Maharaja Agrasen Institute of Technology
ETCS 211
Computer Graphics & Multimedia
UNIT 1

Window to viewport transformation

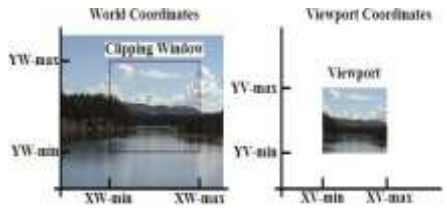
Window to viewport transformation

- Window port
- Viewport
- Window to Viewport mapping is required
- Some transformations are required
- Transformation can Translation, rotation, scaling and shearing

Window to viewport transformation

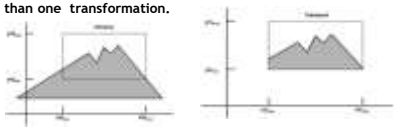
- **Window-to-Viewport mapping** is the process of mapping or transforming a two-dimensional, world- coordinate scene to device coordinates. In particular, objects inside the world or clipping window are mapped to the viewport. The viewport is rectangular area on screen where world coordinates are mapped to be displayed.
- In other words, the clipping window is used to select the part of the scene that is to be displayed. The viewport is used to display selected portion of window on the output device

Window to viewport transformation



Window to viewport transformation

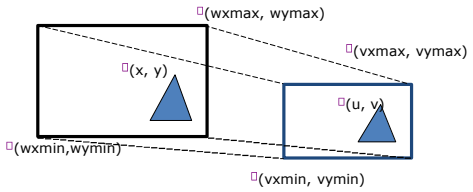
- Window port: **A world coordinate area selected for display.**
- View port: **This is a rectangular region of the screen which is selected for displaying the object. In other words we can say that view port is part of computer screen.**
- **Window to Viewport Mapping- Mapping of a part of a world coordinate scene to device coordinate is referred to as a viewing transformation.**
- **Window to viewport transformation requires more than one transformation.**



Concept of window to viewport transformation

- It may be possible that size of viewport is smaller than size of window or greater than size of window.
- In this case we have to expand or decrease size of window according to the size of viewport.
- In this concept same mapping is required to convert size of window in size of view port.
- Some mathematical computations are required to map window and viewport.

Window to Viewport Mapping



Steps for window to viewport transformation

- Step 1: Translate window towards origin To shift window towards origin, lower left or upper left corner of window will become (-). Hence translation factor will become negative (-tx,-ty).

(-wxL,-wyL) – When origin is lower left corner of the screen.

(-wxL, -wyH)- When origin is upper left corner of window.

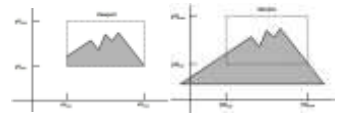
Steps for window to viewport transformation (cont..)

- Step 2: Resize window to the size of view port.

To convert window size in to view port size following computation is required.

$$s_x = \frac{XV_{max} - XV_{min}}{XW_{max} - XW_{min}}$$

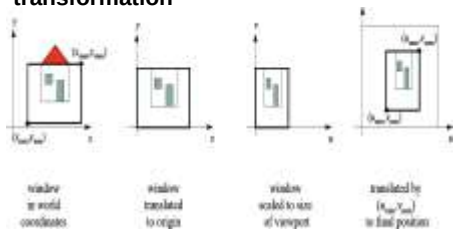
$$s_y = \frac{YV_{max} - YV_{min}}{YW_{max} - YW_{min}}$$



Steps for window to viewport transformation (cont..)

- Step 3: Translate window (position of window must be same as position of view port.
- If lower left corner of viewport is (0,0) we don't need to take step 3 because window lower left corner is already shifted on origin after taking first step.
- If lower left corner is not (0,0) we have to take translation factor (+).

Steps for window to viewport transformation



Steps for window to viewport transformation

$$T(-x_{wmin}, -y_{wmin}) \qquad S\left(\frac{x_{vmax} - x_{vmin}}{x_{wmax} - x_{wmin}}, \frac{y_{vmax} - y_{vmin}}{y_{wmax} - y_{wmin}}\right) \qquad T(x_{vmin}, y_{vmin})$$

$$M_{wv} = T(x_{vmin}, y_{vmin}) S\left(\frac{x_{vmax} - x_{vmin}}{x_{wmax} - x_{wmin}}, \frac{y_{vmax} - y_{vmin}}{y_{wmax} - y_{wmin}}\right) T(-x_{wmin}, -y_{wmin})$$

$$= \begin{bmatrix} 1 & 0 & x_{vmin} \\ 0 & 1 & y_{vmin} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \frac{x_{vmax} - x_{vmin}}{x_{wmax} - x_{wmin}} & 0 & 0 \\ 0 & \frac{y_{vmax} - y_{vmin}}{y_{wmax} - y_{wmin}} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -x_{wmin} \\ 0 & 1 & -y_{wmin} \\ 0 & 0 & 1 \end{bmatrix}$$

Example

Let us consider an example of view transformation.

If our window has coordinates (10,10), (20,10), (20,20), (10,20)
Let our viewport coordinates are (.5,.5), (1,.5),(1,1), (.5,1)
Take step 1: Translate window to origin
In this case translation matrix will become

1	0	0
0	1	0
-10	-10	1

Take step 2: convert size of window to viewport size
sx=(1-0.5)/(11-1)□ 0.5/10 □ 0.05
sy=(1-0.5)/(11-1)□ 0.5/10□0.05

Example

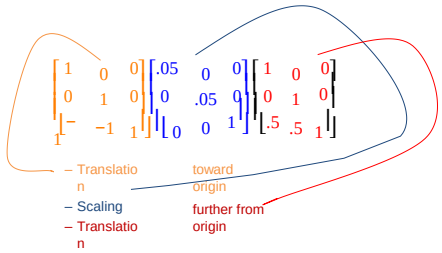
so scaling transformation matrix will be

0.05	0	0
0	0.05	0
0	0	1

Step 3: Finally window to position of view port

1	0	0
0	1	0
0.5	0.5	1

Composition of transformations



– Translation toward origin
– Scaling further from origin
– Translation

QUESTION

Window coordinates are (0,0), (2,0), (2,2), (0,2).
View port coordinates are (0,0), (4,0), (4,4), (0,4).

Find out relative position of coordinate (1,1) of window in viewport.

Calculate scaling factor for this transformation

Write down all three transformation matrix for this viewing transformation.

Formula to find out scaling factor

$$Sx = \frac{xv_{max} - xv_{min}}{xw_{max} - xw_{min}}$$

$$Sy = \frac{yv_{max} - yv_{min}}{yw_{max} - yw_{min}}$$

Sx= width of viewport / width of window
Sy= height of viwport / height of window

Formula to find relative position

xv = xvmin + (xw - xwmin)sx

yv = yvmin + (yw - ywmin)sy

1. The object space or the space in which the application model is defined is called _____
a) World co-ordinate system
b) Screen co-ordinate system
c) World window
d) Interface window

2. What is the name of the space in which the image is displayed?
a) World co-ordinate system
b) Screen co-ordinate system
c) World window
d) Interface window

3,The scale factor of viewport transformation for x co-ordinate is _____
a) $S_x = (sv_{max} - sv_{min})/(sw_{max} - sw_{min})$
b) $S_x = (sv_{max} - sv_{min})/(sw_{max} + sw_{min})$
c) $S_x = (sv_{min} - sv_{max})/(sw_{max} - sw_{min})$
d) $S_x = (sv_{max} + sv_{min})/(sw_{max} - sw_{min})$

4.Panning is a technique in which users can change the size of the area to be viewed in order to see more detail or less detail.
a) True
b) False

5.The process of mapping a world window in World Coordinates to the Viewport is called Viewing transformation.
a) True
b) False

6.What is the rectangle in the world defining the region that is to be displayed?
a) World co-ordinate system
b) Screen co-ordinate system
c) World window
d) Interface window