Ch. 9 Properties of Transformations

9.1 Translate Figures and Use Vectors

- Translate: Slide
  - Preimage $\longrightarrow$ image
  - Rule: $(x,y) \longrightarrow (x + a, y + b)$
  - ABC $\longrightarrow$ A'B'C'
- **Isometry**: same length, same angles
  - Congruent transformation
- A translation is an isometry

- **Vectors**: used in a translation
  - Initial point and terminal point
  - Quantity that has both:
  - 1.) direction and 2.) magnitude (size)
  - Component: $\langle \text{horizontal move}, \text{vertical move} \rangle$

9.2 Matrices

- **Matrix**: rectangular arrangement of numbers
  - Matrices (plural)
  - A way to collect data (like x/y points)
  - Rows (across)
  - Columns (down)
  - Dimensions: row x column
  - Each number an element

- Add or Subtract Matrices: Each element

- Multiply: Each Row by Column, then add parts
  - Row elements must match column elements

9.3 Reflections

- Reflection: transformation
  - Uses a line like a mirror to reflect the image
  - Line of Reflection
- 4 Reflections:
  - 1. x-axis $(x,y) \longrightarrow (x, -y)$
  - 2. y-axis $(x,y) \longrightarrow (-x,y)$
  - 3. Line y = x $(x,y) \longrightarrow (y,x)$
  - 4. Line y = -x $(x,y) \longrightarrow (-y, -x)$

9.4 Perform Rotations

- **Transformations**:
  - 1. Translation (slide)
  - 2. Reflection (flip)
  - 3. Rotation (turn)

- **Rotation**: turn on a fixed point called the
  Center of rotation

  Forms an Angle of rotation

  Clockwise or Counterclockwise (we will use)

- Angle of Rotations: 90°, 180°, 270°, 360°

- 90° (x,y) $\longrightarrow$ (-y, x) or Matrix $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$
- 180° (x,y) $\longrightarrow$ (-x,-y) or Matrix $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$
- 270° (x,y) $\longrightarrow$ (y, -x) or Matrix $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$

9.5 Apply Compositions of Transformations

- **Glide**: 1. translation 2. reflection

- **Composition**: 2 or more transformations

- **Theorem**: Reflections in Parallel Lines
  - Reflect/ reflect again lines k and m
  - 1. PP‘ perpendicular to lines k and m
  - 2. PP‘ = 2 x distance between lines k and m

Theorem: Reflection in Intersecting Lines

reflect/ reflect again

lines *k* and *m* intersect

1. Angle BB‘ = 2 x the angle of *k* and *m*

9.6 Symmetry

- 1. **Line of Symmetry** is the line of reflection
  - An image can have more that 1 line of symmetry

- 2. **Rotational Symmetry**: image mapped onto itself by rotating 180° or less
  - Point of rotation: center of symmetry

9.7 Dilations

- **Transformations**:
  - 1. Translation 2. Reflection 3. Rotation
  - All keep congruency (isometry)

  - 4. **Dilation**: transformation where original figure and new image are **Similar**
    - k = scale factor $\frac{CP'}{CP} = \frac{distancce\ new\ image}{distance\ old\ image}$
    - 0<k<1 Reduction
    - K>1 Enlargement

- **Matrices**: Scalar Multiplication
  - Multiplication by a real number (scalar)
  - Dilation with Matrices
    - Multiplication by scale factor (which is the scalar)