ASSIGNMENT 4

NAME: SHRINIDHI VENKATAKRISHNAN

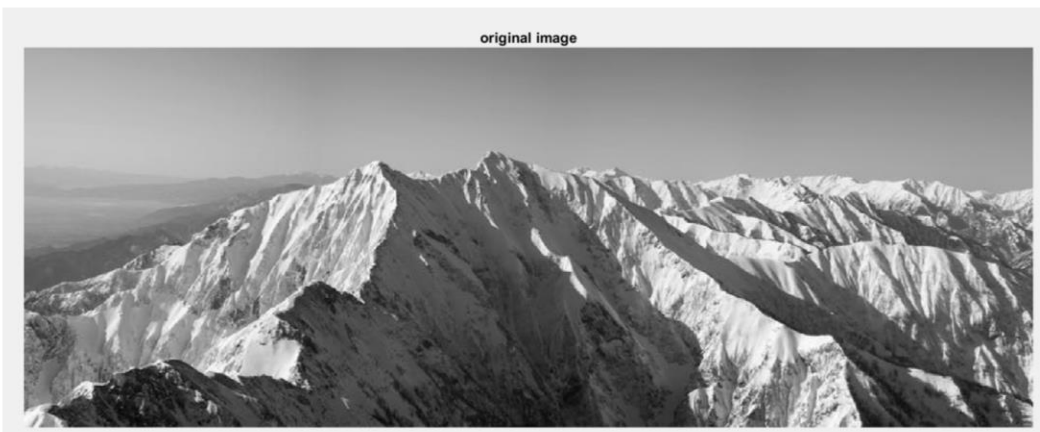
PID: A53272432

Academic Integrity Policy: Integrity of scholarship is essential for an academic community. The University expects that both faculty and students will honor this principle and in so doing protect the validity of University intellectual work. For students, this means that all academic work will be done by the individual to whom it is assigned, without unauthorized aid of any kind.

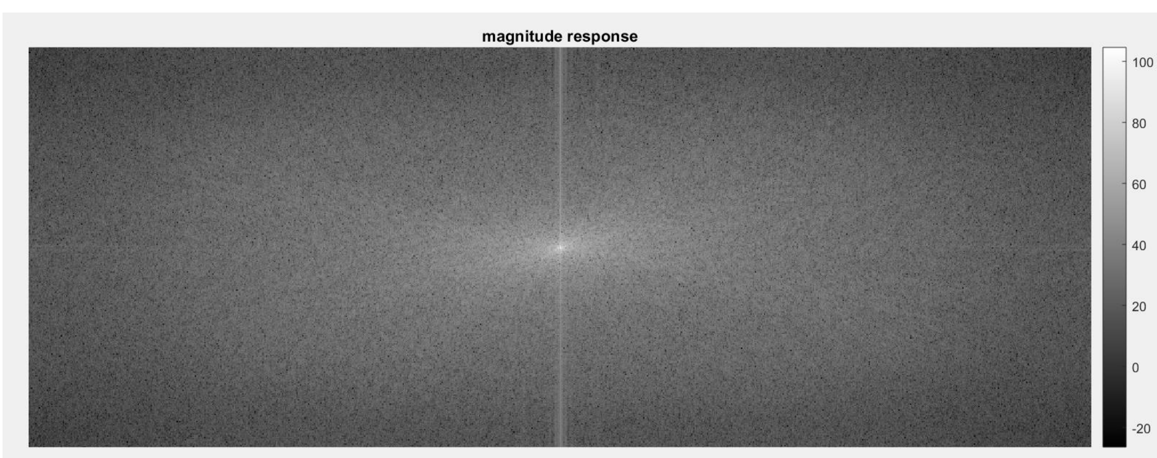
By including this in my report, I agree to abide by the Academic Integrity Policy mentioned above.

Problem 1. Directional Image Filtering

1. THE ORIGNAL IMAGE

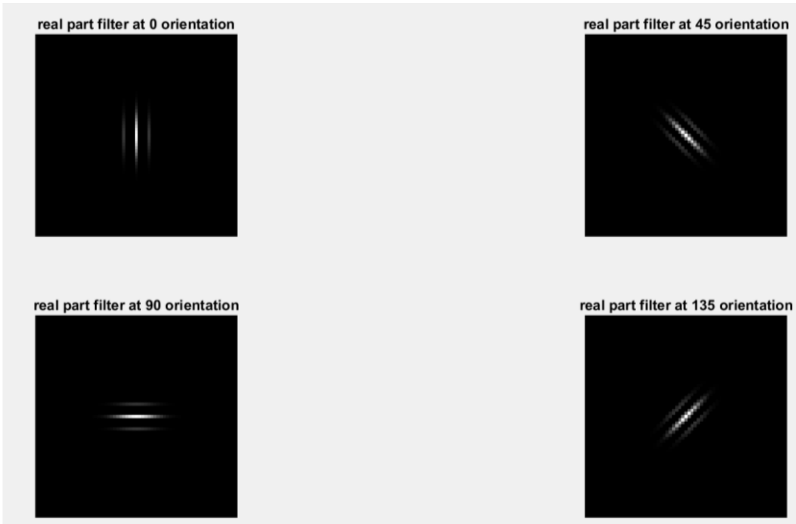


2. MAGNITUDE RESPONSE OF THE ORIGINAL IMAGE



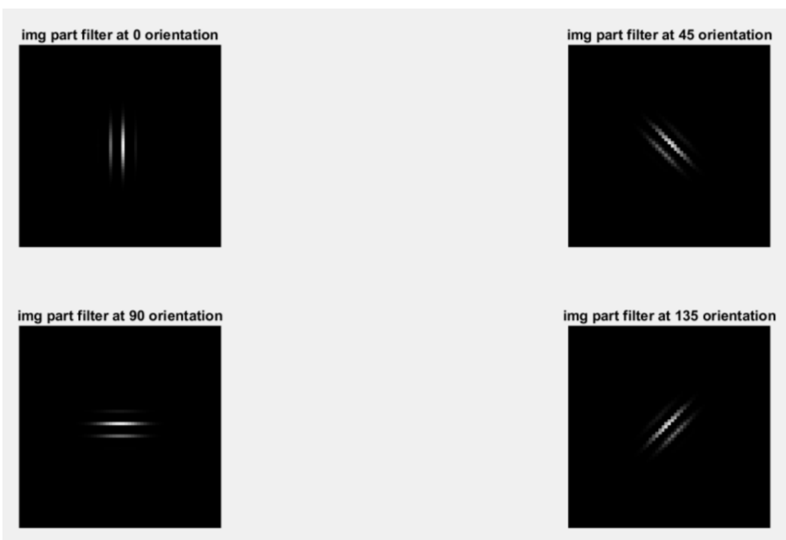
3.A

REAL PART OF THE FILTER AT DIFFERENT ORIENTATIONS

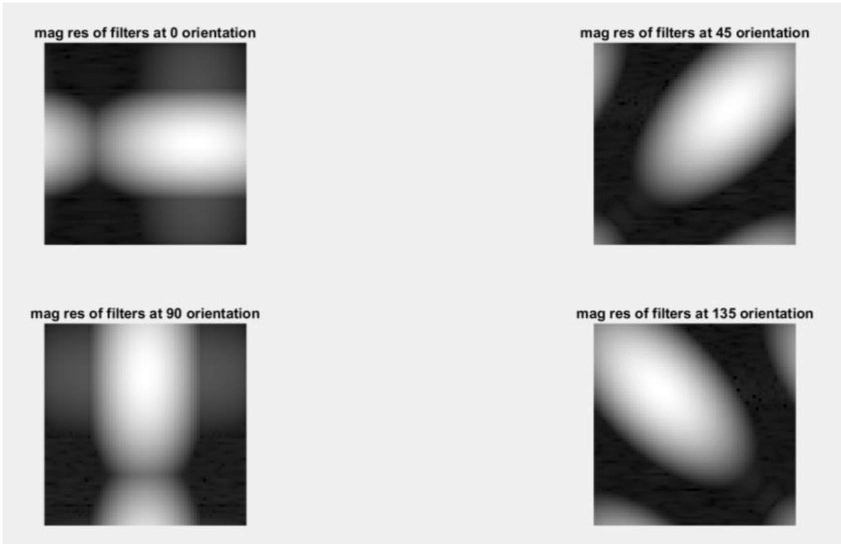


3.B

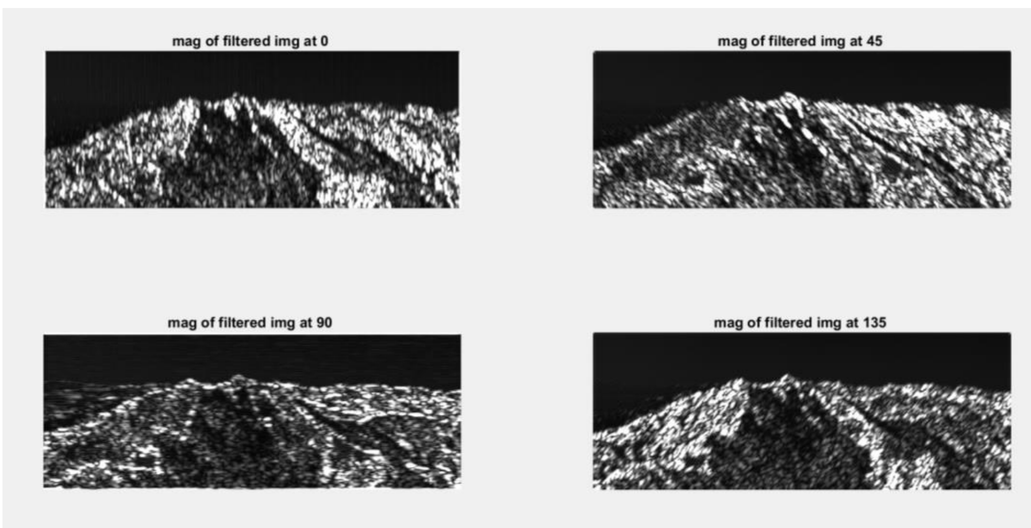
IMAGINARY PORTION OF THE FILTER AT DIFFERENT ORIENTATIONS



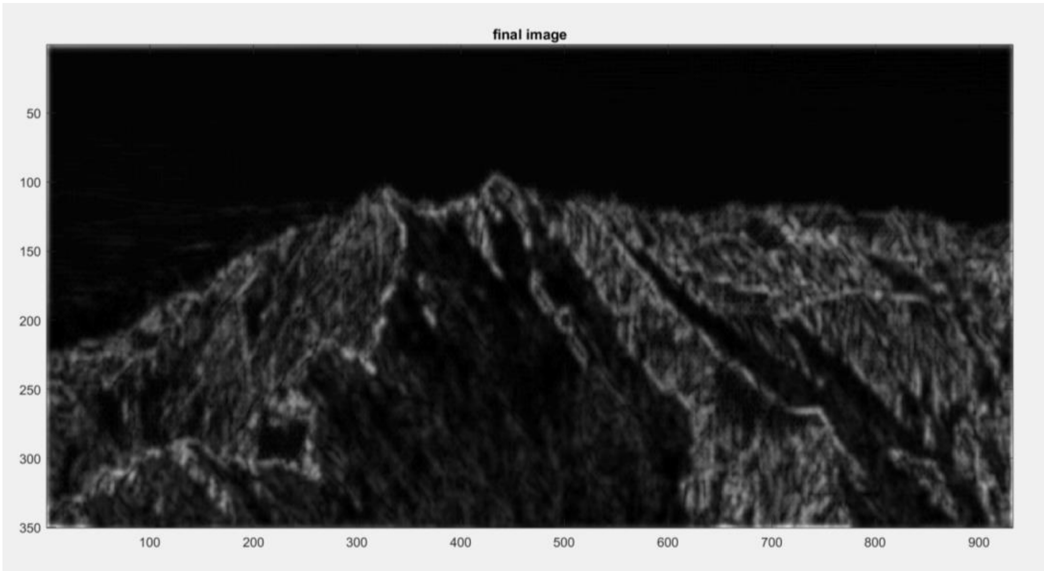
3C. MAGNITUDE RESPONSE OF THE FILTER AT DIFFERENT ORIENTATIONS



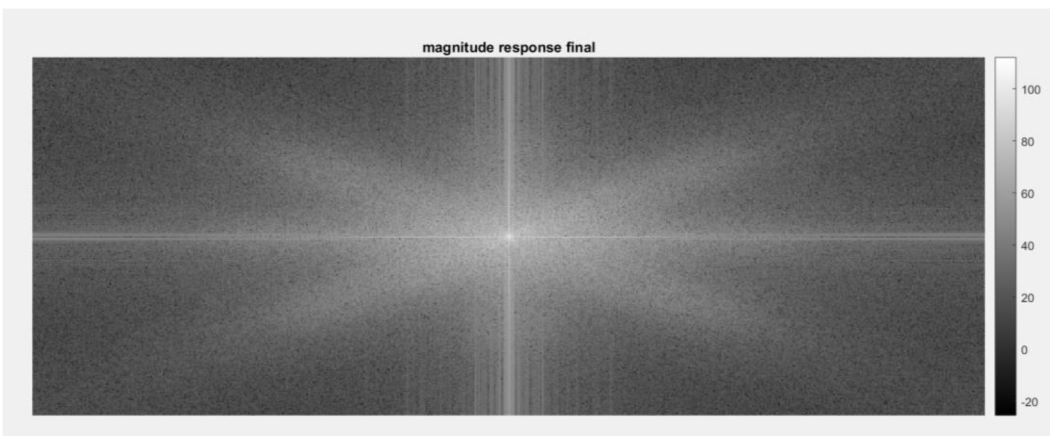
3D. MAGNITUDE OF THE FILTERED IMAGE



4. FINAL IMAGE

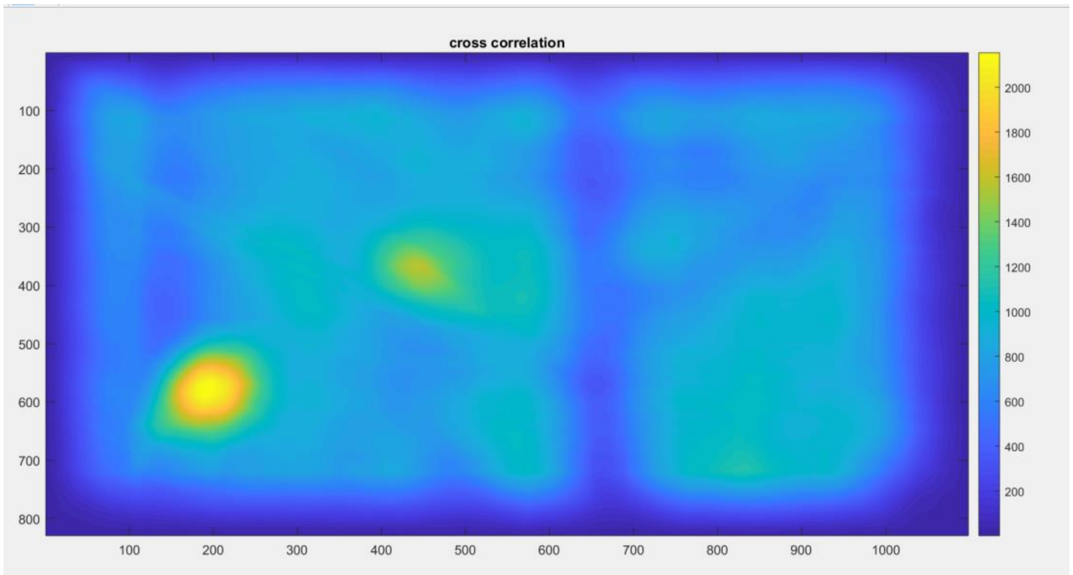


5. Magnitude response of the final image

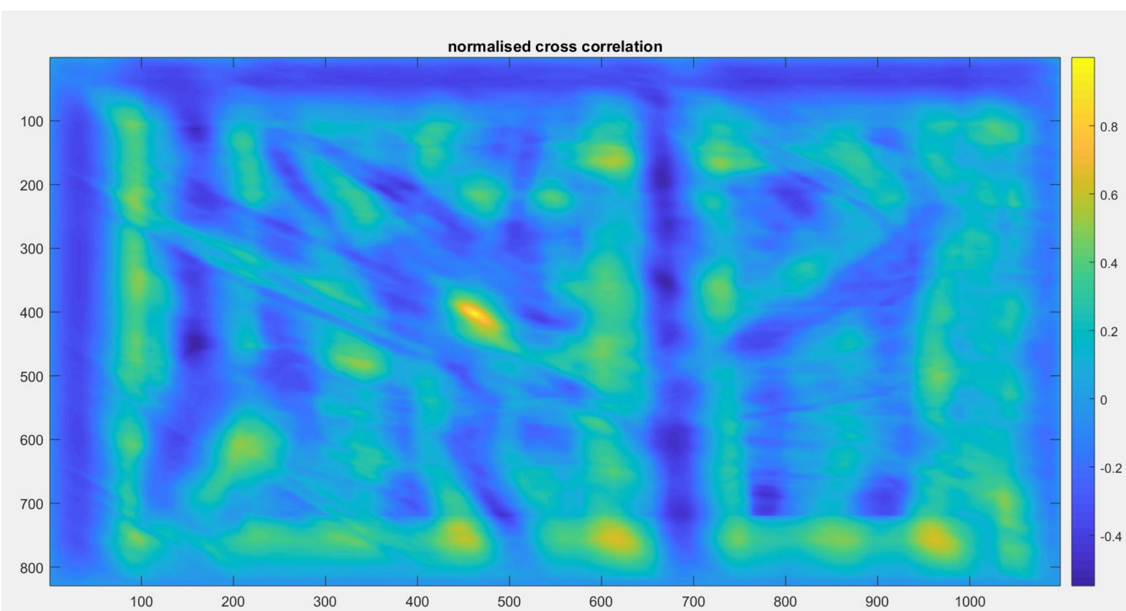


Problem 2. Detecting objects with template matching

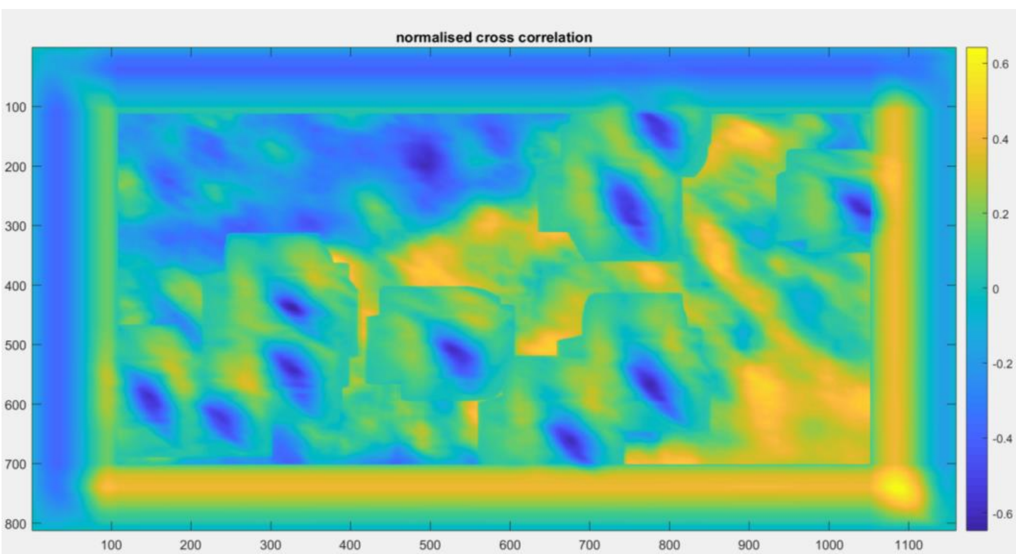
(i)



(ii)



(iii)



normalised cross correlation
100
200
300
400
500
600
700
800
100
200
300
400
500
600
700
800
900
1000
1100
0.6
0.4
0.2
0
-0.2
-0.4
-0.6

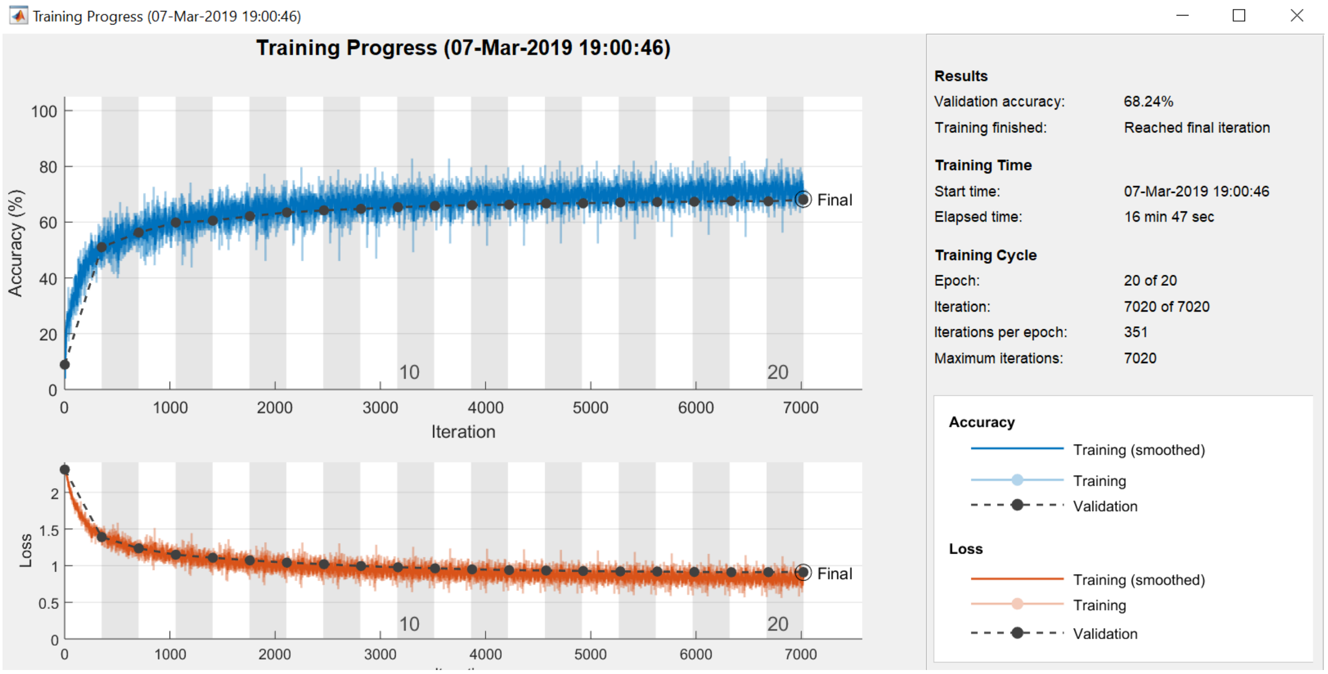
(iv) Why is normalized cross-correlation more effective compared to cross-correlation for template matching?

•When a scene is imaged by different sensors, or under different illumination intensities, both the SSD and the Cfg can be large for windows representing the same area. Hence, normalised xcorr is done which subtracts the mean value. The idea is to normalize the cross correlation within each window.

(v) Comment on the result of normalized cross correlation for birds2.jpeg. Can it be reliably used to detect the birds in this image?

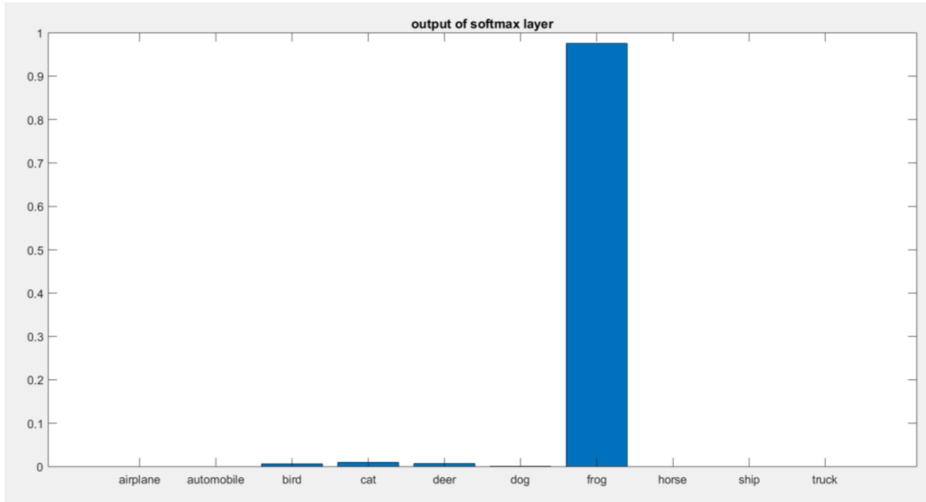
The rectangle does not overlap any bird as the template chosen represents only one type of bird. Hence, it can not be used to find the birds successfully.

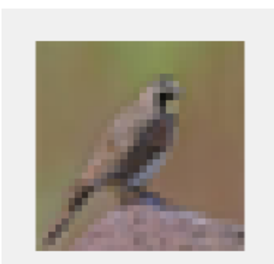
Problem 3. Convolutional Neural Networks
(v)

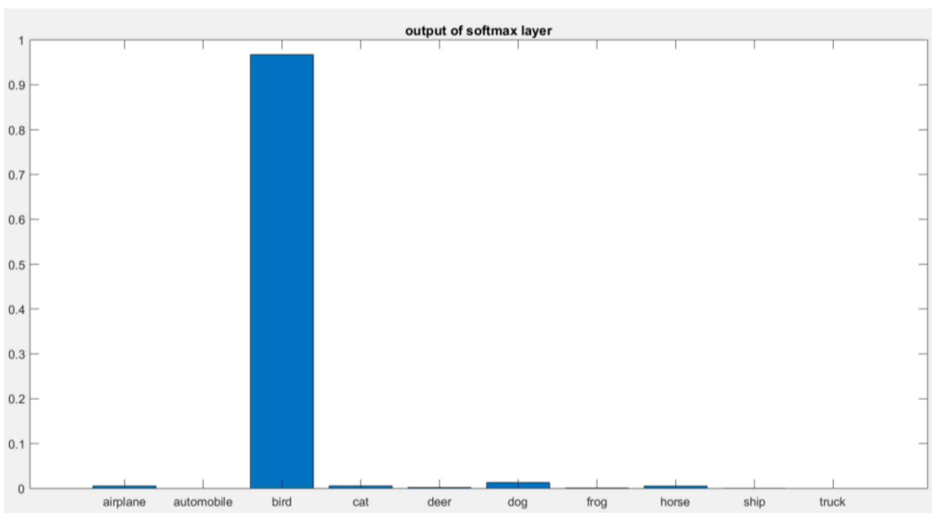


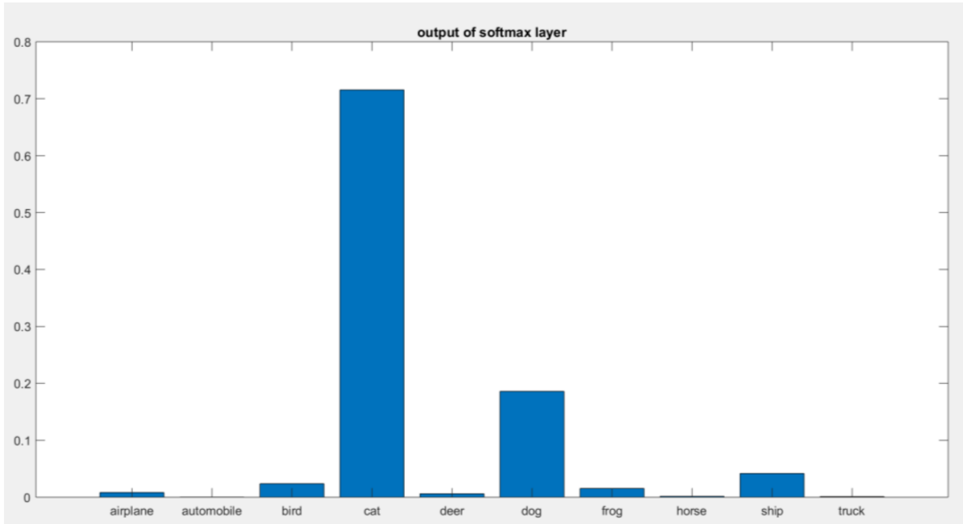
(vi) <u>Correct predictions:</u>

Original test image: Output of softmax layer:



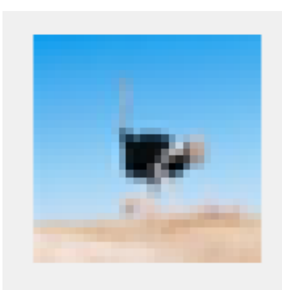


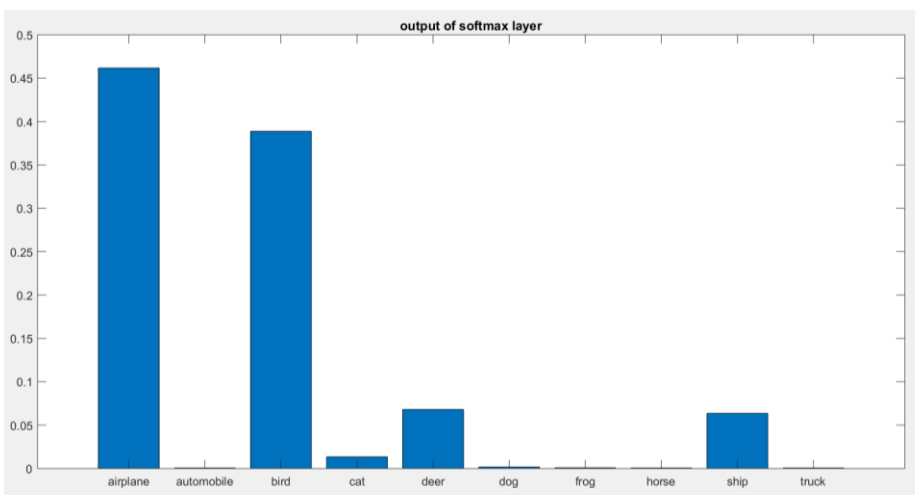


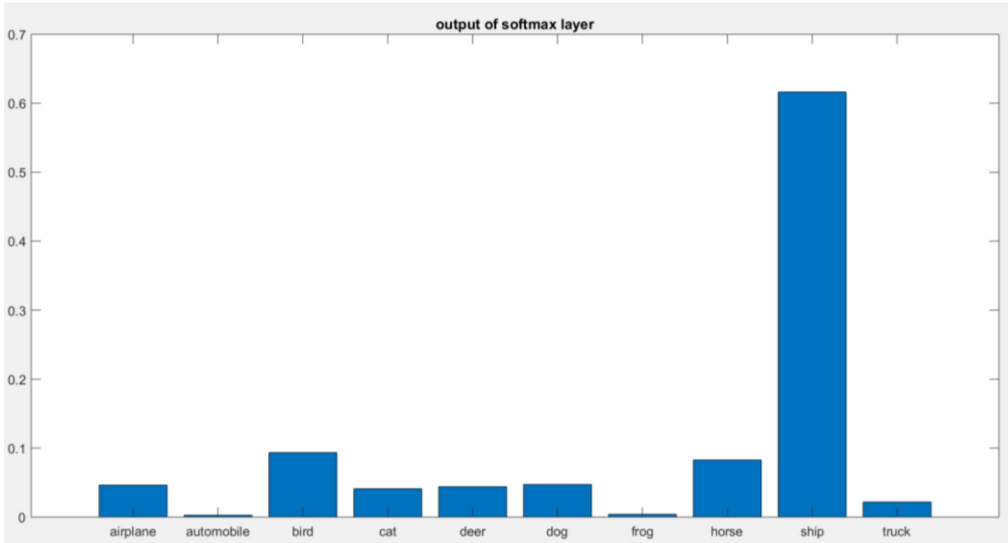


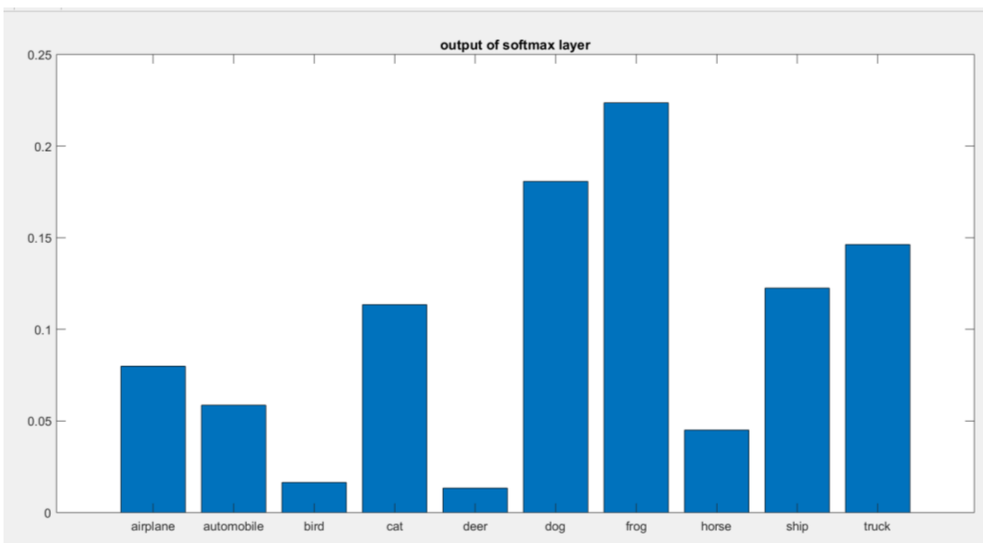
Wrong predictions:

Original test image: Output of the softmax layer:

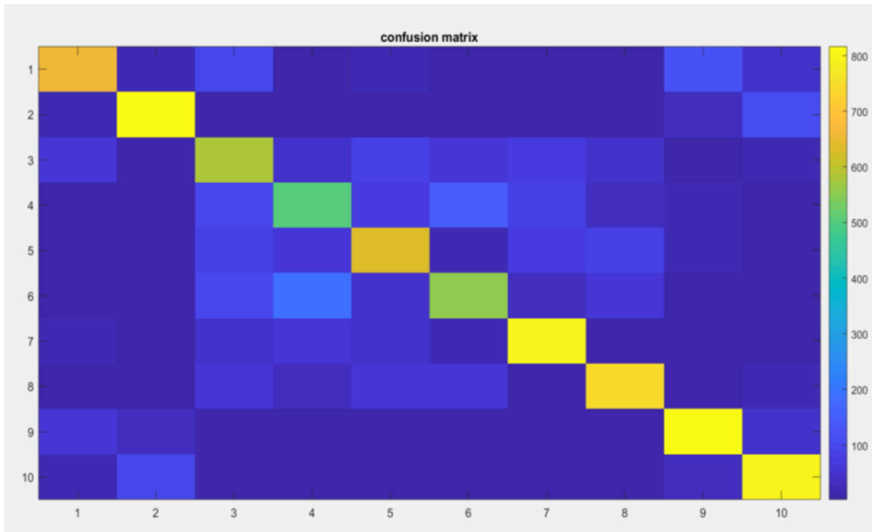


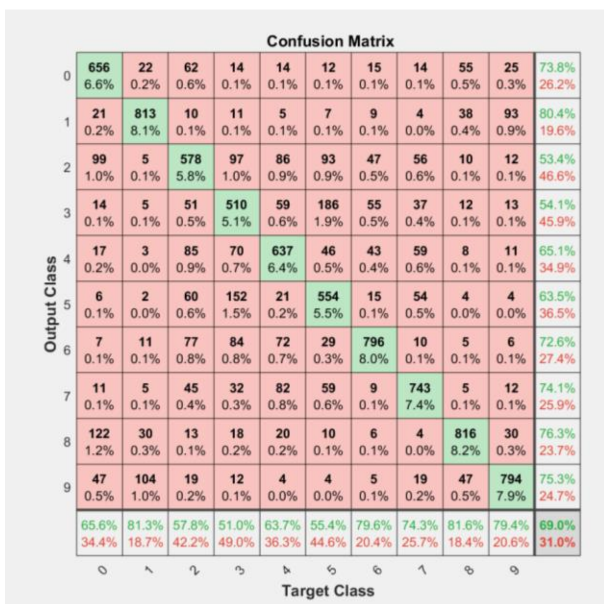



output of softmax layer
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
airplane
automobile
bird
cat
deer
dog
frog
horse
ship
truck

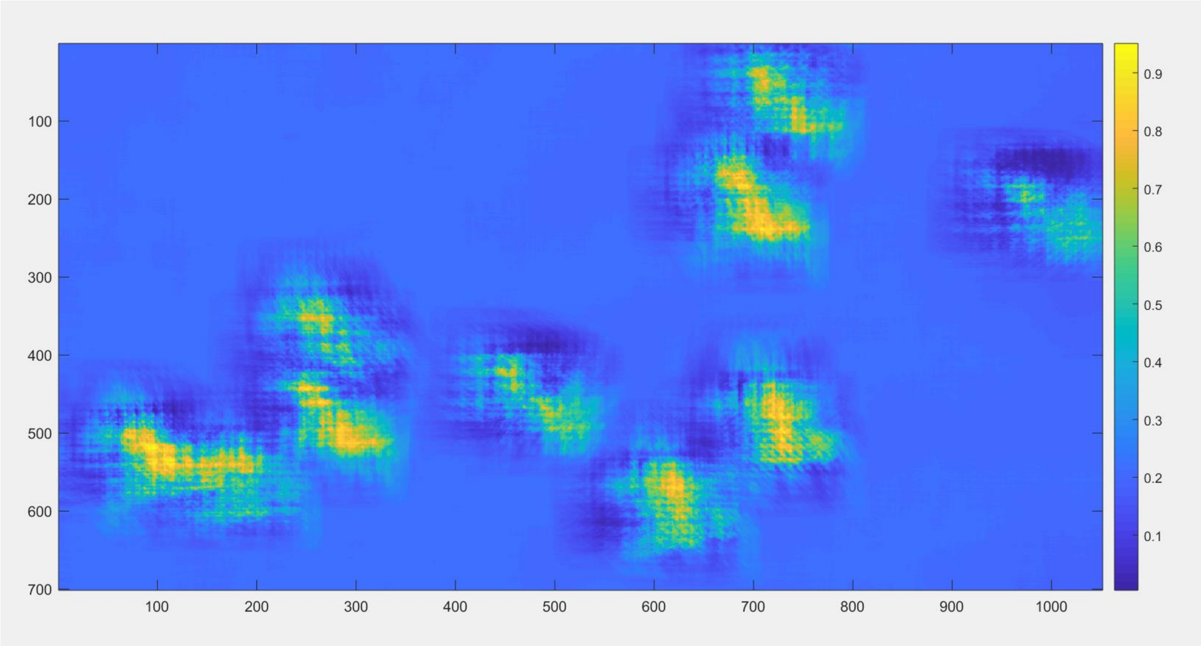

output of softmax layer
0.25
0.2
0.15
0.1
0.05
0
airplane
automobile
bird
cat
deer
dog
frog
horse
ship
truck

(vi) CONFUSION MATRIX:





(vii)



When compared to the heat map of the second question we get better output through the neural networks as it doesn't use just one template but a group of images of birds to identify the birds in the image. Hence, gives better results.

APPENDIX:

Q1:

```
%% 1
figure(1);
imshow(image);
title('original image')
%% 2
mag_res=abs(fftshift(fft2(image)));
F = 20*log10(mag_res);
% F = mat2gray(F);
figure(2)
imshow(F,[]);
title('magnitude response');
%% 3a, b
figure();
for i=1:4
```

```
subplot(2,2,i)
imshow(real(filters(:,:,i)))
str = sprintf('real part filter at %d orientation',
orientations(i));
title(str);
end

figure();
for i=1:4
subplot(2,2,i)
imshow(imag(filters(:,:,i)))
str = sprintf('img part filter at %d orientation',
orientations(i));
title(str);
end
%% 3c
b=[];
figure();
for i=1:4
b=abs(fftshift(fft2(filters(:,:,i))));
b=(20*log10(b));
subplot(2,2,i);
imshow(b,[]);
str = sprintf('mag res of filters at %d
orientation', orientations(i));
title(str);
end
%% 3d

figure();
fil_img=zeros(350,932,4);
for i=1:4

fil_img(:,:,i)=abs(conv2(image,filters(:,:,i),'same
'));
    subplot(2,2,i);
    imshow(fil_img(:,:,i))
```

```
    str = sprintf('mag of filtered img at %d ',
orientations(i));
    title(str);
end
%% 4
figure();
FINAL_IMG=fil_img(:,:,1)+fil_img(:,:,2)+fil_img(:,:
,3)+fil_img(:,:,4);
imshow(double((FINAL_IMG)));
title('final image');

%% 5
mag_res_final=abs(fftshift(fft2(FINAL_IMG)));
F_FINAL = 20*log10(mag_res_final);
% F = mat2gray(F);
figure()
imshow(F_FINAL,[]);
title('magnitude response final');
```

Q2. clc;

```
close all;
clear all;
%% (i)
bird1=im2double(rgb2gray(imread('birds1.jpeg')));
temp=im2double(rgb2gray(imread('template.jpeg')));
temp2=fliplr(temp);
cross_img=conv2(temp2,bird1);
imagesc(cross_img); colorbar;
title('cross correlation');
%% (ii)
C_norm = normxcorr2(temp,bird1);
figure();
imagesc(C_norm); colorbar;
title('normalised cross correlation');
[rmax,cmax]=find(C_norm==max(max(C_norm)));
figure();
[r c]=size(temp);
```

```
imshow(bird1);
hold on;
rectangle('Position',[cmax-c-1,rmax-r-1,c-1,r-
1],'linewidth',1);
%% (iii)
bird2=im2double(rgb2gray(imread('birds2.jpeg')));
D_norm=normxcorr2(temp,bird2);
figure();
imagesc(D_norm); colorbar;
title('normalised cross correlation');
[rmax_d,cmax_d]=find(D_norm==max(max(D_norm)));
figure();
imshow(bird2);
hold on;
rectangle('Position',[cmax_d-c-1,rmax_d-r-1,c-1,r-
1],'linewidth',1);
```

Q3.

```
[trainData,trainLabels,valData,valLabels,testData,t
estLabels]=extractCifar10('C:\Users\shrinidhi\Deskt
op\ece 172\finals_172\cifar-10-batches-mat');
layers = [
    imageInputLayer([32 32 3])

    convolution2dLayer([3,3],16)
    batchNormalizationLayer
    reluLayer

    maxPooling2dLayer(2,'Stride',2)

    convolution2dLayer([3,3],16)
    batchNormalizationLayer
    reluLayer

    maxPooling2dLayer(2,'Stride',2)
```

```
    convolution2dLayer([3,3],16)
    batchNormalizationLayer
    reluLayer

    fullyConnectedLayer(10)
    softmaxLayer
    classificationLayer];
%%
options = trainingOptions('sgdm',
'MaxEpochs',20,'InitialLearnRate',
0.001,'MiniBatchSize',128,'ValidationData',{valData
valLabels},'ValidationFrequency',round(45000/128),'
Plots','training-progress');
[a, b ]=
trainNetwork(trainData,trainLabels,layers,options);
%%
i=400;
figure();
test=testData(:,:,:,i);
imshow(test);
YPred = classify(a,test);
YTest = testLabels(i,:);
act1 = activations(a,test,'softmax');
figure();
bar(act1(:,:));
set(gca,'XTickLabel',{'airplane','automobile','bird
','cat','deer','dog','frog','horse','ship','truck'}
);
title('output of softmax layer');
%%
%to calculate confusion matrix

Y_pred_conf=classify(a,testData);
confusion=confusionmat(testLabels, Y_pred_conf);

%%
im=(imread('birds2.jpeg'));
```

```
[rorg, corg,dim]=size(im);
win_size=150;
im_new = padarray(im,[win_size/2
win_size/2],'symmetric');
[row,col2,dim2]=size(im_new);
A=[];
new=[];
for n=1:1:rorg
    for k=1:1:corg
 i=n:n+150-1;
 p=k:k+150-1;
    data_new=imresize(im_new(i,p,:),[32,32]);
    act1 = activations(a,data_new,'softmax');
    new(n,k)=act1(1,1,3);
    end
    n
end
%%
imagesc(new); colorbar;
```