Group Name : Unfiltered Commentary

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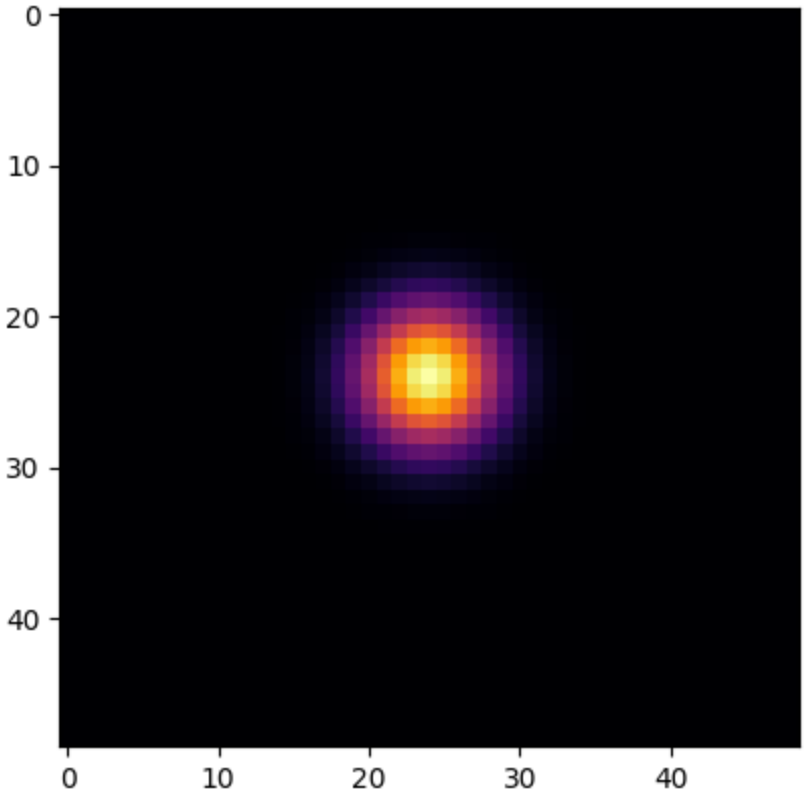
In [ ]:
```
import cv2
import numpy as np
import skimage
import imageio
import mpmath
import matplotlib.pyplot as plt
import seaborn as sns
import PIL
from sklearn.cluster import KMeans
from tqdm import tqdm
```

Question 1 Filters

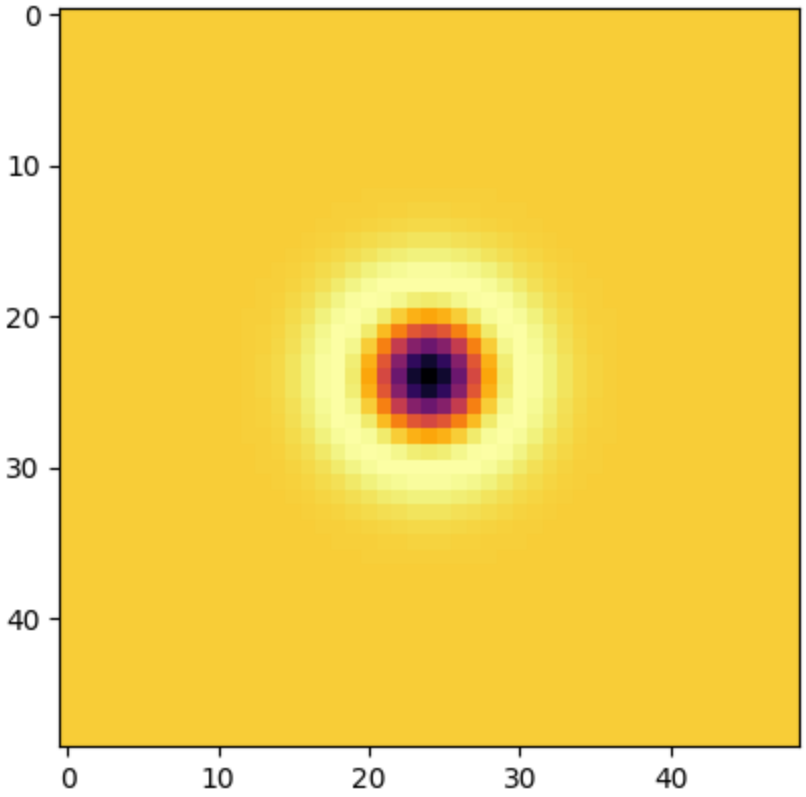
In [ ]:
```
def GaussFilter(size, sigma):
    values =np.arange(-(size//2), size//2 + 1)
    x, y = np.meshgrid(values, values)
    g = (1/(2*np.pi * sigma**2)) * np.exp(-(x**2 + y**2)/(2*sigma**2))
    #normalisng it - sometimes the sum is not perfectly 1...
    g /= np.sum(g)
    # print(np.sum(g))
    return g

test_gauss = GaussFilter(49, 10**0.5)
plt.imshow(test_gauss, cmap="inferno")
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x29c91dab350>
```



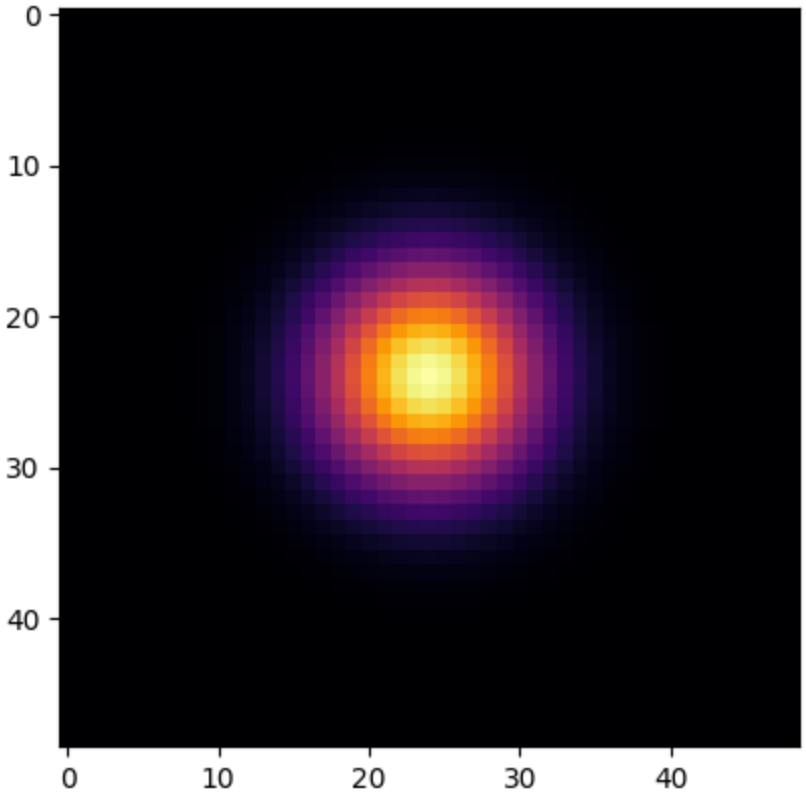
In [ ]:
```
def LoG(size, sigma):
    values =np.arange(-(size//2), size//2 + 1)
    x, y = np.meshgrid(values, values)

    g = -((1)/(np.pi * sigma ** 4 )) * \
        (1- (x**2 + y**2)/(2* sigma **2)) * \
        np.exp(-(x**2 + y**2)/(2*sigma**2))


    return g
test_log = LoG(49, 10**0.5)
plt.imshow(test_log,cmap="inferno")
```

Out[ ]: <matplotlib.image.AxesImage at 0x29cfe7412b0>



In [ ]:
```
def DoG(size, sigma, K):
    values =np.arange(-(size//2), size//2 + 1)
    x, y = np.meshgrid(values, values)

    g = ((1/(2 * np.pi * sigma **2)) * \
        np.exp(-(x**2 + y ** 2)/(2 * sigma **2))) - \
        ((1/ (2 * np.pi * K**2 *sigma**2)) * \
        np.exp(-(x**2 + y ** 2)/(2 * K**2 * sigma **2)))

    return g


test_dog = DoG(49, 5, 10)
plt.imshow(test_dog,cmap="inferno")
```

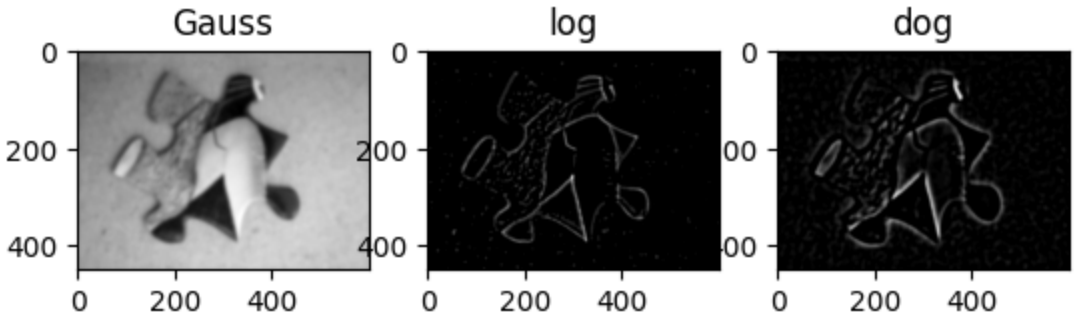
Out[ ]: <matplotlib.image.AxesImage at 0x29c91e274a0>



In [ ]:
```
# Outputs for question 1
gauss = GaussFilter(49, 10**0.5)
lgauss =  LoG(49, 10**0.5)
dgauss = DoG(49,10**0.5,2)

image = cv2.imread('Images/image-35.jpg',cv2.IMREAD_GRAYSCALE)
# get gaussian
gauss = cv2.filter2D(src=image, ddepth=-1, kernel = gauss)

# get log
l_gauss = cv2.filter2D(src=image, ddepth=-1, kernel = lgauss)

# get dog
d_gauss = cv2.filter2D(src=image, ddepth=-1, kernel = dgauss)
```

```
plt.figure()
plt.subplot(1,3,1)
plt.imshow(gauss,cmap='gray')
plt.title("Gauss")

plt.subplot(1,3,2)
plt.imshow(l_gauss,cmap='gray')
plt.title("log")

plt.subplot(1,3,3)
plt.imshow(d_gauss,cmap='gray')
plt.title("dog")
```

Out[ ]: Text(0.5, 1.0, 'dog')



Question 2

In [ ]:
```
from scipy.ndimage import convolve

def create_gaussian_filter(theta, sigma_x, sigma_y, size, filter_type='edge'):
    # Create a grid of (x, y) coordinates
    x = np.linspace(-size//2+1, size//2, size)
    y = np.linspace(-size//2+1, size//2, size)
    x, y = np.meshgrid(x, y)
    # Rotate the coordinates
    x_rot = x * np.cos(theta) + y * np.sin(theta)
    y_rot = -x * np.sin(theta) + y * np.cos(theta)

    # Calculate the Gaussian function f(xrot,sigmax)*f(yrot,sigmay)
    fx = np.exp(-0.5 * (x_rot**2 / sigma_x**2))/(np.sqrt(2 * np.pi) * sigma_x)
    fy = np.exp(-0.5 * (y_rot**2 / sigma_y**2))/(np.sqrt(2 * np.pi) * sigma_y)
```

```
    if filter_type == 'edge':
        # First derivative (edge)
        #x'
        dG_dx = fy*fx*(-x_rot/sigma_x**2)
        #y'
        dG_dy = fx*fy*(-y_rot/sigma_y**2)
        return dG_dx, dG_dy

    elif filter_type == 'bar':
        # Second derivative (bar)
        #x'
        d2G_dx2 = fy*fx*((x_rot**2-sigma_x**2)/sigma_x**4)
        #y'
        d2G_dy2 = fx*fy*((y_rot**2-sigma_y**2)/sigma_y**4)
        return d2G_dx2, d2G_dy2
    else:
        raise ValueError("Unknown filter type. Use 'edge' or 'bar'.")

def construct_rfs(debug: bool = False):
    sigma_x_sigma_y = np.array([(3,1),(6,2),(12,4)])
    thetas = np.array([0, 1/6*np.pi, 2/6*np.pi, 3/6*np.pi, 4/6*np.pi, 5/6*np.pi])

    size = (49, 49)

    rfs_edge = np.zeros((sigma_x_sigma_y.shape[0], thetas.shape[0], size[0], size[1]))
    rfs_bar = np.zeros((sigma_x_sigma_y.shape[0], thetas.shape[0], size[0], size[1]))

    for sigma_ind in range(sigma_x_sigma_y.shape[0]):
        for theta_ind in range(thetas.shape[0]):
            sigma = sigma_x_sigma_y[sigma_ind]
            theta = thetas[theta_ind]

            gaussian_edge = create_gaussian_filter(theta, sigma[0], sigma[1], size[0], 'edge')
            rfs_edge[sigma_ind, theta_ind] = gaussian_edge[1]
            gaussian_bar = create_gaussian_filter(theta, int(sigma[0]), sigma[1], size[0], 'bar')
            rfs_bar[sigma_ind, theta_ind] = gaussian_bar[1]

    # Combine rfs_edge and rfs_bar by concatenating along the theta axis
    rfs_combined = np.concatenate((rfs_edge, rfs_bar), axis=0)

    print(rfs_combined.shape)
```

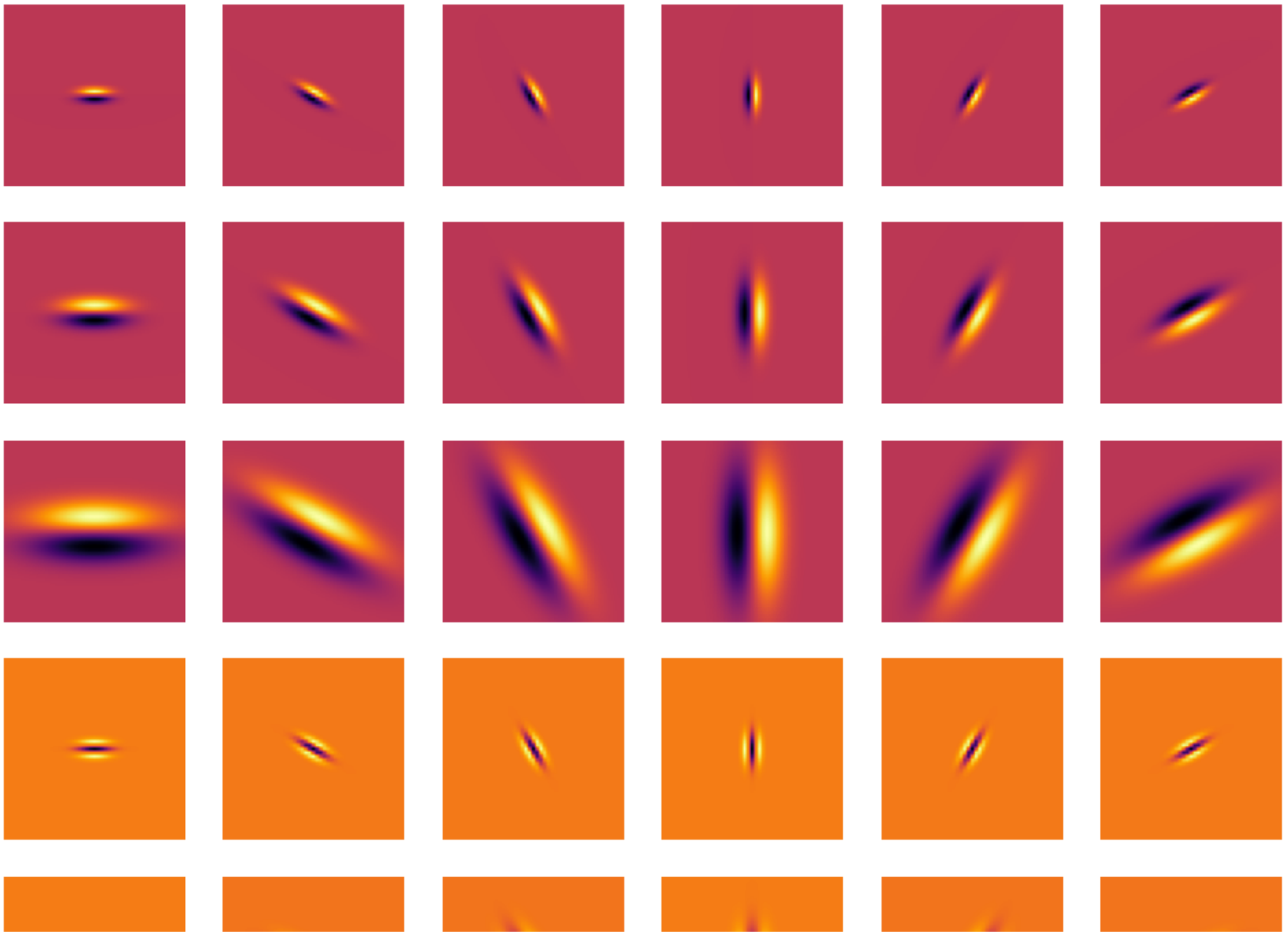
```
    def plot_filters(filters, title, size=(49, 49)):
        rows, cols = filters.shape[:2]
        fig, axes = plt.subplots(rows, cols, figsize=(12, 12))
        fig.suptitle(title, fontsize=16)

        for i in range(rows):
            for j in range(cols):
                ax = axes[i, j]
                ax.imshow(filters[i, j], cmap='inferno')
                ax.axis('off')

        plt.show()

    if debug:
        plot_filters(rfs_combined, title="Combined Edge and Bar Filters (Y component)")

    return rfs_combined

def apply_rfs_filter_scipy(image, rfs_filters):
    max_responses = np.zeros((image.shape[0], image.shape[1], rfs_filters.shape[0] +2)) # plus 2 for the log and gaus

    for sigma_ind in range(rfs_filters.shape[0]):
        # Edge filters
        responses = []
        for theta_ind in range(rfs_filters.shape[1]):
            filter = rfs_filters[sigma_ind, theta_ind]
            response = convolve(image, filter)
            responses.append(response)

        max_responses[:, :, sigma_ind] = np.max(responses, axis=0)
    # now apply log and gauss and add them to the responses at the end of np array
    sigma = 10**0.5

    log_response = convolve(image,LoG(49, sigma))
    gauss_response = convolve(image,GaussFilter(49, sigma))
    max_responses[:,:,max_responses.shape[2]-2] = gauss_response
    max_responses[:,:,max_responses.shape[2]-1] = log_response

    return max_responses
```

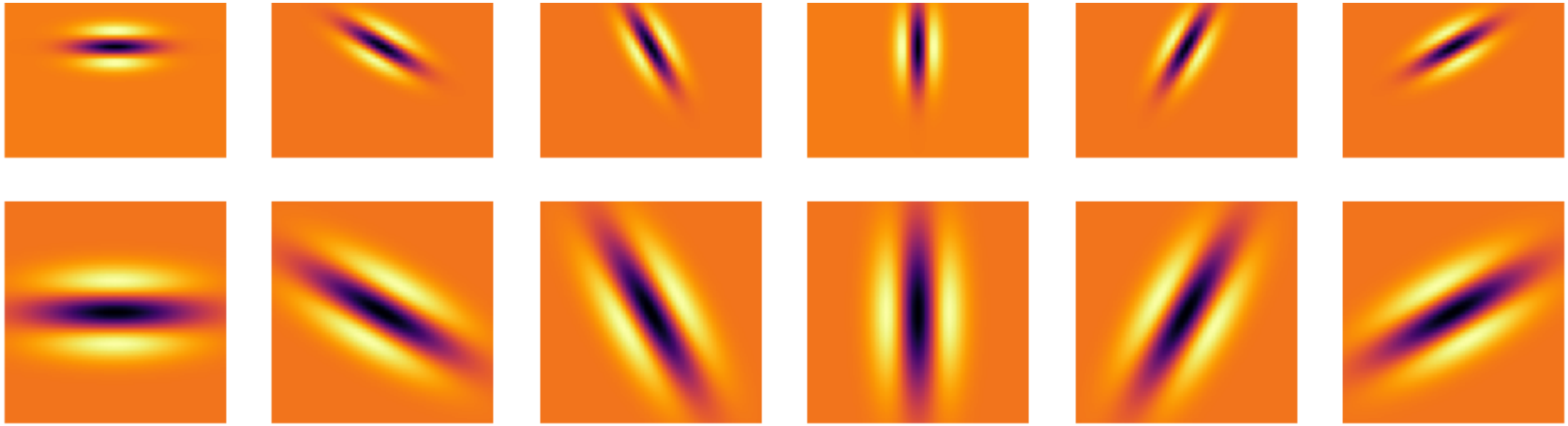
In [ ]:
```
mr8_image = cv2.imread("Images/image-35.jpg", cv2.IMREAD_GRAYSCALE)
# print(mr8_image.shape)
```

```
rfs_filters = construct_rfs(debug=True)

responses = []
for sigma_ind in range(rfs_filters.shape[0]):
    for theta_ind in range(rfs_filters.shape[1]):
        response = convolve(mr8_image,rfs_filters[sigma_ind, theta_ind])
        responses.append(response)


print("count",len(responses))
rows = 6
cols = 6
fig, axes = plt.subplots(rows, cols, figsize=(12, 12))

for i in range(rows):
    for j in range(cols):
        ax = axes[i, j]
        ax.imshow(responses[i*cols +j ],cmap='gray')
        ax.axis('off')
```

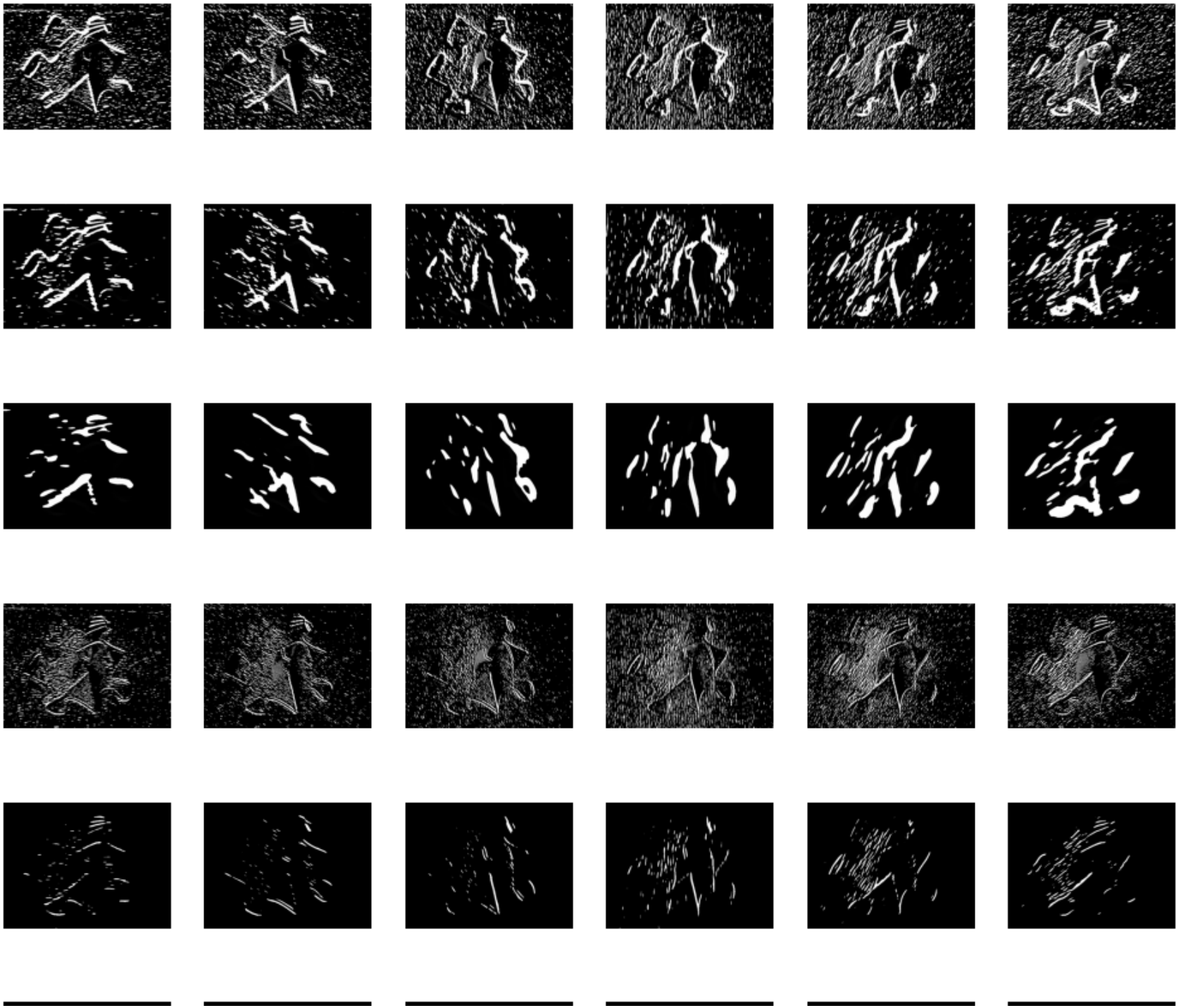
```
(6, 6, 49, 49)
```

Combined Edge and Bar Filters (Y component)





```
count 36
```



In [ ]:
```
mr8_image = cv2.imread("Images/image-35.jpg")
b,g,r = cv2.split(mr8_image)
b_response = apply_rfs_filter_scipy(b, rfs_filters)
g_response = apply_rfs_filter_scipy(g, rfs_filters)
r_response = apply_rfs_filter_scipy(r, rfs_filters)
```

In [ ]:
```
combined_responses = []

# Combine the responses for each filter (total of 6 filters)
for i in range(6):  # Assuming each response set has shape (H, W, 6)
    # Stack the R, G, B responses into a single RGB image
    combined_rgb = cv2.merge((b_response[:, :, i], g_response[:, :, i], r_response[:, :, i]))
    combined_responses.append(combined_rgb)

fig, axes = plt.subplots(nrows = 2, ncols= 3, figsize=(16,8), sharex= True, sharey = True)
for i in range(1,7):
    plt.subplot(2,3,i)
    plt.imshow(combined_responses[i-1])
    plt.axis("off")
```

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
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```
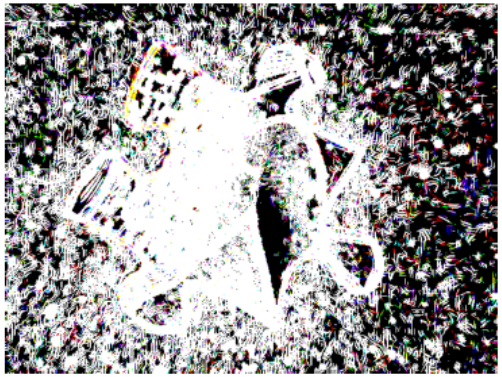






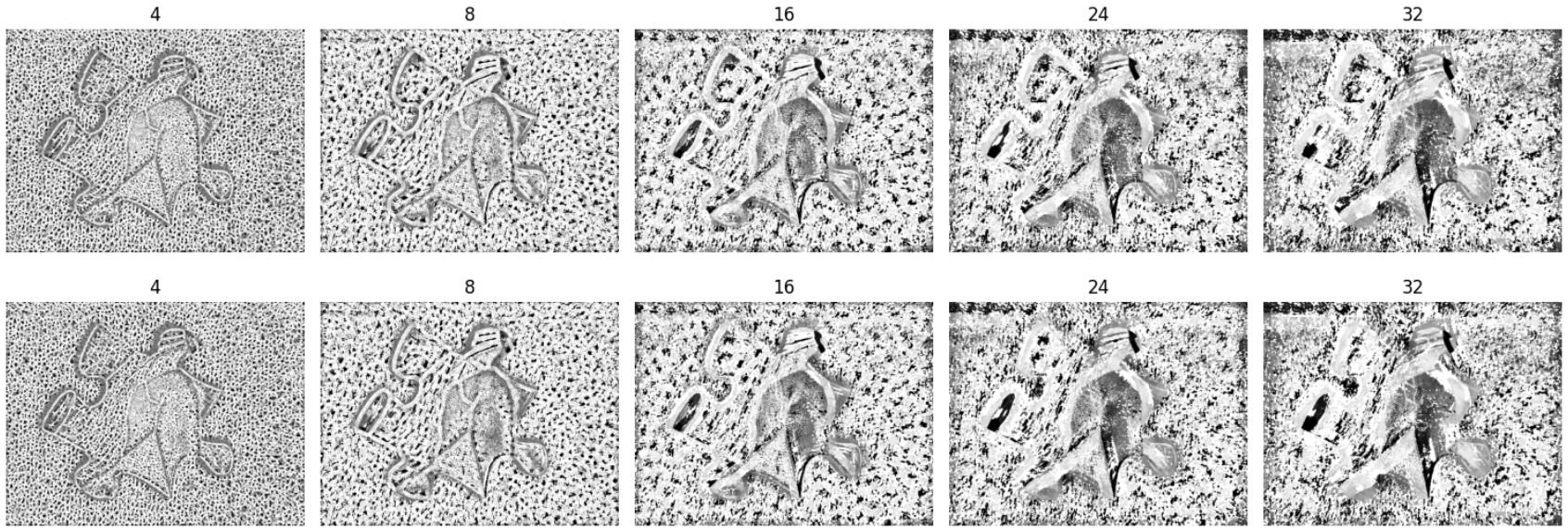
Question 3

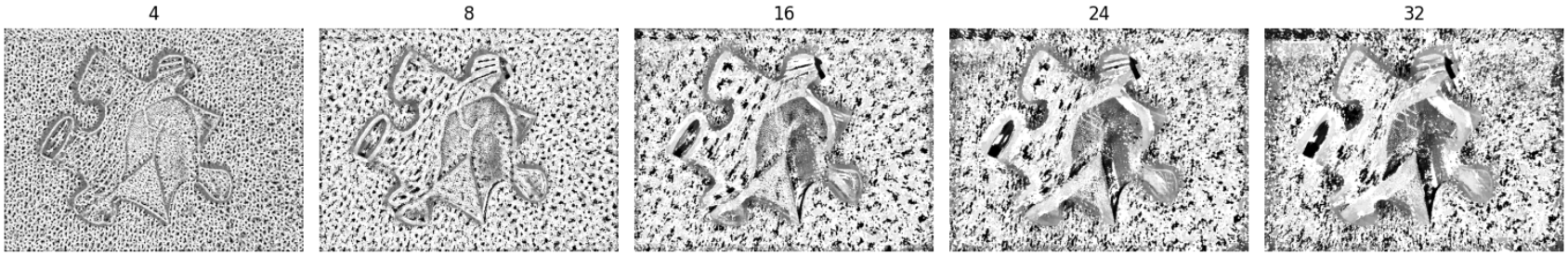
In [ ]:
```python
def getLBPs(img,show_plot=False):
    lbps = []
    radii = [4, 8, 16, 24, 32]
    for radius in radii:
        lbp = skimage.feature.local_binary_pattern(img,12,radius,'uniform')
        lbps.append(lbp)

    if show_plot:
        fig, axes = plt.subplots(1, 5, figsize=(15, 5))
        for i, (img, label) in enumerate(zip(lbps, radii)):
            axes[i].imshow(img, cmap="gray")
            axes[i].axis('off')
            axes[i].set_title(label)

        plt.tight_layout()
        plt.show()

    return np.array(lbps)
```

In [ ]:
```python
def apply_haar_filter(integral_images, filter_size,show_plot=False):
    h, w = integral_images[0].shape
    # integral images have a buffer at the end of each axis
    h= h-1
    w= w-1
    response = np.zeros((len(integral_images),h,w))

    for i in range(len(integral_images)):  # For each channel (R, G, B)
        integral_image = integral_images[i]

        for y in range(h):
            for x in range(w):
                A = integral_image[max(0,y - filter_size//2),max(0,x - filter_size//2)]
                B = integral_image[max(0,y - filter_size//2),min(w,x + filter_size//2)]
                C = integral_image[min(h,y + filter_size//2),max(0,x - filter_size//2)]
                D = integral_image[min(h,y + filter_size//2), min(w,x + filter_size//2)]

                pos_sum = A + D

                neg_sum = B + C

                response[i,y,x] = pos_sum - neg_sum
```

```
    if show_plot:
        fig, axes = plt.subplots(1, 3, figsize=(15, 5))
        for i  in range(response.shape[0]):
            axes[i].imshow(response[i].astype(np.uint8), cmap = 'gray' )
            axes[i].axis('off')

        plt.tight_layout()
        plt.show()

    return response
```

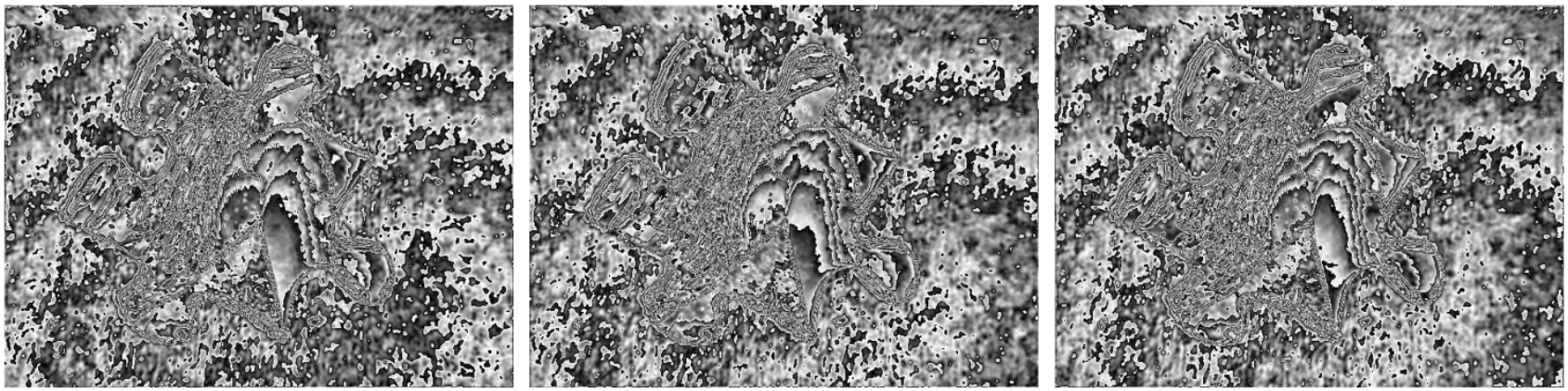
In [ ]:
```
img = cv2.imread('Images/image-35.jpg')
red, green, blue = cv2.split(img)

red_lbps = getLBPs(red,show_plot=True)
green_lbps = getLBPs(green,show_plot=True)
blue_lbps = getLBPs(blue,show_plot=True)
print(red_lbps[0].shape)
print(green_lbps[0].shape)
print(blue_lbps[0].shape)
```

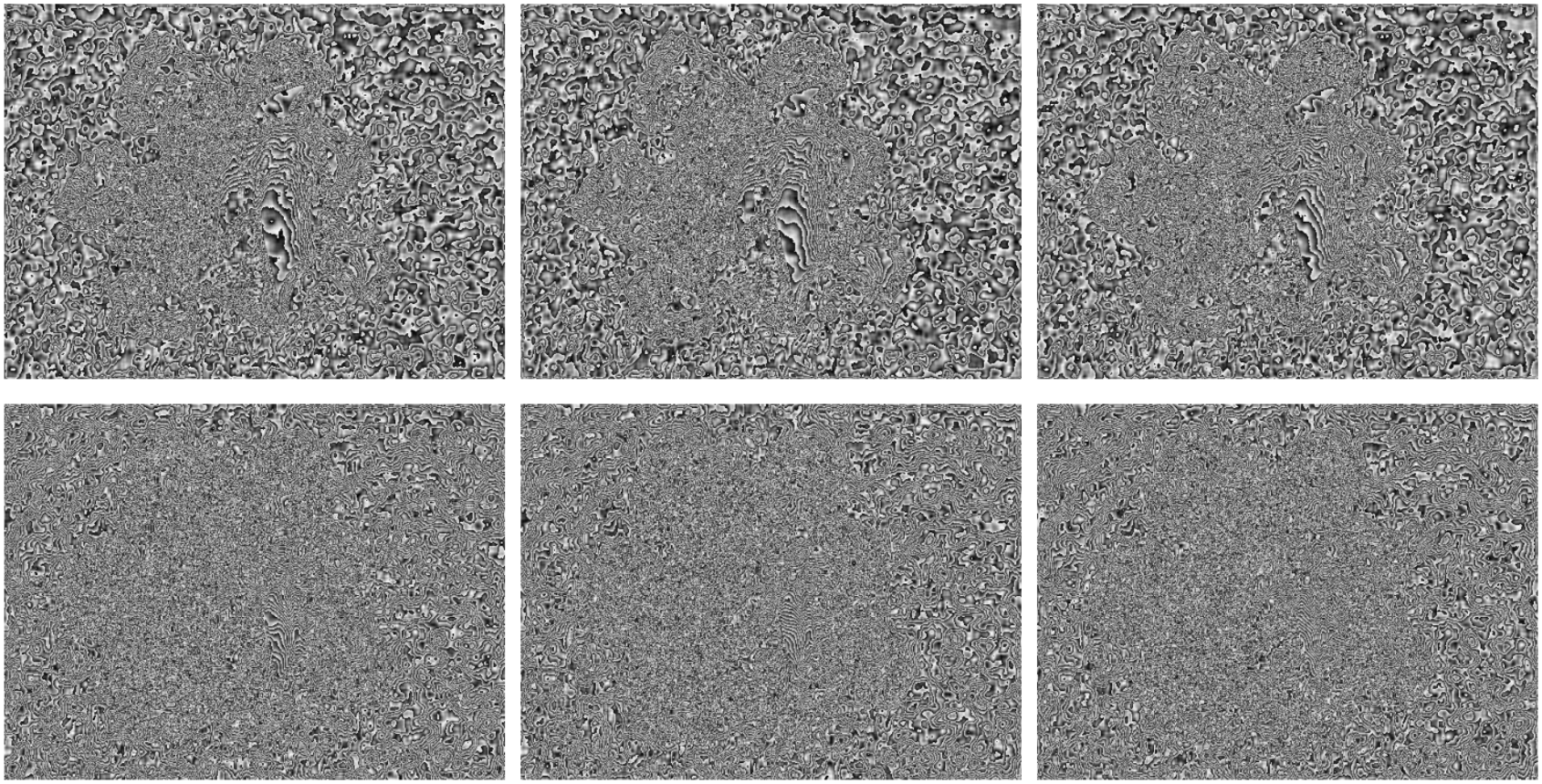





```
(450, 600)
(450, 600)
(450, 600)
```

In [ ]:
```
img = cv2.imread('Images/image-35.jpg')
integral_images =[cv2.integral(img[:, :, i]) for i in range(3)]

haar_response4 = apply_haar_filter(integral_images,4,True)
haar_response8 = apply_haar_filter(integral_images,8,True)
haar_response16 = apply_haar_filter(integral_images,16,True)
print(haar_response4.shape)
print(haar_response8.shape)
print(haar_response16.shape)
```





```
(3, 450, 600)
(3, 450, 600)
(3, 450, 600)
```

Section 4

In [ ]:
```python
from scipy.stats import multivariate_normal
from sklearn.preprocessing import OneHotEncoder

class Stat_Classifier:

    def __init__(self,image) -> None:
        self.image = image
        self.kmeans = None
        pass
```

```
def classify(self, validation_features, fg_features, bg_features, train_mask, train_image):
    # Compute the means and covariances for foreground and background
    fg_feature_matrix = np.stack(fg_features, axis=-1)
    fg_mean_vector = np.mean(fg_feature_matrix, axis=0)
    fg_cov_matrix = np.cov(fg_feature_matrix, rowvar=False)

    bg_feature_matrix = np.stack(bg_features, axis=-1)
    bg_mean_vector = np.mean(bg_feature_matrix, axis=0)
    bg_cov_matrix = np.cov(bg_feature_matrix, rowvar=False)

    print("Features extracted from original")

    # Reshape the validation features for pixel-wise processing
    reshaped_features = validation_features.T
    print("Reshaped the test features")


    probabilities = self.foreground_given_pixel(reshaped_features, fg_mean_vector, fg_cov_matrix,
                                                bg_mean_vector, bg_cov_matrix,mask,image)
    print("Computed the feature array probabilities")
    return probabilities.reshape((450,600))



def foreground_given_pixel(self,x,fg_mean, fg_cov, bg_mean, bg_cov,mask,image):
    """
    Args:
        mask (2d array): Remember to binarize it.
        image (type):the original image.

    Returns:
        type: probability.
    """
    N = image.shape[0]*image.shape[1]
    N_fg = np.sum(mask)
    N_bg = N - N_fg

    numerator = multivariate_normal.pdf( x, mean = fg_mean, cov= fg_cov, allow_singular=True) * (N_fg)
    denominator = multivariate_normal.pdf(x, mean=fg_mean, cov=fg_cov, allow_singular=True)*N_fg \
                + multivariate_normal.pdf( x, mean= bg_mean, cov= bg_cov, allow_singular=True) * (N_bg)
    small_value = 1e-10  # You can adjust the small value if needed
    denominator = np.where(denominator == 0, small_value, denominator)
```

```
        probability = numerator/denominator
        return probability

    def getFeatures(self,training_img, mask, show_plot=False,MR8:bool = False, texton:bool = False, desired_sigma = 1
        """
        Parameters:
            training_img (2d array): training image.
            mask (type): binarized image.

        Returns:
            type: Flattened features.
        """
        if(type(mask[0][0]) != np.bool_):
            binary_mask = mask >128

        vertical_prewitt = np.array([
            [1,1,1],
            [0,0,0],
            [-1,-1,-1]
        ])
        horizontal_prewitt = np.array([
            [1,0,-1],
            [1,0,-1],
            [1,0,-1]
        ])

        laplacian = np.array([
            [0,-1,0],
            [-1,4,-1],
            [0,-1,0]
        ])
        # ceil(6*sigma) x ceil(6*sigma)

        kernel_size = np.ceil(6*desired_sigma)**2
        gauss = GaussFilter(kernel_size, desired_sigma)
        lgauss =  LoG(kernel_size, desired_sigma)
        dgauss = DoG(kernel_size,desired_sigma,2)

        binary_mask = mask>128
        #plt.imshow(binary_mask)

        #add dimensions
```

```
# print(binary_mask.shape)
hsv_training_img = cv2.cvtColor(training_img, cv2.COLOR_BGR2RGB)
v,s,h = cv2.split(hsv_training_img)
h, s,v = h*binary_mask, s*binary_mask, v*binary_mask
# print(h.shape)
b,g,r = cv2.split(training_img)
r,g,b = r*binary_mask, g*binary_mask, b*binary_mask


# get vertical prewitt for separated channels

vert_prewitt_r = cv2.filter2D(src=r, ddepth=-1, kernel=vertical_prewitt)
vert_prewitt_g = cv2.filter2D(src=g, ddepth=-1, kernel=vertical_prewitt)
vert_prewitt_b = cv2.filter2D(src=b, ddepth=-1, kernel=vertical_prewitt)
# get horizontal prewitt for separated channels

hori_prewitt_r = cv2.filter2D(src=r, ddepth=-1, kernel=horizontal_prewitt)
hori_prewitt_g = cv2.filter2D(src=g, ddepth=-1, kernel=horizontal_prewitt)
hori_prewitt_b = cv2.filter2D(src=b, ddepth=-1, kernel=horizontal_prewitt)
# get Laplacian for separated channels

laplace_r = cv2.filter2D(src=r, ddepth=-1, kernel=laplacian)
laplace_g = cv2.filter2D(src=g, ddepth=-1, kernel=laplacian)
laplace_b = cv2.filter2D(src=b, ddepth=-1, kernel=laplacian)

# get gaussian for seperate channels
gauss_r = cv2.filter2D(src=r, ddepth=-1, kernel = gauss)
gauss_g = cv2.filter2D(src=g, ddepth=-1, kernel = gauss)
gauss_b = cv2.filter2D(src=b, ddepth=-1, kernel = gauss)

# get log of gaussian for seperate channels
l_gauss_r = cv2.filter2D(src=r, ddepth=-1, kernel = lgauss)
l_gauss_g = cv2.filter2D(src=g, ddepth=-1, kernel = lgauss)
l_gauss_b = cv2.filter2D(src=b, ddepth=-1, kernel = lgauss)

# get log of gaussian for seperate channels
d_gauss_r = cv2.filter2D(src=r, ddepth=-1, kernel = dgauss)
d_gauss_g = cv2.filter2D(src=g, ddepth=-1, kernel = dgauss)
d_gauss_b = cv2.filter2D(src=b, ddepth=-1, kernel = dgauss)

# get LBPs for seperate channels
lbp_r = getLBPs(r)
```

```
lbp_g = getLBPs(g)
lbp_b = getLBPs(b)

# get Harr for seperate channels and sizes
integral_images = [cv2.integral(training_img[:,:,i]) for i in range(3)]
haar4 = apply_haar_filter(integral_images,4)
haar8 = apply_haar_filter(integral_images,8)
haar16 = apply_haar_filter(integral_images,16)

if show_plot:
    # vertical prewitt plot
    fig, axes = plt.subplots(nrows = 1, ncols = 3, figsize=(16,4))
    plt.subplot(1,3,1), plt.imshow( vert_prewitt_r,cmap="gray"), plt.axis("off")
    plt.subplot(1,3,2), plt.imshow( vert_prewitt_g,cmap="gray"), plt.axis("off")
    plt.subplot(1,3,3), plt.imshow( vert_prewitt_b,cmap="gray"), plt.axis("off")
    plt.suptitle("Vertical Prewitt of RGB image")
    plt.show()

    # horizontal prewitt plot
    fig, axes = plt.subplots(nrows = 1, ncols = 3, figsize=(16,4))
    plt.subplot(1,3,1), plt.imshow( hori_prewitt_r,cmap="gray"), plt.axis("off")
    plt.subplot(1,3,2), plt.imshow( hori_prewitt_g,cmap="gray"), plt.axis("off")
    plt.subplot(1,3,3), plt.imshow( hori_prewitt_b,cmap="gray"), plt.axis("off")
    plt.suptitle("Horizontal Prewitt of RGB image")
    plt.show()

    # laplace plot
    fig, axes = plt.subplots(nrows = 1, ncols = 3, figsize=(16,4))
    plt.subplot(1,3,1), plt.imshow( laplace_r,cmap="gray"), plt.axis("off")
    plt.subplot(1,3,2), plt.imshow( laplace_g,cmap="gray"), plt.axis("off")
    plt.subplot(1,3,3), plt.imshow( laplace_b,cmap="gray"), plt.axis("off")
    plt.suptitle("Laplacian of RGB image")
    plt.show()

    # gaussian plot
    fig, axes = plt.subplots(nrows = 1, ncols = 3, figsize=(16,4))
    plt.subplot(1,3,1), plt.imshow( gauss_r,cmap="gray"), plt.axis("off")
    plt.subplot(1,3,2), plt.imshow( gauss_g,cmap="gray"), plt.axis("off")
    plt.subplot(1,3,3), plt.imshow( gauss_b,cmap="gray"), plt.axis("off")
    plt.suptitle("Gaussian of RGB image")
    plt.show()
```

```
# log of gaussian plot
fig, axes = plt.subplots(nrows = 1, ncols = 3, figsize=(16,4))
plt.subplot(1,3,1), plt.imshow( l_gauss_r,cmap="gray"), plt.axis("off")
plt.subplot(1,3,2), plt.imshow( l_gauss_g,cmap="gray"), plt.axis("off")
plt.subplot(1,3,3), plt.imshow( l_gauss_b,cmap="gray"), plt.axis("off")
plt.suptitle("Log of Gaussian of RGB image")
plt.show()

# difference of gaussian plot
fig, axes = plt.subplots(nrows = 1, ncols = 3, figsize=(16,4))
plt.subplot(1,3,1), plt.imshow( d_gauss_r,cmap="gray"), plt.axis("off")
plt.subplot(1,3,2), plt.imshow( d_gauss_g,cmap="gray"), plt.axis("off")
plt.subplot(1,3,3), plt.imshow( d_gauss_b,cmap="gray"), plt.axis("off")
plt.suptitle("Difference of Gaussian of RGB image")
plt.show()

# LBP Red plot
fig, axes = plt.subplots(1, 5, figsize=(15, 5))
for i, (img, label) in enumerate(zip(lbp_r, [4,8,16,24,32])):
    axes[i].imshow(img, cmap="gray")
    axes[i].axis('off')
    axes[i].set_title(label)

plt.suptitle("LBPs of Red image")
plt.show()

# LBP Green plot
fig, axes = plt.subplots(1, 5, figsize=(15, 5))
for i, (img, label) in enumerate(zip(lbp_g, [4,8,16,24,32])):
    axes[i].imshow(img, cmap="gray")
    axes[i].axis('off')
    axes[i].set_title(label)

plt.suptitle("LBPs of Green image")
plt.show()

# LBP Blue plot
fig, axes = plt.subplots(1, 5, figsize=(15, 5))
for i, (img, label) in enumerate(zip(lbp_b, [4,8,16,24,32])):
    axes[i].imshow(img, cmap="gray")
    axes[i].axis('off')
```

```
            axes[i].set_title(label)

        plt.suptitle("LBPs of Blue image")
        plt.show()

        # Haar4 Filter plot
        fig, axes = plt.subplots(1, 3, figsize=(15, 5))
        for i  in range(haar4.shape[0]):
            axes[i].imshow(haar4[i].astype(np.uint8),cmap="gray")
            axes[i].axis('off')

        plt.suptitle("Haar 4 of RGB image")
        plt.show()

        # Haar8 Filter plot
        fig, axes = plt.subplots(1, 3, figsize=(15, 5))
        for i  in range(haar8.shape[0]):
            axes[i].imshow(haar8[i].astype(np.uint8),cmap="gray")
            axes[i].axis('off')

        plt.suptitle("Haar 8 of RGB image")
        plt.show()

        # Haar16 Filter plot
        fig, axes = plt.subplots(1, 3, figsize=(15, 5))
        for i  in range(haar16.shape[0]):
            axes[i].imshow(haar16[i].astype(np.uint8),cmap="gray")
            axes[i].axis('off')

        plt.suptitle("Haar 16 of RGB image")
        plt.show()


    features = []
    if (feature_matrix[0]):
        features.extend([ vert_prewitt_r, hori_prewitt_r,
            vert_prewitt_g, hori_prewitt_g,
            vert_prewitt_b, hori_prewitt_b,
            laplace_r, laplace_g, laplace_b,])

    if (feature_matrix[1]):
        features.extend([gauss_r, l_gauss_r, d_gauss_r,
```

```
            gauss_g, l_gauss_g, d_gauss_g,
            gauss_b, l_gauss_b, d_gauss_b,])
    if (feature_matrix[2]):
        features.extend([lbp_r[0],lbp_r[1],lbp_r[2],lbp_r[3],lbp_r[4],
            lbp_g[0],lbp_g[1],lbp_g[2],lbp_g[3],lbp_g[4],
            lbp_b[0],lbp_b[1],lbp_b[2],lbp_b[3],lbp_b[4],])
    if (feature_matrix[3]):
        features.extend([haar4[0],haar4[1],haar4[1],
            haar8[0],haar8[1],haar8[1],
            haar16[0],haar16[1],haar16[1],])
    if (feature_matrix[4]):
        features.extend([r, g, b,])
    if (feature_matrix[5]):
        features.extend([ h, s, v,])

    if MR8:
        # apply the MR8 feature bank to the HSV pixels and include these features in your model as well.
        rfs_filters = construct_rfs(debug=False)

        hsv = [h,s,v]
        for channel in hsv:
            channel_rfs_response = apply_rfs_filter_scipy(channel, rfs_filters)
            for i in range(1,channel_rfs_response.shape[2]+1):
                features.append(channel_rfs_response[:, :, i-1])

    flattened_features = np.array([f[binary_mask].flatten() for f in features])
    # print(flattened_features[0].shape)

    flattened_features = np.array([f[binary_mask].flatten() for f in features])
    print("Shape of flattened_features before texton:", flattened_features.shape)
    if texton:

        textons = self.textons(image, mask)

        # One-hot encode the textons
        encoder = OneHotEncoder(categories=[range(4)], sparse_output=False)
        textons_one_hot = encoder.fit_transform(textons.flatten().reshape(-1, 1))


        # Transpose filtered_textons to get the shape
        filtered_textons = textons_one_hot.T
```

```
            print("Shape of filtered_textons:", filtered_textons.shape)

            # Concatenate along the features axis (features should be appended)
            concatenated_features = np.concatenate([flattened_features, filtered_textons], axis=0)

            print("Shape of concatenated_features:", concatenated_features.shape)



        return np.array(flattened_features)

    def textons(self, image, mask, plot=False):
        original_features = self.getFeatures(image, mask, False)
        print(original_features.shape)

        perpixel_features = np.swapaxes(original_features, 0, 1)
        print("Clustering!")

        # mask_flattened = mask.flatten()
        # masked_features = perpixel_features[mask_flattened]

        kmeans = KMeans(n_clusters=4, random_state=42).fit(perpixel_features)
        textons_intern = kmeans.labels_


        if plot:
            plt.imshow(textons_intern.reshape(mask.shape))
            plt.show()

        return textons_intern

    def dummy_test(self, image_path):
        # Mask,inverse and image (original in the lab1)

        # Example usage within the dummy_test or other testing functions:
        image = cv2.imread("Images/image-35.jpg")
        mask = cv2.imread("Images/mask-35.png", cv2.IMREAD_GRAYSCALE)
        inverse_mask = 255 - mask
        class_inst = Stat_Classifier(image)

        # Extract textons from the training image
        # train_textons = class_inst.textons(image, )
```

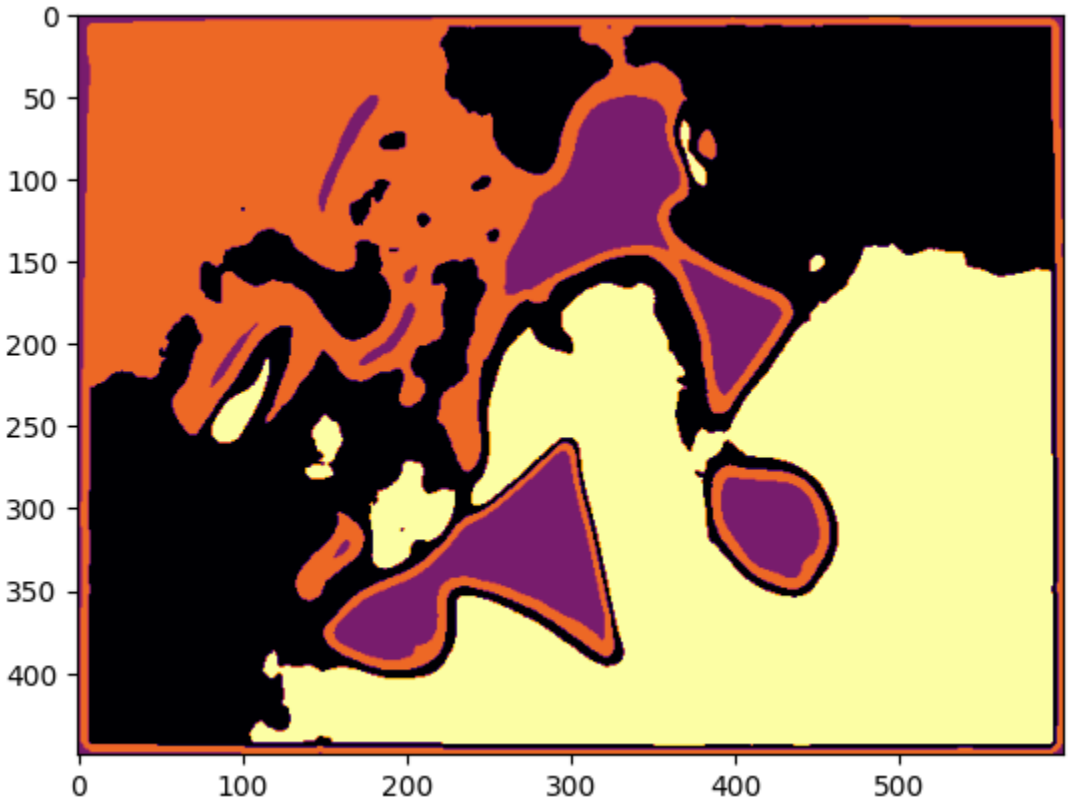
```
        # Validation features
        null = np.ones_like(mask) * 255
        validation_img = cv2.imread("Images/image-83.jpg")

        validation_features = class_inst.getFeatures(validation_img, null, show_plot=False, texton=True)
        fg_features = class_inst.getFeatures(image, mask, show_plot=False, texton=True)
        bg_features = class_inst.getFeatures(image, inverse_mask, show_plot=False, texton=True)

        # Extract textons for the validation image
        # validation_textons = class_inst.textons(validation_img, null)

        # Classify
        verify_img = class_inst.classify(validation_features, fg_features, bg_features, mask, image)
        theta = 0.5
        thresholded_img = verify_img.copy() > theta
        plt.figure()
        plt.imshow(thresholded_img, cmap="gray"), plt.title("Validation image prediction")
        plt.show()
        return verify_img

        # accuracy
```

4.2 Find and display Textons

In [ ]:
```
image = cv2.imread("Images/image-35.jpg")
mask = cv2.imread("Images/mask-35.png", cv2.IMREAD_GRAYSCALE)
classify_inst = Stat_Classifier(image)
null = np.ones_like(mask)*255
original_features = classify_inst.getFeatures(image,null,False)
print(original_features.shape)

perpixel_features = np.swapaxes(original_features,0,1)

kmeans = KMeans(n_clusters=4, random_state=42).fit(perpixel_features)
textons = kmeans.labels_
plt.imshow(textons.reshape(450,600), cmap="inferno")
```

```
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
```

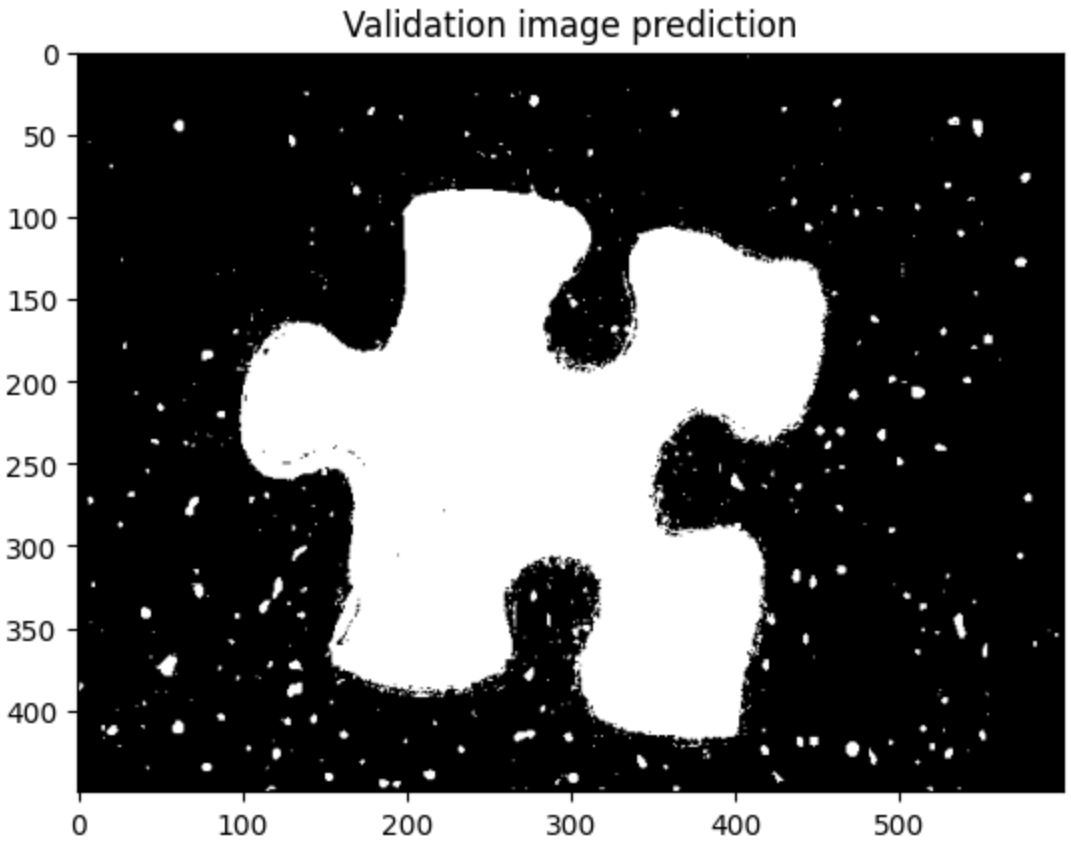
Out[ ]: <matplotlib.image.AxesImage at 0x29c8eb6b3e0>



4.3 Testing model accuracy on test Image

In [ ]:
```
test_image = cv2.imread("Images/image-83.jpg")
image = cv2.imread("Images/image-35.jpg")
print(test_image.shape)
mask = cv2.imread("Images/mask-35.png", cv2.IMREAD_GRAYSCALE)
null = np.ones_like(mask)*255

classify_inst = Stat_Classifier(image)

print("classifying the test image")
test_img_result = classify_inst.dummy_test("Images/image-83.jpg")
```

```
(450, 600, 3)
classifying the test image
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Shape of flattened_features before texton: (48, 74571)
Shape of flattened_features before texton: (48, 74571)
(48, 74571)
Clustering!
Shape of filtered_textons: (4, 74571)
Shape of concatenated_features: (52, 74571)
Shape of flattened_features before texton: (48, 195424)
Shape of flattened_features before texton: (48, 195424)
(48, 195424)
Clustering!
Shape of filtered_textons: (4, 195424)
Shape of concatenated_features: (52, 195424)
Features extracted from original
Reshaped the test features
Computed the feature array probabilities
```



Accuracy using textons - IOU SCORE

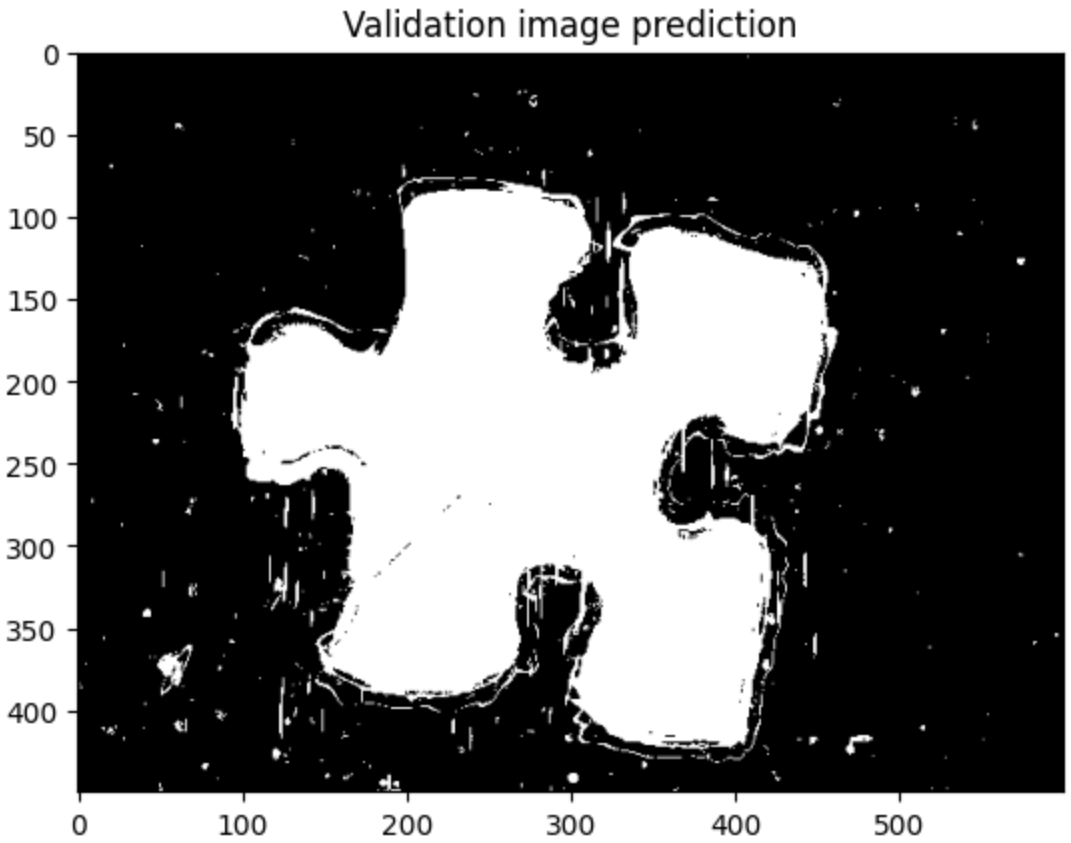
In [ ]:
```
from sklearn.metrics import confusion_matrix
test_mask = cv2.imread("Images/mask-83.png", cv2.IMREAD_GRAYSCALE)
def get_IOU_PosNeg(img1,img2):
    conf_matrix = confusion_matrix((img1 >0.99).astype(int).flatten(), (img2 >0.99).astype(int).flatten())
    TN = conf_matrix[0][0]
    fn = conf_matrix[1][0]
    tp = conf_matrix[1][1]
    fp = conf_matrix[0][1]
    iou = tp / (tp + fp + fn)

    return iou
print(get_IOU_PosNeg(test_mask, test_img_result))
```

```
0.8281889785202214
```

4.4 Using MR8 for classifier

In [ ]:
```
image = cv2.imread("Images/image-35.jpg")
mask = cv2.imread("Images/mask-35.png", cv2.IMREAD_GRAYSCALE)
inverse_mask = 255 - mask
class_inst = Stat_Classifier(image)


# Validation features
null = np.ones_like(mask) * 255
validation_img = cv2.imread("Images/image-83.jpg")

validation_features = class_inst.getFeatures(validation_img, null, show_plot=False,MR8= True, texton=True)
fg_features = class_inst.getFeatures(image, mask, show_plot=False,MR8= True, texton=True)
bg_features = class_inst.getFeatures(image, inverse_mask, show_plot=False,MR8= True, texton=True)



# Classify
verify_img = class_inst.classify(validation_features, fg_features, bg_features, mask, image)
theta = 0.5
thresholded_img = verify_img.copy() > theta
plt.figure()
plt.imshow(thresholded_img, cmap="gray"), plt.title("Validation image prediction")
plt.show()
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (72, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (76, 270000)
(6, 6, 49, 49)
Shape of flattened_features before texton: (72, 74571)
Shape of flattened_features before texton: (48, 74571)
(48, 74571)
Clustering!
Shape of filtered_textons: (4, 74571)
Shape of concatenated_features: (76, 74571)
(6, 6, 49, 49)
Shape of flattened_features before texton: (72, 195424)
Shape of flattened_features before texton: (48, 195424)
(48, 195424)
Clustering!
Shape of filtered_textons: (4, 195424)
Shape of concatenated_features: (76, 195424)
Features extracted from original
Reshaped the test features
Computed the feature array probabilities
```



Accuracy of MR8 + TExtons - IOU SCORE

In [ ]:
```
test_mask = cv2.imread("Images/mask-83.png", cv2.IMREAD_GRAYSCALE)
print(get_IOU_PosNeg(test_mask, verify_img))
```

```
0.7847404063205418
```

Question 4.5

In [ ]:
```
import sklearn.linear_model


image = cv2.imread("Images/image-35.jpg")
mask = cv2.imread("Images/mask-35.png", cv2.IMREAD_GRAYSCALE)
mask = mask>=127.5
```

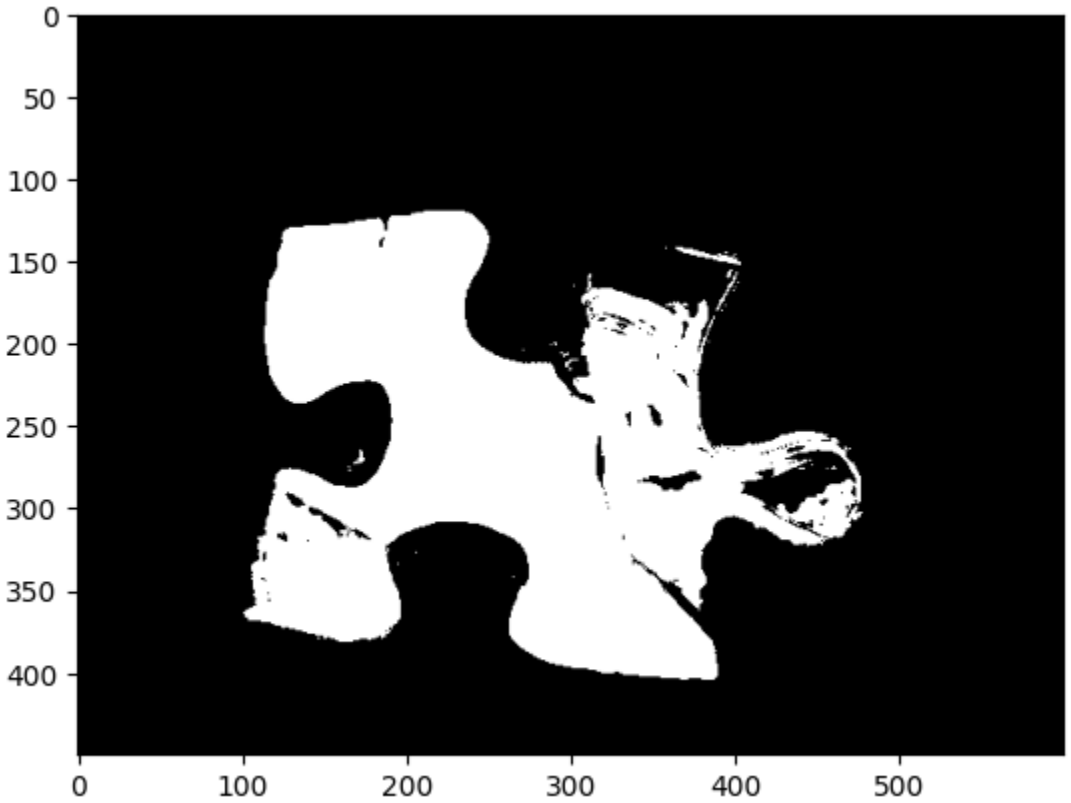
```
null = np.ones_like(mask)*255

classify_inst = Stat_Classifier(image)

original_features = classify_inst.getFeatures(image,null,False,MR8=True)

perpixel_features = np.swapaxes(original_features,0,1)

log_reg = sklearn.linear_model.LogisticRegression().fit(perpixel_features,mask.flatten())
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (72, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

In [ ]:
```
ver = cv2.imread("Images/image-110.jpg")
mask = cv2.imread("Images/mask-110.png", cv2.IMREAD_GRAYSCALE)
mask = mask>=127.5
ver_features = classify_inst.getFeatures(ver,null,False,MR8=True,texton=True)
ver_perpixel_features = np.swapaxes(ver_features,0,1)

predictions = log_reg.predict(ver_perpixel_features)
print("Accuracy", log_reg.score(ver_perpixel_features,mask.flatten()))

print(predictions.shape)

plt.imshow(predictions.reshape(450,600),cmap = 'gray')
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (72, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (76, 270000)
Accuracy 0.9647222222222223
(270000,)
```

Out[ ]: <matplotlib.image.AxesImage at 0x29c832a29c0>



In [ ]:
```python
from itertools import product
from tqdm import tqdm
# Running features with and without MR8
# Length of the boolean array
n = 6
```

```
# Generate all possible combinations of 0s and 1s
combinations = list(product([0, 1], repeat=n))

# Convert tuples to lists
combinations = [list(comb) for comb in combinations]
accuracies = []
# Print the combinations

# MR8 and textons

for comb in tqdm(combinations):
    if(comb != [0,0,0,0,0,0]):
        import sklearn.linear_model


        image = cv2.imread("Images/image-35.jpg")
        mask = cv2.imread("Images/mask-35.png", cv2.IMREAD_GRAYSCALE)
        mask = mask>=127.5
        null = np.ones_like(mask)*255

        classify_inst = Stat_Classifier(image)

        original_features = classify_inst.getFeatures(image,null,False,MR8=True,feature_matrix=comb)

        perpixel_features = np.swapaxes(original_features,0,1)

        log_reg = sklearn.linear_model.LogisticRegression().fit(perpixel_features,mask.flatten())
        ver = cv2.imread("Images/image-110.jpg")
        mask = cv2.imread("Images/mask-110.png", cv2.IMREAD_GRAYSCALE)
        mask = mask>=127.5
        ver_features = classify_inst.getFeatures(ver,null,False,MR8=True,texton=True,feature_matrix=comb)
        ver_perpixel_features = np.swapaxes(ver_features,0,1)

        predictions = log_reg.predict(ver_perpixel_features)
        print("Accuracy", log_reg.score(ver_perpixel_features,mask.flatten()))
        accuracies.append(log_reg.score(ver_perpixel_features,mask.flatten()))
accuracies1 = accuracies
# only textons
accuracies = []
for comb in tqdm(combinations):
    if(comb != [0,0,0,0,0,0]):
        import sklearn.linear_model
```

```
        image = cv2.imread("Images/image-35.jpg")
        mask = cv2.imread("Images/mask-35.png", cv2.IMREAD_GRAYSCALE)
        mask = mask>=127.5
        null = np.ones_like(mask)*255

        classify_inst = Stat_Classifier(image)

        original_features = classify_inst.getFeatures(image,null,False,MR8=False,feature_matrix=comb)

        perpixel_features = np.swapaxes(original_features,0,1)

        log_reg = sklearn.linear_model.LogisticRegression().fit(perpixel_features,mask.flatten())
        ver = cv2.imread("Images/image-110.jpg")
        mask = cv2.imread("Images/mask-110.png", cv2.IMREAD_GRAYSCALE)
        mask = mask>=127.5
        ver_features = classify_inst.getFeatures(ver,null,False,MR8=False,texton=True,feature_matrix=comb)
        ver_perpixel_features = np.swapaxes(ver_features,0,1)

        predictions = log_reg.predict(ver_perpixel_features)
        print("Accuracy", log_reg.score(ver_perpixel_features,mask.flatten()))
        accuracies.append(log_reg.score(ver_perpixel_features,mask.flatten()))
accuracies2 = accuracies

print(np.argmax(accuracies1))
print(np.argmax(accuracies2))
```

```
  0%|          | 0/64 [00:00<?, ?it/s]
(6, 6, 49, 49)
Shape of flattened_features before texton: (27, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (27, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  3%|▌         | 2/64 [01:29<46:07, 44.64s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (31, 270000)
Accuracy 0.9776555555555556
(6, 6, 49, 49)
Shape of flattened_features before texton: (27, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (27, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  5%|▌         | 3/64 [03:01<1:05:22, 64.30s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (31, 270000)
Accuracy 0.9776851851851852
(6, 6, 49, 49)
Shape of flattened_features before texton: (30, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (30, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  6%|▉         | 4/64 [04:31<1:13:58, 73.97s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (34, 270000)
Accuracy 0.9769592592592593
(6, 6, 49, 49)
Shape of flattened_features before texton: (33, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (33, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  8%|▉         | 5/64 [05:59<1:17:43, 79.05s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (37, 270000)
Accuracy 0.9627333333333333
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  9%|▉         | 6/64 [07:26<1:18:47, 81.51s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9623666666666667
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 11%|▉         | 7/64 [08:53<1:19:03, 83.23s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9632407407407407
(6, 6, 49, 49)
Shape of flattened_features before texton: (39, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (39, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 12%|█▏        | 8/64 [10:19<1:18:37, 84.25s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (43, 270000)
Accuracy 0.9612666666666667
(6, 6, 49, 49)
Shape of flattened_features before texton: (39, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (39, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 14%|█▍        | 9/64 [11:46<1:17:50, 84.92s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (43, 270000)
Accuracy 0.9223555555555556
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 16%|█         | 10/64 [13:12<1:16:44, 85.28s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (46, 270000)
Accuracy 0.9366666666666666
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 17%|█▏        | 11/64 [14:38<1:15:33, 85.53s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (46, 270000)
Accuracy 0.9366666666666666
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 19%|██        | 12/64 [16:05<1:14:29, 85.95s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (49, 270000)
Accuracy 0.9595407407407407
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 20%|██        | 13/64 [17:32<1:13:22, 86.32s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Accuracy 0.9629074074074074
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (55, 270000)
Accuracy 0.9618555555555556
 22%|██▏       | 14/64 [19:00<1:12:17, 86.76s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 23%|██▎       | 15/64 [20:27<1:11:03, 87.00s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (55, 270000)
Accuracy 0.9614962962962963
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (58, 270000)
Accuracy 0.9623962962962963
 25%|██▌       | 16/64 [21:54<1:09:38, 87.05s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (33, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (33, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 27%|██▋       | 17/64 [23:20<1:07:47, 86.55s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (37, 270000)
Accuracy 0.9764
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 28%|██▊       | 18/64 [24:45<1:06:08, 86.27s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9779814814814815
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 30%|██▉       | 19/64 [26:11<1:04:34, 86.09s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9779148148148148
(6, 6, 49, 49)
Shape of flattened_features before texton: (39, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (39, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 31%|███       | 20/64 [27:37<1:03:02, 85.97s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (43, 270000)
Accuracy 0.9790925925925926
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 33%|███       | 21/64 [29:03<1:01:36, 85.97s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (46, 270000)
Accuracy 0.9621222222222222
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 34%|███▍      | 22/64 [30:29<1:00:15, 86.09s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (49, 270000)
Accuracy 0.9616518518518519
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 36%|███▌      | 23/64 [31:55<58:53, 86.18s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (49, 270000)
Accuracy 0.9614962962962963
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 38%|███▊      | 24/64 [33:22<57:27, 86.20s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Accuracy 0.9619666666666666
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Accuracy 0.9539592592592593
 39%|███▉      | 25/64 [34:48<56:04, 86.28s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (55, 270000)
Accuracy 0.9430851851851851
 41%|████      | 26/64 [36:15<54:44, 86.44s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (55, 270000)
Accuracy 0.9430481481481482
 42%|████      | 27/64 [37:42<53:22, 86.55s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (58, 270000)
Accuracy 0.9661222222222222
 44%|████▍     | 28/64 [39:10<52:14, 87.06s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (57, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (57, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (61, 270000)
Accuracy 0.9613111111111111
 45%|████▌     | 29/64 [40:38<50:54, 87.27s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (64, 270000)
Accuracy 0.9617518518518519
 47%|████▋     | 30/64 [42:06<49:35, 87.51s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (64, 270000)
Accuracy 0.9622851851851851
 48%|████▊     | 31/64 [43:34<48:12, 87.65s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (63, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (63, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (67, 270000)
Accuracy 0.961237037037037
 50%|████▉     | 32/64 [45:02<46:46, 87.69s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (33, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (33, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 52%|█████     | 33/64 [46:27<44:57, 87.02s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (37, 270000)
Accuracy 0.9353518518518519
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 53%|█████     | 34/64 [47:53<43:18, 86.61s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9625888888888889
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 55%|█████     | 35/64 [49:18<41:41, 86.26s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9625851851851852
(6, 6, 49, 49)
Shape of flattened_features before texton: (39, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (39, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 56%|█████▌    | 36/64 [50:44<40:09, 86.07s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (43, 270000)
Accuracy 0.9639629629629629
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 58%|█████▊    | 37/64 [52:10<38:41, 85.98s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (46, 270000)
Accuracy 0.9613407407407407
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 59%|█████▉    | 38/64 [53:36<37:18, 86.11s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (49, 270000)
Accuracy 0.9599074074074074
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 61%|██████    | 39/64 [55:02<35:55, 86.23s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (49, 270000)
Accuracy 0.9625703703703704
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 62%|██████▏   | 40/64 [56:29<34:29, 86.24s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Accuracy 0.9624814814814815
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 64%|██████▍   | 41/64 [57:55<33:01, 86.17s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Accuracy 0.9251666666666667
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 66%|██████    | 42/64 [59:21<31:39, 86.33s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (55, 270000)
Accuracy 0.9363037037037037
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 67%|██████▏   | 43/64 [1:00:48<30:13, 86.37s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (55, 270000)
Accuracy 0.9368666666666666
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 69%|██████▉   | 44/64 [1:02:15<28:49, 86.49s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (58, 270000)
Accuracy 0.9444814814814815
(6, 6, 49, 49)
Shape of flattened_features before texton: (57, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (57, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (61, 270000)
Accuracy 0.9615518518518519
 70%|███████   | 45/64 [1:03:42<27:28, 86.77s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (64, 270000)
Accuracy 0.9610222222222222
 72%|███████▏  | 46/64 [1:05:10<26:06, 87.04s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (64, 270000)
Accuracy 0.9614962962962963
 73%|███████▎  | 47/64 [1:06:37<24:43, 87.24s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (63, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (63, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (67, 270000)
Accuracy 0.9617740740740741
 75%|███████   | 48/64 [1:08:05<23:19, 87.44s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (42, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 77%|███████▋  | 49/64 [1:09:31<21:43, 86.93s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (46, 270000)
Accuracy 0.9688481481481481
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 78%|███████▊  | 50/64 [1:10:57<20:13, 86.67s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (49, 270000)
Accuracy 0.9624444444444444
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (45, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 80%|████████  | 51/64 [1:12:23<18:43, 86.45s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (49, 270000)
Accuracy 0.9628592592592593
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 81%|████████ | 52/64 [1:13:49<17:15, 86.32s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Accuracy 0.9776925925925926
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (51, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 83%|████████ | 53/64 [1:15:16<15:50, 86.41s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (55, 270000)
Accuracy 0.9616925925925925
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 84%|████████▍ | 54/64 [1:16:43<14:25, 86.54s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (58, 270000)
Accuracy 0.9614037037037036
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (54, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 86%|████████▌ | 55/64 [1:18:09<12:59, 86.60s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (58, 270000)
Accuracy 0.9613481481481482
(6, 6, 49, 49)
Shape of flattened_features before texton: (57, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (57, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (61, 270000)
Accuracy 0.9611444444444445
 88%|████████▊ | 56/64 [1:19:37<11:34, 86.80s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (57, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (57, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (61, 270000)
Accuracy 0.9385222222222223
 89%|████████▉ | 57/64 [1:21:04<10:08, 86.86s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 91%|█████████ | 58/64 [1:22:31<08:41, 86.99s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (64, 270000)
Accuracy 0.9439296296296297
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (60, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (64, 270000)
Accuracy 0.9439333333333333
 92%|█████████| 59/64 [1:23:58<07:15, 87.13s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (63, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (63, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (67, 270000)
Accuracy 0.9389148148148149
 94%|█████████▍| 60/64 [1:25:26<05:48, 87.18s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (66, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (66, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (70, 270000)
Accuracy 0.9619111111111112
 95%|█████████▌| 61/64 [1:26:54<04:22, 87.38s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (69, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (69, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (73, 270000)
Accuracy 0.9622
 97%|█████████▋| 62/64 [1:28:22<02:55, 87.64s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (69, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
(6, 6, 49, 49)
Shape of flattened_features before texton: (69, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (73, 270000)
Accuracy 0.9616370370370371
 98%|█████████▊| 63/64 [1:29:50<01:27, 87.74s/it]
(6, 6, 49, 49)
Shape of flattened_features before texton: (72, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
(6, 6, 49, 49)
Shape of flattened_features before texton: (72, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (76, 270000)
Accuracy 0.9647222222222223
100%|██████████| 64/64 [1:31:19<00:00, 85.62s/it]
  0%|          | 0/64 [00:00<?, ?it/s]
Shape of flattened_features before texton: (3, 270000)
Shape of flattened_features before texton: (3, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  3%|▌         | 2/64 [00:13<06:56,  6.71s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (7, 270000)
Accuracy 0.9676888888888889
Shape of flattened_features before texton: (3, 270000)
Shape of flattened_features before texton: (3, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  5%|▌         | 3/64 [00:26<09:38,  9.49s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (7, 270000)
Accuracy 0.9676888888888889
Shape of flattened_features before texton: (6, 270000)
Shape of flattened_features before texton: (6, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  6%|▋         | 4/64 [00:40<10:59, 10.99s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (10, 270000)
Accuracy 0.9676888888888889
Shape of flattened_features before texton: (9, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (9, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  8%|▉         | 5/64 [00:54<11:54, 12.11s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (13, 270000)
Accuracy 0.9653074074074074
Shape of flattened_features before texton: (12, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (12, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
  9%|▉         | 6/64 [01:08<12:22, 12.79s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (16, 270000)
Accuracy 0.9644
Shape of flattened_features before texton: (12, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (12, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 11%|          | 7/64 [01:22<12:33, 13.22s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (16, 270000)
Accuracy 0.9644148148148148
Shape of flattened_features before texton: (15, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (15, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 12%|          | 8/64 [01:37<12:42, 13.61s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (19, 270000)
Accuracy 0.9683074074074074
Shape of flattened_features before texton: (15, 270000)
Shape of flattened_features before texton: (15, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
```

```
 14%|█         | 9/64 [01:51<12:35, 13.74s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (19, 270000)
Accuracy 0.776062962962963
Shape of flattened_features before texton: (18, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (18, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 16%|█▏        | 10/64 [02:05<12:33, 13.96s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (22, 270000)
Accuracy 0.9808296296296296
Shape of flattened_features before texton: (18, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (18, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 17%|█▏        | 11/64 [02:20<12:28, 14.12s/it]
```

```
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (22, 270000)
Accuracy 0.9769148148148148
Shape of flattened_features before texton: (21, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (21, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 19%|██        | 12/64 [02:34<12:22, 14.28s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (25, 270000)
Accuracy 0.9835851851851852
Shape of flattened_features before texton: (24, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (24, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 20%|██        | 13/64 [02:49<12:16, 14.43s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (28, 270000)
Accuracy 0.9616962962962963
Shape of flattened_features before texton: (27, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (27, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 22%|██▏       | 14/64 [03:04<12:10, 14.61s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (31, 270000)
Accuracy 0.9647370370370371
Shape of flattened_features before texton: (27, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (27, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 23%|██▎       | 15/64 [03:19<12:01, 14.72s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (31, 270000)
Accuracy 0.9646555555555556
Shape of flattened_features before texton: (30, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (30, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 25%|██▌       | 16/64 [03:34<11:50, 14.81s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (34, 270000)
Accuracy 0.9665666666666667
Shape of flattened_features before texton: (9, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (9, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 27%|██▋       | 17/64 [03:48<11:26, 14.61s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (13, 270000)
Accuracy 0.9641111111111111
Shape of flattened_features before texton: (12, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (12, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 28%|██▊       | 18/64 [04:02<11:05, 14.46s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (16, 270000)
Accuracy 0.9774333333333334
Shape of flattened_features before texton: (12, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (12, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 30%|██▉       | 19/64 [04:17<10:46, 14.37s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (16, 270000)
Accuracy 0.9695925925925926
Shape of flattened_features before texton: (15, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (15, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 31%|███       | 20/64 [04:31<10:32, 14.37s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (19, 270000)
Accuracy 0.9763
Shape of flattened_features before texton: (18, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (18, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 33%|███       | 21/64 [04:45<10:18, 14.39s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (22, 270000)
Accuracy 0.9696592592592592
Shape of flattened_features before texton: (21, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (21, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 34%|███▍      | 22/64 [05:00<10:08, 14.48s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (25, 270000)
Accuracy 0.969362962962963
Shape of flattened_features before texton: (21, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (21, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 36%|███▋      | 23/64 [05:15<09:55, 14.52s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (25, 270000)
Accuracy 0.9695111111111111
Shape of flattened_features before texton: (24, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (24, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 38%|███▊      | 24/64 [05:29<09:41, 14.54s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (28, 270000)
Accuracy 0.9711555555555555
Shape of flattened_features before texton: (24, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (24, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 39%|███▉      | 25/64 [05:44<09:27, 14.55s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (28, 270000)
Accuracy 0.9723888888888889
Shape of flattened_features before texton: (27, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (27, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 41%|████      | 26/64 [05:59<09:16, 14.63s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (31, 270000)
Accuracy 0.9704037037037037
Shape of flattened_features before texton: (27, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (27, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 42%|████      | 27/64 [06:14<09:05, 14.75s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (31, 270000)
Accuracy 0.9715666666666667
Shape of flattened_features before texton: (30, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (30, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 44%|████▍     | 28/64 [06:29<08:53, 14.82s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (34, 270000)
Accuracy 0.9720962962962963
Shape of flattened_features before texton: (33, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (33, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 45%|████▌     | 29/64 [06:44<08:39, 14.85s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (37, 270000)
Accuracy 0.9561777777777778
Shape of flattened_features before texton: (36, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 47%|████▋     | 30/64 [06:59<08:26, 14.91s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9618185185185185
Shape of flattened_features before texton: (36, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 48%|████▊     | 31/64 [07:14<08:12, 14.92s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9629925925925926
Shape of flattened_features before texton: (39, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (39, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 50%|█████     | 32/64 [07:29<08:01, 15.05s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (43, 270000)
Accuracy 0.9673962962962963
Shape of flattened_features before texton: (9, 270000)
Shape of flattened_features before texton: (9, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 52%|█████▏    | 33/64 [07:43<07:33, 14.63s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (13, 270000)
Accuracy 0.7871481481481482
Shape of flattened_features before texton: (12, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (12, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
```

```
 53%|█████     | 34/64 [07:57<07:12, 14.41s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (16, 270000)
Accuracy 0.9857296296296296
Shape of flattened_features before texton: (12, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (12, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 55%|█████▌    | 35/64 [08:11<06:55, 14.31s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (16, 270000)
Accuracy 0.9857296296296296
Shape of flattened_features before texton: (15, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (15, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 56%|█████▌    | 36/64 [08:25<06:40, 14.30s/it]
```

```
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (19, 270000)
Accuracy 0.985025925925926
Shape of flattened_features before texton: (18, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (18, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 58%|█████▊    | 37/64 [08:39<06:27, 14.34s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (22, 270000)
Accuracy 0.9639814814814814
Shape of flattened_features before texton: (21, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (21, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 59%|█████▉    | 38/64 [08:54<06:15, 14.43s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (25, 270000)
Accuracy 0.9635111111111111
Shape of flattened_features before texton: (21, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (21, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 61%|██████    | 39/64 [09:09<06:03, 14.53s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (25, 270000)
Accuracy 0.9634444444444444
Shape of flattened_features before texton: (24, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (24, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 62%|██████▏   | 40/64 [09:23<05:47, 14.49s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (28, 270000)
Accuracy 0.9638888888888889
Shape of flattened_features before texton: (24, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (24, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 64%|██████▍   | 41/64 [09:38<05:34, 14.52s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (28, 270000)
Accuracy 0.7895296296296296
Shape of flattened_features before texton: (27, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (27, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 66%|██████▌   | 42/64 [09:53<05:22, 14.68s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (31, 270000)
Accuracy 0.9804259259259259
Shape of flattened_features before texton: (27, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (27, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 67%|██████▋   | 43/64 [10:08<05:10, 14.78s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (31, 270000)
Accuracy 0.980462962962963
Shape of flattened_features before texton: (30, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (30, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 69%|██████▉   | 44/64 [10:23<04:56, 14.84s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (34, 270000)
Accuracy 0.9790962962962962
Shape of flattened_features before texton: (33, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (33, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 70%|███████   | 45/64 [10:38<04:43, 14.92s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (37, 270000)
Accuracy 0.9599444444444445
Shape of flattened_features before texton: (36, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 72%|███████▏  | 46/64 [10:53<04:29, 14.94s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.964062962962963
Shape of flattened_features before texton: (36, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 73%|███████▎  | 47/64 [11:08<04:15, 15.00s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9635481481481482
Shape of flattened_features before texton: (39, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (39, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 75%|███████▌  | 48/64 [11:23<04:01, 15.10s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (43, 270000)
Accuracy 0.9655814814814815
Shape of flattened_features before texton: (18, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (18, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 77%|███████▋  | 49/64 [11:38<03:43, 14.89s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (22, 270000)
Accuracy 0.9745481481481482
Shape of flattened_features before texton: (21, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (21, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 78%|███████▊  | 50/64 [11:52<03:27, 14.82s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (25, 270000)
Accuracy 0.9781592592592593
Shape of flattened_features before texton: (21, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (21, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 80%|███████▉  | 51/64 [12:07<03:11, 14.75s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (25, 270000)
Accuracy 0.9785259259259259
Shape of flattened_features before texton: (24, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (24, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 81%|████████▏ | 52/64 [12:21<02:56, 14.68s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (28, 270000)
Accuracy 0.9835074074074074
Shape of flattened_features before texton: (27, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (27, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 83%|████████▎ | 53/64 [12:36<02:41, 14.71s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (31, 270000)
Accuracy 0.9657407407407408
Shape of flattened_features before texton: (30, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (30, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 84%|████████▍ | 54/64 [12:51<02:27, 14.74s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (34, 270000)
Accuracy 0.9641222222222222
Shape of flattened_features before texton: (30, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (30, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 86%|████████  | 55/64 [13:06<02:13, 14.83s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (34, 270000)
Accuracy 0.9640481481481481
Shape of flattened_features before texton: (33, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (33, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 88%|████████▊ | 56/64 [13:21<01:59, 14.95s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (37, 270000)
Accuracy 0.9648629629629629
Shape of flattened_features before texton: (33, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (33, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 89%|████████▉ | 57/64 [13:36<01:45, 15.01s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (37, 270000)
Accuracy 0.9735185185185186
Shape of flattened_features before texton: (36, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 91%|█████████ | 58/64 [13:52<01:30, 15.06s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9756148148148148
Shape of flattened_features before texton: (36, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (36, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 92%|█████████| 59/64 [14:07<01:15, 15.05s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (40, 270000)
Accuracy 0.9757
Shape of flattened_features before texton: (39, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (39, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 94%|█████████▍| 60/64 [14:22<01:00, 15.10s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (43, 270000)
Accuracy 0.9767259259259259
Shape of flattened_features before texton: (42, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (42, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 95%|█████████ | 61/64 [14:37<00:45, 15.09s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (46, 270000)
Accuracy 0.963362962962963
Shape of flattened_features before texton: (45, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (45, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 97%|█████████▋| 62/64 [14:53<00:30, 15.26s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (49, 270000)
Accuracy 0.9642037037037037
Shape of flattened_features before texton: (45, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (45, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
 98%|█████████▊| 63/64 [15:08<00:15, 15.38s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (49, 270000)
Accuracy 0.9661777777777778
Shape of flattened_features before texton: (48, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
100%|██████████| 64/64 [15:24<00:00, 14.44s/it]
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Accuracy 0.9646851851851852
18
32
```

In [ ]:
```
print(np.max(accuracies1))
print(np.max(accuracies2))

print(combinations[np.argmax(accuracies2)])
```

```
0.9790925925925926
0.9857296296296296
[1, 0, 0, 0, 0, 0]
```

Of all of the feature combinations the prewitt and lapacian features alongside the textons give the best results.

The MR 8 drops the accuracy about 0.06.

In [ ]:
```
```

In [ ]:
```
# Running different standard deviations
array = np.arange(5, 16)
accuracies = []
for x in array:
    image = cv2.imread("Images/image-35.jpg")
    mask = cv2.imread("Images/mask-35.png", cv2.IMREAD_GRAYSCALE)
    mask = mask>=127.5
    null = np.ones_like(mask)*255

    classify_inst = Stat_Classifier(image)

    original_features = classify_inst.getFeatures(image,null,False,MR8=False,desired_sigma=x**0.5)

    perpixel_features = np.swapaxes(original_features,0,1)

    log_reg = sklearn.linear_model.LogisticRegression().fit(perpixel_features,mask.flatten())
    ver = cv2.imread("Images/image-110.jpg")
    mask = cv2.imread("Images/mask-110.png", cv2.IMREAD_GRAYSCALE)
    mask = mask>=127.5
    ver_features = classify_inst.getFeatures(ver,null,False,MR8=False,texton=True,desired_sigma=x**0.5)
    ver_perpixel_features = np.swapaxes(ver_features,0,1)

    predictions = log_reg.predict(ver_perpixel_features)
    accuracies.append(log_reg.score(ver_perpixel_features,mask.flatten()))
```

```
Shape of flattened_features before texton: (48, 270000)
```

```
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Shape of flattened_features before texton: (48, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
Shape of flattened_features before texton: (48, 270000)
Shape of flattened_features before texton: (48, 270000)
(48, 270000)
Clustering!
Shape of filtered_textons: (4, 270000)
Shape of concatenated_features: (52, 270000)
Shape of flattened_features before texton: (48, 270000)
c:\Users\Tumi\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\linear_model\_logistic.py:469: Conver
genceWarning: lbfgs failed to converge (status=1):
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```

In [ ]:
```
print(accuracies)
```

```
[0.9632407407407407, 0.9643666666666667, 0.9666777777777777, 0.9642037037037037, 0.9641148148148149, 0.96468518518518
52, 0.9656592592592592, 0.9670666666666666, 0.967374074074074, 0.9639666666666666, 0.9646888888888889]
```

Iterating the std of the gaussian,log and dog doesnt have too much of a noticible impact on the IOU score.