Part e)

i)

```matlab
%function [f,fnames]=extract_texture_features(im,mask)
if size(im,3)==3
    im=rgb2gray(im);
end
f=nan(48,1);
fnames=cell(48,1);

I_q=uint8(round(im*31));
I_q(mask==0)=32;
% Direction and distance definition
offset=[0 1;-1 1;-1 0;-1 -1];
D=[1 2 3 4];
for k=1:numel(D)
    % GLCM
    G=graycomatrix(I_q,'Offset',D(k)*offset,'NumLevels',33,'GrayLimits',[],'Symmetric',true);
    % Removing unwanted data from areas outside the mask
    G(33,:,:)=[];
    G(:,33,:)=[];
    % Normalize GLCM
    G=G./repmat(sum(sum(G)),size(G,1),size(G,2),1);
    % GLCM grid
    [j,i]=meshgrid(0:size(G,2)-1,0:size(G,1)-1);
    j=repmat(j,1,1,size(G,3));
    i=repmat(i,1,1,size(G,3));
    % Modifications and extra parameters
    LG=log(G)/log(2);
    LG(LG==-inf)=0;
    Mean=sum(sum(i.*G));
    Variance=sum(sum(((i-Mean).^2).*G));
    % Main Parameters
    Ene=sum(sum(G.^2));
    Ent=-sum(sum(G.*LG));
    Con=sum(sum(((i-j).^2).*G));
    Var=sum(sum(((i-Mean).^2).*G));
    Cor=sum(sum((i-Mean).*(j-Mean).*G./Variance));
    Idm=sum(sum((1./(1+(i-j).^2)).*G));
    % Putting mean and variance in place
    Parameters=[Ene;Ent;Con;Var;Cor;Idm];
    f(D(k):8:end)=mean(Parameters,3);
    f(D(k)+4:8:end)=std(Parameters,0,3);
end
Str1=["ene","ent","con","var","cor","idm"];
Str2=["d1","d2","d3","d4"];
Str3=["mean","std"];
l=1;
for i=1:numel(Str1)
    for j=1:numel(Str3)
        for k=1:numel(Str2)
            fnames{l}=['GLCM_' char(Str1(i)) '_' char(Str2(k)) '_' char(Str3(j))];
            l=l+1;
        end
    end
end
end
```

```
%end
```

ii)

```
im=double(imread([cd '\101_ObjectCategories\emu\image_0001.jpg']))/255;
[M,N,~]=size(im);
ann=load([cd '\Annotations\emu\annotation_0001.mat']);
mask=double(poly2mask(ann.obj_contour(1,:)+ann.box_coord(3),ann.obj_contour(2,:)+ann.box_coord(1),M,N));
[f,fnames]=extract_texture_features(im,mask);
disp('f Vector (reshaped for presentation):')
```

```
 f Vector (reshaped for presentation):
```

```
format shortE
disp(reshape(f,4,[])')
```

```
    9.1254e-03    8.3432e-03    8.0471e-03    7.8333e-03
    7.2071e-04    2.9971e-04    2.3621e-04    2.5989e-04
    7.5526e+00    7.6370e+00    7.6693e+00    7.6915e+00
    5.8549e-02    2.7192e-02    2.5975e-02    2.4073e-02
    1.5590e+01    1.9267e+01    2.0910e+01    2.2394e+01
    1.8215e+00    1.7711e+00    1.4175e+00    1.1929e+00
    2.0576e+01    2.0030e+01    1.9653e+01    1.9415e+01
    1.7925e-01    2.0486e-01    1.7030e-01    1.5703e-01
    6.2093e-01    5.1881e-01    4.6785e-01    4.2310e-01
    4.6880e-02    4.7245e-02    3.9394e-02    3.4163e-02
    3.7211e-01    3.4266e-01    3.2878e-01    3.1839e-01
    2.2329e-02    1.1848e-02    1.1802e-02    1.4114e-02
```

```
disp('fnames Cell (reshaped for presentation):')
```

```
 fnames Cell (reshaped for presentation):
```

```
disp(reshape(fnames,4,[])')
```

```
    'GLCM_ene_d1_mean'    'GLCM_ene_d2_mean'    'GLCM_ene_d3_mean'    'GLCM_ene_d4_mean'
    'GLCM_ene_d1_std'     'GLCM_ene_d2_std'     'GLCM_ene_d3_std'     'GLCM_ene_d4_std'
    'GLCM_ent_d1_mean'    'GLCM_ent_d2_mean'    'GLCM_ent_d3_mean'    'GLCM_ent_d4_mean'
    'GLCM_ent_d1_std'     'GLCM_ent_d2_std'     'GLCM_ent_d3_std'     'GLCM_ent_d4_std'
    'GLCM_con_d1_mean'    'GLCM_con_d2_mean'    'GLCM_con_d3_mean'    'GLCM_con_d4_mean'
    'GLCM_con_d1_std'     'GLCM_con_d2_std'     'GLCM_con_d3_std'     'GLCM_con_d4_std'
    'GLCM_var_d1_mean'    'GLCM_var_d2_mean'    'GLCM_var_d3_mean'    'GLCM_var_d4_mean'
    'GLCM_var_d1_std'     'GLCM_var_d2_std'     'GLCM_var_d3_std'     'GLCM_var_d4_std'
    'GLCM_cor_d1_mean'    'GLCM_cor_d2_mean'    'GLCM_cor_d3_mean'    'GLCM_cor_d4_mean'
    'GLCM_cor_d1_std'     'GLCM_cor_d2_std'     'GLCM_cor_d3_std'     'GLCM_cor_d4_std'
    'GLCM_idm_d1_mean'    'GLCM_idm_d2_mean'    'GLCM_idm_d3_mean'    'GLCM_idm_d4_mean'
    'GLCM_idm_d1_std'     'GLCM_idm_d2_std'     'GLCM_idm_d3_std'     'GLCM_idm_d4_std'
```