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April 21, 2025

EXP2 EDA ON TABULAR DATA

[1]:
```
import pandas as pd
df=pd.read_csv('Dataset/Diabetes_Missing.csv')
```

[2]:
```
df.head()
```

[2]:

	Pregnant	Glucose	Diastolic_BP	Skin_Fold	Serum_Insulin	BMI	\
0	6	148.0	72.0	35.0	NaN	33.6	
1	1	85.0	66.0	29.0	NaN	26.6	
2	8	183.0	64.0	NaN	NaN	23.3	
3	1	89.0	66.0	23.0	94.0	28.1	
4	0	137.0	40.0	35.0	168.0	43.1	

	Diabetes_Pedigree	Age	Class
0	0.627	50	1
1	0.351	31	0
2	0.672	32	1
3	0.167	21	0
4	2.288	33	1

[3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 768 entries, 0 to 767
Data columns (total 9 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Pregnant           768 non-null    int64
 1   Glucose            763 non-null    float64
 2   Diastolic_BP       733 non-null    float64
 3   Skin_Fold          541 non-null    float64
 4   Serum_Insulin      394 non-null    float64
 5   BMI                757 non-null    float64
 6   Diabetes_Pedigree  768 non-null    float64
 7   Age                768 non-null    int64
 8   Class              768 non-null    int64
dtypes: float64(6), int64(3)
```

```
memory usage: 54.1 KB
```

[4]:
```
df.describe()
```

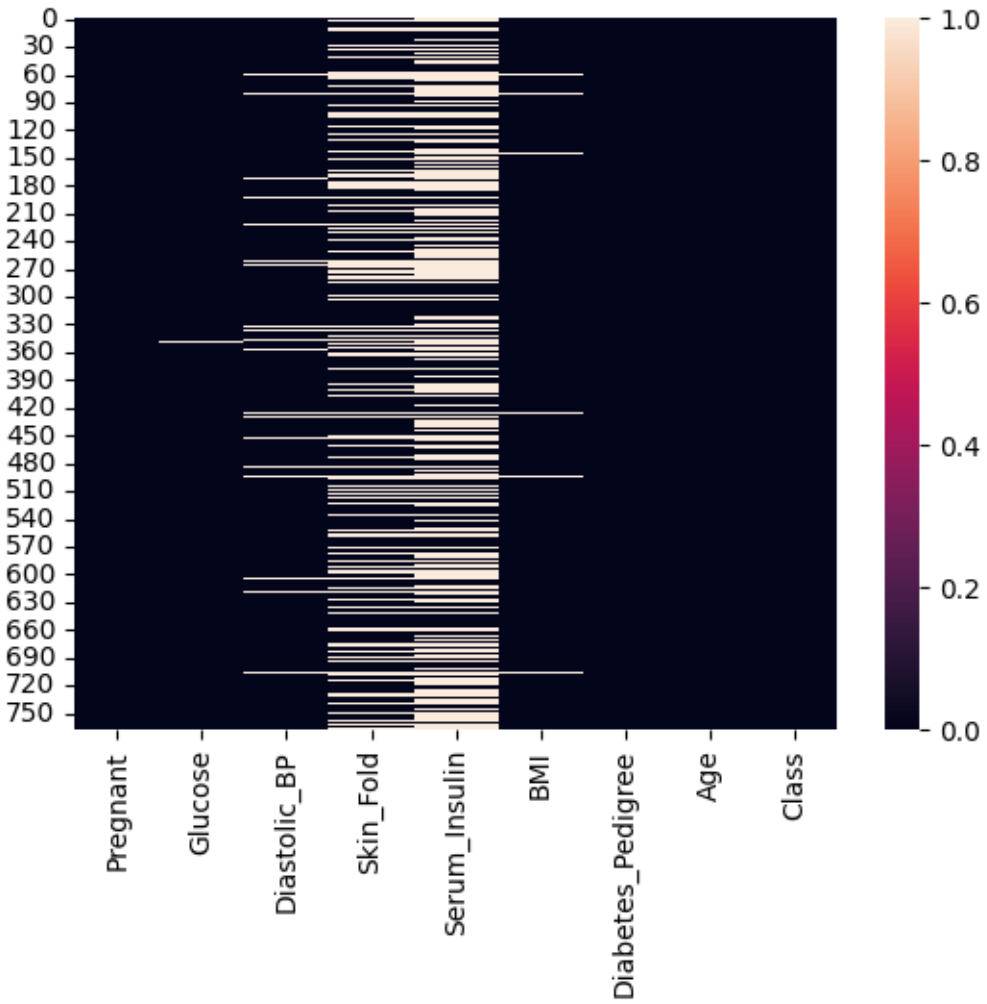
[4]:
```
          Pregnant     Glucose  Diastolic_BP   Skin_Fold  Serum_Insulin  \
count  768.000000  763.000000    733.000000  541.000000     394.000000
mean     3.845052  121.686763     72.405184   29.153420     155.548223
std      3.369578   30.535641     12.382158   10.476982     118.775855
min      0.000000   44.000000     24.000000    7.000000      14.000000
25%      1.000000   99.000000     64.000000   22.000000      76.250000
50%      3.000000  117.000000     72.000000   29.000000     125.000000
75%      6.000000  141.000000     80.000000   36.000000     190.000000
max     17.000000  199.000000    122.000000   99.000000     846.000000

              BMI  Diabetes_Pedigree         Age       Class
count  757.000000         768.000000  768.000000  768.000000
mean    32.457464           0.471876   33.240885    0.348958
std      6.924988           0.331329   11.760232    0.476951
min     18.200000           0.078000   21.000000    0.000000
25%     27.500000           0.243750   24.000000    0.000000
50%     32.300000           0.372500   29.000000    0.000000
75%     36.600000           0.626250   41.000000    1.000000
max     67.100000           2.420000   81.000000    1.000000
```

[5]:
```
df.isnull().sum()
```

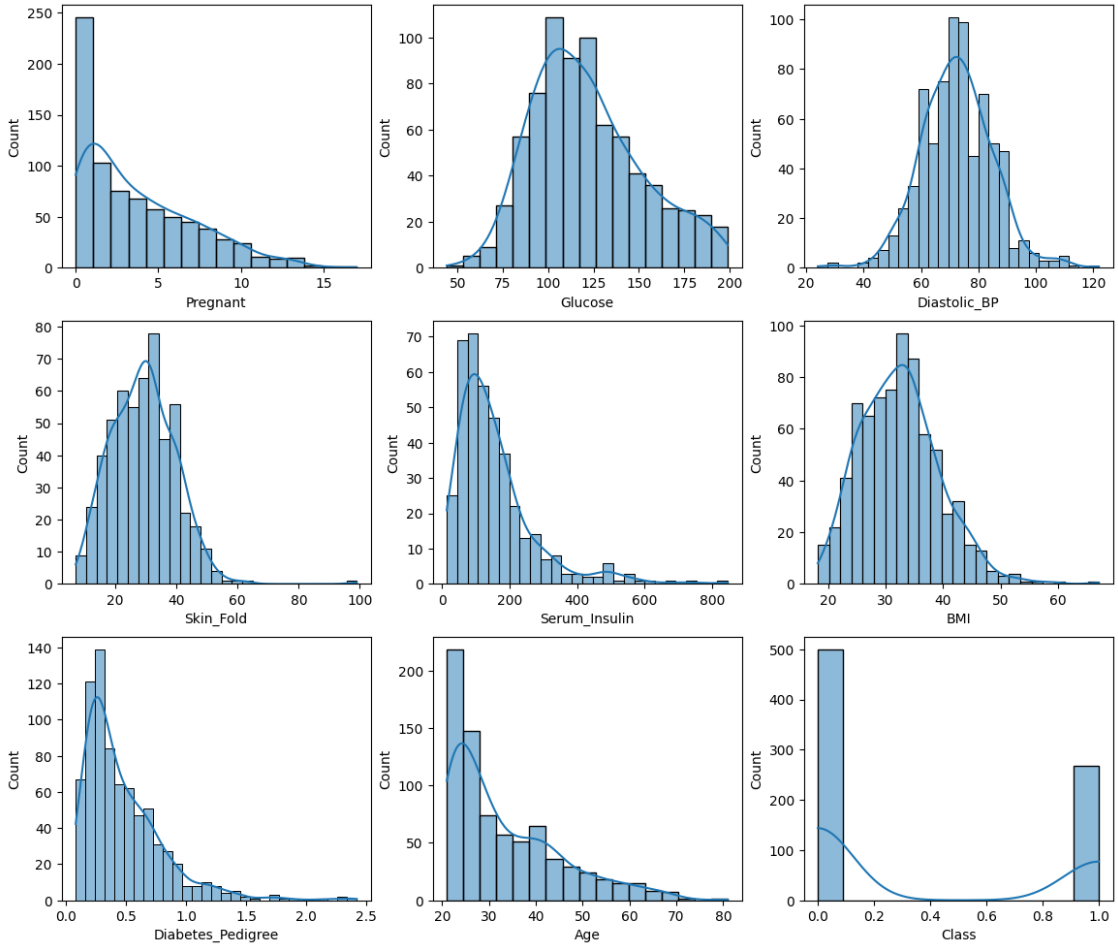
[5]:
```
Pregnant              0
Glucose               5
Diastolic_BP         35
Skin_Fold           227
Serum_Insulin       374
BMI                  11
Diabetes_Pedigree     0
Age                   0
Class                 0
dtype: int64
```

[6]:
```
import seaborn as sns
sns.heatmap(df.isnull())
```

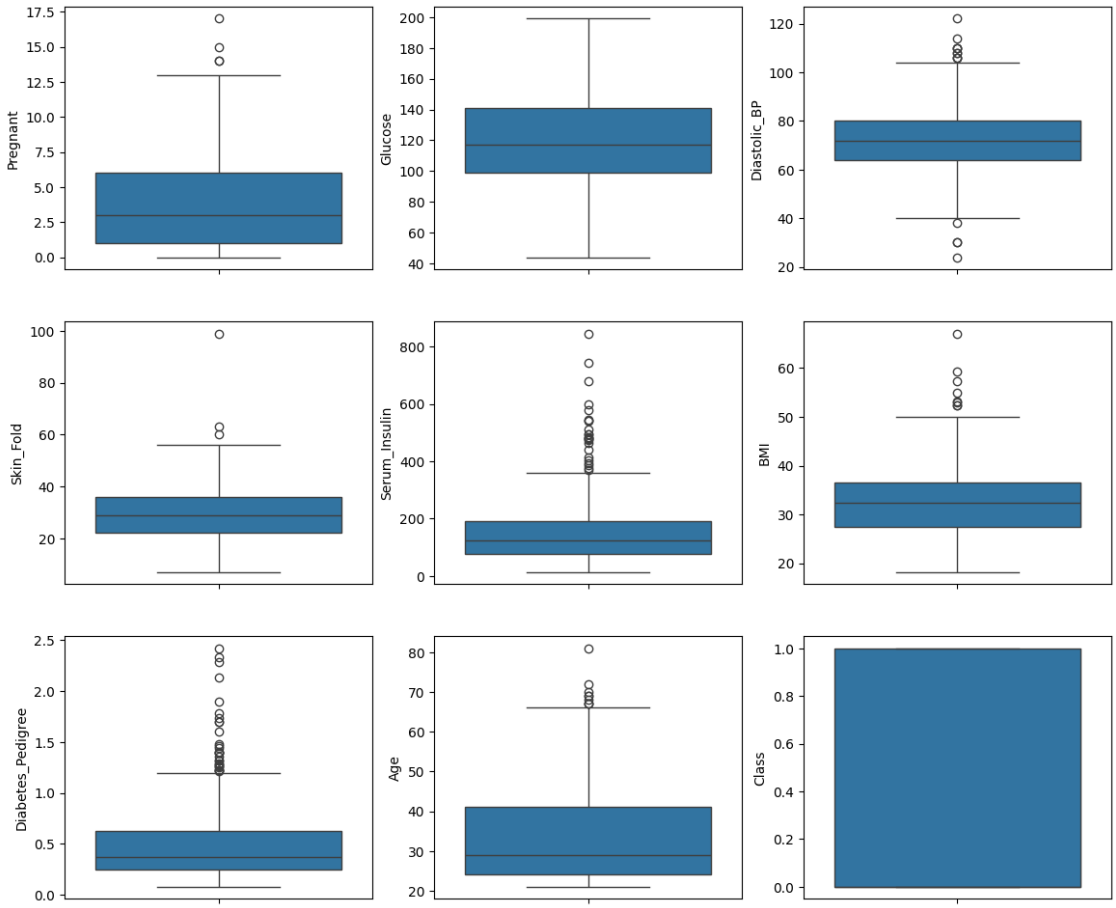
[6]:
```
<Axes: >
```



[8]:
```
import matplotlib.pyplot as plt
cols=df.columns
plt.figure(figsize=(14,12))
for index,col in enumerate(cols):
    plt.subplot(3,3,index+1)
    sns.histplot(df[col],kde=True)
```

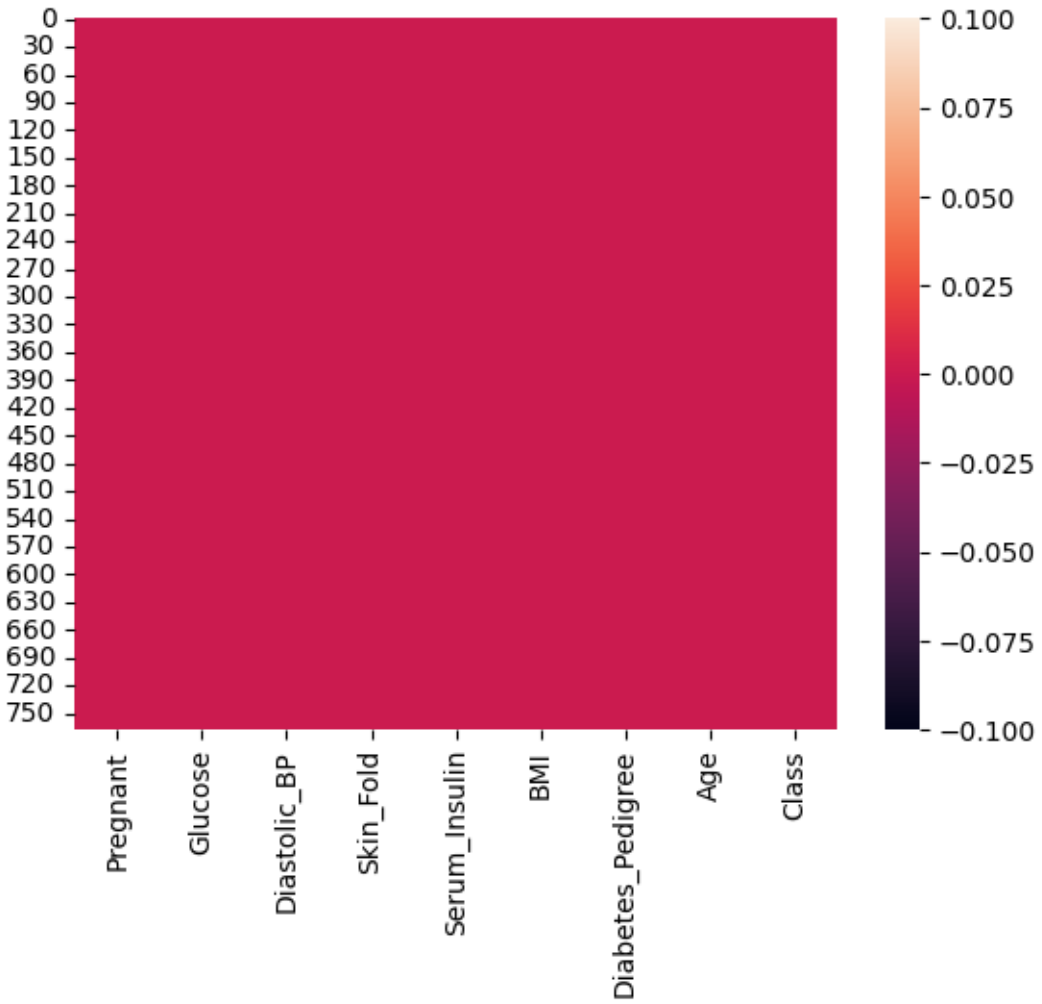


[9]:
```
plt.figure(figsize=(14,12))
for index,col in enumerate(cols):
    plt.subplot(3,3,index+1)
    sns.boxplot(df[col])
```



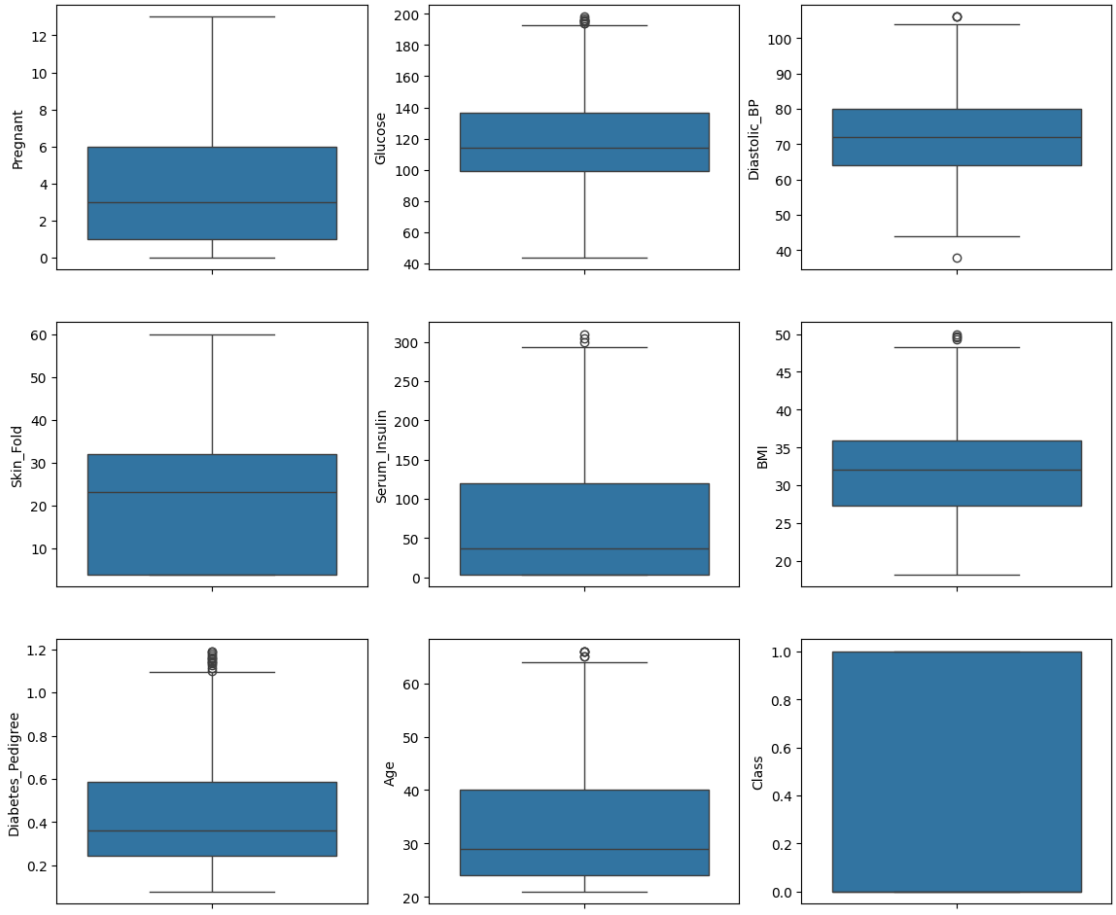
[10]:
```
for col in cols:
    df.fillna(df[col].mean(),inplace=True)
sns.heatmap(df.isnull())
```

[10]: <Axes: >



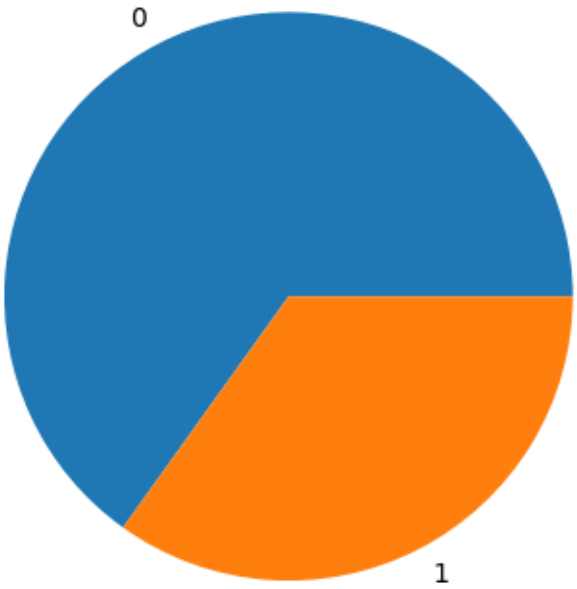
[11]:
```
q1=df.quantile(0.25)
q3=df.quantile(0.75)
iqr=q3-q1
lb=q1-1.5*iqr
ub=q3+1.5*iqr

outliers=((df<lb)|(df>ub))
#print(df[outliers.any(axis=1)]) #This prints only the rows that contain at␣
 ↪least one outlier.
df_no_outliers = df[~outliers.any(axis=1)] #it keeps only rows with no outliers.
```

[13]:
```
plt.figure(figsize=(14,12))
for index,col in enumerate(cols):
    plt.subplot(3,3,index+1)
    sns.boxplot(df_no_outliers[col])
```



[12]:
```
plt.pie(df['Class'].value_counts(),labels=['0','1'])
```

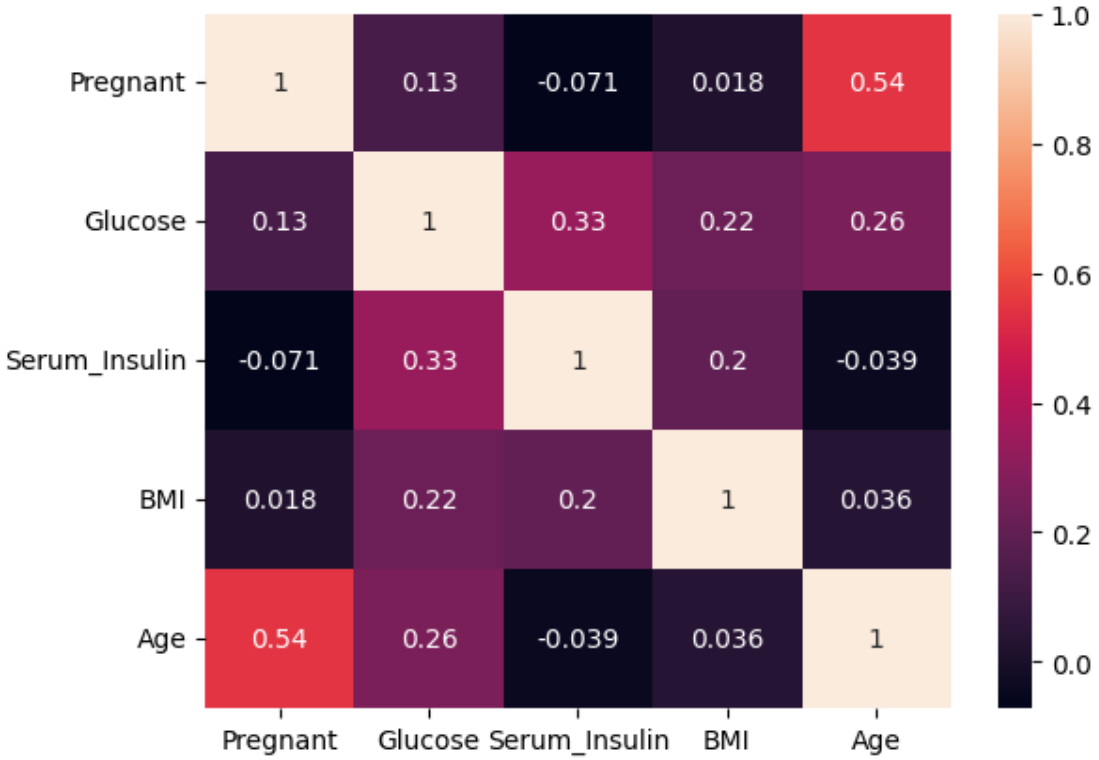
[12]:
```
([<matplotlib.patches.Wedge at 0x18d24c05090>,
  <matplotlib.patches.Wedge at 0x18d24c04fd0>],
 [Text(-0.5025943242672991, 0.9784676515931925, '0'),
  Text(0.5025944158780503, -0.9784676045369114, '1')])
```



[14]:
```
from sklearn.feature_selection import SelectKBest,chi2
selector=SelectKBest(chi2,k=5)
X=df.drop('Class',axis=1)
y=df['Class']
selector.fit_transform(X,y)

select_feat=X.columns[selector.get_support()]
print(select_feat)
corr=df[select_feat].corr()
sns.heatmap(corr,annot=True)
```

```
Index(['Pregnant', 'Glucose', 'Serum_Insulin', 'BMI', 'Age'], dtype='object')
```

[14]: <Axes: >



[ ]:

[ ]:

[ ]:

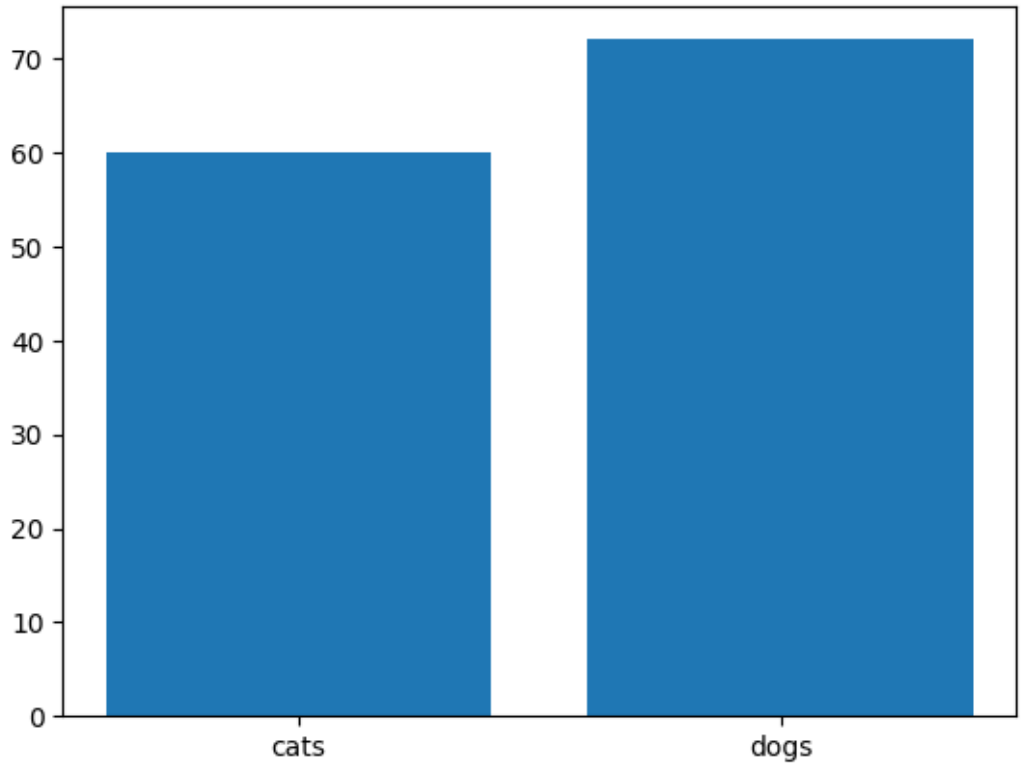
[ ]:

EXP2 EDA ON IMAGE

[1]:
```
import cv2
import os
import numpy as np
import matplotlib.pyplot as plt

dataset_path='Dataset/cats_dogs'
classes=os.listdir(dataset_path)

img_cnts={}
img_shapes=[]
all_pixels=[] #for pixel level distribution check
for label in classes:
    label_dir=os.path.join(dataset_path,label)
```

```
    imgs=os.listdir(label_dir)
    img_cnts[label]=len(imgs)

    for img_file in imgs:
        img_path=os.path.join(label_dir,img_file)
        image=cv2.imread(img_path)
        if image is not None:
            img_shapes.append(image.shape)
            all_pixels.append(image.flatten())
plt.bar(img_cnts.keys(),img_cnts.values())
```

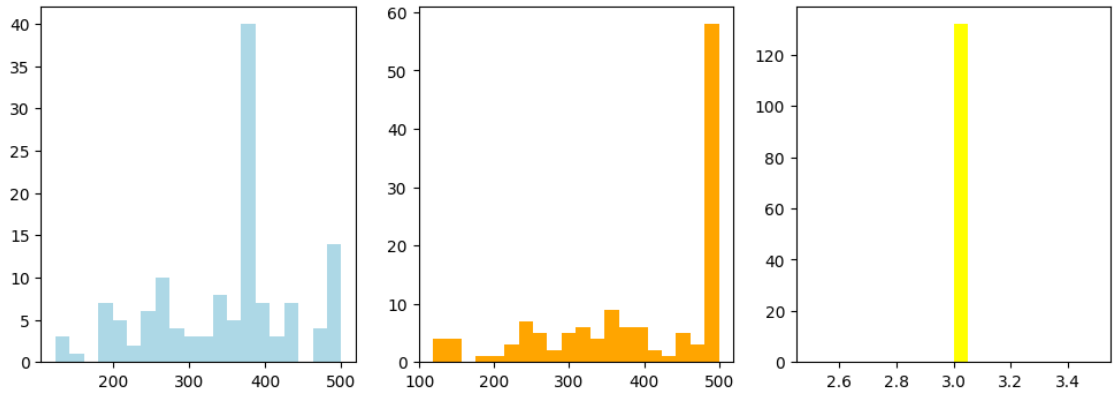
[1]: <BarContainer object of 2 artists>



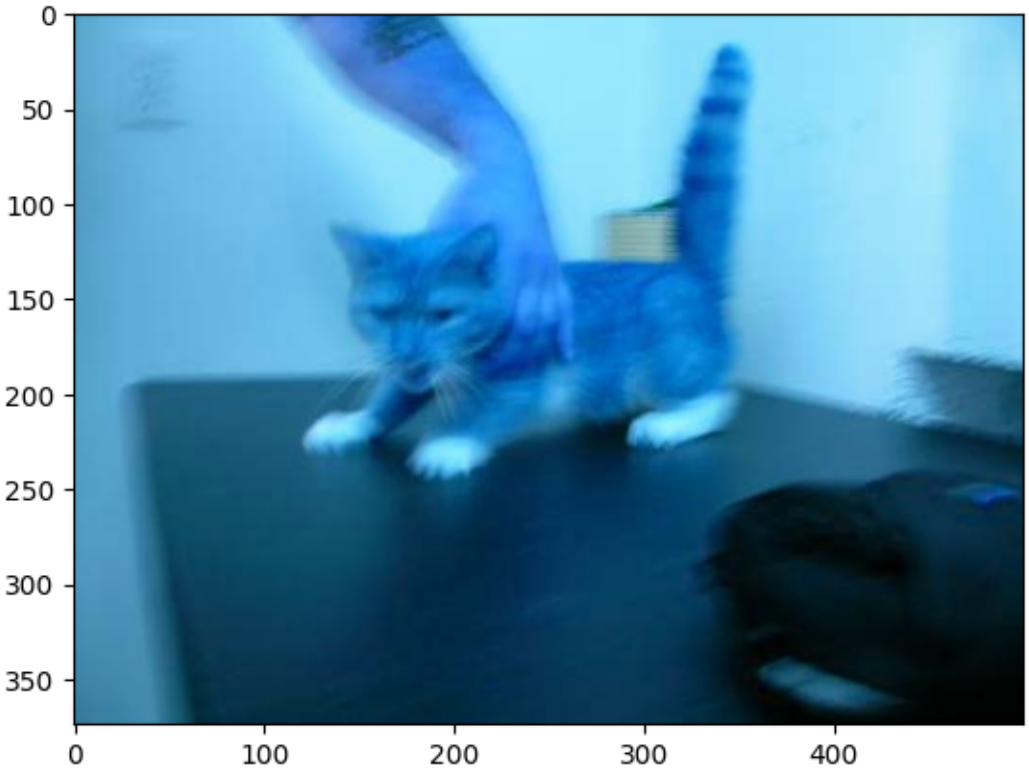
[2]:
```
heights=[s[0] for s in img_shapes]
widths=[s[1] for s in img_shapes]
channels=[s[2] for s in img_shapes]

plt.figure(figsize=(12,4))

plt.subplot(1,3,1)
plt.hist(heights,bins=20,color='lightblue')
```

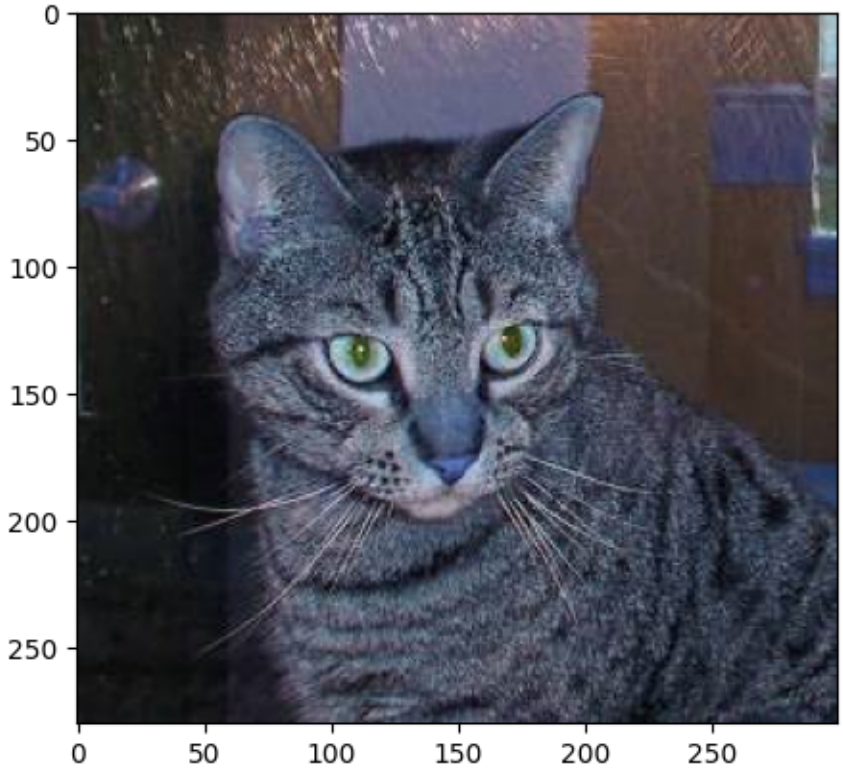
```
plt.subplot(1,3,2)
plt.hist(widths,bins=20,color='orange')

plt.subplot(1,3,3)
plt.hist(channels,bins=20,color='yellow')
```

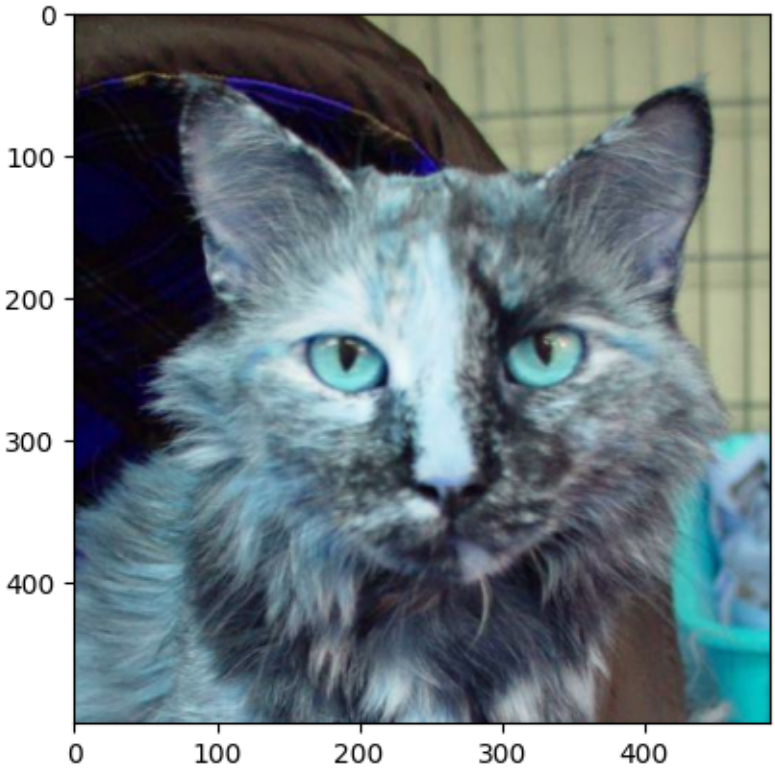
[2]:
```
(array([  0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0., 132.,
          0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.]),
 array([2.5 , 2.55, 2.6 , 2.65, 2.7 , 2.75, 2.8 , 2.85, 2.9 , 2.95, 3.  ,
        3.05, 3.1 , 3.15, 3.2 , 3.25, 3.3 , 3.35, 3.4 , 3.45, 3.5 ]),
 <BarContainer object of 20 artists>)
```



[3]:
```
#First 3 Dog and Cat Images
for label in classes:
    label_dir=os.path.join(dataset_path,label)
    imgs=os.listdir(label_dir)
    img_cnts[label]=len(imgs)

    for img_file in imgs[:3]:
        img_path=os.path.join(label_dir,img_file)
        image=cv2.imread(img_path)
        if image is not None:
            plt.imshow(image)
            plt.show()
```


0
50
100
150
200
250
300
350
0
100
200
300
400


0
50
100
150
200
250
0
50
100
150
200
250


0
100
200
300
400
0
100
200
300
400


0
50
100
150
200
250
300
350
0
100
200
300
400

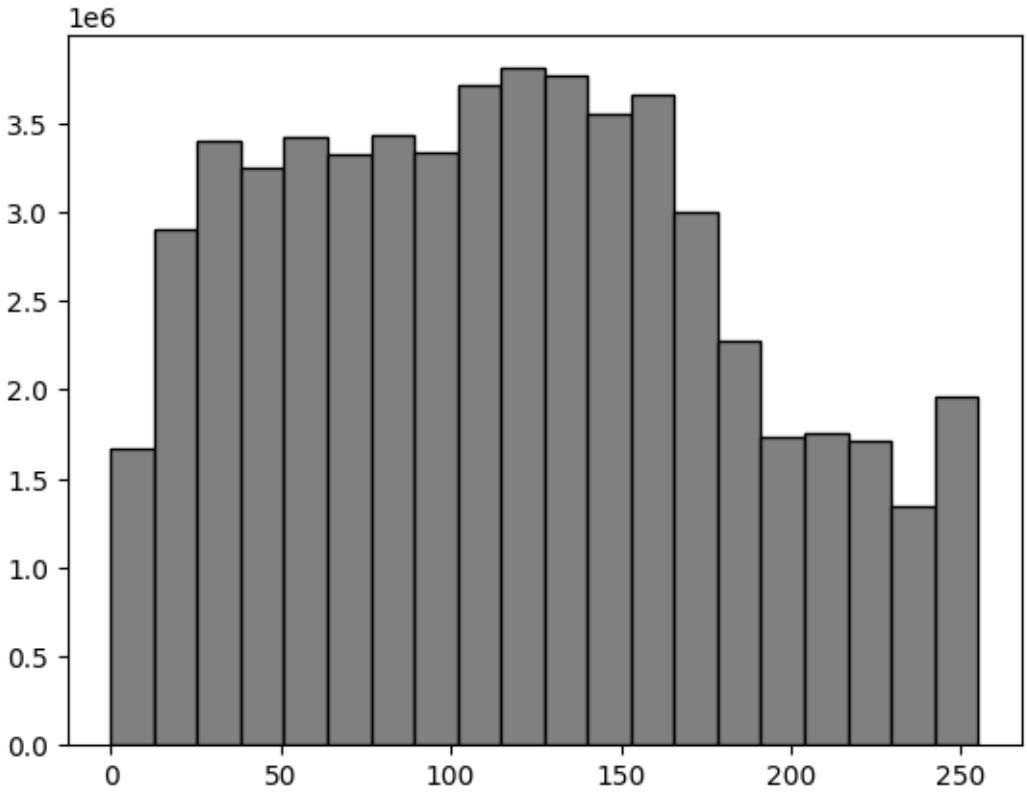

0
50
100
150
200
250
300
0
100
200
300
400

[4]:
```
all_pixels=np.concatenate(all_pixels)
all_pixels
```

[4]:
```
array([ 87, 164, 203, …, 186, 158, 134], dtype=uint8)
```

[7]:
```
plt.hist(all_pixels,bins=20,color='gray',edgecolor='black')
```

[7]:
```
(array([1669233., 2903231., 3397064., 3253448., 3418537., 3324097.,
        3427475., 3339452., 3718186., 3808348., 3768587., 3550880.,
        3659064., 3004065., 2275883., 1734391., 1754574., 1712755.,
        1346374., 1957912.]),
 array([  0.  ,  12.75,  25.5 ,  38.25,  51.  ,  63.75,  76.5 ,  89.25,
        102.  , 114.75, 127.5 , 140.25, 153.  , 165.75, 178.5 , 191.25,
        204.  , 216.75, 229.5 , 242.25, 255.  ]),
 <BarContainer object of 20 artists>)
```



[9]:
```
#Stats of pixel values
print("Pixel Value Summary:")
print("Min:", np.min(all_pixels))
print("Max:", np.max(all_pixels))
print("Mean:", np.mean(all_pixels))
print("Std Dev:", np.std(all_pixels))
```

```
Pixel Value Summary:
Min: 0
Max: 255
Mean: 116.7607045060466
Std Dev: 65.6210385103431
```

EDA ON TEXT DATA

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import string
import nltk
from nltk.corpus import stopwords
```

```
from nltk.stem import PorterStemmer, WordNetLemmatizer
from wordcloud import WordCloud
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.svm import SVC
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, confusion_matrix,␣
 ↪classification_report, roc_auc_score, roc_curve
import warnings
warnings.filterwarnings("ignore")
```

[2]:
```
nltk.download('stopwords')
nltk.download('wordnet')
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     D:\SEM6\XAI_LAB_REQ\xai_env\nltk_data…
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package wordnet to
[nltk_data]     D:\SEM6\XAI_LAB_REQ\xai_env\nltk_data…
[nltk_data]   Package wordnet is already up-to-date!
```

[2]:
```
True
```

[3]:
```
df = pd.read_csv('Dataset/twitter_training.csv', encoding='latin-1')  # adjust␣
 ↪path
df.columns=['Tweet ID','entity','sentiment','Tweet content']
df.head()
```

[3]:

	Tweet ID	entity	sentiment	Tweet content
0	2401	Borderlands	Positive	I am coming to the borders and I will kill you…
1	2401	Borderlands	Positive	im getting on borderlands and i will kill you …
2	2401	Borderlands	Positive	im coming on borderlands and i will murder you…
3	2401	Borderlands	Positive	im getting on borderlands 2 and i will murder …
4	2401	Borderlands	Positive	im getting into borderlands and i can murder y…

[4]:
```
df['sentiment'].value_counts()
```

[4]:
```
Negative      22542
Positive      20831
Neutral       18318
```

```
Irrelevant    12990
Name: sentiment, dtype: int64
```

[5]:
```
df = df[['sentiment', 'Tweet content']]  # Keep only necessary columns
df.columns = ['sentiment', 'Tweet content']
```

[6]:
```
df['Length']=df['Tweet content'].str.len()
```

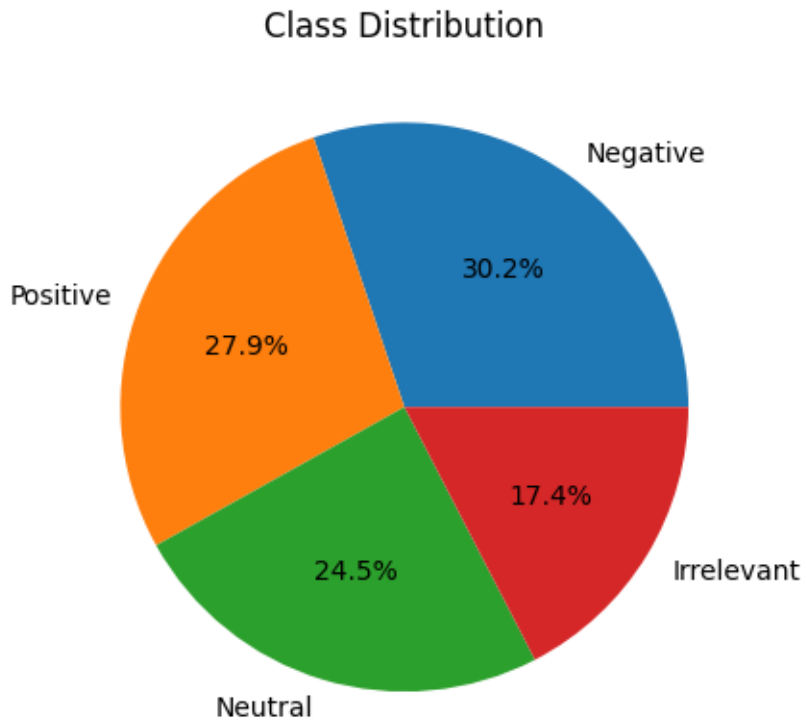
[7]:
```
def word_cnt(tweet):
    words=str(tweet).split()
    return len(words)
df['word_cnt']=df['Tweet content'].apply(word_cnt)
```

[8]:
```
df.head()
```

[8]:

	sentiment	Tweet content	Length	word_cnt
0	Positive	I am coming to the borders and I will kill you…	51.0	12
1	Positive	im getting on borderlands and i will kill you …	50.0	10
2	Positive	im coming on borderlands and i will murder you…	51.0	10
3	Positive	im getting on borderlands 2 and i will murder …	57.0	12
4	Positive	im getting into borderlands and i can murder y…	53.0	10

[9]:
```
plt.pie(df['sentiment'].value_counts(), labels=[␣
↪'Negative','Positive','Neutral','Irrelevant'], autopct='%1.1f%%')
plt.title('Class Distribution')
plt.show()
```

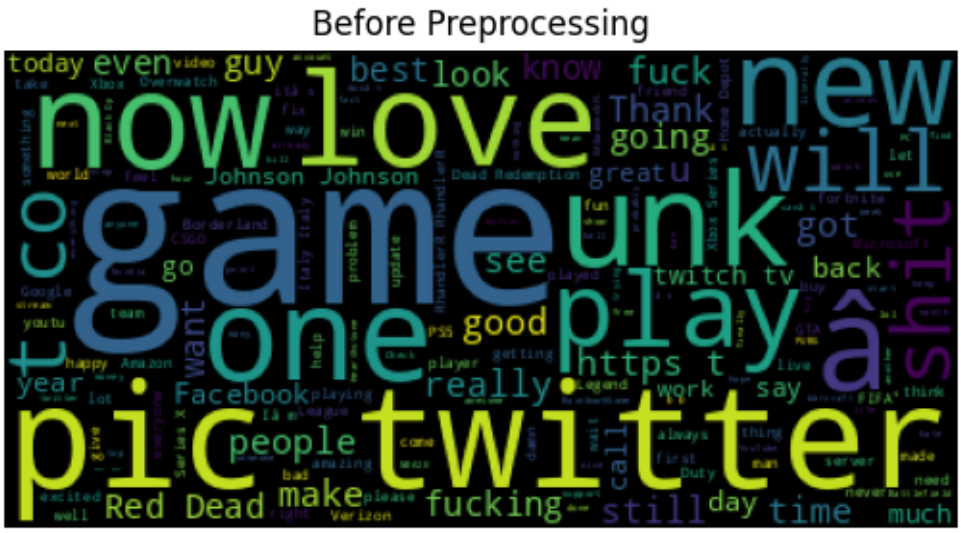


[10]:
```
stop_words = set(stopwords.words('english'))
stemmer = PorterStemmer()
lemmatizer = WordNetLemmatizer()
```

[29]:
```
def preprocess(text):
    # Lowercase
    text=str(text)
    text = text.lower()

    # Remove punctuation
    text = text.translate(str.maketrans('', '', string.punctuation))
    # Tokenize
    tokens = text.split()
    # Remove stopwords
    tokens = [t for t in tokens if t not in stop_words]
    # Lemmatize + Stem
    tokens = [stemmer.stem(lemmatizer.lemmatize(t)) for t in tokens]
    return ' '.join(tokens)
```

[42]:
```
wc = WordCloud().generate(
    ' '.join(df['Tweet content'].astype(str))
)
```

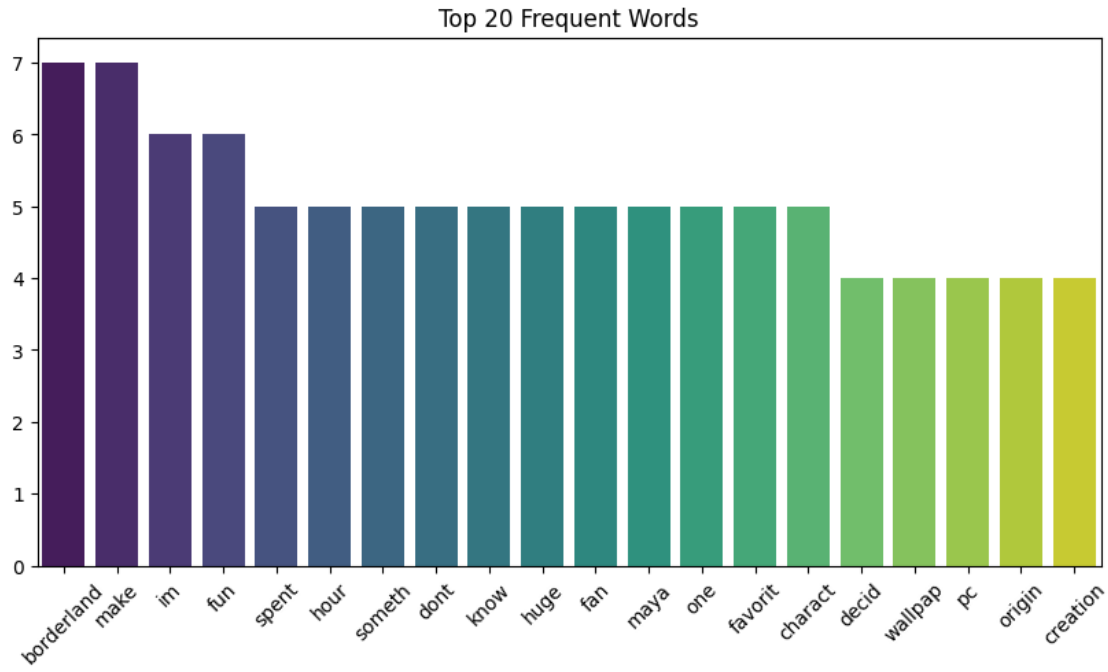
```
plt.imshow(wc)
plt.title('Before Preprocessing')
plt.axis('off')
plt.show()
```



[43]:
```
df['clean_text'] = df['Tweet content'][:50].apply(preprocess)
```

[39]:
```
wc = WordCloud().generate(' '.join(df['clean_text'].astype(str)))
plt.imshow(wc, interpolation='bilinear')
plt.title('After Preprocessing')
plt.axis('off')
plt.show()
```

[44]:
```
from collections import Counter
words = ' '.join(df['clean_text'][:10]).split()
word_freq = Counter(words).most_common(20)

words, counts = zip(*word_freq)
plt.figure(figsize=(10, 5))
sns.barplot(x=list(words), y=list(counts), palette='viridis')
plt.title("Top 20 Frequent Words")
plt.xticks(rotation=45)
plt.show()
```



[48]:
```
print(word_freq)
```

```
[('game', 10890), ('play', 6959), ('get', 5647), ('like', 5207), ('fuck', 4357),
('go', 4088), ('2', 4073), ('love', 3865), ('im', 3827), ('one', 3713), ('good',
3587), ('time', 3544), ('realli', 3260), ('new', 3208), ('see', 3131), ('look',
2979), ('u', 2936), ('make', 2922), ('peopl', 2915), ('johnson', 2869)]
```

[49]:
```
X_train, X_test, y_train, y_test = train_test_split(df['Tweet content'],␣
↪df['sentiment'], test_size=0.2, random_state=42)
X_train = X_train.fillna("").astype(str)
X_test = X_test.fillna("").astype(str)
```

[64]:
```
# Vectorization
vectorizer = TfidfVectorizer()
X_train_vec = vectorizer.fit_transform(X_train[:200])
X_test_vec = vectorizer.transform(X_test[:80])
y_train=y_train[:200]
y_test=y_test[:80]
```

[67]:
```
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.svm import SVC

# Split data
X_train_full, X_test_full, y_train_full, y_test_full = train_test_split(
    df['Tweet content'], df['sentiment'], test_size=0.2, random_state=42)

# Clean the text data
X_train_full = X_train_full.fillna("").astype(str)
X_test_full = X_test_full.fillna("").astype(str)

# Subset the data for faster training (optional)
X_train = X_train_full[:200]
y_train = y_train_full[:200]

X_test = X_test_full[:80]
y_test = y_test_full[:80]

# Vectorization
vectorizer = TfidfVectorizer()
X_train_vec = vectorizer.fit_transform(X_train)
X_test_vec = vectorizer.transform(X_test)

# SVM Classifier
model = SVC(probability=True)
model.fit(X_train_vec, y_train)

# Predictions
y_pred = model.predict(X_test_vec)
y_prob = model.predict_proba(X_test_vec)[:, 1]
```

[ ]:
```
```

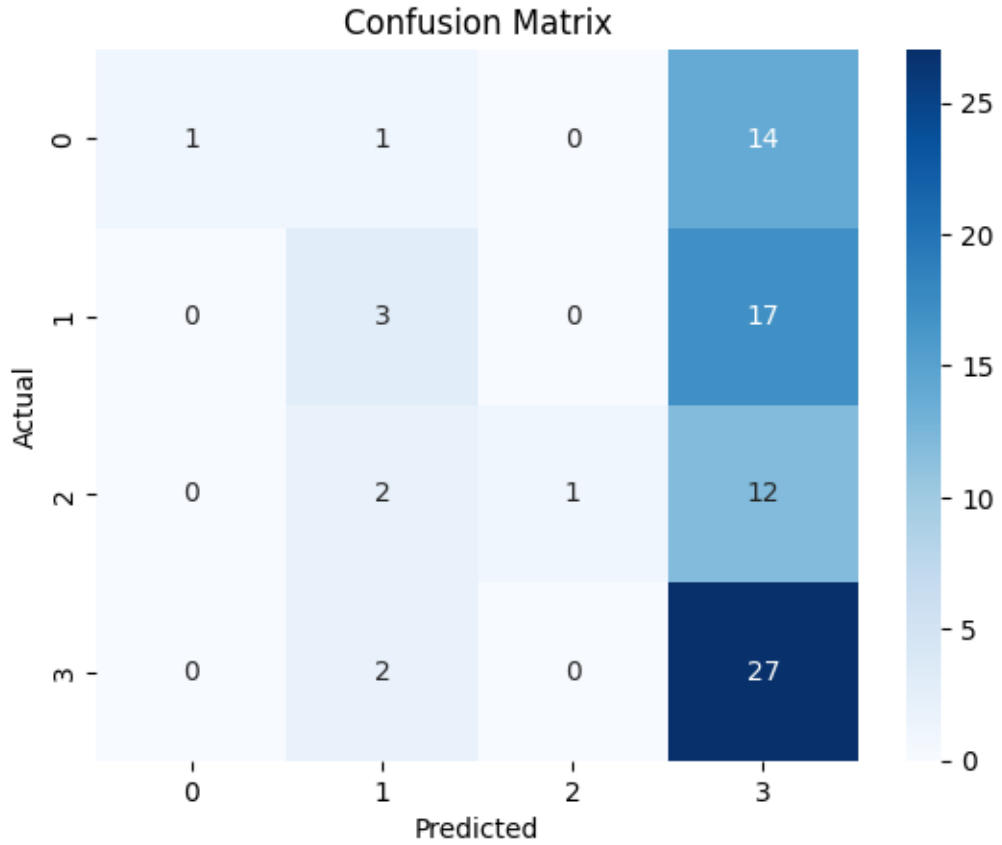
[68]:
```
# Accuracy
print("Accuracy:", accuracy_score(y_test, y_pred))
print("\nClassification Report:\n", classification_report(y_test, y_pred))
```

```
Accuracy: 0.4
```

```
Classification Report:
                precision    recall  f1-score   support

    Irrelevant       1.00      0.06      0.12        16
      Negative       0.38      0.15      0.21        20
       Neutral       1.00      0.07      0.12        15
      Positive       0.39      0.93      0.55        29

      accuracy                           0.40        80
     macro avg       0.69      0.30      0.25        80
  weighted avg       0.62      0.40      0.30        80
```

[ ]:

[69]:
```
conf_matrix = confusion_matrix(y_test, y_pred)
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues')
plt.title("Confusion Matrix")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.show()
```



[ ]:

[ ]:

EXP2 – PDP,LRP,GRADCAM,GuidedBackProp,Surrogate Exp

1.PDP

[45]:
```
import numpy as np
import pandas as pd
from sklearn.inspection import PartialDependenceDisplay
from sklearn.ensemble import RandomForestClassifier
```

[46]:
```
df=pd.read_csv('Dataset/diabetes.csv')
```

[47]:
```
df.head()
```

[47]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	\
0	6	148	72	35	0	33.6	
1	1	85	66	29	0	26.6	
2	8	183	64	0	0	23.3	
3	1	89	66	23	94	28.1	
4	0	137	40	35	168	43.1	

	DiabetesPedigreeFunction	Age	Outcome
0	0.627	50	1
1	0.351	31	0
2	0.672	32	1
3	0.167	21	0
4	2.288	33	1

[48]:
```
from sklearn.model_selection import train_test_split
X = df.drop('Outcome', axis=1)
y = df['Outcome']
X_train,X_test,y_train,y_test=train_test_split(X,y,random_state=42)
```

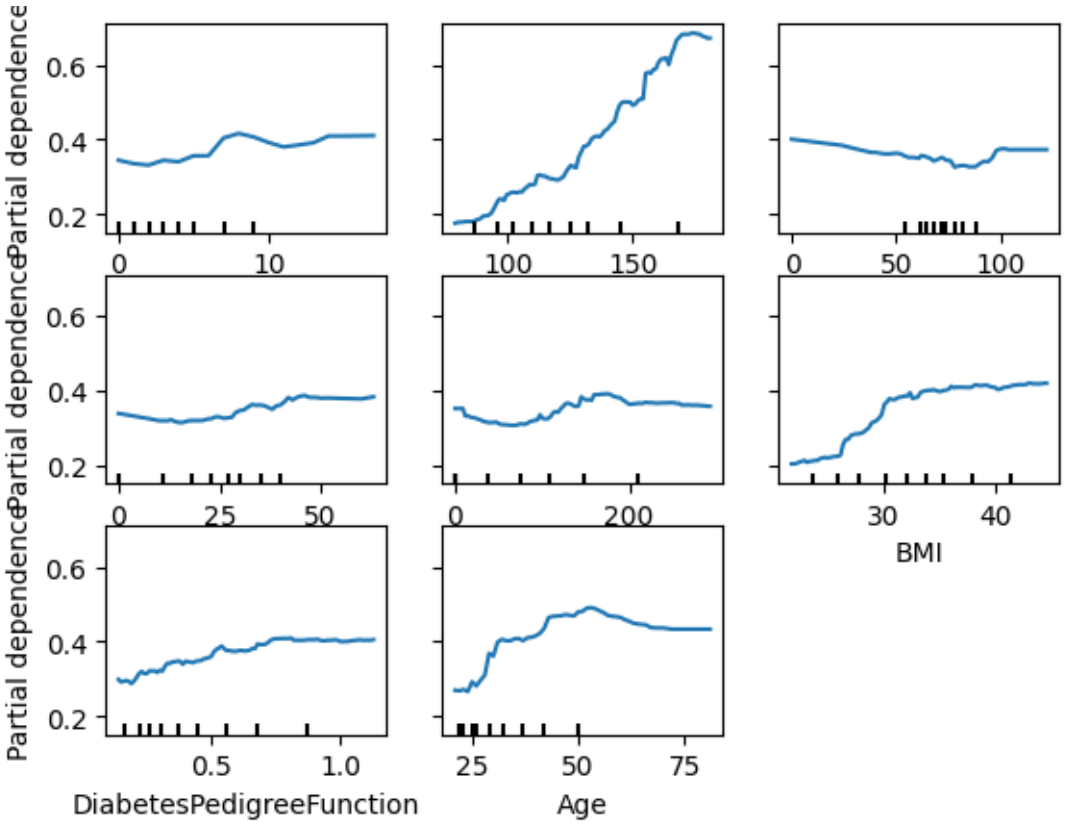
[49]:
```
rf_model=RandomForestClassifier()
rf_model.fit(X_train,y_train)
y_pred=rf_model.predict(X_test)
```

[50]:
```
from sklearn.metrics import accuracy_score
acc=accuracy_score(y_test,y_pred)
print(acc)
```

```
0.7291666666666666
```

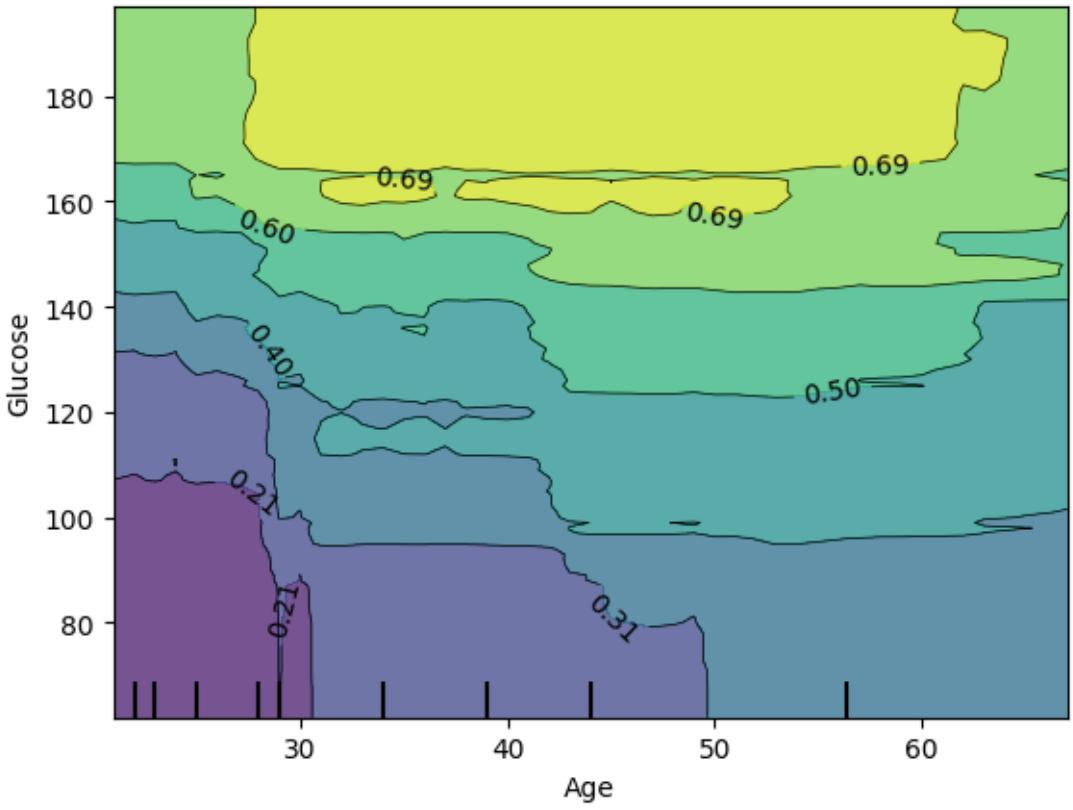
[51]:
```
feat = df.columns[:-1]
PartialDependenceDisplay.from_estimator(rf_model, X_train, features=feat)
```

[51]:
```
<sklearn.inspection._plot.partial_dependence.PartialDependenceDisplay at
0x1df4ef63d00>
```



[54]:
```
PartialDependenceDisplay.from_estimator(rf_model, X_test,␣
↪features=[('Age','Glucose')])
```

[54]:
```
<sklearn.inspection._plot.partial_dependence.PartialDependenceDisplay at
0x1df4fa10e20>
```



[1]:
```
import tensorflow as tf
```

GRADCAM

[24]:
```
import numpy as np
import pandas as pd

from tensorflow.keras.layers import Dense,Flatten,MaxPool2D,Conv2D,Input
from tensorflow.keras.models import Model
```

[11]:
```
!python --version
```

```
Python 3.10.11
```

[25]:
```
from tf_keras_vis.utils.scores import CategoricalScore
from tf_keras_vis.utils.model_modifiers import ReplaceToLinear
from tf_keras_vis.gradcam import Gradcam
from tensorflow.keras.preprocessing.image import load_img,img_to_array
```

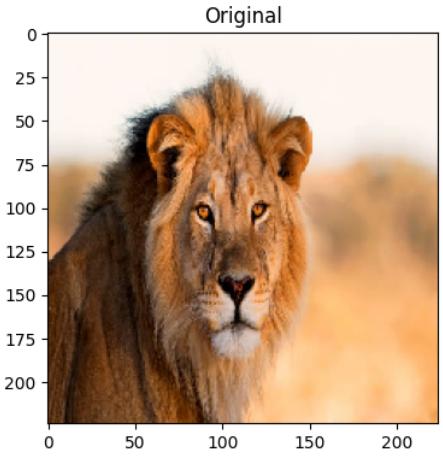
[40]:
```
def build_cnn(inp_shape=(224,224,3),num_cls=2):
    inp=Input(shape=inp_shape)
    x=Conv2D(16,(3,3),activation='relu')(inp)
```

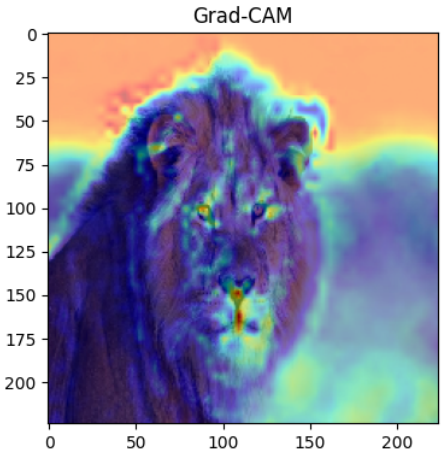
```
    x=MaxPool2D((2,2))(x)
    x=Conv2D(32,(3,3),activation='relu')(x)
    x=MaxPool2D((2,2))(x)
    x=Conv2D(32,(3,3),activation='relu')(x)
    x=MaxPool2D((2,2))(x)
    x=Flatten()(x)
    x=Dense(64,activation='relu')(x)
    outputs=Dense(num_cls,activation='softmax')(x)
    model=Model(inputs=inp,outputs=outputs)
    return model

model = build_cnn()
model.compile(optimizer='adam', loss='categorical_crossentropy',␣
 ↪metrics=['accuracy'])
```

[41]:
```
img_path = 'Dataset/lion.jpg'
img = load_img(img_path, target_size=(224, 224))
img_array = img_to_array(img) / 255.0
img_input = np.expand_dims(img_array, axis=0)

# 4. Apply Grad-CAM
pred_class = np.argmax(model.predict(img_input))
score = CategoricalScore([pred_class])
gm = Gradcam(model, model_modifier=ReplaceToLinear())
cam = gm(score, img_input, penultimate_layer=-1)
```

```
1/1             0s 205ms/step
```

[28]:
```
import matplotlib.pyplot as plt
f, ax = plt.subplots(1, 2, figsize=(12, 4))
ax[0].imshow(img)
ax[0].set_title("Original")
ax[1].imshow(img_array)
ax[1].imshow(cam[0], cmap='jet', alpha=0.5)
ax[1].set_title("Grad-CAM")
plt.tight_layout()
plt.show()
```





[42]:
```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dropout,␣
 ↪Dense
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import numpy as np
import matplotlib.pyplot as plt
import cv2

# Your CNN model
model = Sequential([
    Conv2D(32, (3,3), activation='relu', input_shape=(150, 150, 3)),
    MaxPooling2D(2, 2),

    Conv2D(64, (3,3), activation='relu'),
    MaxPooling2D(2,2),

    Conv2D(128, (3,3), activation='relu'),
    MaxPooling2D(2,2),

    Flatten(),
    Dropout(0.5),
    Dense(512, activation='relu'),
    Dense(1, activation='sigmoid')
])
```

[34]:
```
train_datagen = ImageDataGenerator(rescale=1./255, validation_split=0.2)

train_generator = train_datagen.flow_from_directory(
    'Dataset/cats_dogs',
    target_size=(150, 150),
```

```
    batch_size=32,
    class_mode='binary',
    subset='training'
)

val_generator = train_datagen.flow_from_directory(
    'Dataset/cats_dogs',
    target_size=(150, 150),
    batch_size=32,
    class_mode='binary',
    subset='validation'
)
```

```
Found 107 images belonging to 2 classes.
Found 26 images belonging to 2 classes.
```

[35]:
```
model.compile(optimizer='adam', loss='binary_crossentropy',␣
 ↪metrics=['accuracy'])
model.fit(train_generator, validation_data=val_generator, epochs=5)
```

```
Epoch 1/5
4/4             5s 612ms/step -
accuracy: 0.4290 - loss: 1.1594 - val_accuracy: 0.5385 - val_loss: 0.7351
Epoch 2/5
4/4             2s 521ms/step -
accuracy: 0.6127 - loss: 0.6374 - val_accuracy: 0.5385 - val_loss: 0.6927
Epoch 3/5
4/4             2s 456ms/step -
accuracy: 0.6303 - loss: 0.6892 - val_accuracy: 0.5385 - val_loss: 0.6914
Epoch 4/5
4/4             2s 507ms/step -
accuracy: 0.5393 - loss: 0.6826 - val_accuracy: 0.5385 - val_loss: 0.6938
Epoch 5/5
4/4             2s 510ms/step -
accuracy: 0.5542 - loss: 0.6786 - val_accuracy: 0.5385 - val_loss: 0.6941
```

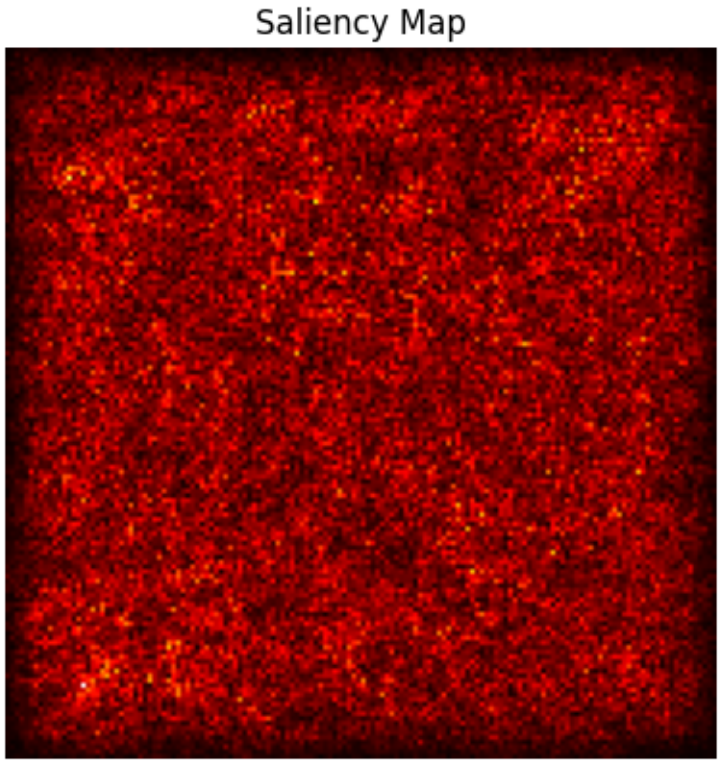
[35]:
```
<keras.src.callbacks.history.History at 0x14223525180>
```

[36]:
```
# Get one image
sample_image, label = next(val_generator)
img = sample_image[0]  # Shape: (150, 150, 3)
img_batch = np.expand_dims(img, axis=0)
```

SALIENCY MAP

[44]:
```
img_tensor = tf.convert_to_tensor(img_batch)
with tf.GradientTape() as tape:
    tape.watch(img_tensor)
```

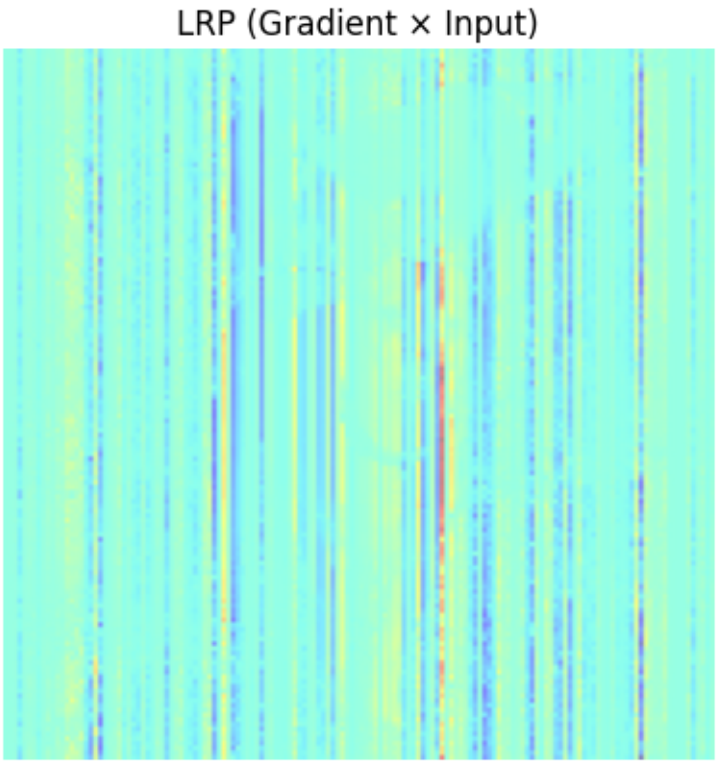
```
    pred = model(img_tensor)
    loss = pred[0]

grads = tape.gradient(loss, img_tensor)[0].numpy()
saliency = np.max(np.abs(grads), axis=-1)

plt.imshow(saliency, cmap='hot')
plt.title("Saliency Map")
plt.axis('off')
plt.show()
```



LRP

[38]:
```
# Basic LRP: treat gradient * input as relevance
with tf.GradientTape() as tape:
    img_tensor = tf.convert_to_tensor(img_batch)
    tape.watch(img_tensor)
    preds = model(img_tensor)
    loss = preds[0]

grads = tape.gradient(loss, img_tensor)[0].numpy()
relevance = grads[0] * img
```

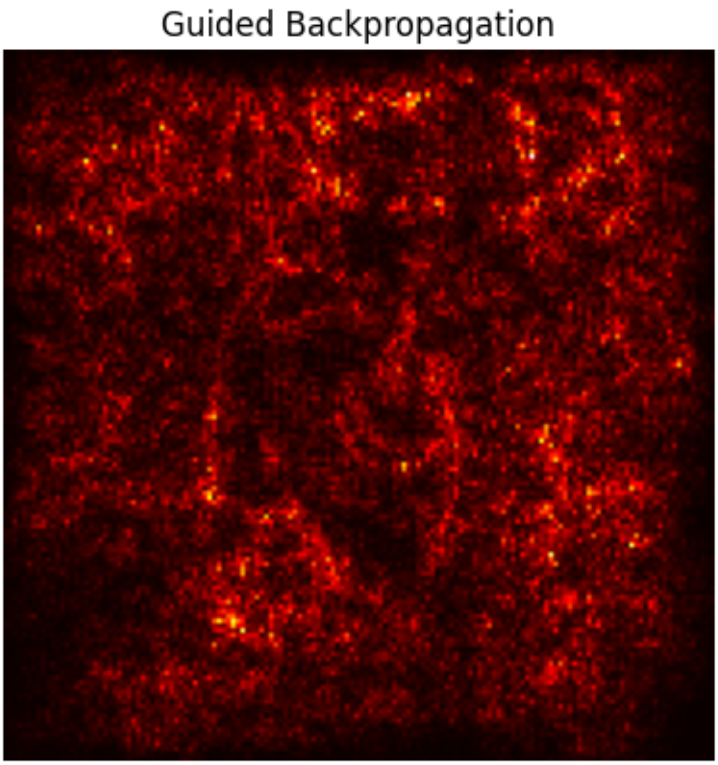
```
lrp_map = np.sum(relevance, axis=-1)
plt.imshow(lrp_map, cmap='jet',alpha=0.5)
plt.title("LRP (Gradient × Input)")
plt.axis('off')
plt.show()
```



GUIDED BACKPROPAGATION

[21]:
```
import tensorflow as tf
import numpy as np
import matplotlib.pyplot as plt

# Define guided ReLU
@tf.custom_gradient
def guided_relu(x):
    def grad(dy):
        return tf.cast(dy > 0, tf.float32) * tf.cast(x > 0, tf.float32) * dy
    return tf.nn.relu(x), grad

# Replace ReLU activations with guided ReLU
def make_guided_model(model):
```

```
    guided_model = tf.keras.models.clone_model(model)
    for layer in guided_model.layers:
        if hasattr(layer, 'activation') and layer.activation == tf.keras.
 ↪activations.relu:
            layer.activation = guided_relu
    guided_model.set_weights(model.get_weights())
    return guided_model

guided_model = make_guided_model(model)

# Guided backprop code (almost same as your saliency code)
img_tensor = tf.convert_to_tensor(img_batch)
with tf.GradientTape() as tape:
    tape.watch(img_tensor)
    pred = guided_model(img_tensor)
    loss = pred[0]  # Or use tf.reduce_max(pred) if needed

grads = tape.gradient(loss, img_tensor)[0].numpy()
guided_backprop = np.max(np.abs(grads), axis=-1)

plt.imshow(guided_backprop, cmap='hot')
plt.title("Guided Backpropagation")
plt.axis('off')
plt.show()
```



[ ]:

[ ]:

[ ]:

[ ]:

SURROGATE EXPLAINER

[15]:
```
import numpy as np
import pandas as pd
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier,plot_tree
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
```

[11]:
```
df=pd.read_csv('Dataset/diabetes.csv')
```

[12]:
```
df.head()
```

[12]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

[13]:
```
df.describe()
```

[13]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin
count	768.000000	768.000000	768.000000	768.000000	768.000000
mean	3.845052	120.894531	69.105469	20.536458	79.799479
std	3.369578	31.972618	19.355807	15.952218	115.244002
min	0.000000	0.000000	0.000000	0.000000	0.000000
25%	1.000000	99.000000	62.000000	0.000000	0.000000
50%	3.000000	117.000000	72.000000	23.000000	30.500000
75%	6.000000	140.250000	80.000000	32.000000	127.250000

```
max      17.000000  199.000000     122.000000      99.000000  846.000000

              BMI  DiabetesPedigreeFunction         Age     Outcome
count  768.000000                768.000000  768.000000  768.000000
mean    31.992578                  0.471876   33.240885    0.348958
std      7.884160                  0.331329   11.760232    0.476951
min      0.000000                  0.078000   21.000000    0.000000
25%     27.300000                  0.243750   24.000000    0.000000
50%     32.000000                  0.372500   29.000000    0.000000
75%     36.600000                  0.626250   41.000000    1.000000
max     67.100000                  2.420000   81.000000    1.000000
```

[19]:
```
rf_model=RandomForestClassifier()
X=df.drop('Outcome',axis=1)
y=df['Outcome']
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.
 ↪2,random_state=42)
rf_model.fit(X_train,y_train)

y_pred=rf_model.predict(X_test)
print(accuracy_score(y_test,y_pred))
```

```
0.7402597402597403
```

[21]:
```
dt_model=DecisionTreeClassifier()
dt_model.fit(X_test,y_pred)
```

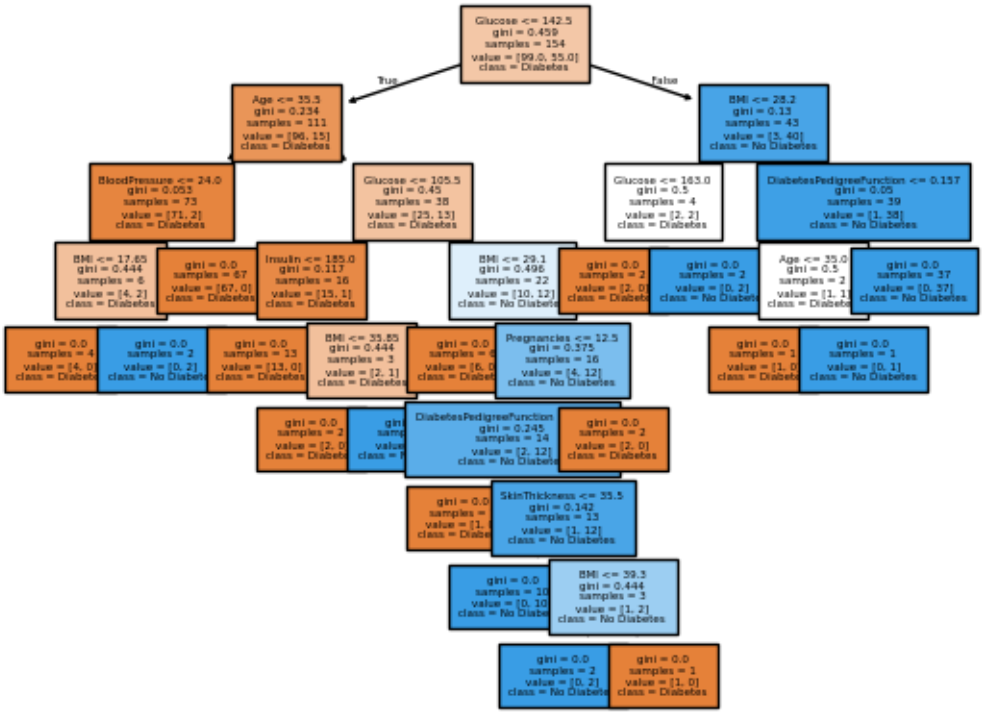
[21]:
```
DecisionTreeClassifier()
```

[32]:
```
plot_tree(dt_model,
          feature_names=X.columns,
          class_names=['Diabetes','No Diabetes'],
          filled=True,
          fontsize=4
         )
```

[32]:
```
[Text(0.5394736842105263, 0.9444444444444444, 'Glucose <= 142.5\ngini =
0.459\nsamples = 154\nvalue = [99.0, 55.0]\nclass = Diabetes'),
 Text(0.2894736842105263, 0.8333333333333334, 'Age <= 35.5\ngini =
0.234\nsamples = 111\nvalue = [96, 15]\nclass = Diabetes'),
 Text(0.4144736842105263, 0.8888888888888888, 'True  '),
 Text(0.15789473684210525, 0.7222222222222222, 'BloodPressure <= 24.0\ngini =
0.053\nsamples = 73\nvalue = [71, 2]\nclass = Diabetes'),
 Text(0.10526315789473684, 0.6111111111111112, 'BMI <= 17.65\ngini =
0.444\nsamples = 6\nvalue = [4, 2]\nclass = Diabetes'),
 Text(0.05263157894736842, 0.5, 'gini = 0.0\nsamples = 4\nvalue = [4, 0]\nclass
= Diabetes'),
```

```
 Text(0.15789473684210525, 0.5, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]\nclass
= No Diabetes'),
 Text(0.21052631578947367, 0.6111111111111112, 'gini = 0.0\nsamples = 67\nvalue
= [67, 0]\nclass = Diabetes'),
 Text(0.42105263157894735, 0.7222222222222222, 'Glucose <= 105.5\ngini =
0.45\nsamples = 38\nvalue = [25, 13]\nclass = Diabetes'),
 Text(0.3157894736842105, 0.6111111111111112, 'Insulin <= 185.0\ngini =
0.117\nsamples = 16\nvalue = [15, 1]\nclass = Diabetes'),
 Text(0.2631578947368421, 0.5, 'gini = 0.0\nsamples = 13\nvalue = [13, 0]\nclass
= Diabetes'),
 Text(0.3684210526315789, 0.5, 'BMI <= 35.85\ngini = 0.444\nsamples = 3\nvalue =
[2, 1]\nclass = Diabetes'),
 Text(0.3157894736842105, 0.3888888888888889, 'gini = 0.0\nsamples = 2\nvalue =
[2, 0]\nclass = Diabetes'),
 Text(0.42105263157894735, 0.3888888888888889, 'gini = 0.0\nsamples = 1\nvalue =
[0, 1]\nclass = No Diabetes'),
 Text(0.5263157894736842, 0.6111111111111112, 'BMI <= 29.1\ngini =
0.496\nsamples = 22\nvalue = [10, 12]\nclass = No Diabetes'),
 Text(0.47368421052631576, 0.5, 'gini = 0.0\nsamples = 6\nvalue = [6, 0]\nclass
= Diabetes'),
 Text(0.5789473684210527, 0.5, 'Pregnancies <= 12.5\ngini = 0.375\nsamples =
16\nvalue = [4, 12]\nclass = No Diabetes'),
 Text(0.5263157894736842, 0.3888888888888889, 'DiabetesPedigreeFunction <=
0.196\ngini = 0.245\nsamples = 14\nvalue = [2, 12]\nclass = No Diabetes'),
 Text(0.47368421052631576, 0.2777777777777778, 'gini = 0.0\nsamples = 1\nvalue =
[1, 0]\nclass = Diabetes'),
 Text(0.5789473684210527, 0.2777777777777778, 'SkinThickness <= 35.5\ngini =
0.142\nsamples = 13\nvalue = [1, 12]\nclass = No Diabetes'),
 Text(0.5263157894736842, 0.16666666666666666, 'gini = 0.0\nsamples = 10\nvalue
= [0, 10]\nclass = No Diabetes'),
 Text(0.631578947368421, 0.16666666666666666, 'BMI <= 39.3\ngini =
0.444\nsamples = 3\nvalue = [1, 2]\nclass = No Diabetes'),
 Text(0.5789473684210527, 0.05555555555555555, 'gini = 0.0\nsamples = 2\nvalue =
[0, 2]\nclass = No Diabetes'),
 Text(0.6842105263157895, 0.05555555555555555, 'gini = 0.0\nsamples = 1\nvalue =
[1, 0]\nclass = Diabetes'),
 Text(0.631578947368421, 0.3888888888888889, 'gini = 0.0\nsamples = 2\nvalue =
[2, 0]\nclass = Diabetes'),
 Text(0.7894736842105263, 0.8333333333333334, 'BMI <= 28.2\ngini = 0.13\nsamples
= 43\nvalue = [3, 40]\nclass = No Diabetes'),
 Text(0.6644736842105263, 0.8888888888888888, '  False'),
 Text(0.6842105263157895, 0.7222222222222222, 'Glucose <= 163.0\ngini =
0.5\nsamples = 4\nvalue = [2, 2]\nclass = Diabetes'),
 Text(0.631578947368421, 0.6111111111111112, 'gini = 0.0\nsamples = 2\nvalue =
[2, 0]\nclass = Diabetes'),
 Text(0.7368421052631579, 0.6111111111111112, 'gini = 0.0\nsamples = 2\nvalue =
[0, 2]\nclass = No Diabetes'),
```

```
 Text(0.8947368421052632, 0.7222222222222222, 'DiabetesPedigreeFunction <=
0.157\ngini = 0.05\nsamples = 39\nvalue = [1, 38]\nclass = No Diabetes'),
 Text(0.8421052631578947, 0.6111111111111112, 'Age <= 35.0\ngini = 0.5\nsamples
= 2\nvalue = [1, 1]\nclass = Diabetes'),
 Text(0.7894736842105263, 0.5, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]\nclass =
Diabetes'),
 Text(0.8947368421052632, 0.5, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]\nclass =
No Diabetes'),
 Text(0.9473684210526315, 0.6111111111111112, 'gini = 0.0\nsamples = 37\nvalue =
[0, 37]\nclass = No Diabetes')]
```



[ ]:

EXP-4 FEATURE IMPORTANCE

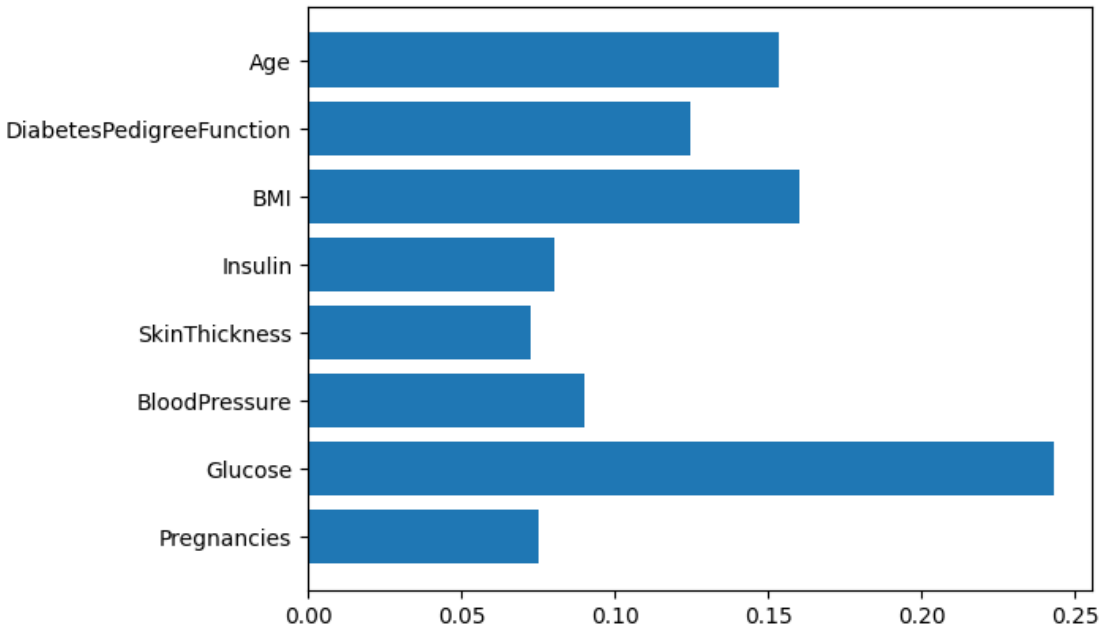
[33]:
```
df=pd.read_csv('Dataset/diabetes.csv')
```

[35]:
```
model=RandomForestClassifier()
model.fit(X_train,y_train)
```

[35]:
```
RandomForestClassifier()
```

[43]:
```
import matplotlib.pyplot as plt

y_pred=model.predict(X_test)

feat_imp=model.feature_importances_
feat=X.columns
plt.barh(feat,feat_imp)
```

[43]:
```
<BarContainer object of 8 artists>
```



EXP4 - CFE

[46]:
```
import dice_ml
from dice_ml import Dice
```

[51]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 768 entries, 0 to 767
Data columns (total 9 columns):
 #   Column                    Non-Null Count  Dtype
---  ------                    --------------  -----
 0   Pregnancies               768 non-null    int64
 1   Glucose                   768 non-null    int64
 2   BloodPressure             768 non-null    int64
 3   SkinThickness             768 non-null    int64
 4   Insulin                   768 non-null    int64
```

```
 5   BMI                       768 non-null    float64
 6   DiabetesPedigreeFunction  768 non-null    float64
 7   Age                       768 non-null    int64
 8   Outcome                   768 non-null    int64
dtypes: float64(2), int64(7)
memory usage: 54.1 KB
```

[70]:
```
train_df=pd.concat([X_train,y_train],axis=1)

#Need to take all columns which are having int64,float64
cont_feat=['Pregnancies','Glucose','BloodPressure','SkinThickness','Insulin','BMI','DiabetesPe
d=dice_ml.Data(dataframe=train_df,
               continuous_features=cont_feat,
               outcome_name='Outcome')

m=dice_ml.Model(model=model,backend='sklearn')

exp=Dice(d,m)

query=X_test.iloc[2:3]

cf=exp.generate_counterfactuals(query,total_CFs=3,desired_class='opposite')
cf.visualize_as_dataframe()
```

```
100%|
    | 1/1 [00:00<00:00,  3.16it/s]
Query instance (original outcome : 0)


   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin        BMI  \
0            2      108             64              0        0  30.799999

   DiabetesPedigreeFunction  Age  Outcome
0                     0.158   21        0


Diverse Counterfactual set (new outcome: 1)
   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI  \
0            2      123             64              0        0  30.8
1            2      179             64             39        0  30.8
2            2      156             64              0        0  30.8

   DiabetesPedigreeFunction  Age  Outcome
0                     0.158   46        1
1                     0.158   21        1
2                     0.158   78        1
```

[ ]:

EXP6 - LIME

LIME - TABULAR DATA

[8]:
```
import lime
import pandas as pd
import lime.lime_tabular
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report
df=pd.read_csv('Dataset/diabetes.csv')
```

[9]:
```
df.head()
```

[9]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	\
0	6	148	72	35	0	33.6	
1	1	85	66	29	0	26.6	
2	8	183	64	0	0	23.3	
3	1	89	66	23	94	28.1	
4	0	137	40	35	168	43.1	

	DiabetesPedigreeFunction	Age	Outcome
0	0.627	50	1
1	0.351	31	0
2	0.672	32	1
3	0.167	21	0
4	2.288	33	1

[10]:
```
X=df.drop('Outcome',axis=1)
y=df['Outcome']
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.
  ↪2,random_state=42)
model=RandomForestClassifier()
model.fit(X_train,y_train)
y_pred=model.predict(X_test)

print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.80      0.78      0.79        99
           1       0.62      0.65      0.64        55

    accuracy                           0.73       154
   macro avg       0.71      0.72      0.71       154
weighted avg       0.74      0.73      0.74       154
```

[22]:
```
lime_exp=lime.lime_tabular.LimeTabularExplainer(
    training_data=X_train.values,
    feature_names=X_train.columns,
    class_names=['Diabetes','No Diabetes'],
    mode='classification'
)

exp=lime_exp.explain_instance(X_test.iloc[0].values,model.predict_proba)
exp.show_in_notebook()
```

```
D:\SEM6\XAI_LAB_REQ\xai_env\lib\site-packages\sklearn\utils\validation.py:2739:
UserWarning: X does not have valid feature names, but RandomForestClassifier was
fitted with feature names
  warnings.warn(
```

```
<IPython.core.display.HTML object>
```

LIME - TEXT DATA

[16]:
```
import lime
import lime.lime_text
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.pipeline import make_pipeline
import pandas as pd
df=pd.read_csv('Dataset/sms.tsv',sep='\t',names=['senti','Desc'])
```

[17]:
```
df.head()
```

[17]:

	senti	Desc
0	ham	Go until jurong point, crazy.. Available only …
1	ham	Ok lar… Joking wif u oni…
2	spam	Free entry in 2 a wkly comp to win FA Cup fina…
3	ham	U dun say so early hor… U c already then say…
4	ham	Nah I don't think he goes to usf, he lives aro…

[18]:
```
df['senti'].map({'ham':1,'spam':0})
```

[18]:
```
0       1
1       1
2       0
3       1
4       1
       ..
5567    0
5568    1
```

```
5569    1
5570    1
5571    1
Name: senti, Length: 5572, dtype: int64
```

[19]:
```
df.head()
df.dropna(inplace=True)
```

[76]:
```
X=df['Desc']
y=df['senti']
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.
 ↪2,random_state=42)

tfidf=TfidfVectorizer()
model=LogisticRegression()
mod_pip=make_pipeline(tfidf,model)
mod_pip.fit(X_train,y_train)
```

[76]:
```
Pipeline(steps=[('tfidfvectorizer', TfidfVectorizer()),
                ('logisticregression', LogisticRegression())])
```

[78]:
```
lime_exp=lime.lime_text.LimeTextExplainer(class_names=['Positive','Negative'])
query=X_train.iloc[5]
exp=lime_exp.explain_instance(
    query,
    mod_pip.predict_proba,
)
exp.show_in_notebook()
```

```
<IPython.core.display.HTML object>
```

LIME - ON IMAGE

[20]:
```
import tensorflow as tf
```

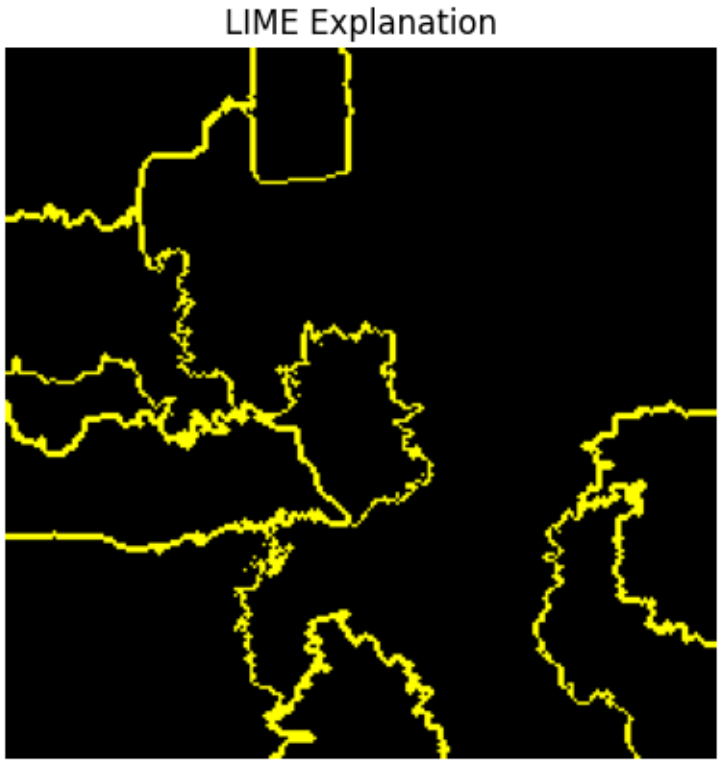
[66]:
```
from lime import lime_image
from skimage.segmentation import mark_boundaries
from tensorflow.keras.preprocessing import image
from tensorflow.keras.applications.mobilenet import preprocess_input
from tensorflow.keras.models import load_model
import matplotlib.pyplot as plt
import numpy as np
import os
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D,MaxPooling2D,Flatten,Dense,Dropout
```

[67]:
```
model = load_model('EffcientNet.h5')
# Assume trained on cats vs dogs
```

```
# Your CNN model
# model = Sequential([
#     Conv2D(32, (3,3), activation='relu', input_shape=(224, 224, 3)),
#     MaxPooling2D(2, 2),

#     Conv2D(64, (3,3), activation='relu'),
#     MaxPooling2D(2,2),

#     Conv2D(128, (3,3), activation='relu'),
#     MaxPooling2D(2,2),

#     Flatten(),
#     Dropout(0.5),
#     Dense(512, activation='relu'),
#     Dense(1, activation='sigmoid')
# ])

img_path = 'Dataset/cats_dogs/cats/cat.1.jpg'
img = image.load_img(img_path, target_size=(224, 224))
img_array = image.img_to_array(img)
img_preprocessed = preprocess_input(np.expand_dims(img_array, axis=0))

explainer = lime_image.LimeImageExplainer()
explanation = explainer.explain_instance(
    image=img_array,
    classifier_fn=lambda x: model.predict(preprocess_input(x)),
    top_labels=2,
    hide_color=0,
    num_samples=10
)

# Show explanation for top label
temp,mask = explanation.get_image_and_mask(
    label=explanation.top_labels[0],
    positive_only=False,
    hide_rest=False,
    num_features=10,
    min_weight=0.0
)

plt.imshow(mark_boundaries(temp / 255.0, mask))
plt.title('LIME Explanation')
plt.axis('off')
plt.show()
```

```
D:\SEM6\XAI_LAB_REQ\xai_env\lib\site-
```

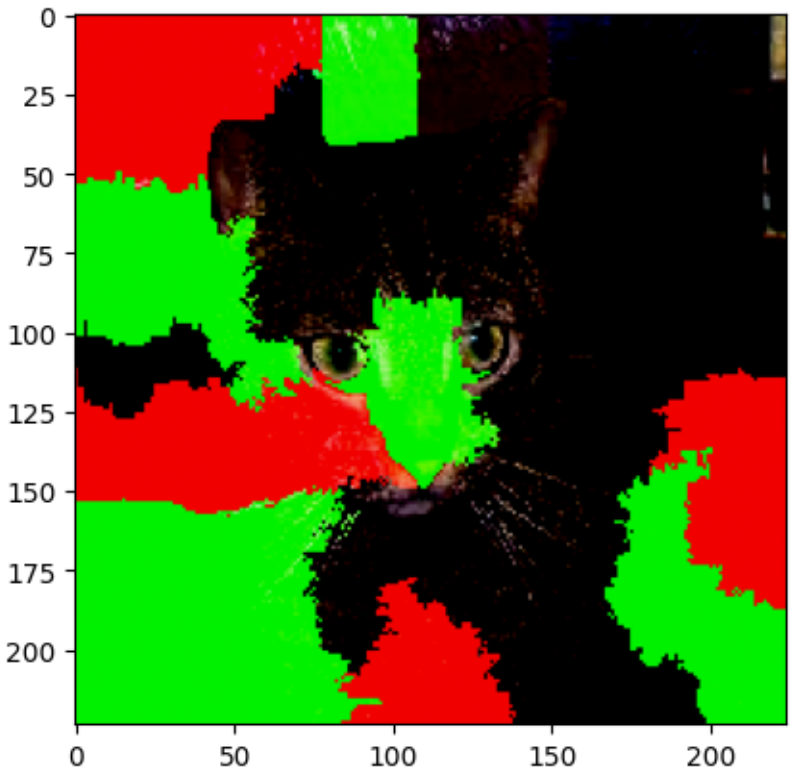
```
packages\keras\src\layers\convolutional\base_conv.py:107: UserWarning: Do not
pass an `input_shape`/`input_dim` argument to a layer. When using Sequential
models, prefer using an `Input(shape)` object as the first layer in the model
instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
  0%|          | 0/10 [00:00<?, ?it/s]
1/1             1s 898ms/step
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers). Got range
[-0.003921569..1.0].
```



[68]:
```
plt.imshow(temp)
```

```
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers). Got range
[-1.0..0.94509804].
```

[68]: `<matplotlib.image.AxesImage at 0x14382abdae0>`



SHAP ON DL MODELS

[45]:
```
import shap
import numpy as np
import tensorflow as tf
from tensorflow.keras.applications.mobilenet import preprocess_input,␣
 ↪decode_predictions
from tensorflow.keras.applications import MobileNet,VGG16
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing.image import load_img, img_to_array
import matplotlib.pyplot as plt
```

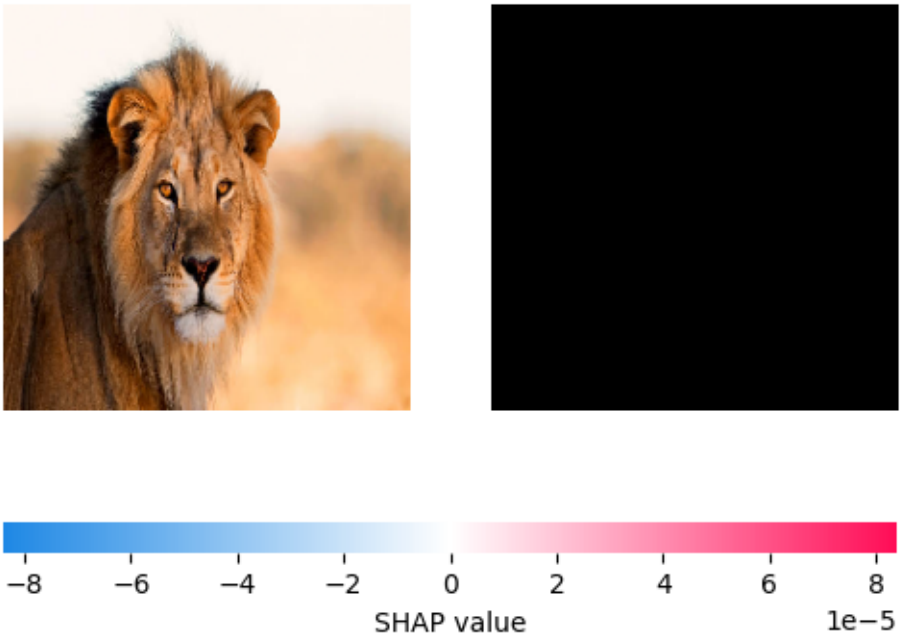
[62]:
```
#OWN DL MODEL
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dropout,␣
 ↪Dense
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import numpy as np
import matplotlib.pyplot as plt
import cv2
```

```
# Your CNN model
model = Sequential([
    Conv2D(32, (3,3), activation='relu', input_shape=(224, 224, 3)),
    MaxPooling2D(2, 2),

    Conv2D(64, (3,3), activation='relu'),
    MaxPooling2D(2,2),

    Conv2D(128, (3,3), activation='relu'),
    MaxPooling2D(2,2),

    Flatten(),
    Dropout(0.5),
    Dense(512, activation='relu'),
    Dense(2, activation='sigmoid')
])


img_path = 'Dataset/lion.jpg'  # change this path
img = load_img(img_path, target_size=(224,224))
img_array = img_to_array(img)
img_preprocessed = np.expand_dims(img_array, axis=0)/255.0

# Show top predicted class
preds = model.predict(img_preprocessed)

background = np.random.rand(10, 224, 224, 3)

# Use GradientExplainer (only accepts NumPy arrays!)
explainer = shap.GradientExplainer(model, background)

# Compute SHAP values for the top predicted class
# Note: ranked_outputs=1 returns SHAP for top class only
shap_values, indexes = explainer.shap_values(
    img_preprocessed,
    ranked_outputs=2
)

# Plot SHAP values
shap.image_plot(shap_values, img_preprocessed)
```

```
1/1             0s 249ms/step
```

```
D:\SEM6\XAI_LAB_REQ\xai_env\lib\site-
packages\keras\src\models\functional.py:238: UserWarning: The structure of
`inputs` doesn't match the expected structure.
Expected: keras_tensor_427
Received: inputs=['Tensor(shape=(1, 224, 224, 3))']
```

```
  warnings.warn(msg)
D:\SEM6\XAI_LAB_REQ\xai_env\lib\site-
packages\keras\src\models\functional.py:238: UserWarning: The structure of
`inputs` doesn't match the expected structure.
Expected: keras_tensor_427
Received: inputs=['Tensor(shape=(50, 224, 224, 3))']
  warnings.warn(msg)
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers). Got range
[-0.00012459726713132113..0.00012009297279291786].
```



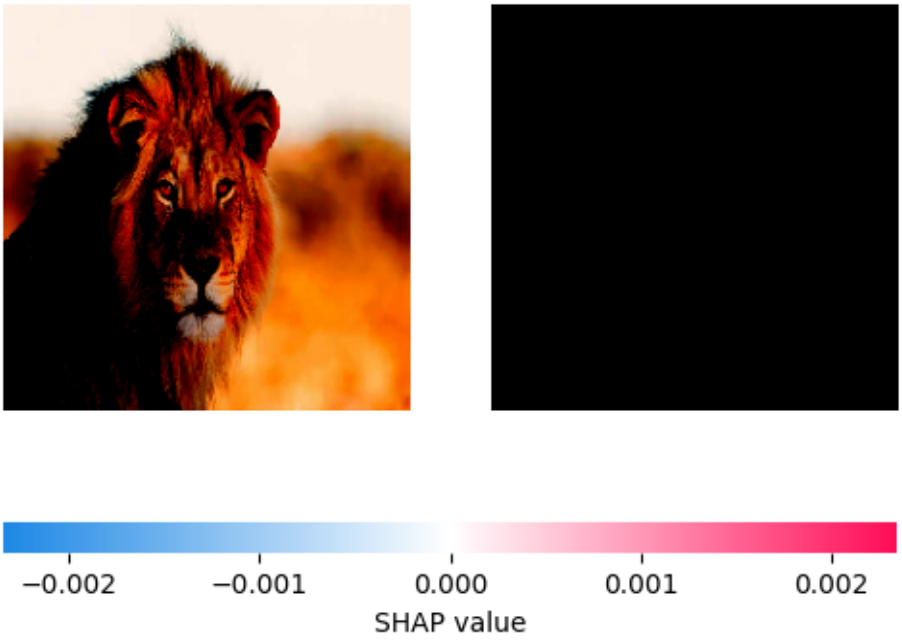
[64]:
```
import shap
import numpy as np
import tensorflow as tf
from tensorflow.keras.applications.mobilenet import preprocess_input,␣
 ↪decode_predictions
from tensorflow.keras.applications import MobileNet,VGG16
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing.image import load_img, img_to_array
import matplotlib.pyplot as plt

# Load the model
#model = Mobilenet(weights='imagenet')
model=load_model('mobilenet_model.h5')
# Load and preprocess image
img_path = 'Dataset/lion.jpg'  # change this path
```

```
img = load_img(img_path, target_size=(224, 224))
img_array = img_to_array(img)
img_preprocessed = preprocess_input(np.expand_dims(img_array, axis=0))

# Show top predicted class
preds = model.predict(img_preprocessed)
# top_pred = decode_predictions(preds, top=3)[0]
# print(top_pred)
# print(f"Predicted: {top_pred[0][1]} ({top_pred[0][2]*100:.2f}%)")

# Background: use multiple zeros or random images for better explanations
background = np.random.rand(10, 224, 224, 3)  # try random sampled ones for␣
 ↪better result

# Use GradientExplainer (only accepts NumPy arrays!)
explainer = shap.GradientExplainer(model, background)

# Compute SHAP values for the top predicted class
# Note: ranked_outputs=1 returns SHAP for top class only
shap_values, indexes = explainer.shap_values(
    img_preprocessed,
    ranked_outputs=2
)

# Plot SHAP values
shap.image_plot(shap_values, img_preprocessed)
```

```
WARNING:absl:No training configuration found in the save file, so the model was
*not* compiled. Compile it manually.
```

```
1/1             1s 1s/step
```

```
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers). Got range [-1.0..1.0].
WARNING:matplotlib.image:Clipping input data to the valid range for imshow with
RGB data ([0..1] for floats or [0..255] for integers). Got range
[-0.004145076760323718..0.005040959571488202].
```



[ ]:

[ ]:

EXP8 - TRAnSFORMERS

[77]:
```
import shap
import numpy as np
from transformers import pipeline, AutoTokenizer
from transformers import AutoTokenizer, AutoModelForSequenceClassification

model_name = 'distilbert-base-uncased-finetuned-sst-2-english'

# Download and cache model/tokenizer locally
AutoTokenizer.from_pretrained(model_name)
AutoModelForSequenceClassification.from_pretrained(model_name)
from transformers import pipeline, AutoTokenizer

# Download and cache model + tokenizer
pipeline("text-classification", model="distilbert-base-uncased")
AutoTokenizer.from_pretrained("distilbert-base-uncased")
```

```
config.json:   0%|          | 0.00/483 [00:00<?, ?B/s]
```

```
D:\SEM6\XAI_LAB_REQ\xai_env\lib\site-
packages\huggingface_hub\file_download.py:144: UserWarning: `huggingface_hub`
cache-system uses symlinks by default to efficiently store duplicated files but
```

```
your machine does not support them in
C:\Users\sukhe\.cache\huggingface\hub\models--distilbert-base-uncased. Caching
files will still work but in a degraded version that might require more space on
your disk. This warning can be disabled by setting the
`HF_HUB_DISABLE_SYMLINKS_WARNING` environment variable. For more details, see
https://huggingface.co/docs/huggingface_hub/how-to-cache#limitations.
To support symlinks on Windows, you either need to activate Developer Mode or to
run Python as an administrator. In order to activate developer mode, see this
article: https://docs.microsoft.com/en-us/windows/apps/get-started/enable-your-
device-for-development
  warnings.warn(message)
Xet Storage is enabled for this repo, but the 'hf_xet' package is not installed.
Falling back to regular HTTP download. For better performance, install the
package with: `pip install huggingface_hub[hf_xet]` or `pip install hf_xet`
WARNING:huggingface_hub.file_download:Xet Storage is enabled for this repo, but
the 'hf_xet' package is not installed. Falling back to regular HTTP download.
For better performance, install the package with: `pip install
huggingface_hub[hf_xet]` or `pip install hf_xet`

model.safetensors:   0%|          | 0.00/268M [00:00<?, ?B/s]

Some weights of DistilBertForSequenceClassification were not initialized from
the model checkpoint at distilbert-base-uncased and are newly initialized:
['classifier.bias', 'classifier.weight', 'pre_classifier.bias',
'pre_classifier.weight']
You should probably TRAIN this model on a down-stream task to be able to use it
for predictions and inference.

tokenizer_config.json:   0%|          | 0.00/48.0 [00:00<?, ?B/s]

vocab.txt:   0%|          | 0.00/232k [00:00<?, ?B/s]

tokenizer.json:   0%|          | 0.00/466k [00:00<?, ?B/s]

Device set to use cpu
```

[77]:
```
DistilBertTokenizerFast(name_or_path='distilbert-base-uncased',
vocab_size=30522, model_max_length=512, is_fast=True, padding_side='right',
truncation_side='right', special_tokens={'unk_token': '[UNK]', 'sep_token':
'[SEP]', 'pad_token': '[PAD]', 'cls_token': '[CLS]', 'mask_token': '[MASK]'},
clean_up_tokenization_spaces=False, added_tokens_decoder={
        0: AddedToken("[PAD]", rstrip=False, lstrip=False, single_word=False,
normalized=False, special=True),
        100: AddedToken("[UNK]", rstrip=False, lstrip=False, single_word=False,
normalized=False, special=True),
        101: AddedToken("[CLS]", rstrip=False, lstrip=False, single_word=False,
normalized=False, special=True),
        102: AddedToken("[SEP]", rstrip=False, lstrip=False, single_word=False,
normalized=False, special=True),
        103: AddedToken("[MASK]", rstrip=False, lstrip=False, single_word=False,
```

```
normalized=False, special=True),
}
)
```

[83]:
```
from transformers import pipeline, AutoModelForSequenceClassification,␣
↪AutoTokenizer
import shap

model_name = "distilbert-base-uncased-finetuned-sst-2-english"
classifier = pipeline("sentiment-analysis", model=model_name)
explainer = shap.Explainer(classifier)

shap_values = explainer(["I love using SHAP with transformers"])
shap.plots.text(shap_values)
```

```
Device set to use cpu
```

```
<IPython.core.display.HTML object>
```

[ ]:

[ ]:

[ ]: