

Drawing Tools

By

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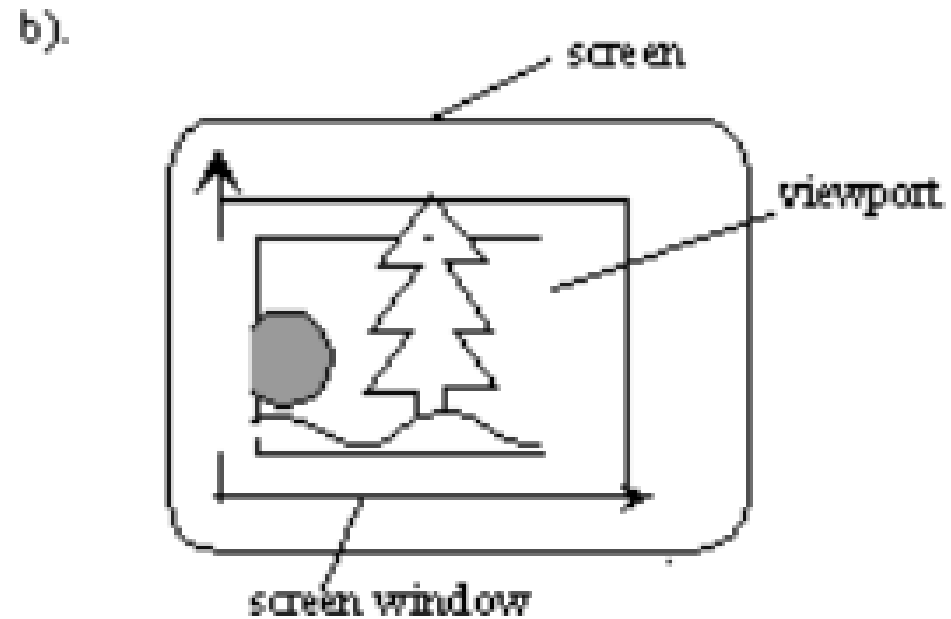
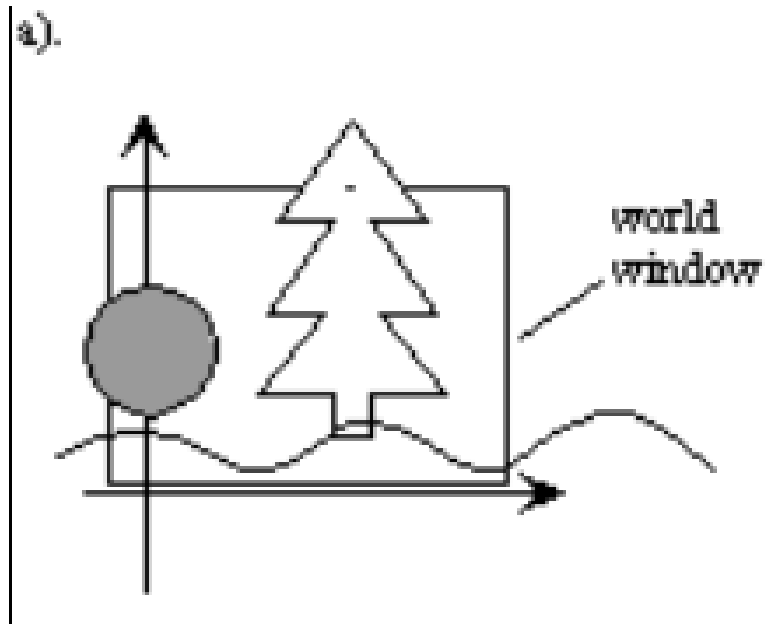
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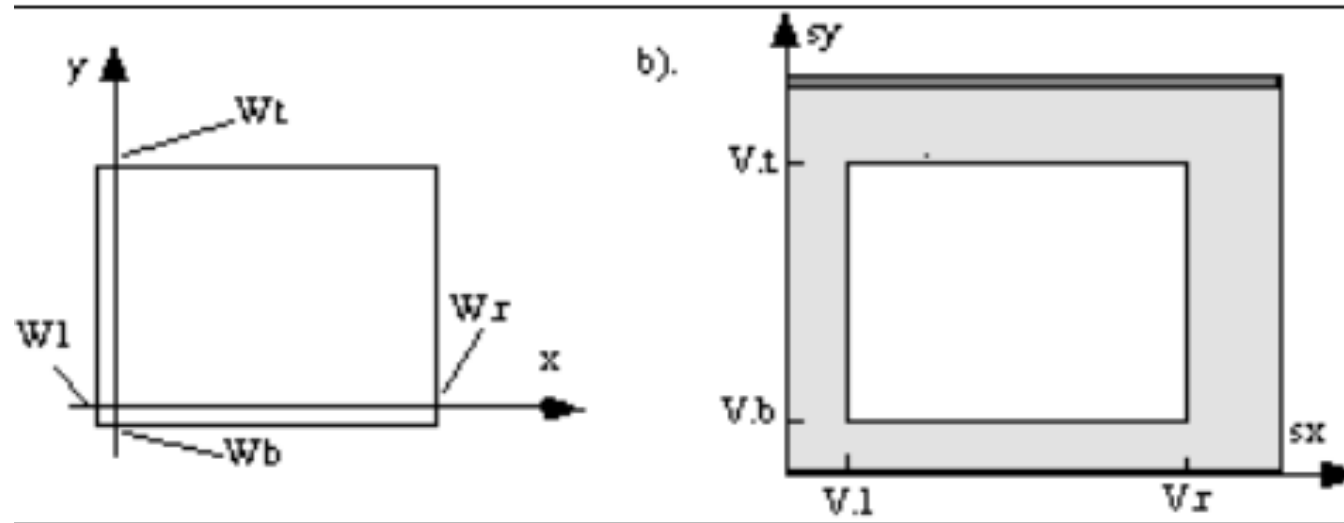
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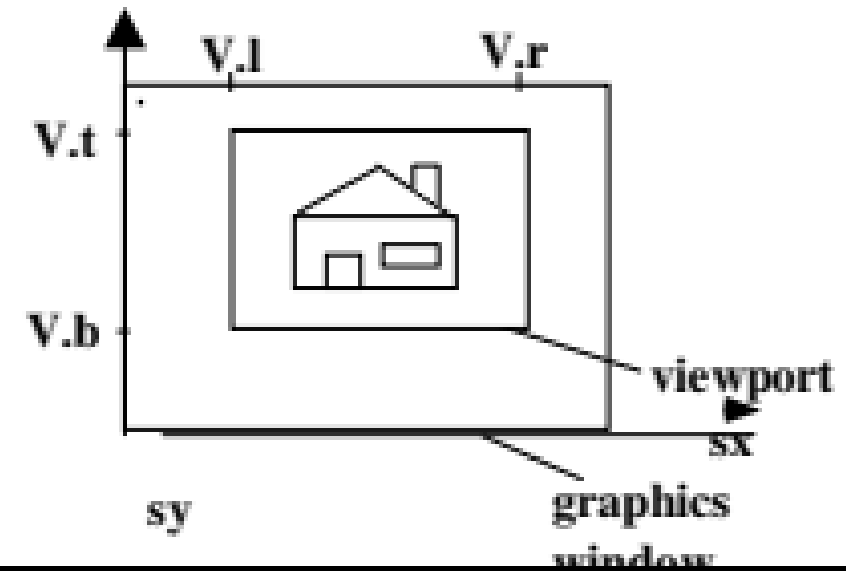
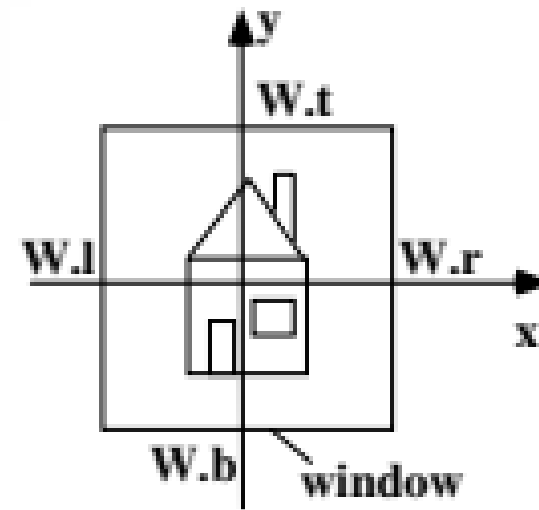
World Windows and Viewports



- The window and viewport are both aligned rectangles specified by the programmer.
- The window resides in world coordinates.
- The viewport is a portion of the screen window.
- Figure shows an example world window and viewport.
- The notion is that whatever lies in the world window is scaled and shifted so that it appears in the viewport; the rest is clipped off and not displayed

The mapping from the window to the viewport





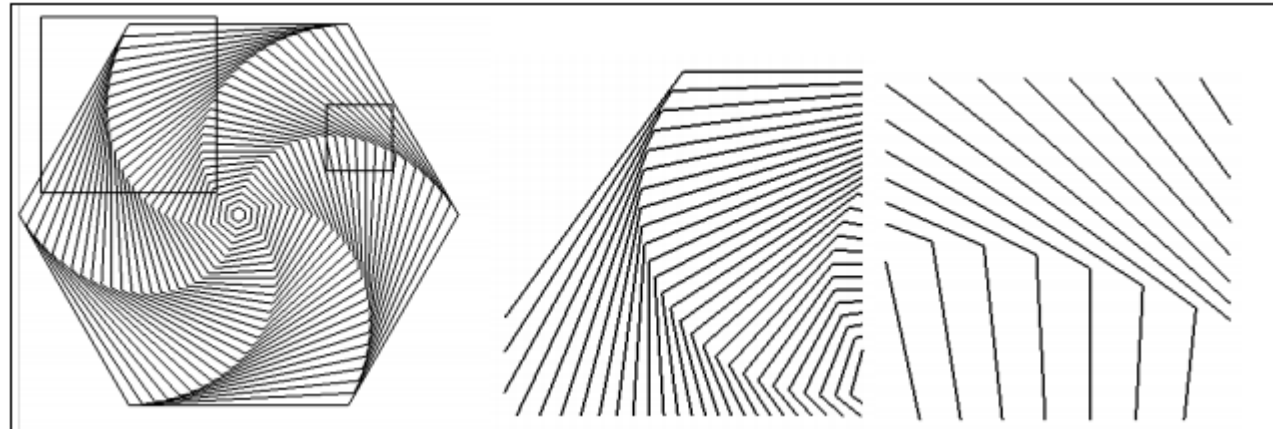
- **Distortion** occurs because the figure in the window must be stretched to fit in the viewport.
- **Window- to-viewport mapping** or **Transformation**
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- OpenGL makes it very easy to use the window to viewport mapping: it automatically passes each vertex it is given (via a `glVertex2*()` command) through a sequence of transformations that carry out the desired mapping.
- It also automatically clips off parts of objects lying outside the world window.
- All we need do is to set up these transformations properly, and OpenGL does the rest.

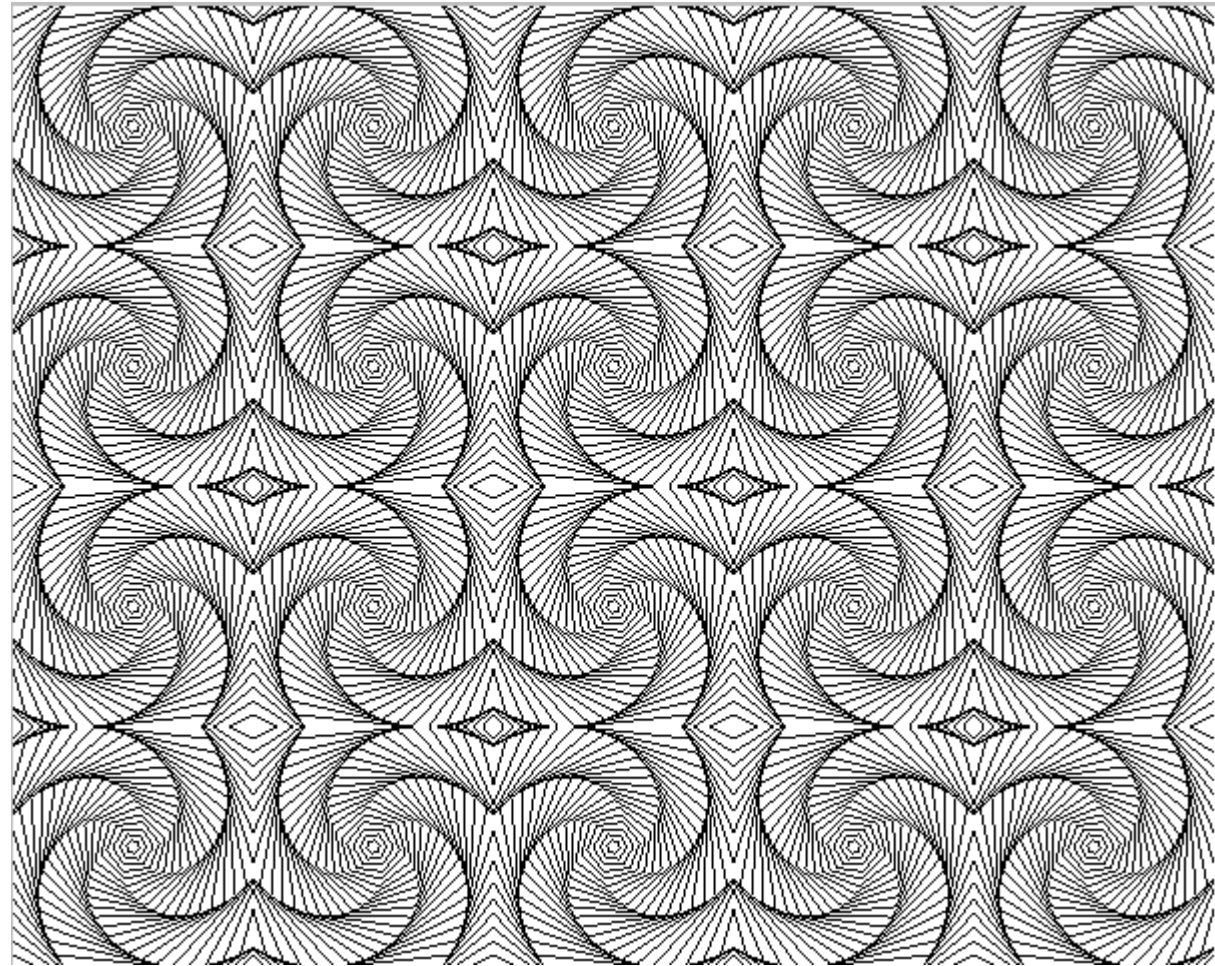
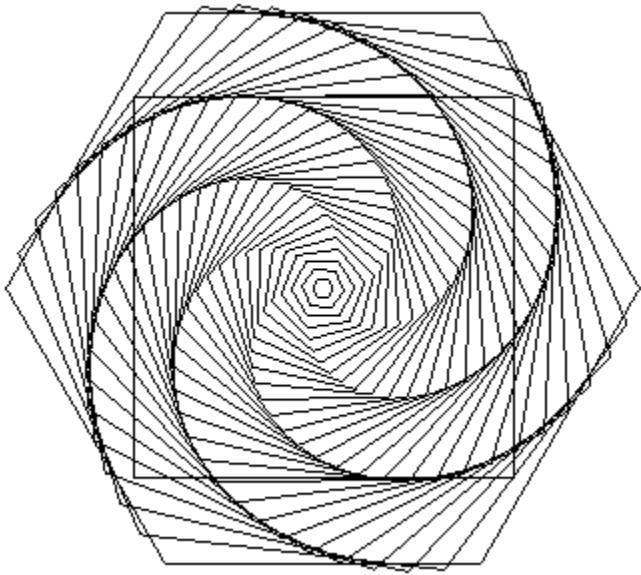
- For 2D drawing the world window is set by the function `gluOrtho2D()`, and the viewport is set by the function `glViewport()`.
 - ***`void gluOrtho2D(GLdouble left, GLdouble right, GLdouble bottom, GLdouble top);`***
- which sets the window to have lower left corner (left, bottom) and upper right corner (right, top), and
 - ***`void glViewport(GLint x, GLint y, GLint width, GLint height);`***
- which sets the viewport to have lower left corner (x, y) and upper right corner (x + width, y + height).

Zooming and Roaming

- Making the window smaller is much like **zooming** in on the object with a camera. Whatever is in the window must be stretched to fit in the fixed viewport, so when the window is made smaller there must be greater enlargement of the portion inside. Similarly making the window larger is equivalent to zooming out from the object.



A camera can also **roam** (sometimes called “pan”) around a scene, taking in different parts of it at different times. This is easily accomplished by shifting the window to a new position.

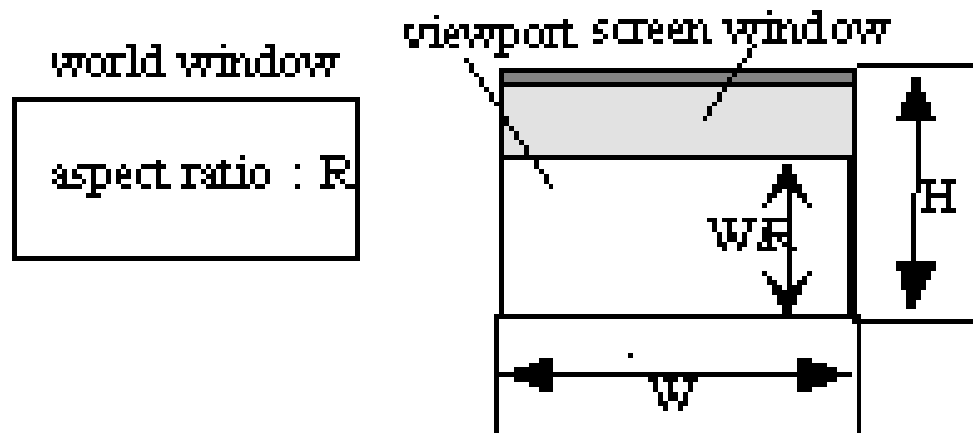


. a). Whirling hexagons in a fixed window. b). A tiling formed using many viewpoints

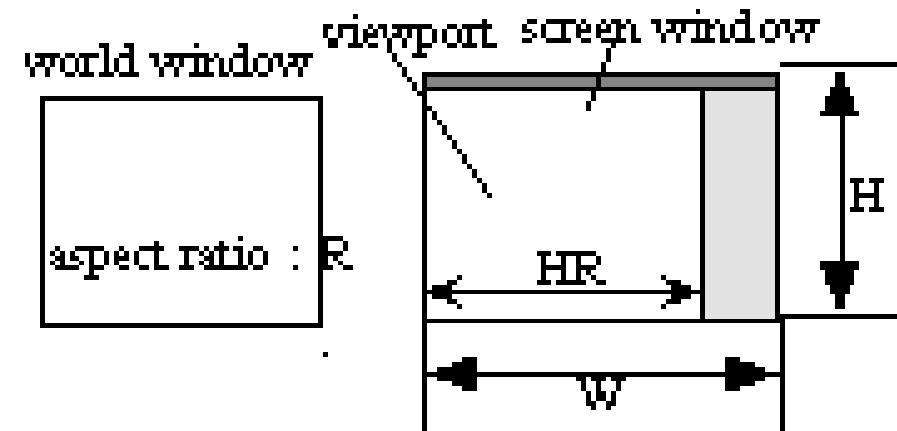
The **aspect ratio** of an image is the ratio of its width to its height.

Automatic setting of the viewport to Preserve Aspect Ratio

a). $R \geq W/H$



b). $R \leq W/H$



Example#01

- **A tall window.** Suppose the window has aspect ratio $R = 1.6$ and the screen window has $H = 200$ and $W = 360$, and hence $W/H = 1.8$.
- Therefore Case b) applies, and the viewport is set to have a height of 200 pixels and a width of 320 pixels.

Example#02

- **A short window.** Suppose $R = 2$ and the screen window is the same as in the example above. Then
- case a) applies, and the viewport is set to have a height of 180 pixels and a width of 360 pixels.

Resizing the screen window, and the resize event.

- `glutReshape(myReshape);`
 - `//` specifies the function called on a resize event
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Thank you