BSc Computer Science
CS1541 Computer Graphics

Module II

Windowing

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Overview

- The process of selecting and viewing an image with different views, called windowing.
- The Capability to show some part of an object in a window is known as windowing.
- The rectangular area describes in the world coordinate system is called the window.
- The viewport can be defined as an area on the screen which is used to display the object.

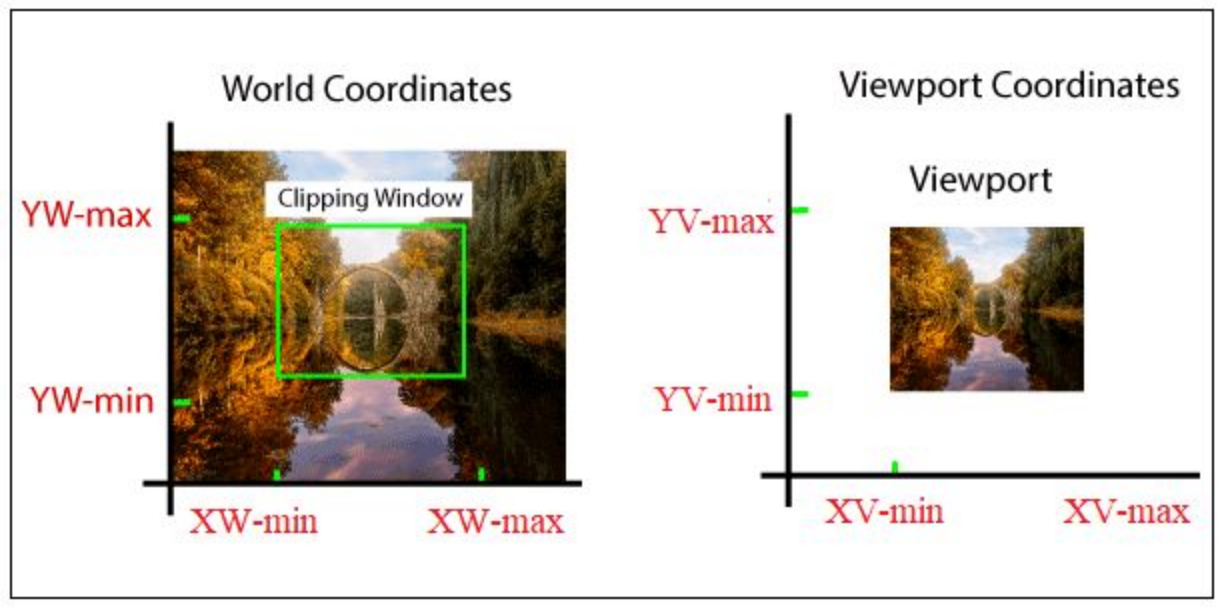
General Terms:

World coordinate – It is the Cartesian coordinate w.r.t which we define the diagram, like X_{wmin}, X_{wmax}, Y_{wmin}, Y_{wmax}

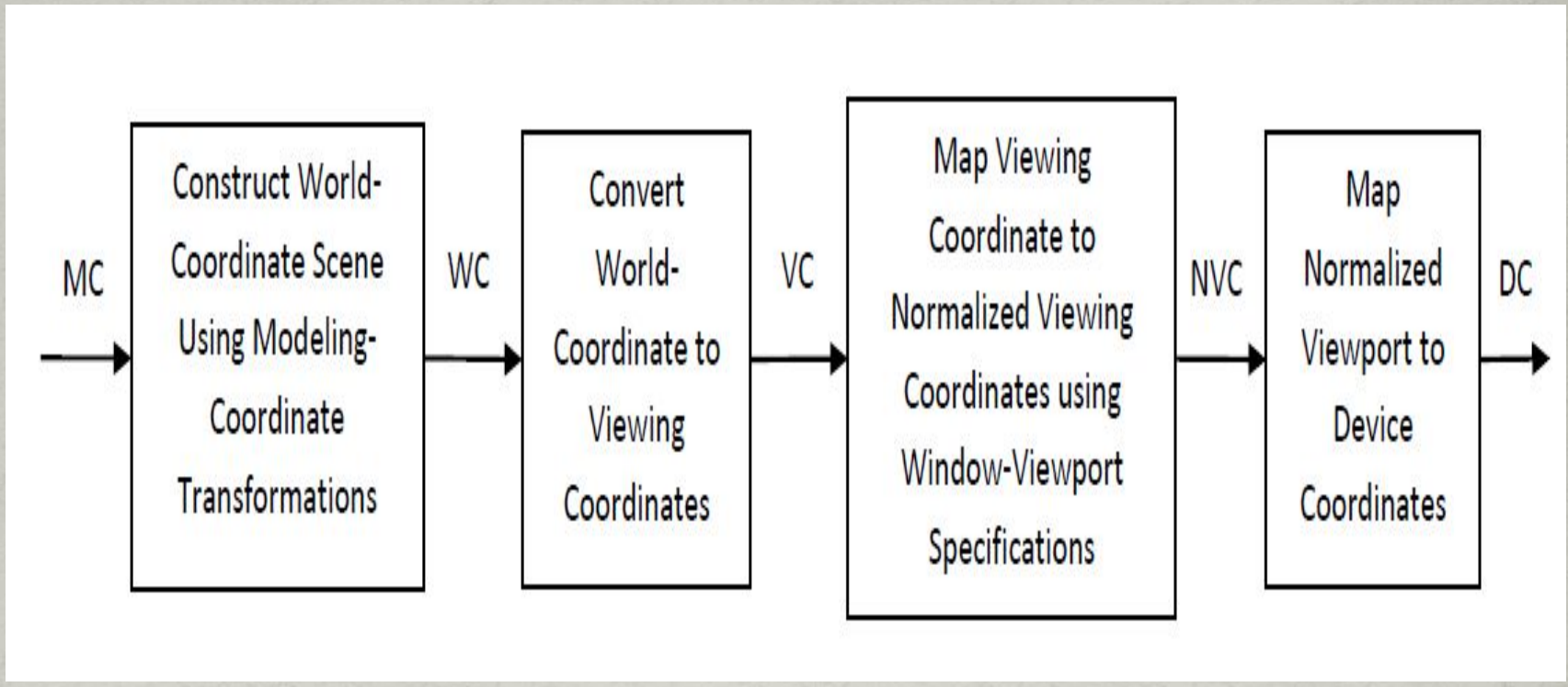
Device Coordinate –It is the screen coordinate where the objects are to be displayed, like X_{vmin}, X_{vmax}, Y_{vmin}, Y_{vmax}

Window –It is the area on world coordinate selected for display.

ViewPort –It is the area on the device coordinate where graphics is to be displayed.

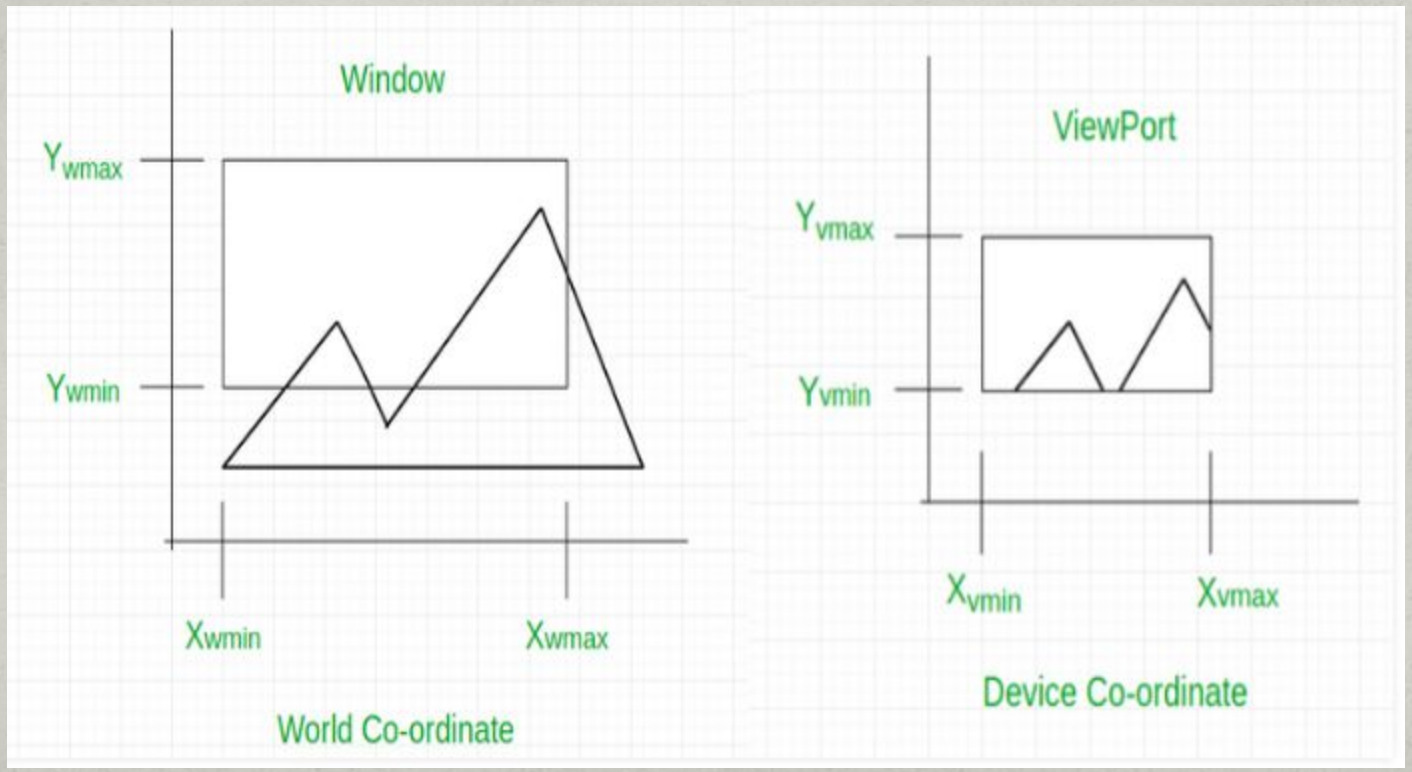


2D Viewing Pipeline



Window to Viewport Transformation

- The process of transforming 2D world-coordinate objects to device coordinates.
- Objects inside the world or clipping window are mapped to the viewport which is the area on the screen where world coordinates are mapped to be displayed.



Window to Viewport Transformations

- (x_w, y_w): A point on Window (x_v, y_v) Corresponding point on Viewport

Normalized Point on Window

$$\left(\frac{X_w - X_{wmin}}{X_{wmax} - X_{wmin}}, \frac{Y_w - Y_{wmin}}{Y_{wmax} - Y_{wmin}} \right)$$

Normalized Point on Viewport

$$\left(\frac{X_v - X_{vmin}}{X_{vmax} - X_{vmin}}, \frac{Y_v - Y_{vmin}}{Y_{vmax} - Y_{vmin}} \right)$$

Mathematical Calculation of Window to Viewport

$$\frac{x_v - x_{vmin}}{x_{vmax} - x_{vmin}} = \frac{x_w - x_{wmin}}{x_{wmax} - x_{wmin}}$$

$$\frac{y_v - y_{vmin}}{y_{vmax} - y_{vmin}} = \frac{y_w - y_{wmin}}{y_{wmax} - y_{wmin}}$$

$$x_v = x_{vmin} + (x_w - x_{wmin})s_x$$

$$y_v = y_{vmin} + (y_w - y_{wmin})s_y$$

$$s_x = \frac{x_{vmax} - x_{vmin}}{x_{wmax} - x_{wmin}}$$

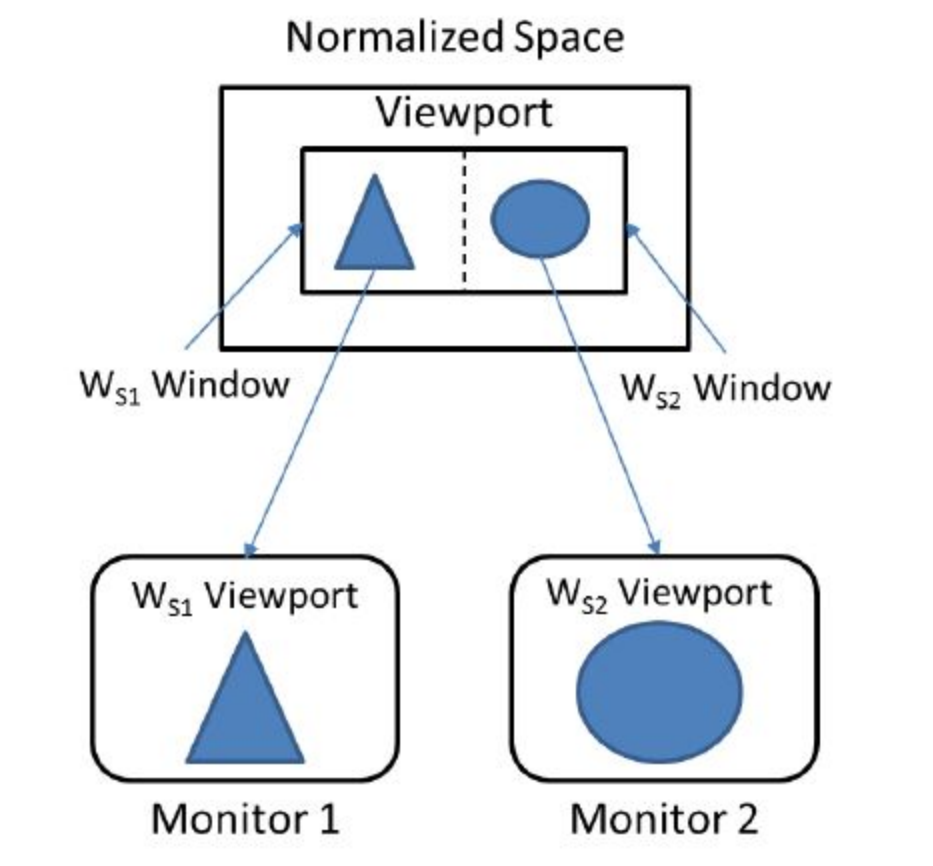
$$s_y = \frac{y_{vmax} - y_{vmin}}{y_{wmax} - y_{wmin}}$$

Example

- for window, $\mathbf{X_{wmin} = 20, X_{wmax} = 80, Y_{wmin} = 40, Y_{wmax} = 80}$.
- for viewport, $\mathbf{X_{vmin} = 30, X_{vmax} = 60, Y_{vmin} = 40, Y_{vmax} = 60}$.
- Now a point (X_w, Y_w) be (30, 80) on the window.
- Calculate that point on the viewport i.e **(X_v, Y_v)**.
- Calculate the scaling factor of x coordinate S_x and the scaling factor of y coordinate S_y using the above-mentioned formula.
  - S_x = (60 - 30) / (80 - 20) = 30 / 60
  - S_y = (60 - 40) / (80 - 40) = 20 / 40
- Calculate the point on the viewport (X_v, Y_v).
  - X_v = 30 + (30 - 20) * (30 / 60) = 35
  - Y_v = 40 + (80 - 40) * (20 / 40) = 60
- Point on window (X_w, Y_w) = (30, 80) will be
- **(X_v, Y_v) = (35, 60)** on viewport.

Workstation Transformations

Number of display device can be used in application and for each we can use different window-to-viewport transformation. This mapping is called the **workstation transformation.**



Thank You