2-D Graphics

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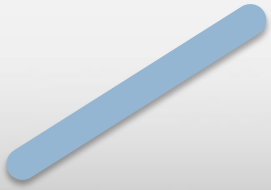
What Will We Learn?

- What is the difference between vector graphics and raster graphics?
- What coordinate systems are used for vector graphics and raster graphics?

Vector v. Raster Graphics

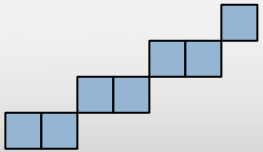
Vector Graphics

- Plotters, laser displays
- “Clip art,” illustrations
- PostScript, PDF, SVG
- Low memory (display list)
- Easy to draw line
- Solid/gradient/texture fills

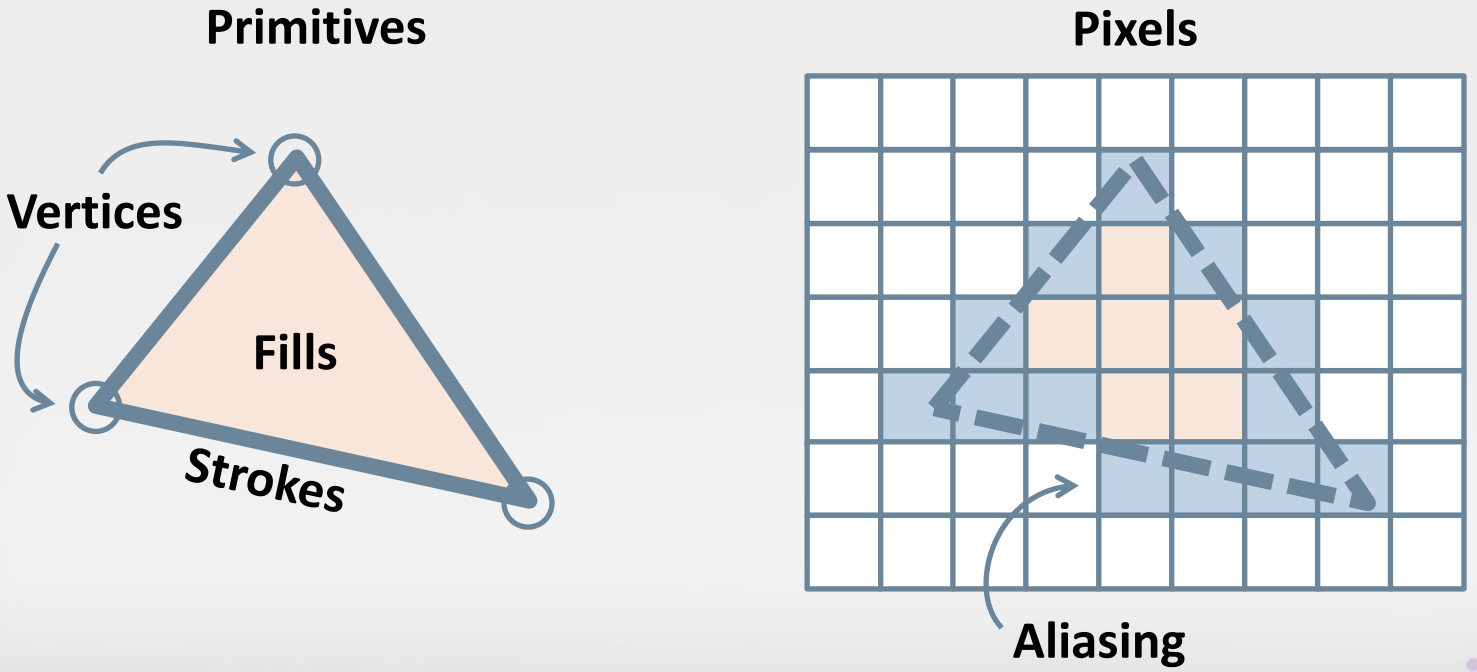


Raster Graphics

- TV’s, monitors, phones
- Photographs
- GIF, JPG, etc.
- High memory (frame buffer)
- Hard to draw line
- Arbitrary fills

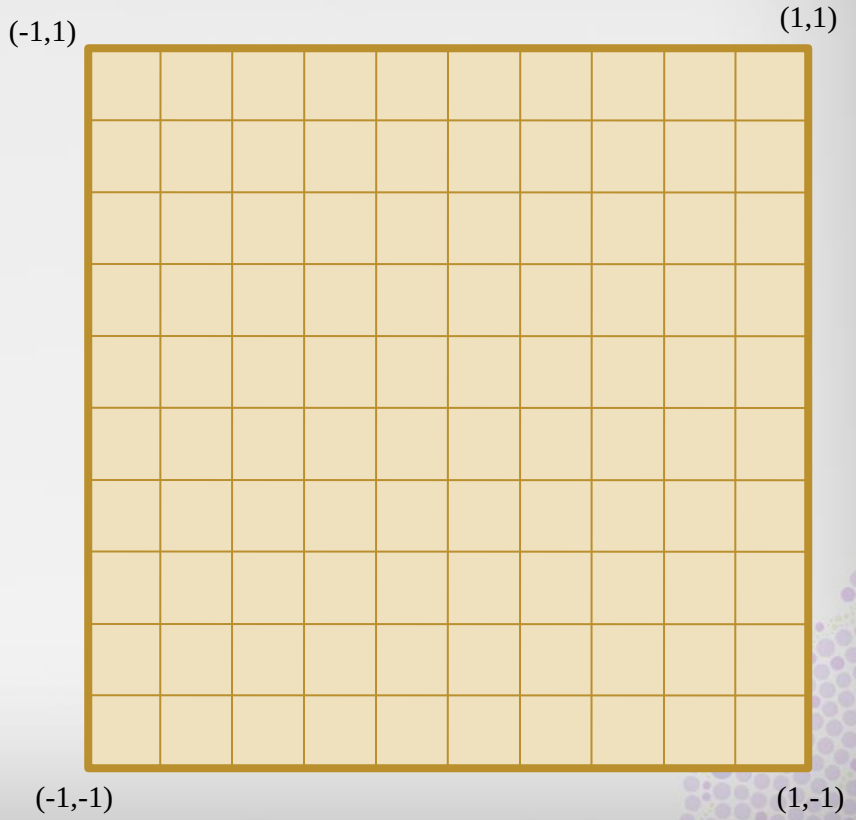


Rasterization



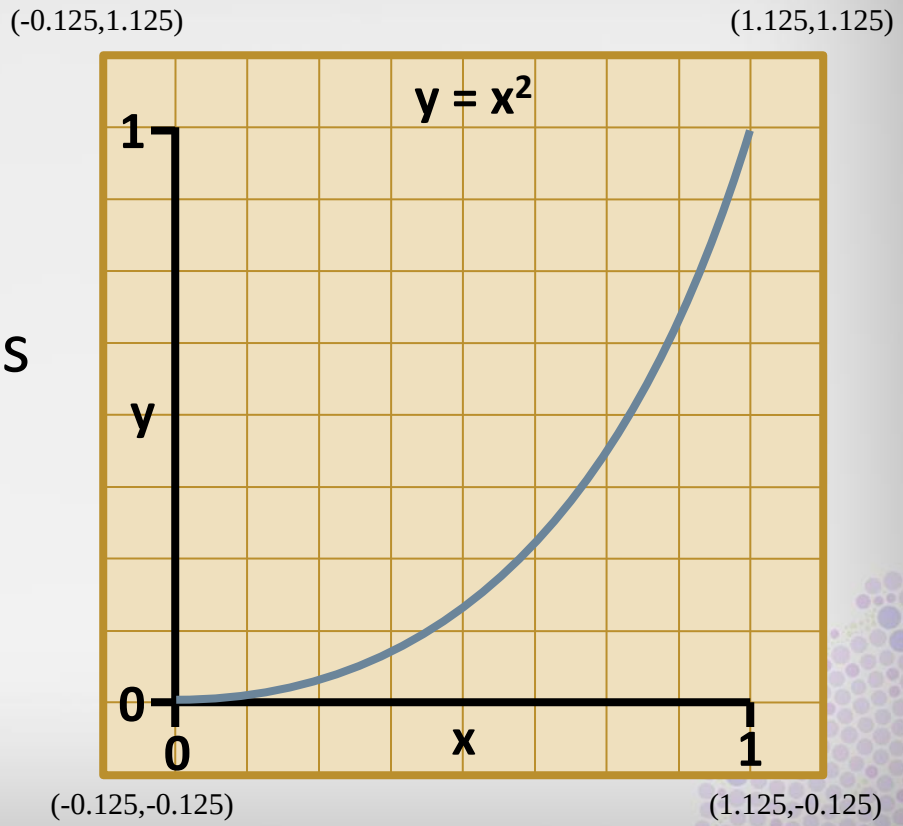
Canvas Coordinates

- Mathematical plotting coordinates
- Used to define positions of vertices for graphics primitives (e.g. triangles)



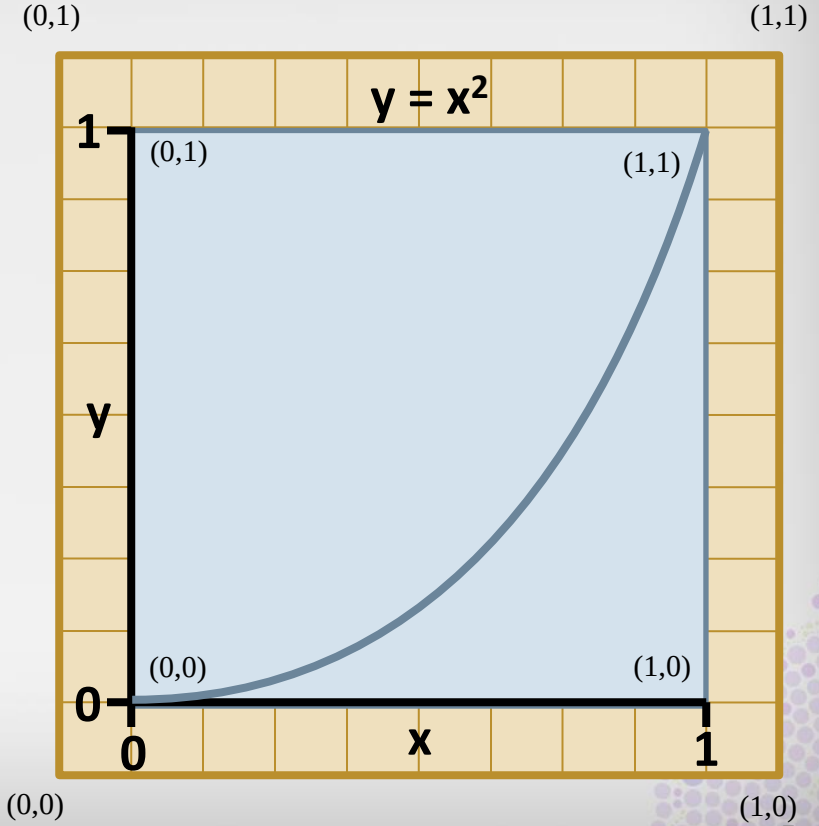
Canvas Coordinates

- Can redefine corners of canvas coordinates to whatever is convenient
- Can use graph's coordinates for domain and range, but leave room for axes and notation



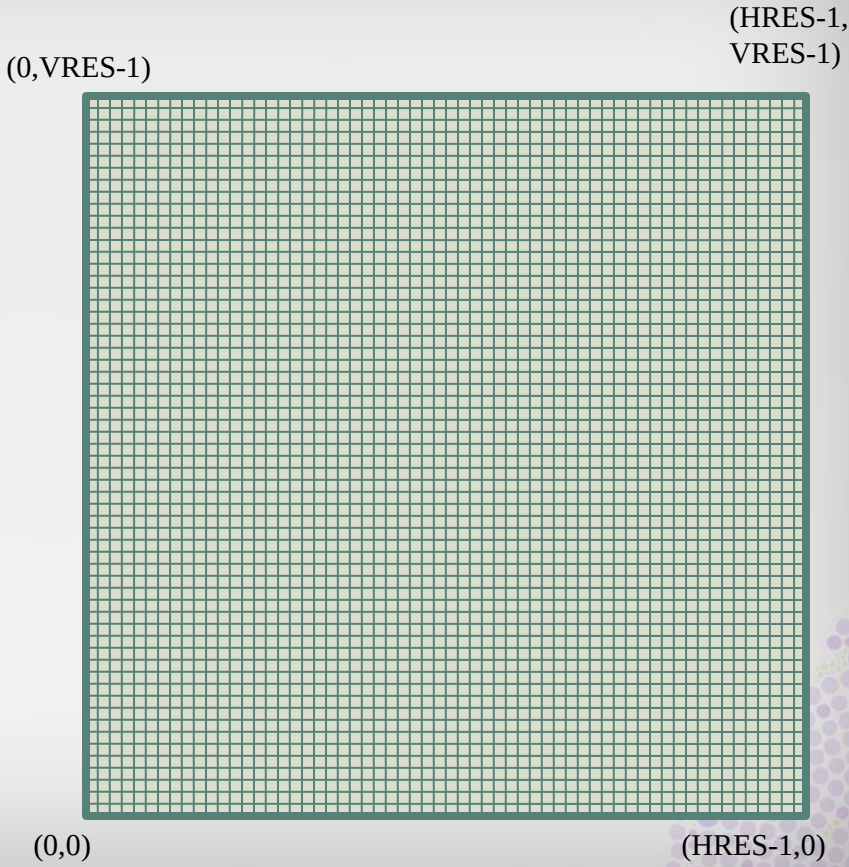
Hierarchical Coordinate Systems

- Create a canvas for entire visualization
  - Extends across area of screen
  - Plots coords from (0,0) to (1,1)
- Create a sub-canvas for plotting data
  - Extends from (1/8,1/8) to (7/8,7/8) of parent canvas
  - Plots coords from (0,0) to (1,1)



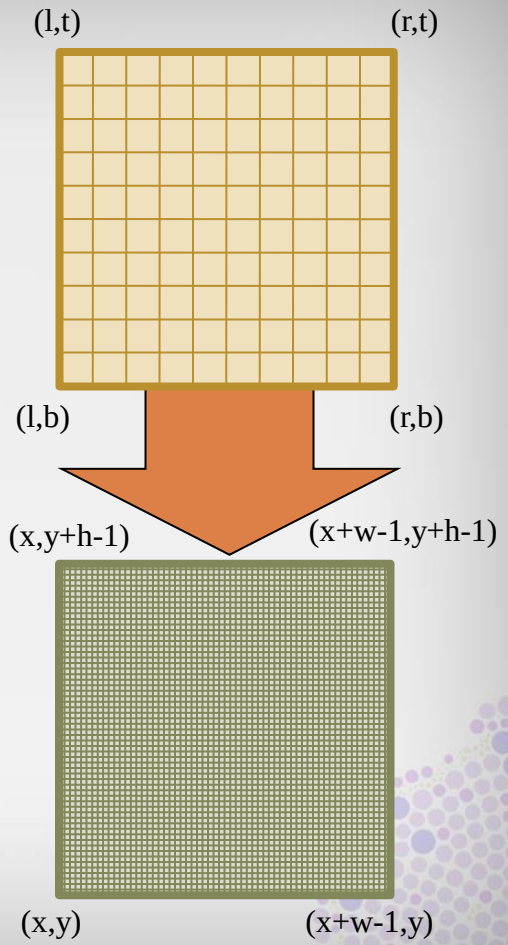
Screen Coordinates

- Physical per-pixel integer coordinates
- Sometimes (0,0) is in the upper left corner (e.g. for mouse input)



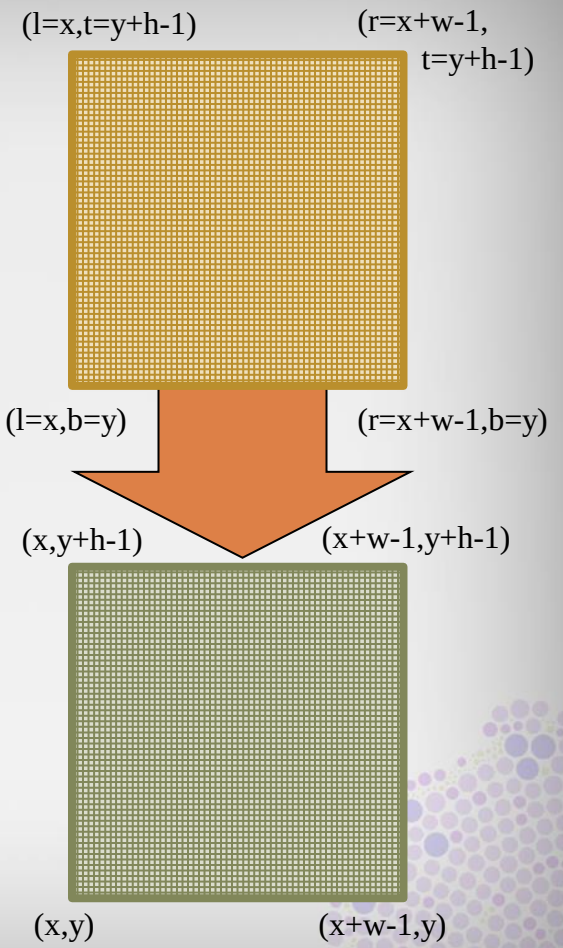
Canvas→Screen Transformation

- Draw primitives in canvas coordinates
  - Extending horizontally from l to r
  - Extending vertically from b to t
- Primitives automatically transformed to screen's pixel coordinates
- Rasterization fills in transformed outline with pixel
  - Positions
  - Colors



Working in Screen Coordinates

- Can use the same coordinates for both canvas and screen coordinates
- Specify primitives using pixel locations
- Can result in non-scalable resolution dependent output



What Have We Learned?

- Vector graphics describes shapes with vertices, strokes and fills
- Raster graphics describes shapes with a table of pixels
- The coordinates used to plot in a canvas can be different than the coordinates used to display a canvas
- A canvas can contain a canvas, which sets up a hierarchy of coordinate systems