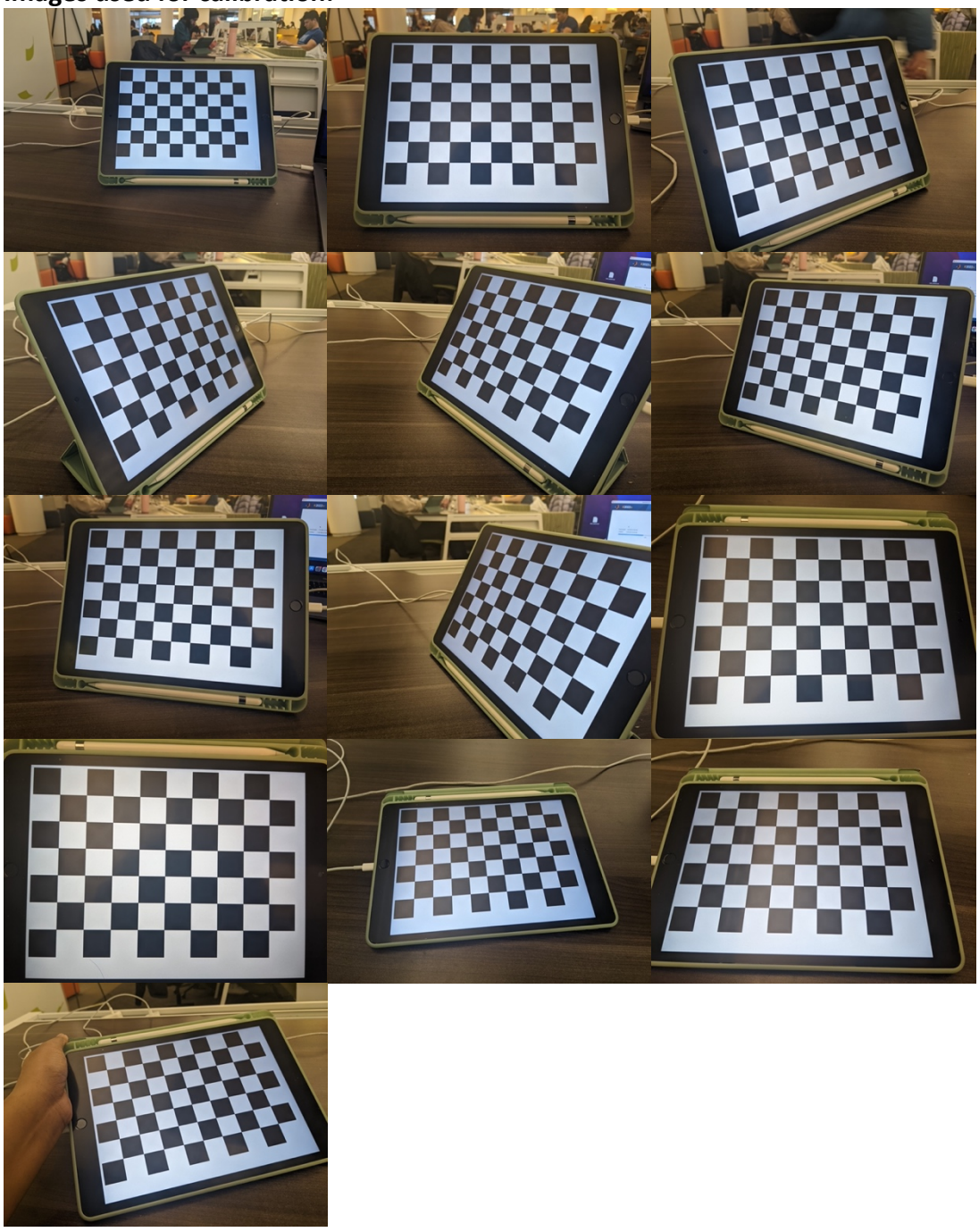
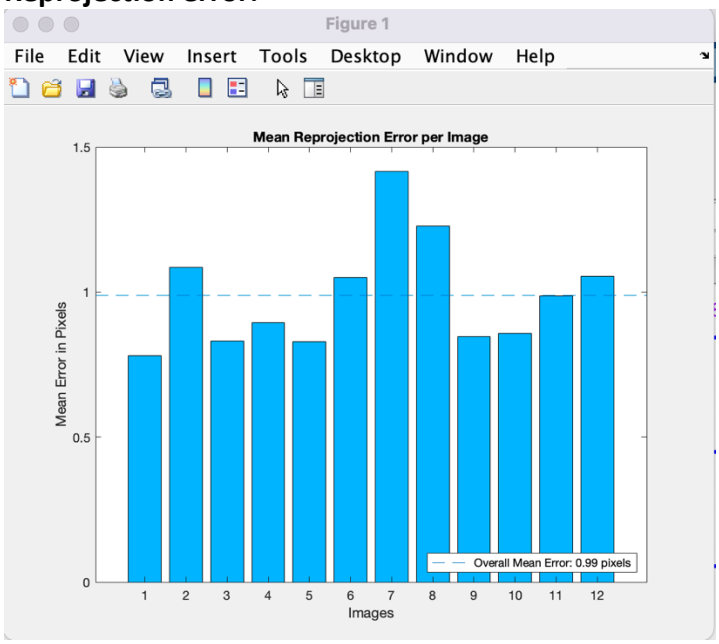
Lab 5
Camera Calibration and Photomosaicing

Part 2: Camera Calibration

Images used for calibration:



Reprojection error:



Calibration parameters:

```
Intrinsics
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Focal length (pixels):    [ 3227.1385 +/- 3.7332     3223.5869 +/- 3.5317  ]
Principal point (pixels):[ 1940.3806 +/- 1.3782     1509.9627 +/- 2.1845  ]
Radial distortion:        [    0.1164 +/- 0.0028       -0.3455 +/- 0.0103  ]

Extrinsics
----------
Rotation vectors:
                         [   -0.1774 +/- 0.0009      -0.0015 +/- 0.0007       0.0042 +/- 0.0002  ]
                         [   -0.1108 +/- 0.0008      -0.4115 +/- 0.0007      -0.2405 +/- 0.0002  ]
                         [    0.0031 +/- 0.0007      -0.7356 +/- 0.0006      -0.4744 +/- 0.0003  ]
                         [   -0.1009 +/- 0.0009       0.6923 +/- 0.0007       0.4513 +/- 0.0003  ]
                         [   -0.1161 +/- 0.0011       0.1511 +/- 0.0008       0.0627 +/- 0.0002  ]
                         [   -0.0913 +/- 0.0009       0.8545 +/- 0.0007       0.4578 +/- 0.0003  ]
                         [   -0.2538 +/- 0.0007      -0.0582 +/- 0.0005      -0.0083 +/- 0.0001  ]
                         [   -0.0302 +/- 0.0007      -0.0384 +/- 0.0005       0.0156 +/- 0.0001  ]
                         [   -0.4814 +/- 0.0009      -0.0457 +/- 0.0007      -0.0833 +/- 0.0002  ]
                         [   -0.4347 +/- 0.0007       0.0247 +/- 0.0005       0.0180 +/- 0.0002  ]
                         [   -0.4131 +/- 0.0008      -0.0769 +/- 0.0007      -0.2232 +/- 0.0002  ]
                         [   -0.2096 +/- 0.0015      -0.0057 +/- 0.0013       0.0124 +/- 0.0003  ]

Translation vectors (centimeters):
                         [   -7.1933 +/- 0.0111      -6.7535 +/- 0.0173      26.6791 +/- 0.0313  ]
                         [   -7.4364 +/- 0.0112      -4.2957 +/- 0.0165      24.6544 +/- 0.0300  ]
                         [   -5.7409 +/- 0.0097      -4.2843 +/- 0.0142      21.2818 +/- 0.0276  ]
                         [    0.3419 +/- 0.0142     -10.4200 +/- 0.0225      33.2460 +/- 0.0336  ]
                         [   -5.9764 +/- 0.0120      -7.7937 +/- 0.0192      29.5439 +/- 0.0342  ]
                         [    1.4658 +/- 0.0138      -8.0435 +/- 0.0217      32.0951 +/- 0.0310  ]
                         [   -7.0256 +/- 0.0094      -5.0953 +/- 0.0148      22.7596 +/- 0.0266  ]
                         [   -7.4743 +/- 0.0085      -4.9506 +/- 0.0132      19.6688 +/- 0.0233  ]
                         [   -8.2705 +/- 0.0134      -4.8040 +/- 0.0215      32.5845 +/- 0.0376  ]
                         [   -8.9845 +/- 0.0105      -5.2184 +/- 0.0171      26.2370 +/- 0.0301  ]
                         [   -5.7590 +/- 0.0119      -3.7529 +/- 0.0189      28.6519 +/- 0.0335  ]
                         [   -4.3137 +/- 0.0177      -7.7867 +/- 0.0275      41.8513 +/- 0.0504  ]
>>
```
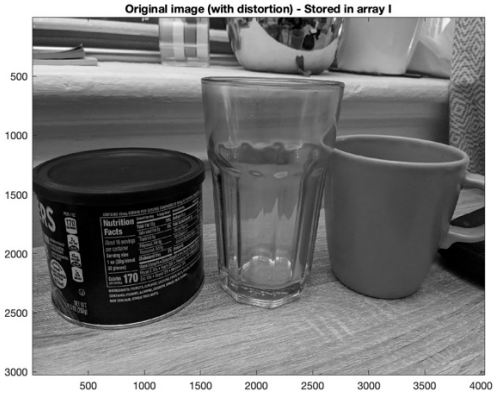
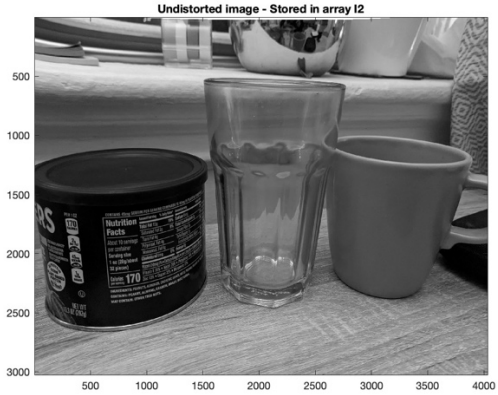
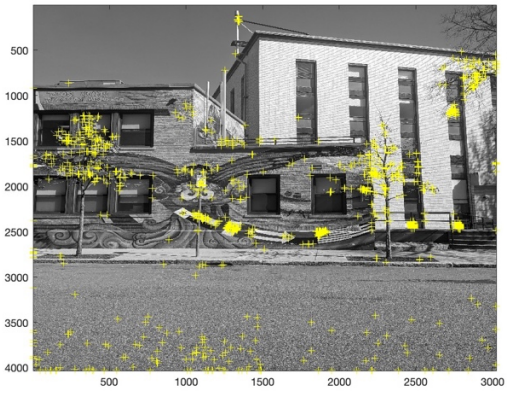

Before and after calibration:





Part 3: Data collection

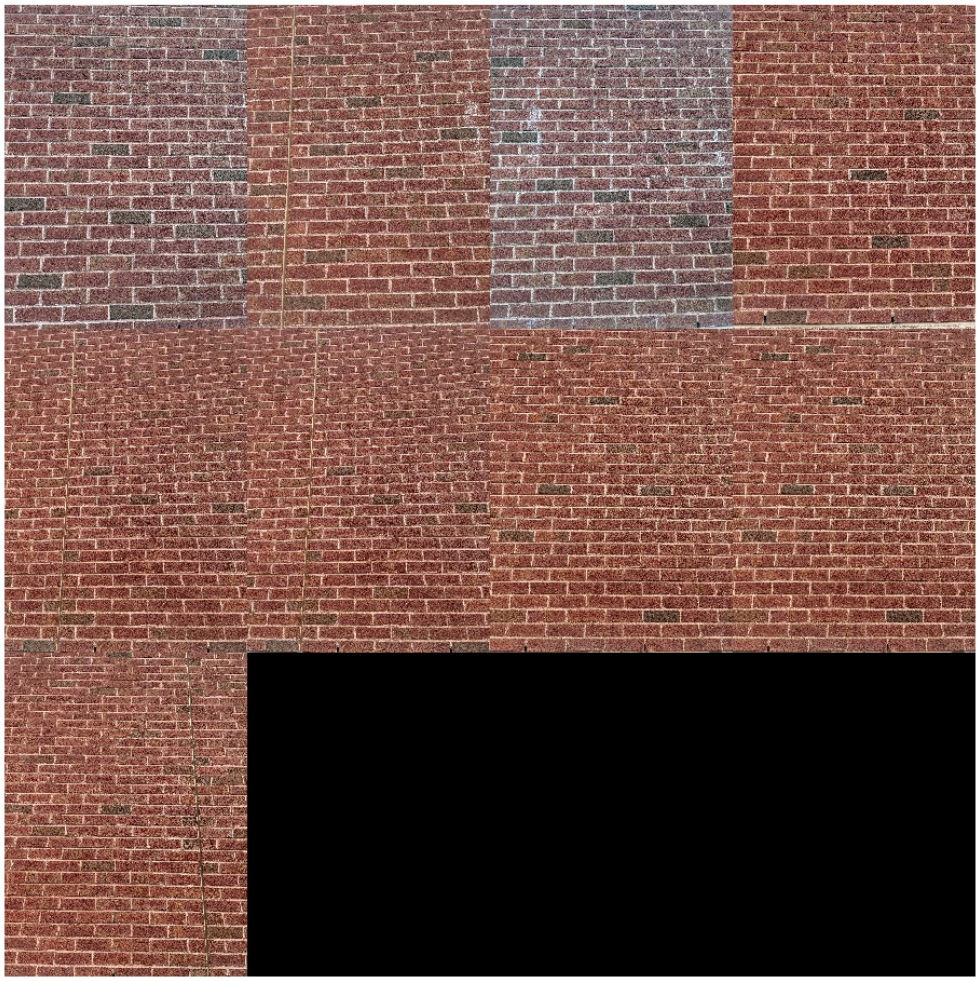
Part 4: Harris Corners across a single (or more) representative set of images



Part 5: Final mosaic

Part 6: Cinder block imagery

Images used:



Error:

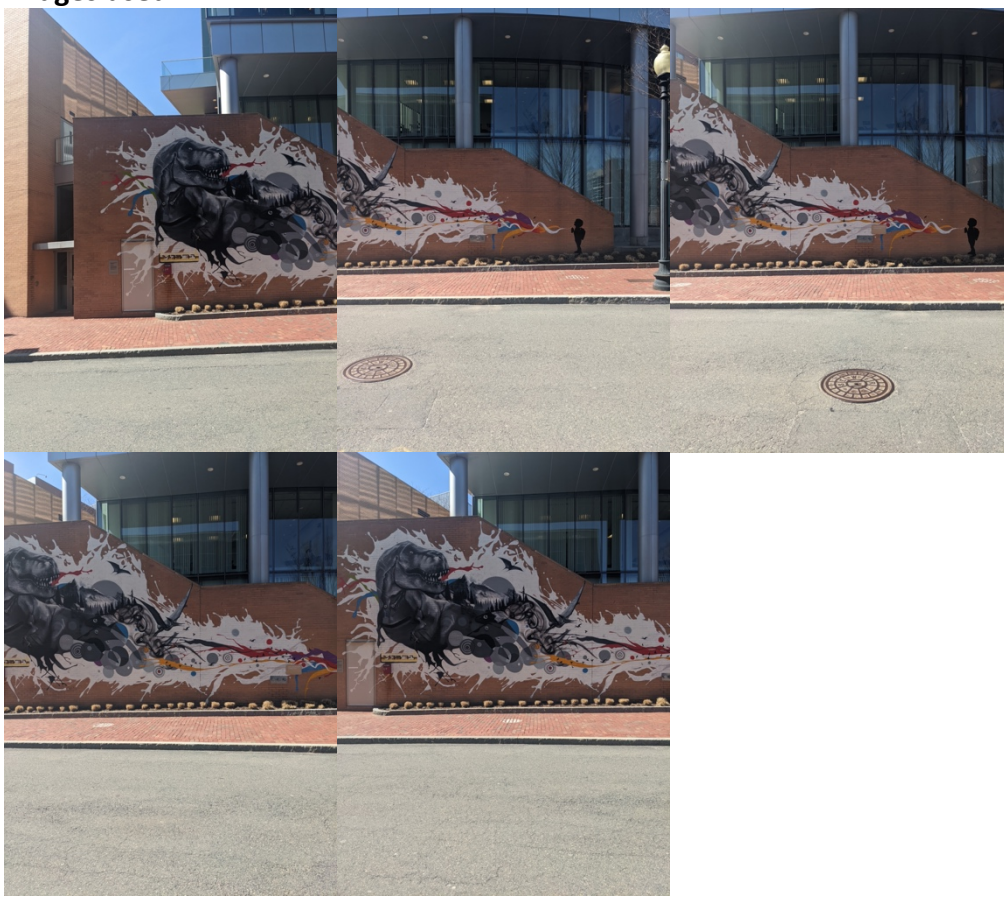
```
Command Window
Error using vision.internal.geotrans.algEstimateGeometricTransform>checkRuntimeStatus
matchedPoints1 and matchedPoints2 do not have enough points. The number of points in each set must be at
least 4.
Error in vision.internal.geotrans.algEstimateGeometricTransform (line 70)
    checkRuntimeStatus(statusCode, status, sampleSize);
Error in estimateGeometricTransform2D (line 152)
    vision.internal.geotrans.algEstimateGeometricTransform(...
Error in lab5_5 (line 58)
    tforms(n) = estimateGeometricTransform2D(matchedPoints, matchedPointsPrev,...
```

The process followed for image stitching involves finding matching features between 2 images, estimating the geometric transformation, and then mapping the image into the panorama image. But as the cinder block images do not have enough distinguishing features to allow us to get matching points and then be able to find the geometric transformation, our code fails. One point would end up getting matched to multiple points given the similarity in the detected features and hence we wouldn't be able to stitch the images

together. This can be resolved by experimenting with other feature detection methods such as Sobel filters or magnitude gradients.

Part 7: Graffiti with 15% overlap

Images used:



Final Panorama/Mosaic: