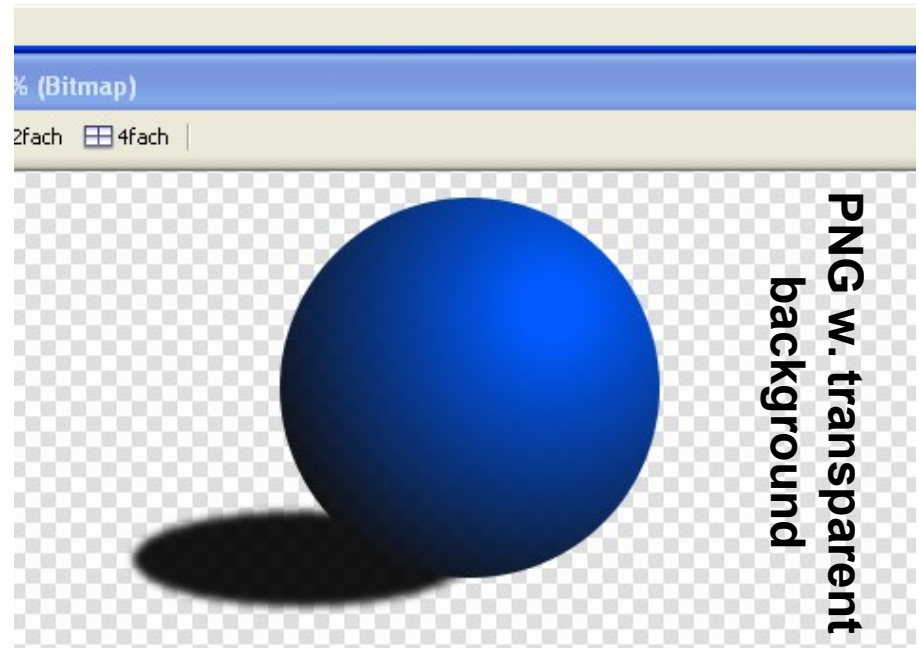


Image Transparency

- Images w/o transparency cover everything within their borders
- Transparency allows to define one/multiple colors appearing transparent during rendering



non-transparent JPG



PNG w. transparent background

The Image Tag

- The Image Tag

```

```

- Specifying image dimensions:

```

```

- Clickable Images:

- Embedding of image tag to anchor tag

```
<a href="mypage.html"></a>
```

Image Maps

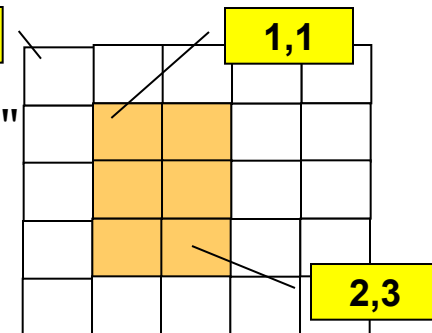
- Allows to specify "hotspots" for a single image file
- Coordinates are defined in pixels (x,y) from the top left corner
- First specify the image to be used as an imagemap

```

```

- Then specify map tag and define clickable regions:

```
<map name="m_image_map" id="m_image_map">  
  <area shape="rect" coords="226,8,392,188" href="left.html" />  
  <area shape="rect" coords="18,6,184,187" href="left.html" />  
</map>
```

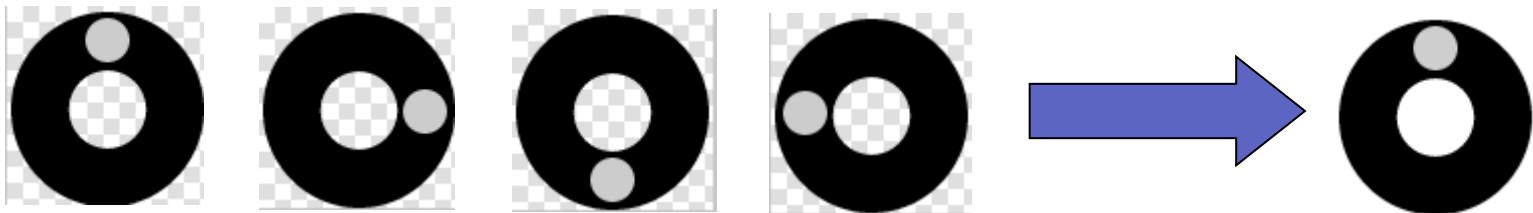


- The following shapes are supported:
 - rect: rectangular area; specified by coordinates of upper-left and lower-right corner
 - circle: circular area; specified by coordinates of center and radius
 - poly: polygon area; coordinates of each point specified

Animation

Flip-Books in the Internet Era

- Animated GIFs combine multiple images to one animation ("flip-book approach")
- Various tools are available for creating animated GIFs
- Approach:
 1. Create animation as single images
 2. Use tool to combine images
 3. Set animation properties (timing)
 4. Export to GIF



Exercises (2.7), 2.8, 2.9