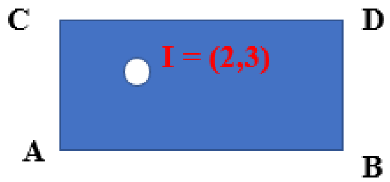
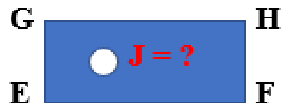
- **Assignment 6:**
  - Given that:
    - A = (1,1), B = (5,1), C = (1,4), D= (5,4), I = (2,3) in world coordinates.
    - E = (2,2), F = (4,2), G = (2,3), H = (4,3) in view coordinates.
  - Compute the point J which is the projection of point I (from the world coordinates to the view coordinates).



World Coordinates



View Coordinates

Solution

$$x_v = s_x x_w + t_x$$

$$y_v = s_y y_w + t_y$$

$$s_x = \frac{x_{v\,max} - x_{v\,min}}{x_{w\,max} - x_{w\,min}}$$

$$s_y = \frac{y_{v\,max} - y_{v\,min}}{y_{w\,max} - y_{w\,min}}$$

$$t_x = \frac{x_{w\,max}\, x_{v\,min} - x_{w\,min}\, x_{v\,max}}{x_{w\,max} - x_{w\,min}}$$

$$t_y = \frac{y_{w\,max}\, y_{v\,min} - y_{w\,min}\, y_{v\,max}}{y_{w\,max} - y_{w\,min}}$$

- $Y_{Wmin} = 1$, $Y_{Wmax} = 4$,
  $X_{Wmin} = 1$, $X_{Wmax} = 5$,
  $Y_w = 3$, $X_w = 2$

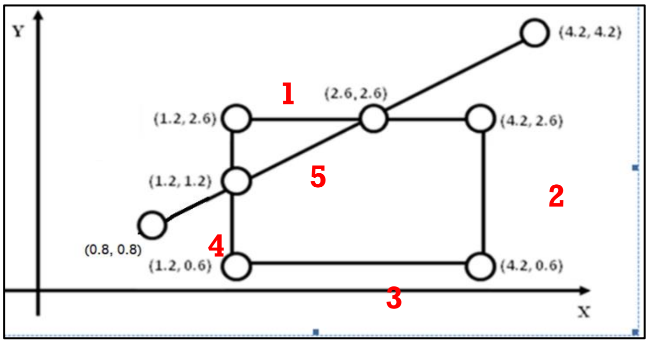
  $Y_{Vmin} = 2$, $Y_{Vmax} = 3$,
  $X_{Vmin} = 2$, $X_{Vmax} = 4$,
  $Y_v = ?$, $X_v = ?$

- $S_x = \frac{4-2}{5-1} = \frac{1}{2}$
- $S_y = \frac{3-2}{4-1} = \frac{1}{3}$
- $t_x = \frac{10-4}{4} = \frac{3}{2}$
- $t_y = \frac{8-3}{3} = \frac{5}{3}$

- $X_v = \frac{1}{2} * 2 + \frac{3}{2} = 2.5$

- $Yv = \frac{1}{3} * 3 + \frac{5}{3} = 2.6$

- **Assignment 7:**
  a. Compute, analytically; the visible and invisible part of the line connecting (0.8, 0.8) to (4.2, 4.2)
  b. Use Cohen-Sutherland Clipping algorithm to compute the visible and invisible part of the same line.



Solution

$$\frac{Y-Y_1}{X-X_1} = \frac{Y_2-Y_1}{X_2-X_1}$$

a. Analytically:

- Equation for line 1:
  - $X_1 = 1.2, \; X_2 = 4.2, Y_1 = 2.6, Y_2 = 2.6$
  - $\frac{Y-2.6}{X-1.2} = \frac{2.6-2.6}{4.2-1.2} = \frac{0}{3} = 0$
  - $\frac{Y-2.6}{X-1.2} = 0$
  - $Y - 2.6 = 0$
  - $\mathbf{Y = 2.6}$

- Equation for line 2:
  - $X_1 = 4.2, \; X_2 = 4.2, Y_1 = 2.6, Y_2 = 0.6$
  - $\frac{Y-2.6}{X-4.2} = \frac{0.6-2.6}{4.2-4.2} = \frac{-2}{0}$
  - $\frac{Y-2.6}{X-4.2} = \frac{-2}{0}$
  - $-2\,(X - 4.2) = 0$
  - $\mathbf{X = 4.2}$

- Equation for line 3:
  - $X_1 = 1.2, \; X_2 = 4.2, Y_1 = 0.6, Y_2 = 0.6$
  - $\frac{Y-0.6}{X-1.2} = \frac{0.6-0.6}{4.2-1.2} = \frac{0}{3} = 0$
  - $\frac{Y-0.6}{X-1.2} = 0$
  - $Y - 0.6 = 0$
  - $\mathbf{Y = 0.6}$

- Equation for line 4:
  - $X_1 = 1.2$, $X_2 = 1.2$, $Y_1 = 2.6$, $Y_2 = 0.6$
  - $\frac{Y-2.6}{X-1.2} = \frac{0.6-2.6}{1.2-1.2} = \frac{-2}{0}$
  - $\frac{Y-2.6}{X-1.2} = \frac{-2}{0}$
  - $-2\,(X - 1.2) = 0$
  - **$X = 1.2$**

- Equation for line 5:
  - $X_1 = 0.8$, $X_2 = 4.2$, $Y_1 = 0.8$, $Y_2 = 4.2$
  - $\frac{Y-0.8}{X-0.8} = \frac{4.2-0.8}{4.2-0.8} = 1$
  - $\frac{Y-0.8}{X-0.8} = 1$
  - $Y - 0.8 = X - 0.8$
  - **$Y = X$**

- Solve equation 5 with equation 1:
  - $Y = X$
  - $Y = 2.6$
  - $X = 2.6$
- Solve equation 5 with equation 2:
  - $Y = X$
  - $X = 4.2$
  - $Y = 4.2$
- Solve equation 5 with equation 3:
  - $Y = X$
  - $Y = 0.6$
  - $X = 0.6$
- Solve equation 5 with equation 4:
  - $Y = X$
  - $Y = 1.2$
  - $X = 1.2$

- The line new end points are (1.2, 1.2) (2.6, 2.6)

b. Cohen-Sutherland Clipping:

- $Y_{min} = 0.6$, $Y_{max} = 2.6$, $X_{min} = 1.2$, $X_{max} = 4.2$,
  $Y_0 = 0.8$, $Y_1 = 4.2$, $X_0 = 0.8$, $X_1 = 4.2$

- For (0.8, 0.8):
  - Region code**: 5, bottom & left**
  - For bottom:
    - $Y = Y_{min} = 0.6$
    - $X = X_0 + \left[(X_1 - X_0) * (Y_{min} - Y_0)/(Y_1 - Y_0)\right]$
      $= 0.8 + \left[(4.2 - 0.8) * (0.6 - 0.8)/(4.2 - 0.8)\right]$
      $= 0.8 + (0.6 - 0.8) = 0.6$
    - The point is (0.6, 0.6)

  - For left:
    - $X = X_{min} = 1.2$
    - $Y = Y_0 + \left[(Y_1 - Y_0) * (X_{min} - X_0)/(X_1 - X_0)\right]$
      $= 0.8 + \left[(4.2 - 0.8) * (1.2 - 0.8)/(4.2 - 0.8)\right]$
      $= 0.8 + (1.2 - 0.8) = 1.2$
    - The point is (1.2,1.2)

- For (4.2, 4.2):
  - Region code: **10, top & right**
  - For bottom:
    - $Y = Y_{max} = 2.6$
    - $X = X_0 + \left[(X_1 - X_0) * (Y_{max} - Y_0)/(Y_1 - Y_0)\right]$
      $= 0.8 + \left[(4.2 - 0.8) * (2.6 - 0.8)/(4.2 - 0.8)\right]$
      $= 0.8 + (2.6 - 0.8) = 2.6$
    - The point is (2.6, 2.6)

  - For right:
    - $X = X_{max} = 4.2$
    - $Y = Y_0 + \left[(Y_1 - Y_0) * (X_{max} - X_0)/(X_1 - X_0)\right]$
      $= 0.8 + \left[(4.2 - 0.8) * (4.2 - 0.8)/(4.2 - 0.8)\right]$
      $= 0.8 + (4.2 - 0.8) = 4.2$
    - The point is (4.2,4.2)

- The line new end points are (1.2, 1.2) (2.6, 2.6)

- **Assignment 8:**
  a. Justify the following :
     - WHITE (Hex: #FFFFFF), given that it has 255,255,255 values in RGB.
     - BLACK (Hex: #000000), given that it has 0,0,0 values in RGB system.

  b. Compute the RGB values for the white and black colors, given that they have Hex #FFFFFF and #000000 respectively

Solution

a.

1. **RGB value of 255, 255, 255**

   255/16 = 15 + 15/16

   255/16 = 15 + 15/16

   255/16 = 15 + 15/16

   - Hexadecimal: #FF FF FF

2. **RGB value of 0, 0, 0**

   0/16 = 0 + 0/16

   0/16 = 0 + 0/16

   0/16 = 0 + 0/16

   - Hexadecimal: #00 00 00

b.

1. **Hex value of #FFFFFF**

   (15 (F) * 16) + 15 = 255

   (15 (F) * 16) + 15 = 255

   (15 (F) * 16) + 15 = 255

   - RGB: 255, 255, 155

2. **Hex value of #000000**

   (0 * 16) + 0 = 0

   (0 * 16) + 0 = 0

   (0 * 16) + 0 = 0

   - RGB: 0, 0, 0

- **Assignment 9:**
  - Given that we have a brass (an alloy of copper and zinc) material object with shinny constant n =27.897, exposed to a single light source; with the following data:

	Object Reflection Constants			Object light intensity		
	K_a	K_d	K_s	i_a	i_d	i_s
Red	0.3294	0.7803	0.9921	10	20	30
Green	0.2235	0.5689	0.9411	40	50	60
Blue	0.0274	0.1137	0.8078	70	80	90

L = (3, 2, 5) & N = (1, 2, 3) & V = (4, 5, 6) & R = (7, 8, 9)

Compute:

a. shade value for each surface point I_p for Red
b. shade value for each surface point I_p for Green
c. shade value for each surface point I_p for Blue

. Give your comment about the dominate shaded color

Solution

a. I_p for Red:

I_p = (0.3294 * 10) + (0.7803 * [(3, 2, 5) . (1, 2, 3)] * 20)

+ (0.9921 * [(7, 8, 9) . (4, 5, 6)] $^{27.897}$ * 30)

I_p = 3.294 + (0.7803 * (3 + 4 + 15) * 20) + (0.9921 * (28 + 40 + 54) $^{27.897}$ * 30)

I_p = 3.294 + (0.7803 * 22 * 20) + (0.9921 * 122$^{27.897}$ * 30)

I_p = 4.75 * 10^{59}

b. I_p for Green:

I_p = (0.2235 * 40) + (0.5689 * [(3, 2, 5) . (1, 2, 3)] * 50)

+ (0.9411* [(7, 8, 9) . (4, 5, 6)] $^{27.897}$ * 60)

I_p = 8.94 + (0.5689 * (3 + 4 + 15) * 50) + (0.9411 * (28 + 40 + 54) $^{27.897}$ * 60)

I_p = 8.94 + (0.5689 * 22 * 50) + (0.9411 * 122$^{27.897}$ * 60)

I_p = 9.02 * 10^{59}

c. **I_p for Blue:**

$$I_p = (0.0274 * 70) + (0.1137 * [(3, 2, 5) . (1, 2, 3)] * 80) + (0.8078 * [(7, 8, 9) . (4, 5, 6)]^{27.897} * 90)$$

$$I_p = 1.918 + (0.1137 * (3 + 4 + 15) * 80) + (0.8078 * (28 + 40 + 54)^{27.897} * 90)$$

$$I_p = 1.918 + (0.1137 * 22 * 80) + (0.8078 * 122^{27.897} * 90)$$

$$I_p = 1.16 * 10^{60}$$

The dominate shaded color is the blue.