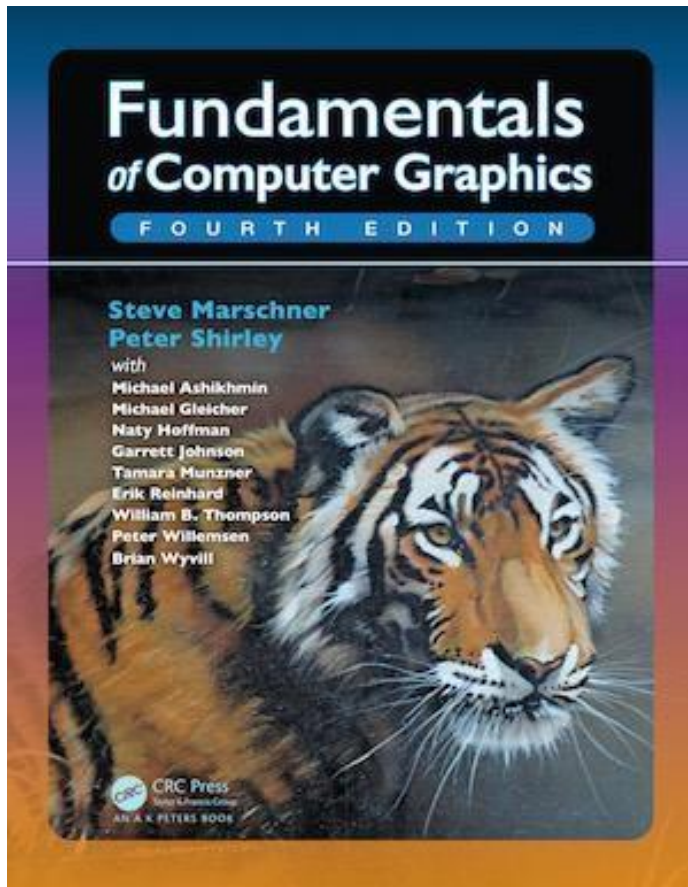


CSE4203: Computer Graphics
Chapter – 3
Raster Images

Outline

- Raster and Raster Images
- Display Devices
- Pixel Values
- RGB Color
- Alpha Compositing

Credit



CS4620: Introduction to Computer Graphics

Cornell University

Instructor: Steve Marschner

<http://www.cs.cornell.edu/courses/cs4620/2019fa/>

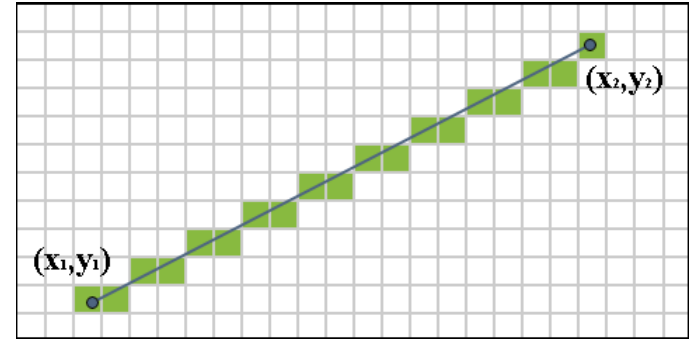
Raster (1/1)

- Most computer graphics images are presented on *raster display*.

- i.e. television

– has rectangular array of small light-emitting **pixels**

- individually set to different colors to create desired image.

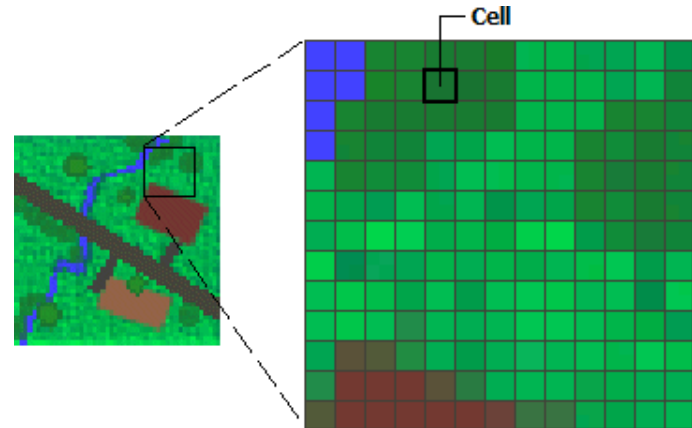


Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/>

Image source: https://commons.wikimedia.org/wiki/File:Bresenham_line.png

Storing Images (1/2)

- Raster Image:
 - used to store and process images, as rasters are common in devices
- simply a **2D array**
- stores the pixel value for each pixel
- usually a color stored as **three numbers (r, g, b)**



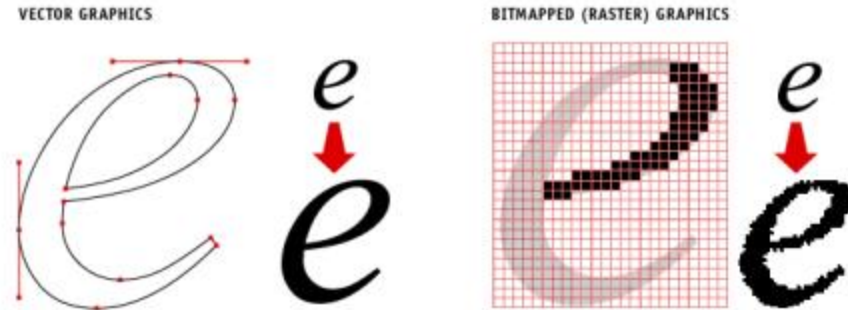
Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/>

Image source: <https://desktop.arcgis.com/en/arcmap/10.3/manage-data/raster-and-images/what-is-raster-data.htm>

Image Source: Internet

Storing Images (2/2)

- Vector Image:
 - storing descriptions of shapes
 - areas of color bounded by lines or curves
 - no reference to any pixel grid.



- Need to store *instructions for displaying the image rather than the pixels needed to display it.*

Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/>

Image source: <https://signalizenj.wordpress.com/2015/01/29/vector-vs-raster/>

Image Source: Internet

Storing Images (2/2)

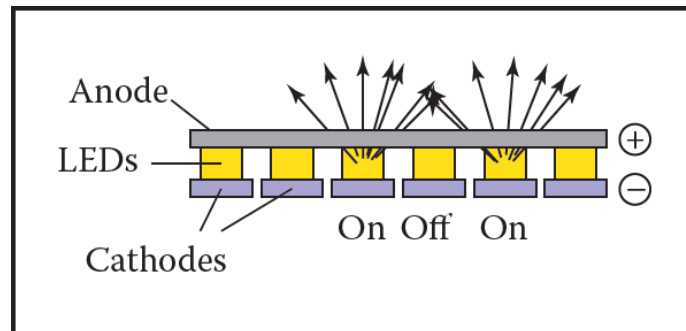
- Vector Image:
 - **Q: Advantage/ Disadvantage?**

Display Devices (1/1)

- **Transmissive Displays:**
 - require a light source to illuminate them
 - backlight behind the array
 - i.e. in a projector, a lamp emits light projected onto the screen after passing through the array.
- **Emissive Display:**
 - it is its own light source.

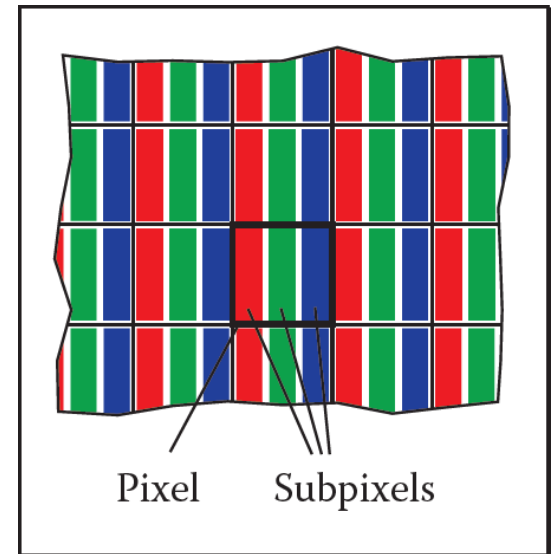
Emissive Displays (1/2)

- Emissive Displays:
 - Example: light-emitting diode (LED)
 - Each pixel is composed of one or more LEDs (semiconductor devices)
 - emit light with intensity \leftrightarrow electrical current passing through them



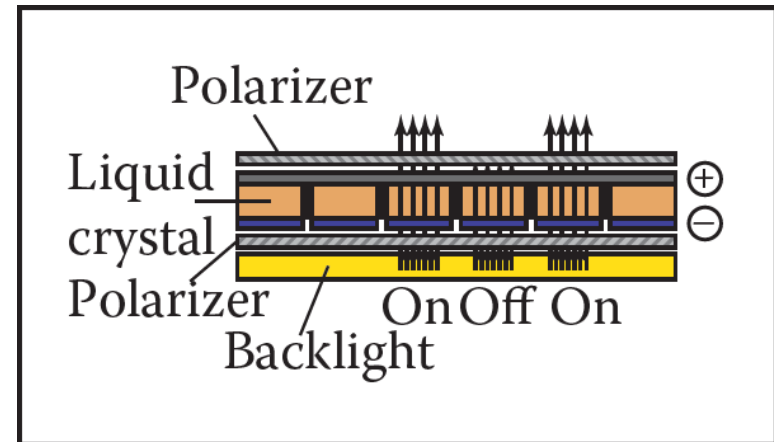
Emissive Displays (2/2)

- Sub-pixel:
 - Pixels divided into three independently controlled sub-pixels (R, G, B)
 - each with own LED (different materials)
 - emit light of different colors



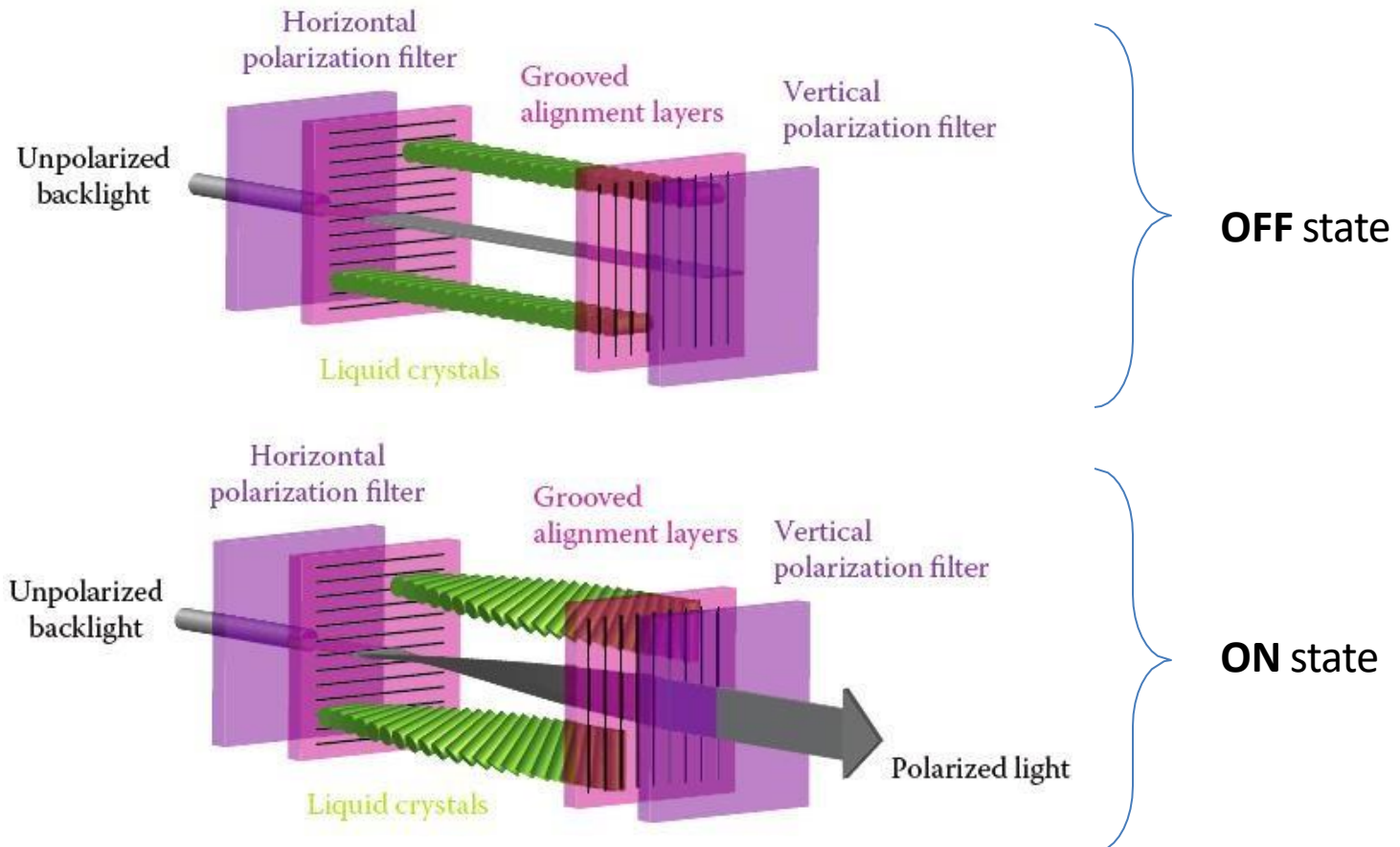
Transmissive Displays (1/3)

- Transmissive Displays:
 - Example: light crystal display (LCD)
- Molecular structure of liquid crystal rotates the polarization of light that passes through it
- LCDs also have sub-pixels.



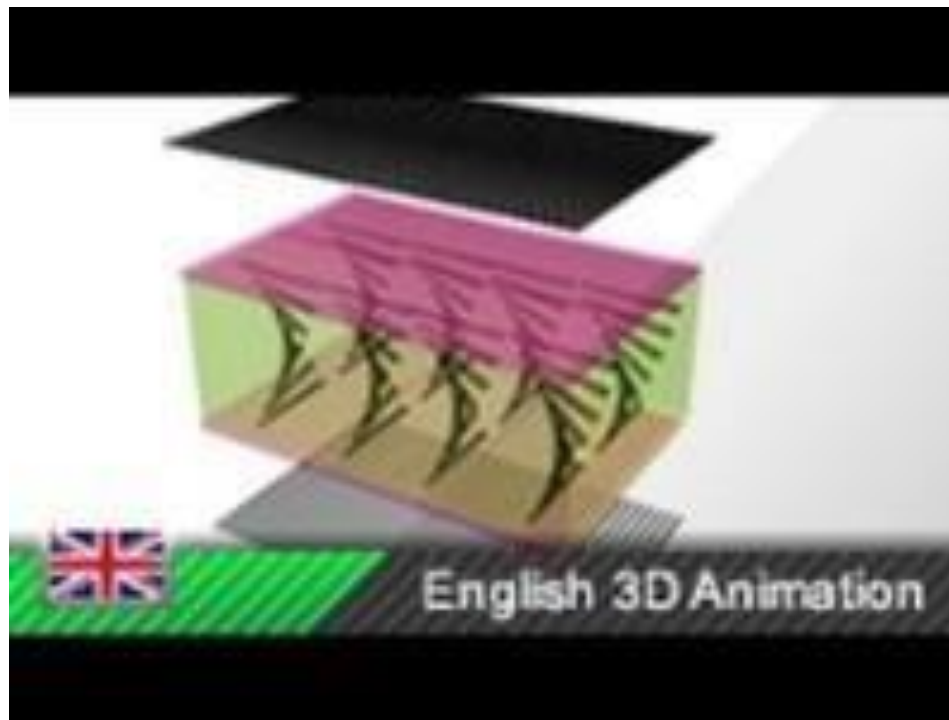
Transmissive Displays (2/3)

- Degree of rotation \leftrightarrow applied voltage



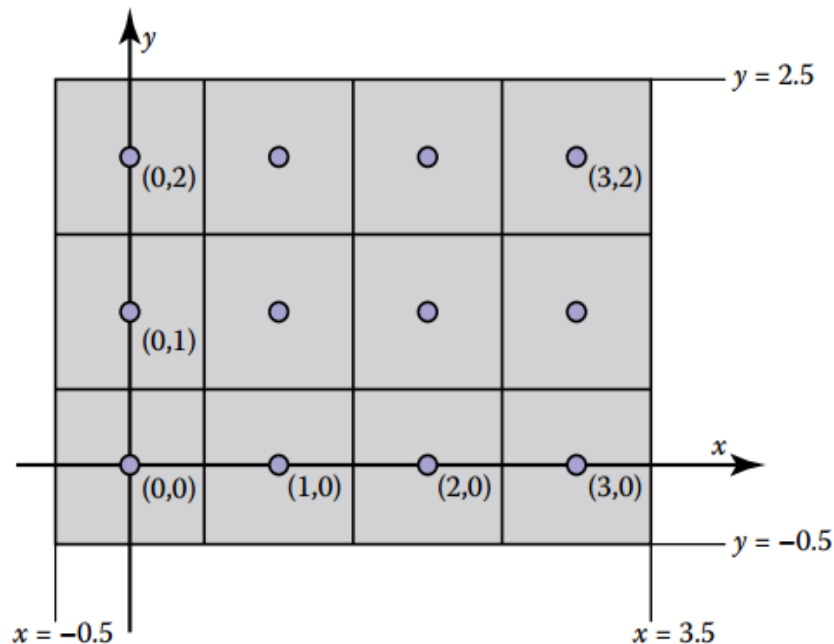
Transmissive Displays (3/3)

youtu.be/k7xGQKpQAWw?t=77



Pixel Values (1/1)

- Coordinate system for raster screen:
 - Convention:



RGB Color (1/1)

black = (0, 0, 0), red = (1, 0, 0), green = (0, 1, 0),
blue = (0, 0, 1), yellow = (1, 1, 0), magenta = (1, 0, 1),
cyan = (0, 1, 1), white = (1, 1, 1)

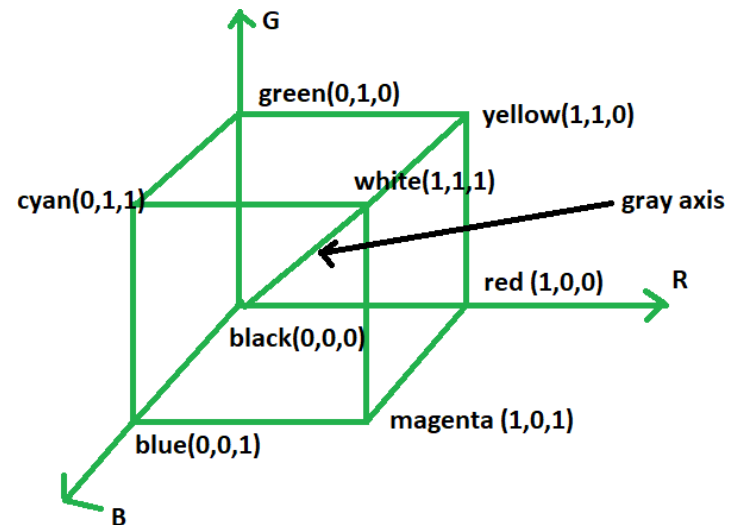
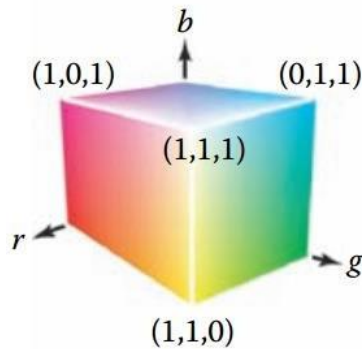
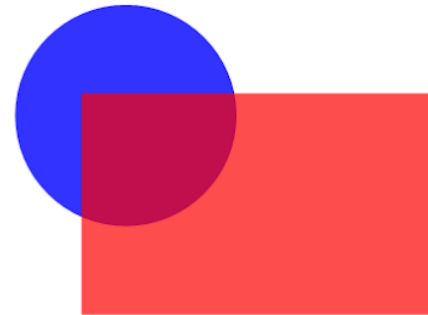


Image Source: <https://www.geeksforgeeks.org/computer-graphics-the-rgb-color-model/>

Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/>

Alpha Compositing (1/3)

- Partially overwriting the contents of a pixel.
 - Where we have a background and want to insert a foreground image over it.
 - Transparent
 - Opaque (not transparent)
 - Partially Transparent



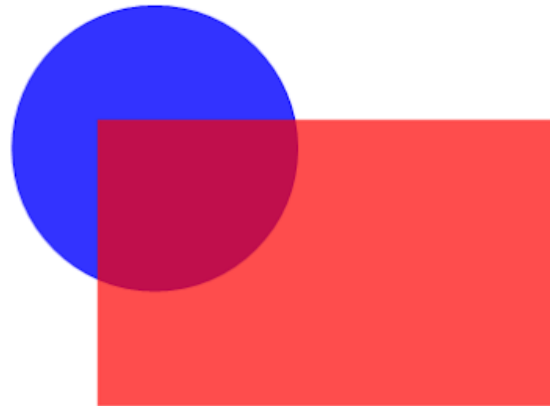
Credit: Fundamentals of Computer Graphics 3rd Edition by Peter Shirley, Steve Marschner | <http://www.cs.cornell.edu/courses/cs4620/2019fa/>
Image source: <http://www.graphicalweb.org/2005/papers/abstractsvgopen/index.html>

Alpha Compositing (2/3)

- foreground and background must be blended.

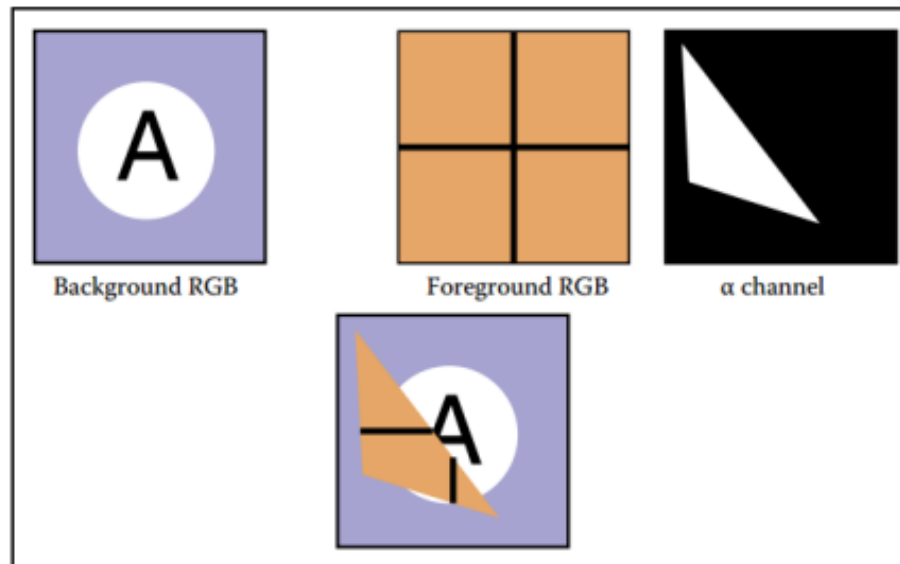
$$c = \alpha c_f + (1 - \alpha) c_b$$

- α = Fraction of the pixel covered by the foreground layer



Alpha Compositing (3/3)

- Alpha Mask:
 - The α values for all the pixels is stored in a separate gray scale image.



Practice Question 1

- Given that, $C_f = 1.0$, $C_b = 0.5$ and $C = 0.8$, where, C_f , C_b and C are the foreground, background and composite intensities respectively. Determine the alpha(α) value to perform alpha compositing.

Additional Reading

- 3.1.2: Hardcopy Devices.
- 3.2.1: Pixel formats with typical applications.
- 3.2.2: Monitor Intensities and Gamma.
- Frequently Asked Questions

Thank You