CZ2003 Tutorial 8 (2022/2023, Semester 1)

2D Transformations

1. A quadrilateral on the XY plane is defined by four corner points whose homogeneous coordinates are (0, 2, -2), (2, -2, 1), (-1, -0.5, -0.5), and (0, 3, 3). Analyze whether the quadrilateral is a square, a rectangle, or a trapezium.

2. Find an affine transformation that transforms polygon **A** to polygon **A'** with vertex $\mathbf{v_a}$ corresponding to $\mathbf{v_a'}$, $\mathbf{v_b}$ to $\mathbf{v_b'}$, $\mathbf{v_c}$ to $\mathbf{v_c'}$, etc, as shown in Figure Q2. A point P = (2, 3) lies on polygon **A.** Compute the coordinates of the image of P under this transformation.

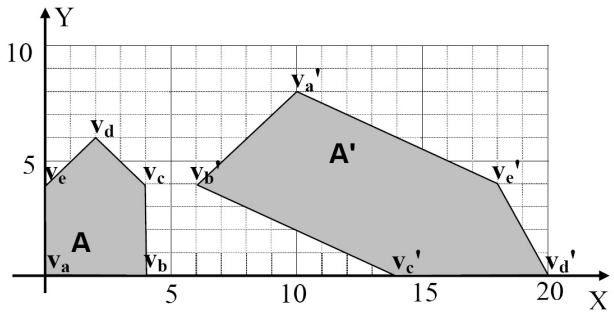

Figure Q2

3. A 2D geometric object is first scaled with respect to the point with coordinates (1,1) in the *x*-coordinate by 5 times and in the *y*-coordinate by 3 times. Then the object is rotated clockwise about the origin by 90°. Finally, the object is reflected through the *y*-axis. Write in a proper order the matrices constituting this transformation.

4. Suppose that **R** and **S** represent a rotation transformation and a scaling transformation. Both transformations are performed with respect to the point with coordinates (1, 2). Discuss the conditions under which **SR** and **RS** define the same transformation.