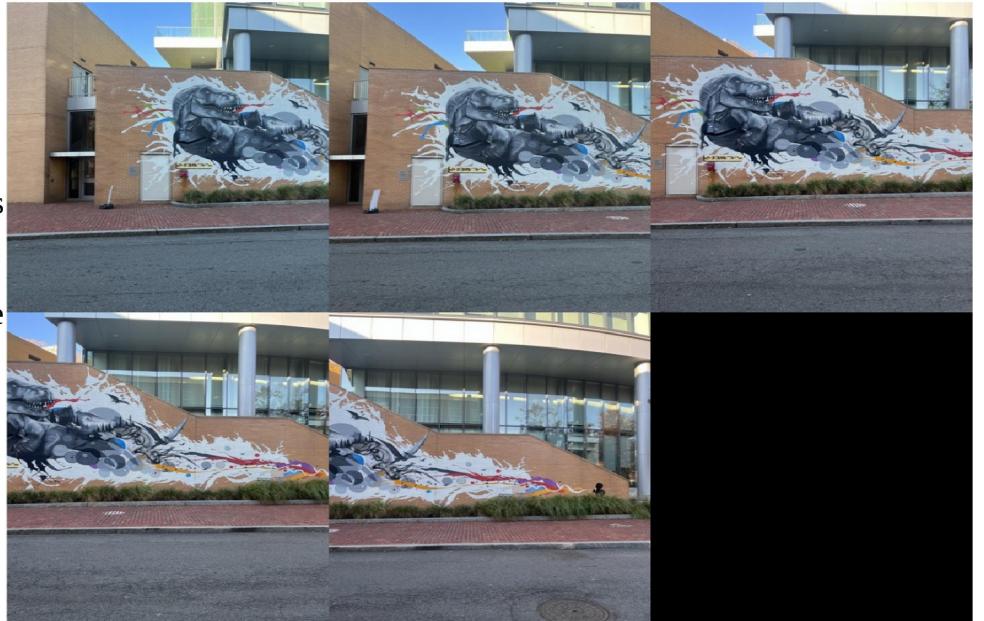


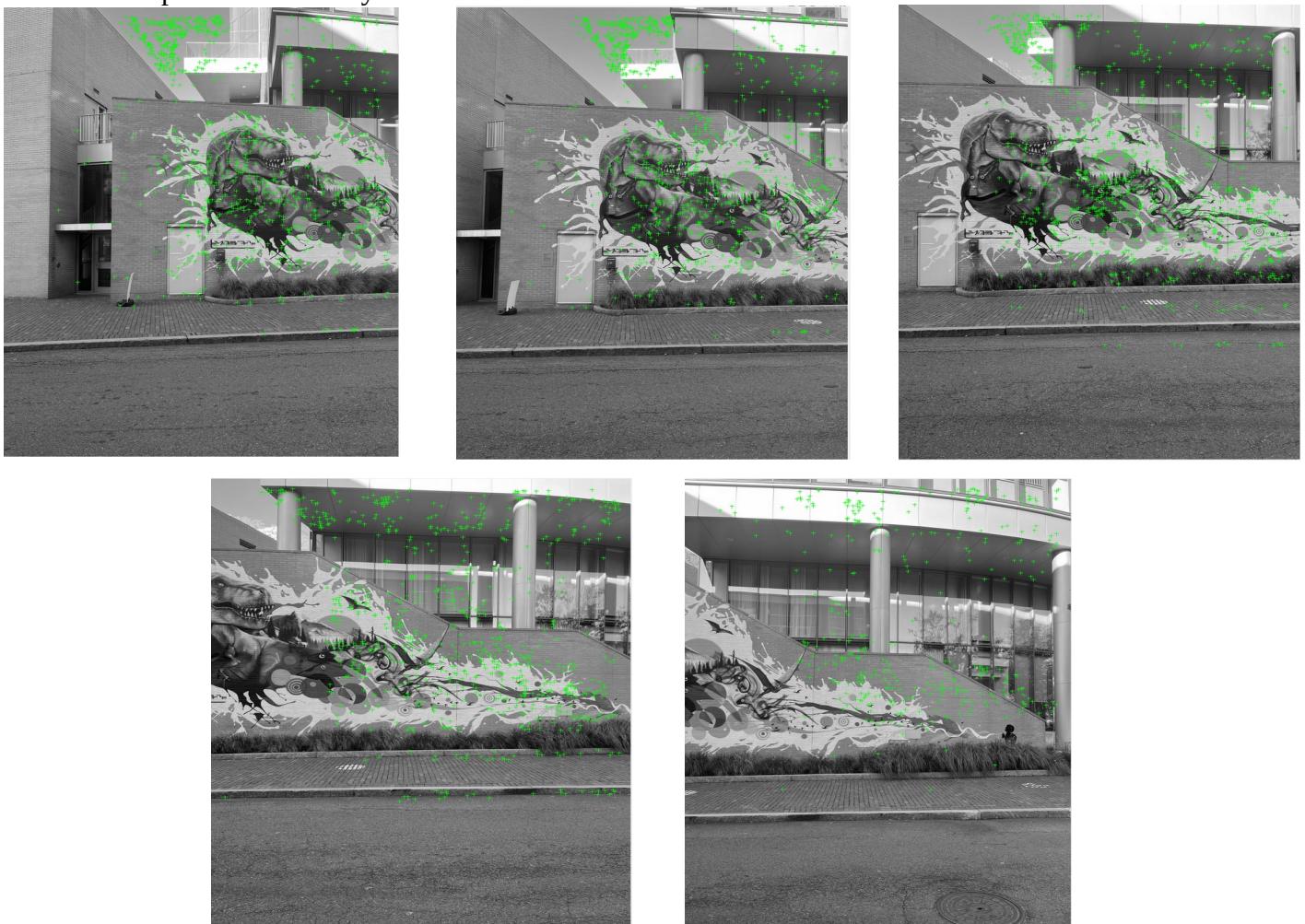
## REPORT

### LSC MOSAIC:

These set of images were taken outside Ryder hall inside Northeastern University campus. Each image is taken 5 feet apart from the succeeding image. We can see overlapping of features (paintings, mural, shapes) in each image which would help us to detect the matching features in the current image and the preceding image so as to map the matching points and generate a panorama of the entire set of image. We used Harris feature to detect corners in an image and try to match the corner points of the current image and preceding image.



Corner points with Harris feature detection is shown below. The green "+" marker on the image shows all the corner points detected by the Harris feature Matlab code.



After detecting the feature and matching the corner points, we created a transformed image consisting of matching points of current image and the preceding image for the entire set and overlayed each transformed image onto each other to generate a panorama of the entire image set as shown below.



To generate such a panorama, the image size was reduced from its original size by 1/20th, the reason for reducing the size is to reduce the number of pixels for the Matlab code to scan the image for Harris corner points detection so that it decreases the processing time of Matlab code and also increases the precision of detecting corners. After reducing the size, 1,50,000 interest points was passed on to Harris feature detection i.e. Harris feature detection function would return 1,50,000 interest points out of which the function could detect only 28,738 corner points and 370 matching points from the preceding image and the current image. We can also see that the function could detect 31554 corner points from the previous image. The above values are mentioned for last two images from the entire set of images shown above. We can estimate values of other images as well from the current example being shown. After detecting the matching points from the current and preceding image, 2D geometric affine transform is created using matching points with 99.9% confidence. Affine transformation is a type of transformation that preserve points, lines, planes. Its a combination of transformation matrix (rotational and position matrix) and translation matrix. This transform is given 3000 max number trials, this values allows the code to make randomized attempts to find matching point pairs. The reason a higher value is mentioned, it increases the likelihood of finding inliers.

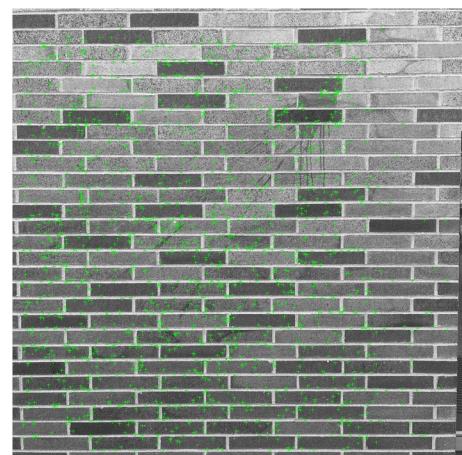
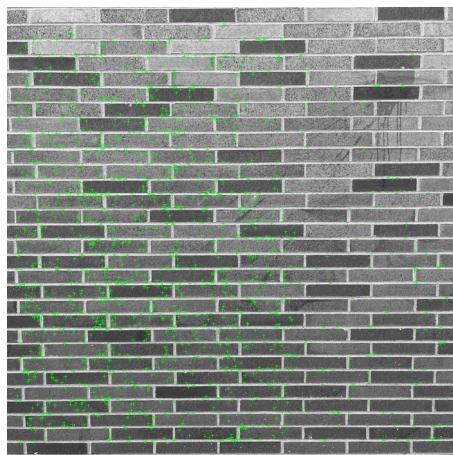
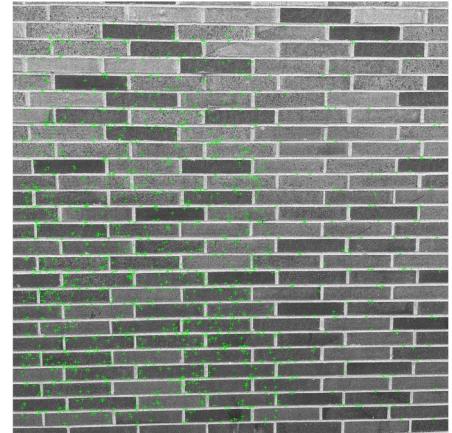
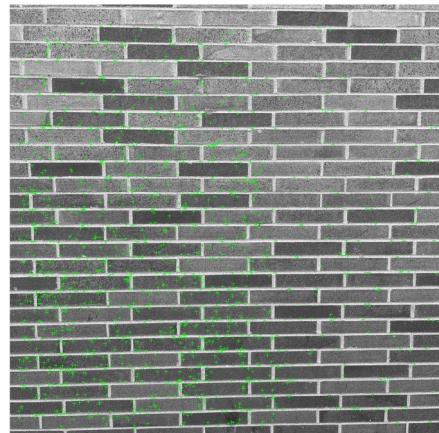
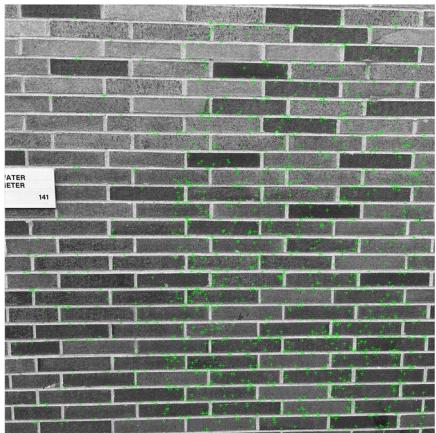
avgXLim	[0.5000;496.8292;643.5078;...
blender	1x1 <i>AlphaBlender</i>
buildingDir	panorama\*.jpg'
buildingScene	1x1 <i>ImageDatastore</i>
centerIdx	3
centerImageIdx	3
features	1x1 <i>binaryFeatures</i>
featuresPrev	1x1 <i>binaryFeatures</i>
grayImage	1024x768 uint8
height	1083
i	5
I	1024x768x3 uint8
idx	[1:2;3:4;5]
imageSize	[0.0;1024.768;1024.768;102...
index_pairs	370x2 uint32
mask	1083x1429 logical
matchpts	370x1 <i>cornerPoints</i>
matchptsPrev	370x1 <i>cornerPoints</i>
maxImageSize	[1024.768]
n	5
numImages	5
panorama	1083x1429x3 uint8
panoramaView	1x1 <i>imref2d</i>
point	43822x1 <i>cornerPoints</i>
pointm	43822x1 double
points	28738x1 <i>cornerPoints</i>
pointsPrev	31554x1 <i>cornerPoints</i>
pointx	43822x1 double
pointy	43822x1 double
tforms	1x5 <i>affinetform2d</i>
Tinv	1x1 <i>affinetform2d</i>
warpedImage	1083x1429x3 uint8
width	1429
xlim	[-306.8767,-305.7981;-174.6...
xLimits	[-306.8767,1.1224e+03]
xMax	1.1224e+03
xMin	-306.8767
yLim	[-49.1408,-48.0834;-54.8342...
yLimits	[-54.8342,1.0278e+03]
yMax	1.0278e+03
yMin	-54.8342

## CINDER BLOCK MOSAIC:

To detect matching features from cinder block images could a bit laborious. This is because the images replicates each other thus it becomes difficult for code to detect Unique matching points from both the images. Here, the code depends on the other parameters of the image such as change in light intensity, shadows etc. to detect corners in the image. The image on the right shows a cinder block image with color variations.



Matching points of cinder block images are shown below



To generate a panorama of the above image, interest points were reduced to 1,00,000 points and the code could detect 1681 matching points. And the maximum number of trials was set to 2000 with 99.9% confidence. Panorama of the above cinder block image set is shown below.



In the above panorama, we can see that images are matched points are mapped but not accurate.

### GRAFFITI MOSAIC:

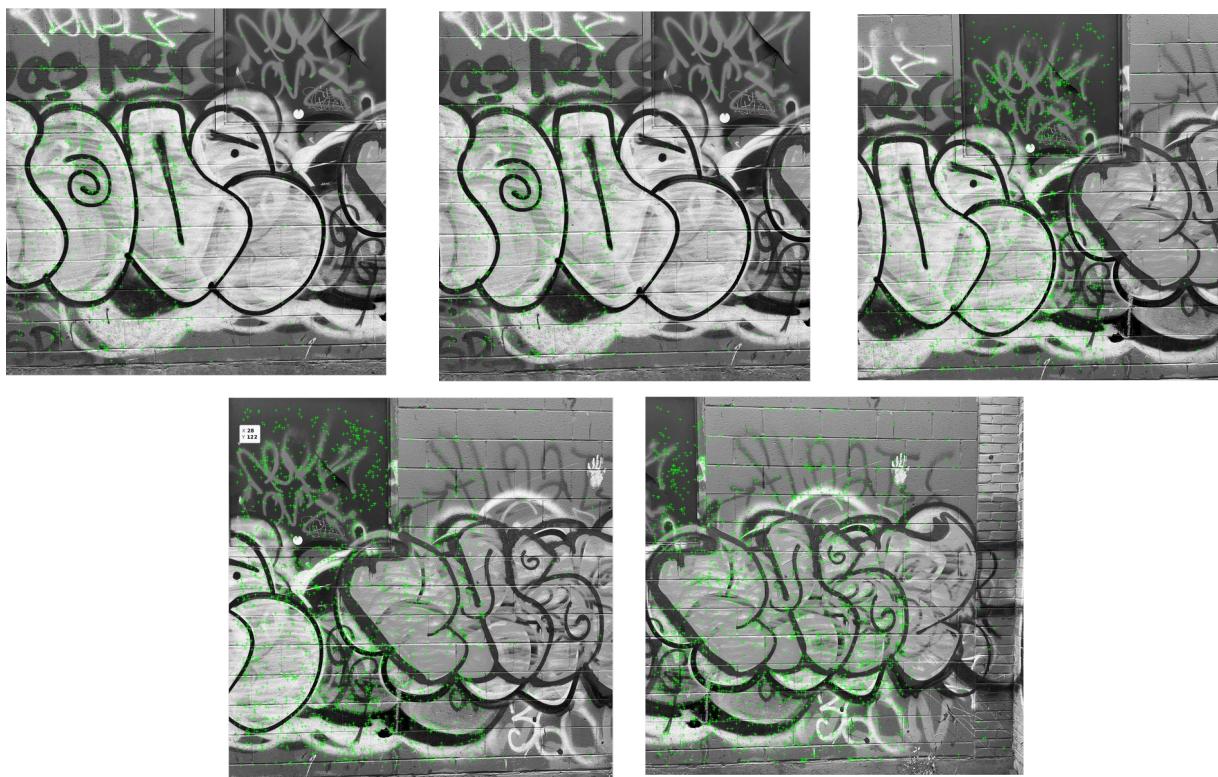
The image on the left shows graffiti image with 50% of image overlap and the images on the right shows graffiti images with 15% of image overlapping. To create a panorama of images with higher percentage of overlap is easier than images with lower percentage of overlap. The reason is simple that code can detect more matching points and map those points easily.



Matching points for 15% image overlap is shown below



Matching points for 50% image overlapping is shown below.



If we compare both the matching points of 15% overlap and 50% overlap, we can see that images with 50% overlap detected more matching points as compared to images with 15% overlap.

Panorama images of 15% overlap is shown below



Panorama with 50% overlap is shown below



#### 50% image overlap details

```

avgLum [0.5000:1.0142e+03:1.3341...
blender
buildingDir
buildingScene
centerIdx
centerImageIdx
3
features
1x1 binaryFeatures
featuresPrev
1x1 binaryFeatures
grayImage
1022x1023 uint8
height
5
I
1022x1023x3 uint8
idx
[1:2:3:4:5]
imageSize
[0.001022:1023:1022,1023:1...
index_pairs
2314x1 uint32
mask
1084x2384 logical
matchpts
2314x1 cornerPoints
matchptsPrev
2314x1 cornerPoints
maxImageSize
[1022,1023]
n
5
numImages
5
panorama
1084x2384x3 uint8
panoramaView
1x1 imref2d
point
65064x1 cornerPoints
points
59524x1 cornerPoints
pointsPrev
59524x1 cornerPoints
pointsx
65064x1 double
pointy
65064x1 double
tform
1x3 affineform2d
Tinv
1x1 affineform2d
warpedImage
1084x2384x3 uint8
width
2384
xIm
[-744.8828:743.8959:-27.48...
xImLimits
[-744.8828:1.6394e+03]
xMax
1.6394e+03
xMin
-744.8828
yIm
[0.1464:0.010746:73.3415.1...
yImLimits
[0.1464:0.010630e+03]
yMax
1.0630e+03
yMin
-20.8970

```

Comparing the 2 images, panorama with 50% image overlap creates a better mosaic as compared to panorama generated of 15% image overlap as the code has mapped more number of matching points. For 15% image overlap, processing time of the code increases because it needs to find more corner points in the harris feature detection. By mentioning higher number of interest points for harris feature detection function, processing time increases in order to get more matching points. Even after mentioning 1,50,000 points, code could detect 1293 match points for 15% image overlap as shown in the image on the left whereas same number of interest points could generate almost double match points for 50% overlap (2314 match points)

#### 15% image overlap details

```

avgLum [0.5000:1.0797e+03:1.16960...
blender
buildingDir
buildingScene
centerIdx
centerImageIdx
3
features
1x1 binaryFeatures
featuresPrev
1x1 binaryFeatures
grayImage
1022x1023 uint8
height
1112
I
1022x1023x3 uint8
idx
[1:2:3:4:5]
imageSize
[0.0:1.022:1023:1022,1023:1...
index_pairs
1293x2 uint32
mask
1112x3084 logical
matchpts
1293x1 cornerPoints
matchptsPrev
1293x1 cornerPoints
maxImageSize
[1022,1023]
n
5
numImages
5
panorama
1112x3084x3 uint8
panoramaView
1x1 imref2d
point
63948x1 cornerPoints
points
58791x1 cornerPoints
pointsPrev
59524x1 cornerPoints
pointsx
63948x1 double
pointy
63948x1 double
tform
1x3 affineform2d
Tinv
1x1 affineform2d
warpedImage
1112x3084x3 uint8
width
3084
xIm
[-999.6104:-998.6869:-508.8...
xImLimits
[-999.6104:2.0842e+03]
xMax
2.0842e+03
xMin
-999.6104
yIm
[0.001022:1.1127e+03]
yMax
1.4812271.0642e+03
yMin
1.0642e+03
yMax
-48.1227

```

To generate corner points, harris.m code was used which required convolve2.m code. In order to generate more matching points for 15% overlap image and a better panorama image, interest points was increased to 3,00,000 and maximum number trials was also increased from 3000 to 5000.

