Task Document: Rotating Rectangle Python Program

Objective:

Implement the rotating rectangle program as described in the PRD, breaking it into clear tasks for development.

Tasks:

1. Environment Setup

- Install Python 3.x.
- Install necessary packages: NumPy and Matplotlib.
- Verify installation with a simple script.

2. Define Rectangle

- Define rectangle dimensions: width = 4, height = 2.
- Calculate half-width and half-height.
- Compute initial corner points centered at origin.
- Include first point as last point to close rectangle.
- Store points in a NumPy array (vector).

3. Define Rotation

- Define rotation angle $\theta = \pi/128$ radians.
- Create 4x4 rotation matrix in homogeneous coordinates.
- Verify matrix correctness with a test point.

4. Plot Setup

- Initialize Matplotlib interactive plot (`plt.ion()`).
- Plot initial rectangle lines (blue) and corner points (red).
- Set axes to equal size.
- Set plot title to "Rotate Rectangle" in red.

5. Animation Loop

- Loop for 200 steps:
  - Multiply rotation matrix with current points vector.
  - Update line and scatter plot with new points.
  - Pause for 10 milliseconds (`plt.pause(0.01)`).
- Ensure rectangle remains centered.

6. Finalization

- Turn off interactive mode (`plt.ioff()`).

- Display final plot (`plt.show()`).

7. Testing & Validation

- Confirm rectangle rotates correctly around origin.
- Verify corner points are stored correctly.
- Ensure lines are blue, points are red, axes equal, and title correct.
- Test performance and smoothness of animation.

8. Documentation

- Comment the code with clear explanations.
- Provide instructions to run the program.
- Include screenshots or recorded animation for demonstration.

Notes:

- Each task should be completed and verified before moving to the next.
- Ensure proper version control for the code files.