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Assignment 3 – Practical
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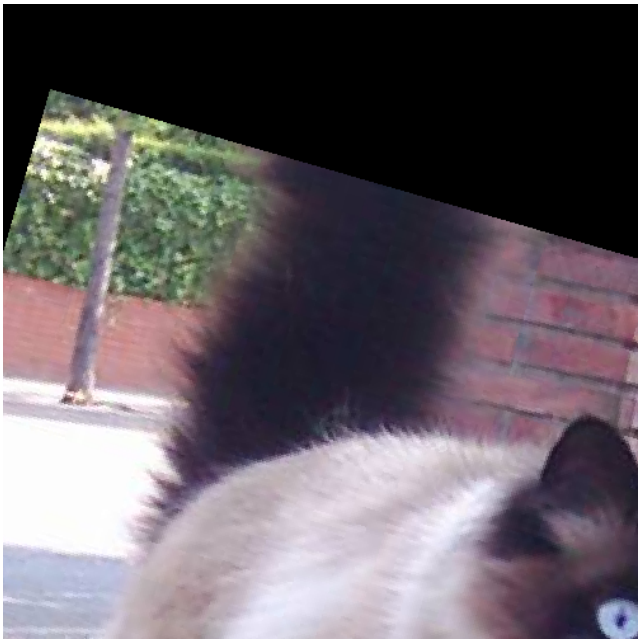
Question A

A1) We define the 3 transformation matrices for translation, rotation and scaling and multiply these to get one transformation matrix.

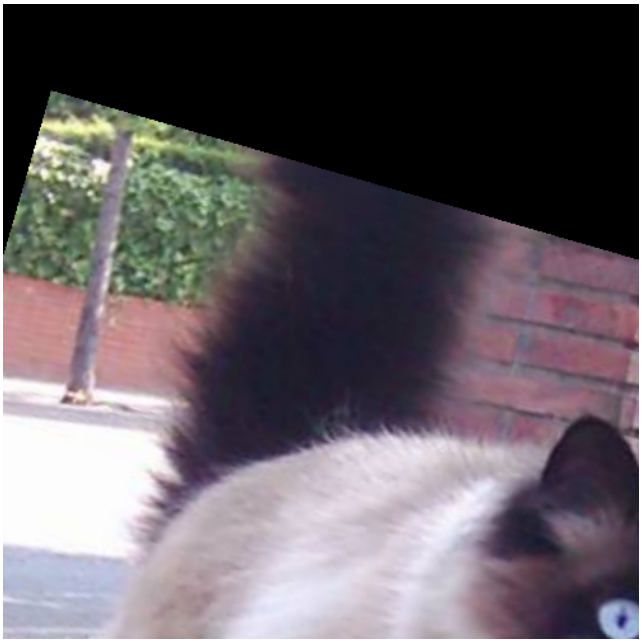
```
scale = np.array([[1.01, 0, 0],
                  [0, 1.01, 0],
                  [0, 0, 1]])


trans = np.array([[1, 0, 30],
                  [0, 1, 30],
                  [0, 0, 1]])


cos = math.pow(3, 0.5)
sin = 0.5
rot = np.array([[cos, sin, 0],
                [-sin, cos, 0],
                [0, 0, 1]])
matrix = np.dot(rot, trans)
matrix = np.dot(scale, matrix)
```

Here scale is the scaling matrix, trans is the translation matrix and rot is the matrix for rotation.

After applying the backward transformation we get the following results :



Nearest Neighbor



Bilinear Interpolation

To see the difference between the 2 methods we can zoom in and compare the results.
After applying 8x zoom we get the following images:

Nearest Neighbor

Bilinear Interpolation

We can see that when we use Nearest Neighbor the image appears to be too pixelated when compared to the bilinear image; The bilinear transformation gives us a smoother image since we take the ratio of the pixel intensities.

Question B

Given 2 images and a set of landmarks for each image we can calculate the affine transform.

We have taken these images as the source images:

Image 1

Image 2

We apply the formula $\mathbf{X^{-1}x = a}$ where X^{-1} is the pseudoinverse matrix corresponding to the first image and x is the matrix corresponding to the landmarks in Image 2.
After computing the matrix **a** which is a linear array of 6 values which correspond to a_{11}, a_{12}, a_{13}, a_{21}, a_{22}, a_{23} of the transformation matrix.

Figure 1: 3 Landmarks

Figure 2: 5 Landmarks

When we use 3 landmarks i.e, the center of each eye and the center of the mouth, the resultant image is as shown in Figure 1.

When we use an additional 2 landmarks i.e, the corners of the ears, the resultant image is shown in Figure 2.

We see that there is slight difference between the 2 transformations because in Figure 2 it tries to align more points.

Figure 1 Figure 2 Figure 3

Here Figure 1 and Figure 2 are the source images and Figure 3 is what we get after applying the affine transformation on the first image.

We see that the height of the face is slightly shortened since in Figure 2 the vertical distance between the eyes and the mouth is slightly less and the width is also slightly shortened since the face in the second image is slightly narrow when compared to the first image.