Programming Assignment -1

(a) CroppingandResizeImagesinYour4-classImagesDataset

https://www.kaggle.com/code/espriella/stanford-dogs-transfer-crop-stack/notebook

In [3]:
```
import os
import xml.etree.ElementTree as ET
import cv2

directory = os.getcwd()
main_img_folder = 'Images/'
main_annot_folder = 'Annotation/'
output_folder = "cropped_images"
target_size = (128, 128)
given_folders = ["n02090379-redbone","n02097047-miniature_schnauzer","n02104365-sch
os.makedirs(output_folder, exist_ok=True)
def is_xml_file(file_path):
    try:
        with open(file_path, 'r') as file:
            content = file.read()
            return '<annotation>' in content
    except Exception as e:
        return False

# Loop through each specific folder
for folder in given_folders:
    images_folder = os.path.join(main_img_folder, folder)
    annotations_folder = os.path.join(main_annot_folder, folder)

    for filename in os.listdir(annotations_folder):
        file_path = os.path.join(annotations_folder, filename)

        if is_xml_file(file_path):
            tree = ET.parse(file_path)
            root = tree.getroot()

            # Find image file corresponding to the annotation
            image_filename = root.find('filename').text
            image_path = os.path.join(directory, images_folder, image_filename)

            # Ensure correct file extension for the image
            image = cv2.imread(image_path+".jpg")

            if image is not None:
                for obj in root.findall('object'):
                    bbox = obj.find('bndbox')
                    xmin = int(bbox.find('xmin').text)
                    ymin = int(bbox.find('ymin').text)
                    xmax = int(bbox.find('xmax').text)
```

```
                    ymax = int(bbox.find('ymax').text)

                    # Crop and resize the region of interest (ROI)
                    roi = image[ymin:ymax, xmin:xmax]
                    roi_resized = cv2.resize(roi, target_size)

                    # Save the cropped and resized image
                    output_folder_path = os.path.join(output_folder, folder)
                    os.makedirs(output_folder_path, exist_ok=True)
                    output_path = os.path.join(output_folder_path, f'{image_filenam
                    cv2.imwrite(output_path, roi_resized)
```

(b) Feature Extraction: Edge histogram AND Similarity Measurements

https://scikit-image.org/docs/stable/auto_examples/color_exposure/plot_rgb_to_gray.html

https://scikit-image.org/docs/stable/api/skimage.exposure.html#skimage.exposure.histogram

https://scikit-learn.org/stable/modules/generated/sklearn.metrics.pairwise.distance_metrics.html#sklearn.n

https://scikit-image.org/docs/stable/auto_examples/features_detection/plot_hog.html#sphx-glr-auto-examples-features-detection-plot-hog-py

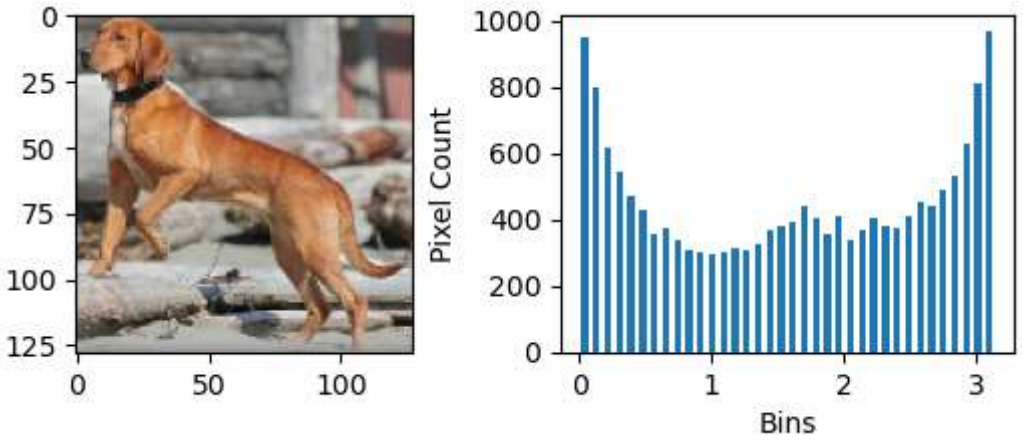
https://scikit-learn.org/stable/auto_examples/decomposition/plot_pca_iris.html

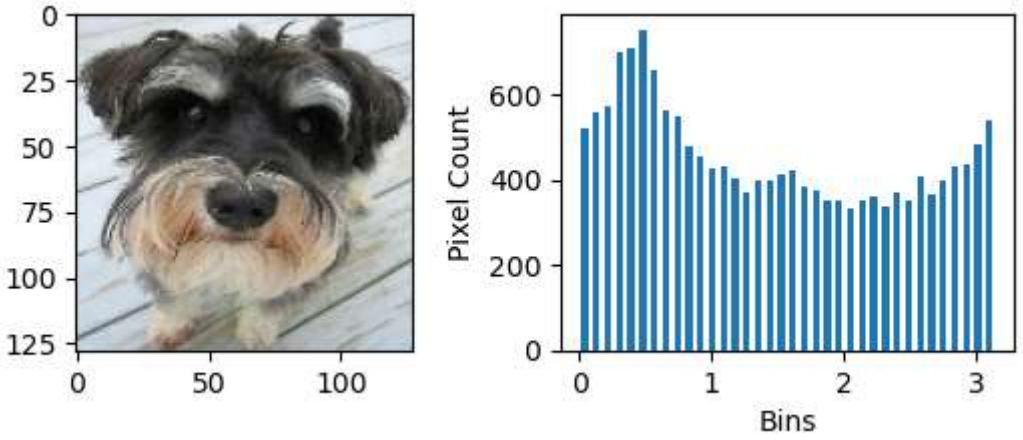
In [5]:
```
import numpy as np
import matplotlib.pyplot as plt
from skimage import io, color, filters, exposure
from sklearn.metrics.pairwise import euclidean_distances, manhattan_distances, cosi
def get_images(n):
    img= []
    for folder in os. listdir('cropped_images'):
        path = os.path. join('cropped_images', folder)
        if os. path. isdir (path):
            images = os. listdir (path)
            crop_images = [image for image in images if image. lower().endswith(('.
            for image in crop_images:
                src_path = os. path. join (path, image)
                img.append(src_path)
    return img
```

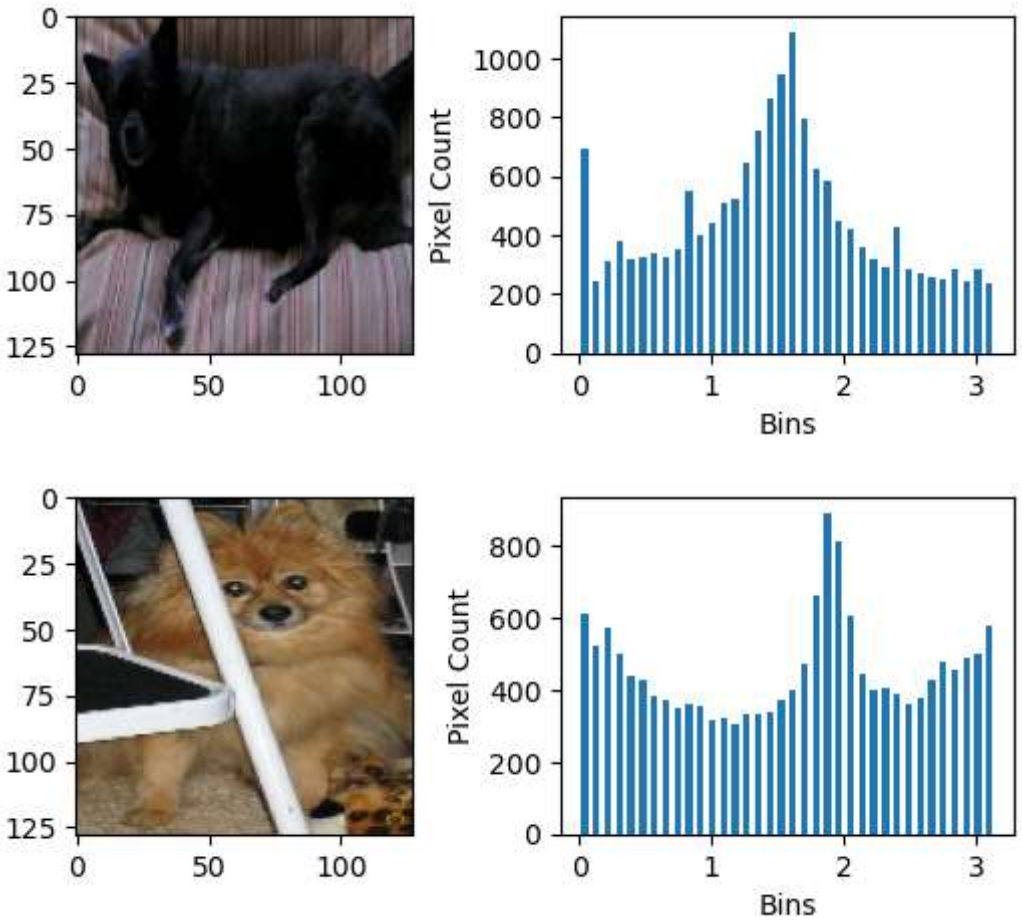
In [6]:
```
img=get_images(1)
```

In [7]:
```
def angle(dx, dy):
    """Calculate the angles between horizontal and vertical Sobel operators."""
    return np.mod(np.arctan2(dy, dx), np.pi)
hist_vectors=[]
for imge in img:
    image = io.imread(imge)
    gray_img = color.rgb2gray(image)
    angle_sobel = angle(filters.sobel_h(gray_img), filters.sobel_v(gray_img))
```

```
    hist,hist_centers =exposure.histogram(angle_sobel,nbins=36)
    hist_vectors.append(hist)
    plt.subplot(221),plt.imshow(image)
    plt.subplot(222),plt.bar(hist_centers, hist, width=0.05, align='center'),plt.xl
    plt.show()

hist1 = hist_vectors[1].reshape(1, -1)
hist2 = hist_vectors[2].reshape(1, -1)

# Calculate distances
euclidean = euclidean_distances(hist1, hist2)[0][0]
print(f"Euclidean Distance: {euclidean}")
manhattan = manhattan_distances(hist1, hist2)[0][0]
print(f"Manhattan Distance: {manhattan}")
cosine = cosine_distances(hist1, hist2)[0][0]
print(f"Cosine Distance: {cosine}")
```



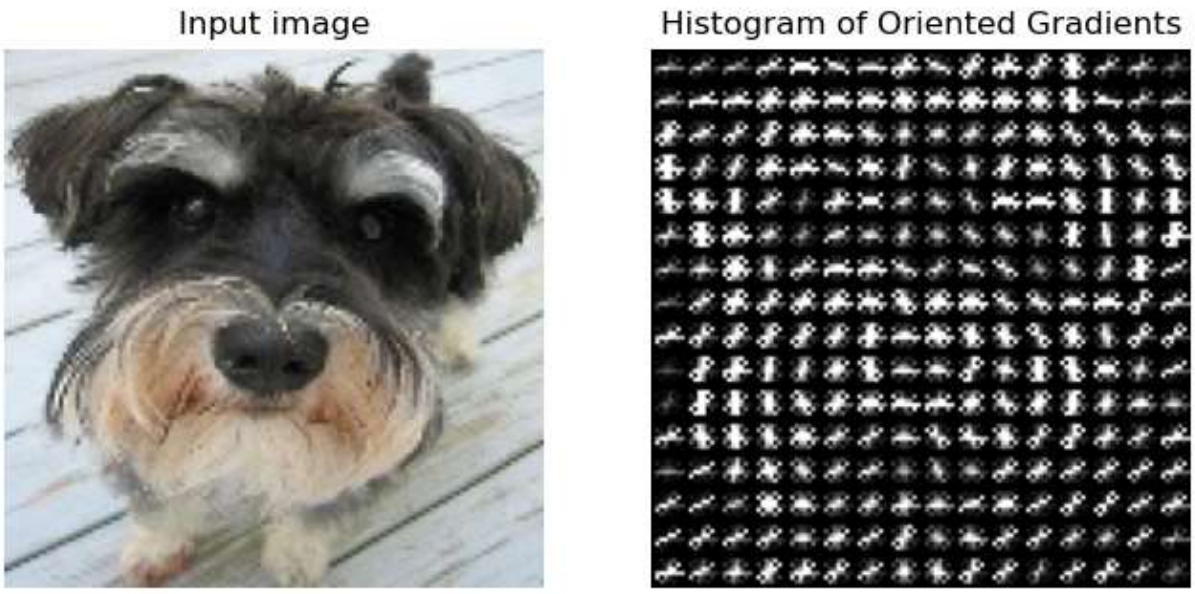




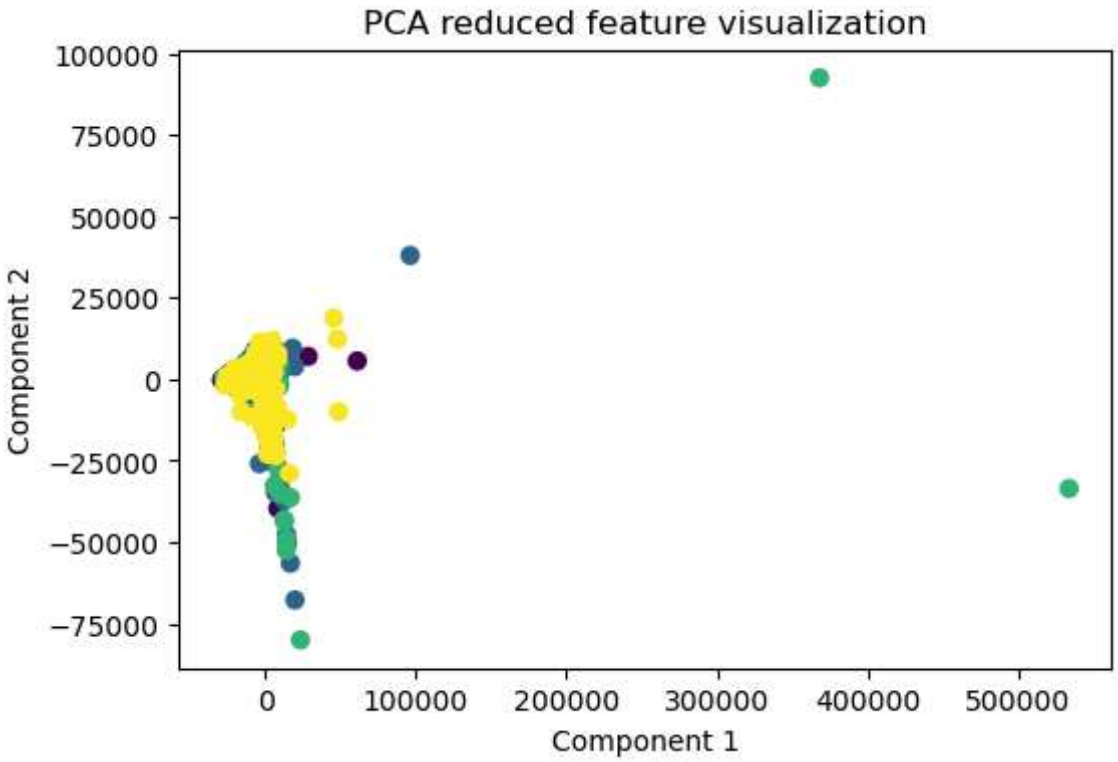

```
Euclidean Distance: 1602.912973308283
Manhattan Distance: 7818.0
Cosine Distance: 0.1486179553006004
```

In [8]:
```python
from skimage.feature import hog

image_path = img[1]
image = io.imread(image_path)
fd, hog_image = hog(
    image,
    orientations=9,
    pixels_per_cell=(8, 8),
    cells_per_block=(2, 2),
    visualize=True,
    channel_axis=-1,
)

fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(8, 4), sharex=True, sharey=True)

ax1.axis('off')
ax1.imshow(image, cmap=plt.cm.gray)
ax1.set_title('Input image')

# Rescale histogram for better display
hog_image_rescaled = exposure.rescale_intensity(hog_image, in_range=(0, 10))

ax2.axis('off')
ax2.imshow(hog_image_rescaled, cmap='gray')
```

```
ax2.set_title('Histogram of Oriented Gradients')
plt.show()
```



In [9]:
```
import numpy as np
from sklearn.decomposition import PCA
from sklearn.preprocessing import StandardScaler

edge_histograms = []
labels = []

for class_idx, class_name in enumerate(given_folders):
    class_folder = os.path.join(main_img_folder, class_name)
    for image_file in os.listdir(class_folder):
        if image_file.endswith('.jpg') or image_file.endswith('.png'):
            image_path = os.path.join(class_folder, image_file)
            image = io.imread(image_path)
            gray_img = color.rgb2gray(image)
            angle_sobel = angle(filters.sobel_h(gray_img), filters.sobel_v(gray_img
            hist,hist_centers =exposure.histogram(angle_sobel,nbins=36)
            edge_histograms.append(hist)
            labels.append(class_idx)

edge_histograms = np.array(edge_histograms)
labels = np.array(labels)
pca = PCA(n_components=2)
histograms_pca = pca.fit_transform(edge_histograms)

plt.figure(figsize=(6, 4))
plt.scatter(histograms_pca[:, 0], histograms_pca[:, 1], c=labels)

plt.title('PCA reduced feature visualization')
plt.xlabel('Component 1')
plt.ylabel('Component 2')
plt.show()
```



As i can see in my figure all classes are overlapping so no classes are visually separable

text processing steps on a tweet (i.e., text) dataset

https://scikit-learn.org/stable/api/sklearn.feature_extraction.html#module-sklearn.feature_extraction.text

In [12]:
```
import pandas as pd
import json
from sklearn.feature_extraction.text import CountVectorizer, TfidfVectorizer
file_path = 'train.json'
data = []
with open(file_path, 'r') as file:
    for line in file:
        data.append(json.loads(line))
df = pd.DataFrame(data)

print(df.head(2))
texts = df['Tweet'].astype(str)

count_vectorizer = CountVectorizer()
tfidf_vectorizer = TfidfVectorizer()

count_matrix = count_vectorizer.fit_transform(texts)
tfidf_matrix = tfidf_vectorizer.fit_transform(texts)
```

```
# Print the dimensionality
print("CountVectorizer dimensions:", count_matrix.shape)
print("TfidfVectorizer dimensions:", tfidf_matrix.shape)

count_df = pd.DataFrame(count_matrix.toarray(), columns=count_vectorizer.get_featur
tfidf_df = pd.DataFrame(tfidf_matrix.toarray(), columns=tfidf_vectorizer.get_featur
```

```
             ID                                              Tweet  anger  \
0  2017-En-40457  Niggas murking in each other. In murky water, ...   True
1  2017-En-41422  @funkxwidme only #true #depression #fans will ...  False

   anticipation  disgust   fear    joy   love  optimism  pessimism  sadness  \
0         False     True  False  False  False      True      False    False
1         False    False  False  False  False     False       True     True

   surprise  trust
0     False  False
1     False  False
CountVectorizer dimensions: (3000, 9562)
TfidfVectorizer dimensions: (3000, 9562)
```

In [13]:
```
for class_name in ['anger', 'anticipation', 'disgust', 'fear', 'joy', 'love', 'opti
    print(f"Top tokens for class: {class_name}")

    # Get tweets where the class is True
    class_tweets = df[df[class_name] == True]

    # Sum the token counts for the selected class
    class_counts = count_df.loc[class_tweets.index].sum().sort_values(ascending=Fal
    tf_counts = tfidf_df.loc[class_tweets.index].sum().sort_values(ascending=False)
    print(class_counts,tf_counts)
    print()
```

```
Top tokens for class: anger
the     538
to      430
and     319
is      253
it      221
you     215
of      211
in      193
that    185
my      166
dtype: int64 the     44.125561
to      37.947209
and     31.901413
is      27.448886
you     25.472938
it      24.831852
me      23.469322
that    23.010648
my      22.853498
of      21.892766
dtype: float64

Top tokens for class: anticipation
the     192
to      190
and      90
is       88
in       87
of       86
it       77
you      71
for      66
that     65
dtype: int64 to      17.307969
the     16.193444
in      10.189251
is       9.538813
it       9.534103
and      9.258451
of       9.127534
for      8.973453
you      8.652191
that     8.373725
dtype: float64

Top tokens for class: disgust
the     543
to      433
and     319
is      262
of      235
you     216
in      201
it      195
that    186
```

```
my      155
dtype: int64 the     44.621758
to      37.957937
and     32.137983
is      28.514551
you     26.097386
of      24.280455
that    23.131975
in      22.690260
it      22.162173
me      22.118952
dtype: float64

Top tokens for class: fear
the     245
to      244
of      151
and     138
is      128
in      112
it      111
my       84
you      82
that     75
dtype: int64 to           22.269836
the          21.248306
of           16.730426
and          14.142710
it           13.858136
is           13.502785
in           12.739955
my           10.820448
fear         10.703006
nightmare    10.467492
dtype: float64

Top tokens for class: joy
the     477
to      390
and     281
you     240
is      234
of      220
it      207
in      189
my      165
that    150
dtype: int64 the     41.244402
to      35.210354
you     30.052734
and     28.904501
is      26.429196
it      24.905299
of      23.211079
in      21.222042
my      21.157757
```

```
that    20.121698
dtype: float64

Top tokens for class: love
the     129
to      116
and      97
you      93
my       76
of       73
is       67
it       66
love     64
in       49
dtype: int64 love     13.590438
you      12.074530
the      11.402605
to       10.591173
and      10.083120
my        9.745995
happy     8.613142
it        8.256600
of        7.747229
is        7.311599
dtype: float64

Top tokens for class: optimism
the     436
to      364
you     257
and     242
is      215
it      210
of      203
in      156
my      131
that    127
dtype: int64 the     36.848860
to      32.647995
you     31.004229
it      25.501135
and     24.330627
is      23.742820
of      21.289865
in      16.949787
be      16.886329
that    16.627101
dtype: float64

Top tokens for class: pessimism
the    169
to     132
and    105
of      93
is      83
it      83
```

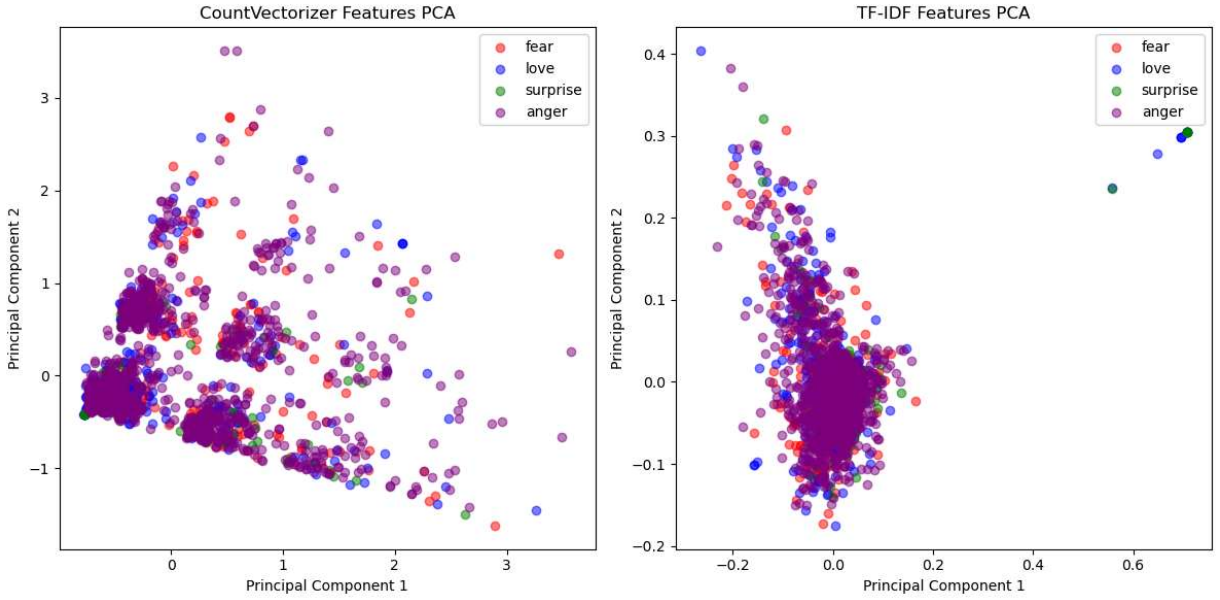
```
my      63
in      62
you     52
so      40
dtype: int64 the     14.063580
to      12.338574
and     10.981671
of      10.737516
it       9.769472
is       9.246041
my       8.483165
in       7.451825
you      6.463520
just     6.267085
dtype: float64

Top tokens for class: sadness
the     401
to      364
and     258
of      204
it      203
is      197
my      180
you     163
in      149
that    109
dtype: int64 the    34.518455
to     33.154808
and    26.921953
it     24.341488
my     23.577972
of     22.544101
is     21.701003
you    20.262234
in     17.874103
me     16.767191
dtype: float64

Top tokens for class: surprise
the         71
to          41
it          37
is          33
that        32
and         32
in          29
shocking    28
was         26
for         26
dtype: int64 shocking    7.525666
the         6.077871
that        4.565416
it          4.279209
was         4.106853
this        3.868358
```

```
is          3.694077
to          3.648690
and         3.608631
for         3.405176
dtype: float64

Top tokens for class: trust
the     69
to      67
you     65
is      49
of      39
and     39
in      33
your    25
it      25
so      25
dtype: int64 you     7.909270
the     6.063729
to      5.639573
is      5.199774
of      3.967739
and     3.792029
your    3.784857
so      3.783346
in      3.515769
be      3.121648
dtype: float64
```

based on the count vectorizer and tfidf vectorizer i find Anger, love, surprise , fear to be the separable features as they have unique tokens which separate from other classes.

In [15]:
```
import warnings
warnings.filterwarnings("ignore")
# Filter for selected classes
selected_classes = ['anger', 'love', 'surprise', 'fear']
df_filtered = df[df[selected_classes].any(axis=1)]

X_count = CountVectorizer().fit_transform(df_filtered['Tweet'])
X_tfidf = TfidfVectorizer().fit_transform(df_filtered['Tweet'])

# Dimensionality Reduction
pca_count = PCA(n_components=2).fit_transform(X_count.toarray())
pca_tfidf = PCA(n_components=2).fit_transform(X_tfidf.toarray())

# Create a color map for the classes
class_colors = {'fear': 'red', 'love': 'blue', 'surprise': 'green', 'anger': 'purpl
df_filtered['class'] = df_filtered[selected_classes].idxmax(axis=1)
df_filtered['color'] = df_filtered['class'].map(class_colors)

# Plot CountVectorizer
plt.figure(figsize=(12, 6))
plt.subplot(1, 2, 1)
```

```
for class_name, color in class_colors.items():
    plt.scatter(pca_count[df_filtered['class'] == class_name, 0],
                pca_count[df_filtered['class'] == class_name, 1],
                label=class_name, color=color, alpha=0.5)
plt.title('CountVectorizer Features PCA')
plt.xlabel('Principal Component 1')
plt.ylabel('Principal Component 2')
plt.legend()

# Plot TfidfVectorizer
plt.subplot(1, 2, 2)
for class_name, color in class_colors.items():
    plt.scatter(pca_tfidf[df_filtered['class'] == class_name, 0],
                pca_tfidf[df_filtered['class'] == class_name, 1],
                label=class_name, color=color, alpha=0.5)
plt.title('TF-IDF Features PCA')
plt.xlabel('Principal Component 1')
plt.ylabel('Principal Component 2')
plt.legend()

plt.tight_layout()
plt.show()
```



visually classes are not separable on either plots.

In [ ]:

In [ ]: