```
import json
import tweepy
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import missingno as msno
import time
import seaborn as sns
import regex

from datetime import datetime
```

```
# !pip install emoji
```

```
import nltk
import contractions
import re
import emoji
import emojis
import wordcloud as wc
import string

from collections import Counter
```

```
from sklearn.model_selection import train_test_split
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression

from sklearn.metrics import confusion_matrix, classification_report
from sklearn.feature_extraction.text import CountVectorizer

```

```

nltk.download('punkt')
nltk.download('wordnet')
nltk.download('stopwords')
nltk.download('averaged_perceptron_tagger')
stop_words = nltk.corpus.stopwords.words('spanish')
```

```
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]     /root/nltk_data...
[nltk_data]   Package averaged_perceptron_tagger is already up-to-
[nltk_data]       date!
```

```
                          max_words=100,
                          scale=10,
                          background_color="white")\
                          .generate(text)
    plt.figure(figsize=(10,5))
    plt_.imshow(wordcloud, interpolation="bilinear")
    plt_.axis("off")
#     plt.show()

def remove_links(text):
    text_ = re.sub(r'https?:\/\/.*[\r\n]*', '', text, flags=re.MULTILINE)
    return text_


def get_emojis(text):
    emoji_list = []
    data = regex.findall(r'\X', text)
    for word in data:
        if any(char in emoji.UNICODE_EMOJI for char in word):
            emoji_list.append(word)

    return emoji_list


def get_hashtags(text):
    patter = re.compile(r"#(\w+)")
    all_hashtags = [f"#{i}" for i in patter.findall(text)]
    return all_hashtags

def get_mentions(text):
    patter = re.compile(r"@(\w+)")
    all_hashtags = [f"@{i}" for i in patter.findall(text)]
    return all_hashtags

def remove_special_characters(text):
    punctuation = string.punctuation+"¡"
    text = re.sub(f"[{punctuation}]", '', text)
    return text

def remove_repeated_word(text):
    tokens = nltk.word_tokenize(" ".join(data3['text']))


def remove_stopwords(text):
    tokens = nltk.word_tokenize(text)
    tokens = [token.strip() for token in tokens]
    filtered_tokens = [token for token in tokens if token.lower() not in stop_words]
    filtered_text = " ".join(filtered_tokens)
    return filtered_text

def clean_df(df):
    df['text'] = df['text'].apply(lambda x: x.replace('#', ''))
    df['text'] = df['text'].apply(lambda x: x.replace('@', ''))
```

```
data = pd.read_csv('data_tweets_model.csv')
```

```
print(data.shape)
data.head(3)
```

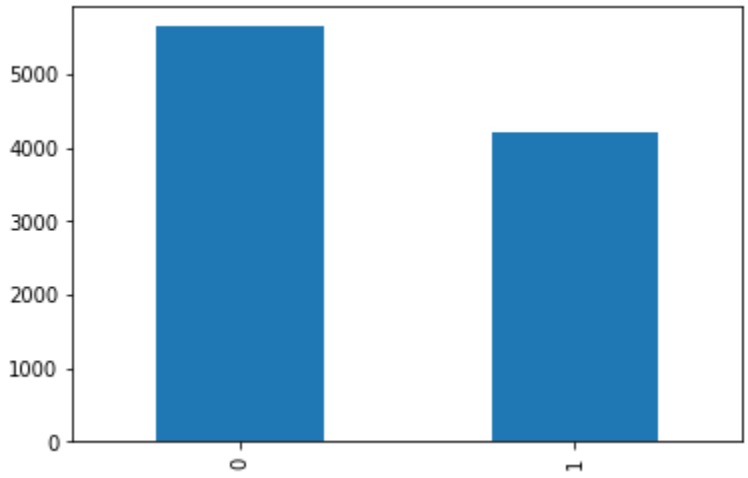
```
(9846, 34)
```

	created_at	status_id	user_id	screen_name	text	source	repl
0	2020-03-29 00:00:37	1244051801516711938	803282972317204480	redcomunitariat	Este lunes estaremos hablando sobre la situaci...	Twitter for iPhone	
1	2020-03-29 00:01:33	1244052036511051778	2476348920	SebasCamposCol	Aquí con frío🥶 viendo cómo pasa la cuarentena 🕯...	Twitter for Android	
2	2020-03-29 00:02:45	1244052338412847104	239176842	Jonathan_518	Hoy es #sábado, apenas es hora de bañarme y or...	Twitter for iPhone	

```
data['score'] = (data['Positive'] > data['Negative']).apply(lambda x: 0 if x else 1)
```

```
data['score'].value_counts().plot.bar()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd747d8a390>
```




```
def create_wordcloud(text, plt_):
    wordcloud = wc.WordCloud(max_font_size=50,
```

```
    return df
```

```
data_ = data[~data['text'].isnull()].copy()
```

```
data_ = clean_df(data_)
```

```
X_train, X_test, y_train, y_test = train_test_split(data_[['text']], data_['score'], random_state=42
X_train.shape, X_test.shape
```

```
((7374, 1), (2459, 1))
```

```

```

Count based Features

```
X_train['char_count'] = X_train['text'].apply(len)
X_train['word_count'] = X_train['text'].apply(lambda x: len(x.split()))
X_train['word_density'] = X_train['char_count'] / (X_train['word_count']+1)
X_train['punctuation_count'] = X_train['text'].apply(lambda x: len("".join(_ for _ in x if _ in stri
X_train['title_word_count'] = X_train['text'].apply(lambda x: len([wrd for wrd in x.split() if wrd.i
X_train['upper_case_word_count'] = X_train['text'].apply(lambda x: len([wrd for wrd in x.split() if


X_test['char_count'] = X_test['text'].apply(len)
X_test['word_count'] = X_test['text'].apply(lambda x: len(x.split()))
X_test['word_density'] = X_test['char_count'] / (X_test['word_count']+1)
X_test['punctuation_count'] = X_test['text'].apply(lambda x: len("".join(_ for _ in x if _ in string
X_test['title_word_count'] = X_test['text'].apply(lambda x: len([wrd for wrd in x.split() if wrd.ist
X_test['upper_case_word_count'] = X_test['text'].apply(lambda x: len([wrd for wrd in x.split() if wr
```

```
X_train.head()
```

	text	char_count	word_count	word_density	punctuation_count	title_word_coun
6512	AEstaHora otro punto de la ciudad es parte de ...	180	30	5.806452	2	
7717	COVID-19 | Colombia | 24abr2020\nVersión .pdf:...	77	10	7.000000	6	
	Cifras sobre la					

Training a Logistic Model

```
log_reg = LogisticRegression(C=1, random_state=42, solver='liblinear')
```

```
log_reg.fit(X_train.drop(['text'], axis=1), y_train)
predictions = log_reg.predict(X_test.drop(['text'], axis=1))
```

```
log_reg.coef_
```

```
array([[-0.0086319 ,  0.07836795, -0.11171836,  0.03890717, -0.07872397,
         0.01427874]])
```

Model Evaluation

```
print(classification_report(y_test, predictions))
pd.DataFrame(confusion_matrix(y_test, predictions))
```

```
              precision    recall  f1-score   support

           0       0.64      0.78      0.70      1418
           1       0.57      0.39      0.46      1041

    accuracy                           0.62      2459
   macro avg       0.60      0.59      0.58      2459
weighted avg       0.61      0.62      0.60      2459
```

	0	1
0	1110	308
1	633	408

Text Pre-processing and Wrangling

```
nltk.stem.snowball
```

```
<module 'nltk.stem.snowball' from '/usr/local/lib/python3.6/dist-packages/nltk/stem/snowball.py'>
```

```
# ps = nltk.porter.PorterStemmer()
from nltk.stem.snowball import SnowballStemmer
snowball_stemmer = SnowballStemmer('spanish')

# from nltk.stem import PorterStemmer
# porter = PorterStemmer()

def simple_text_preprocessor(document):
    # lower case
    document = str(document).lower()

    # simple porter stemming
    document = ' '.join([snowball_stemmer.stem(word) for word in document.split()])
```

```
    document = ' '.join([word for word in document.split() if word not in stop_words])

    return document

stp = np.vectorize(simple_text_preprocessor)
```

```
X_train['Clean text'] = stp(X_train['text'].values)
X_test['Clean text'] = stp(X_test['text'].values)

X_train.head()
```

	text	char_count	word_count	word_density	punctuation_count	title_word_coun
6512	AEstaHora otro punto de la ciudad es parte de ... COVID-19 |	180	30	5.806452	2	

```

```

```
X_train_metadata = X_train.drop(['text', 'Clean text'], axis=1).reset_index(drop=True)
X_test_metadata = X_test.drop(['text', 'Clean text'], axis=1).reset_index(drop=True)

X_train_metadata.head()
```

	char_count	word_count	word_density	punctuation_count	title_word_count	upper_case_word_cou
0	180	30	5.806452	2	1	
1	77	10	7.000000	6	4	
2	159	23	6.625000	1	2	
3	189	28	6.517241	1	2	
4	53	9	5.300000	1	1	

Adding Bag of Words based Features - 1-grams

```

cv = CountVectorizer(min_df=0.0, max_df=1.0, ngram_range=(1, 1))
X_traincv = cv.fit_transform(X_train['Clean text']).toarray()
X_traincv = pd.DataFrame(X_traincv, columns=cv.get_feature_names())

```

```
X_testcv = cv.transform(X_test['Clean text']).toarray()
X_testcv = pd.DataFrame(X_testcv, columns=cv.get_feature_names())
X_traincv.head()
```

	00	000	0000	0001	000m	002	003	0037	00am	00m	00pm	01	012	015	017	018000	01abr	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

5 rows × 19590 columns

```
X_train_comb = pd.concat([X_train_metadata, X_traincv], axis=1)
X_test_comb = pd.concat([X_test_metadata, X_testcv], axis=1)

X_train_comb.head()
```

	char_count	word_count	word_density	punctuation_count	title_word_count	upper_case_word_cou
0	180	30	5.806452	2	1	
1	77	10	7.000000	6	4	
2	159	23	6.625000	1	2	
3	189	28	6.517241	1	2	
4	53	9	5.300000	1	1	

5 rows × 19596 columns

Model Training and Evaluation

```
log_reg.fit(X_train_comb, y_train)
predictions = log_reg.predict(X_test_comb)

log_reg.coef_
```

```
array([[-0.00091642,  0.06229296, -0.17914691, ..., -0.10746255,
        -0.10746255, -0.10746255]])
```

```
print(classification_report(y_test, predictions))
pd.DataFrame(confusion_matrix(y_test, predictions))
```

```
              precision    recall  f1-score   support

           0       0.79      0.81      0.80      1418
           1       0.73      0.70      0.71      1041

    accuracy                           0.76      2459
   macro avg       0.76      0.76      0.76      2459
weighted avg       0.76      0.76      0.76      2459
```

	0	1
0	1154	264
1	315	726

SVM

```
from sklearn import svm
```

```
svm_m = svm.SVC()
svm_m.fit(X_train_metadata, y_train)

```

```
SVC(C=1.0, break_ties=False, cache_size=200, class_weight=None, coef0=0.0,
    decision_function_shape='ovr', degree=3, gamma='scale', kernel='rbf',
    max_iter=-1, probability=False, random_state=None, shrinking=True,
    tol=0.001, verbose=False)
```

```
predictions = svm_m.predict(X_test_metadata)

```

```
# predictions.
```

```
print(classification_report(y_test, predictions))
pd.DataFrame(confusion_matrix(y_test, predictions))
```

```
              precision    recall  f1-score   support

           0       0.60      0.90      0.72      1418
           1       0.59      0.20      0.30      1041

    accuracy                           0.60      2459
   macro avg       0.60      0.55      0.51      2459
weighted avg       0.60      0.60      0.54      2459
```

	0	1
0	1275	143
1	835	206

```
1
```

Neural network

```
import numpy as np
import pandas as pd
import tensorflow as tf
import matplotlib.pyplot as plt

from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.metrics import confusion_matrix

import nltk
from nltk import word_tokenize
from wordcloud import WordCloud
nltk.download('stopwords')
import re

from tensorflow.keras import regularizers
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.layers import Embedding, Dense, GlobalMaxPooling1D, Dropout
from tensorflow.keras.models import Sequential
from tensorflow.keras import regularizers
from tensorflow.keras.callbacks import EarlyStopping

try:
    tf.set_random_seed(1337)                    # set the random seed for reproducibility
except:
    tf.random.set_seed(1337)                     # NOTE: Newer version of tensorflow uses tf.random.
np.random.seed(1337)                         #       instead of tf.set_random_seed
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

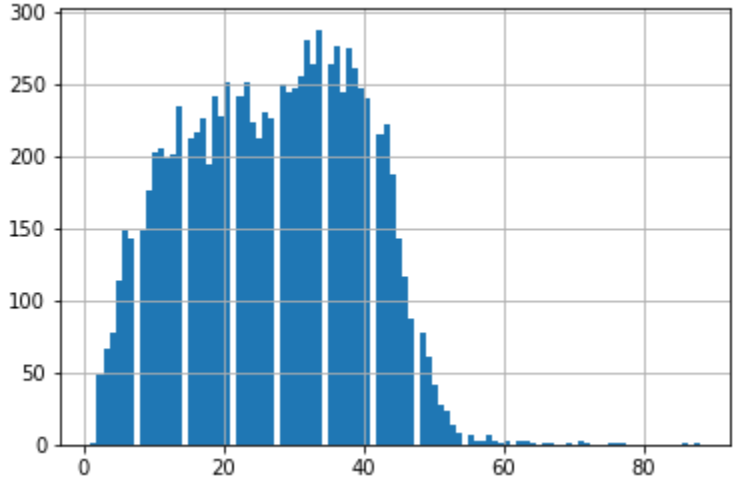
```
def plot_validation_model(hist_):
    history_dict = hist_.history

    acc = history_dict['accuracy']
    val_acc = history_dict['val_accuracy']
    loss=history_dict['loss']
    val_loss=history_dict['val_loss']

    epochs = range(1, len(acc) + 1)

    plt.figure(figsize=(8,6))
    plt.plot(epochs, loss, 'bo', label='Training loss')
    plt.plot(epochs, val_loss, 'b', label='Validation loss')
    plt.title('Training and validation loss')
    plt.xlabel('Epochs')
```

```
    plt.ylabel('Loss')
    plt.legend()
    plt.show()

    plt.figure(figsize=(8,6))
    plt.plot(epochs, acc, 'bo', label='Training acc')
    plt.plot(epochs, val_acc, 'b', label='Validation acc')
    plt.title('Training and validation accuracy')
    plt.xlabel('Epochs')
    plt.ylabel('Accuracy')
    plt.legend(loc='lower right')
    # plt.ylim((0.5,1))
    plt.show()

    acc_ = [(acc[i], val_acc[i]) for i in range(len(acc))]
    acc_.sort(key=lambda x: (x[0], x[1]), reverse=True)
    return acc_[1]
```

```
X_train, X_test, y_train, y_test = train_test_split(data_['text'],
                                                    data_['score'],
                                                    test_size=0.2)
```

```
number_words_per_review = data_['text'].apply(lambda x: len(str(x).split(' ')) if not x in stop_word
number_words_per_review.hist(bins=100)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd7449c16a0>
```




```
perc80np = np.percentile(number_words_per_review, 80)
print(f"Percentil 80th: {perc80np}")
```

```
Percentil 80th: 39.0
```

```
print(len(nltk.word_tokenize(" ".join(X_train)))*0.8)
```

```
181439.2
```

```
tokenizer = Tokenizer(num_words=180000) #We create the tokenizer using only top 20000 words
```

```
tokenizer.fit_on_texts(X_train)  #Then, we create the text->indices mapping.
```

```

```

```
train_sequence = tokenizer.texts_to_sequences(X_train)
test_sequence = tokenizer.texts_to_sequences(X_test)

train_sequences = tf.keras.preprocessing.sequence.pad_sequences(train_sequence, 39)
test_sequences = tf.keras.preprocessing.sequence.pad_sequences(test_sequence, 39)
```

```
model = Sequential()
model.add(Embedding(181700, 128, input_length=39))
model.add(Dense(128, activation='relu'))
model.add(Dense(128, activation='relu'))
model.add(GlobalMaxPooling1D())
model.add(Dense(2, activation='sigmoid'))
model.compile(loss='sparse_categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
```

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 39, 128)           23257600
_________________________________________________________________
dense (Dense)                (None, 39, 128)           16512
_________________________________________________________________
dense_1 (Dense)              (None, 39, 128)           16512
_________________________________________________________________
global_max_pooling1d (Global (None, 128)               0
_________________________________________________________________
dense_2 (Dense)              (None, 2)                 258
=================================================================
Total params: 23,290,882
Trainable params: 23,290,882
Non-trainable params: 0
_________________________________________________________________
```

```
print(train_sequences.shape)
print(y_train.shape)
```

```
(7866, 39)
(7866,)
```

```
history = model.fit(train_sequences, y_train, validation_split=0.2, epochs=10)
```

```
Epoch 1/10
197/197 [==============================] - 43s 220ms/step - loss: 0.6128 - accuracy: 0.6615 - val
Epoch 2/10
197/197 [==============================] - 43s 218ms/step - loss: 0.3992 - accuracy: 0.8249 - val
Epoch 3/10
197/197 [==============================] - 42s 215ms/step - loss: 0.1590 - accuracy: 0.9444 - val
Epoch 4/10
197/197 [==============================] - 43s 218ms/step - loss: 0.0416 - accuracy: 0.9894 - val
Epoch 5/10
197/197 [==============================] - 43s 217ms/step - loss: 0.0167 - accuracy: 0.9963 - val
Epoch 6/10
197/197 [==============================] - 43s 219ms/step - loss: 0.0116 - accuracy: 0.9973 - val
Epoch 7/10
197/197 [==============================] - 42s 214ms/step - loss: 0.0065 - accuracy: 0.9981 - val
Epoch 8/10
```

```
1
```

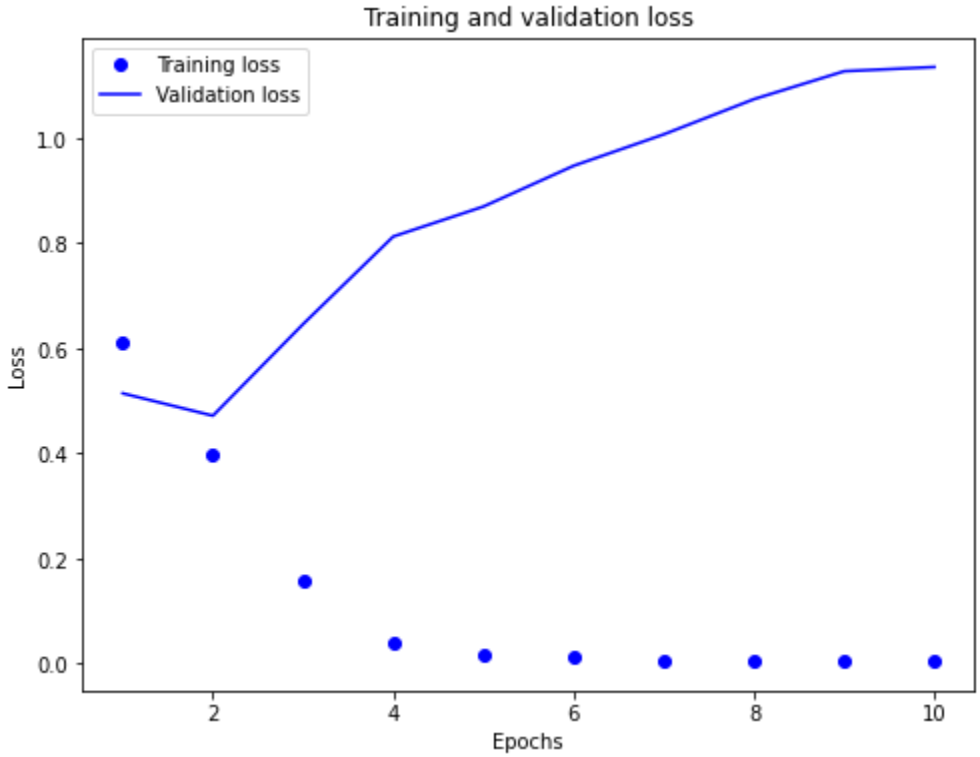
```
Epoch 10/10
```

```
1 plot_validation_model(history)
```


```
model2 = Sequential()
model2.add(Embedding(181700, 128, input_length=39))
model2.add(Dropout(0.2)) # ------------------------->Dropout layer will affect the output of previ
model2.add(Dense(128, activation='relu'))
model2.add(Dense(128, activation='relu'))
model2.add(GlobalMaxPooling1D())
model2.add(Dense(2, activation='sigmoid'))
model2.compile(loss='sparse_categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
history2 = model2.fit(train_sequences, y_train, validation_split=0.2, epochs=10)
```

```
Epoch 1/10
197/197 [==============================] - 44s 222ms/step - loss: 0.6204 - accuracy: 0.6613 - val
Epoch 2/10
197/197 [==============================] - 43s 220ms/step - loss: 0.4304 - accuracy: 0.8001 - val
Epoch 3/10
197/197 [==============================] - 43s 220ms/step - loss: 0.2149 - accuracy: 0.9142 - val
Epoch 4/10
197/197 [==============================] - 43s 220ms/step - loss: 0.0741 - accuracy: 0.9762 - val
Epoch 5/10
197/197 [==============================] - 44s 221ms/step - loss: 0.0265 - accuracy: 0.9936 - val
Epoch 6/10
197/197 [==============================] - 43s 220ms/step - loss: 0.0121 - accuracy: 0.9975 - val
Epoch 7/10
197/197 [==============================] - 43s 219ms/step - loss: 0.0073 - accuracy: 0.9984 - val
Epoch 8/10
197/197 [==============================] - 44s 221ms/step - loss: 0.0084 - accuracy: 0.9983 - val
Epoch 9/10
197/197 [==============================] - 43s 220ms/step - loss: 0.0064 - accuracy: 0.9986 - val
Epoch 10/10
197/197 [==============================] - 43s 221ms/step - loss: 0.0053 - accuracy: 0.9987 - val
```

```
plot_validation_model(history)
```

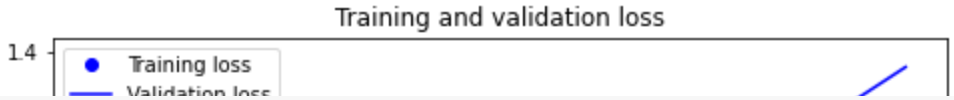



```
model3 = Sequential()
model3.add(Embedding(80000, 128, input_length=39))
model3.add(Dropout(0.2)) # ------------------------->Dropout layer will affect the output of previ
model3.add(Dense(128, activation='relu'))
model3.add(Dropout(0.2))
model3.add(Dense(128, activation='relu'))
model3.add(Dropout(0.2))
model3.add(GlobalMaxPooling1D())
model3.add(Dense(2, activation='sigmoid'))
model3.compile(loss='sparse_categorical_crossentropy', optimizer='adam', metrics=['accuracy'])

```

```
history3 = model3.fit(train_sequences, y_train, validation_split=0.2, epochs=10)

```

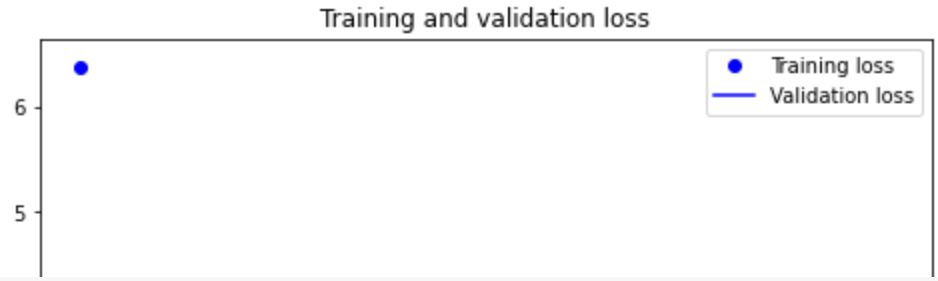
```
Epoch 1/10
197/197 [==============================] - 23s 117ms/step - loss: 0.6297 - accuracy: 0.6435 - val
Epoch 2/10
197/197 [==============================] - 23s 114ms/step - loss: 0.4679 - accuracy: 0.7748 - val
Epoch 3/10
197/197 [==============================] - 23s 115ms/step - loss: 0.2696 - accuracy: 0.8908 - val
Epoch 4/10
197/197 [==============================] - 23s 115ms/step - loss: 0.1243 - accuracy: 0.9572 - val
Epoch 5/10
197/197 [==============================] - 23s 115ms/step - loss: 0.0529 - accuracy: 0.9828 - val
Epoch 6/10
197/197 [==============================] - 23s 115ms/step - loss: 0.0239 - accuracy: 0.9925 - val
```

```
1 plot_validation_model(history3)
```



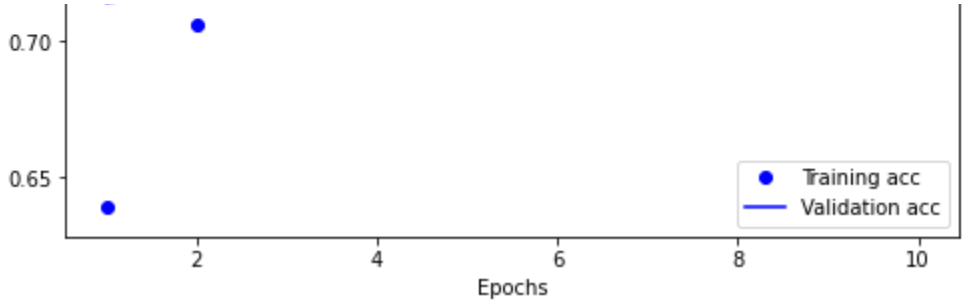

```
c = 1/10000
print(f"Lambda: {c}")

model7 = Sequential()
model7.add(Embedding(180000, 128, input_length=39, embeddings_regularizer=regularizers.l1(c)))
model7.add(Dense(128, activation='relu', activity_regularizer=regularizers.l2(c)))
model7.add(Dense(128, activation='relu', activity_regularizer=regularizers.l2(c)))
model7.add(GlobalMaxPooling1D())
model7.add(Dense(2, activation='sigmoid'))
model7.compile(loss='sparse_categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
history7 = model7.fit(train_sequences, y_train, validation_split=0.2, epochs=10)
plot_validation_model(history7)

```

```
Lambda: 0.0001
Epoch 1/10
/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/indexed_slices.py:432: UserWar
  "Converting sparse IndexedSlices to a dense Tensor of unknown shape. "
197/197 [==============================] - 43s 219ms/step - loss: 6.3699 - accuracy: 0.6392 - val
Epoch 2/10
197/197 [==============================] - 43s 218ms/step - loss: 0.8904 - accuracy: 0.7061 - val
Epoch 3/10
197/197 [==============================] - 43s 219ms/step - loss: 0.8771 - accuracy: 0.7287 - val
Epoch 4/10
197/197 [==============================] - 43s 219ms/step - loss: 0.8653 - accuracy: 0.7455 - val
Epoch 5/10
197/197 [==============================] - 43s 218ms/step - loss: 0.8623 - accuracy: 0.7665 - val
Epoch 6/10
197/197 [==============================] - 43s 217ms/step - loss: 0.8507 - accuracy: 0.7832 - val
Epoch 7/10
197/197 [==============================] - 43s 219ms/step - loss: 0.8301 - accuracy: 0.8047 - val
Epoch 8/10
197/197 [==============================] - 44s 221ms/step - loss: 0.7970 - accuracy: 0.8242 - val
Epoch 9/10
197/197 [==============================] - 43s 218ms/step - loss: 0.7659 - accuracy: 0.8396 - val
Epoch 10/10
197/197 [==============================] - 43s 217ms/step - loss: 0.7300 - accuracy: 0.8566 - val
```




```
c = 1/100000
print(f"Lambda: {c}")

model8 = Sequential()
model8.add(Embedding(180000, 128, input_length=39, embeddings_regularizer=regularizers.l1(c)))
model8.add(Dense(128, activation='relu', activity_regularizer=regularizers.l2(c)))
model8.add(Dense(128, activation='relu', activity_regularizer=regularizers.l2(c)))
model8.add(GlobalMaxPooling1D())
model8.add(Dense(2, activation='sigmoid'))
model8.compile(loss='sparse_categorical_crossentropy', optimizer='adam', metrics=['accuracy'])

callbacks_ = [
    tf.keras.callbacks.EarlyStopping(
            monitor='val_loss', min_delta=0, patience=3, verbose=0, mode='auto',
            baseline=None, restore_best_weights=False
            )
]

history8 = model8.fit(train_sequences, y_train, validation_split=0.2, epochs=10, callbacks=callbacks
plot_validation_model(history8)
```

```

```




```
(0.8396376371383667, 0.761753499507904)
```