1. Let \( u = [u_1, u_2, 1]^T \) and \( v = [v_1, v_2, 1]^T \) denote the homogeneous coordinates of points in planes \( P \) and \( Q \), respectively. Matching point pairs are related by a projection matrix \( H \) as
\[
v_i = Hu_i, \quad i = 1, 2, \ldots, n
\]
(a) A transform from \( P \) to \( Q \) in the form of a translation by \((x_0, x_1)\) then a rotation by \( \theta \) then a scaling by \((s_0, s_1)\) is described by the matrix
\[
H = \begin{bmatrix}
0.951623 & 0.443749 & -6.97686 \\
-0.401487 & 0.860992 & -2.29753 \\
0 & 0 & 1
\end{bmatrix}
\]
Determine the values of \((x_0, x_1, s_0, s_1, \theta)\).
(b) A transform from \( P \) to \( Q \) in the form of a translation by \((x_0, x_1)\) then a scaling by \((s_0, s_1)\) then a rotation by \( \theta \) is described by the matrix
\[
H = \begin{bmatrix}
0.951623 & 0.401487 & -6.76555 \\
-0.443749 & 0.860992 & -2.08622 \\
0 & 0 & 1
\end{bmatrix}
\]
Determine the values of \((x_0, x_1, s_0, s_1, \theta)\) for this order transformations.

2. Matching pairs of points from \( P \) and \( Q \) are given by the columns of the arrays \( U \) and \( V \) below.
\[
U = \begin{bmatrix}
59.260 & 62.040 & 65.310 & 36.440 & 50.510 & 60.200 & 37.740 & 57.080 \\
1.000 & 1.000 & 1.000 & 1.000 & 1.000 & 1.000 & 1.000 & 1.000
\end{bmatrix}
\]
\[
V = \begin{bmatrix}
52.587 & 56.753 & 60.691 & 36.368 & 45.732 & 56.870 & 32.699 & 52.848 \\
1.000 & 1.000 & 1.000 & 1.000 & 1.000 & 1.000 & 1.000 & 1.000
\end{bmatrix}
\]
(a) Find a matrix \( H \) that maps points from \( P \) to \( Q \).
(b) Assume that the mapping is a translation, a scaling, and a rotation in that order. Find the parameters of the individual transformations.

3. Images LWIR087c.png, MWIR087c.png, SWIR087c.png are provided in the images directory http://www.cis.rit.edu/class/simg782/images
(a) Find a transformation matrix \( H_1 \) that maps the MW image to the LW image.
(b) Find a transformation \( H_2 \) that maps the SW image to the LW image.
(c) Construct two greyscale images by mapping the MW and SW images.
(d) Construct an RGB image by building an array that has the mapped SW, the mapped MW and the original LW as array layers. This is a raw image array that can be displayed with IDL or other tools.