Exercise

1. On graph paper, make a box 4 pixels wide by 7 tall.
   • Color the boxes as follows, left to right: empty, full, full, empty; full, empty, empty, full; full, empty, empty, full; full, empty, empty, empty; empty, full, full, empty; empty, empty, empty, full; empty, full, full, empty.

2. Make another box the same size, and draw in it:
   • A half circle (top only), radius 2, with center at (2,2)*
   • A half circle (bottom only), radius 2, with center at (2,5)*
   • A line from (0,2) to (0,5)

*measured right and down from top left
Happy Labor Day
Line Art

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Part 1: Image Representations
Your Questions

Q. Why do programs such as the one we're using start at the upper left corner instead of the center or the lower right hand corner?

Q. What was the advantage of making the y-axis inverted?

A. On old CRT screens the raster scan began at the top and moved to the left and downwards. It was natural to define the axes accordingly. This also means that the top left pixel is stored first in memory.

There’s a discussion of this topic here: https://gamedev.stackexchange.com/questions/83570/why-is-the-origin-in-computer-graphics-coordinates-at-the-top-left#%3A%3A%20Because%20screens%20start%20rendering%20the%20axis%20going%20into%20the%20screen. &text=Red%20arrow%20would%20be%20upside,NOT%20use%20top%2Dleft%20origin.
Q. In reading section 1.2, it talks about the final step in 3D graphics being rasterization and rendering. Is this step necessary because these 3D graphics are being displayed on a 2D computer screen? What if we were creating 3D graphics to be displayed in virtual reality, which gives the user a 3D experience; would this final step (rasterization and rendering) be necessary?

A. Nearly all modern display devices use raster graphics, even the cameras used in 3D virtual reality goggles. Thus the rasterization step is still necessary, even when drawing 3D objects.
Your Questions

Q. Why do vector graphics take less space to store?
A. A description in vector graphics is the same size regardless of the image size. Raster graphics use more and more data for larger images.

Q. How do the file format descriptions for vector graphics work (like what is the vector graphic equivalent of the text file in slide 29)?
A. The vector description would list three items:
   • White background
   • Red square in upper left corner
   • Blue square in lower right corner
Your Questions

Q. In the descriptions for gifs and png files, what exactly does "lossless compression" mean and how does it work?

A. “Lossless” means that you get exactly the same pixel colors out as you started with. Lossy compression is the opposite. For example, GIF compression uses a limited color palette and other colors are replaced with the closest palette color.

Q. In what circumstances would you use a gif vs. a png vs. a jpeg vs. a svg file?

A. GIF: animation. PNG: Flat-color graphics. JPEG: photographs. SVG: Rescalable graphics (e.g., character fonts)
Your Questions

Q. I'm interested in learning more about lossy compression and digital decay! As well energy-consumption in processing and generating computer graphics.

A. Both of these are tangential subjects, but I’ll describe the basics. JPEG compression is lossy, but in a more complicated way than GIF. Each time you store an image using JPEG, the pixel values can drift farther away from the original. Eventually the differences (called “artifacts”) become noticeable. Degree of compression also matters. Modern Graphics Processing Units (GPU) consume up to 300 watts.
Q. There are infinite combinations of colors out there, so I wonder what happens when a camera or a program like Photoshop encounters a color that might be between (0,0,255) and (0,0,254) for example. Is that slight difference detectable?

A. You tell me!

The bigger problem with color representations is not resolution but inability to express all human-visible colors with a mix of just three primary tones.
Q. I do not have any questions but I was unable to open my image.ppm on photoshop.

A. On some operating systems, you may also need to change a file type indicator before using a text file as an image.
Part 2: Coordinate Systems
Q. Why do some applications choose to use corner origin over pixel centered origin and vice versa? Is it just a matter of preference?

A. Yes!

Q. What are the pros and cons of both pixel center origin and corner origin? In what circumstances would one origin convention be used over the other?

A. The designers of a software platform will make the decision.

Q. For pixel center origin, does the upper left-hand corner have coordinates (-0.5, -0.5)?

A. Yes!
Q. For the last question, I do not think I understood the reasoning behind why it was the corner origin. (qz 3)

Q. I had originally selected "Pixel center origin" for the last question before unpausing the video, so I'm not sure why it's corner and not pixel center, especially since the answer to the question before was fractional.

Q. Can you please explain more the third question?

A. Here’s the source of the confusion, I think: with corner origin, the center of a pixel will always have coordinates ending in .5. However, the center of the image may land either in a pixel center or on a pixel boundary, depending whether the image dimensions are odd or even.
Coordinate Alignment with Pixels

Two conventions exist for how coordinate values align with pixels.

Whole numbers at pixel centers, fractions at boundaries

Pixel centered origin: the origin point corresponds to the centre of the top-left pixel.

Corner origin: the origin point corresponds to the top-left corner of the top-left pixel.

Whole numbers at pixel boundaries, fractions at centers

WebGL uses corner origin!

All coordinates are higher by 0.5 than PCO
Coordinates of Image Center (Corner origin)

Odd dimensions: Center point is inside pixel

Even dimensions: Center point is on corners

Mixed even/odd dimensions: Center point is on side
Part 3: HTML & Javascript
Your Questions

Q. I am a little confused on when we would use "graphics.fillStyle" over the other fill methods.
A. Calling graphics.fillStyle changes the behavior of all future fill methods. It’s like changing the color of your marker.

Q. I'm wondering how much the init() command can do. What are its limitations?
A. We write init() ourselves. So it can do whatever we want (within the computational limits of Javascript and WebGL)!
Your Questions

Q. Why do we need to use both HTML and JavaScript?
A. By using HTML we take advantage of the browser as a WebGL renderer. Javascript is the programming language most compatible with HTML.

Q. Why are "canvas" and "graphics" variables?
A. Our program needs a way to access WebGL objects.

Q. How does the init() function recognize the HTML "theCanvas"?
A. This line makes the connection:

```javascript
canvas = document.getElementById("theCanvas");
```
Lab: Checkerboard
First Homework!

• Start early!
• Line drawing video will post this evening
• Implement line drawing algorithm
• Importance of testing
Pair-programming

• Option on *some* assignments (Homework 1 included)
  • Will always specify explicitly if allowed
• Work on the code only together (one person shouldn’t go ahead and then “catch the other person up”)
  • If your schedules don’t match, pick another partner
• Switch “driver” every 20-30 min
  • Other partner supervises, checks for errors, etc.
• Consider repl.it “multiplayer” mode for remote collaboration