

# ICS2311 – Computer Graphics

## CAT on Transformations and Shapes

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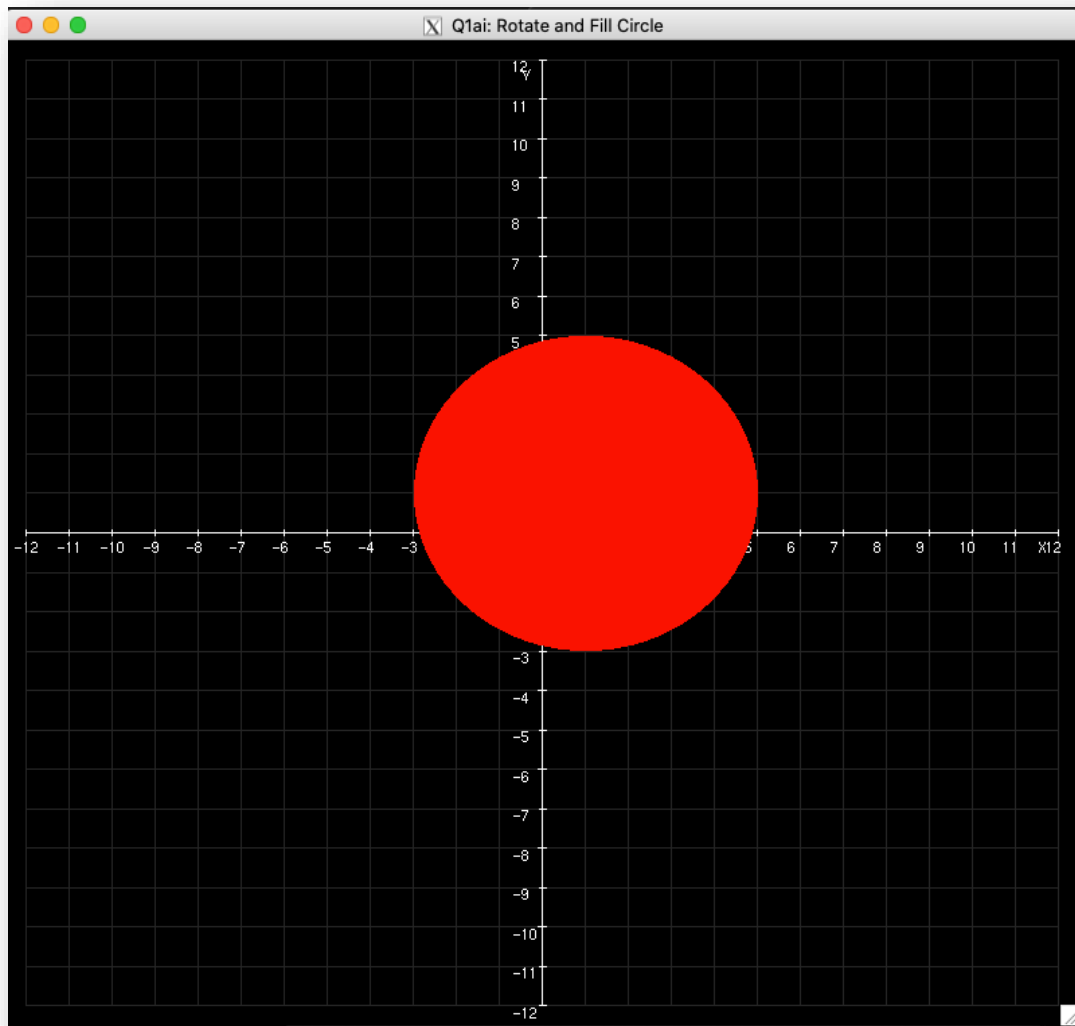
### 1: Bresenham Circle

#### 1(a)(i): Rotate and Fill the Circle

##### *Approach & Implementation*

- Rotated the **circle 60° clockwise** using OpenGL's `glRotatef` function.
- Filled the circle with **red color (#FF0000)** using `GL_TRIANGLE_FAN`.
- **Rotation is centered at (1,1)** for accuracy

## Output & Screenshots

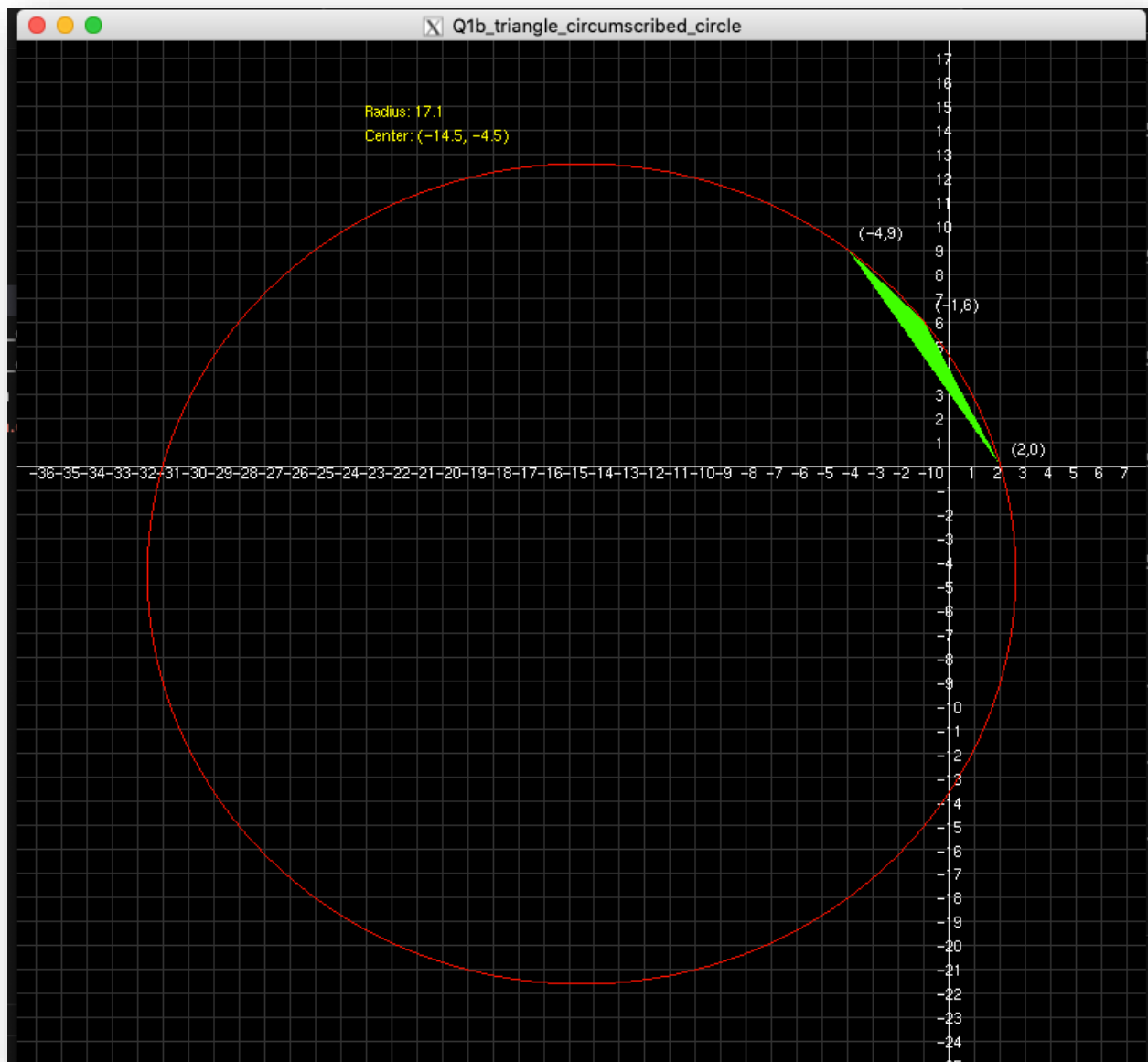


### 1(b): Triangle with Circumscribed Circle

#### Approach & Implementation

- **Define the Triangle** using given vertices  $(-1,6)$ ,  $(2,0)$ ,  $(-4,9)$ .
- **Calculate the Circumcenter and Circumradius** using perpendicular bisectors.
- **Draw the Triangle** with `GL_TRIANGLES`.
- **Draw the Circumscribed Circle** using `GL_LINE_LOOP` and parametric equations.
- **Render the Cartesian Plane** with labeled axes for reference.
- **Label the Circumcenter** with computed coordinates.

## Output & Screenshots



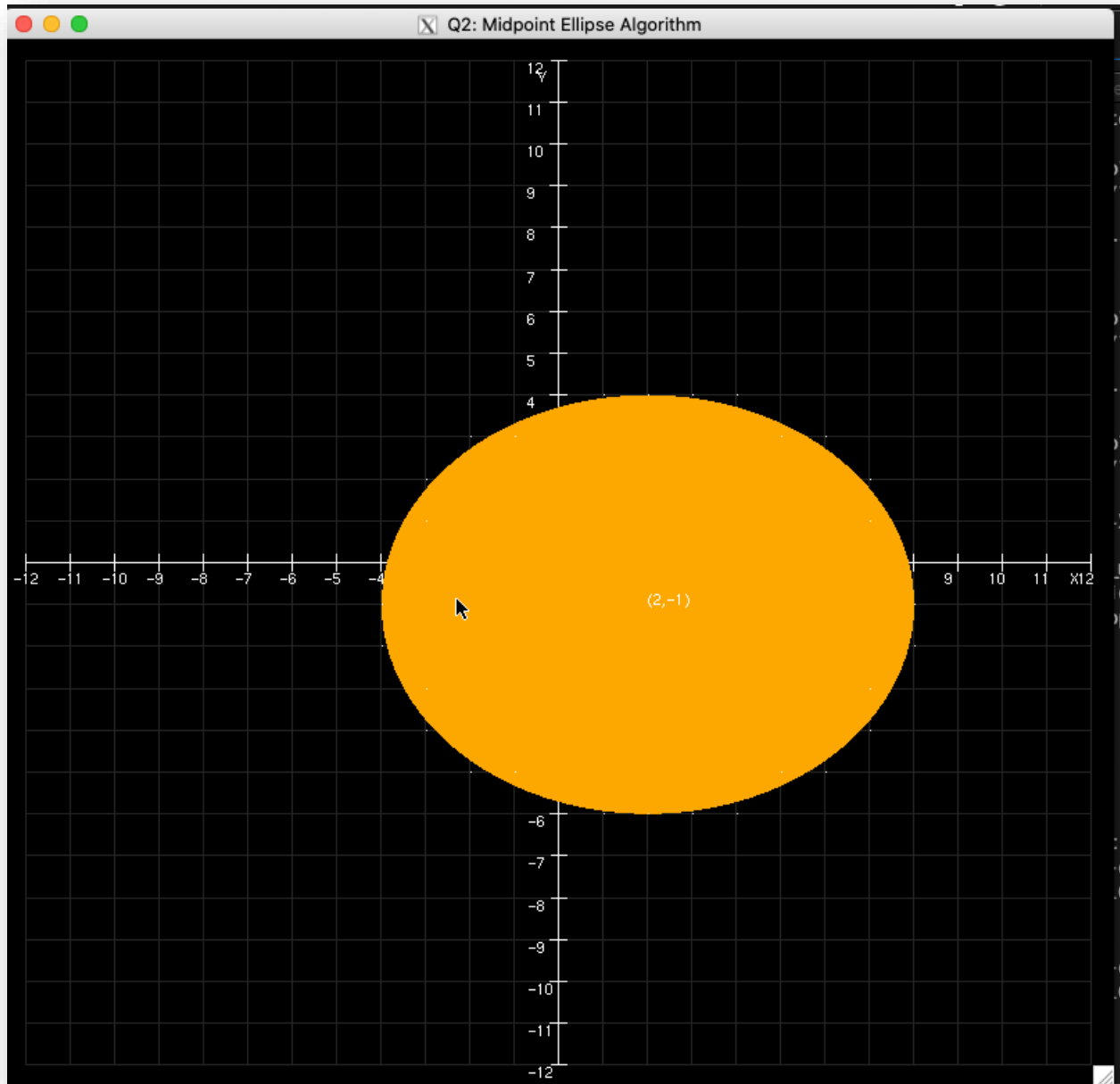
## Question 2: Ellipse Drawing

### Approach & Implementation

- **Implement the Midpoint Ellipse Algorithm** to plot the given ellipse.
- **Apply transformations** to shift the center of the ellipse to **(2, -1)**.
- **Ensure proper scaling** so that the ellipse fits within the Cartesian plane.
- **Fill the ellipse with an orange color** (#FFA500).

- **Label the ellipse center and axes** for clarity.

### Output & Screenshots



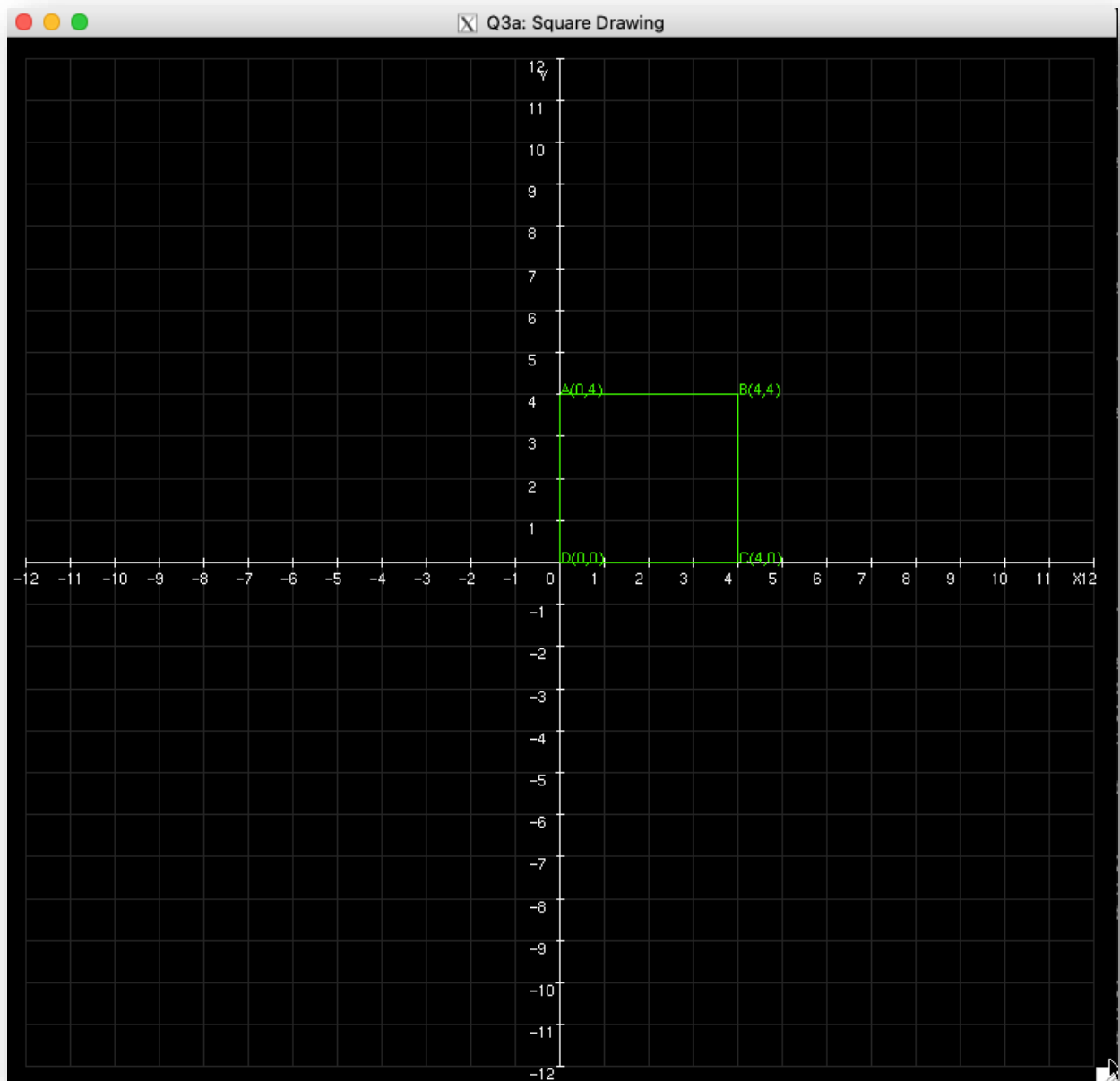
## Question 3: Square Transformations

### 3(a): Square Drawing

#### *Approach & Implementation*

- **Define the Square** using given vertices **A(0,4), B(4,4), C(4,0), D(0,0)**.
- **Draw the Square** using `GL_LINE_LOOP` to outline it without filling.
- **Integrate the Square into the Cartesian Plane** for proper visualization.
- **Ensure the Cartesian Plane** has grid lines, axes, and small perpendicular ticks.
- **Label the Square's Vertices.**

## Output & Screenshots



### 3(a)(i): Translation

#### Approach & Implementation

- **Apply Translation Transformation** using:

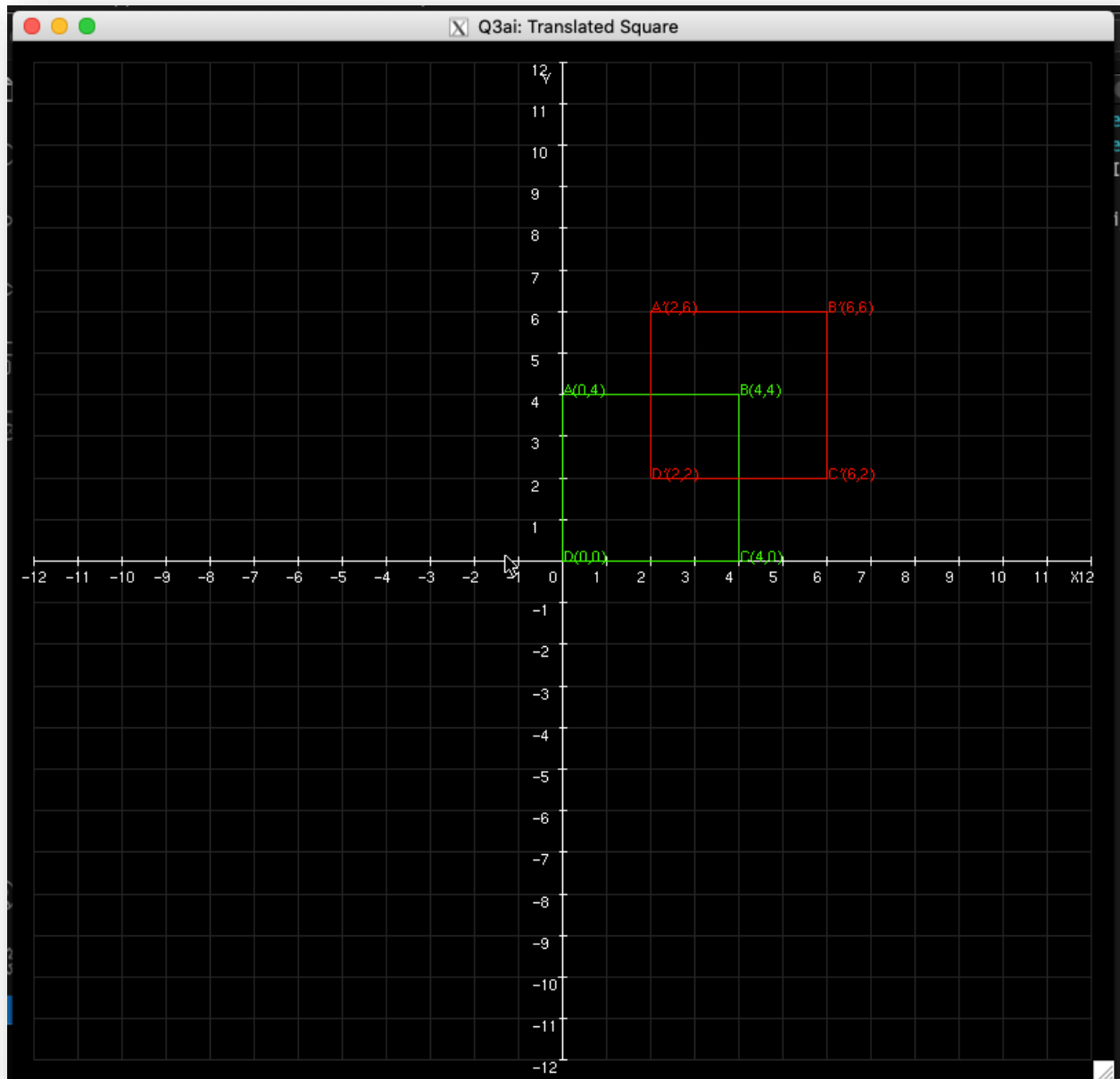
$$x' = x + 2, y' = y + 2$$

- **Compute New Coordinates:**

$$A'(2,6), B'(6,6), C'(6,2), D'(2,2)$$

- **Draw the Translated Square** in a different color for distinction.
- **Label the New Translated Vertices**

## Output & Screenshots



### 3(a)(ii): Rotation

#### Approach & Implementation

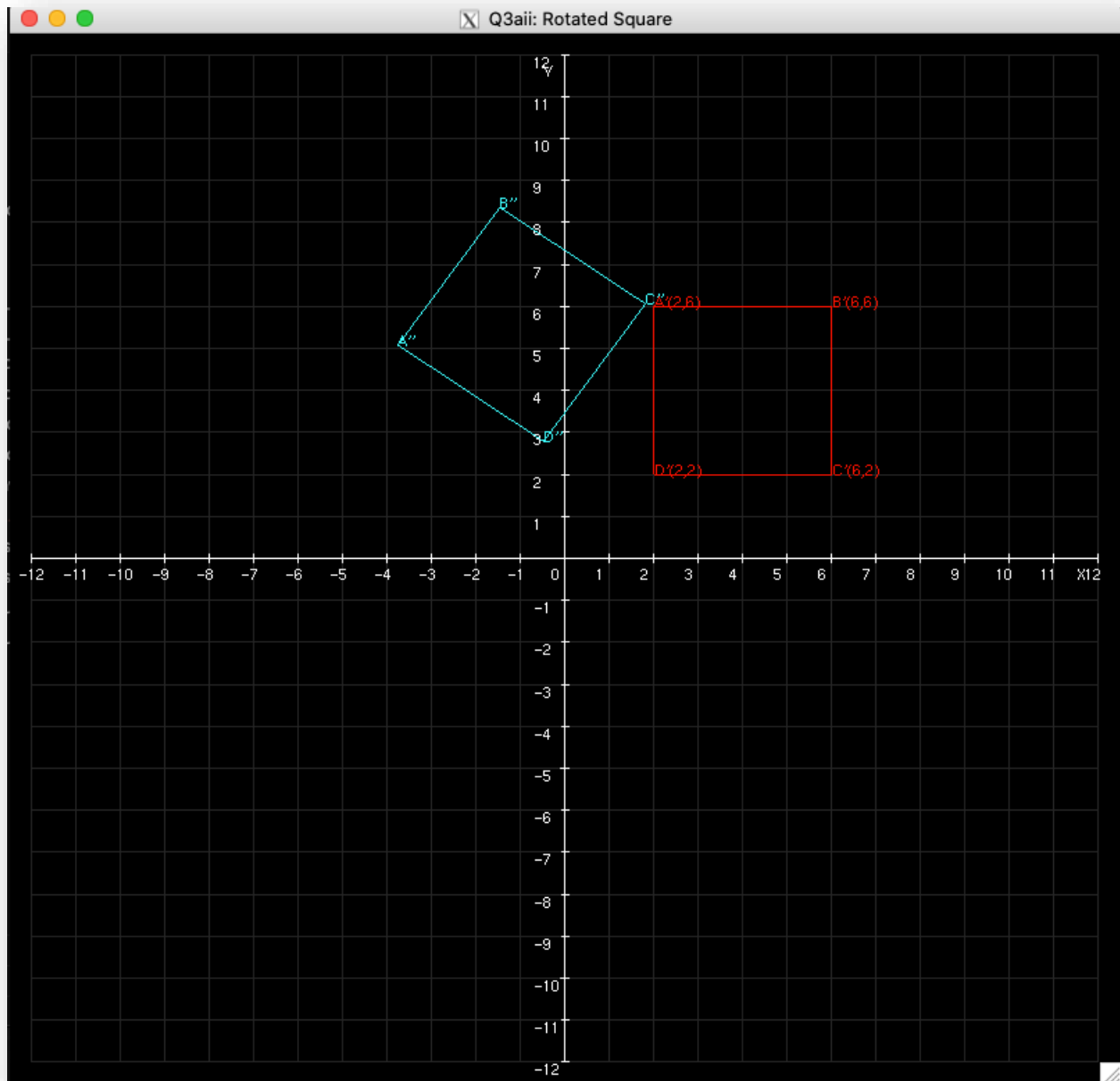
- **Apply Rotation Transformation** using:

$$x' = x \cos(55) - y \sin(55), y' = x \sin(55) + y \cos(55)$$



- **Compute New Rotated Coordinates:**  
 $A'(x',y')$ ,  $B'(x',y')$ ,  $C'(x',y')$ ,  $D'(x',y')$
- **Draw the Rotated Square** in a different color for distinction.
- **Label the New Rotated Vertices** for clarity.

### Output & Screenshots



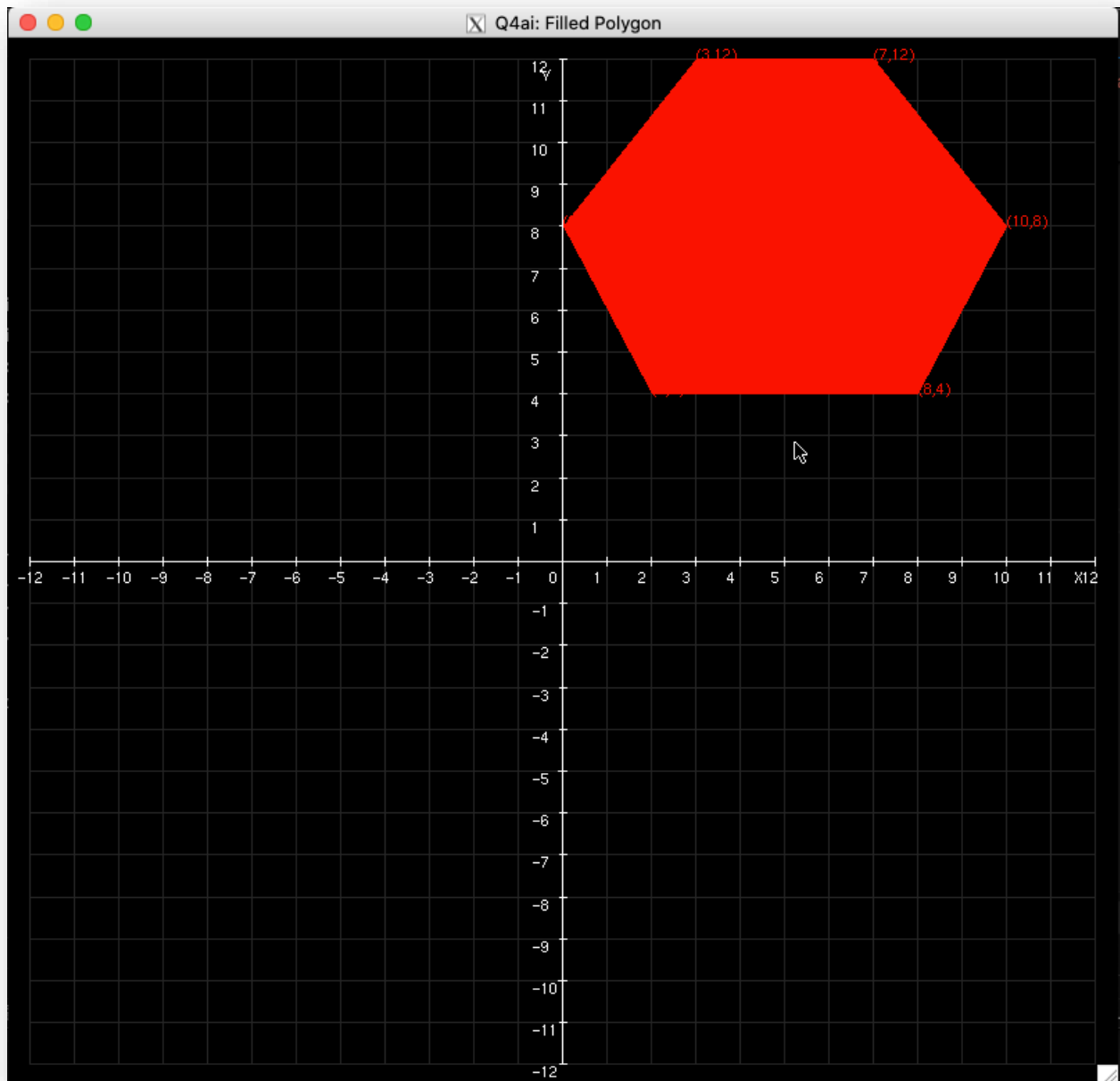
## Question 4: Polygon Drawing and Scaling

### 4(a)(i): Polygon Drawing

#### *Approach & Implementation*

- **Define the Polygon** using the given vertices **(8,4), (2,4), (0,8), (3,12), (7,12), (10,8)**.
- **Use GL\_POLYGON** to draw the filled shape.
- **Integrate the Polygon into the Cartesian Plane** for proper visualization.
- **Fill the Polygon with Red (#FF0000).**
- **Label the Polygon's Vertices**

## Output & Screenshots



### 4(a)(ii): Scaling the Polygon by a Factor of 2

#### Approach & Implementation

- **Apply Scaling Transformation** using:

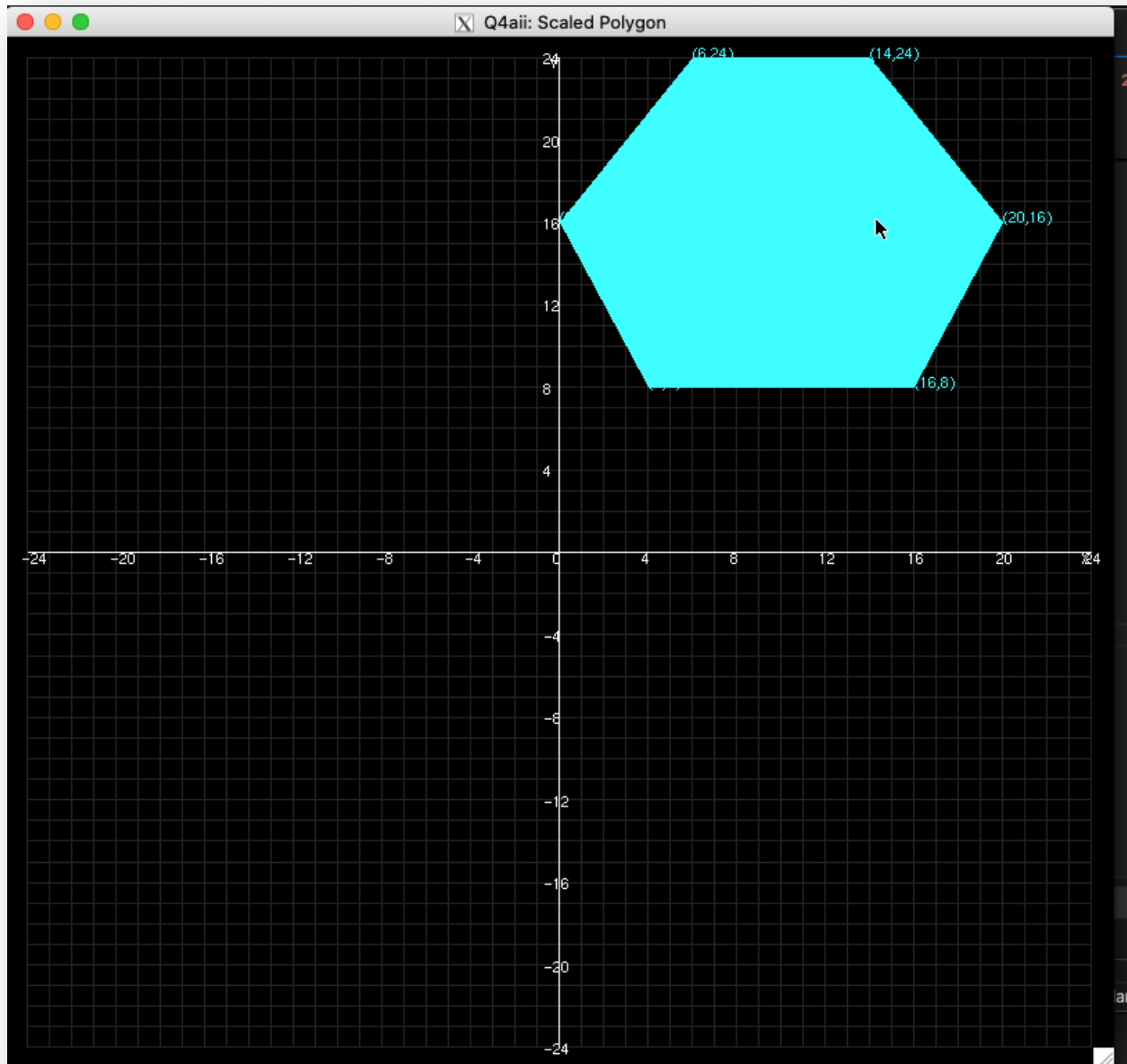
$$x' = x \times 2, y' = y \times 2$$

- **Compute New Scaled Coordinates:**

$A'(16,8)$ ,  $B'(4,8)$ ,  $C'(0,16)$ ,  $D'(6,24)$ ,  $E'(14,24)$ ,  $F'(20,16)$

- **Draw the Scaled Polygon** in a different color for distinction.
- **Label the New Scaled Vertices** for clarity.

### Output & Screenshots

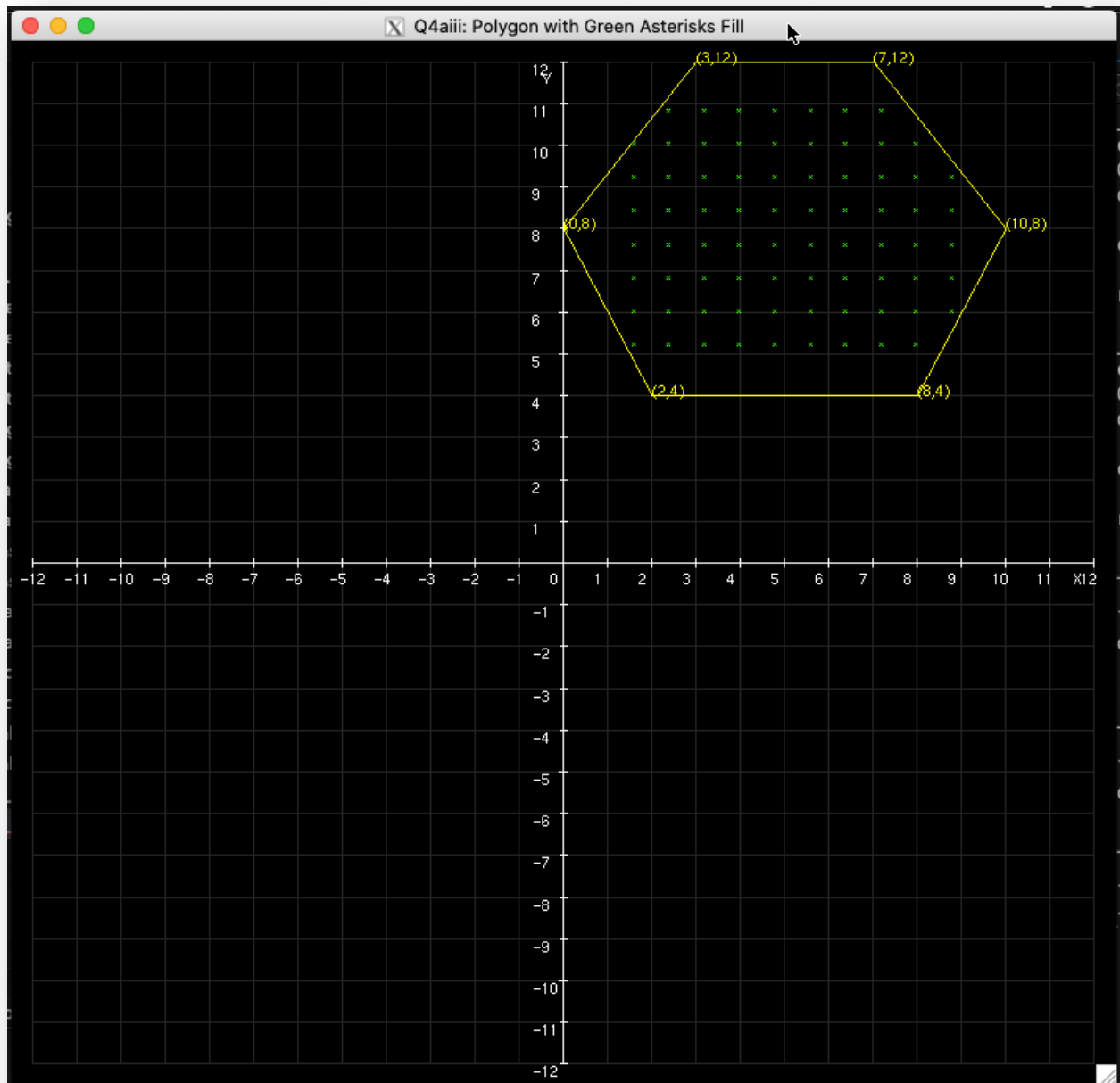


#### 4(a)(iii): Filling the Polygon with Green Asterisks

##### *Approach & Implementation*

- **Use Raster Positioning (`glRasterPos2f`)** to place asterisks inside the polygon.
- **Iterate through a grid within the polygon's bounding box** to determine fill points.
- **Use `glutBitmapCharacter` to render '\*' at valid positions.**
- **Maintain the Cartesian Plane for reference.**
- **Label the Polygon's Vertices** for clarity.

## Output & Screenshots



## Question 5: Parabola Drawing

### Approach & Implementation

- **Implement the Midpoint Parabola Algorithm** to plot the curve ( $x = y^2$ ).
- **Use symmetry** to reflect points across the x-axis for completeness.
- **Integrate the parabola** into the Cartesian Plane for reference.
- **Ensure proper scaling** so the parabola is well-positioned and visible

- **Label key points** on the curve for clarity.

### Output & Screenshots

