**MATH 232: Engineering Mathematics**

**Reading Guide for LAS, Section 1.3: Affine Transformations**

**Goals:**
1. To be able to describe the fundamental types of affine transformations in \( \mathbb{R}^2 \) and \( \mathbb{R}^3 \), and to be able to find an appropriate matrix \( A \) for which the mapping \( x \mapsto Ax \) gives these transformations.
2. To be able to take a verbal description of an affine transformation and break it up into the composition of fundamental ones.

**Read:** Section 1.3 of LAS

**Terms to know:**
- affine transformations, homogeneous coordinates, unit vector, the mapping \( (v \mapsto Av) : \mathbb{R}^n \to \mathbb{R}^m \) corresponding to a given \( m \)-by-\( n \) matrix \( A \)

**Questions you should be able to answer:**
1. For which type(s) of affine transformations of the plane does one need to employ homogeneous coordinates?

2. Suppose you wished to move every point \((x, y)\) of the plane to a new point \((x', y')\) which was 1 unit higher and 2 units to the left of the reflection of \((x, y)\) across the line \(y = x\). How could you achieve this through matrix multiplication?

3. For what matrix \( A \) would \( Av \) have a
   - 1\(^{\text{st}}\) coordinate that was three times as long as that of \( v \),
   - 2\(^{\text{nd}}\) coordinate that was half as long as that of \( v \),
   - 3\(^{\text{rd}}\) coordinate that was twice as long as that of \( v \) and opposite in sign to it,
   for each \( v \in \mathbb{R}^3 \)?