

CS543 Assignment 4

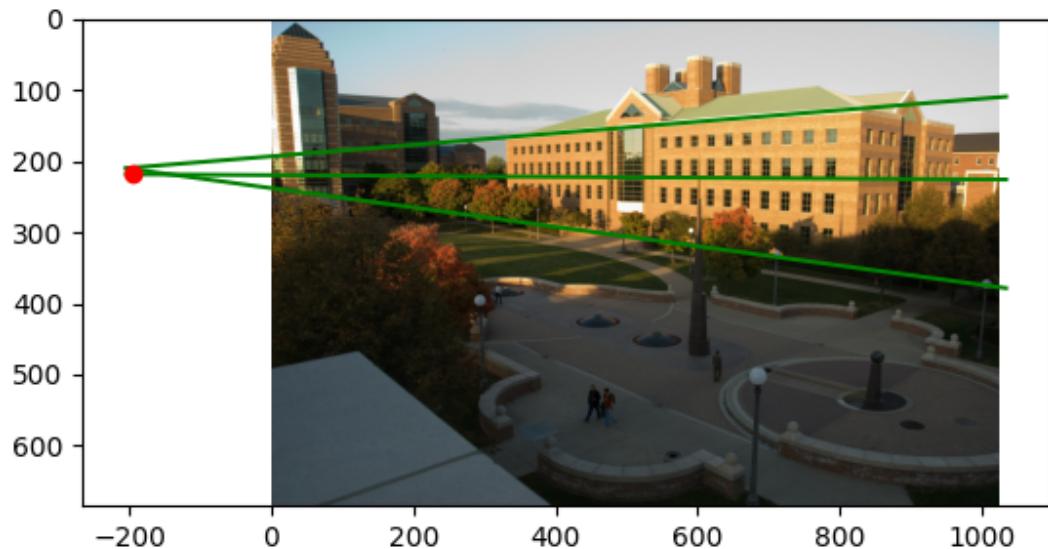
Your Name: Karan Pandya

Your NetId: karandp2

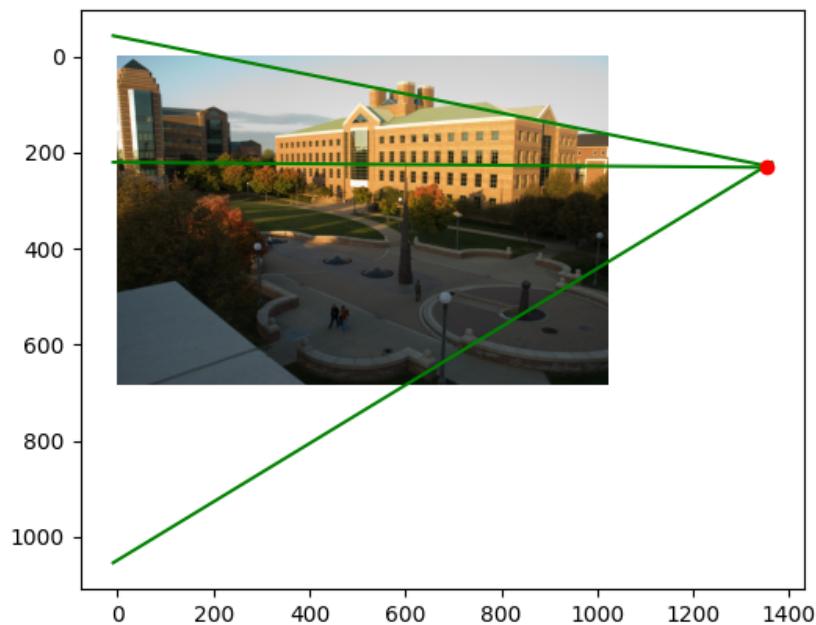
Part 1 Single-View Geometry:

Plot the VPs and the lines used to estimate them on the image plane using the provided code.

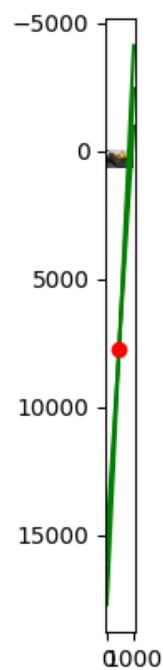
VP1



VP2



VP3



Specify the VP pixel coordinates.

$$VP[i] = Col[i]$$

```
vpts is [[-1.69666667e+02 1.37000000e+03 4.13333333e+01]
[ 2.14333333e+02 2.07666667e+02 1.51116667e+04]
[ 1.00000000e+00 1.00000000e+00 1.00000000e+00]]
```

Plot the ground horizon line and specify its parameters in the form $a * x + b * y + c = 0$. Normalize the parameters so that: $a^2 + b^2 = 1$.



Horizon Line Parameters(Normalized):

```
get horizon param:
[ 4.32990096e-03 9.99990626e-01 -2.13596684e+02]
```

Using the fact that the vanishing directions are orthogonal, solve for the focal length and optical center (principal point) of the camera. Show all your work.

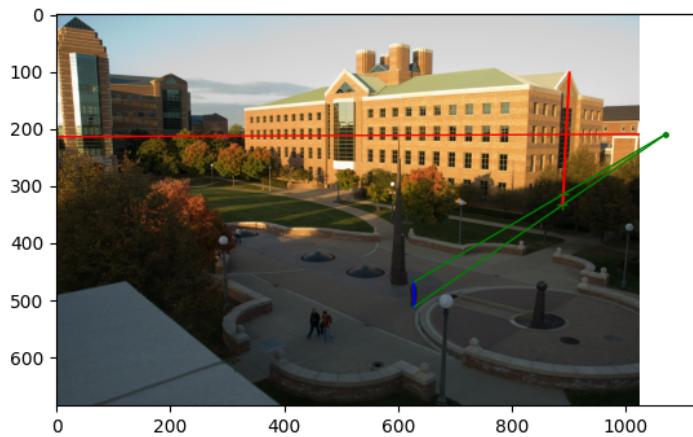
```
focal length: 451.559448315524
optical center x: -23.1146790884542
optical center y: 227.398197854866
```

Compute the rotation matrix for the camera.

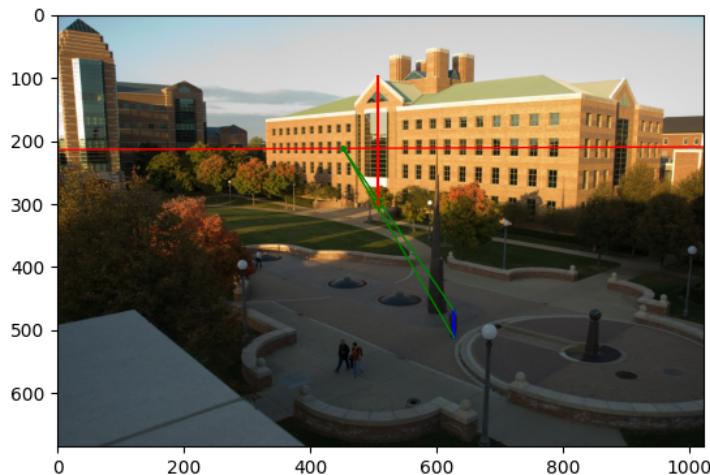
```
rotation matrix: [[ 0.95118888  0.00432791 -0.30857898]]
```

Using the interface, construct the lines on the image that establish that the two gables on the CSL building are the same height. In your report, explain why these lines do so.

Gable 1 height wrt person1 :1442 units



Gable 2 height wrt person 1: 1458 units

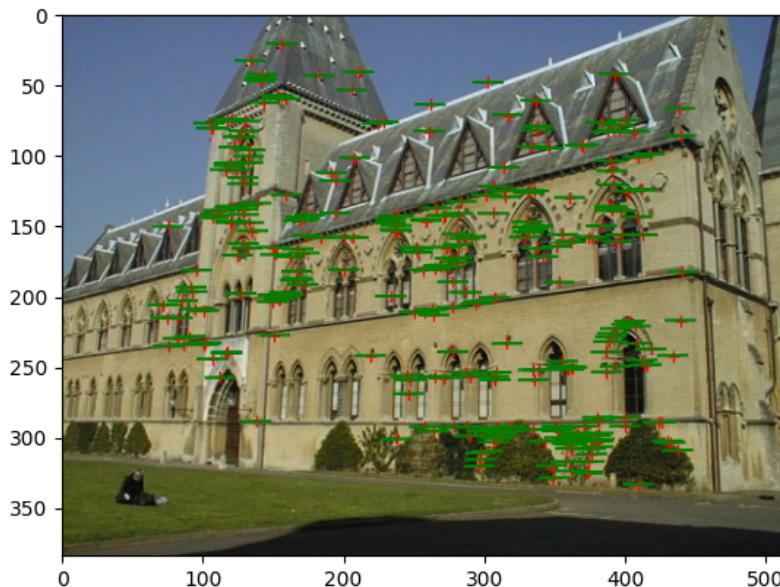


By comparing the two gables individually wrt to the person we can say that they are of the same height (slight height difference is because of pixel selection). We can also calculate the actual height of the gable, assuming the person is 6ft, the actual height of the gable will be 87 feet.

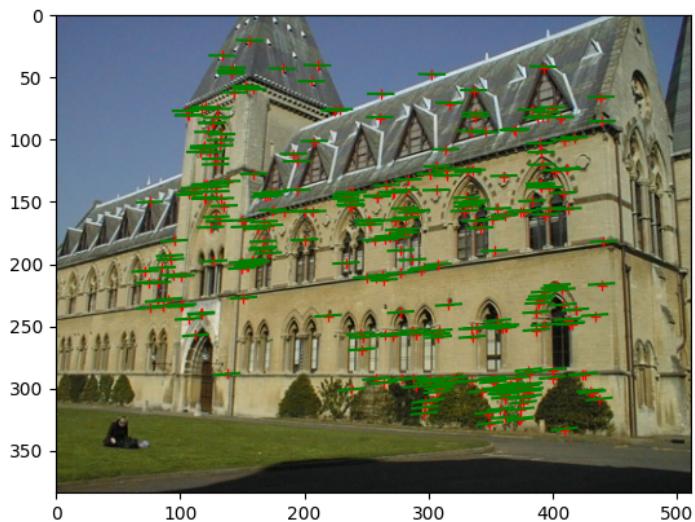
Part 2 Fundamental Matrix Estimation, Camera Calibration, Triangulation:

For the lab and library image pairs, display your result (points and epipolar lines) and report your residual for both unnormalized and normalized fundamental matrix estimation.

Lib_normalized :residual = 0.183



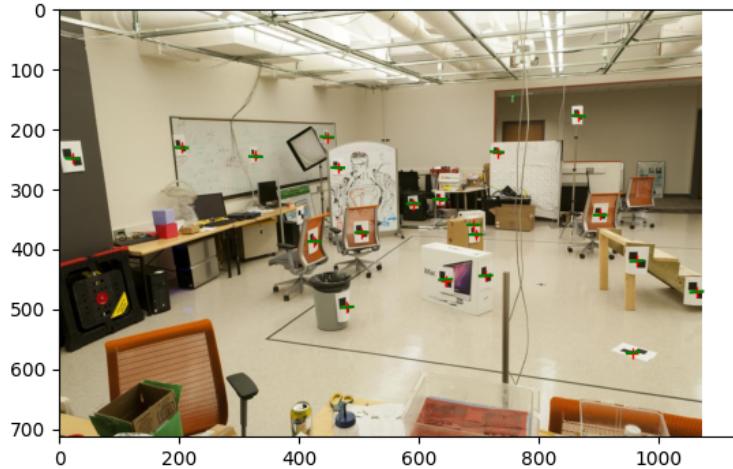
Lib_unnormalized :residual = 0.33



Lab_unnormalized :residual = 2.23



Lab_normalized :residual = 0.617



For the lab image pair, show your estimated 3×4 camera projection matrices. Report the residual between the projected and observed 2D points.

Estimated camera projection matrix for lab1 is:

```
[[-3.09971524e-03 -1.46250174e-04  4.48354919e-04  9.78974905e-01]
 [-3.06744636e-04 -6.36810842e-04  2.77389022e-03  2.03932211e-01]
 [-1.67995219e-06 -2.74565792e-06  6.83395792e-07  1.32842138e-03]]
```

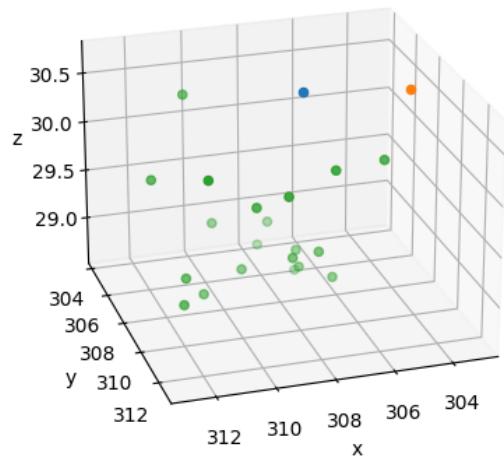
Estimated camera projection matrix for lab2 is:

```
[[-6.88970692e-03  3.96429852e-03  1.39263702e-03  8.28289829e-01]
 [-1.53909600e-03 -1.02084411e-03  7.22962251e-03  5.60181867e-01]
 [-7.58603647e-06 -3.72293087e-06  2.03836990e-06  3.38133189e-03]]
```

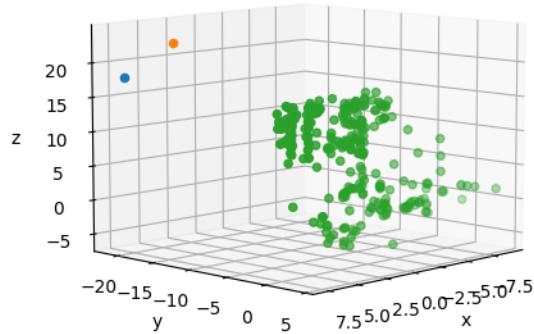
```
The residual between the projected and observed 2D points for lab1 is: 13.765
The residual between the projected and observed 2D points for lab2 is: 17.781
```

For the lab and library image pairs, visualize 3D camera centers and triangulated 3D points.

LAB_3D:



Library 3D:

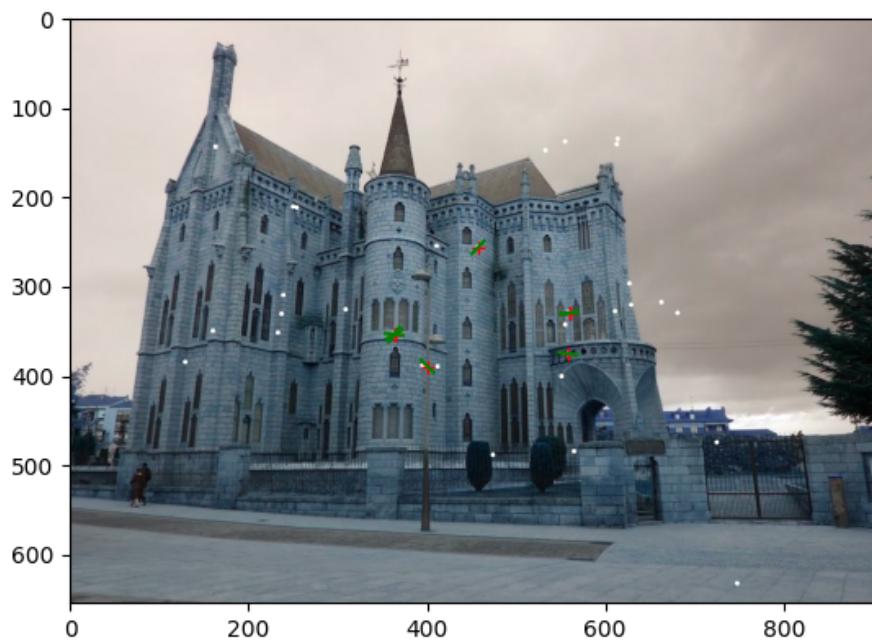


For the house and gaudi image pairs, display your result and report your number of inliers and average inlier residual for normalized estimation without ground truth matches.

Gaudi Inliers: (No. of inliers - 34)



Gaudi Normalized: $\text{residual} = 1.1040981784116166\text{e-}06$

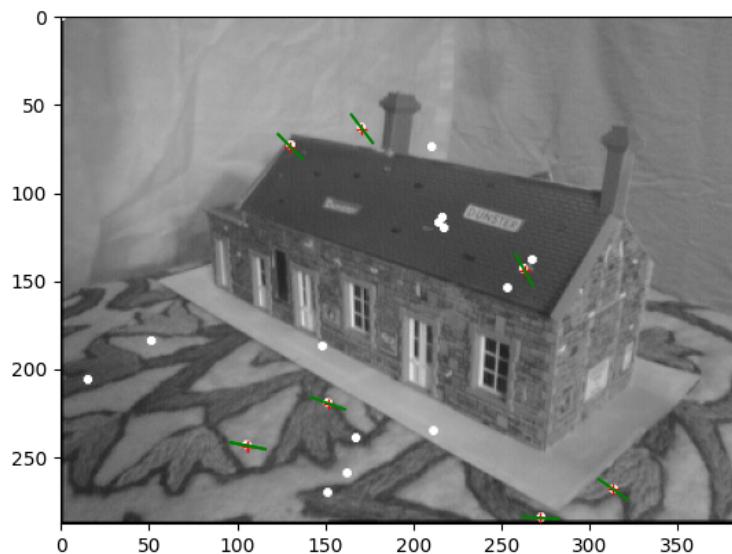


House inliers: (No. of inliers: 21)



House Normalized:

residual = 0.00036



Extra Credit:

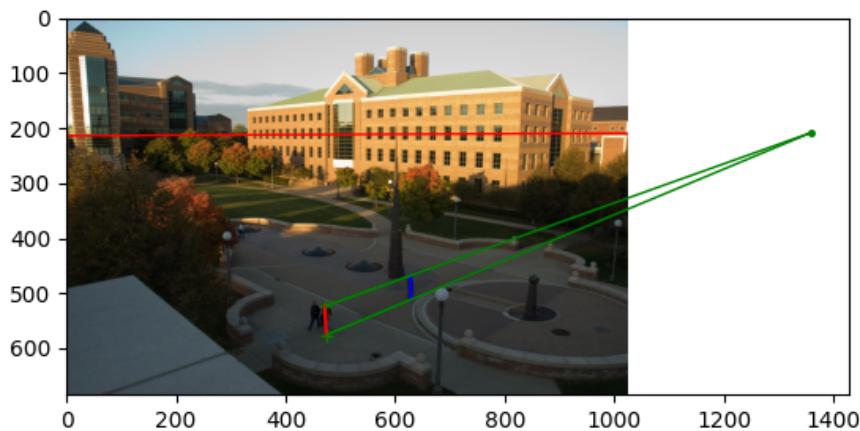
Part 1:

Perform additional measurements on the image: which of the people visible are the tallest? What are the heights of the windows?

Part 1: Person height comparison using person 1 as reference (100 units). Person one is the person near the spike structure.

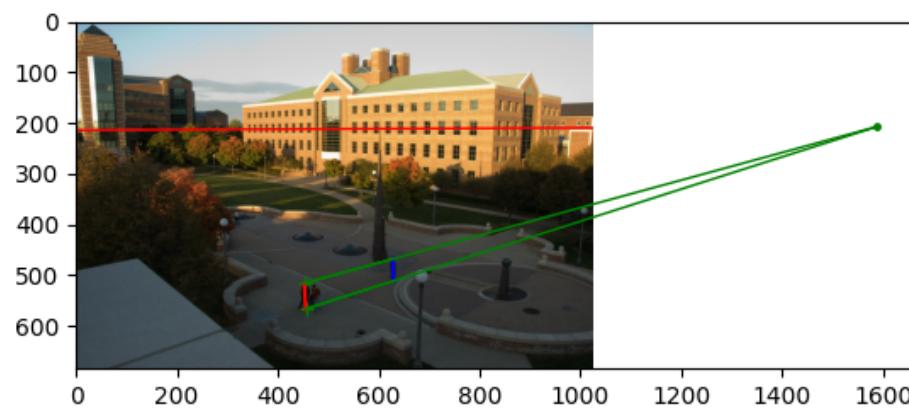
Height of Person 2 (red) w.r.t Person 1 (reference= 100 units) (blue)

Height of person2 is 102.5035977267842



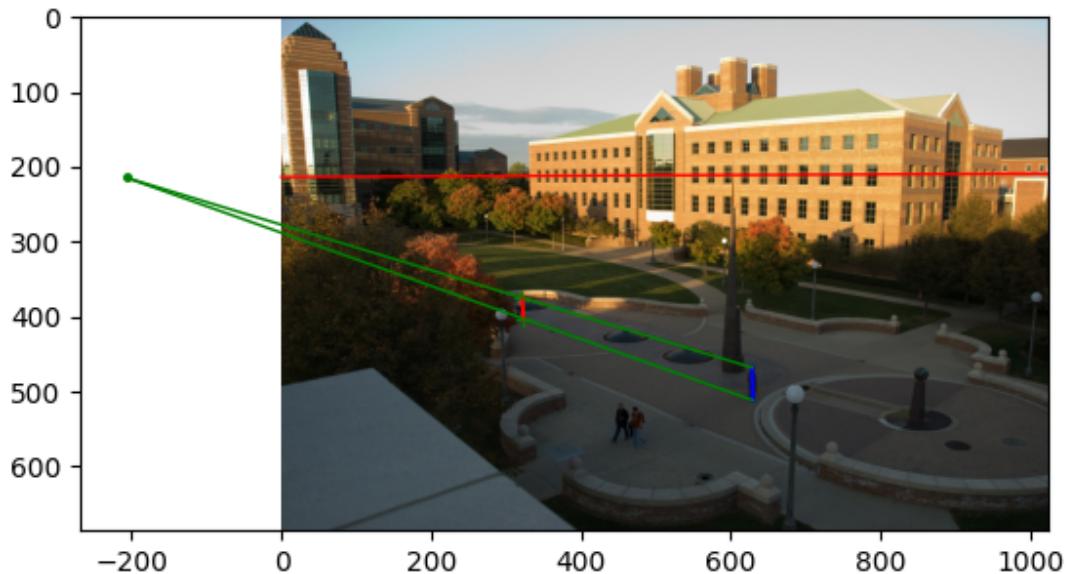
Height of Person 3 (red) w.r.t person 1(blue):

Height of person3 is 97.88790407203575



Height of person 4(red) wrt person 1 (blue):

Height of person4 is 100.51281238392285



From the results, we can say that Person 2 is the tallest among all!

Height of window: 268 units wrt person 1 (100 units)

Actual height of window = $6 \times 2 = 12$ ft (assuming person 1 is 6ft)

