Game Programming

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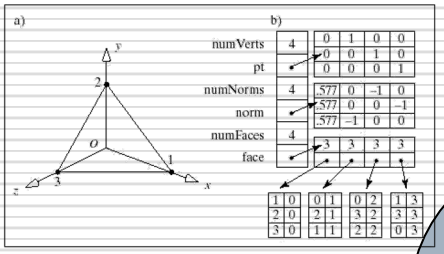
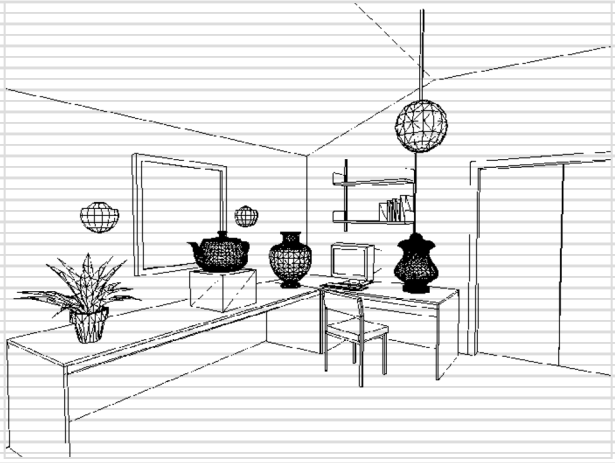
What is Computer Graphics ?



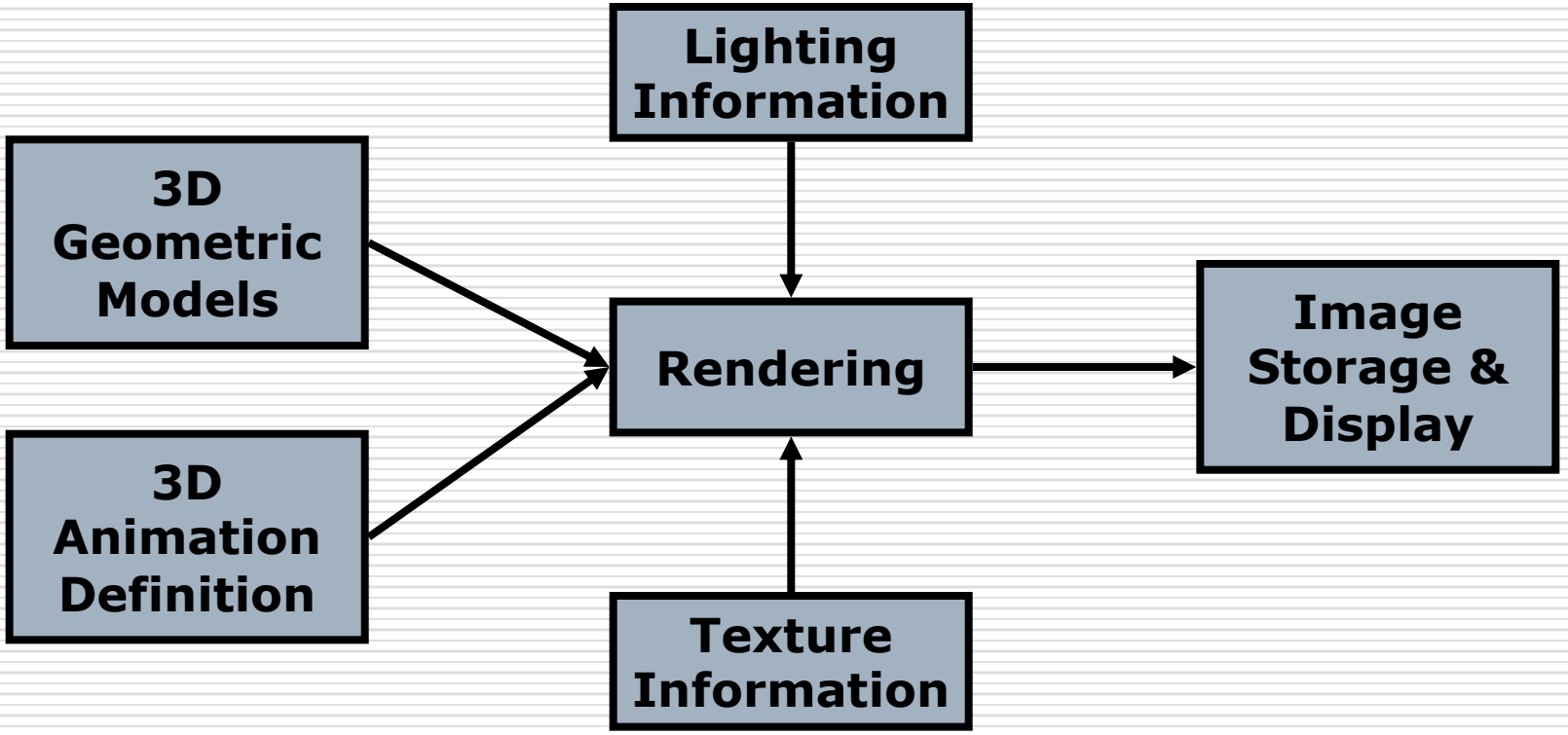
modeling

rendering

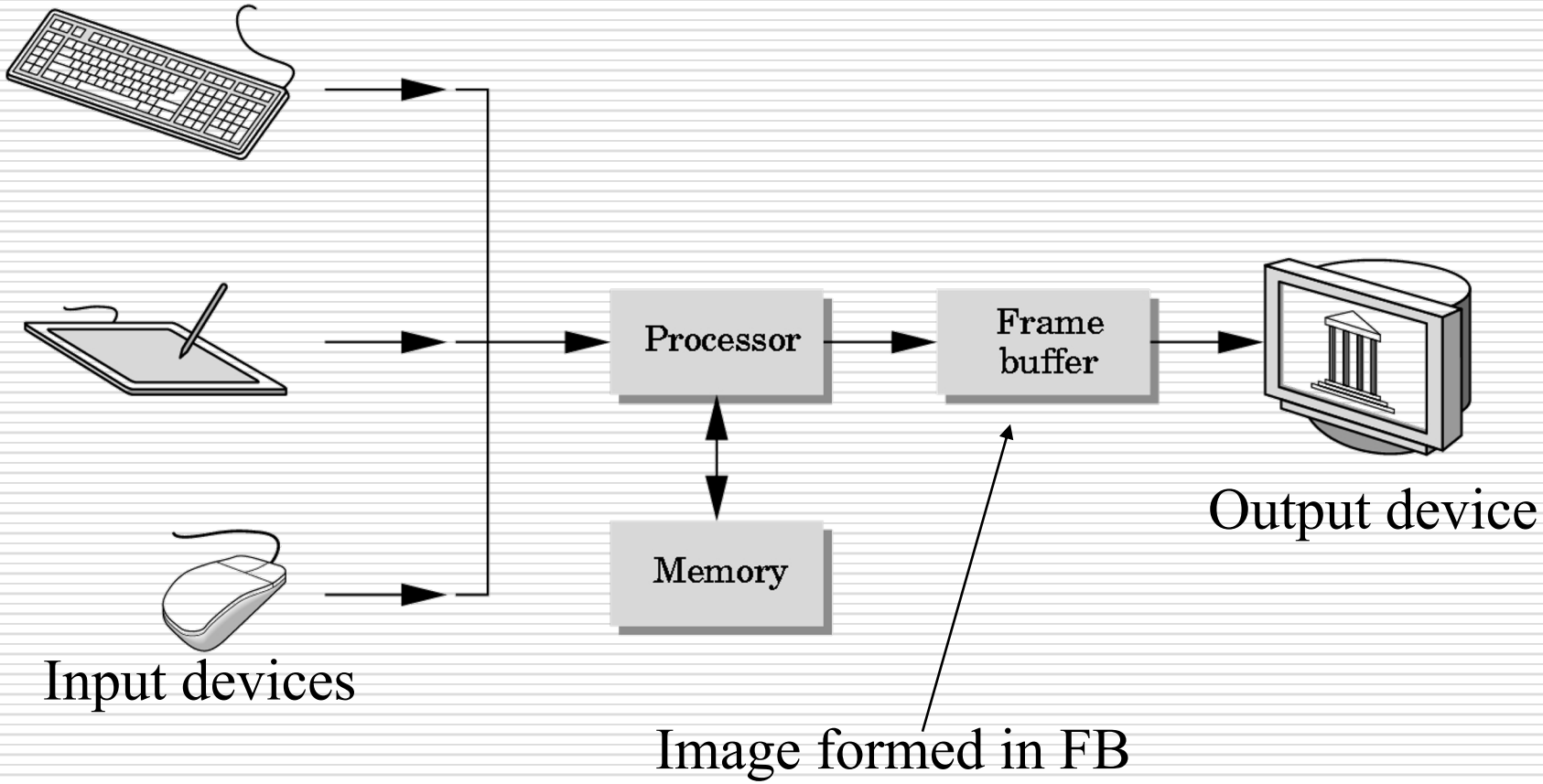
animation



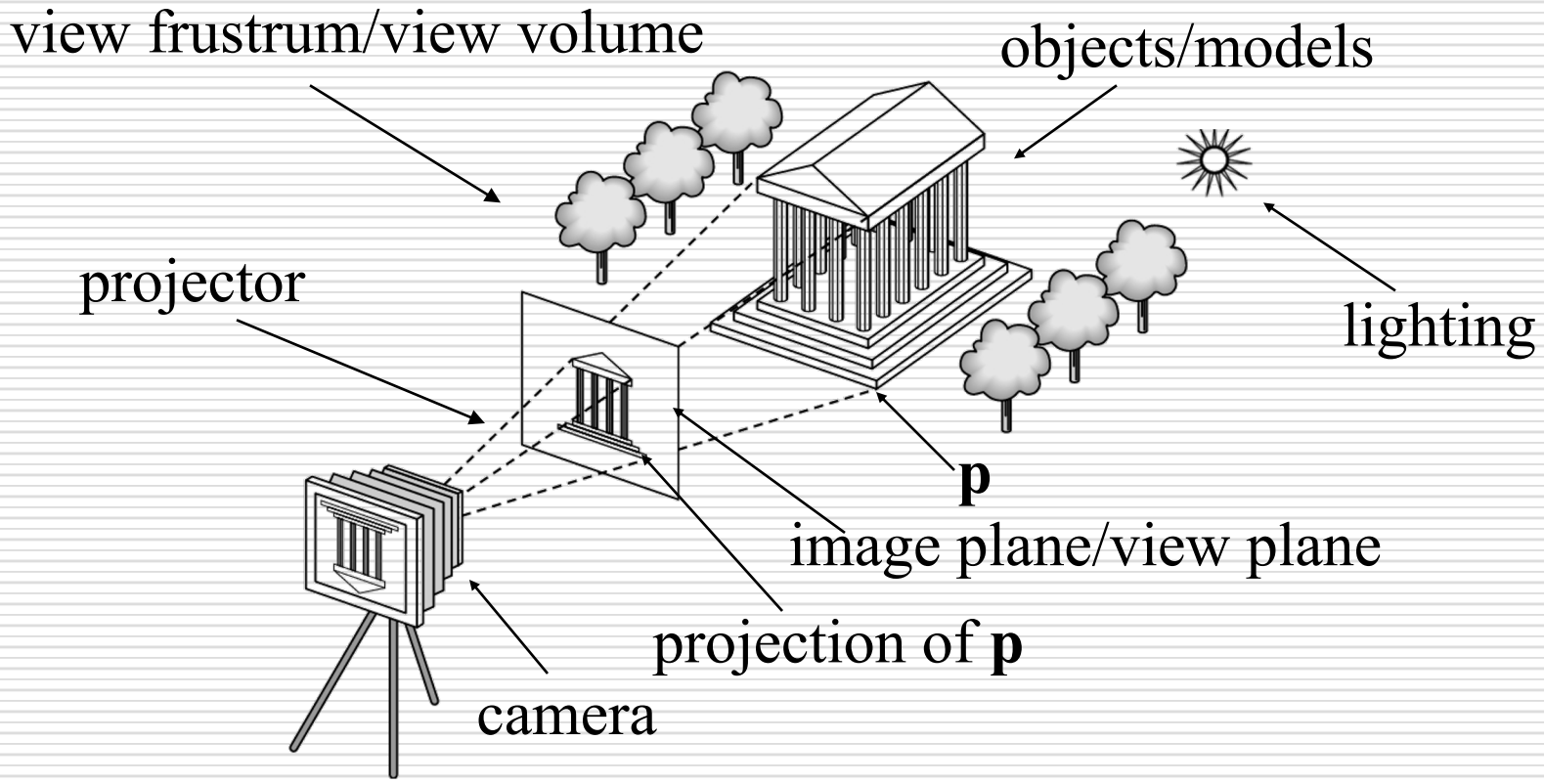
The Graphics Process



Basic Graphics System

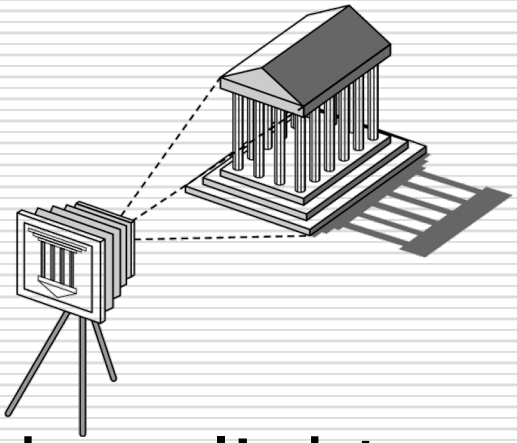


Synthetic Camera Model



Elements of Image Formation

- Objects
- Viewer
- Light source(s)



- Attributes that govern how light interacts with the materials in the scene
- Note the independence of the objects, viewer, and light source(s)

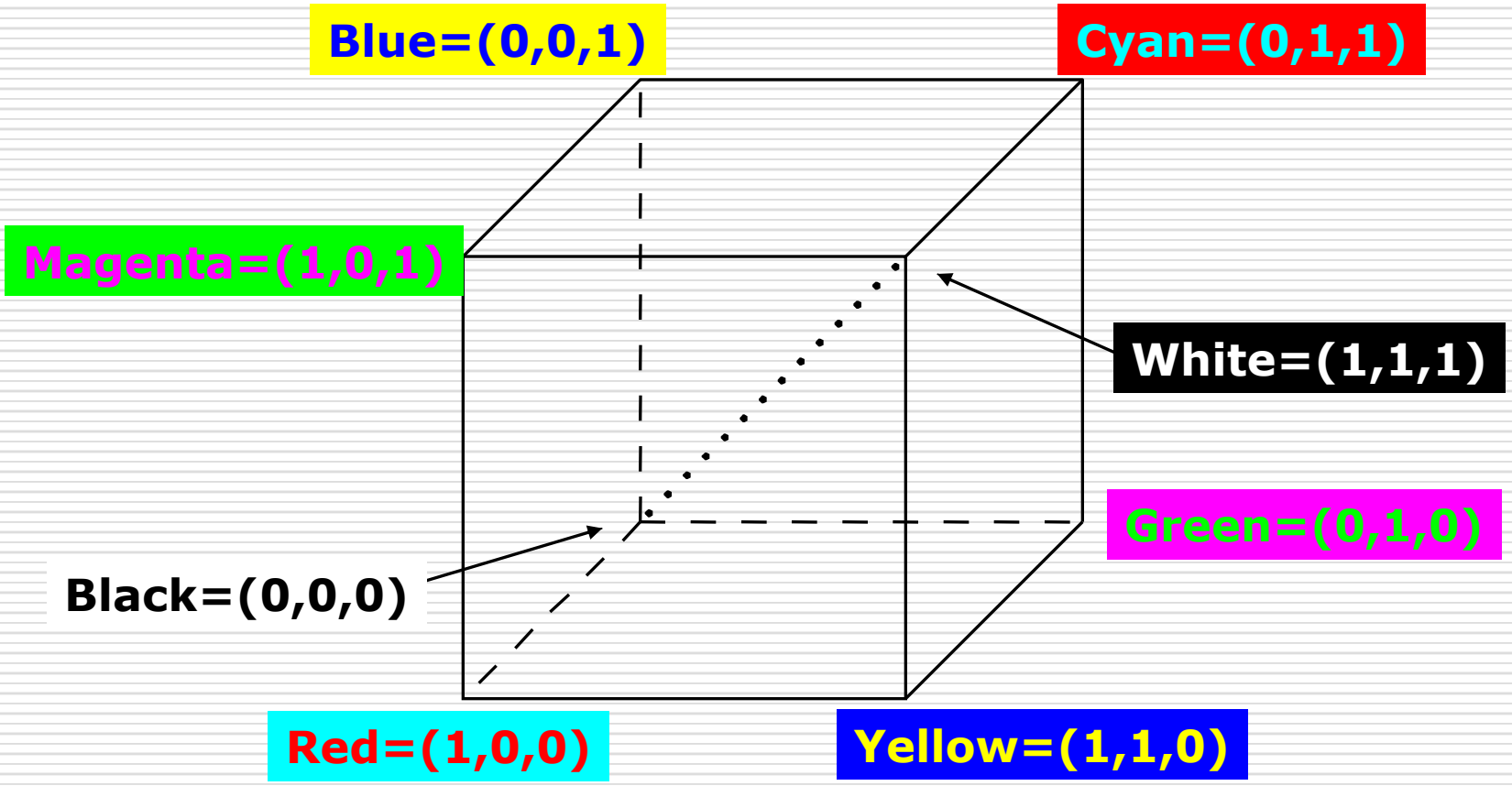
Luminance and Color Images

- Luminance
  - Monochromatic
  - Values are gray levels
  - Analogous to working with black and white film or television
- Color
  - Has perceptional attributes of hue, saturation, and lightness
  - Do we have to match every frequency in visible spectrum? No!

Additive and Subtractive Color

- Additive color
  - Form a color by adding amounts of three primaries
    - CRTs, projection systems, positive film
  - Primaries are Red (R), Green (G), Blue (B)
- Subtractive color
  - Form a color by filtering white light with Cyan (C), Magenta (M), and Yellow (Y) filters
    - Light-material interactions
    - Printing
    - Negative film

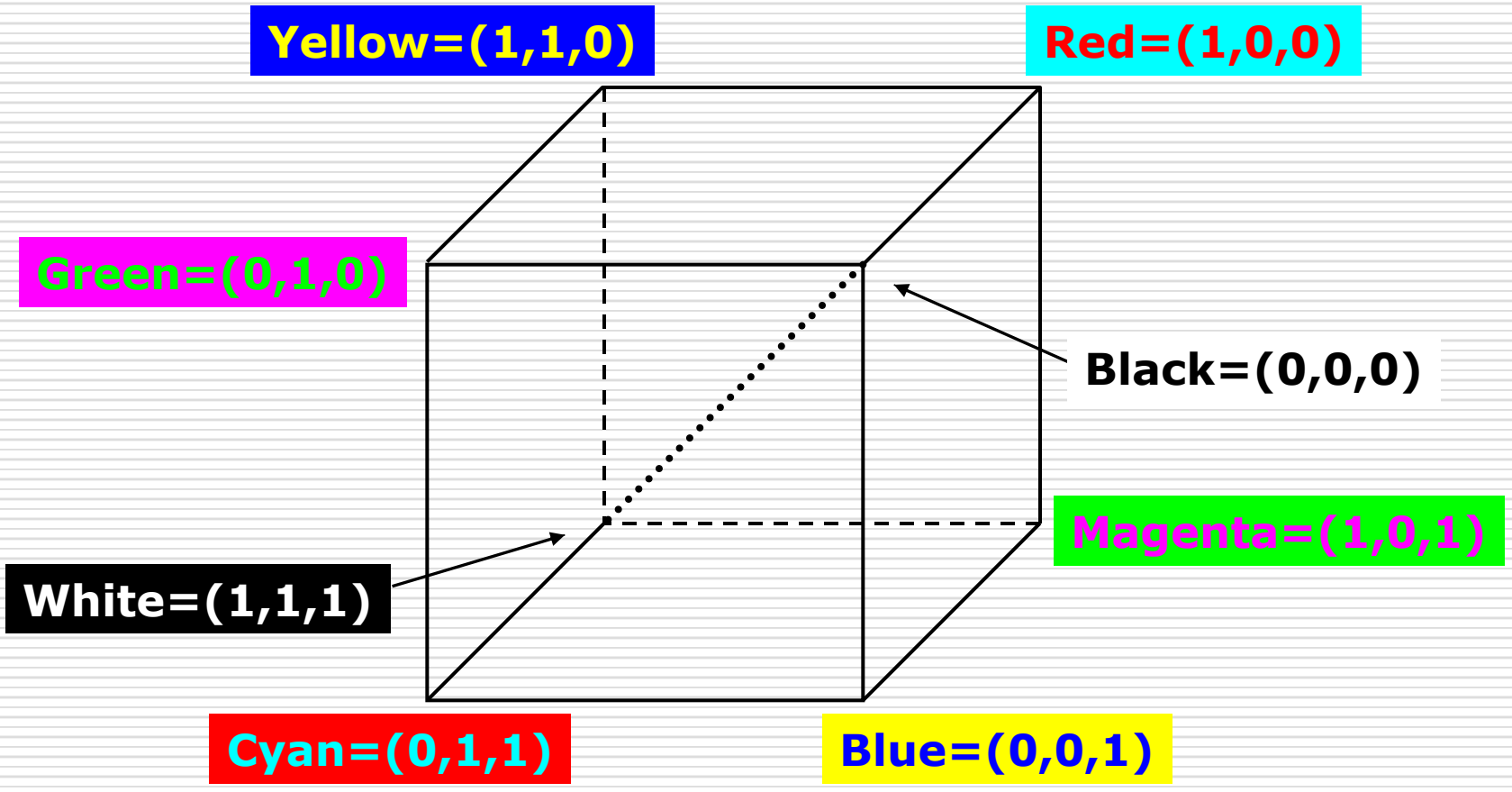
The RGB Color Model – for CRT



Color Depth

- Can choose number of bits for each of *r*, *g* and *b*
  - More bits per component means more colors can be distinguished, but image files will be larger
  - 8 bits (1 byte) per component: *24-bit color*, millions of colors
- If $r = g = b$, color is a shade of gray, so grayscale can be represented by a single value
  - 8 bits permits 256 grays

The CMY Color Model – for hardcopy

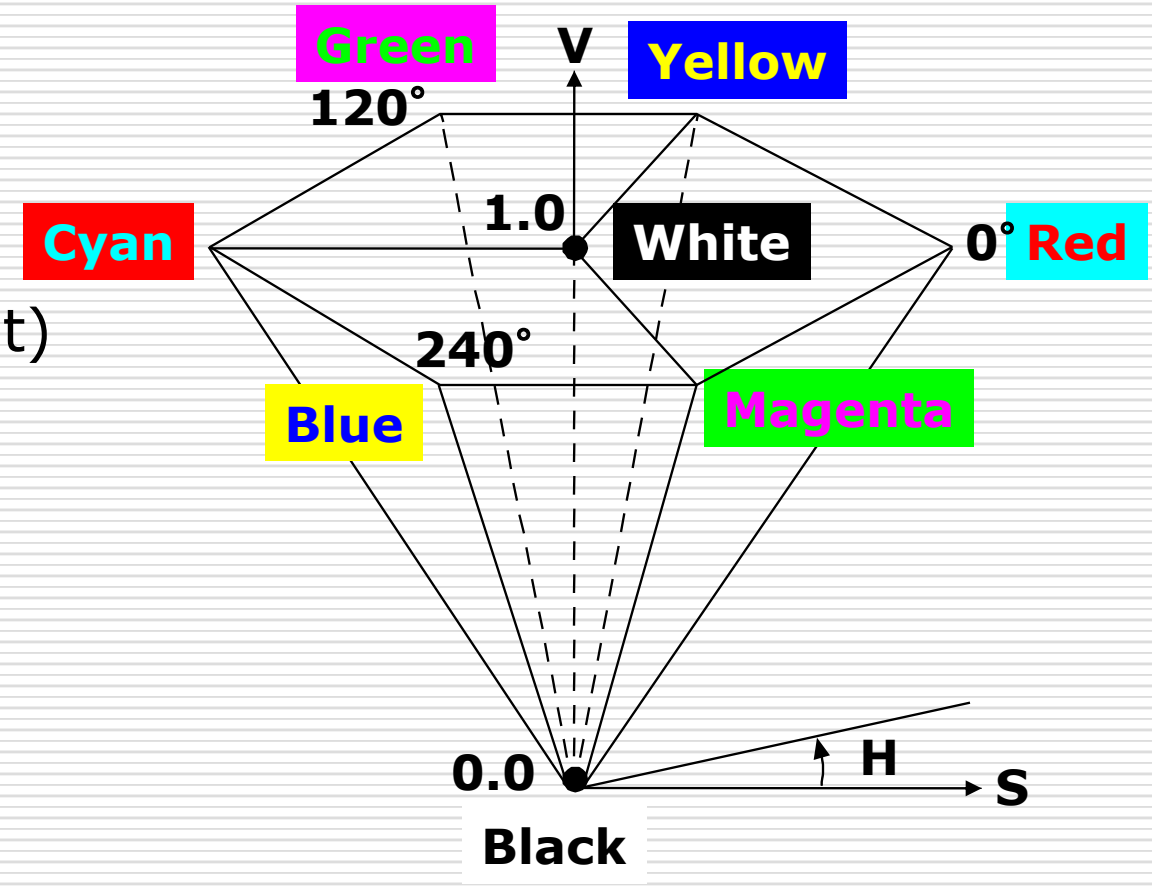


The HSV Color Model – for user-oriented

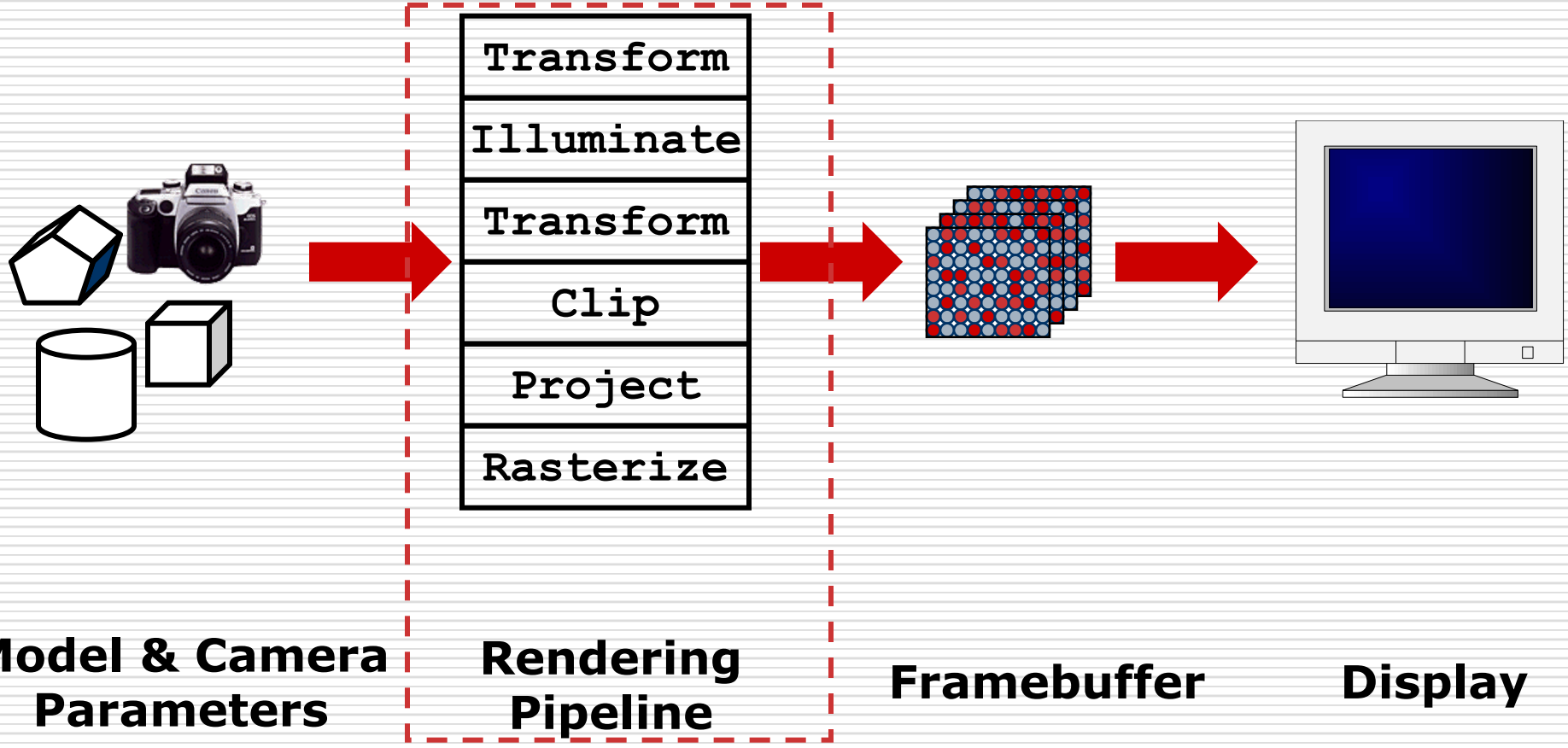
- Alternative way of specifying color
- *Hue* (roughly, dominant wavelength)
- *Saturation* (purity)
- *Value* (brightness)
- Model HSV as a cylinder: *H* angle, *S* distance from axis, *V* distance along axis
- Basis of popular style of *color picker*

The HSV Color Model – for user-oriented

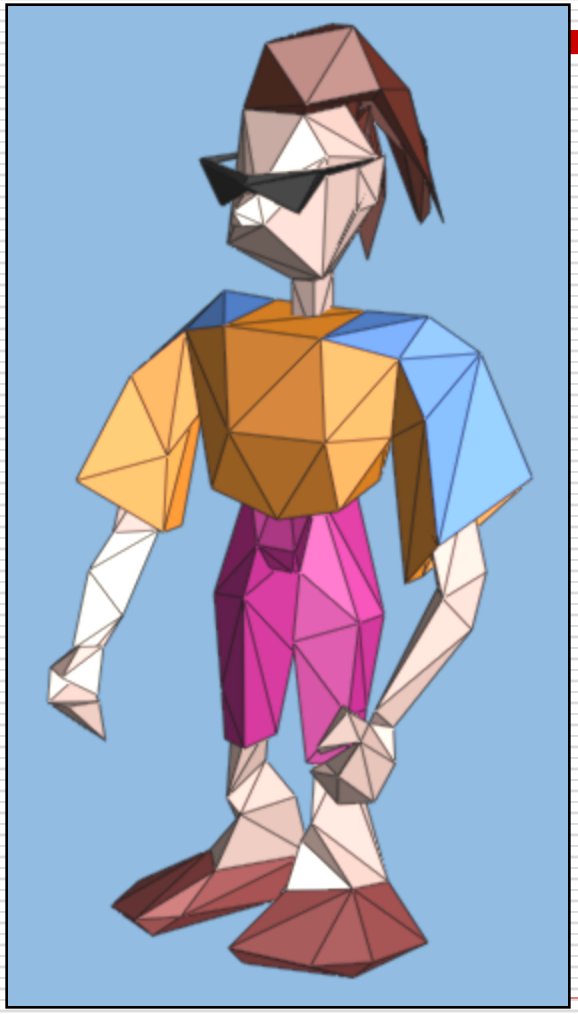
- H : hue
- S : saturation
- V : value
  - (or B for blight)



Pipeline Rendering



Definitions of Triangle Meshes



[Hoppe 99']

$\{f_1\} : \{ v_1 , v_2 , v_3 \}$
$\{f_2\} : \{ v_3 , v_2 , v_4 \}$
…

connectivity

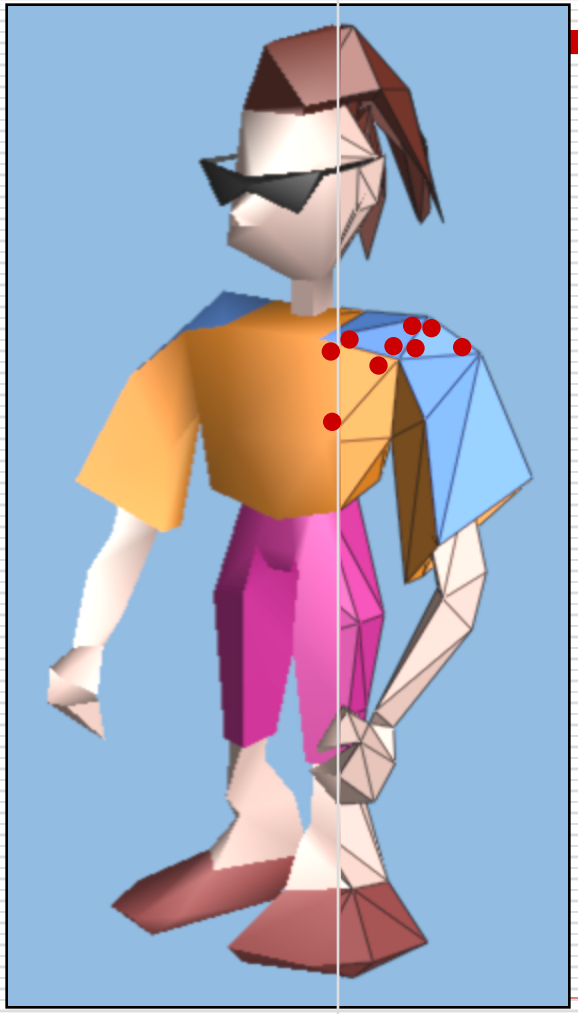
$\{v_1\} : (x,y,z)$
$\{v_2\} : (x,y,z)$
…

geometry

$\{f_1\}$: *"skin material"*
$\{f_2\}$: *"brown hair"*
…

face attributes

Definitions of Triangle Meshes



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face attributes

$\{v_2,f_1\} : (n_x,n_y,n_z)\ (u,v)$
$\{v_2,f_2\} : (n_x,n_y,n_z)\ (u,v)$
…

corner attributes

Rendering: Transformations

- So far, discussion has been in *screen space*
- But model is stored in *model space* (a.k.a. object space or world space)
- Three sets of geometric transformations:
  - Modeling transforms
  - Viewing transforms
  - Projection transforms

The Rendering Pipeline