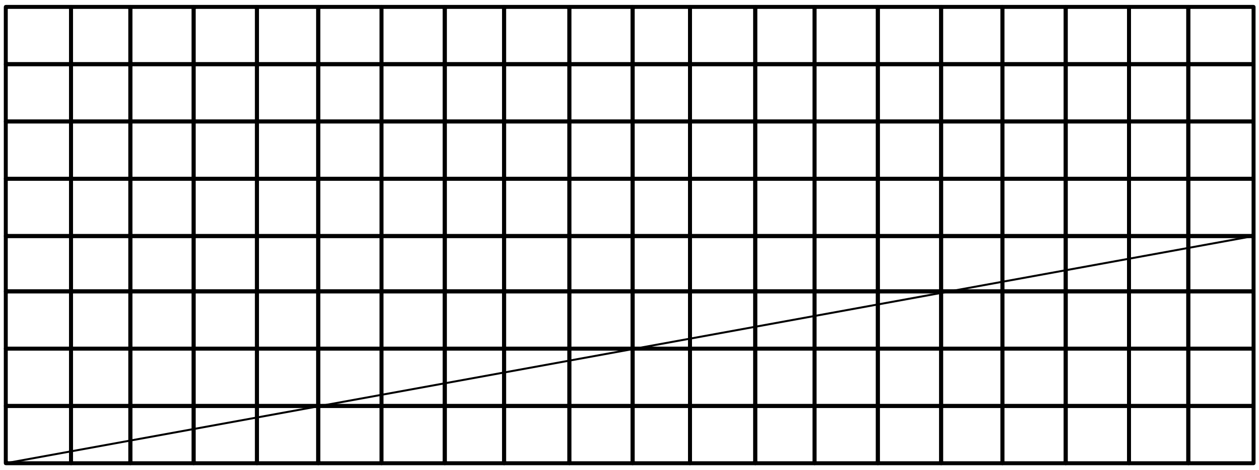
CS450/550 — MIDTERM EXAM — Spring 1995

This exam is open book, open notes. You have 50 minutes to work the exam. The number of points for each problem is shown in square brackets [50] next to each problem. One point = one minute. **Please write your name on each page!**

1. [4] The following figure shows a grid of pixels. One pixel is located at each point where the grid lines intersect. The thin line connects pixel (0,0) with pixel (20,4). Circle each pixel that will be set by Bresenham's line drawing algorithm.



2. Consider the code

```
point_t p;
vertex_t v;
point3_t p3;
vertex3_t v3;
convex_t con;
```

For each of these variables, indicate what data members (fields) it has and what they are used for.

(a) [2] Variable p:

(b) [2] Variable v:

(c) [2] Variable p3:

(d) [2] Variable v3:

(e) [2] Variable con:

3. Consider a 2-D window defined by

$$\begin{aligned} left &= 2 \\ right &= 4 \\ top &= 0 \\ bottom &= -5 \end{aligned}$$

Suppose this is to be mapped onto an X-window viewport having dimensions of 100 pixels by 100 pixels. (You may assume that the `viewport_t` normalized device coordinates are $(left = 0, right = 1, bottom = 0, top = 1)$).

(a) [4] Give the device coordinates for each of the following points (given in world coordinates):

(2,0)

(2,-5)

(3,-2.5)

(3.5,-2.5)

(b) [4] Give the world coordinates for each of the following pixels (given in X-window device coordinates):

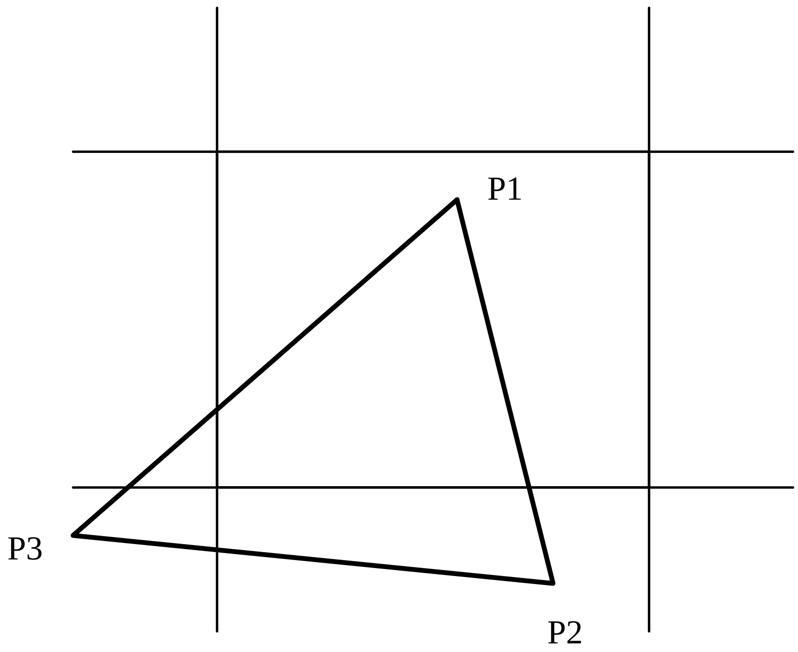
(25,25)

(100,100)

(75,50)

(80,80)

4. [10] Hand-execute both passes of the polygon clipping algorithm on the following polygon. Name any new vertexes using lower case letters and mark them on the drawing.



5. [2] In the figure from Problem 4, suppose that the coordinates of P1 are (5,6) and the coordinates of P2 are (7,-2). Suppose the bottom of the window is at $y = 0$. What are the coordinates of the point where the line connecting P1 to P2 crosses the bottom boundary of the window?

6. [2] Let P have coordinates (2,3). Let P' be the point that results from first scaling P by 3 and then translating it by $(-1, -2)$. What are the coordinates of P'?

7. [2] Let V have coordinates (1,3,5). Suppose the viewpoint is located at $(0, 0, -10)$. Let V' be the point that results from applying perspective projection to project V onto the x-y plane. What are the coordinates of V'?

8. [4] Consider a perspective projection with the viewpoint at $(0, 0, -10)$. Let T be a triangular face of a `tmesh_t`. Suppose the outward-pointing normal vector of T is $(1, 0, -1)$. Suppose also that the plane containing T intersects the x-axis at $x = 11$. Is this a backface? Justify your answer.

9. [4] Can an RGB color monitor display all of the colors that the human brain can perceive? Why or why not?

10. [4] Define “hue” and “saturation” in terms of the CIE color diagram.