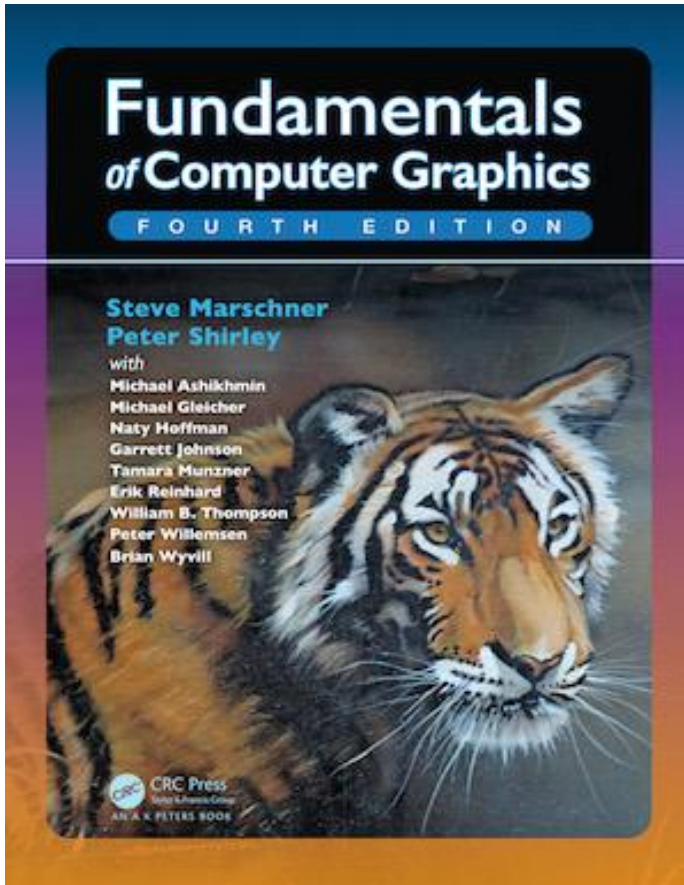# CSE4203: Computer Graphics
Chapter – 3
Raster Images

Mohammad Imrul Jubair

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/
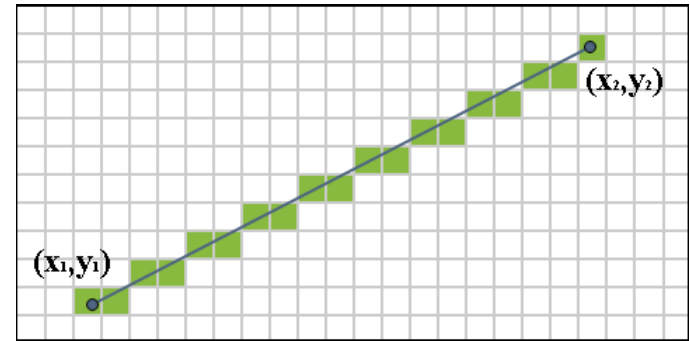
Raster (1/1)

- Most computer graphics images are presented on *raster display*.
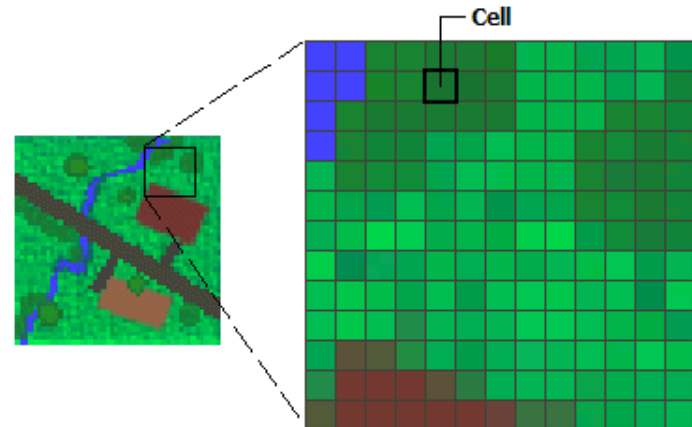 - i.e. television
- has rectangular array of small light-emitting **pixels**
  - individually set to different colors to create desired image.

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
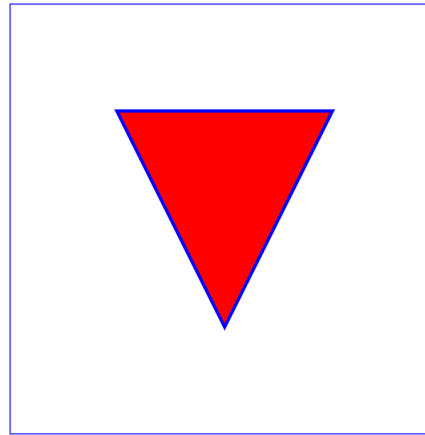   - usually a color stored as **three numbers (r, g, b)**

M. I. Jubair

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.

Storing Images (2/2)

- Vector Image:
  - Example


```
<svg width="4cm" height="4cm" viewBox="0 0 400 400"
    xmlns="http://www.w3.org/2000/svg" version="1.1">
  <title>Example triangle01- simple example of a 'path'</title>
  <desc>A path that draws a triangle</desc>
  <rect x="1" y="1" width="398" height="398"
        fill="none" stroke="blue" />
  <path d="M 100 100 L 300 100 L 200 300 z"
        fill="red" stroke="blue" stroke-width="3" />
```

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.

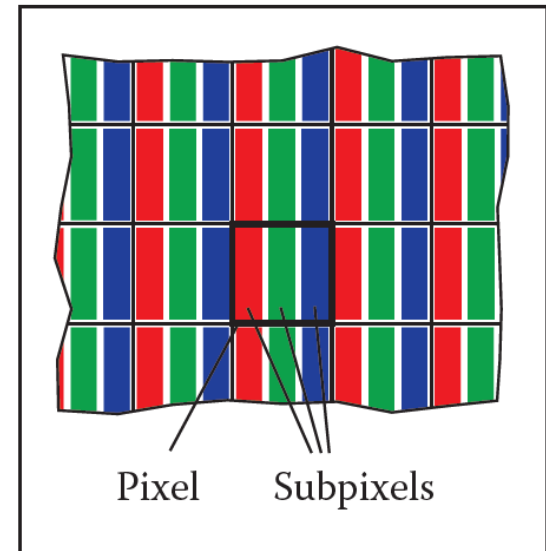# Emissive Displays (1/2)

- Emissive Displays:
    - Example: light-emitting diode (LED)
  – Each pixel is composed of one or more LEDs (semiconductor devices)
    - emit light with intensity ↔ electrical current passing through them
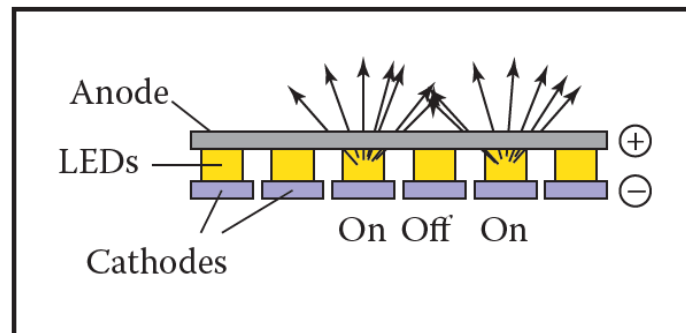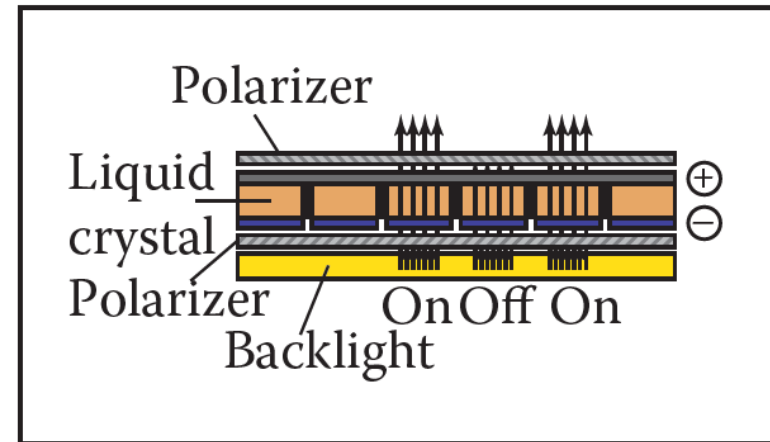
Emissive Displays (2/2)

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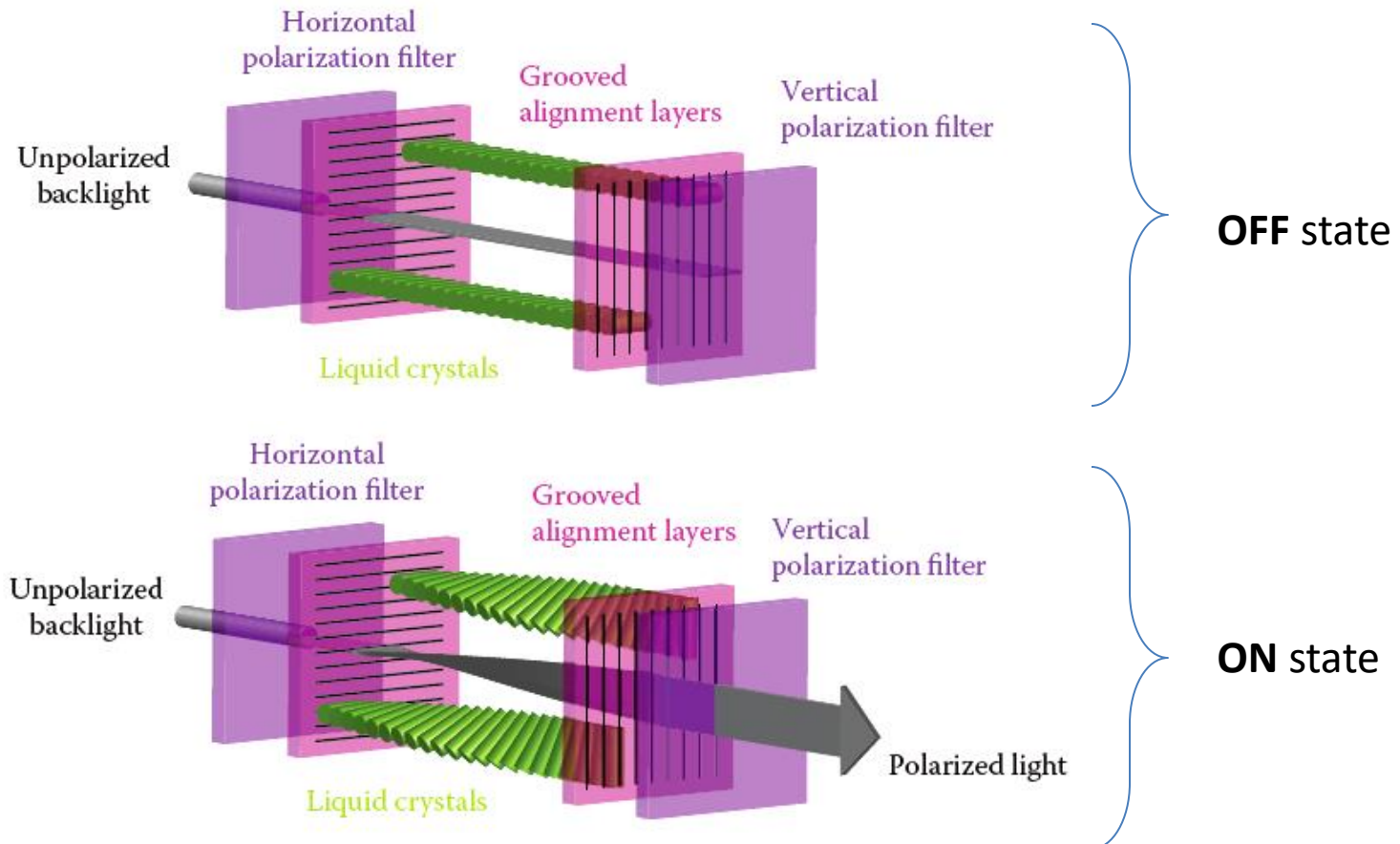   - emit light of different colors

Pixel   Subpixels

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

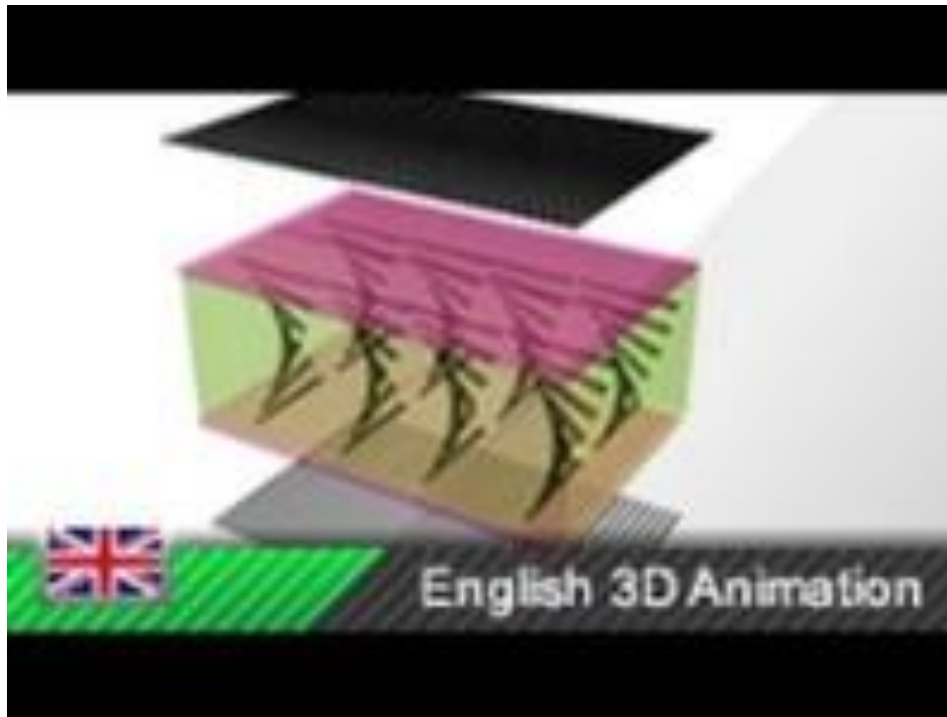- LCDs also have sub-pixels.

Transmissive Displays (2/3)

- Degree of rotation ↔ applied voltage

Horizontal polarization filter
Grooved alignment layers
Vertical polarization filter
Unpolarized backlight
Liquid crystals
OFF state

Horizontal polarization filter
Grooved alignment layers
Vertical polarization filter
Unpolarized backlight
Liquid crystals
Polarized light
ON state

Transmissive Displays (3/3)

youtu.be/k7xGQKpQAWw?t=77

English 3D Animation
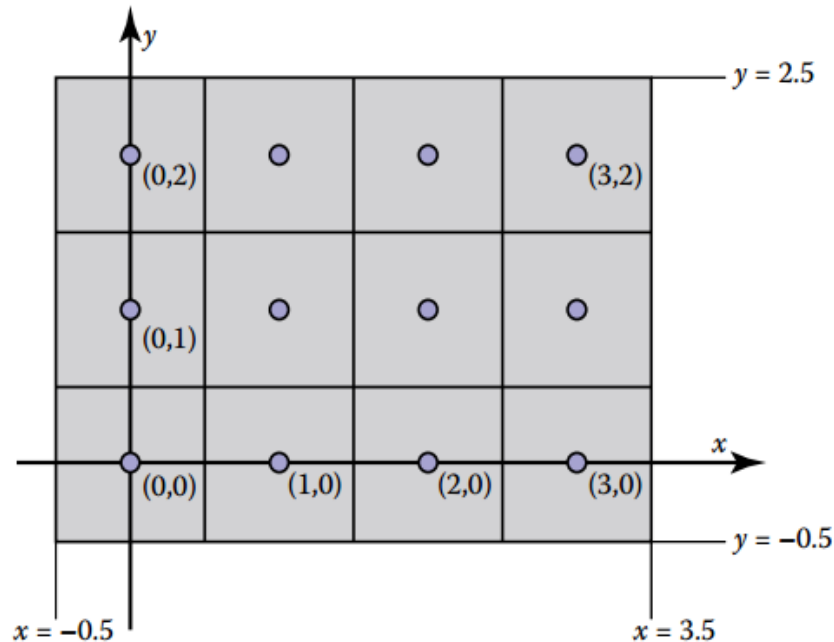
Pixel Values (1/1)

- 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),
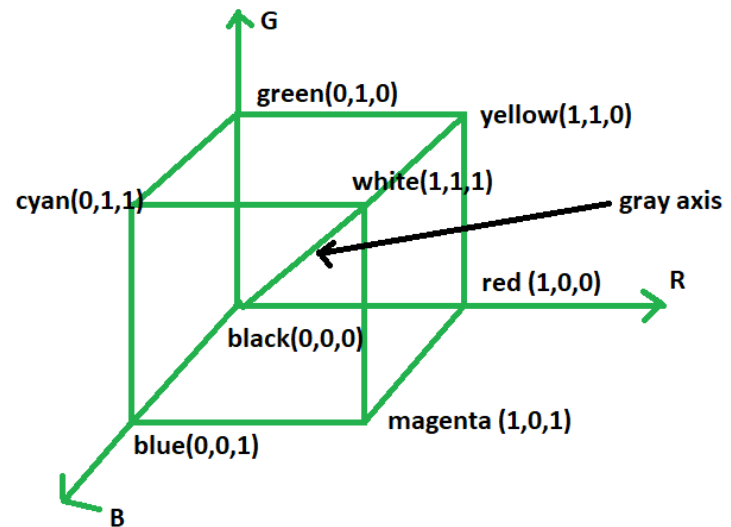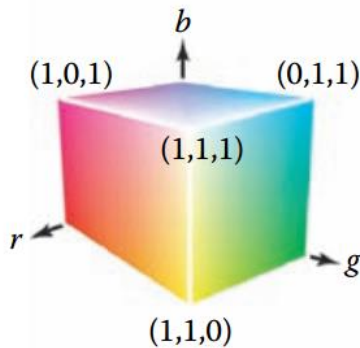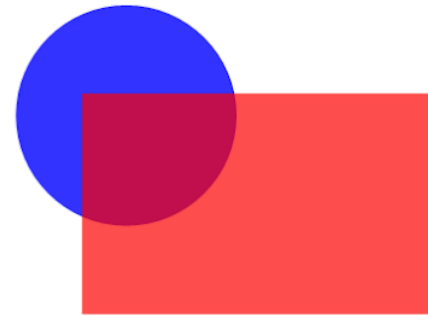
cyan = (0, 1, 1), white = (1, 1, 1)

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

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
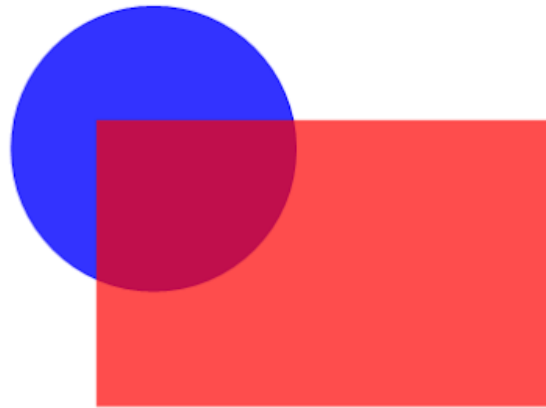   - Opaque (not transparent)
    - Partially Transparent

Alpha Compositing (2/3)

- foreground and background must be blended.

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

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