Marcanthony Huong
mh25
mp1

1) (0,0)
(28.65,0)
(28.65, 15.24)
(0, 15.24)

2) I did SVD on

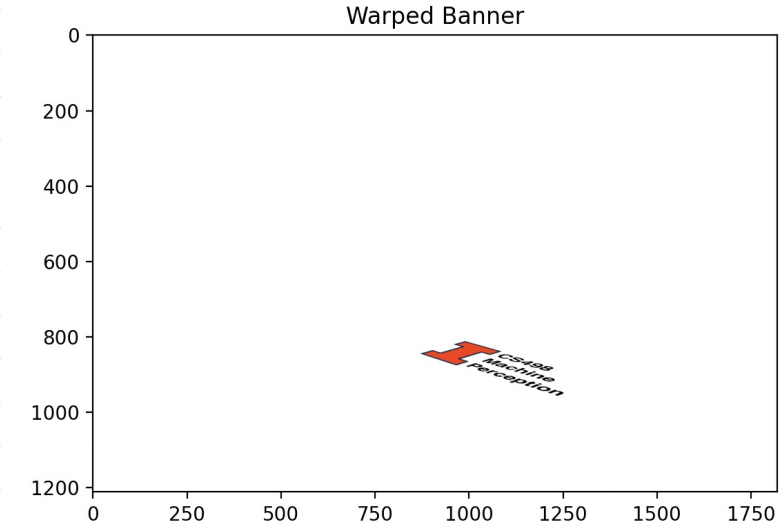
$$A = \begin{bmatrix} 0, & 0, & 0, & X_1, Y_1, 1, & -y_1 x_1, & -y_1 Y_1, -y_1 \\ x_1, & Y_1, & 1, & 0, 0, 0, & -x_1 x_1, & -x_1 Y_1, -x_1 \\ \vdots & & & \vdots & & \vdots \end{bmatrix}$$

The found the last vector of v_1 which are singular vectors.

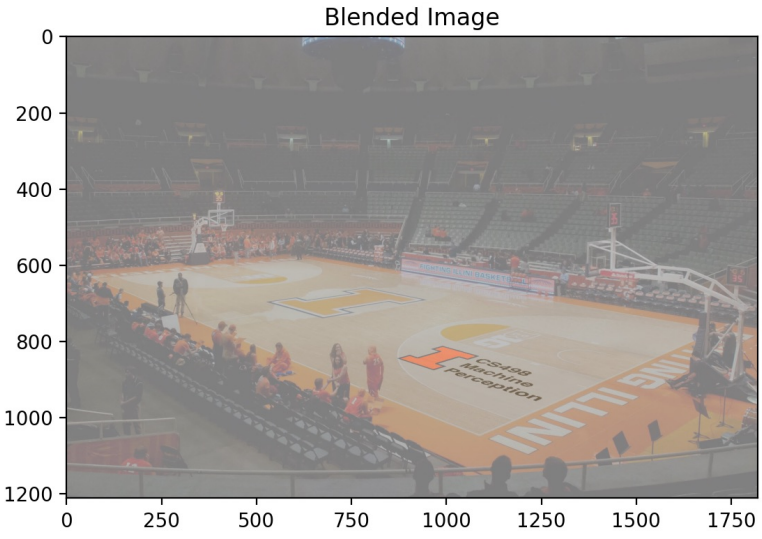
resulting matrix:

$$\begin{bmatrix} 1.14 \times 10^{-2} & -4.22 \times 10^{-2} & 7.19 \times 10^{-1} \\ -7.65 \times 10^{-3} & -5.47 \times 10^{-3} & 6.94 \times 10^{-1} \\ -2.019 \times 10^{-5} & -1.57 \times 10^{-5} & 1.19 \times 10^{-3} \end{bmatrix}$$

3b)


Warped Banner
0
200
400
600
800
1000
1200
0
250
500
750
1000
1250
1500
1750
CS498
Machine
Perception

3c)


Blended Image
0
200
400
600
800
1000
1200
0
250
500
750
1000
1250
1500
1750
CS498
Machine
Perception

4)

0, 15.24, 0	1.22, 6.705, 3.965
28.65, 15.24, 0	1.22, 8.535, 3.965
28.65, 0, 0	1.22, 8.535, 2.749
0, 0, 0	1.22, 6.705, 2.749

5a)

$$\begin{bmatrix} 0 & x_1 & -y_1 x_1 \\ x_1 & 0 & -x_1 x_1 \end{bmatrix} \begin{bmatrix} p_1 \\ p_2 \\ p_3 \end{bmatrix}$$

_ = little

$$x_1 p_2^T - (y_1 x_1) p_3^T = 0$$

$$x_1 p_1^T - (x_1 x_1) p_3^T = 0$$

According to the statement given previously ...

$$x_i = \alpha P X_i = \alpha \begin{bmatrix} p_1^T \\ p_2^T \\ p_3^T \end{bmatrix} X_i = \alpha \begin{bmatrix} p_1^T X_i \\ p_2^T X_i \\ p_3^T X_i \end{bmatrix}$$

Therefore:

$$x_1 p_2^T - (y_1 x_1) p_3^T = 0$$

$$x_1 p_1^T - (x_1 x_1) p_3^T = 0$$

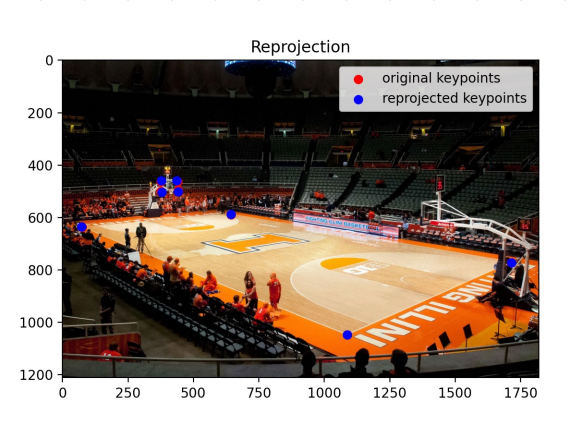
$$y_1 - y_1 \times 1 = 0$$

$$x_1 - x_1 \times 1 = 0$$

$$0 = 0$$

$$0 = 0$$

5 b)


Reprojection
original keypoints
reprojected keypoints
0
200
400
600
800
1000
1200
0
250
500
750
1000
1250
1500
1750

5c)

1) We would only need 6 points, to give 12 equations, to find the 12 variables.

2) No since the same z values would leave some columns of A the same values, and solving for $\begin{bmatrix} p_1 \\ p_2 \\ p_3 \end{bmatrix}$ would give an infinite amount of possible solutions. We need points to span the space of all 3 orthogonal basis vectors.

6)