Multimedia and coding

What media types we know?

- Texts
- Images
- Sounds
- Music
- Video
- Interactive content
  - Games
  - Virtual reality

Examples of multimedia

- **Movie** –
  audio + video
- **Computer game** –
  - audio + video + interactive
- **WWW** –
  - text + images + audio + video + interactive
  - hypermedia

- passive
- (inter-)active
  usually linear
- interactive
  non-linear

Representing multimedia

- Individual media representation
  - images, videos, sound, interaction, script...
  - graphical information, audio information, etc.
- Binding media into multimedia
  - standards and formats for multimedia systems
  - principles of media combination

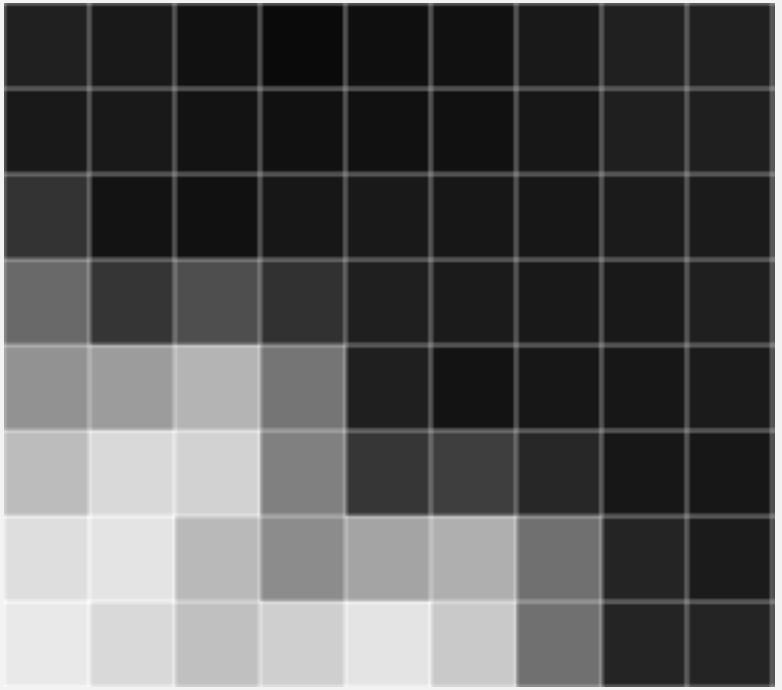
Graphical information

- models, materials, scene, geometry
  - usually parametric, continuous
  - we’ve been there
- **images, videos**
  - usually discrete, rasterized

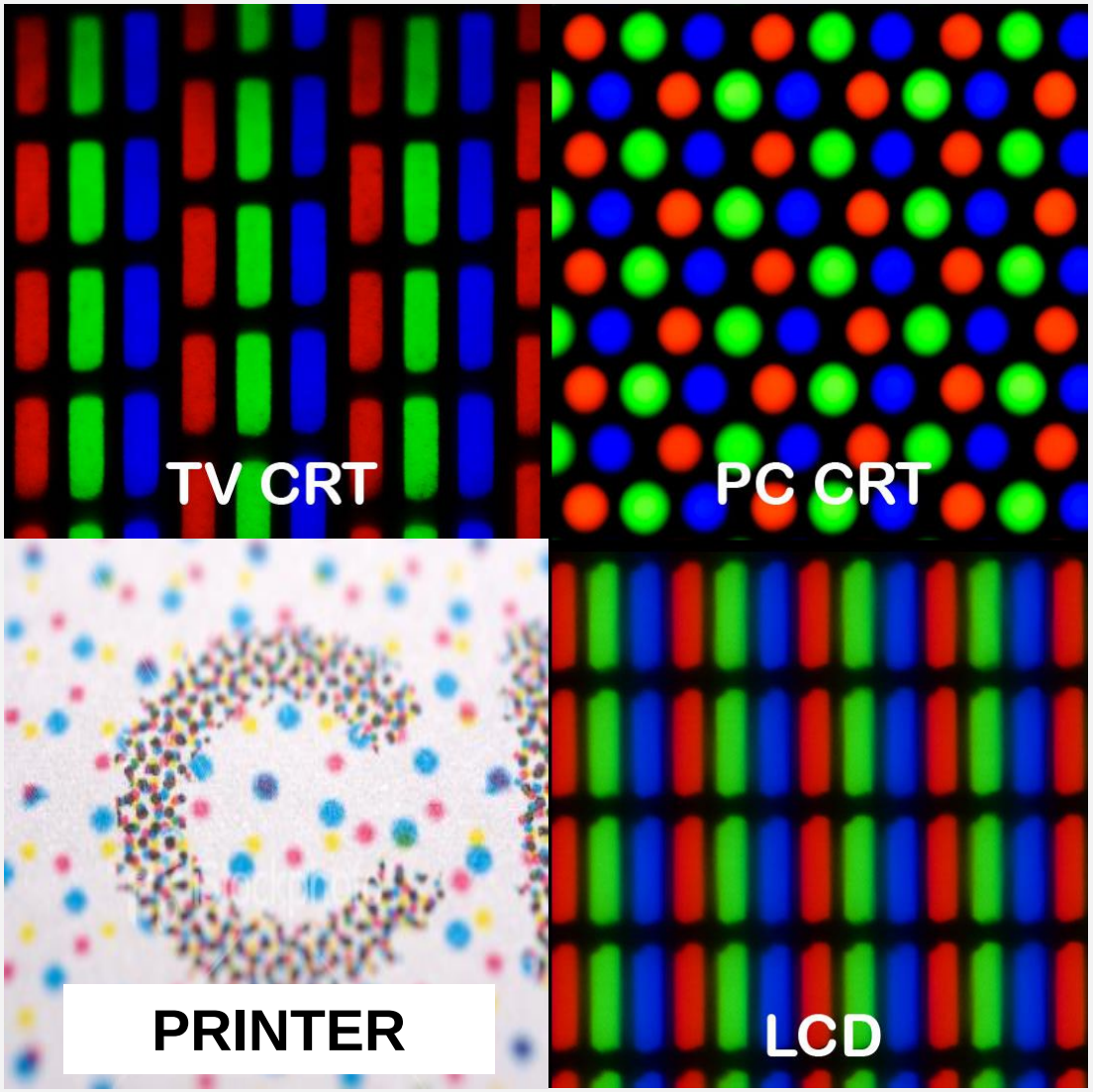
Images

Discrete representation

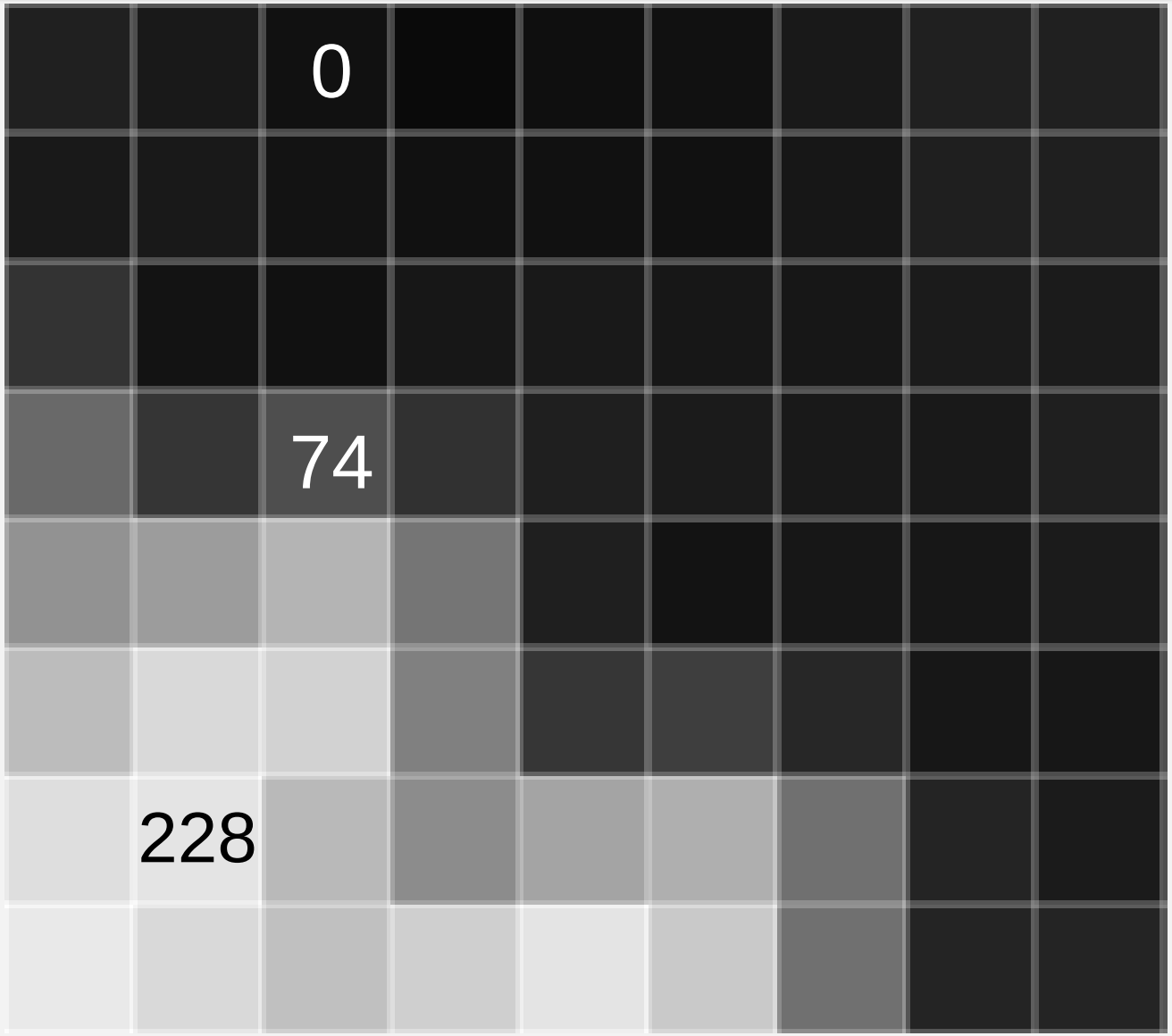
- Pixel = picture element
- Image resolution = digital size : physical size
  - DPI, PPI (dots per inch, points per inch)
  - 72 – 130 dpi (monitors)
  - 150 – 600 dpi (print)
  - 600 – 1200 dpi (scanners)



Devices close-up



Pixel values



Color representation

- Grayscale
- Indexed color
- 24bit RGB
- 32bit RGBA, CMYK

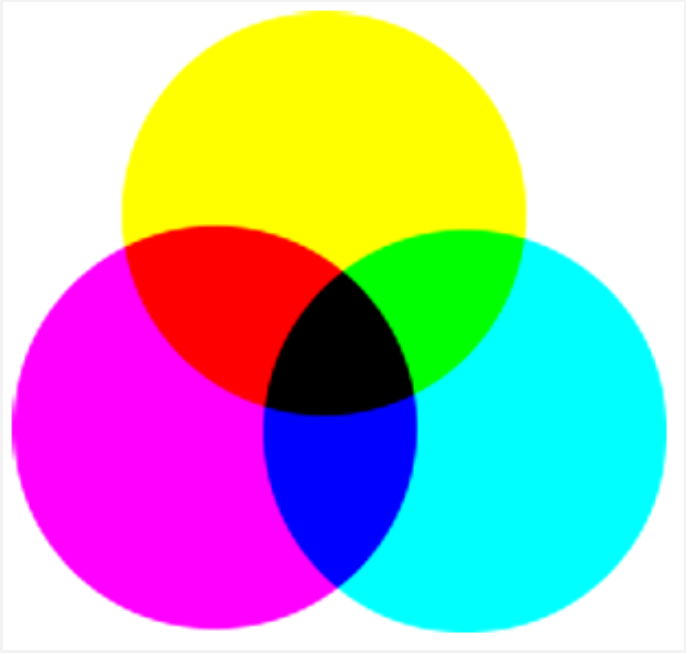
- Special: 30bit, 36bit (more color resolution – medical imaging, scanning...)

Color spaces / models

Color models

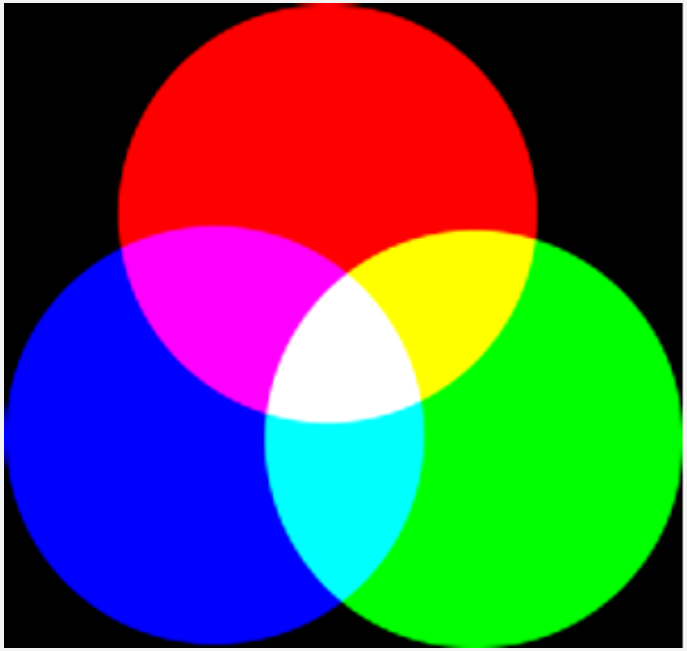
- Combining the primaries

Subtractive



Pigments

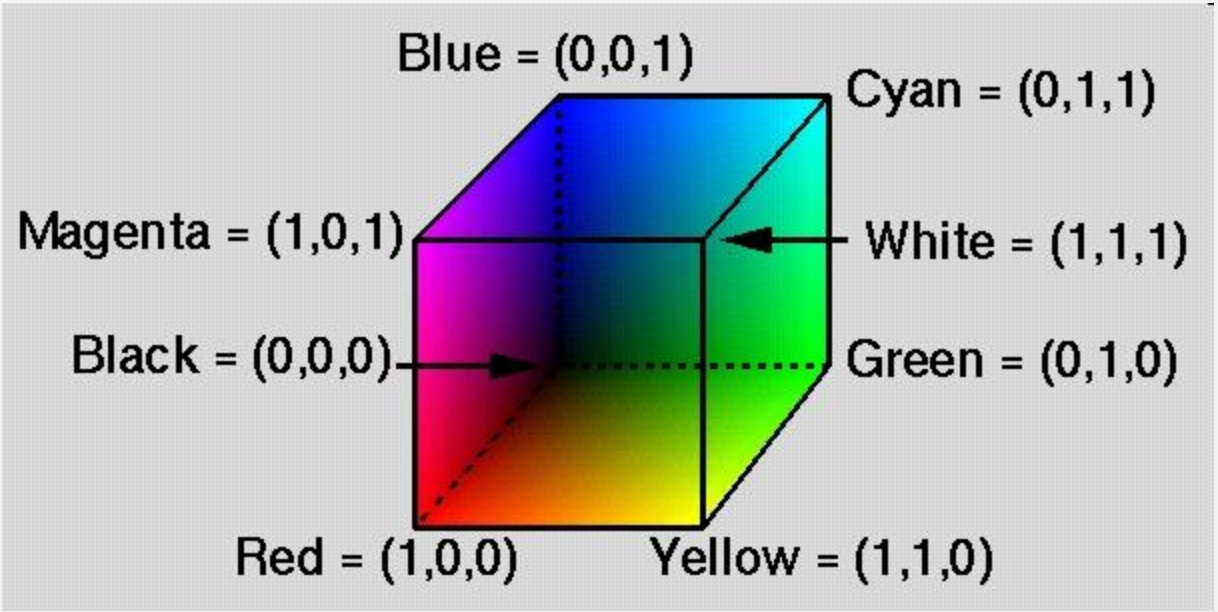
Additive



Lights

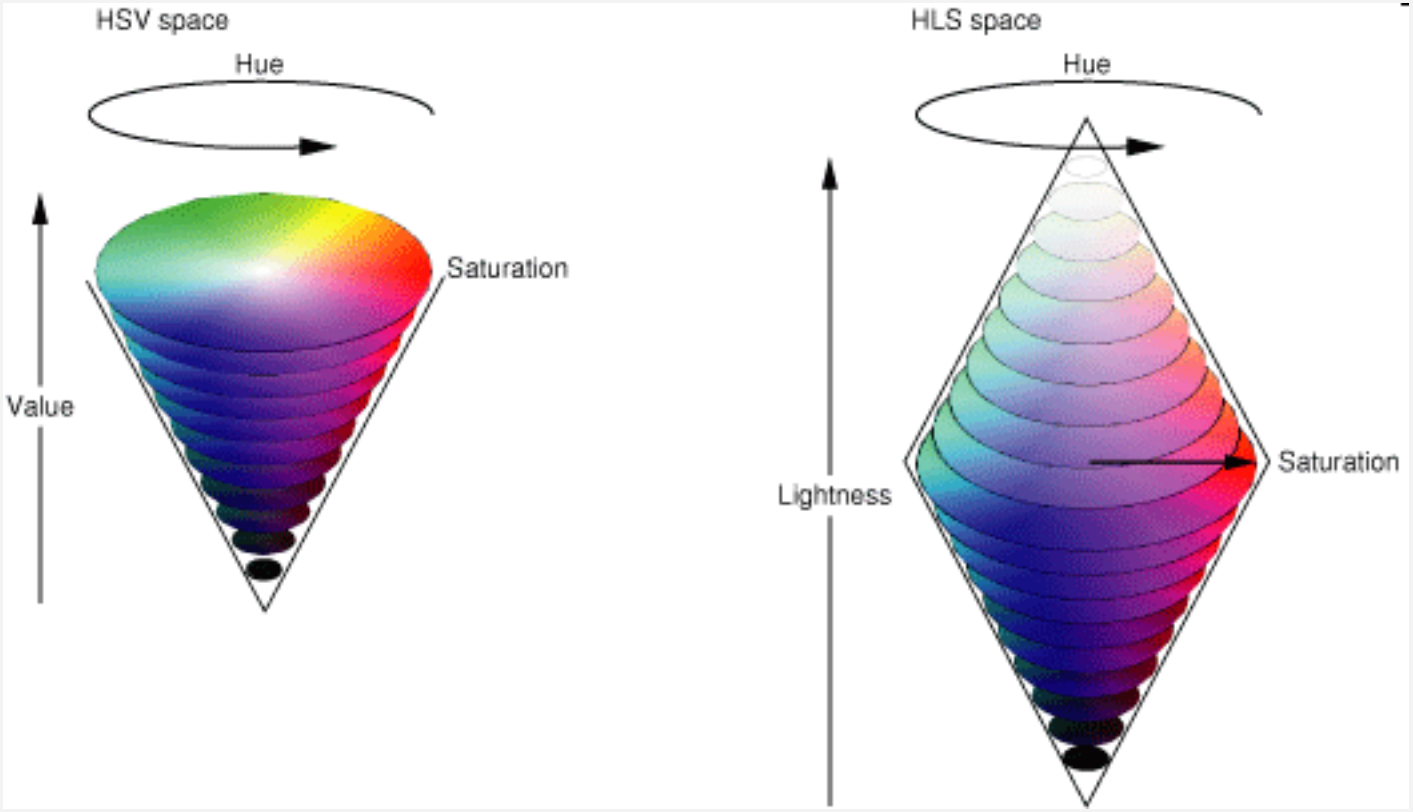
Color spaces – technical

- CMY(K) - subtractive model
  - printers
- RGB - additive model
  - monitors, projectors
- YCbCr
  - television

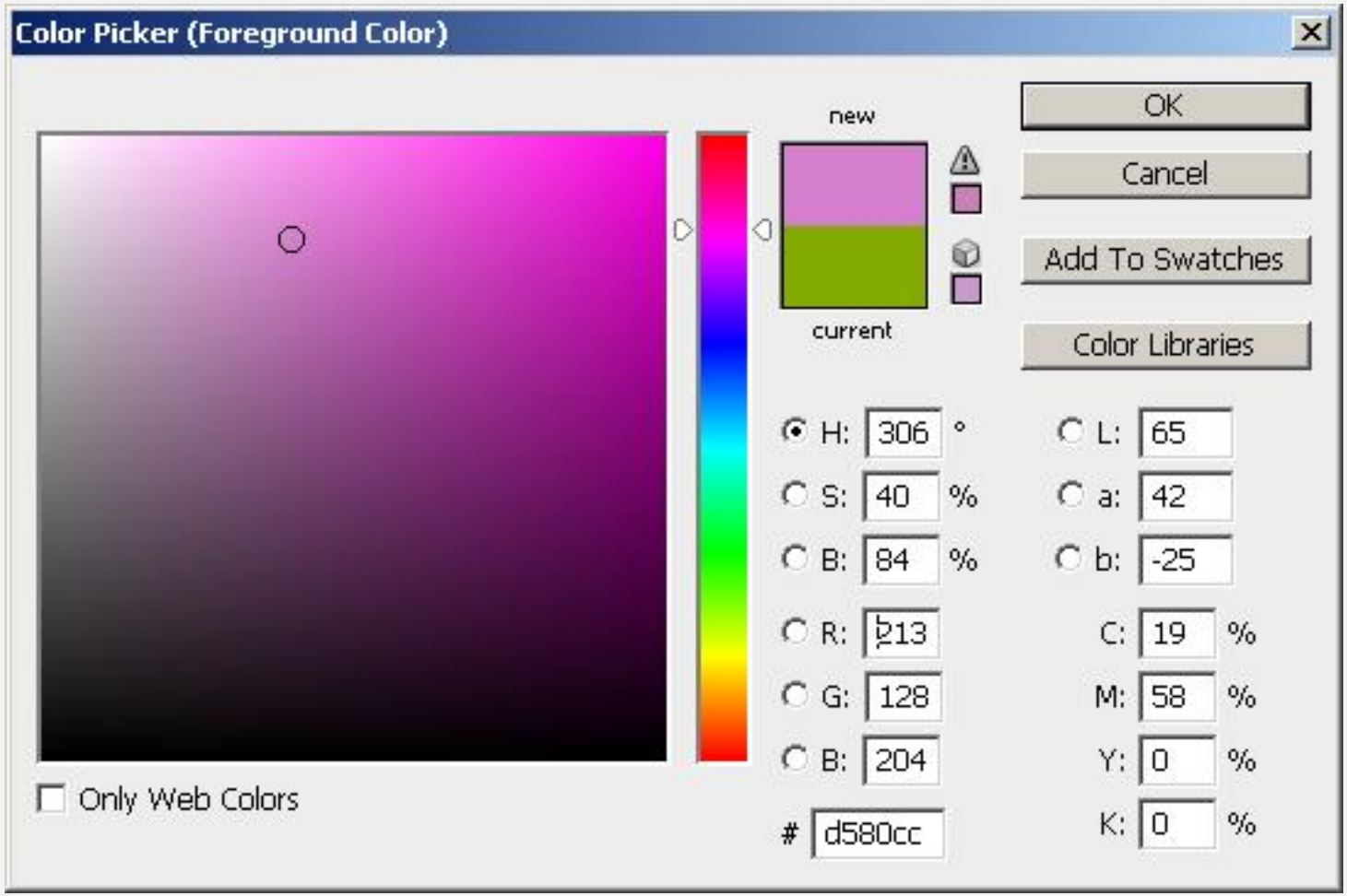


Color spaces – intuitive

- HSB, HSL, HSV
  - Separate hue, saturation, brightness

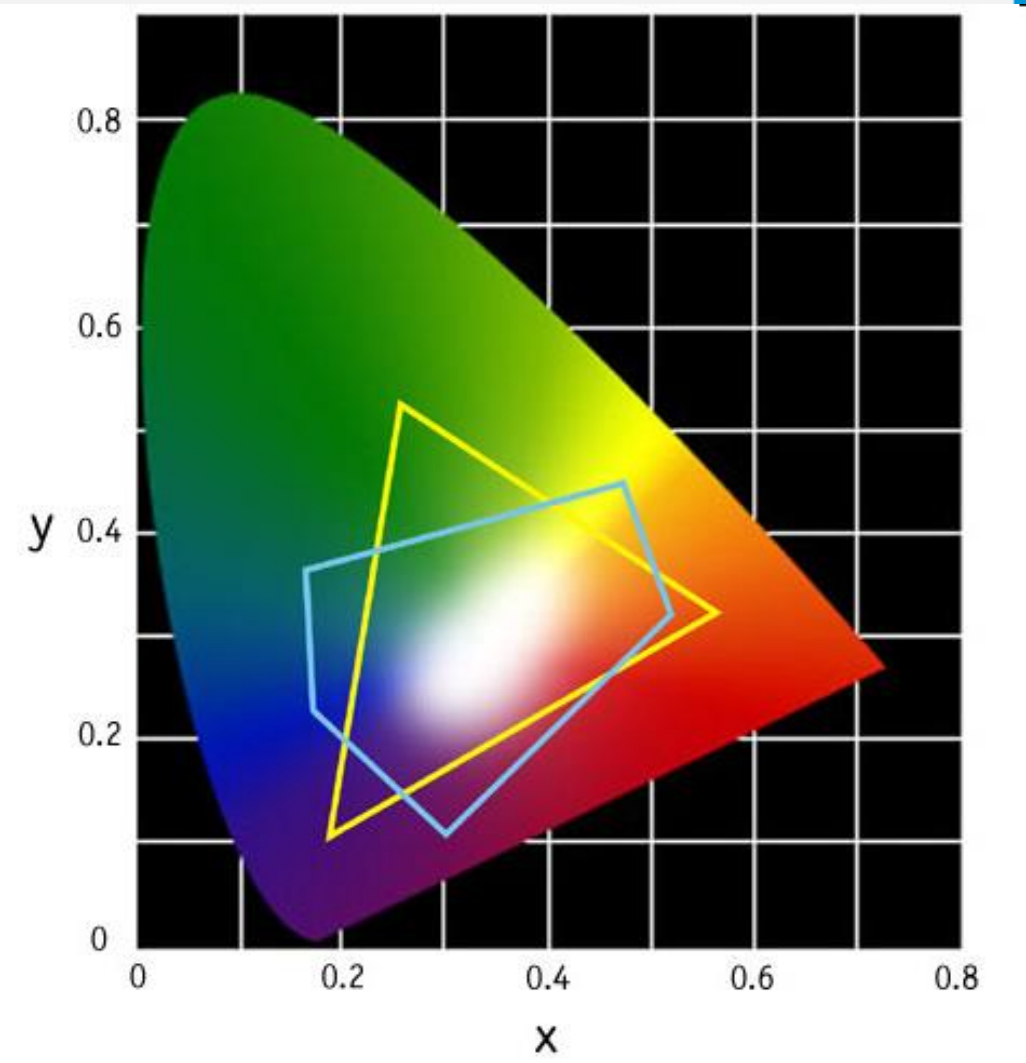


HSB color picker



CIE color space and gamut

- ‘Pure’ colors on the spectral locus (perimeter)
- Convex combinations of colors



Images

Image formats

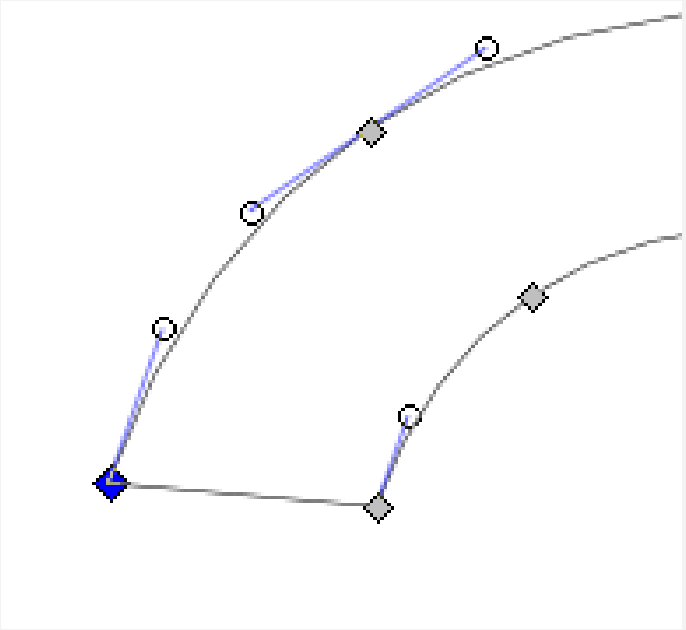
- you tell me ☺
- JPEG, PNG, GIF, BMP, TIFF, PSD, AI, EPS, WMF, CDR, PS, PDF, TGA, SVG, …
- bitmap formats vs. vector formats
- combination of both

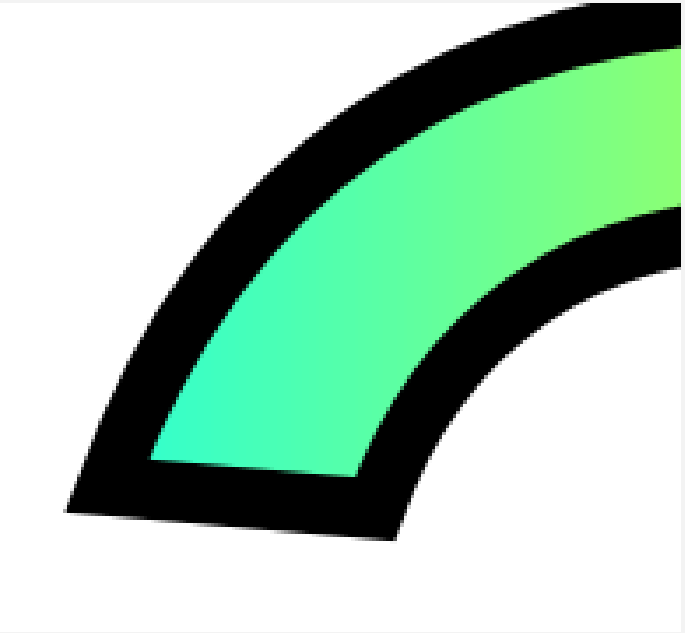
Bitmap vs. vector graphics

- Bitmaps
  - Ugly scaling
  - Perfect for realistic pictures
- Shapes
  - Perfect scaling
  - Perfect for symbols, logos
  - Bad with realistic pictures
  - Parametric = editable
  - Small size for simple objects

Vector graphics

- parametric or polygonal representation in 2D
- **SVG**, EPS, PS, AI, CDR, PDF, WMF, EMF



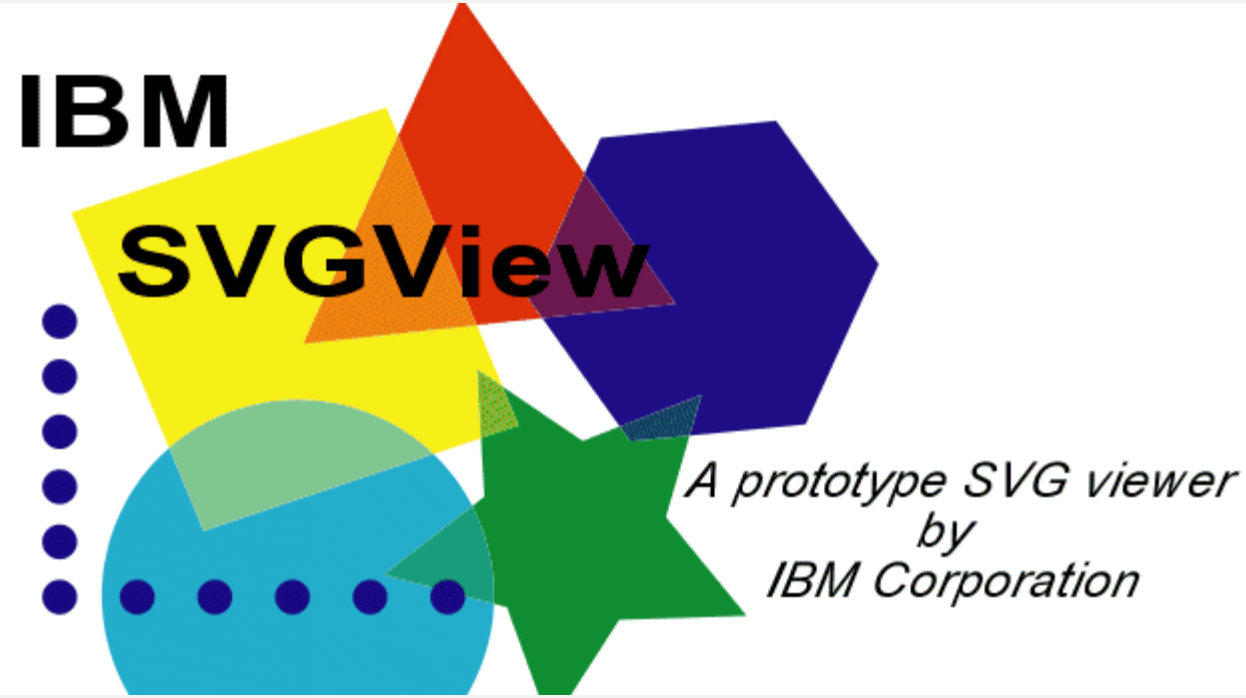


SVG

- **Scalable Vector Graphics**
  - 2D graphics & animations in XML
  - Developed by W3C
  - Open, free
  - Nice for dynamic visualizations
  - http://www.w3.org/Graphics/SVG/
  - Runs in web browsers

Basic objects

- Shapes
  - Curves, lines, geom. objects
- Images
- Text

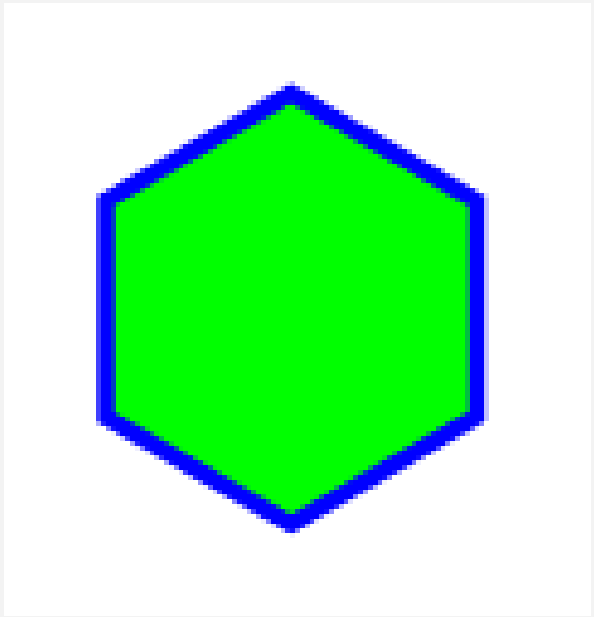


Shapes and texts

- Shapes
  - Fill
  - Stroke
  - Markers
- Text
  - Glyphs (font)
  - Unicode text

Example elements - polygon

- <polygon
  fill="lime"
  stroke="blue"
  stroke-width="10"
  points=“ 850,75 958,137.5
  958,262.5 850,325
  742,262.6 742,137.5"
  />



2D raster images

- **width, height**
- palette
- **bitmap**
- color order (RGB, BGR), bit order (little endian, big endian)
- compression parameters (optional)

What is coding?

- Representing information in a certain way
  - Encoding, decoding, transcoding
- E.g. date (year, month, day) = DD.MM.YYYY

- Graphical information
  - 2D/3D geometry
  - Colors
  - Motion

Examples of coded info

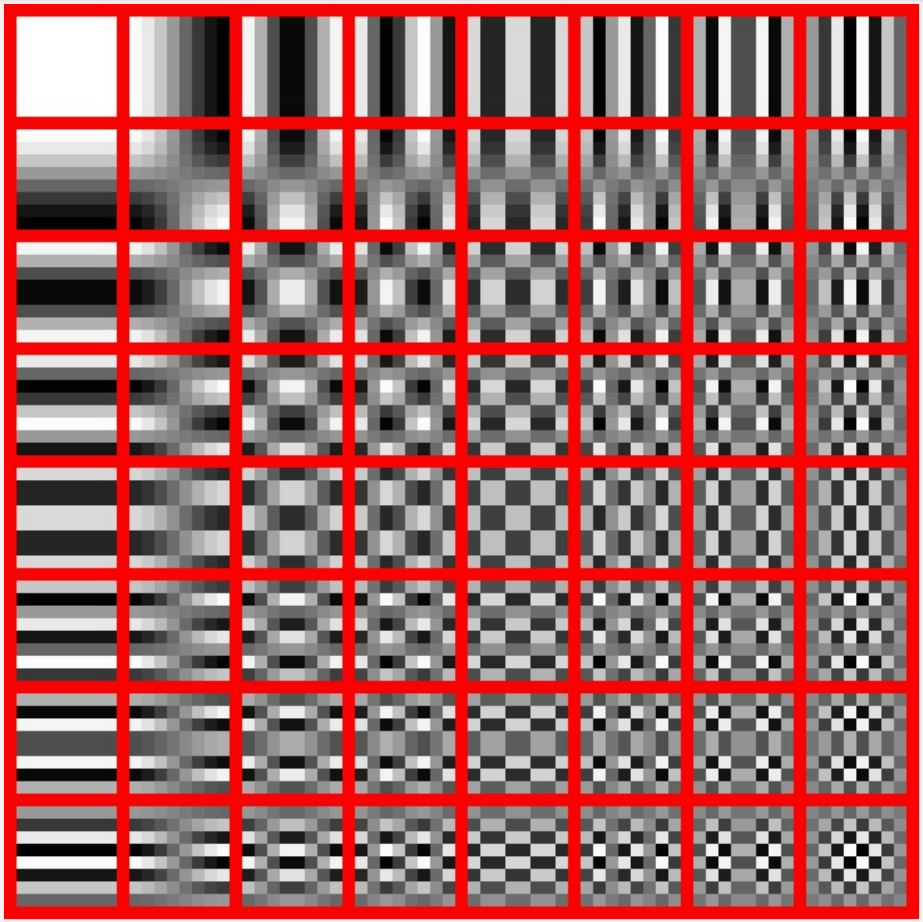
- JPEG
- PDF
- DVD
- FLASH

Image compression

- RLE (run-length encoding)
  - AAAAAAABBBBCCCCCC = 7A4B6C (35%)
  - ABCBABCBABCB = 1A1B1C....1C1B (200%)
- Dictionary
  - **ABCB**ABCB**ABCB** = 3#Q; #Q = ABCB (25%)
- LZW (GIF), Huffman code, DEFLATE (PNG)
- Lossless compression

Image compression

- DCT
- JPEG
  - 8x8 blocks
  - block decomposed by DCT into 64 values
  - 64 reduced to n
    - picture quality
- Lossy compression



JPEG lossy compression

- Control how many basis functions will contribute to the final result
  - quality

a. Original image

b. With 10:1 compression

c. With 45:1 compression

FIGURE 27-15
Example of JPEG distortion. Figure (a) shows the original image, while (b) and (c) shows restored images using compression ratios of 10:1 and 45:1, respectively. The high compression ratio used in (c) results in each 8×8 pixel group being represented by less than 12 bits.

www.dspguide.com

Lossless vs. Lossy

- Lossless
  - decompress = reconstruct
  - smaller ratios
  - safe
- Lossy
  - decompress = approximate
  - better ratios
  - destructive, artifacts

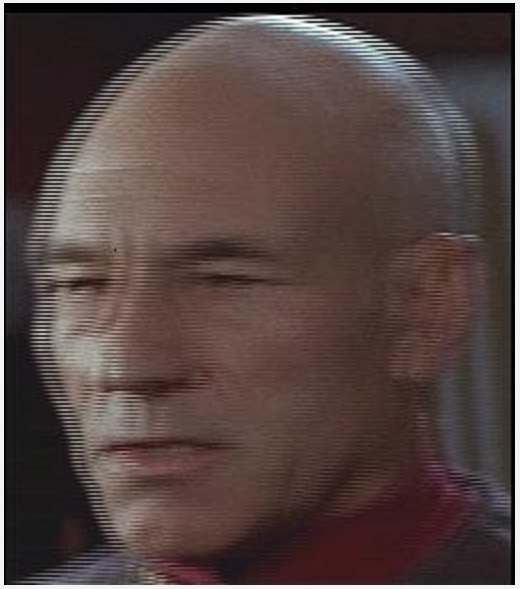
Image formats usage

- GIF – 8bit + animation + 1 bit transparency
- PNG – lossless, uniform areas, up to 64bit, no animation, 8bit transparency, no CMYK
- JPEG – lossy, photographic areas, also CMYK, no transparency
- PDF – include vector and bitmap graphics, both RGB and/or CMYK, document exchange, printing, compatibility

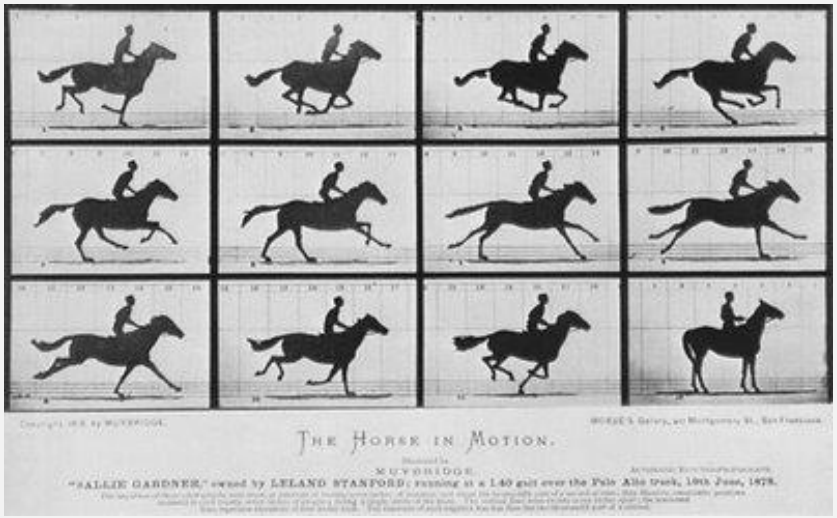
Videos

Moving pictures

- framerate
- interlaced / progressive
- inheritance from analog era
  - NTSC, PAL, interlacing



- YUV, YCbCr color spaces



YCbCr, YUV & company

- separation of luma & chroma
- Luminance =
  Y= 0.2126 R +
  0.7152 G +
  0.0722 B
- Cb = Luminance – B
- Cr = Luminance – R

- JPEGs

Movie formats

- you tell me ☺
- AVI, MPEG, MOV, MPEG2, MPEG4, x264, XviD, DivX;-), h.263, AVC,FLV, 3GP, TS, DV ...
- container vs. format
- file format vs. video format
- streaming – yes / no
- bandwidth

Standards in digital age

- NTSC (USA, East Asia, 30fps)
- PAL (Europe, Africa, 25fps)
  - remnants of the analog era
- HDTV (1280x720, 1920x1080)
  - 24fps, 25fps, 30fps...
- 4K2K (3840 x 2160)
  - digital 3D cinema

Movie compression

- Intra-frame compression
  - see Image compression
- Inter-frame compression
  - Keyframes + delta frames
  - I, P, B
  - Object tracking
  - Motion estimation
- MPEG and its offsprings

Inter-frame compression

Third dimension as a medium

Really a medium?

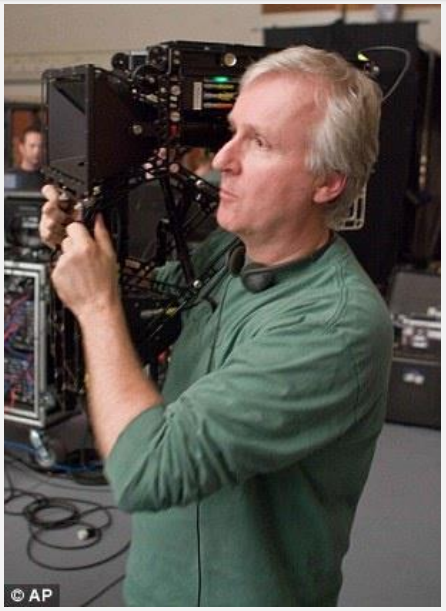
- image sequence = movie
- steroscopic image composition = 3D

Augmented reality used for surgery planning

Monsters vs. Aliens
First movie published in Blu-ray 3D

Principle and formats

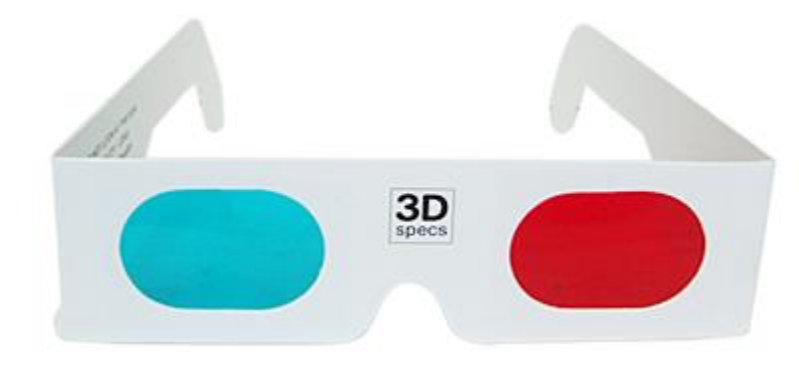
- 2d = one picture @ (2x one eye)
- 3d = 2x (one picture @ one eye)
- Anaglyph
- Head-mounted display
- Active shutter
- Polarization
- Autostereoscopy

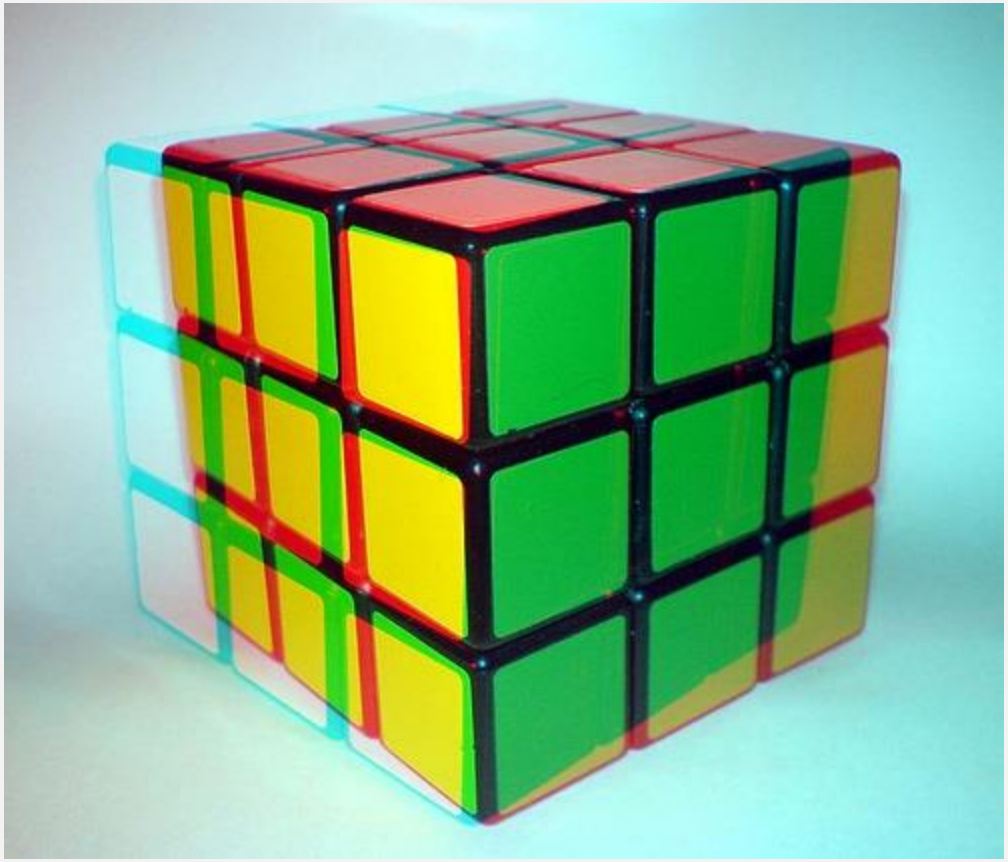


www.reald.com

Anaglyph

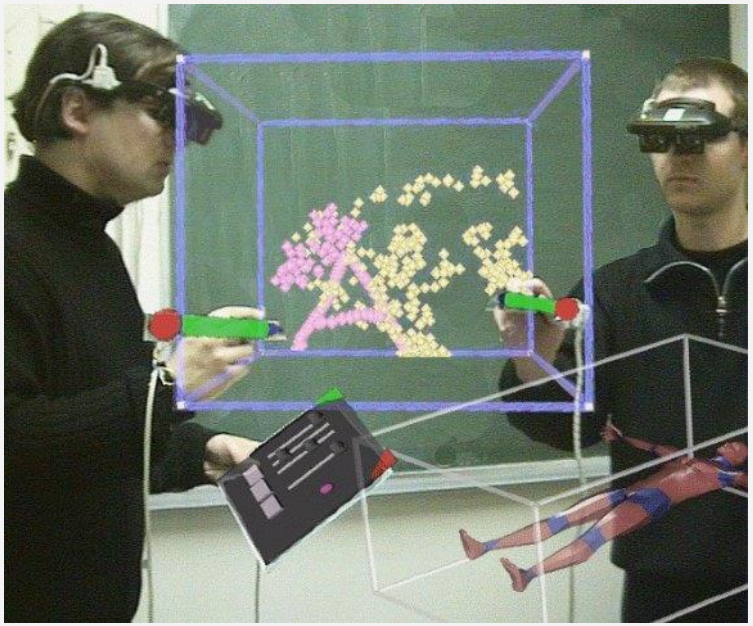
- Cheapest, oldest, passive (works for prints)
- Undesired color modulation
- Red-Cyan
- Magenta-Red





HMD

- Head-mounted display
- Separate small monitor for each individual eye



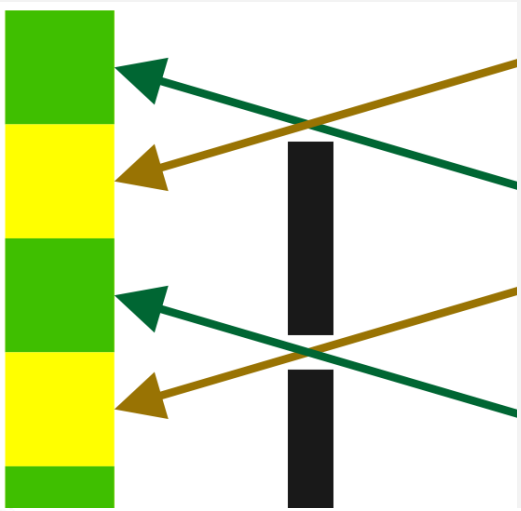
- Heavy
- Cables
- Flicker at short distance

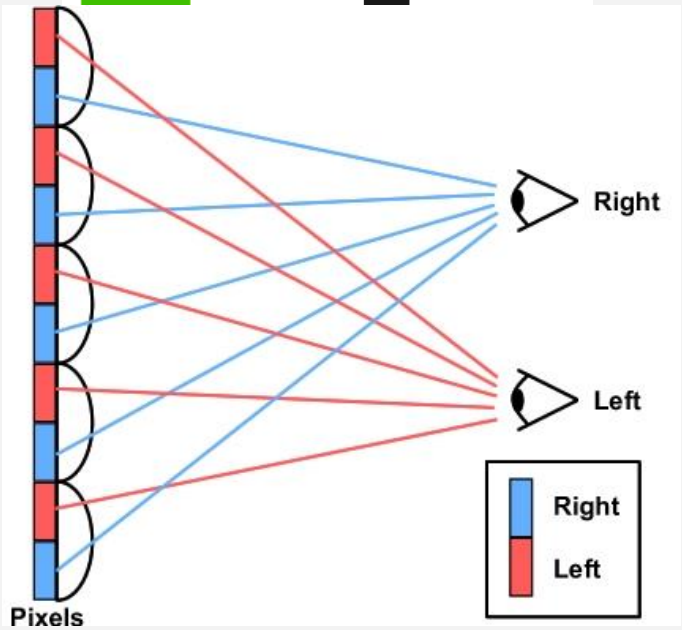
Active shutter & polarization

- Lightweight, no cables
- Shutter glasses
  - active, need batteries
  - glasses “open/close”
  - full brightness, might flicker
- Polarized glasses
  - 1 eye gets ½ of the signal
  - no flicker, less brightness

Autostereoscopy

- no glasses
- lenticular lens
- parallax barrier
- sensitive to viewing angles





Multimedia system

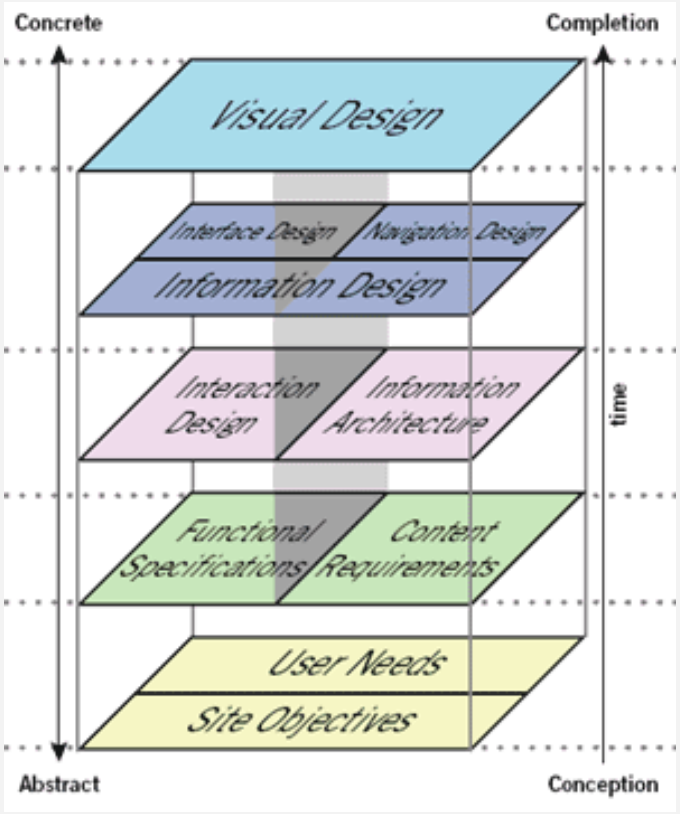
Putting it all together

- Directed elements
  - linear experience
  - guided navigation, predictable
  - author makes the choices
  - e.g. slide show, video
- Elements of choice
  - non-linear experience
  - unguided navigation, unpredictable
  - user makes the choices
  - e.g. WWW, computer game

Multimedia directing

ION-s

- narration
- immersion
- interaction
- navigation
- emotion



- Example: web site design

jjg.net

Watch and learn

- www.europrix.org

The end