

CSE423 - Computer Graphics

Assignment: 2

Total Marks: 35

Submission Deadline: 11:50 PM, 23rd November 2025

Assignment Tasks:

1. Suppose a line segment starts at (120, 23) and ends at (423, 428). If we draw this problem using the DDA algorithm, determine the number of times y will be increased. How many pixels will be needed to draw this line?

$$\frac{x}{7} - \frac{y}{12} = 5$$

2. Suppose a line segment has the equation above, and the starting point is at $y = 12$ and the ending point is at $y = 0$. Find the first 6 pixels using the Midpoint Line Algorithm.
3. A clipping window is 70 units wide and 30 units tall, and has its center at (0, 35). The endpoints of a line segment are (-45, 65) and (23, -10). Apply Cohen-Sutherland Algorithm, and identify whether the line is "partially inside", "completely inside", or "completely outside". If it is the first case, run the algorithm to calculate new endpoints for the line segment so that it is inside the clipping window. Does Cyrus-Beck line clipping algorithm produce the same output?
4. Arya drew a triangle on a coordinate plane with vertices A(3, 2), B(5, 1), and C(4, 3). She performed the following transformations in sequence: At first, she translated the triangle by (-2, 3). Then, rotate the triangle 90° counterclockwise about the origin. After that, she reflected the triangle on the x -axis. Finally, she scaled the triangle uniformly by a factor of 2 about the point (1, -1). After applying these transformations, the new location of one vertex was found to be (a, b).
 - a. Now, identify the position of the vertices before only the reflection is applied. (That means only translation and Rotation are applied to each of the vertices).
 - b. Write the composite matrix formulation for all transformations applied to the triangle. (You do not need to perform matrix

multiplication.)

- c. Which geometric properties are preserved after each transformation?
5. A 3D composite transformation is defined by a shearing along the X axis by a shearing factor of (2, 4) about point (423, 0, 0), followed by a uniform scaling by factor 3 again, followed by a 30-degree counterclockwise rotation on the X axis about point (2, 10, 12) and finally followed by a translation of (-4, -2, -3). A point P is transformed into P' with the above transformation.
- a. Now, write down the composite transformation matrix representation for P' in the correct sequence of matrix multiplications. [N.B. The shearing factor will be $Sh_y = 2$ and $Sh_z = 4$. Go sequentially if it is not mentioned.]
- b. Also, find out the inverse composite transformation matrix representation for P' in the correct sequence of matrix multiplications.
6. A composite transformation is defined by a scaling on the X-axis and Y-axis (first transformation) followed by a second transformation, via the following equations:
- $$x' = 5x - 11$$
- $$y' = 10y + 22$$
- $$z' = 33 + z$$
- a. Find the composite transformation matrix. What was the second transformation after scaling?
- b. Write down the scaling matrix from the above composite transformation.
- c. If a 3D point M has the coordinate (4, 2, 3), what is the new coordinate of the point M', after the transformation defined by the equations?
7. A robot is positioned at (2, 0, 3) with the endpoint of its hand at (2, -2, 1). The robot wants to grab a fruit located at (12, 5, 13). To achieve this, it performs the following transformations *sequentially* on its hand's endpoint:
- **Rotation:** At first, the hand's endpoint is rotated 90° counter-clockwise around the X-axis, using the robot's position

as the center of rotation.

- **Scaling:** Then, the hand's endpoint is scaled by some factors of S_x , S_y , and S_z . [Hint: Scaling was done with respect to the Robot's position, too.]
- **Translation:** Lastly, the robot itself is translated by $(10, 0, 15)$, bringing the hand's endpoint to the fruit's position so that it can grab the fruit.

Find the values of S that ensure the hand's endpoint aligns with the fruit (the hand's endpoint will be the same as the fruit's location). Show your calculations using the composition of transformations. Also, explain whether the scaling is uniform or non-uniform.

Submission Guidelines:

1. You MUST write the answers on the paper. You can also use a Tab.
2. Make a cover page including your Assignment Number, Name, ID, Section, and Date.
3. Scan the pages and make a PDF. The file name should follow the format: StudentID_Section_Assignment_1 (eg 10301040_6_Assignment_1)
4. No late submissions will be accepted.
5. Upload the PDF to the Google form. Use G-suite Mail only.