Midpoint Ellipse Algorithm

1. **Input**: Provide the radii r_x, r_y, and the ellipse center (x_c, y_c). Initialize the first point on the ellipse centered on the origin as:

$$(x_0, y_0) = (0, r_y)$$

2. **Region 1 Decision Parameter**: Calculate the initial decision parameter for Region 1 as:

$$P_1 = r_y^2 - r_x^2 r_y + \frac{1}{4} r_x^2$$

3. **Iteration in Region 1**: For each x-position in Region 1 (starting at $k = 0$), perform the following:
   - If $P_1 < 0$, the next point is $(x_k + 1, y_k)$ and update:

$$P_1 = P_1 + 2r_y^2 x_k + r_y^2$$

   - Otherwise, the next point is $(x_k + 1, y_k - 1)$ and update:

$$P_1 = P_1 + 2r_y^2 x_k - 2r_x^2 y_k + r_y^2$$

   - Continue until $2r_y^2 x = 2r_x^2 y$.

4. **Region 2 Decision Parameter**: Using the last point (x_p, y_p) from Region 1, calculate the initial decision parameter for Region 2:

$$P_2 = r_y^2 (x_p + \frac{1}{2})^2 + r_x^2 (y_p - 1)^2 - r_x^2 r_y^2$$

5. **Iteration in Region 2**: For each y-position in Region 2 (starting at $k = 0$), perform the following:
   - If $P_2 > 0$, the next point is $(x_k, y_k - 1)$ and update:

$$P_2 = P_2 - 2r_x^2 y_k + r_x^2$$

   - Otherwise, the next point is $(x_k + 1, y_k - 1)$ and update:

$$P_2 = P_2 + 2r_y^2 x_k - 2r_x^2 y_k + r_x^2$$

6. **Symmetry Points**: For each calculated pixel position (x, y), determine the symmetric points in the other three quadrants.

7. **Translation**: Translate each pixel position to the ellipse centered at (x_c, y_c):

$$(x', y') = (x + x_c, y + y_c)$$

8. **Plot**: Plot the points for both regions until the stopping condition $2r_y^2 x = 2r_x^2 y$ is satisfied.