```
import warnings
warnings.filterwarnings("ignore")
import numpy as np
from numpy import array
import pandas as pd
from tqdm import tqdm
import datetime as datetime
import tensorflow as tf
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
from wordcloud import WordCloud
import glob
import string
import cv2
import random
import imgaug.augmenters as iaa
from pickle import dump, load
from keras.preprocessing import image
from keras.preprocessing.image import load_img, img_to_array
from keras.applications.vgg16 import VGG16, preprocess_input
from keras.layers import LSTM, Embedding, Dense, Activation, Dropout
from keras.callbacks import ModelCheckpoint, ModelCheckpoint, TensorBoard
from keras.layers.merge import Add
from keras.preprocessing import sequence
from keras.models import Model
from keras import Input, layers
from keras import optimizers
from keras.preprocessing.text import Tokenizer
from keras.preprocessing.sequence import pad_sequences
from nltk.translate.bleu_score import sentence_bleu
tf.random.set_seed(3)


image_path = '/content/Flicker8k_Dataset/'
dir_Flickr_text = '/content/Flickr_txt/Flickr8k.token.txt'
images_lst = glob.glob(image_path + '*.jpg')
no_of_image = len(images_lst)
print(f'Total Images in Datset : {no_of_image}')
```

```
Total Images in Datset : 8091
```

Utility Fuctions:

- **Load text**
- **Preparing Text data from Flickr8k.txt file**
- **Prepare DataFrames**

```
def load_txt(txt_file):
  with open(txt_file,'r') as file:
    text = file.read()
  return text

def prepare_clean_txt(text):
  text_data = []
  table = str.maketrans('', '', string.punctuation)
  for line in tqdm(text.split('\n')):                          # spiltting over each line
    col = line.split('\t')                                     # splitting over each space in
    if len(col) == 1:                                          # neglecting data if full info
        continue
    filename, index = col[0].split("#")
    filename_path = image_path + filename                      # splitting to gather informat
    txt = col[1].split()
    txt = [word.lower() for word in txt]                       # convert each word to lower c
    txt = [w.translate(table) for w in txt]                    # to remove punctuations from
    txt = [word for word in txt if len(word)>1]                # to discard words of length 1
    txt = [word for word in txt if word.isalpha()]             # to discard numeric string
    txt = ' '.join(txt)
    text_data.append([index]+ [filename_path] + [txt])
  return text_data                                              # [index, filename, caption t


def prepare_dataframes(text_data):
  data_df = pd.DataFrame(text_data, columns=[ 'index', 'filename', 'caption'])
  data_df = data_df[data_df.filename != '2258277193_586949ec62.jpg.1']
  data_df['caption_with_tags'] = data_df['caption'].apply(lambda txt : 'startseq ' + txt + '
  tokenizer = Tokenizer()
  tokenizer.fit_on_texts(data_df.caption.values)
  data_df['caption_word_count'] = data_df['caption'].apply(lambda caption: len(caption.split(
  word = []
  frequency = []
  for k,v in tokenizer.word_counts.items():
    word.append(k)
    frequency.append(v)
  df_word_count = pd.DataFrame({'word': word, 'frequency': frequency})
  df_word_count.sort_values('frequency', ascending=False, inplace=True, ignore_index=True)
  return data_df, df_word_count


text = load_txt(dir_Flickr_text)
text_data = prepare_clean_txt(text)
data_df, df_word_count = prepare_dataframes(text_data)
```

```
100%|██████████| 40461/40461 [00:00<00:00, 74415.53it/s]
```

```
data_df.head(3)
```

	index	filename	caption	caption_with_tags	cap
0	0	/content/Flicker8k_Dataset/1000268201_693b08cb...	child in pink dress is climbing	startseq child in pink dress is climbing up	se

Exploratory Data Analysis

```
from collections import Counter
def utility_counter(data):
  filename = data_df.filename.values
  caption_count = Counter(filename).values()
  uni_filenames = np.unique(filename)
  print(f'Number of unique file names : {len(uni_filenames)}')
  print(f'Number of captions per image : {set(caption_count)}')
  print(f'All image have same number of captions: {all(caption_count)}')

utility_counter(data_df)
```

```
Number of unique file names : 8092
Number of captions per image : {5}
All image have same number of captions: True
```

Image - Caption visualization

```
def image_caption_plotter(data):
  npic = 3
  target_size = (350, 500, 3)
  count = 1
  fig = plt.figure(figsize=(25, 22))
  for file in tqdm(random.sample(list(data['filename']), npic)):
    captions = list(data['caption'].loc[data['filename'] == file].values)
    image_load = load_img(file, target_size = target_size)
    ax = fig.add_subplot(npic, 2, count)
    ax.axis('off')
    ax.imshow(image_load, interpolation='nearest')
    count += 1
    ax = fig.add_subplot(npic, 2, count)
    ax.axis('off')
    ax.set_ylim(0, len(captions))
    for i, caption in enumerate(captions):
      ax.text(0, i, caption, fontsize = 30, fontfamily= 'fantasy', bbox=dict(facecolor='black
    count += 1
    plt.grid(None)
  plt.show()

image_caption_plotter(data_df)
```

```
100%|██████████| 3/3 [00:00<00:00, 18.83it/s]
```

THE BIKER CARRIES HIS BIKE OVER THE OBSTACLE

MAN CARRIES BIKE OVER OBSTACLE

MAN WALKS OVER SMALL SIGN CARRYING HIS BICYCLE

MAN IS JUMPING OVER LOW WALL HOLDING BICYCLE

BIKER JUMPS AN OBSTACLE

TODDLER WALKS ALONG FENCE

TODDLER IN GREEN SHORTS IS STANDING BY WOODEN FENCE

BLOND TODDLER IN GREEN TROUSERS PEEKS THROUGH FENCE

BLOND LITTLE BOY IS STANDING BY FENCE

Observation

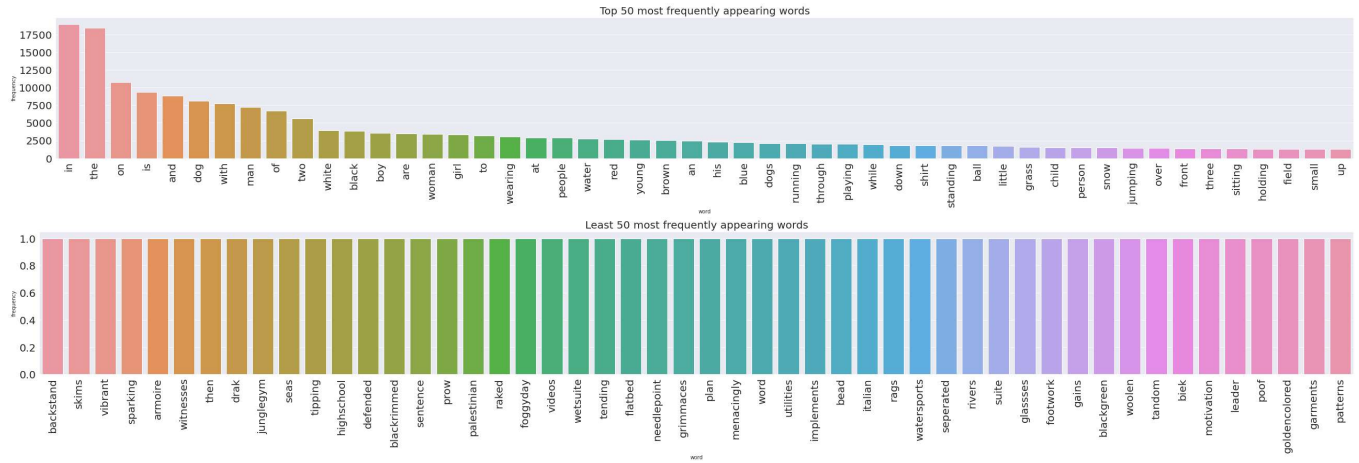
- We can see each image has 5 captions associated with it.

YOUNG GIRL CLIMBS TREE

Plot for word - frequency

CHILD CLIMBS TREE

```
count = 50

def plot_word_count(df, title = ''):
    sns.set_style('darkgrid')
    plt.figure(figsize = (45, 5))
    sns.barplot(x=df['word'], y=df["frequency"])
    plt.yticks(fontsize = 20)
    plt.xticks( rotation = 'vertical', fontsize = 20)
    plt.title(title, fontsize = 20)
    plt.show()

plot_word_count(df_word_count.iloc[:count, :], title= 'Top 50 most frequently appearing words
plot_word_count(df_word_count.iloc[-count:, :], title= 'Least 50 most frequently appearing wo
```

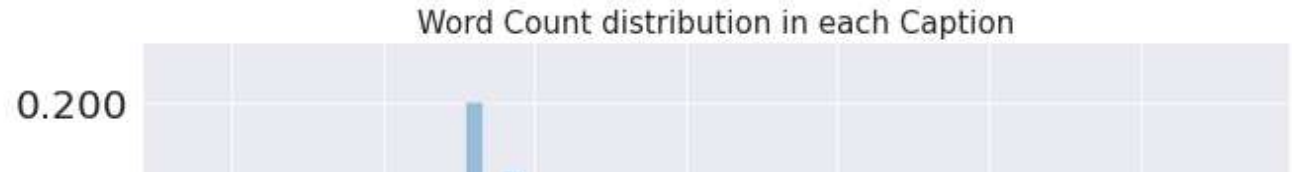


Word Cloud Visualization

```
text = ' '
for caption in data_df.caption:
  text = text + caption
plt.figure(figsize=(16, 12))
word_cloud = WordCloud(width = 1000, height = 500, random_state=1, collocations= True, backgr
plt.imshow(word_cloud, interpolation='bilinear')
plt.axis("off")
plt.title('Strength of word in complete data corpus', fontsize = 30)
plt.show()
```

Distribution of number of words in each caption

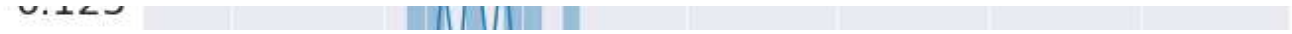
```
sns.set_style('darkgrid')
sns.FacetGrid(data_df, height = 9).map(sns.distplot, 'caption_word_count').add_legend()
plt.yticks(fontsize = 20)
plt.xticks(fontsize = 20)
plt.title('Word Count distribution in each Caption', fontsize = 15)
plt.show()
```



Observation:

- We can see most of captions contain words in range of 7 to 10

- **Train_filename_container : Train image path**
- Test_filename_container : Test image path



```
train_images_file = '/content/Flickr_txt/Flickr_8k.trainImages.txt'
train_images = set(open(train_images_file, 'r').read().strip().split('\n'))
train_filename_container = [image_path+filename for filename in train_images if image_path+fi

test_images_file = '/content/Flickr_txt/Flickr_8k.testImages.txt'
test_images = set(open(test_images_file, 'r').read().strip().split('\n'))
test_filename_container = [image_path+filename for filename in test_images if image_path+file
```

Augumentation on images

```
def augument_image(image_path, aug=True, visualize=False):
  if visualize:
    image = cv2.imread(image_path, cv2.IMREAD_UNCHANGED)
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image = cv2.resize(image, (224, 224))
  else:
    image = load_img(image_path, target_size=(224, 224))
    image = img_to_array(image)
  if aug:
    aug2 = iaa.Fliplr(1)
    aug3 = iaa.Flipud(1)
    aug4 = iaa.Emboss(alpha=(1), strength=1)
    aug5 = iaa.DirectedEdgeDetect(alpha=(0.8), direction=(1.0))
    aug6 = iaa.Sharpen(alpha=(1.0), lightness=(1.5))

    a = np.random.uniform()
    if a<0.2:
      aug_image = aug2.augment_image(image)
    elif a<0.4:
      aug_image = aug3.augment_image(image)
    elif a<0.6:
      aug_image = aug4.augment_image(image)
    elif a<0.8:
      aug_image = aug5.augment_image(image)
```

```
      else:
        aug_image = aug6.augment_image(image)
      return image, aug_image
    else:
      return image


row = 3
col = 2
dataset = [augument_image(train_filename_container[np.random.randint(0, 5000)], aug=True, vis
fig = plt.figure(figsize=(15, 20))
for counter in range(0, row*col):
  fig.add_subplot(row, col, counter+1)
  plt.imshow((dataset[int(counter/2)][counter%2]))
  plt.axis('off')
  plt.grid(None)
```




- train_caption_mapping: Train image caption
- test_caption_mapping: Train image caption


```
train_caption_mapping = {}
for file in tqdm(train_filename_container):
    train_caption_mapping[file]= list(data_df.loc[data_df['filename'] == file].caption_with_t

test_caption_mapping = {}
for file in tqdm(test_filename_container):
    test_caption_mapping[file]= list(data_df.loc[data_df['filename'] == file].caption_with_ta
```

```
 100%|██████████| 6000/6000 [00:18<00:00, 318.31it/s]
 100%|██████████| 1000/1000 [00:02<00:00, 334.52it/s]
```


Model load VGG16


```
def encode_image(filename_container, aug=True):
  encoding = {}
  augmented_image_path = []
  for image_path in tqdm(filename_container):
    image = augument_image(image_path, aug=aug)
    if aug:
      image = preprocess_input(image[0])
```

```
      aug_image = preprocess_input(image[1])

      features = model_new(np.expand_dims(image, axis=0))
      features = np.reshape(features, (features.shape[1],))
      features_aug = model_new(np.expand_dims(image, axis=0))
      features_aug = np.reshape(features_aug, (features_aug.shape[1],))

      encoding[image_path] = features
      aug_path = image_path[:-4]+'_aug.jpg'
      augmented_image_path.append(aug_path)
      train_caption_mapping[aug_path] = train_caption_mapping[image_path]
      encoding[aug_path] = features_aug
    else:
      image = preprocess_input(image)
      features = model_new(np.expand_dims(image, axis=0))
      fearures = np.reshape(features, (features.shape[1],))
      encoding[image_path] = features
  global train_filename_container
  train_filename_container += augmented_image_path
  return encoding

model_vgg16 = VGG16(weights='imagenet', include_top=True)
model_new = Model(model_vgg16.input, model_vgg16.layers[-2].output)
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16
553467904/553467096 [==============================] - 4s 0us/step
553476096/553467096 [==============================] - 4s 0us/step
```

Save the bottleneck train and test features to disk

```
encoding_train = encode_image(train_filename_container)
with open('/content/encoded_train_image_features.pkl', 'wb') as p:
    dump(encoding_train, p)
```

```
100%|██████████| 6000/6000 [08:20<00:00, 12.00it/s]
```

```
encoding_test = encode_image(test_filename_container, aug=False)
with open('/content/encoded_test_image_feature.pkl', 'wb') as p:
    dump(encoding_test, p)
```

```
100%|██████████| 1000/1000 [00:43<00:00, 23.19it/s]
```

Loading saved features

```
train_features = load(open("/content/encoded_train_image_features.pkl", "rb"))
print('Number of train image features', len(train_features))
```

```
test_features = load(open("/content/encoded_test_image_feature.pkl", "rb"))
print('Number of test image features', len(test_features))
```

```
Number of train image features 12000
Number of test image features 1000
```

List of all the train, test captions

```
all_train_captions = set()
for _, caption_lst in tqdm(train_caption_mapping.items()):
    for caption in caption_lst:
        all_train_captions.add(caption)

all_test_captions = set()
for _, caption_lst in tqdm(test_caption_mapping.items()):
    for caption in caption_lst:
        all_test_captions.add(caption)
```

```
100%|██████████| 12000/12000 [00:00<00:00, 387697.37it/s]
100%|██████████| 1000/1000 [00:00<00:00, 371703.65it/s]
```

Frequency of words in train, test caption

```
train_tokenizer = Tokenizer(oov_token = '<UNK>')
train_tokenizer.fit_on_texts(all_train_captions)
words = []
frequency = []
for word,freq in tqdm(train_tokenizer.word_counts.items()):
  words.append(word)
  frequency.append(freq)
df_wc_train = pd.DataFrame({'word': words, 'frequency': frequency})
df_wc_train.sort_values('frequency', ascending=False, inplace=True, ignore_index=True)
```

```
100%|██████████| 7578/7578 [00:00<00:00, 1032230.31it/s]
```

Word-Index/Index-Word Mapping

```
ixtoword = dict((index, word) for word, index in train_tokenizer.word_index.items())
wordtoix = train_tokenizer.word_index
max_length = max(map(lambda caption: len(caption.split()), all_train_captions))
vocab_size = len(wordtoix)+1
```

Dataset Preparation/Dataloader

```
def dataset_loader(tokenizer, image_caption_mapping, image_features, max_length, images_per_b
```

```
    image_feature, input_seq, output_seq = list(), list(), list()
    image_count=0
    while 1:
        for image_path, captions in image_caption_mapping.items():
            image_count+=1
            feature = image_features[image_path]
            sequences = tokenizer.texts_to_sequences(captions)
            for seq in sequences:
              for i in range(1, len(seq)):
                  in_seq, out_seq = seq[:i], seq[i]
                  in_seq = pad_sequences([in_seq], maxlen=max_length)[0]
                  out_seq = tf.keras.utils.to_categorical([out_seq], num_classes=vocab_size)[
                  image_feature.append(feature)
                  input_seq.append(in_seq)
                  output_seq.append(out_seq)
            if image_count==images_per_batch:
                yield [[array(image_feature), array(input_seq)], array(output_seq)]
                image_feature, input_seq, output_seq = list(), list(), list()
                image_count=0
```

Embeddings: Load Glove vectors

```
embeddings_index = {}
f = open('/content/glove.6B.200d.txt', encoding="utf-8")

for line in tqdm(f):
    values = line.split()
    word = values[0]
    coefs = np.asarray(values[1:], dtype='float32')
    embeddings_index[word] = coefs
f.close()
print(f'\n Number of words in glove vector: {len(embeddings_index)}')
```

```
 400000it [00:19, 20599.85it/s]
  Number of words in glove vector: 400000
```

Embedding matrix

```
embedding_dim = 200
embedding_matrix = np.zeros((vocab_size, embedding_dim))
for word, i in wordtoix.items():
    embedding_vector = embeddings_index.get(word)
    if embedding_vector is not None:
        embedding_matrix[i] = embedding_vector

embedding_matrix.shape
```

```
 (7580, 200)
```

Model Architecture

```
input_image = Input(shape=(4096, ), name='Image_Feature_input')
fe1 = Dropout(0.5, name='Dropout_image')(input_image)
fe2 = Dense(256, activation='relu', name='Activation_Encoder')(fe1)
input_text = Input(shape=(max_length,), name='Text_input')
se1 = Embedding(vocab_size, embedding_dim, mask_zero=True, weights=[embedding_matrix], traina
se2 = Dropout(0.5, name='Dropout_text')(se1)
se3 = LSTM(256, name='LSTM')(se2)
decoder1 = Add(name='Add')([fe2, se3])
decoder2 = Dense(256, activation='relu', name='Activation_Decoder')(decoder1)
output = Dense(vocab_size, activation='softmax',name='Output')(decoder2)
model = Model(inputs=[input_image, input_text], outputs=output)
```

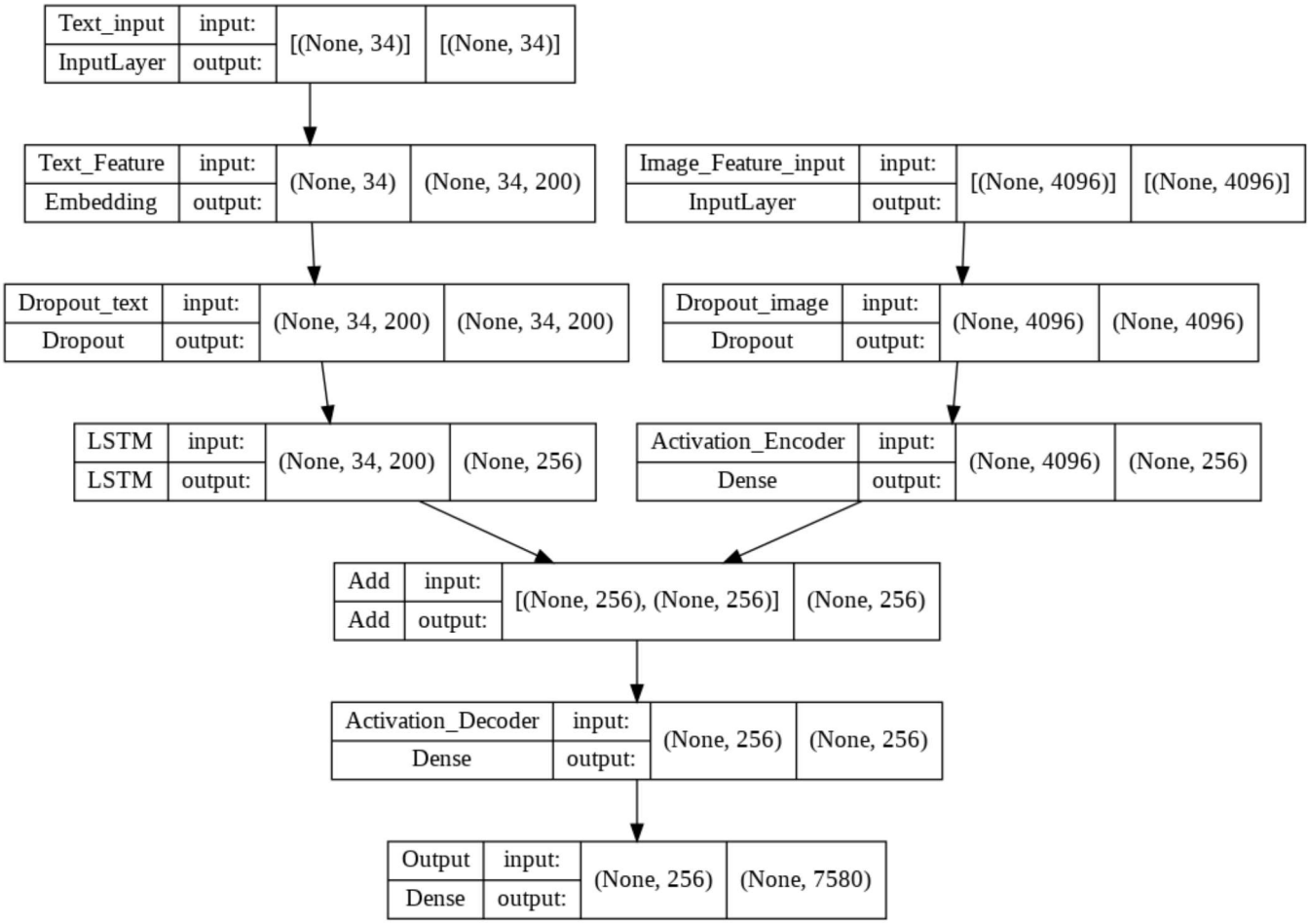
Model Summary

```
model.summary()
```

```
Model: "model_1"
__________________________________________________________________________________________
 Layer (type)                   Output Shape         Param #     Connected to
==========================================================================================
 Text_input (InputLayer)        [(None, 34)]         0           []

 Image_Feature_input (InputLaye  [(None, 4096)]      0           []
 r)

 Text_Feature (Embedding)       (None, 34, 200)      1516000     ['Text_input[0][0]']

 Dropout_image (Dropout)        (None, 4096)         0           ['Image_Feature_input[0

 Dropout_text (Dropout)         (None, 34, 200)      0           ['Text_Feature[0][0]']

 Activation_Encoder (Dense)     (None, 256)          1048832     ['Dropout_image[0][0]']

 LSTM (LSTM)                    (None, 256)          467968      ['Dropout_text[0][0]']

 Add (Add)                      (None, 256)          0           ['Activation_Encoder[0]
                                                                  'LSTM[0][0]']

 Activation_Decoder (Dense)     (None, 256)          65792       ['Add[0][0]']

 Output (Dense)                 (None, 7580)         1948060     ['Activation_Decoder[0]

==========================================================================================
Total params: 5,046,652
Trainable params: 3,530,652
Non-trainable params: 1,516,000
__________________________________________________________________________________________
```

Model Architecture

```
tf.keras.utils.plot_model(model, to_file='model.png', show_shapes = True, show_layer_names =
```



Compile/Callbacks

```
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
filepath = 'model-ep{epoch:03d}-loss{loss:.3f}.h5'
checkpoint = ModelCheckpoint(filepath, monitor='loss', verbose=1, save_best_only=True, mode='
log_dir = "logs/fit/"+ datetime.datetime.now().strftime("%Y%m%d-%H%M%S")
tensorboard = TensorBoard(log_dir = log_dir, histogram_freq=1)

model.load_weights('/content/image_model10.hdf5')
```

Model Fitting

```
number_pics_per_bath = 16
steps = len(train_caption_mapping)//number_pics_per_bath
learning_rate = 0.001

train_generator = dataset_loader(train_tokenizer, train_caption_mapping, train_features, max_
history = model.fit(train_generator, epochs=60, steps_per_epoch=steps, verbose=1, callbacks =
```

```
750/750 [==============================] - ETA: 0s - loss: 1.9561 - accuracy: 0.4815
Epoch 43: loss improved from 1.95980 to 1.95614, saving model to model-ep043-loss1.95
750/750 [==============================] - 181s 241ms/step - loss: 1.9561 - accuracy:
Epoch 44/60
750/750 [==============================] - ETA: 0s - loss: 1.9494 - accuracy: 0.4818
Epoch 44: loss improved from 1.95614 to 1.94940, saving model to model-ep044-loss1.94
750/750 [==============================] - 180s 241ms/step - loss: 1.9494 - accuracy:
Epoch 45/60
750/750 [==============================] - ETA: 0s - loss: 1.9491 - accuracy: 0.4829
Epoch 45: loss improved from 1.94940 to 1.94908, saving model to model-ep045-loss1.94
750/750 [==============================] - 180s 240ms/step - loss: 1.9491 - accuracy:
Epoch 46/60
750/750 [==============================] - ETA: 0s - loss: 1.9384 - accuracy: 0.4845
Epoch 46: loss improved from 1.94908 to 1.93841, saving model to model-ep046-loss1.93
750/750 [==============================] - 183s 243ms/step - loss: 1.9384 - accuracy:
Epoch 47/60
750/750 [==============================] - ETA: 0s - loss: 1.9333 - accuracy: 0.4862
Epoch 47: loss improved from 1.93841 to 1.93330, saving model to model-ep047-loss1.93
750/750 [==============================] - 181s 242ms/step - loss: 1.9333 - accuracy:
Epoch 48/60
750/750 [==============================] - ETA: 0s - loss: 1.9276 - accuracy: 0.4861
Epoch 48: loss improved from 1.93330 to 1.92756, saving model to model-ep048-loss1.92
750/750 [==============================] - 182s 243ms/step - loss: 1.9276 - accuracy:
Epoch 49/60
750/750 [==============================] - ETA: 0s - loss: 1.9245 - accuracy: 0.4869
Epoch 49: loss improved from 1.92756 to 1.92445, saving model to model-ep049-loss1.92
750/750 [==============================] - 182s 242ms/step - loss: 1.9245 - accuracy:
Epoch 50/60
750/750 [==============================] - ETA: 0s - loss: 1.9206 - accuracy: 0.4873
Epoch 50: loss improved from 1.92445 to 1.92063, saving model to model-ep050-loss1.92
750/750 [==============================] - 182s 242ms/step - loss: 1.9206 - accuracy:
Epoch 51/60
750/750 [==============================] - ETA: 0s - loss: 1.9152 - accuracy: 0.4887
Epoch 51: loss improved from 1.92063 to 1.91520, saving model to model-ep051-loss1.91
750/750 [==============================] - 182s 242ms/step - loss: 1.9152 - accuracy:
Epoch 52/60
750/750 [==============================] - ETA: 0s - loss: 1.9134 - accuracy: 0.4898
```

```
750/750 [==============================] - ETA: 0s - loss: 1.9134 - accuracy: 0.4898
Epoch 52: loss improved from 1.91520 to 1.91342, saving model to model-ep052-loss1.91
750/750 [==============================] - 181s 242ms/step - loss: 1.9134 - accuracy:
Epoch 53/60
750/750 [==============================] - ETA: 0s - loss: 1.9089 - accuracy: 0.4897
Epoch 53: loss improved from 1.91342 to 1.90886, saving model to model-ep053-loss1.90
750/750 [==============================] - 182s 242ms/step - loss: 1.9089 - accuracy:
Epoch 54/60
750/750 [==============================] - ETA: 0s - loss: 1.9059 - accuracy: 0.4903
Epoch 54: loss improved from 1.90886 to 1.90590, saving model to model-ep054-loss1.90
750/750 [==============================] - 182s 243ms/step - loss: 1.9059 - accuracy:
Epoch 55/60
750/750 [==============================] - ETA: 0s - loss: 1.9018 - accuracy: 0.4920
Epoch 55: loss improved from 1.90590 to 1.90183, saving model to model-ep055-loss1.90
750/750 [==============================] - 182s 242ms/step - loss: 1.9018 - accuracy:
Epoch 56/60
750/750 [==============================] - ETA: 0s - loss: 1.8970 - accuracy: 0.4920
Epoch 56: loss improved from 1.90183 to 1.89700, saving model to model-ep056-loss1.89
750/750 [==============================] - 181s 241ms/step - loss: 1.8970 - accuracy:
Epoch 57/60
750/750 [==============================] - ETA: 0s - loss: 1.8914 - accuracy: 0.4931
```

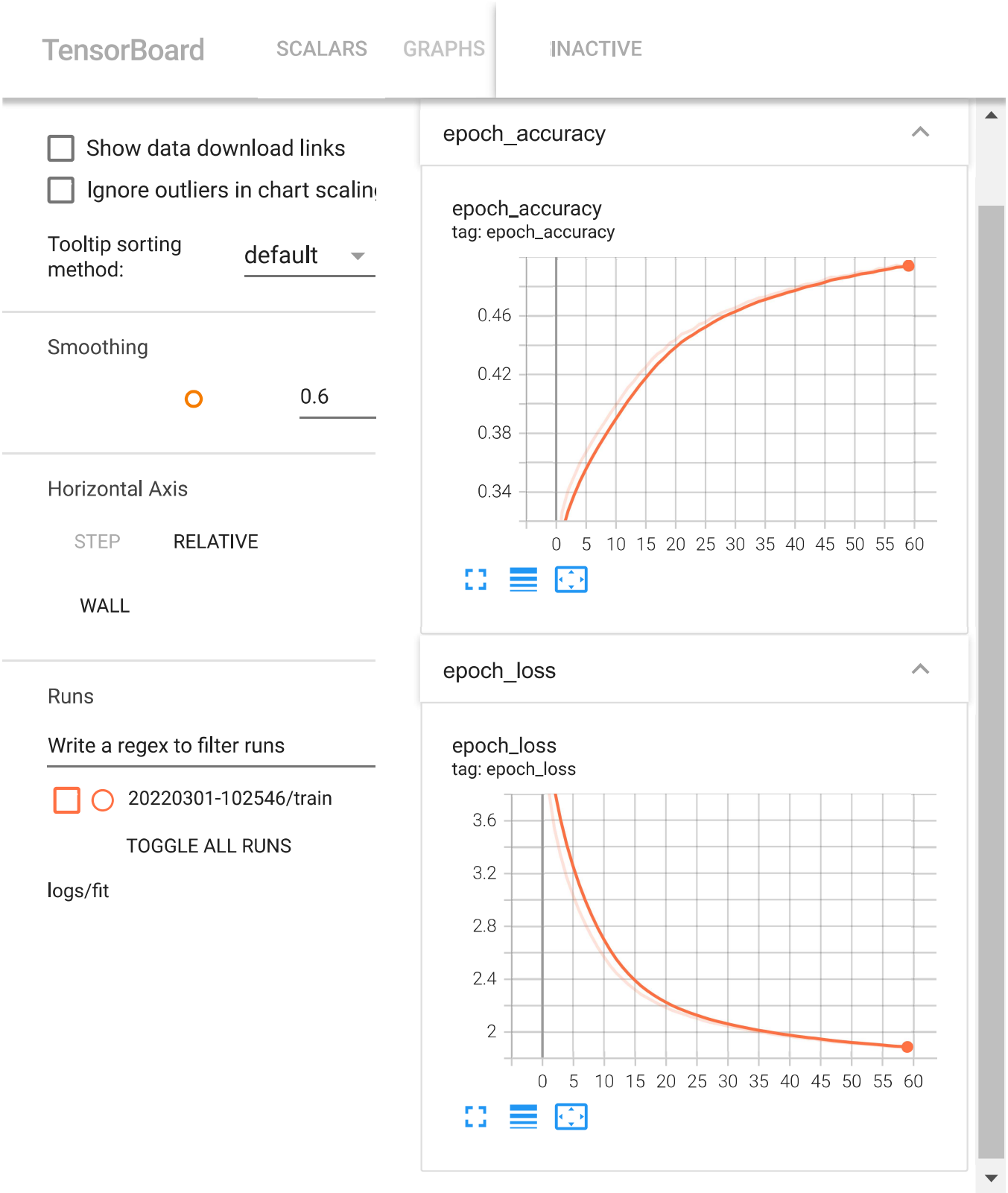
Loss/Accuracy Plot

```
plt.figure(figsize=(30, 5))
plt.subplot(121)
plt.plot(history.history['loss'])
plt.plot(history.history['accuracy'])
plt.title('Model - Loss/Accuracy', fontsize=20)
plt.ylabel('Loss/Accuracy')
plt.xlabel('Epoch')
plt.legend(['Loss', 'Accuracy'], loc='upper left')
```

```
<matplotlib.legend.Legend at 0x7f465bfba090>
```

Tensorboard Plot


```
%load_ext tensorboard
%tensorboard --logdir logs/fit
```



Inference

```
with open("/content/encoded_test_image_feature.pkl", "rb") as encoded_pickle:
    encoding_test = load(encoded_pickle)


def greedySearch(image):
    image = encoding_test[image]
    image = np.reshape(image, (1,4096))
    in_text = 'startseq'
    for i in range(max_length):
        sequence = [wordtoix[word] for word in in_text.split()]
        sequence = pad_sequences([sequence], maxlen=max_length)
        yhat = model.predict([image,sequence], verbose=0)
        yhat = np.argmax(yhat)
        word = ixtoword[yhat]
        in_text += ' ' + word
        if word == 'endseq':
            break
    final = in_text.split()
    final = final[1:-1]
    final = ' '.join(final)
    return final


def image_caption_score_extractor(data):
  npic = 6
  target_size = (224, 224, 3)
  count = 1
  fig = plt.figure(figsize=(60,65))
  for file in tqdm(random.sample(test_filename_container, npic)):
    predicted_caption = greedySearch(file)
    captions = list(data['caption'].loc[data['filename'] == file].values)
    image_load = load_img(file, target_size = target_size)
    ax = fig.add_subplot(npic, 2, count)
    ax.axis('off')
    ax.imshow(image_load, interpolation='nearest')
    reference = [caption.split() for caption in captions]
    candidate = predicted_caption.split()
    score = round(sentence_bleu(reference, candidate), 3)
    count += 1
    ax = fig.add_subplot(npic, 2, count)
    ax.axis('off')
    ax.set_ylim(0, len(captions)+2)
    for i, caption in enumerate(captions):
      ax.text(0, i, caption, fontsize = 40, bbox=dict(facecolor='blue', alpha=0.1), color='re
    ax.text(0, i+1, greedySearch(file),  fontsize =40, fontfamily= 'fantasy', bbox=dict(facec
    ax.text(0, i+2, 'BLEU Score: '+str(score),  fontsize = 40, fontfamily= 'fantasy', bbox=di
    count += 1
  plt.grid(None)
  plt.show()
```

```
image_caption_score_extractor(data_df)
```

100%| | 6/6 [00:10<00:00, 1.81s/it]

BLEU SCORE: 0.693

PERSON IN YELLOW JACKET IS STANDING IN THE SNOW POSING BY THE SNOW

people some dressed in costumes and dogs on snowy mountain

people dressed in costumes are on skis

four people holding each others shoulders with brown dog in front of them standing on snow

man dressed in horned hat poses for picture on skis with three other people and dog

group of people on skis with two dogs

BLEU SCORE: 0.88

DOG RUNNING DOWN TRAIL WITH PURPLE LEAVES IN ITS MOUTH

dog in desert area with distant man in background

yellow dog is walking along mountain trail

white dog is going for walk through the desert with its owner

tan dog walks ahead of man in dry area

dog walks down the dirt road as person follows

BLEU SCORE: 0.809

MAN IN RED SHIRT IS RIDING HIS BIKE THROUGH THE MIDDLE OF THE OCEAN

young man is performing trick on skateboard in park

the young man is skateboarding at skate park

the helmeted boy is doing stunt on skateboard

young man wearing red jacket performs jump on red skateboard

man wearing red helmet jumps up while riding skateboard

BLEU SCORE: 0.435

MAN IN GREEN SHORTS IS SURFING INTO THE WATER

the boy wearing red shorts is jumping into the river as other children swim

the boy in the red shorts jumps into the water to join other people

boy takes flying leap into the water

boy in red swimsuit jumps into the water to join two people

boy in red suit plays in the water

BLEU SCORE: 0.459

THIN DOG IS RUNNING AWAY DOWN PATH SURROUNDED BY TREES

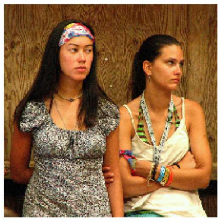
white puppy walks down dirt path trailing his leash on the ground behind him

white dog with loose leash is on dirt road

white dog runs along path trailing leash

white dog is walking down dirt road

small white dog has on leash and is walking next to fence



BLEU SCORE: 0.406

TWO WOMEN ARE POSING FOR PICTURE

two young women one with folded arms look off screen

two young women are leaning up against wooden wall

two women with black hair stand in front of plywood

two girls are standing by wooden wall looking off to their left

two females are standing next to each other and appear to be unexcited