HW4 Question 4:

The CTW doesn't make sense from my camera calibration, as:

1. The original projection:

   Using the HW3 results, my calibrated camera intrinsic matrix is:

```
M_int = np.array([[-100,   0,  200],
                  [   0, 100,  200],
                  [   0,   0,    1]])
```

   Location and motion of the camera is:

```
Rc_0 = rotation_matrix_C(0, 0, 0)
C_0 = np.array([[0, 0, -10]])
```

   Final camera matrix is:

```
M = [ [-1.e+02  0.e+00  2.e+02  2.e+03]
      [ 0.e+00  1.e+02  2.e+02  2.e+03]
      [ 0.e+00  0.e+00  1.e+00  1.e+01]]
```

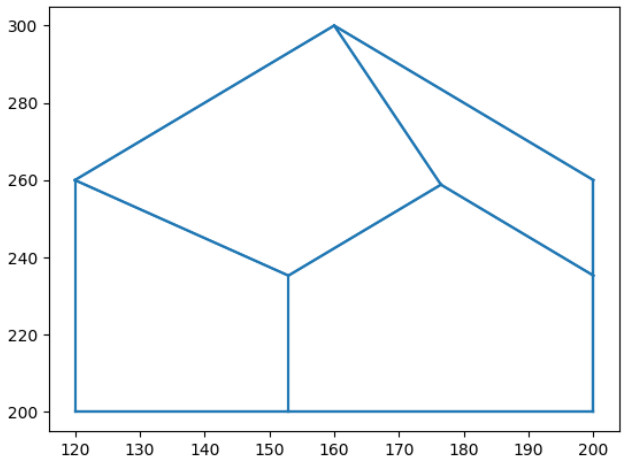
   Selected points in world coordinates are:

```
world_coords = np.array([
    [0, 0, 0],
    [8, 0, 0],
    [8, 6, 0],
    [4, 10, 0],
    [0, 6, 0],
    [0, 0, 7],
    [8, 0, 7],
    [8, 6, 7],
    [4, 10, 7],
    [0, 6, 7],
])
```

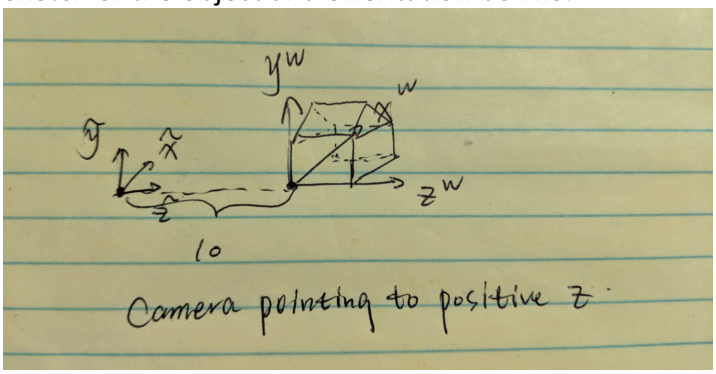
   Projected as pixel coordinates:

```
[[200.         200.        ]
 [120.         200.        ]
 [120.         260.        ]
 [160.         300.        ]
 [200.         260.        ]
 [200.         200.        ]
 [152.94117647 200.        ]
 [152.94117647 235.29411765]
 [176.47058824 258.82352941]
 [200.         235.29411765]]
```

The final image is (drawn by Line2D function):



Sketch of the object and orientation be like:



2. The reprojection:
   Camera matrix is calculated as

```
Camera Matrix M
[[ 1.10472383e-01  1.41114070e-02  8.19794826e-05 -9.93770606e-01]
 [-7.68159076e-04  4.45572421e-05  1.18398761e-03  2.33376726e-04]
 [ 1.50464256e-04 -1.49815797e-03 -1.90659153e-04 -3.51361994e-03]]
```

   Using svd and QR decomposition introduced in the lectures, I got:

```
R
[[-0.9999749   0.00695323 -0.00136197]
 [-0.00200689 -0.09360362  0.99560752]
 [ 0.0067952   0.99558526  0.09361522]]

K
[[  -9.05180893   83.79499575   21.12957116]
 [  -0.         -656.13866449 -169.93496484]
 [   0.            0.          860.97857633]]

Camera origin w.r.t. world
```

```
[11.17093713 -0.20878466 -0.72363132]
```

It is already deviating from what my original camera pose, rotation matrix and intrinsic matrix.

I tried to reproject the points using the matrices I got, and I got this image with uncertain context below. However it still looks like a house (somehow).