

## ▼ Facial Expression Recognition

### Description

Computer animated agents and robots bring new dimension in human computer interaction which computers can affect our social life in day-to-day activities. Face to face communication is a real-time scale in the order of milliseconds. The level of uncertainty at this time scale is considerable humans and machines to rely on sensory rich perceptual primitives rather than slow symbolic inference.

In this project we are presenting the real time facial expression recognition of seven most basic human expressions: DISGUST, FEAR, HAPPY, NEUTRAL, SAD, SURPRISE.

This model can be used for prediction of expressions of both still images and real time video. However, we have to provide image to the model. In case of real time video the image should be taken at any point of time and given to the model for prediction of expression. The system automatically detects face using HAAR cascade, resizes the image to a specific size and gives it to the model for prediction. The model will generate a probability corresponding to seven expressions. The highest probability value is the corresponding expression for that image.

### Business Problem

However, our goal here is to predict the human expressions. And if the expression is sad and fear, then a care taker should be assigned to that person.

**For any image our goal is to predict the expression of the face in that image out of seven basic human expressions.**

### Problem Statement

**CLASSIFY THE EXPRESSION OF FACE IN IMAGE OUT OF SEVEN BASIC HUMAN EXPRESSIONS**

### Performance Metric

This is a multi-class classification problem with 7 different classes, so we have considered three performance metrics:

1. Multi-Class Log-loss
2. Accuracy
3. Confusion Metric

## Source Data

We have downloaded data from :

<https://www.kaggle.com/jonathanoheix/face-expression-recognition-dataset>

## Real-World Business Objective & Constraints

1. Low-latency is required.
2. Interpretability is important for still images but not in real time. For still images, probability can be given.
3. Errors are not costly.

## Y- Encoded Labels

**Angry--1**

**Disgust --2**

**Fear--3**

**Happy--4**


**Neutral--5**

**Sad--6**

**Surprise--7**

## ▼ Mapping real-world to ML Problem

```
1 !git clone https://chethan1996:Chethan%409066@github.com/chethan1996/Dataset.git
```

 fatal: destination path 'Dataset' already exists and is not an empty directory

```
1 !ls
```


 BEFinalProject Dataset sample\_data

```
1 import os
2 import numpy as np
3 import pandas as pd
4 import seaborn as sns
5 import matplotlib
6 import matplotlib.pyplot as plt
7 from PIL import Image
8 import glob
9 import cv2
10 from sklearn.model_selection import train_test_split
11 from keras.layers import Dropout, Dense
12 from keras.layers.normalization import BatchNormalization
```

```

13 from keras.models import Sequential, load_model
14 from keras.applications import VGG16
15 from keras.layers import Dense, Conv2D, MaxPool2D , Flatten
16 from keras.preprocessing.image import ImageDataGenerator
17 from sklearn.metrics import accuracy_score, confusion_matrix
18 base_path="Dataset/Data/face-expression-recognition-dataset/images/images/"
19 print("All libraries imported successfully")

```

 All libraries imported successfully


## ▼ 1. Reading the Data of Human Images

### ▼ Angry

```

1 #human_angry1 = glob.glob('../Data/face-expression-recognition-dataset/images/i
2 human_angry = glob.glob(base_path+"train/angry/*")
3 #human_angry.remove('../Data/face-expression-recognition-dataset/images/images/
4 print("Number of images in Angry emotion = "+str(len(human_angry)))
5 #print(human_angry)


```

 Number of images in Angry emotion = 3911

```

1 human_angry_folderName = [os.path.dirname(i)+"/" for i in human_angry]
2 human_angry_imageName = [os.path.basename(i) for i in human_angry]
3 human_angry_emotion = [["Angry"]*len(human_angry)][0]
4 human_angry_label = [1]*len(human_angry)
5 len(human_angry_folderName), len(human_angry_imageName), len(human_angry_emotio


```

 (3911, 3911, 3911, 3911)

```

1 df_angry = pd.DataFrame()
2 p1=df_angry["folderName"] = human_angry_folderName
3 p2=df_angry["imageName"] = human_angry_imageName
4 df_angry["Emotion"] = human_angry_emotion
5 df_angry["Labels"] = human_angry_label
6 #print(p1)
7 #print(p2)
8 df_angry.head()


```




	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	32306.jpg	Angry	1
1	Dataset/Data/face-expression-recognition-datas...	29153.jpg	Angry	1
2	Dataset/Data/face-expression-recognition-datas...	7390.jpg	Angry	1
3	Dataset/Data/face-expression-recognition-datas...	13967.jpg	Angry	1
4	Dataset/Data/face-expression-recognition-datas...	33986.jpg	Angry	1

## ▼ Disgust


```
1 human_disgust = glob.glob(base_path+"train/disgust/*")
2 print("Number of images in Disgust emotion = "+str(len(human_disgust)))
```

 Number of images in Disgust emotion = 431

```
1 human_disgust_folderName = [os.path.dirname(i)+"/" for i in human_disgust]
2 human_disgust_imageName = [os.path.basename(i) for i in human_disgust]
3 human_disgust_emotion = ["Disgust"]*len(human_disgust)[0]
4 human_disgust_label = [2]*len(human_disgust)
5
6 len(human_disgust_folderName), len(human_disgust_imageName), len(human_disgust_
```

 (431, 431, 431, 431)


```
1 df_disgust = pd.DataFrame()
2 #print(human_disgust_folderName)
3 df_disgust["folderName"] = human_disgust_folderName
4 df_disgust["imageName"] = human_disgust_imageName
5 df_disgust["Emotion"] = human_disgust_emotion
6 df_disgust["Labels"] = human_disgust_label
7 df_disgust.head()
```




	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	826.jpg	Disgust	2
1	Dataset/Data/face-expression-recognition-datas...	26324.jpg	Disgust	2
2	Dataset/Data/face-expression-recognition-datas...	14396.jpg	Disgust	2
3	Dataset/Data/face-expression-recognition-datas...	14979.jpg	Disgust	2
4	Dataset/Data/face-expression-recognition-datas...	7837.jpg	Disgust	2

## ▼ Fear

```
1 human_fear = glob.glob(base_path+"train/fear/*")
2 print("Number of images in Fear emotion = "+str(len(human_fear)))
```

 Number of images in Fear emotion = 4061

```
1 human_fear_folderName = [os.path.dirname(i)+"/" for i in human_fear]
2 human_fear_imageName = [os.path.basename(i) for i in human_fear]
3 human_fear_emotion = ["Fear"]*len(human_fear)[0]
4 human_fear_label = [3]*len(human_fear)
5
6 len(human_fear_folderName), len(human_fear_imageName), len(human_fear_emotion),
```

 (4061, 4061, 4061, 4061)

```
1 df_fear = pd.DataFrame()
```

```

2 df_fear["folderName"] = human_fear_folderName
3 df_fear["imageName"] = human_fear_imageName
4 df_fear["Emotion"] = human_fear_emotion
5 df_fear["Labels"] = human_fear_label
6 df_fear.head()

```



	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	1100.jpg	Fear	3
1	Dataset/Data/face-expression-recognition-datas...	25526.jpg	Fear	3
2	Dataset/Data/face-expression-recognition-datas...	15982.jpg	Fear	3
3	Dataset/Data/face-expression-recognition-datas...	13312.jpg	Fear	3
4	Dataset/Data/face-expression-recognition-datas...	20531.jpg	Fear	3

## ▼ Happy

```

1 human_happy = glob.glob(base_path+'train/happy/*')
2 print("Number of images in Happy emotion = "+str(len(human_happy)))

```



Number of images in Happy emotion = 6921

```

1 human_happy_folderName = [os.path.dirname(i)+"/" for i in human_happy]
2 human_happy_imageName = [os.path.basename(i) for i in human_happy]
3 human_happy_emotion = ["Happy"]*len(human_happy)[0]
4 human_happy_label = [4]*len(human_happy)
5
6 len(human_happy_folderName), len(human_happy_imageName), len(human_happy_emotio

```



(6921, 6921, 6921, 6921)

```

1 df_happy = pd.DataFrame()
2 df_happy["folderName"] = human_happy_folderName
3 df_happy["imageName"] = human_happy_imageName
4 df_happy["Emotion"] = human_happy_emotion
5 df_happy["Labels"] = human_happy_label
6 df_happy.head()


```



	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	16868.jpg	Happy	4
1	Dataset/Data/face-expression-recognition-datas...	12612.jpg	Happy	4
2	Dataset/Data/face-expression-recognition-datas...	4487.jpg	Happy	4
3	Dataset/Data/face-expression-recognition-datas...	282.jpg	Happy	4
4	Dataset/Data/face-expression-recognition-datas...	30168.jpg	Happy	4

## ▼ Neutral


```
1 human_neutral = glob.glob(base_path+'train/neutral/*')
2 print("Number of images in Neutral emotion = "+str(len(human_neutral)))
```

 Number of images in Neutral emotion = 4870

```
1 human_neutral_folderName = [os.path.dirname(i)+"/" for i in human_neutral]
2 human_neutral_imageName = [os.path.basename(i) for i in human_neutral]
3 human_neutral_emotion = ["Neutral"]*len(human_neutral)[0]
4 human_neutral_label = [5]*len(human_neutral)
5
6 len(human_neutral_folderName), len(human_neutral_imageName), len(human_neutral_
```

 (4870, 4870, 4870, 4870)


```
1 df_neutral = pd.DataFrame()
2 df_neutral["folderName"] = human_neutral_folderName
3 df_neutral["imageName"] = human_neutral_imageName
4 df_neutral["Emotion"] = human_neutral_emotion
5 df_neutral["Labels"] = human_neutral_label
6 df_neutral.head()
```



	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	22598.jpg	Neutral	5
1	Dataset/Data/face-expression-recognition-datas...	22161.jpg	Neutral	5
2	Dataset/Data/face-expression-recognition-datas...	34915.jpg	Neutral	5
3	Dataset/Data/face-expression-recognition-datas...	602.jpg	Neutral	5
4	Dataset/Data/face-expression-recognition-datas...	22542.jpg	Neutral	5

## ▼ Sad

```
1 human_sad = glob.glob(base_path+'train/sad/*')
2 print("Number of images in Sad emotion = "+str(len(human_sad)))
```

 Number of images in Sad emotion = 4897

```
1 human_sad_folderName = [os.path.dirname(i)+"/" for i in human_sad]
2 human_sad_imageName = [os.path.basename(i) for i in human_sad]
3 human_sad_emotion = ["Sad"]*len(human_sad)[0]
4 human_sad_label = [6]*len(human_sad)
5
6 len(human_sad_folderName), len(human_sad_imageName), len(human_sad_emotion), le
```

 (4897, 4897, 4897, 4897)

```
1 df_sad = pd.DataFrame()
2 df_sad["folderName"] = human_sad_folderName
3 df_sad["imageName"] = human_sad_imageName
```

```

3 df_sad[ 'imageName' ] = human_sad_imageName
4 df_sad["Emotion"] = human_sad_emotion
5 df_sad["Labels"] = human_sad_label
6 df_sad.head()

```



	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	11348.jpg	Sad	6
1	Dataset/Data/face-expression-recognition-datas...	24352.jpg	Sad	6
2	Dataset/Data/face-expression-recognition-datas...	2515.jpg	Sad	6
3	Dataset/Data/face-expression-recognition-datas...	20762.jpg	Sad	6
4	Dataset/Data/face-expression-recognition-datas...	23458.jpg	Sad	6

## ▼ Surprise

```

1 human_surprise = glob.glob(base_path+'train/surprise/*')
2 #human_surprise.remove('../Data/Human/Surprise\\Thumbs.db')
3 print("Number of images in Surprise emotion = "+str(len(human_surprise)))

```



Number of images in Surprise emotion = 3173

```

1 human_surprise_folderName = [os.path.dirname(i) + "/" for i in human_surprise]
2 human_surprise_imageName = [os.path.basename(i) for i in human_surprise]
3 human_surprise_emotion = ["Surprise"]*len(human_surprise)[0]
4 human_surprise_label = [7]*len(human_surprise)
5
6 len(human_surprise_folderName), len(human_surprise_imageName), len(human_surpri

```



(3173, 3173, 3173, 3173)

```

1 df_surprise = pd.DataFrame()
2 df_surprise["folderName"] = human_surprise_folderName
3 df_surprise["imageName"] = human_surprise_imageName
4 df_surprise["Emotion"] = human_surprise_emotion
5 df_surprise["Labels"] = human_surprise_label
6 df_surprise.head()

```




	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	24103.jpg	Surprise	7
1	Dataset/Data/face-expression-recognition-datas...	18229.jpg	Surprise	7
2	Dataset/Data/face-expression-recognition-datas...	1399.jpg	Surprise	7
3	Dataset/Data/face-expression-recognition-datas...	28866.jpg	Surprise	7
4	Dataset/Data/face-expression-recognition-datas...	23692.jpg	Surprise	7

```


1 length = df_angry.shape[0] + df_disgust.shape[0] + df_fear.shape[0] + df_happy.
2 print("Total number of images in all the emotions = "+str(length))

```


 Total number of images in all the emotions = 28264

## ▼ Concatenating all dataframes

```
1 frames = [df_angry, df_disgust, df_fear, df_happy, df_neutral, df_sad, df_surpr
2 Final_human = pd.concat(frames)
3 Final_human.shape
```

 (28264, 4)


```
1 Final_human.reset_index(inplace = True, drop = True)
2 Final_human = Final_human.sample(frac = 1.0) #shuffling the dataframe
3 Final_human.reset_index(inplace = True, drop = True)
4 Final_human.head()
```



	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	28694.jpg	Happy	4
1	Dataset/Data/face-expression-recognition-datas...	21553.jpg	Surprise	7
2	Dataset/Data/face-expression-recognition-datas...	1117.jpg	Happy	4
3	Dataset/Data/face-expression-recognition-datas...	222.jpg	Neutral	5
4	Dataset/Data/face-expression-recognition-datas...	31044.jpg	Angry	1

## ▼ 2. Train, CV and Test Split for Human Images

```
1 df_human_train_data, df_human_test = train_test_split(Final_human, stratify=Fin
2 df_human_train, df_human_cv = train_test_split(df_human_train_data, stratify=df
3 df_human_train.shape, df_human_cv.shape, df_human_test.shape)
```

 ((18892, 4), (3779, 4), (5593, 4))

```
1 df_human_train.reset_index(inplace = True, drop = True)
2 df_human_train.to_pickle(base_path+"train.pkl")
3
4 df_human_test.reset_index(inplace = True, drop = True)
5 df_human_test.to_pickle(base_path+"validation.pkl")
```


```
1 df_human_train = pd.read_pickle(base_path+"train.pkl")
2 df_human_train.head()
```






	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	31219.jpg	Surprise	7
1	Dataset/Data/face-expression-recognition-datas...	7432.jpg	Fear	3
2	Dataset/Data/face-expression-recognition-datas...	5586.jpg	Angry	1
3	Dataset/Data/face-expression-recognition-datas...	6768.jpg	Fear	3
4	Dataset/Data/face-expression-recognition-datas...	31762.jpg	Sad	6

```
1 df_human_train.shape
```

 (18892, 4)

```
1 df_human_test = pd.read_pickle(base_path+"validation.pkl")
2 df_human_test.head()
3 #print(df_human_test["folderName"][1])
```



	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	17890.jpg	Fear	3
1	Dataset/Data/face-expression-recognition-datas...	30654.jpg	Sad	6
2	Dataset/Data/face-expression-recognition-datas...	27170.jpg	Neutral	5
3	Dataset/Data/face-expression-recognition-datas...	26671.jpg	Happy	4
4	Dataset/Data/face-expression-recognition-datas...	16183.jpg	Surprise	7

```
1 df_human_test.shape
```

 (5593, 4)

### ▼ 3. Analysing Data of Human Images

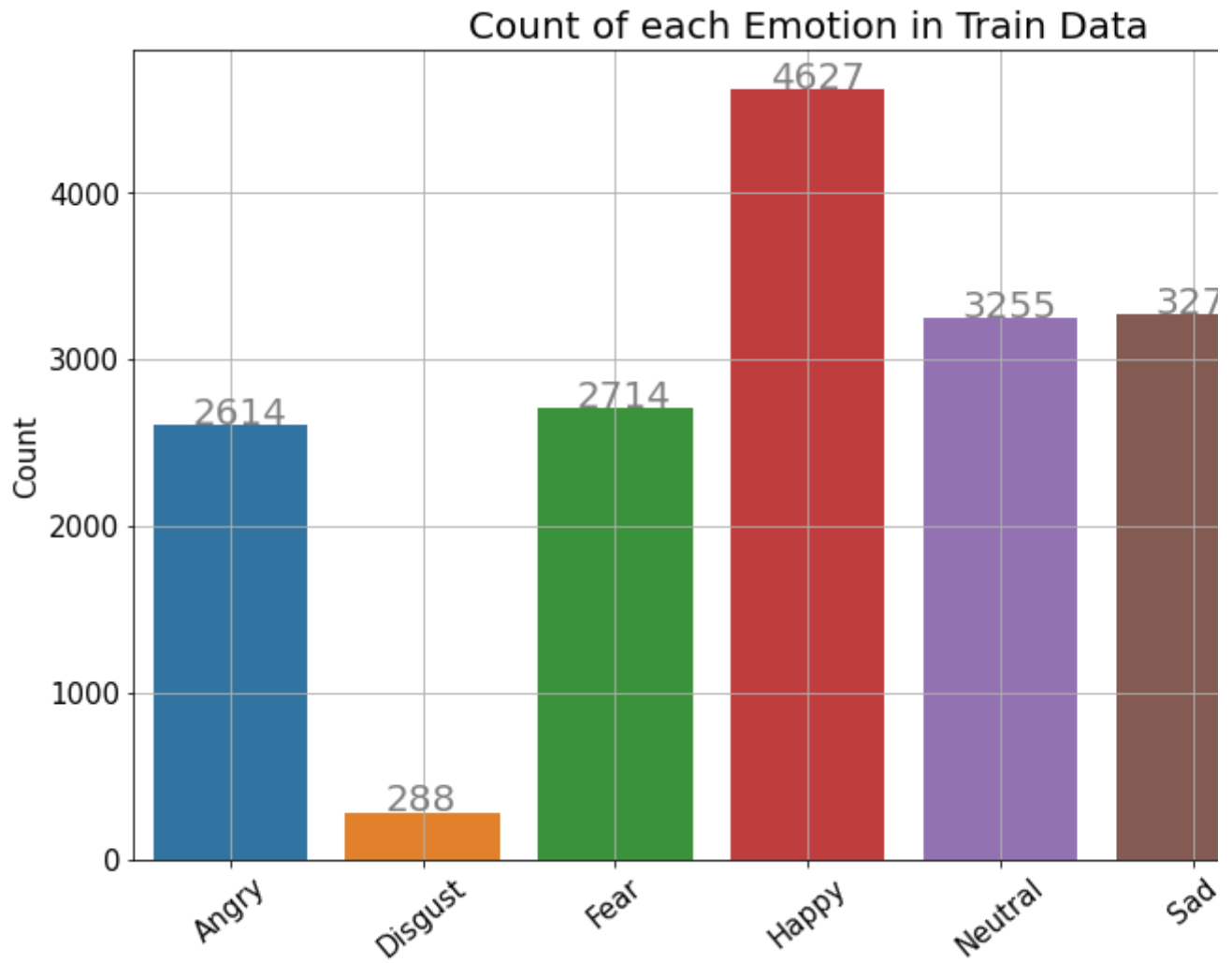
#### Distribution of class labels in Train and Test

```
1 df_temp_train = df_human_train.sort_values(by = "Labels", inplace = False)
2 df_temp_test = df_human_test.sort_values(by = "Labels", inplace = False)
3
4 TrainData_distribution = df_human_train["Emotion"].value_counts().sort_index()
5 TestData_distribution = df_human_test["Emotion"].value_counts().sort_index()
6
7 TrainData_distribution_sorted = sorted(TrainData_distribution.items(), key = la
8 TestData_distribution_sorted = sorted(TestData_distribution.items(), key = lamb

1 fig = plt.figure(figsize = (10, 6))
2 ax = fig.add_axes([0,0,1,1])
3 ax.set_title("Count of each Emotion in Train Data", fontsize = 20)
```

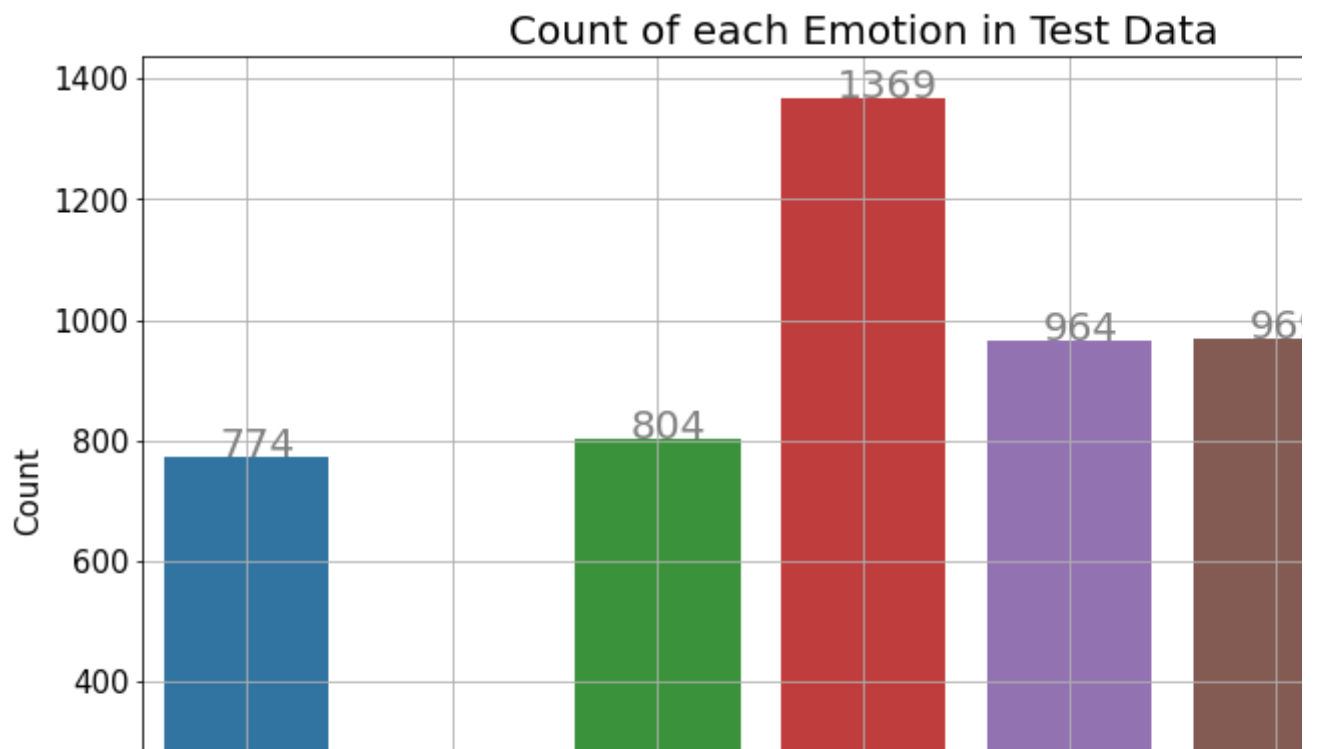
```
4 sns.countplot(x = "Emotion", data = df_temp_train)
5 plt.grid()
6 for i in ax.patches:
7     ax.text(x = i.get_x() + 0.2, y = i.get_height()+1.5, s = str(i.get_height())
8 plt.xlabel("")
9 plt.ylabel("Count", fontsize = 15)
10 plt.tick_params(labelsize = 15)
11 plt.xticks(rotation = 40)
12 plt.show()
13
14 for i in TrainData_distribution_sorted:
15     print("Number of training data points in class "+str(i[0])+" = "+str(i[1])+
16
17 print("-"*80)
18
19
20 fig = plt.figure(figsize = (10, 6))
21 ax = fig.add_axes([0,0,1,1])
22 ax.set_title("Count of each Emotion in Test Data", fontsize = 20)
23 sns.countplot(x = "Emotion", data = df_temp_test)
24 plt.grid()
25 for i in ax.patches:
26     ax.text(x = i.get_x() + 0.27, y = i.get_height()+0.2, s = str(i.get_height(
27 plt.xlabel("")
28 plt.ylabel("Count", fontsize = 15)
29 plt.tick_params(labelsize = 15)
30 plt.xticks(rotation = 40)
31 plt.show()
32
33 for i in TestData_distribution_sorted:
34     print("Number of training data points in class "+str(i[0])+" = "+str(i[1])+
```

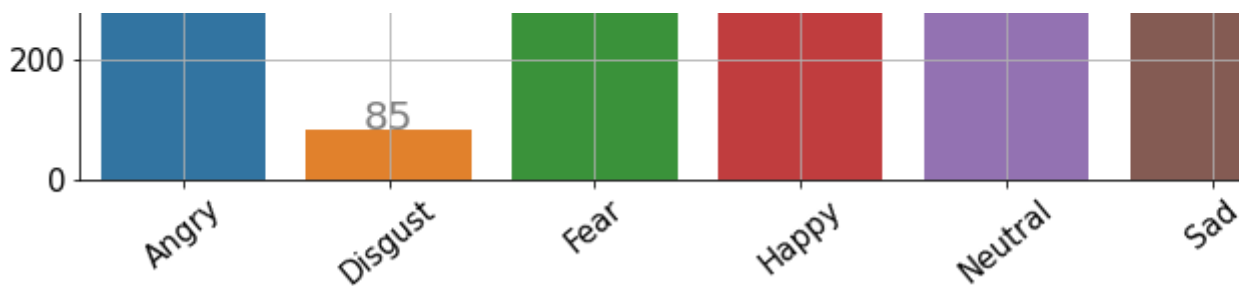




Number of training data points in class Happy = 4627(24.4918%)  
Number of training data points in class Sad = 3273(17.3248%)  
Number of training data points in class Neutral = 3255(17.2295%)  
Number of training data points in class Fear = 2714(14.3659%)  
Number of training data points in class Angry = 2614(13.8365%)  
Number of training data points in class Surprise = 2121(11.227%)  
Number of training data points in class Disgust = 288(1.5245%)

-----





Number of training data points in class Happy = 1369(24.477%)  
 Number of training data points in class Sad = 969(17.3252%)  
 Number of training data points in class Neutral = 964(17.2358%)  
 Number of training data points in class Fear = 804(14.3751%)  
 Number of training data points in class Angry = 774(13.8387%)  
 Number of training data points in class Surprise = 628(11.2283%)  
 Number of training data points in class Disgust = 85(1.5198%)

## ▼ 4. Pre-Processing Human Images

### ▼ 4.1 Converting all the images to grayscale and save them

```

1 def convt_to_gray(df):
2     count = 0
3     for i in range(len(df)):
4         path1 = df["folderName"][i]
5         path2 = df["imageName"][i]
6         #print(os.path.join(path1, path2))
7         img = cv2.imread(os.path.join(path1, path2))
8         gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
9         cv2.imwrite(os.path.join(path1, path2), gray)
10        count += 1
11    print("Total number of images converted and saved = "+str(count))
  
```

```
1 convt_to_gray(df_human_train)
```

Total number of images converted and saved = 18892

```
1 convt_to_gray(df_human_test)
```

Total number of images converted and saved = 5593

### ▼ 4.2 Detecting face in image using HAAR then crop it then resize then save the

```
1 !git clone https://github.com/chethan1996/BEFinalProject.git
```

fatal: destination path 'BEFinalProject' already exists and is not an empty d

```

1 #detect the face in image using HAAR cascade then crop it then resize it and fi
2 face_cascade = cv2.CascadeClassifier('BEFinalProject/haarcascade_frontalface_de
3 #download this xml file from link: https://github.com/opencv/opencv/tree/master
4 def face_det_crop_resize(img, path):
  
```

```

4 def face_det_crop_resize(img_path):
5     img = cv2.imread(img_path)
6     gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
7     faces = face_cascade.detectMultiScale(gray, 1.3, 5)
8
9     for (x,y,w,h) in faces:
10         face_clip = img[y:y+h, x:x+w] #cropping the face in image
11         cv2.imwrite(img_path, cv2.resize(face_clip, (48, 48))) #resizing image


1 for i, d in df_human_train.iterrows():
2     img_path = os.path.join(d["folderName"], d["imageName"])
3     face_det_crop_resize(img_path)


1 for i, d in df_human_cv.iterrows():
2     img_path = os.path.join(d["folderName"], d["imageName"])
3     face_det_crop_resize(img_path)


1 for i, d in df_human_test.iterrows():
2     img_path = os.path.join(d["folderName"], d["imageName"])
3     face_det_crop_resize(img_path)

```

## 5. Creating bottleneck features from VGG-16 model. Here, we are us learning.

```

1 Train_Data = pd.read_pickle(base_path+"train.pkl")
2 Test_Data = pd.read_pickle(base_path+"validation.pkl")
3 Train_Data.shape, Test_Data.shape

```

((18892, 4), (5593, 4))

```
1 Train_Data.head()
```


	folderName	imageName	Emotion	Labels
0	Dataset/Data/face-expression-recognition-datas...	31219.jpg	Surprise	7
1	Dataset/Data/face-expression-recognition-datas...	7432.jpg	Fear	3
2	Dataset/Data/face-expression-recognition-datas...	5586.jpg	Angry	1
3	Dataset/Data/face-expression-recognition-datas...	6768.jpg	Fear	3
4	Dataset/Data/face-expression-recognition-datas...	31762.jpg	Sad	6

```
1 pip install pandas==0.25.3
```

```
Requirement already satisfied: pandas==0.25.3 in /usr/local/lib/python3.6/dist-packages
1 TrainData_batch_pointer = 0
2 TestData_batch_pointer = 0
Requirement already satisfied: cv2==1.5 in /usr/local/lib/python3.6/dist-packages
```


## ▼ 5.1 Bottleneck features for Train Data

```
1 TrainData_Labels = pd.get_dummies(Train_Data["Labels"]).as_matrix()
2 TrainData_Labels.shape
```


 /usr/local/lib/python3.6/dist-packages/ipykernel\_launcher.py:1: FutureWarning  
 """Entry point for launching an IPython kernel.  
 (18892, 7)

```
1
```

```
1 trdata = ImageDataGenerator()
2 traindata = trdata.flow_from_directory(directory=base_path+"/train",target_size
3 tsdata = ImageDataGenerator()
4 testTestdata = tsdata.flow_from_directory(directory=base_path+"/validation", ta
```

 Found 28264 images belonging to 7 classes.  
 Found 7066 images belonging to 7 classes.

```
1 Train_Data = Train_Data.dropna(how='any',axis=0)
2 print(int(len(Train_Data)))
```

 18892

```
1 batch_images = []
2 batch_labels = []
3 for i in range(len(Test_Data)):
4     #print(i)
5     path1 = Test_Data.iloc[i]["folderName"]
6     path2 = Test_Data.iloc[ i]["imageName"]
7     read_image = cv2.imread(os.path.join(path1, path2))
8     #read_image_final = read_image/255.0 #here, we are normalizing the images
9     try:
10         if(read_image.shape!=(48,48,3)):
11             print("Removed {}, {}".format(os.path.join(path1, path2), read_imag
12             os.remove(os.path.join(path1, path2))
13         else:
14             print(read_image.shape)
15     except AttributeError :
16         print(read_image)
17         print("gotti")
18         os.remove(os.path.join(path1, path2))
```



[illegible]

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<https://colab.research.google.com/github/chethan1996/BEFinalProject/blob/co-labs/FacialExpressionRecognition.ipynb#scrol...> 18/232

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[illegible]

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[illegible]

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(12 12 2)

[illegible]

$$(48 \quad 48 \quad 3)$$



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[illegible]

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[illegible]

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[illegible]



$$(48 \quad 48 \quad 3)$$

[illegible]

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(12 12 2)



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110 10 21

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```
1 TestData_batch_pointer=0
2 print(TrainData_batch_pointer)
3 print(TestData_batch_pointer)
```

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```
1 def loadTrainBatch(batch_size):
2     global TrainData_batch_pointer
3     batch_images = []
4     batch_labels = []
5     for i in range(batch_size):
6         path1 = Train_Data.iloc[TrainData_batch_pointer + i]["folderName"]
7         path2 = Train_Data.iloc[TrainData_batch_pointer + i]["imageName"]
8         read_image = cv2.imread(os.path.join(path1, path2))
9         #read_image_final = read_image/255.0 #here, we are normalizing the ima
10        #print(read_image_final)
11        batch_images.append(read_image)
12        try:
13            print(read_image.shape)
14        except AttributeError :
15            print("gotti")
16            print(read_image)
17            print(os.path.join(path1, path2))
18            os.remove(os.path.join(path1, path2))
19        batch_labels.append(TrainData_Labels[TrainData_batch_pointer + i]) #app
20
```



```
21 TrainData_batch_pointer += batch_size
22
23 return np.array(batch_images), np.array(batch_labels)

1 #creating bottleneck features for train data using VGG-16- Image-net model
2 img_height,img_width=48,48
3 model=VGG16(weights= 'imagenet', include_top=False,input_shape= (img_height,img
4 #model = VGG16(weights='imagenet', include_top=False)
5 SAVEDIR = "Dataset/Data/Bottleneck_Features/Bottleneck_TrainData/"
6 SAVEDIR_LABELS = "Dataset/Data/Bottleneck_Features/TrainData_Labels/"
7 batch_size =10
8 for i in range(int(len(Train_Data)/batch_size)):
9     x, y = loadTrainBatch(batch_size)
10    print("Batch {} loaded".format(i+1))
11
12    np.save(os.path.join(SAVEDIR_LABELS, "bottleneck_labels_{}".format(i+1)), y
13
14    print("Creating bottleneck features for batch {}". format(i+1))
15    bottleneck_features = model.predict(x)
16
17    np.save(os.path.join(SAVEDIR, "bottleneck_{}".format(i+1)), bottleneck_feat
18    print("Bottleneck features for batch {} created and saved\n".format(i+1))
```



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Batch 1533 loaded

Creating bottleneck features for batch 1533

Bottleneck features for batch 1533 created and saved

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Batch 1534 loaded

Creating bottleneck features for batch 1534

Bottleneck features for batch 1534 created and saved

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Batch 1535 loaded

Creating bottleneck features for batch 1535

Bottleneck features for batch 1535 created and saved

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Batch 1536 loaded

Creating bottleneck features for batch 1536

Bottleneck features for batch 1536 created and saved

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Batch 1537 loaded

Creating bottleneck features for batch 1537

Bottleneck features for batch 1537 created and saved

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Batch 1538 loaded

Creating bottleneck features for batch 1538

Bottleneck features for batch 1538 created and saved

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Batch 1539 loaded

Creating bottleneck features for batch 1539

Bottleneck features for batch 1539 created and saved

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Batch 1540 loaded

Creating bottleneck features for batch 1540

Bottleneck features for batch 1540 created and saved

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Batch 1546 loaded

Creating bottleneck features for batch 1546

Bottleneck features for batch 1546 created and saved

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Batch 1547 loaded

Creating bottleneck features for batch 1547

Bottleneck features for batch 1547 created and saved

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Batch 1548 loaded

Creating bottleneck features for batch 1548

Bottleneck features for batch 1548 created and saved

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Batch 1549 loaded

Creating bottleneck features for batch 1549

Bottleneck features for batch 1549 created and saved

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Batch 1550 loaded

Creating bottleneck features for batch 1550

Bottleneck features for batch 1550 created and saved

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Batch 1551 loaded

Creating bottleneck features for batch 1551

Bottleneck features for batch 1551 created and saved

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Batch 1552 loaded

Creating bottleneck features for batch 1552

Bottleneck features for batch 1552 created and saved

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Batch 1553 loaded

Creating bottleneck features for batch 1553

Bottleneck features for batch 1553 created and saved

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Batch 1554 loaded

Creating bottleneck features for batch 1554

Bottleneck features for batch 1554 created and saved

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Batch 1555 loaded

Creating bottleneck features for batch 1555

Bottleneck features for batch 1555 created and saved

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Batch 1556 loaded

Creating bottleneck features for batch 1556

Bottleneck features for batch 1556 created and saved

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Batch 1557 loaded

Creating bottleneck features for batch 1557

Bottleneck features for batch 1557 created and saved

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Batch 1558 loaded

Creating bottleneck features for batch 1558

Bottleneck features for batch 1558 created and saved

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Batch 1559 loaded

Creating bottleneck features for batch 1559

Bottleneck features for batch 1559 created and saved

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Batch 1560 loaded

Creating bottleneck features for batch 1560

Bottleneck features for batch 1560 created and saved

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Batch 1561 loaded

Creating bottleneck features for batch 1561

Bottleneck features for batch 1561 created and saved

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Batch 1562 loaded

Creating bottleneck features for batch 1562

Bottleneck features for batch 1562 created and saved

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Batch 1563 loaded
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Creating bottleneck features for batch 1563
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Bottleneck features for batch 1563 created and saved
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Batch 1564 loaded
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Creating bottleneck features for batch 1564
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Bottleneck features for batch 1564 created and saved
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Batch 1565 loaded
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Creating bottleneck features for batch 1565
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Bottleneck features for batch 1565 created and saved
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Batch 1566 loaded
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Creating bottleneck features for batch 1566
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Bottleneck features for batch 1566 created and saved
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Batch 1567 loaded
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Creating bottleneck features for batch 1567
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```
Bottleneck features for batch 1567 created and saved
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Batch 1568 loaded

Creating bottleneck features for batch 1568

Bottleneck features for batch 1568 created and saved

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Batch 1569 loaded

Creating bottleneck features for batch 1569

Bottleneck features for batch 1569 created and saved

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Batch 1570 loaded

Creating bottleneck features for batch 1570

Bottleneck features for batch 1570 created and saved

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Batch 1571 loaded

Creating bottleneck features for batch 1571

Bottleneck features for batch 1571 created and saved

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Batch 1572 loaded

Creating bottleneck features for batch 1572

Bottleneck features for batch 1572 created and saved

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Batch 1573 loaded

Creating bottleneck features for batch 1573

Bottleneck features for batch 1573 created and saved

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Batch 1574 loaded

Creating bottleneck features for batch 1574

Bottleneck features for batch 1574 created and saved

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Batch 1575 loaded

Creating bottleneck features for batch 1575

Bottleneck features for batch 1575 created and saved

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(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1576 loaded

```
Creating bottleneck features for batch 1576
Bottleneck features for batch 1576 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1577 loaded
Creating bottleneck features for batch 1577
Bottleneck features for batch 1577 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1578 loaded
Creating bottleneck features for batch 1578
Bottleneck features for batch 1578 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1579 loaded
Creating bottleneck features for batch 1579
Bottleneck features for batch 1579 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1580 loaded
Creating bottleneck features for batch 1580
Bottleneck features for batch 1580 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1581 loaded

Creating bottleneck features for batch 1581

Bottleneck features for batch 1581 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1582 loaded

Creating bottleneck features for batch 1582

Bottleneck features for batch 1582 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1583 loaded

Creating bottleneck features for batch 1583

Bottleneck features for batch 1583 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1584 loaded

Creating bottleneck features for batch 1584

Bottleneck features for batch 1584 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
Batch 1585 loaded
Creating bottleneck features for batch 1585
Bottleneck features for batch 1585 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1586 loaded
Creating bottleneck features for batch 1586
Bottleneck features for batch 1586 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1587 loaded
Creating bottleneck features for batch 1587
Bottleneck features for batch 1587 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1588 loaded
Creating bottleneck features for batch 1588
Bottleneck features for batch 1588 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1589 loaded
Creating bottleneck features for batch 1589
Bottleneck features for batch 1589 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1590 loaded

Creating bottleneck features for batch 1590

Bottleneck features for batch 1590 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1591 loaded

Creating bottleneck features for batch 1591

Bottleneck features for batch 1591 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1592 loaded

Creating bottleneck features for batch 1592

Bottleneck features for batch 1592 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1593 loaded

Creating bottleneck features for batch 1593

Bottleneck features for batch 1593 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1594 loaded

Creating bottleneck features for batch 1594

Bottleneck features for batch 1594 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1595 loaded

Creating bottleneck features for batch 1595

Bottleneck features for batch 1595 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1596 loaded

Creating bottleneck features for batch 1596

Bottleneck features for batch 1596 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1597 loaded

Creating bottleneck features for batch 1597

Bottleneck features for batch 1597 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1598 loaded



```
Batch 1598 loaded
```

```
Creating bottleneck features for batch 1598
```

```
Bottleneck features for batch 1598 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

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(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1599 loaded
```

```
Creating bottleneck features for batch 1599
```

```
Bottleneck features for batch 1599 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

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(48, 48, 3)
```

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(48, 48, 3)
```

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(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1600 loaded
```

```
Creating bottleneck features for batch 1600
```

```
Bottleneck features for batch 1600 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

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(48, 48, 3)
```

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(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1601 loaded
```

```
Creating bottleneck features for batch 1601
```

```
Bottleneck features for batch 1601 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1602 loaded
```

```
Creating bottleneck features for batch 1602
```

```
Bottleneck features for batch 1602 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1603 loaded

Creating bottleneck features for batch 1603

Bottleneck features for batch 1603 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1604 loaded

Creating bottleneck features for batch 1604

Bottleneck features for batch 1604 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1605 loaded

Creating bottleneck features for batch 1605

Bottleneck features for batch 1605 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1606 loaded

Creating bottleneck features for batch 1606

Bottleneck features for batch 1606 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
\n\n\n(48, 48, 3)\n(48, 48, 3)
```

```
Batch 1607 loaded
```

```
Creating bottleneck features for batch 1607
```

```
Bottleneck features for batch 1607 created and saved
```

```
(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)
```

```
Batch 1608 loaded
```

```
Creating bottleneck features for batch 1608
```

```
Bottleneck features for batch 1608 created and saved
```

```
(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)
```

```
Batch 1609 loaded
```

```
Creating bottleneck features for batch 1609
```

```
Bottleneck features for batch 1609 created and saved
```

```
(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)
```

```
Batch 1610 loaded
```

```
Creating bottleneck features for batch 1610
```

```
Bottleneck features for batch 1610 created and saved
```

```
(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)
```

```
Batch 1611 loaded
```

```
Creating bottleneck features for batch 1611
```

```
Bottleneck features for batch 1611 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1612 loaded

Creating bottleneck features for batch 1612

Bottleneck features for batch 1612 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1613 loaded

Creating bottleneck features for batch 1613

Bottleneck features for batch 1613 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1614 loaded

Creating bottleneck features for batch 1614

Bottleneck features for batch 1614 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1615 loaded

Creating bottleneck features for batch 1615

Bottleneck features for batch 1615 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1616 loaded

Creating bottleneck features for batch 1616

Bottleneck features for batch 1616 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1617 loaded

Creating bottleneck features for batch 1617

Bottleneck features for batch 1617 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1618 loaded

Creating bottleneck features for batch 1618

Bottleneck features for batch 1618 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1619 loaded

Creating bottleneck features for batch 1619

Bottleneck features for batch 1619 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1620 loaded
Creating bottleneck features for batch 1620
Bottleneck features for batch 1620 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1621 loaded
Creating bottleneck features for batch 1621
Bottleneck features for batch 1621 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1622 loaded
Creating bottleneck features for batch 1622
Bottleneck features for batch 1622 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1623 loaded
Creating bottleneck features for batch 1623
Bottleneck features for batch 1623 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1624 loaded
Creating bottleneck features for batch 1624
Bottleneck features for batch 1624 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
```

```
... ..  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1625 loaded

Creating bottleneck features for batch 1625

Bottleneck features for batch 1625 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1626 loaded

Creating bottleneck features for batch 1626

Bottleneck features for batch 1626 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1627 loaded

Creating bottleneck features for batch 1627

Bottleneck features for batch 1627 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1628 loaded

Creating bottleneck features for batch 1628

Bottleneck features for batch 1628 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1629 loaded

Creating bottleneck features for batch 1629

Bottleneck features for batch 1629 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1630 loaded

Creating bottleneck features for batch 1630

Bottleneck features for batch 1630 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1631 loaded

Creating bottleneck features for batch 1631

Bottleneck features for batch 1631 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1632 loaded

Creating bottleneck features for batch 1632

Bottleneck features for batch 1632 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1633 loaded

Creating bottleneck features for batch 1633

Bottleneck features for batch 1633 created and saved



```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1634 loaded

Creating bottleneck features for batch 1634

Bottleneck features for batch 1634 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1635 loaded

Creating bottleneck features for batch 1635

Bottleneck features for batch 1635 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1636 loaded

Creating bottleneck features for batch 1636

Bottleneck features for batch 1636 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1637 loaded

Creating bottleneck features for batch 1637

Bottleneck features for batch 1637 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1638 loaded

Creating bottleneck features for batch 1638

Bottleneck features for batch 1638 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1639 loaded

Creating bottleneck features for batch 1639

Bottleneck features for batch 1639 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1640 loaded

Creating bottleneck features for batch 1640

Bottleneck features for batch 1640 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1641 loaded

Creating bottleneck features for batch 1641

Bottleneck features for batch 1641 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1642 loaded
Creating bottleneck features for batch 1642
Bottleneck features for batch 1642 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1643 loaded
Creating bottleneck features for batch 1643
Bottleneck features for batch 1643 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1644 loaded
Creating bottleneck features for batch 1644
Bottleneck features for batch 1644 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1645 loaded
Creating bottleneck features for batch 1645
Bottleneck features for batch 1645 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1646 loaded
Creating bottleneck features for batch 1646
Bottleneck features for batch 1646 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1647 loaded

Creating bottleneck features for batch 1647

Bottleneck features for batch 1647 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1648 loaded

Creating bottleneck features for batch 1648

Bottleneck features for batch 1648 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1649 loaded

Creating bottleneck features for batch 1649

Bottleneck features for batch 1649 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1650 loaded

Creating bottleneck features for batch 1650

Bottleneck features for batch 1650 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1651 loaded

Creating bottleneck features for batch 1651

Bottleneck features for batch 1651 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1652 loaded

Creating bottleneck features for batch 1652

Bottleneck features for batch 1652 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1653 loaded

Creating bottleneck features for batch 1653

Bottleneck features for batch 1653 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1654 loaded

Creating bottleneck features for batch 1654

Bottleneck features for batch 1654 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1655 loaded

Creating bottleneck features for batch 1655

Bottleneck features for batch 1655 created and saved

Bottleneck features for batch 1655 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1656 loaded

Creating bottleneck features for batch 1656

Bottleneck features for batch 1656 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1657 loaded

Creating bottleneck features for batch 1657

Bottleneck features for batch 1657 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1658 loaded

Creating bottleneck features for batch 1658

Bottleneck features for batch 1658 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1659 loaded

Creating bottleneck features for batch 1659

Bottleneck features for batch 1659 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

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(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1660 loaded

Creating bottleneck features for batch 1660

Bottleneck features for batch 1660 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1661 loaded

Creating bottleneck features for batch 1661

Bottleneck features for batch 1661 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1662 loaded

Creating bottleneck features for batch 1662

Bottleneck features for batch 1662 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1663 loaded

Creating bottleneck features for batch 1663

Bottleneck features for batch 1663 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

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(48, 48, 3)
```

```
Batch 1664 loaded
```

```
Creating bottleneck features for batch 1664
```

```
Bottleneck features for batch 1664 created and saved
```

```
(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
```

```
Batch 1665 loaded
```

```
Creating bottleneck features for batch 1665
```

```
Bottleneck features for batch 1665 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
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(48, 48, 3)
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```
(48, 48, 3)
```

```
Batch 1666 loaded
```

```
Creating bottleneck features for batch 1666
```

```
Bottleneck features for batch 1666 created and saved
```

```
(48, 48, 3)
```

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(48, 48, 3)
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(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1667 loaded
```

```
Creating bottleneck features for batch 1667
```

```
Bottleneck features for batch 1667 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
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(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1668 loaded
```

```
Creating bottleneck features for batch 1668
```

```
Bottleneck features for batch 1668 created and saved
```

```
(48, 48, 3)
```



```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1669 loaded

Creating bottleneck features for batch 1669

Bottleneck features for batch 1669 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1670 loaded

Creating bottleneck features for batch 1670

Bottleneck features for batch 1670 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1671 loaded

Creating bottleneck features for batch 1671

Bottleneck features for batch 1671 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1672 loaded

Creating bottleneck features for batch 1672

Bottleneck features for batch 1672 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1673 loaded

Creating bottleneck features for batch 1673

Bottleneck features for batch 1673 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1674 loaded

Creating bottleneck features for batch 1674

Bottleneck features for batch 1674 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1675 loaded

Creating bottleneck features for batch 1675

Bottleneck features for batch 1675 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1676 loaded

Creating bottleneck features for batch 1676

Bottleneck features for batch 1676 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1677 loaded

Creating bottleneck features for batch 1677

Bottleneck features for batch 1677 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1678 loaded

Creating bottleneck features for batch 1678

Bottleneck features for batch 1678 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1679 loaded

Creating bottleneck features for batch 1679

Bottleneck features for batch 1679 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1680 loaded

Creating bottleneck features for batch 1680

Bottleneck features for batch 1680 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1681 loaded

Creating bottleneck features for batch 1681

Bottleneck features for batch 1681 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1682 loaded

Creating bottleneck features for batch 1682

Bottleneck features for batch 1682 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1683 loaded

Creating bottleneck features for batch 1683

Bottleneck features for batch 1683 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1684 loaded

Creating bottleneck features for batch 1684

Bottleneck features for batch 1684 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1685 loaded

Creating bottleneck features for batch 1685

Bottleneck features for batch 1685 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
Batch 1686 loaded
Creating bottleneck features for batch 1686
Bottleneck features for batch 1686 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1687 loaded
Creating bottleneck features for batch 1687
Bottleneck features for batch 1687 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1688 loaded
Creating bottleneck features for batch 1688
Bottleneck features for batch 1688 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1689 loaded
Creating bottleneck features for batch 1689
Bottleneck features for batch 1689 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1690 loaded
Creating bottleneck features for batch 1690
Bottleneck features for batch 1690 created and saved
```

```
(48, 48, 3)
```

```
... ..  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1691 loaded

Creating bottleneck features for batch 1691

Bottleneck features for batch 1691 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1692 loaded

Creating bottleneck features for batch 1692

Bottleneck features for batch 1692 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1693 loaded

Creating bottleneck features for batch 1693

Bottleneck features for batch 1693 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1694 loaded

Creating bottleneck features for batch 1694

Bottleneck features for batch 1694 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
...
```

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1695 loaded

Creating bottleneck features for batch 1695

Bottleneck features for batch 1695 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1696 loaded

Creating bottleneck features for batch 1696

Bottleneck features for batch 1696 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1697 loaded

Creating bottleneck features for batch 1697

Bottleneck features for batch 1697 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1698 loaded

Creating bottleneck features for batch 1698

Bottleneck features for batch 1698 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1699 loaded

Creating bottleneck features for batch 1699

```
.....  
Bottleneck features for batch 1699 created and saved
```

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

```
Batch 1700 loaded
```

```
Creating bottleneck features for batch 1700
```

```
Bottleneck features for batch 1700 created and saved
```

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

```
Batch 1701 loaded
```

```
Creating bottleneck features for batch 1701
```

```
Bottleneck features for batch 1701 created and saved
```

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

```
Batch 1702 loaded
```

```
Creating bottleneck features for batch 1702
```

```
Bottleneck features for batch 1702 created and saved
```

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

```
Batch 1703 loaded
```

```
Creating bottleneck features for batch 1703
```

```
Bottleneck features for batch 1703 created and saved
```

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```



```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1704 loaded

Creating bottleneck features for batch 1704

Bottleneck features for batch 1704 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1705 loaded

Creating bottleneck features for batch 1705

Bottleneck features for batch 1705 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1706 loaded

Creating bottleneck features for batch 1706

Bottleneck features for batch 1706 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1707 loaded

Creating bottleneck features for batch 1707

Bottleneck features for batch 1707 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
Batch 1708 loaded
Creating bottleneck features for batch 1708
Bottleneck features for batch 1708 created and saved

(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1709 loaded
Creating bottleneck features for batch 1709
Bottleneck features for batch 1709 created and saved

(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1710 loaded
Creating bottleneck features for batch 1710
Bottleneck features for batch 1710 created and saved

(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1711 loaded
Creating bottleneck features for batch 1711
Bottleneck features for batch 1711 created and saved

(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1712 loaded
Creating bottleneck features for batch 1712
Bottleneck features for batch 1712 created and saved

(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1713 loaded

Creating bottleneck features for batch 1713

Bottleneck features for batch 1713 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1714 loaded

Creating bottleneck features for batch 1714

Bottleneck features for batch 1714 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1715 loaded

Creating bottleneck features for batch 1715

Bottleneck features for batch 1715 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1716 loaded

Creating bottleneck features for batch 1716

Bottleneck features for batch 1716 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1717 loaded

Creating bottleneck features for batch 1717

Bottleneck features for batch 1717 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1718 loaded

Creating bottleneck features for batch 1718

Bottleneck features for batch 1718 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1719 loaded

Creating bottleneck features for batch 1719

Bottleneck features for batch 1719 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1720 loaded

Creating bottleneck features for batch 1720

Bottleneck features for batch 1720 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1721 loaded

Creating bottleneck features for batch 1721

```
Creating bottleneck features for batch 1721
```

```
Bottleneck features for batch 1721 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1722 loaded
```

```
Creating bottleneck features for batch 1722
```

```
Bottleneck features for batch 1722 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1723 loaded
```

```
Creating bottleneck features for batch 1723
```

```
Bottleneck features for batch 1723 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1724 loaded
```

```
Creating bottleneck features for batch 1724
```

```
Bottleneck features for batch 1724 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1725 loaded
```

```
Creating bottleneck features for batch 1725
```

```
Bottleneck features for batch 1725 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1726 loaded

Creating bottleneck features for batch 1726

Bottleneck features for batch 1726 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1727 loaded

Creating bottleneck features for batch 1727

Bottleneck features for batch 1727 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1728 loaded

Creating bottleneck features for batch 1728

Bottleneck features for batch 1728 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1729 loaded

Creating bottleneck features for batch 1729

Bottleneck features for batch 1729 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1730 loaded
```

```
Creating bottleneck features for batch 1730
```

```
Bottleneck features for batch 1730 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

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(48, 48, 3)
```

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(48, 48, 3)
```

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(48, 48, 3)
```

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(48, 48, 3)
```

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(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1731 loaded
```

```
Creating bottleneck features for batch 1731
```

```
Bottleneck features for batch 1731 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1732 loaded
```

```
Creating bottleneck features for batch 1732
```

```
Bottleneck features for batch 1732 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

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(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1733 loaded
```

```
Creating bottleneck features for batch 1733
```

```
Bottleneck features for batch 1733 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1734 loaded
```

```
Creating bottleneck features for batch 1734
```

```
Bottleneck features for batch 1734 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1735 loaded

Creating bottleneck features for batch 1735

Bottleneck features for batch 1735 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1736 loaded

Creating bottleneck features for batch 1736

Bottleneck features for batch 1736 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1737 loaded

Creating bottleneck features for batch 1737

Bottleneck features for batch 1737 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1738 loaded

Creating bottleneck features for batch 1738

Bottleneck features for batch 1738 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```



```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1739 loaded

Creating bottleneck features for batch 1739

Bottleneck features for batch 1739 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1740 loaded

Creating bottleneck features for batch 1740

Bottleneck features for batch 1740 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1741 loaded

Creating bottleneck features for batch 1741

Bottleneck features for batch 1741 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1742 loaded

Creating bottleneck features for batch 1742

Bottleneck features for batch 1742 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1743 loaded

```
Creating bottleneck features for batch 1743
Bottleneck features for batch 1743 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1744 loaded
Creating bottleneck features for batch 1744
Bottleneck features for batch 1744 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1745 loaded
Creating bottleneck features for batch 1745
Bottleneck features for batch 1745 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1746 loaded
Creating bottleneck features for batch 1746
Bottleneck features for batch 1746 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1747 loaded
Creating bottleneck features for batch 1747
Bottleneck features for batch 1747 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1748 loaded

Creating bottleneck features for batch 1748

Bottleneck features for batch 1748 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1749 loaded

Creating bottleneck features for batch 1749

Bottleneck features for batch 1749 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1750 loaded

Creating bottleneck features for batch 1750

Bottleneck features for batch 1750 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1751 loaded

Creating bottleneck features for batch 1751

Bottleneck features for batch 1751 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
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Batch 1752 loaded
Creating bottleneck features for batch 1752
Bottleneck features for batch 1752 created and saved
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Batch 1753 loaded
Creating bottleneck features for batch 1753
Bottleneck features for batch 1753 created and saved
```

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Batch 1754 loaded
Creating bottleneck features for batch 1754
Bottleneck features for batch 1754 created and saved
```

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Batch 1755 loaded
Creating bottleneck features for batch 1755
Bottleneck features for batch 1755 created and saved
```

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Batch 1756 loaded
Creating bottleneck features for batch 1756
Bottleneck features for batch 1756 created and saved
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(48, 48, 3)  
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Batch 1757 loaded

Creating bottleneck features for batch 1757

Bottleneck features for batch 1757 created and saved

(48, 48, 3)  
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Batch 1758 loaded

Creating bottleneck features for batch 1758

Bottleneck features for batch 1758 created and saved

(48, 48, 3)  
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Batch 1759 loaded

Creating bottleneck features for batch 1759

Bottleneck features for batch 1759 created and saved

(48, 48, 3)  
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Batch 1760 loaded

Creating bottleneck features for batch 1760

Bottleneck features for batch 1760 created and saved

(48, 48, 3)  
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Batch 1761 loaded

Creating bottleneck features for batch 1761

Bottleneck features for batch 1761 created and saved

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```

Batch 1762 loaded

Creating bottleneck features for batch 1762

Bottleneck features for batch 1762 created and saved

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(48, 48, 3)
(48, 48, 3)
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```

Batch 1763 loaded

Creating bottleneck features for batch 1763

Bottleneck features for batch 1763 created and saved

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```

Batch 1764 loaded

Creating bottleneck features for batch 1764

Bottleneck features for batch 1764 created and saved

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```

Batch 1765 loaded

```
Batch 1765 loaded
Creating bottleneck features for batch 1765
Bottleneck features for batch 1765 created and saved
```

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Batch 1766 loaded
Creating bottleneck features for batch 1766
Bottleneck features for batch 1766 created and saved
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Batch 1767 loaded
Creating bottleneck features for batch 1767
Bottleneck features for batch 1767 created and saved
```

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```

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Batch 1768 loaded
Creating bottleneck features for batch 1768
Bottleneck features for batch 1768 created and saved
```

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```

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Batch 1769 loaded
Creating bottleneck features for batch 1769
Bottleneck features for batch 1769 created and saved
```

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Batch 1770 loaded

Creating bottleneck features for batch 1770

Bottleneck features for batch 1770 created and saved

(48, 48, 3)  
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Batch 1771 loaded

Creating bottleneck features for batch 1771

Bottleneck features for batch 1771 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
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Batch 1772 loaded

Creating bottleneck features for batch 1772

Bottleneck features for batch 1772 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
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Batch 1773 loaded

Creating bottleneck features for batch 1773

Bottleneck features for batch 1773 created and saved

(48, 48, 3)  
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Batch 1774 loaded
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```
Creating bottleneck features for batch 1774
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```
Bottleneck features for batch 1774 created and saved
```

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```
Batch 1775 loaded
```

```
Creating bottleneck features for batch 1775
```

```
Bottleneck features for batch 1775 created and saved
```

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```
Batch 1776 loaded
```

```
Creating bottleneck features for batch 1776
```

```
Bottleneck features for batch 1776 created and saved
```

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```
Batch 1777 loaded
```

```
Creating bottleneck features for batch 1777
```

```
Bottleneck features for batch 1777 created and saved
```

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```
Batch 1778 loaded
```

```
Creating bottleneck features for batch 1778
```

```
Bottleneck features for batch 1778 created and saved
```

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(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
```

Batch 1779 loaded

Creating bottleneck features for batch 1779

Bottleneck features for batch 1779 created and saved

```
(48, 48, 3)
(48, 48, 3)
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```

Batch 1780 loaded

Creating bottleneck features for batch 1780

Bottleneck features for batch 1780 created and saved

```
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
```

Batch 1781 loaded

Creating bottleneck features for batch 1781

Bottleneck features for batch 1781 created and saved

```
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
```

Batch 1782 loaded

Creating bottleneck features for batch 1782

Bottleneck features for batch 1782 created and saved

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(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
```

Batch 1783 loaded

Creating bottleneck features for batch 1783

Bottleneck features for batch 1783 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
```

Batch 1784 loaded

Creating bottleneck features for batch 1784

Bottleneck features for batch 1784 created and saved

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(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
```

Batch 1785 loaded

Creating bottleneck features for batch 1785

Bottleneck features for batch 1785 created and saved

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(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
```

Batch 1786 loaded

Creating bottleneck features for batch 1786

Bottleneck features for batch 1786 created and saved

```
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
```

```
Batch 1787 loaded
```

```
Creating bottleneck features for batch 1787
```

```
Bottleneck features for batch 1787 created and saved
```

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(48, 48, 3)
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```
Batch 1788 loaded
```

```
Creating bottleneck features for batch 1788
```

```
Bottleneck features for batch 1788 created and saved
```

```
(48, 48, 3)
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```
Batch 1789 loaded
```

```
Creating bottleneck features for batch 1789
```

```
Bottleneck features for batch 1789 created and saved
```

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(48, 48, 3)
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```
Batch 1790 loaded
```

```
Creating bottleneck features for batch 1790
```

```
Bottleneck features for batch 1790 created and saved
```

```
(48, 48, 3)
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(48, 48, 3)
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```
Batch 1791 loaded
```

```
Creating bottleneck features for batch 1791
```

```
Bottleneck features for batch 1791 created and saved
```

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(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
(48, 48, 3)
```

Batch 1792 loaded

Creating bottleneck features for batch 1792

Bottleneck features for batch 1792 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1793 loaded

Creating bottleneck features for batch 1793

Bottleneck features for batch 1793 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1794 loaded

Creating bottleneck features for batch 1794

Bottleneck features for batch 1794 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1795 loaded

Creating bottleneck features for batch 1795

Bottleneck features for batch 1795 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
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```
Batch 1796 loaded
```

```
Creating bottleneck features for batch 1796
```

```
Bottleneck features for batch 1796 created and saved
```

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(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
```

```
Batch 1797 loaded
```

```
Creating bottleneck features for batch 1797
```

```
Bottleneck features for batch 1797 created and saved
```

```
(48, 48, 3)
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(48, 48, 3)
```

```
Batch 1798 loaded
```

```
Creating bottleneck features for batch 1798
```

```
Bottleneck features for batch 1798 created and saved
```

```
(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
```

```
Batch 1799 loaded
```

```
Creating bottleneck features for batch 1799
```

```
Bottleneck features for batch 1799 created and saved
```

```
(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
```

```
Batch 1800 loaded
```

```
Creating bottleneck features for batch 1800
```

```
Bottleneck features for batch 1800 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
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(48, 48, 3)
```

Batch 1801 loaded

Creating bottleneck features for batch 1801

Bottleneck features for batch 1801 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
```

Batch 1802 loaded

Creating bottleneck features for batch 1802

Bottleneck features for batch 1802 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1803 loaded

Creating bottleneck features for batch 1803

Bottleneck features for batch 1803 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1804 loaded

Creating bottleneck features for batch 1804

Bottleneck features for batch 1804 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1805 loaded

Creating bottleneck features for batch 1805

Bottleneck features for batch 1805 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1806 loaded

Creating bottleneck features for batch 1806

Bottleneck features for batch 1806 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
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(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1807 loaded

Creating bottleneck features for batch 1807

Bottleneck features for batch 1807 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1808 loaded

Creating bottleneck features for batch 1808

Bottleneck features for batch 1808 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```



```
Batch 1809 loaded
Creating bottleneck features for batch 1809
Bottleneck features for batch 1809 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1810 loaded
Creating bottleneck features for batch 1810
Bottleneck features for batch 1810 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1811 loaded
Creating bottleneck features for batch 1811
Bottleneck features for batch 1811 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1812 loaded
Creating bottleneck features for batch 1812
Bottleneck features for batch 1812 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
Batch 1813 loaded
Creating bottleneck features for batch 1813
Bottleneck features for batch 1813 created and saved
```

```
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1814 loaded

Creating bottleneck features for batch 1814

Bottleneck features for batch 1814 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1815 loaded

Creating bottleneck features for batch 1815

Bottleneck features for batch 1815 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1816 loaded

Creating bottleneck features for batch 1816

Bottleneck features for batch 1816 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1817 loaded

Creating bottleneck features for batch 1817

Bottleneck features for batch 1817 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1818 loaded

Creating bottleneck features for batch 1818

Bottleneck features for batch 1818 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1819 loaded

Creating bottleneck features for batch 1819

Bottleneck features for batch 1819 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1820 loaded

Creating bottleneck features for batch 1820

Bottleneck features for batch 1820 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1821 loaded

Creating bottleneck features for batch 1821

Bottleneck features for batch 1821 created and saved

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

(48, 48, 3)

Batch 1822 loaded

Creating bottleneck features for batch 1822

Bottleneck features for batch 1822 created and saved

Bottleneck features for batch 1822 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1823 loaded

Creating bottleneck features for batch 1823

Bottleneck features for batch 1823 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1824 loaded

Creating bottleneck features for batch 1824

Bottleneck features for batch 1824 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1825 loaded

Creating bottleneck features for batch 1825

Bottleneck features for batch 1825 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1826 loaded

Creating bottleneck features for batch 1826

Bottleneck features for batch 1826 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1827 loaded

Creating bottleneck features for batch 1827

Bottleneck features for batch 1827 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1828 loaded

Creating bottleneck features for batch 1828

Bottleneck features for batch 1828 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1829 loaded

Creating bottleneck features for batch 1829

Bottleneck features for batch 1829 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1830 loaded

Creating bottleneck features for batch 1830

Bottleneck features for batch 1830 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
\n\nBatch 1831 loaded\nCreating bottleneck features for batch 1831\nBottleneck features for batch 1831 created and saved
```

```
(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)
```

```
Batch 1832 loaded\nCreating bottleneck features for batch 1832\nBottleneck features for batch 1832 created and saved
```

```
(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)
```

```
Batch 1833 loaded\nCreating bottleneck features for batch 1833\nBottleneck features for batch 1833 created and saved
```

```
(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)
```

```
Batch 1834 loaded\nCreating bottleneck features for batch 1834\nBottleneck features for batch 1834 created and saved
```

```
(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)\n(48, 48, 3)
```

```
Batch 1835 loaded\nCreating bottleneck features for batch 1835\nBottleneck features for batch 1835 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1836 loaded

Creating bottleneck features for batch 1836

Bottleneck features for batch 1836 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1837 loaded

Creating bottleneck features for batch 1837

Bottleneck features for batch 1837 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1838 loaded

Creating bottleneck features for batch 1838

Bottleneck features for batch 1838 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1839 loaded

Creating bottleneck features for batch 1839

Bottleneck features for batch 1839 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
..., ..., ...,  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1840 loaded

Creating bottleneck features for batch 1840

Bottleneck features for batch 1840 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1841 loaded

Creating bottleneck features for batch 1841

Bottleneck features for batch 1841 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1842 loaded

Creating bottleneck features for batch 1842

Bottleneck features for batch 1842 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1843 loaded

Creating bottleneck features for batch 1843

Bottleneck features for batch 1843 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1844 loaded

Creating bottleneck features for batch 1844



Bottleneck features for batch 1844 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1845 loaded

Creating bottleneck features for batch 1845

Bottleneck features for batch 1845 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1846 loaded

Creating bottleneck features for batch 1846

Bottleneck features for batch 1846 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1847 loaded

Creating bottleneck features for batch 1847

Bottleneck features for batch 1847 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

Batch 1848 loaded

Creating bottleneck features for batch 1848

Bottleneck features for batch 1848 created and saved

(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)

```
... ..  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1849 loaded

Creating bottleneck features for batch 1849

Bottleneck features for batch 1849 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1850 loaded

Creating bottleneck features for batch 1850

Bottleneck features for batch 1850 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1851 loaded

Creating bottleneck features for batch 1851

Bottleneck features for batch 1851 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)
```

Batch 1852 loaded

Creating bottleneck features for batch 1852

Bottleneck features for batch 1852 created and saved

```
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
(48, 48, 3)  
... ..
```

```
(48, 48, 3)
Batch 1853 loaded
Creating bottleneck features for batch 1853
Bottleneck features for batch 1853 created and saved

(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1854 loaded
Creating bottleneck features for batch 1854
Bottleneck features for batch 1854 created and saved

(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1855 loaded
Creating bottleneck features for batch 1855
Bottleneck features for batch 1855 created and saved

(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1856 loaded
Creating bottleneck features for batch 1856
Bottleneck features for batch 1856 created and saved

(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
Batch 1857 loaded
Creating bottleneck features for batch 1857
Bottleneck features for batch 1857 created and saved

(48, 48, 3)
```

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1858 loaded

Creating bottleneck features for batch 1858

Bottleneck features for batch 1858 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1859 loaded

Creating bottleneck features for batch 1859

Bottleneck features for batch 1859 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1860 loaded

Creating bottleneck features for batch 1860

Bottleneck features for batch 1860 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

Batch 1861 loaded

Creating bottleneck features for batch 1861

Bottleneck features for batch 1861 created and saved

```
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1862 loaded
```

```
Creating bottleneck features for batch 1862
```

```
Bottleneck features for batch 1862 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1863 loaded
```

```
Creating bottleneck features for batch 1863
```

```
Bottleneck features for batch 1863 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

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(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1864 loaded
```

```
Creating bottleneck features for batch 1864
```

```
Bottleneck features for batch 1864 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
Batch 1865 loaded
```

```
Creating bottleneck features for batch 1865
```

```
Bottleneck features for batch 1865 created and saved
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
```

```
(48, 48, 3)
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Batch 1866 loaded
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Creating bottleneck features for batch 1866
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Bottleneck features for batch 1866 created and saved

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Batch 1867 loaded

Creating bottleneck features for batch 1867

Bottleneck features for batch 1867 created and saved

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Batch 1868 loaded

Creating bottleneck features for batch 1868

Bottleneck features for batch 1868 created and saved

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Batch 1869 loaded

Creating bottleneck features for batch 1869

Bottleneck features for batch 1869 created and saved

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Batch 1870 loaded

Creating bottleneck features for batch 1870

Bottleneck features for batch 1870 created and saved

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Batch 1871 loaded

Creating bottleneck features for batch 1871

Bottleneck features for batch 1871 created and saved

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Batch 1872 loaded

Creating bottleneck features for batch 1872

Bottleneck features for batch 1872 created and saved

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Batch 1873 loaded

Creating bottleneck features for batch 1873

Bottleneck features for batch 1873 created and saved

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Batch 1874 loaded

Creating bottleneck features for batch 1874

Bottleneck features for batch 1874 created and saved

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Batch 1875 loaded
Creating bottleneck features for batch 1875
Bottleneck features for batch 1875 created and saved
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Batch 1876 loaded
Creating bottleneck features for batch 1876
Bottleneck features for batch 1876 created and saved
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Batch 1877 loaded
Creating bottleneck features for batch 1877
Bottleneck features for batch 1877 created and saved
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Batch 1878 loaded
Creating bottleneck features for batch 1878
Bottleneck features for batch 1878 created and saved
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Batch 1879 loaded
Creating bottleneck features for batch 1879
Bottleneck features for batch 1879 created and saved
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Batch 1880 loaded

Creating bottleneck features for batch 1880

Bottleneck features for batch 1880 created and saved

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Batch 1881 loaded

Creating bottleneck features for batch 1881

Bottleneck features for batch 1881 created and saved

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Batch 1882 loaded

Creating bottleneck features for batch 1882

Bottleneck features for batch 1882 created and saved

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Batch 1883 loaded

Creating bottleneck features for batch 1883

Bottleneck features for batch 1883 created and saved

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Batch 1884 loaded

Creating bottleneck features for batch 1884

Bottleneck features for batch 1884 created and saved

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Batch 1885 loaded

Creating bottleneck features for batch 1885

Bottleneck features for batch 1885 created and saved

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Batch 1886 loaded

Creating bottleneck features for batch 1886

Bottleneck features for batch 1886 created and saved

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Batch 1887 loaded

Creating bottleneck features for batch 1887

Bottleneck features for batch 1887 created and saved

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Batch 1888 loaded

Creating bottleneck features for batch 1888

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Creating bottleneck features for batch 1888
Bottleneck features for batch 1888 created and saved

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Batch 1889 loaded
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```
Creating bottleneck features for batch 1889
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Bottleneck features for batch 1889 created and saved
```

## ▼ Bottle neck feature for Test Data

```

1 TestData_Labels = pd.get_dummies(Test_Data["Labels"]).as_matrix()
2 TestData_Labels.shape

```

 /usr/local/lib/python3.6/dist-packages/ipykernel\_launcher.py:1: FutureWarning  
 """Entry point for launching an IPython kernel.  
 (5593, 7)

```

1 def loadTestDataBatch(batch_size):
2     global TestData_batch_pointer
3     batch_images = []
4     batch_labels = []
5     for i in range(batch_size):
6         path1 = Test_Data.iloc[TestData_batch_pointer + i]["folderName"]
7         path2 = Test_Data.iloc[TestData_batch_pointer + i]["imageName"]
8         read_image = cv2.imread(os.path.join(path1, path2))
9         read_image_final = read_image/255.0 #here, we are normalizing the image
10        batch_images.append(read_image_final)
11
12        batch_labels.append(TestData_Labels[TestData_batch_pointer + i]) #append
13
14    TestData_batch_pointer += batch_size
15

```

```
16     return np.array(batch_images), np.array(batch_labels)

1 #creating bottleneck features for Test Humans data using VGG-16- Image-net mode
2 img_height,img_width=48,48
3 model = VGG16(weights='imagenet', include_top=False,input_shape= (img_height,im
4 SAVEDIR = "Dataset/Data/Bottleneck_Features/Bottleneck_TestData/"
5 SAVEDIR_LABELS = "Dataset/Data/Bottleneck_Features/TestData_Labels/"
6 batch_size = 10
7 for i in range(int(len(Test_Data)/batch_size)):
8     x, y = loadTestDataBatch(batch_size)
9     print("Batch {} loaded".format(i+1))
10
11     np.save(os.path.join(SAVEDIR_LABELS, "bottleneck_labels_{}".format(i+1)), y
12
13     print("Creating bottleneck features for batch {}". format(i+1))
14     bottleneck_features = model.predict(x)
15     np.save(os.path.join(SAVEDIR, "bottleneck_{}".format(i+1)), bottleneck_feat
16     print("Bottleneck features for batch {} created and saved\n".format(i+1))
17
18 leftover_points = len(Test_Data) - TestData_batch_pointer
19 x, y = loadTestDataBatch(leftover_points)
20 np.save(os.path.join(SAVEDIR_LABELS, "bottleneck_labels_{}".format(int(len(Test
21 bottleneck_features = model.predict(x)
22 np.save(os.path.join(SAVEDIR, "bottleneck_{}".format(int(len(Test_Data)/batch_s
```



Batch 1 loaded  
Creating bottleneck features for batch 1  
Bottleneck features for batch 1 created and saved

Batch 2 loaded  
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Batch 3 loaded  
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## ▼ 11. Modelling & Training

```
1 no_of_classes = 7
```

```
1 def validation(model):
2     if (model is None):
3         print("No model passed for validation, loading model from Dataset/Data/Mo
4         model = load_model("Dataset/Data/Model_Save/model.h5")
5         predicted_labels = []
6         true_labels = []
7         batch_size = 10
8         total_files = int(len(Test_Data) / batch_size) #here, I have added 2 becaus
9         for i in range(1, total_files, 1):
10             img_load = np.load("Dataset/Data/Bottleneck_Features/Bottleneck_TestDat
11             img_label = np.load("Dataset/Data/Bottleneck_Features/TestData_Labels/b
12             img_bundle = img_load.reshape(img_load.shape[0], img_load.shape[1]*img_
13             for j in range(img_bundle.shape[0]):
14                 img = img_bundle[j]
15                 img = img.reshape(1, img_bundle.shape[1])
16                 pred = model.predict(img)
17                 predicted_labels.append(pred[0].argmax())
```

```

17         predicted_labels.append(predict.argmax())
18         true_labels.append(img_label[j].argmax())
19     acc = accuracy_score(true_labels, predicted_labels)
20     print("Accuracy on Test Data = {}".format(np.round(float(acc*100), 2)))
21     return acc

1 #training the model
2 SAVEDIR_TRAIN = "Dataset/Data/Bottleneck_Features/Bottleneck_TrainData/"
3 SAVEDIR_TRAIN_LABELS = "Dataset/Data/Bottleneck_Features/TrainData_Labels/"
4
5 SAVER = "Dataset/Data/Model_Save/"
6
7 #input_shape =48*48*3    #this is the shape of bottleneck feature of each image
8
9 #model = model(input_shape)
10 #model.load_weights(os.path.join(SAVER, "model.h5"))
11
12 model = Sequential()
13
14 model.add(Dense(512, input_shape=(512,), activation='relu'))
15 model.add(Dense(512, input_shape=(256,), activation='relu'))
16 model.add(Dropout(0.5))
17 model.add(Dense(128, input_shape=(256,), activation='relu'))
18 model.add(Dense(output_dim = no_of_classes, activation='softmax'))
19
20 model.summary()
21 model.compile(loss = 'categorical_crossentropy', optimizer = "adam", metrics =
22
23 epochs = 50
24 batch_size = 10
25 step = 0
26 Train_bottleneck_files = int(len(Train_Data) / batch_size)
27 epoch_number, Train_loss, Train_acc ,test_acc = [],[], [], []
28 model_save_interval = 3 # every x epochs for saving model
29
30 for epoch in range(epochs):
31     avg_epoch_Tr_loss, avg_epoch_Tr_acc= 0, 0
32     epoch_number.append(epoch + 1)
33
34     for i in range(Train_bottleneck_files):
35
36         step += 1
37
38         #loading batch of train bottleneck features for training MLP.
39         X_Train_load = np.load(os.path.join(SAVEDIR_TRAIN, "bottleneck_{}.npy".
40         X_Train = X_Train_load.reshape(X_Train_load.shape[0], X_Train_load.shap
41         Y_Train = np.load(os.path.join(SAVEDIR_TRAIN_LABELS, "bottleneck_labels
42
43         Train_Loss, Train_Accuracy = model.train_on_batch(X_Train, Y_Train) #tr
44
45         # print("Epoch: {}, Step: {}, Tr_Loss: {}, Tr_Acc: {}".format(epoch+1,
46         avg_epoch_Tr_loss += Train_Loss / Train_bottleneck_files
47         avg_epoch_Tr_acc += Train_Accuracy / Train_bottleneck_files
48
49     print("Avg_Train_Loss: {}, Avg_Train_Acc: {}".format(np.round(float(avg_epo

```

```
50
51 Train_loss.append(avg_epoch_Tr_loss)
52 Train_acc.append(avg_epoch_Tr_acc)
53
54 #if(epoch < 5 or epoch % model_save_interval == 0 or epoch == epochs )
55 if(epoch == epochs ):
56     model.save(os.path.join(SAVER, "model.h5")) #saving the model for last e
57     model.save_weights(os.path.join(SAVER, "model_weights.h5")) #saving the w
58     print("Model and weights saved at epoch {}".format(epoch + 1))
59 test_acc_val = validation(model)
60 test_acc.append(test_acc_val)
61 print("Test Accuracy: ",test_acc_val)
62     ## test validation accuracy
63
64 log_frame = pd.DataFrame(columns = ["Epoch", "Train_Loss", "Train_Accuracy", "Te
65 log_frame["Epoch"] = epoch_number
66 log_frame["Train_Loss"] = Train_loss
67 log_frame["Train_Accuracy"] = Train_acc
68 log_frame["Test_Accuracy"] = test_acc
69 log_frame.to_csv("Dataset/Data/Logs/Log.csv", index = False)
70
71
```



/usr/local/lib/python3.6/dist-packages/ipykernel\_launcher.py:17: UserWarning: Model: "sequential\_3"

Layer (type)	Output Shape	Param #
dense_9 (Dense)	(None, 512)	262656
dense_10 (Dense)	(None, 512)	262656
dropout_3 (Dropout)	(None, 512)	0
dense_11 (Dense)	(None, 128)	65664
dense_12 (Dense)	(None, 7)	903

=====  
Total params: 591,879

Trainable params: 591,879

Non-trainable params: 0

=====  
Avg\_Train\_Loss: 2.0, Avg\_Train\_Acc: 0.29  
Accuracy on Test Data = 18.37%  
Test Accuracy: 0.18369175627240145  
Avg\_Train\_Loss: 1.64, Avg\_Train\_Acc: 0.36  
Accuracy on Test Data = 17.63%  
Test Accuracy: 0.17634408602150536  
Avg\_Train\_Loss: 1.6, Avg\_Train\_Acc: 0.38  
Accuracy on Test Data = 18.53%  
Test Accuracy: 0.18530465949820787  
Avg\_Train\_Loss: 1.55, Avg\_Train\_Acc: 0.4  
Accuracy on Test Data = 17.69%  
Test Accuracy: 0.17688172043010753  
Avg\_Train\_Loss: 1.5, Avg\_Train\_Acc: 0.42  
Accuracy on Test Data = 18.1%  
Test Accuracy: 0.18100358422939067  
Avg\_Train\_Loss: 1.44, Avg\_Train\_Acc: 0.45  
Accuracy on Test Data = 17.46%  
Test Accuracy: 0.17455197132616487  
Avg\_Train\_Loss: 1.38, Avg\_Train\_Acc: 0.47  
Accuracy on Test Data = 15.97%  
Test Accuracy: 0.1596774193548387  
Avg\_Train\_Loss: 1.32, Avg\_Train\_Acc: 0.49  
Accuracy on Test Data = 14.66%  
Test Accuracy: 0.14659498207885305  
Avg\_Train\_Loss: 1.25, Avg\_Train\_Acc: 0.52  
Accuracy on Test Data = 14.09%  
Test Accuracy: 0.14086021505376345  
Avg\_Train\_Loss: 1.2, Avg\_Train\_Acc: 0.55  
Accuracy on Test Data = 14.41%  
Test Accuracy: 0.14408602150537633  
Avg\_Train\_Loss: 1.14, Avg\_Train\_Acc: 0.56  
Accuracy on Test Data = 14.05%  
Test Accuracy: 0.14050179211469535  
Avg\_Train\_Loss: 1.1, Avg\_Train\_Acc: 0.58  
Accuracy on Test Data = 14.0%  
Test Accuracy: 0.1399641577060932  
Avg\_Train\_Loss: 1.06, Avg\_Train\_Acc: 0.6  
Accuracy on Test Data = 14.5%  
Test Accuracy: 0.1449820788530466  
Avg\_Train\_Loss: 1.02, Avg\_Train\_Acc: 0.62  
Accuracy on Test Data = 14.37%  
Test Accuracy: 0.14372759856630823

Avg\_Train\_Loss: 0.98, Avg\_Train\_Acc: 0.63  
Accuracy on Test Data = 14.18%  
Test Accuracy: 0.14175627240143368  
Avg\_Train\_Loss: 0.94, Avg\_Train\_Acc: 0.65  
Accuracy on Test Data = 14.35%  
Test Accuracy: 0.1435483870967742  
Avg\_Train\_Loss: 0.91, Avg\_Train\_Acc: 0.66  
Accuracy on Test Data = 14.19%  
Test Accuracy: 0.14193548387096774  
Avg\_Train\_Loss: 0.88, Avg\_Train\_Acc: 0.67  
Accuracy on Test Data = 14.44%  
Test Accuracy: 0.14444444444444443  
Avg\_Train\_Loss: 0.87, Avg\_Train\_Acc: 0.68  
Accuracy on Test Data = 13.91%  
Test Accuracy: 0.13906810035842293  
Avg\_Train\_Loss: 0.84, Avg\_Train\_Acc: 0.69  
Accuracy on Test Data = 14.41%  
Test Accuracy: 0.14408602150537633  
Avg\_Train\_Loss: 0.81, Avg\_Train\_Acc: 0.7  
Accuracy on Test Data = 14.21%  
Test Accuracy: 0.14211469534050178  
Avg\_Train\_Loss: 0.78, Avg\_Train\_Acc: 0.71  
Accuracy on Test Data = 14.34%  
Test Accuracy: 0.14336917562724014  
Avg\_Train\_Loss: 0.78, Avg\_Train\_Acc: 0.72  
Accuracy on Test Data = 14.03%  
Test Accuracy: 0.1403225806451613  
Avg\_Train\_Loss: 0.75, Avg\_Train\_Acc: 0.73  
Accuracy on Test Data = 15.22%  
Test Accuracy: 0.1521505376344086  
Avg\_Train\_Loss: 0.72, Avg\_Train\_Acc: 0.74  
Accuracy on Test Data = 14.39%  
Test Accuracy: 0.1439068100358423  
Avg\_Train\_Loss: 0.72, Avg\_Train\_Acc: 0.74  
Accuracy on Test Data = 14.43%  
Test Accuracy: 0.1442652329749104  
Avg\_Train\_Loss: 0.69, Avg\_Train\_Acc: 0.75  
Accuracy on Test Data = 14.55%  
Test Accuracy: 0.14551971326164875  
Avg\_Train\_Loss: 0.67, Avg\_Train\_Acc: 0.76  
Accuracy on Test Data = 14.57%  
Test Accuracy: 0.1456989247311828  
Avg\_Train\_Loss: 0.68, Avg\_Train\_Acc: 0.77  
Accuracy on Test Data = 15.22%  
Test Accuracy: 0.1521505376344086  
Avg\_Train\_Loss: 0.65, Avg\_Train\_Acc: 0.77  
Accuracy on Test Data = 15.27%  
Test Accuracy: 0.15268817204301074  
Avg\_Train\_Loss: 0.63, Avg\_Train\_Acc: 0.78  
Accuracy on Test Data = 14.73%  
Test Accuracy: 0.14731182795698924  
Avg\_Train\_Loss: 0.62, Avg\_Train\_Acc: 0.78  
Accuracy on Test Data = 15.16%  
Test Accuracy: 0.15161290322580645  
Avg\_Train\_Loss: 0.62, Avg\_Train\_Acc: 0.79  
Accuracy on Test Data = 15.81%  
Test Accuracy: 0.15806451612903225  
Avg\_Train\_Loss: 0.58, Avg\_Train\_Acc: 0.8  
Accuracy on Test Data = 16.0%  
Test Accuracy: 0.1600358422939068  
Avg\_Train\_Loss: 0.57, Avg\_Train\_Acc: 0.8  
Accuracy on Test Data = 14.87%

```
Accuracy on Test Data = 14.64%
Test Accuracy: 0.14874551971326164
Avg_Train_Loss: 0.58, Avg_Train_Acc: 0.8
Accuracy on Test Data = 14.64%
Test Accuracy: 0.14641577060931898
Avg_Train_Loss: 0.56, Avg_Train_Acc: 0.81
Accuracy on Test Data = 14.84%
Test Accuracy: 0.14838709677419354
Avg_Train_Loss: 0.56, Avg_Train_Acc: 0.81
Accuracy on Test Data = 14.98%
Test Accuracy: 0.14982078853046596
Avg_Train_Loss: 0.54, Avg_Train_Acc: 0.81
Accuracy on Test Data = 15.39%
Test Accuracy: 0.1539426523297491
Avg_Train_Loss: 0.53, Avg_Train_Acc: 0.82
Accuracy on Test Data = 14.8%
Test Accuracy: 0.14802867383512544
Avg_Train_Loss: 0.56, Avg_Train_Acc: 0.81
Accuracy on Test Data = 15.27%
Test Accuracy: 0.15268817204301074
Avg_Train_Loss: 0.52, Avg_Train_Acc: 0.83
Accuracy on Test Data = 15.05%
Test Accuracy: 0.15053763440860216
Avg_Train_Loss: 0.5, Avg_Train_Acc: 0.83
Accuracy on Test Data = 14.95%
Test Accuracy: 0.14946236559139786
Avg_Train_Loss: 0.52, Avg_Train_Acc: 0.82
Accuracy on Test Data = 15.16%
Test Accuracy: 0.15161290322580645
Avg_Train_Loss: 0.48, Avg_Train_Acc: 0.84
Accuracy on Test Data = 14.98%
Test Accuracy: 0.14982078853046596
Avg_Train_Loss: 0.48, Avg_Train_Acc: 0.84
Accuracy on Test Data = 15.11%
Test Accuracy: 0.1510752688172043
Avg_Train_Loss: 0.48, Avg_Train_Acc: 0.84
Accuracy on Test Data = 15.25%
Test Accuracy: 0.1525089605734767
Avg_Train_Loss: 0.46, Avg_Train_Acc: 0.85
Accuracy on Test Data = 15.14%
Test Accuracy: 0.15143369175627241
Avg_Train_Loss: 0.47, Avg_Train_Acc: 0.84
Accuracy on Test Data = 14.95%
Test Accuracy: 0.14946236559139786
Avg_Train_Loss: 0.47, Avg_Train_Acc: 0.85
Accuracy on Test Data = 15.57%
Test Accuracy: 0.1557347670250896
```

```
1 log = pd.read_csv("Dataset/Data/Logs/Log.csv")  
2 log
```



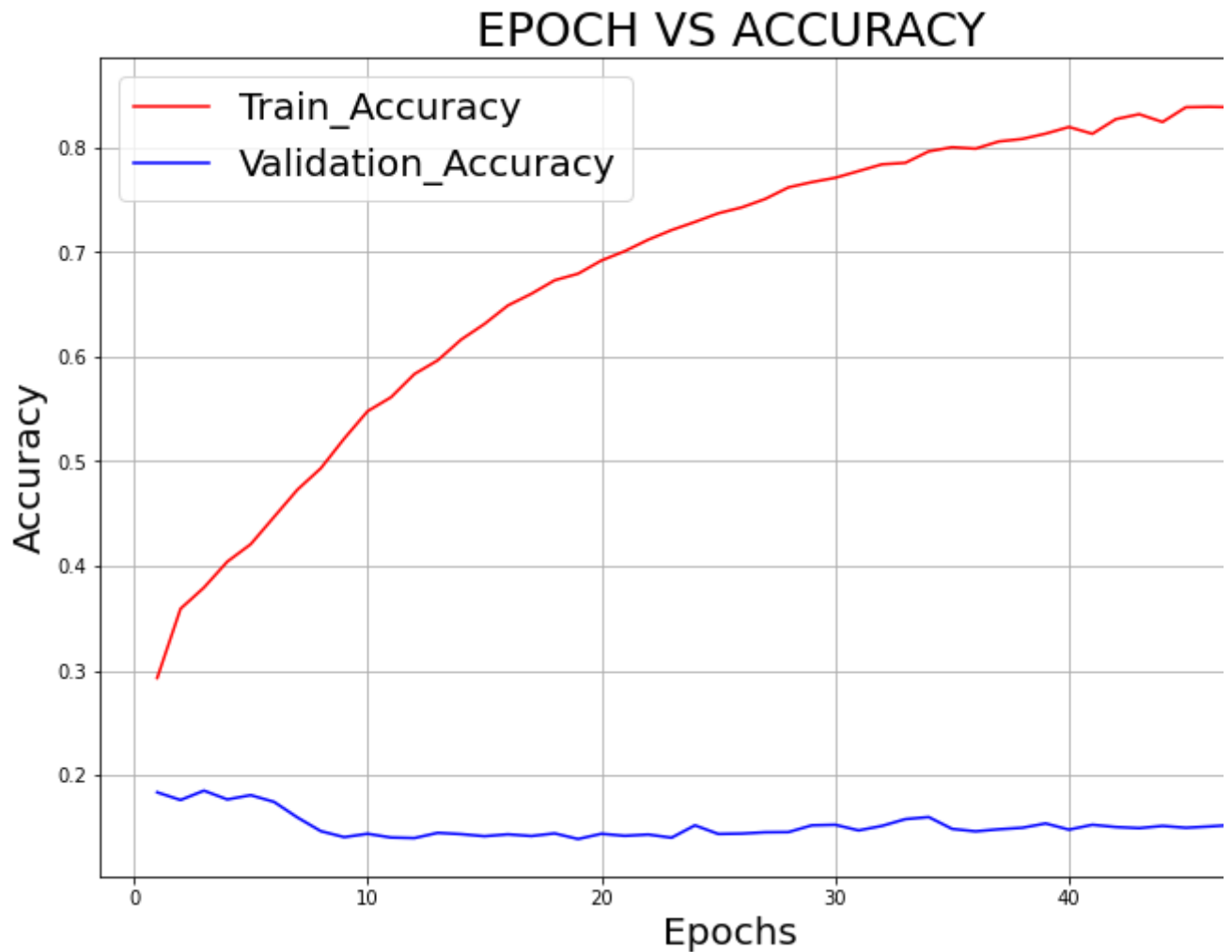
	Epoch	Train_Loss	Train_Accuracy	Test_Accuracy
0	1	1.999021	0.292906	0.183692
1	2	1.641509	0.359132	0.176344
2	3	1.596820	0.379301	0.185305
3	4	1.551534	0.404129	0.176882
4	5	1.498657	0.420752	0.181004
5	6	1.440742	0.446850	0.174552
6	7	1.376701	0.472896	0.159677
7	8	1.318895	0.493330	0.146595
8	9	1.250950	0.521705	0.140860
9	10	1.201116	0.547856	0.144086
10	11	1.144739	0.561143	0.140502
11	12	1.095188	0.583325	0.139964
12	13	1.057131	0.596453	0.144982
13	14	1.016224	0.616252	0.143728
14	15	0.981634	0.631233	0.141756
15	16	0.935808	0.648862	0.143548
16	17	0.914324	0.659979	0.141935
17	18	0.878494	0.672949	0.144444
18	19	0.871236	0.679195	0.139068
19	20	0.840016	0.691848	0.144086
20	21	0.812334	0.700794	0.142115
21	22	0.784460	0.711699	0.143369
22	23	0.777910	0.720911	0.140323
23	24	0.746911	0.728692	0.152151

```

1 def plotting(epoch, train_acc, val,title):
2     fig, axes = plt.subplots(1,1, figsize = (12, 8))
3     axes.plot(epoch, train_acc, color = 'red', label = "Train_Accuracy")
4     axes.plot(epoch, val, color = 'blue', label = "Validation_Accuracy")
5     axes.set_title(title, fontsize = 25)
6     axes.set_xlabel("Epochs", fontsize = 20)
7     axes.set_ylabel("Accuracy", fontsize = 20)
8     axes.grid()
9     axes.legend(fontsize = 20)
10
11 plotting(list(log["Epoch"]), list(log["Train_Accuracy"]),list(log["Test_Accurac

```





## ▼ 12. Checking Test Accuracy

```
1 def print_confusionMatrix(Y_TestLabels, PredictedLabels):
2     confusionMatx = confusion_matrix(Y_TestLabels, PredictedLabels)
3
4     precision = confusionMatx/confusionMatx.sum(axis = 0)
5
6     recall = (confusionMatx.T/confusionMatx.sum(axis = 1)).T
7
8     sns.set(font_scale=1.5)
9
10    # confusionMatx = [[1, 2],
11    #                  [3, 4]]
```

```

12 # confusionMatx.T = [[1, 3],
13 #                     [2, 4]]
14 # confusionMatx.sum(axis = 1) axis=0 corresponds to columns and axis=1 cor
15 # confusionMatx.sum(axix =1) = [[3, 7]]
16 # (confusionMatx.T)/(confusionMatx.sum(axis=1)) = [[1/3, 3/7]
17 #                                                  [2/3, 4/7]]
18
19 # (confusionMatx.T)/(confusionMatx.sum(axis=1)).T = [[1/3, 2/3]
20 #                                                  [3/7, 4/7]]
21 # sum of row elements = 1
22
23 labels = ["ANGRY", "DISGUST", "FEAR", "HAPPY", "NEUTRAL", "SAD", "SURPRISE"]
24
25 plt.figure(figsize=(16,7))
26 sns.heatmap(confusionMatx, cmap = "Blues", annot = True, fmt = ".1f", xtick
27 plt.title("Confusion Matrix", fontsize = 30)
28 plt.xlabel('Predicted Class', fontsize = 20)
29 plt.ylabel('Original Class', fontsize = 20)
30 plt.tick_params(labelsize = 15)
31 plt.xticks(rotation = 90)
32 plt.show()
33
34 print("-"*125)
35
36 plt.figure(figsize=(16,7))
37 sns.heatmap(precision, cmap = "Blues", annot = True, fmt = ".2f", xticklabe
38 plt.title("Precision Matrix", fontsize = 30)
39 plt.xlabel('Predicted Class', fontsize = 20)
40 plt.ylabel('Original Class', fontsize = 20)
41 plt.tick_params(labelsize = 15)
42 plt.xticks(rotation = 90)
43 plt.show()
44
45 print("-"*125)
46
47 plt.figure(figsize=(16,7))
48 sns.heatmap(recall, cmap = "Blues", annot = True, fmt = ".2f", xticklabels=
49 plt.title("Recall Matrix", fontsize = 30)
50 plt.xlabel('Predicted Class', fontsize = 20)
51 plt.ylabel('Original Class', fontsize = 20)
52 plt.tick_params(labelsize = 15)
53 plt.xticks(rotation = 90)
54 plt.show()

```

## ▼ Test Data of Human Images

```

1 model = load_model("Dataset/Data/Model_Save/model.h5")
2 predicted_labels = []
3 true_labels = []
4 batch_size = 10
5 total_files = int(len(Test_Data) / batch_size) #here, I have added 2 because th
6 for i in range(1, total_files, 1):
7     img load = np.load("Dataset/Data/Bottleneck Features/Bottleneck TestData/bo

```

```
8     img_label = np.load("Dataset/Data/Bottleneck_Features/TestData_Labels/bottl
9     img_bundle = img_load.reshape(img_load.shape[0], img_load.shape[1]*img_load
10    for j in range(img_bundle.shape[0]):
11        img = img_bundle[j]
12        img = img.reshape(1, img_bundle.shape[1])
13        pred = model.predict(img)
14        predicted_labels.append(pred[0].argmax())
15        true_labels.append(img_label[j].argmax())
16 acc = accuracy_score(true_labels, predicted_labels)
17 print("Accuracy on Test Data = {}".format(np.round(float(acc*100), 2)))
```



Accuracy on Test Data = 20.95%

```
1 print_confusionMatrix(true_labels, predicted_labels)
```



## Confusion Matrix

Original Class	ANGRY	103.0	0.0	134.0	118.0	208.0	206.0
	DISGUST	13.0	0.0	22.0	13.0	22.0	15.0
	FEAR	81.0	0.0	165.0	119.0	179.0	251.0
	HAPPY	181.0	1.0	236.0	263.0	338.0	338.0
	NEUTRAL	125.0	0.0	236.0	124.0	236.0	237.0
	SAD	130.0	1.0	137.0	123.0	201.0	373.0
	SURPRISE	25.0	0.0	189.0	147.0	120.0	116.0
		ANGRY	DISGUST	FEAR	HAPPY	NEUTRAL	SAD
							Predicted Class

## Precision Matrix

Original Class	ANGRY	0.16	0.00	0.12	0.13	0.16	0.13
	DISGUST	0.02	0.00	0.02	0.01	0.02	0.01
	FEAR	0.12	0.00	0.15	0.13	0.14	0.16
	HAPPY	0.28	0.50	0.21	0.29	0.26	0.22
	NEUTRAL	0.19	0.00	0.21	0.14	0.18	0.15
	SAD	0.20	0.50	0.12	0.14	0.15	0.24
	SURPRISE	0.04	0.00	0.17	0.16	0.09	0.08
		ANGRY	DISGUST	FEAR	HAPPY	NEUTRAL	SAD
Predicted Class							

## Recall Matrix



Original Class	ANGRY	0.13	0.00	0.17	0.15	0.27	0.27
	DISGUST	0.15	0.00	0.26	0.15	0.26	0.18
	FEAR	0.10	0.00	0.21	0.15	0.22	0.31
	HAPPY	0.13	0.00	0.17	0.19	0.25	0.25
	NEUTRAL	0.13	0.00	0.25	0.13	0.25	0.25
	SAD	0.13	0.00	0.14	0.13	0.21	0.39
	SURPRISE	0.04	0.00	0.30	0.23	0.19	0.19
		ANGRY	DISGUST	FEAR	HAPPY	NEUTRAL	SAD
		Predicted Class					

### ▼ 13. Testing on Real World with Still Images

```

1 # Now for testing the model on real world images we have to follow all of the s
2 # and test images. Like here we have to first pre-process our images then crea
3 # bottleneck features through our own MLP model for prediction.
4 # Steps are as follows:
5 # 1. Read the image, convert it to grayscale and save it.
6 # 2. Read that grayscale saved image, then detect face in it using HAAR cascade.
7 # 3. Crop the image to the detected face and resize it to 350*350 and save the
8 # 4. Read that processed cropped-resized image, then reshape it and normalize i
9 # 5. Then feed that image to VGG-16 and create bottleneck features of that imag
10 # 6. Then use our own model for final prediction of expression.

```

```

1 EMOTION_DICT = {1:"ANGRY", 2:"DISGUST", 3:"FEAR", 4:"HAPPY", 5:"NEUTRAL", 6:"SA
2 model_VGG = VGG16(weights='imagenet', include_top=False)
3 model_top = load_model("Dataset/Data/Model_Save/model.h5")

```

```

1 def make_prediction(path):
2     #converting image to gray scale and save it
3     img = cv2.imread(path)
4     gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
5     cv2.imwrite(path, gray)
6
7     #detect face in image, crop it then resize it then save it
8     face_cascade = cv2.CascadeClassifier('BEFinalProject/haarcascade_frontalfac

```

```

9     img = cv2.imread(path)
10    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
11    faces = face_cascade.detectMultiScale(gray, 1.3, 5)
12    for (x,y,w,h) in faces:
13        face_clip = img[y:y+h, x:x+w]
14        cv2.imwrite(path, cv2.resize(face_clip, (350, 350)))
15
16    #read the processed image then make prediction and display the result
17    read_image = cv2.imread(path)
18    read_image = read_image.reshape(1, read_image.shape[0], read_image.shape[1])
19    read_image_final = read_image/255.0 #normalizing the image
20    VGG_Pred = model_VGG.predict(read_image_final) #creating bottleneck featur
21    VGG_Pred = VGG_Pred.reshape(1, VGG_Pred.shape[1]*VGG_Pred.shape[2]*VGG_Pred
22    top_pred = model_top.predict(VGG_Pred) #making prediction from our own mod
23    emotion_label = top_pred[0].argmax() + 1
24    print("Predicted Expression Probabilities")
25    print("ANGRY: {} \nDISGUST: {} \nFEAR: {} \nHAPPY: {} \nNEUTRAL: {} \nSAD: {} \nS
26    print("Dominant Probability = "+str(EMOTION_DICT[emotion_label])+" : "+str(m

```

## ▼ Image Prediction

```

1 path=base_path+"validation/angry/11467.jpg"
2 Image.open(path)

```



```

1 make_prediction(path)

```



```

Predicted Expression Probabilities
ANGRY: 1.900677728541248e-14
DISGUST: 2.113942667561399e-14
FEAR: 1.0
HAPPY: 2.042021269416626e-14
NEUTRAL: 1.070611211209454e-15
SAD: 1.5749976193038528e-12
SURPRISE: 7.880991052897773e-14

```

```

Dominant Probability = FEAR: 1.0

```

## ▼ Correct Result

```

1 Image.open("../Data/Test_Images/Angry_2.png")

1 make_prediction("../Data/Test_Images/Angry_2.png")

```

DISGUST

## ▼ Incorrect Result

```
1 Image.open("../Data/Test_Images/Disgust_1.jpg")
```

```
1 make_prediction("../Data/Test_Images/Disgust_1.jpg")
```

## ▶ Correct Result

↳ 2 cells hidden

FEAR

## ▶ Correct Result

↳ 2 cells hidden

## ▶ Correct Result

↳ 2 cells hidden

HAPPY

## ▶ Correct Result

↳ 2 cells hidden

## ▶ Correct Result

↳ 2 cells hidden

Neutral

## ▶ Correct Result

↳ 2 cells hidden

Sad

▶ Correct Prediction

↳ 2 cells hidden

▶ Correct Prediction

↳ 2 cells hidden

Surprise

▶ Correct Prediction

↳ 2 cells hidden

▶ Correct Prediction

↳ 9 cells hidden