

# CS421 Prerequisite Assessment

Work in groups to answer your assigned question.

## 1. Clipping

A 2-D polygon is to be clipped to the line  $y = 2x - 5$  such that the origin is considered on the inside of the clip line.

If a closed polygon contains the following vertices, in order:

$$\mathbf{V}_1 = \begin{bmatrix} 0 \\ 5 \end{bmatrix}, \mathbf{V}_2 = \begin{bmatrix} 4 \\ 1 \end{bmatrix}, \mathbf{V}_3 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \mathbf{V}_4 = \begin{bmatrix} -1 \\ 2 \end{bmatrix}, \mathbf{V}_5 = \begin{bmatrix} 3 \\ -3 \end{bmatrix}, \mathbf{V}_6 = \begin{bmatrix} 1 \\ -5 \end{bmatrix}$$

Clip this polygon to the line and provide the new set of vertices that describe the resulting closed polygon.

## 2. Illumination

Describe in some detail all of the factors that might be relevant in determining the intensity of a pixel due to illumination from light sources. In your discussion explain why each factor is important.

## 3. Line Drawing

An abbreviated version of Bresenham's Line Algorithm is listed below. Use it to identify the pixels in the line from (9,11) to (3,3).

$$p_0 = 2\Delta y - \Delta x$$

At each point:

if  $p_k < 0$

pick point  $(x_{k+1}, y_k)$

$$p_{k+1} = p_k + 2\Delta y$$

else

pick point  $(x_{k+1}, y_{k+1})$

$$p_{k+1} = p_k + 2\Delta y - 2\Delta x$$

## 4. Transformations

Sketch a diagram that illustrates the concept embodied in the perspective transformation.

Using the diagram as a guide, show how objects of the same size are projected so that the farther away from the observer they are, the smaller they will appear.

If you can, show the transformation matrix that implements this.

## 5. Curves

Discuss the following methods of drawing curves: Cubic spline, Hermite spline, Cardinal spline, Bézier curve. How are the “control points” or “nodes” used in each method? How does a Bézier curve with 7 control points differ from the combination of 2 Bézier curves (one created from the first 4 points and the other created from the last 4 points, reusing the center point)? Why might you use each of these methods? **Additional questions (if you have time...):** What is  $\{0^{\text{th}}, 1^{\text{st}}, n^{\text{th}}\}$ -order continuity? How do the continuity conditions of a cubic spline differ from those of a Bézier curve? A common method of drawing curves is lining up several cubic Bézier curves (a cubic Bézier curve is defined by 4 control points); how can 1<sup>st</sup>-order continuity be ensured when using this method?

## 6. Color

What is a primary color? Why do most color models use 3 primaries (RGB, CMY) (not 2 or 4)? What is special about the RGB color model? What is a gamut? What are some methods of translating between color models (e.g., consider  $\text{RGB} \leftrightarrow \text{YIQ}$  and  $\text{RGB} \leftrightarrow \text{HSV}$ )? State and support a situation in which each of the following color models is especially useful: RGB, YIQ, HSV, CMY(K).