CS 4476 Project 3

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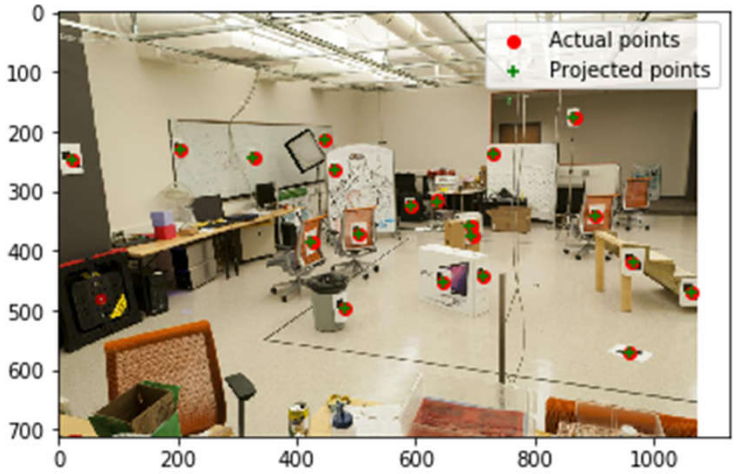
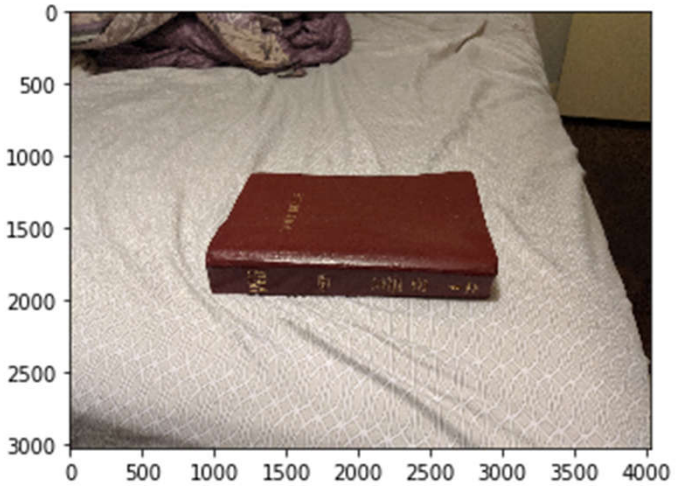
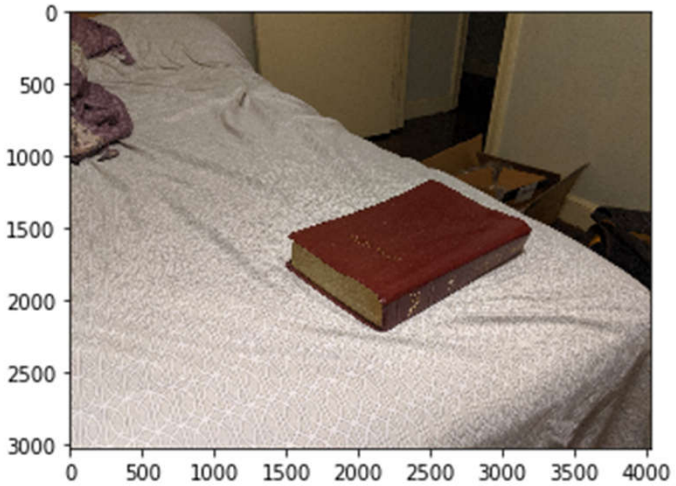
Part 1: Projection Matrix

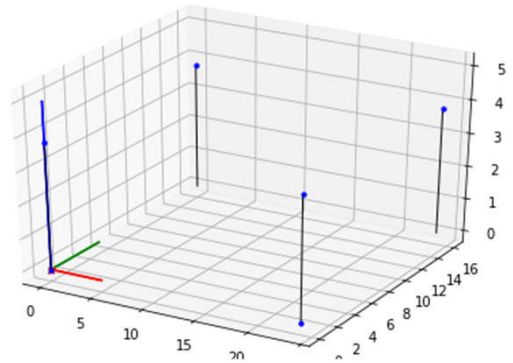
<insert visualization of projected 3D points and actual 2D points for image provided by us here>

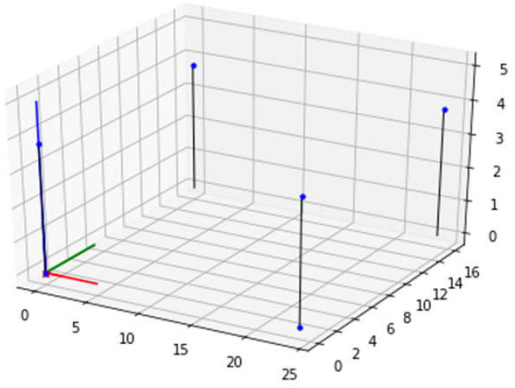


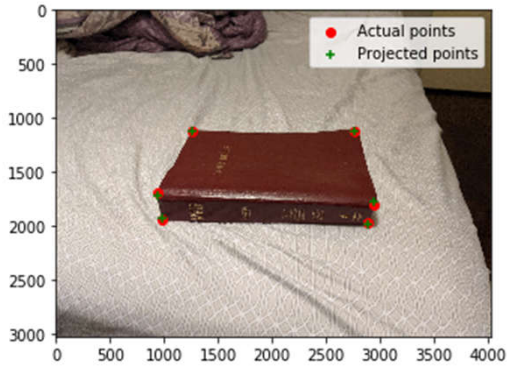


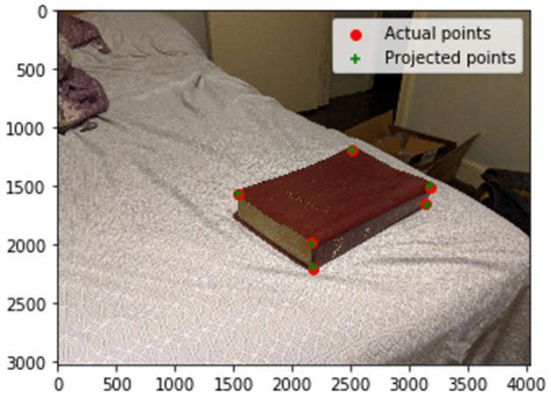


Part 1: Projection Matrix



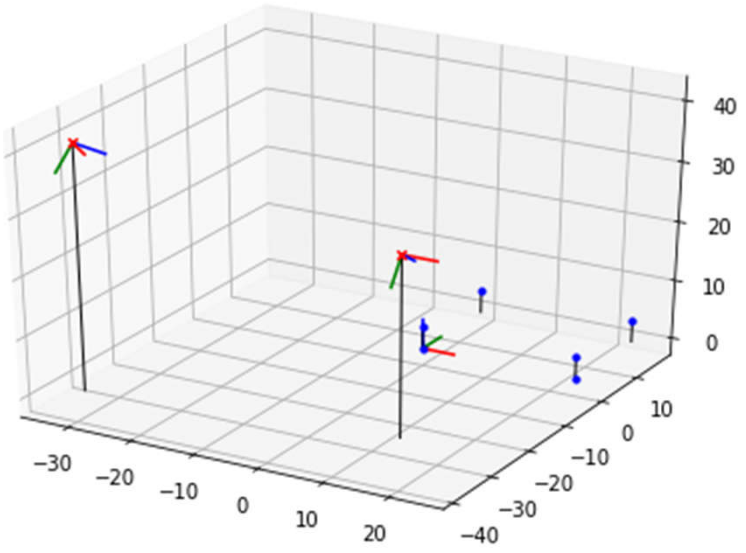






Part 1: Projection Matrix

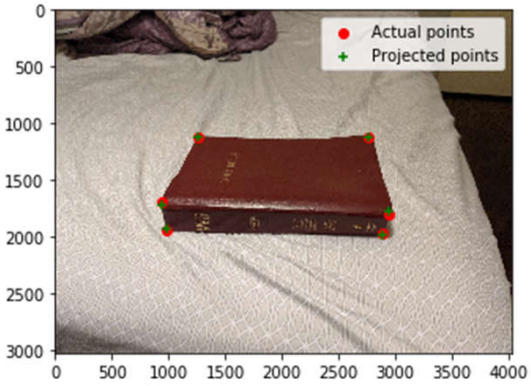
<insert visualization of both camera poses here>

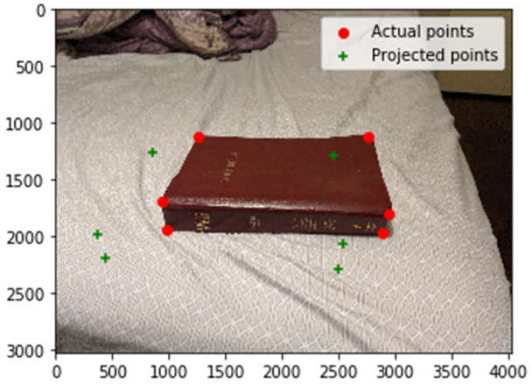


Part 1: Projection Matrix

<your answers and images for the report questions>

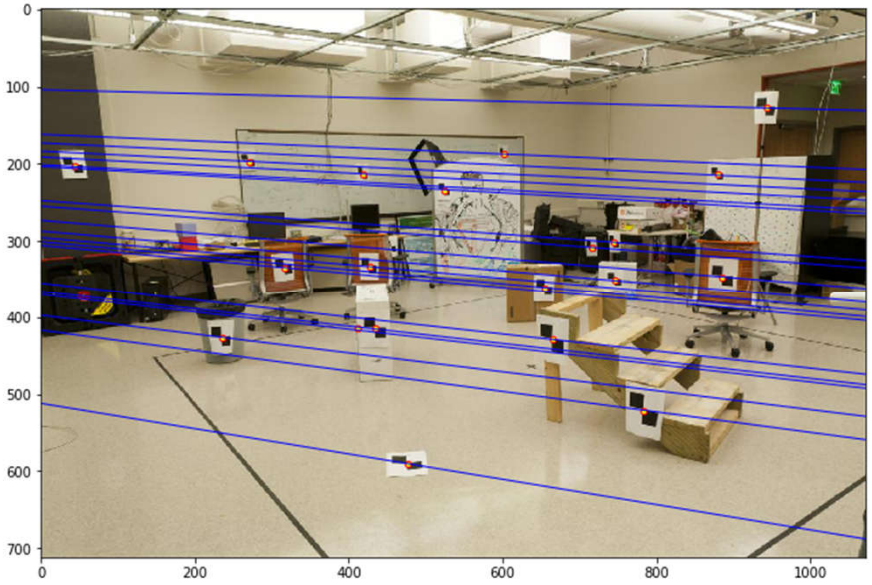
- The projected points will be shifted in the negative direction where the coordinates is increased or decreased.
- Yes.



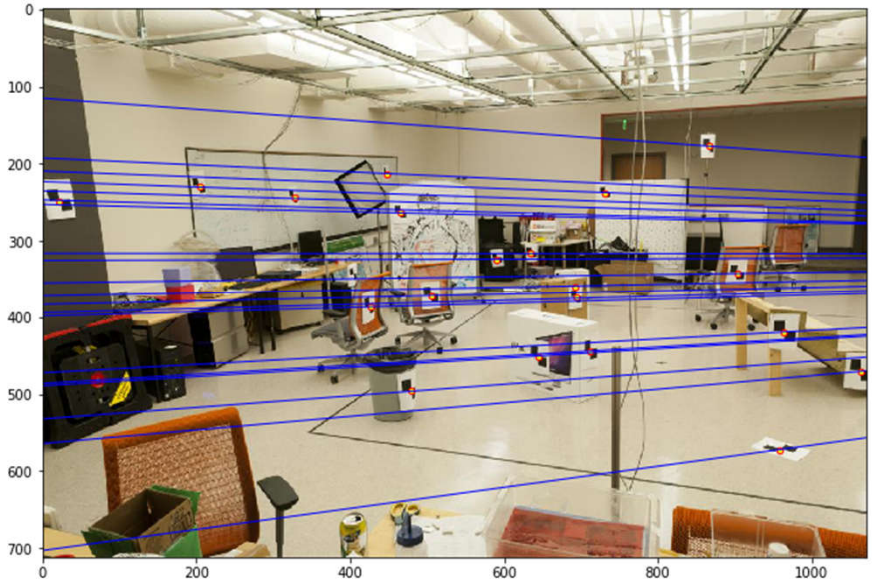


Part 2: Fundamental Matrix Estimation

Room: Left Image with Epipolar Lines



Room: Right Image with Epipolar Lines



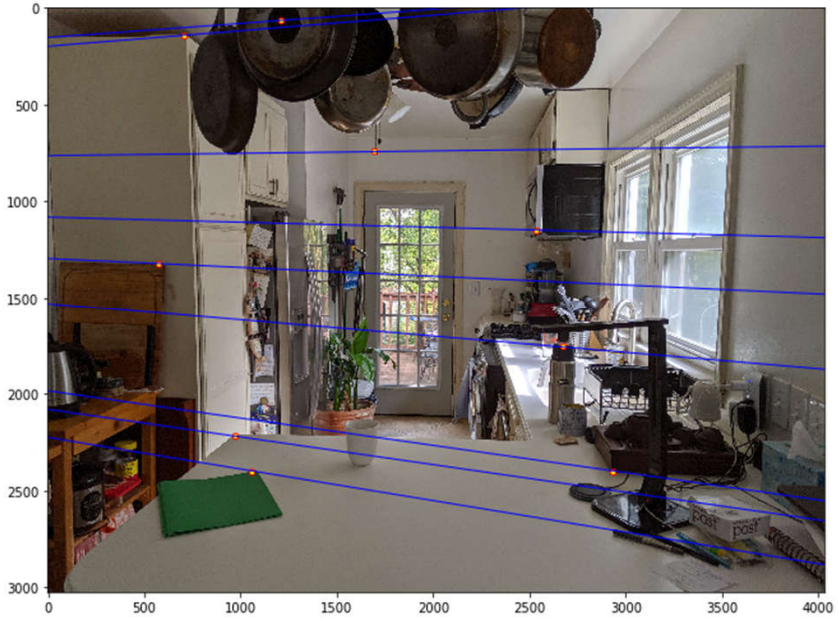
Part 2: Fundamental Matrix Estimation

Fundamental Matrix Estimation Result:

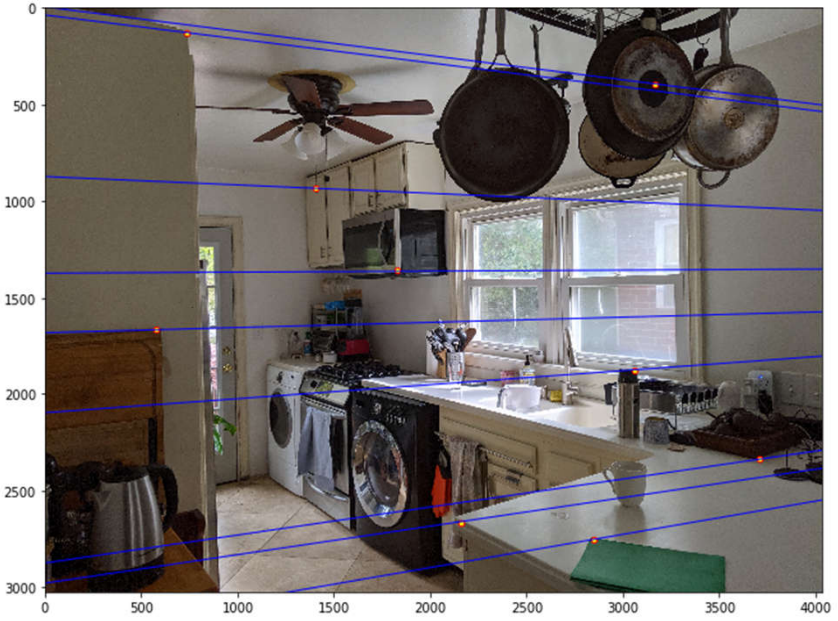
```
[[-2.92047686e-06  3.08884896e-05 -7.58137612e-04]
 [ 4.54276184e-05 -8.05155314e-06 -1.24796647e-01]
 [-1.15939390e-02  9.10719749e-02  2.97402466e+00]]
```

Part 2: Fundamental Matrix Estimation: Your Images

Your Image: Left Image with Epipolar Lines



Your Image: Right Image with Epipolar Lines



Part 2: Fundamental Matrix Estimation: Your Image

Fundamental Matrix Estimation Result:

```
[[ 1.32837086e-08  9.99584811e-07 -1.09239860e-03]
 [ 1.21870922e-06 -4.14774816e-07 -1.27132014e-02]
 [-1.37794412e-03  9.02561807e-03  2.20650458e+00]]
```

Part 2: Reflection Questions

1. The epipole will be in the exact same location for the 2 image in this case.

2. It is not possible to determine depth of the point in the 2nd image. Therefore, it must be represented as a line

3. The epipolar lines will intersect in the image at the epipole, which is the camera center within the image. This is because epipolar line represent the view from the other camera, and it all begins from the camera center.

4. It means that the image planes are parallel.

5. The image scale is not changed when moving location. Therefore, F is defined up to scale.

6. Fundamental matrix maps a 2d plane in image 1, into a 1d line in image 2. Therefore, it must be rank 2.

Part 2: Extra Credit: Fundamental Matrix Song

Reflect on the Fundamental Matrix Song

<write a couple sentences about the Fundamental Matrix Song and what you learned>

Link here: https://www.youtube.com/watch?v=DgGV3l82NTk

I personally found the song quite interesting. It manages to compress a lot of information into 2 minutes. However, it is relatively hard to understand without constantly pausing as there is just so much information packed into it.

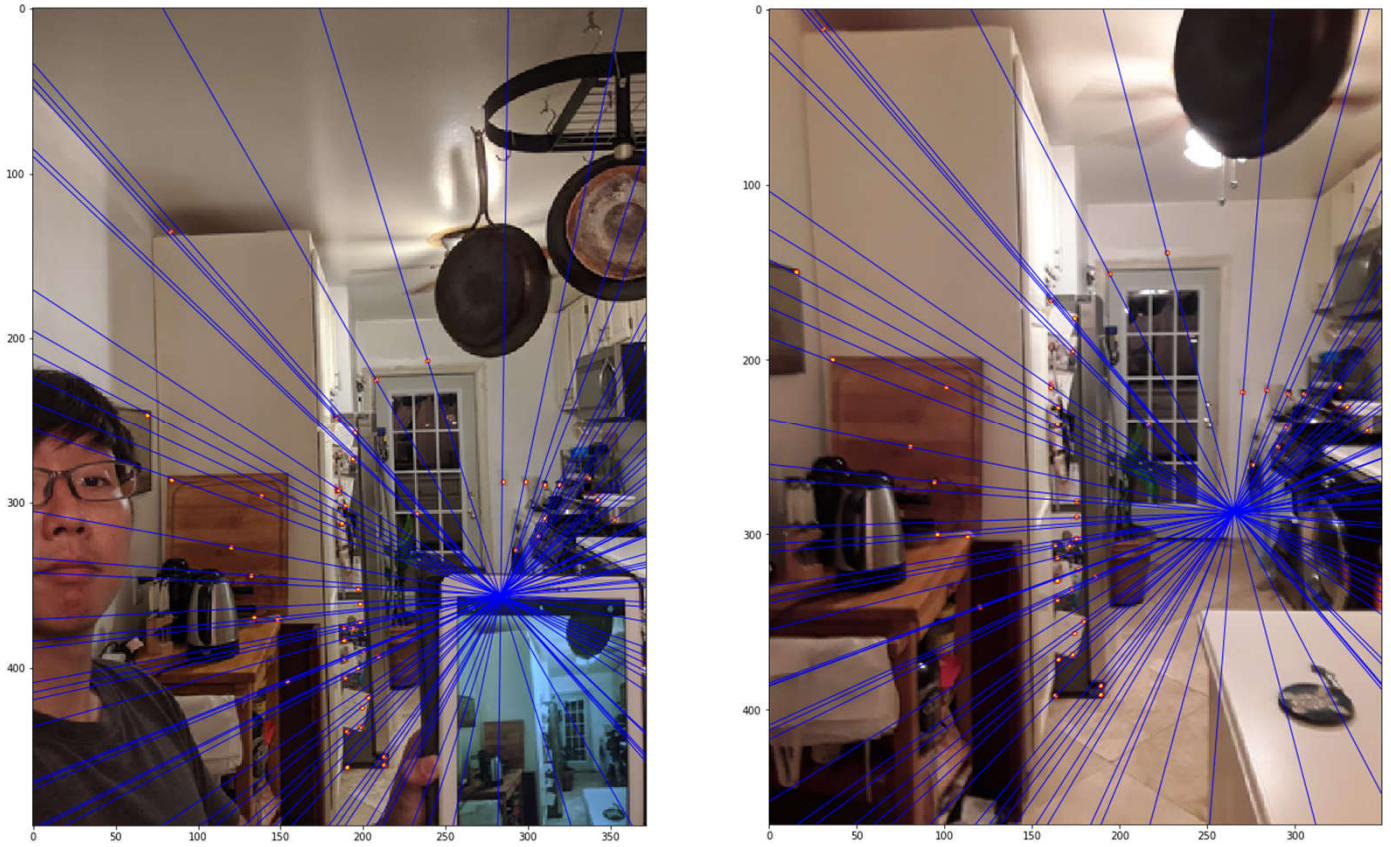
One thing I learned from the song is that the left and right nullspace of F is actually the epipoles.

Part 3: RANSAC Iterations Questions

Delete the questions and type your answers to the three RANSAC Iterations questions from the jupyter notebook below:

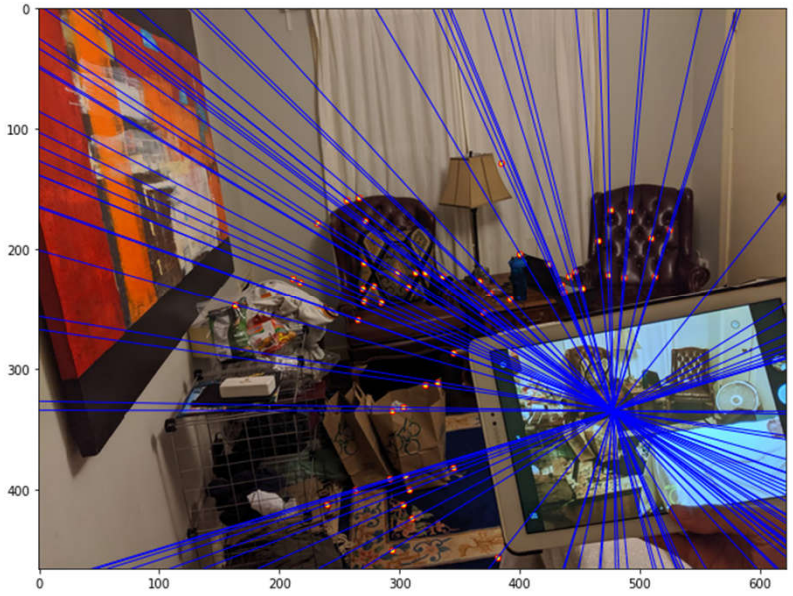
1. Assuming sample size of 9, number of iterations = 14
2. 42
3. For sample size 9, number of iterations = 167. For sample size 18, number of iterations = 4238

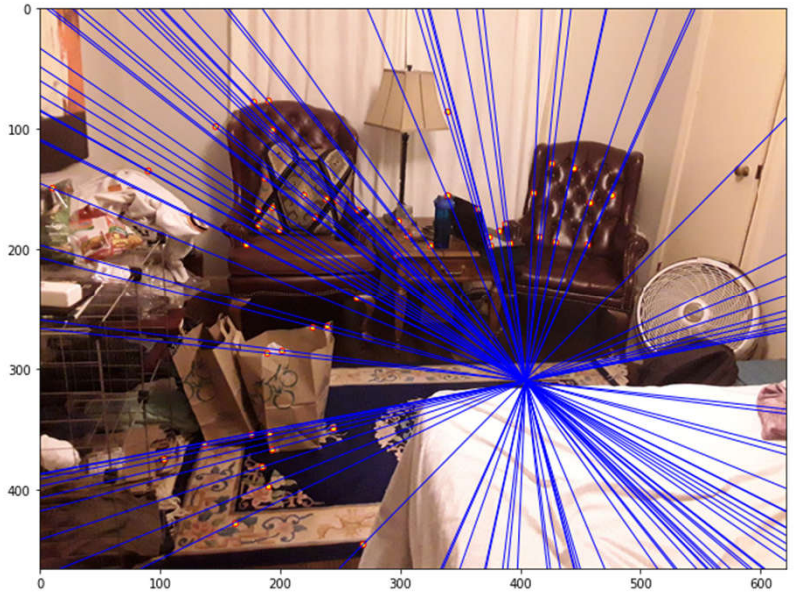
Part 3: RANSAC Implementation



Part 3: RANSAC Extra Credit!!!

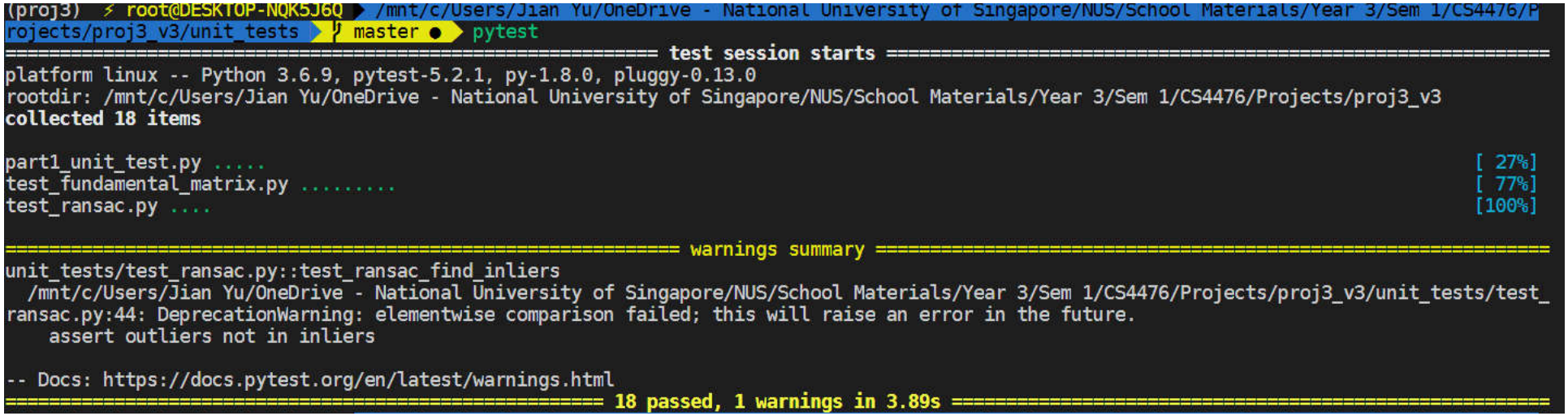
Paste a *second* image pair that *you created* demonstrating the use of your RANSAC algorithm in a *different* environment, and reflect on how your code relates to the RANSAC song. https://www.youtube.com/watch?v=1YNjMxxXO-E





Tests

<Provide a screenshot of the results when you run `pytest` from the unit tests directory with your final code implementation (note: we will re-run these tests).>



Conclusions

<Describe what you have learned in this project. Feel free to include any challenges you ran into.>

I have learnt how to perform image alignment given 2 images with different camera center. I also now better understand the purpose of the fundamental matrix and how it works.

The challenges I faced in this project mainly stem from the fact that I have not yet understood the concepts fully. Thanks to the vast amount of information online, and helps from the TAs, I was able to finish this project successfully.

Code results (do not modify this slide!)

Part 1

Part 2

Part 3