```
from google.colab import drive
drive.mount('/content/gdrive')
```

```
     Mounted at /content/gdrive
```

```
import pandas as pd
import numpy as np
import bz2
import re
import matplotlib.pyplot as plt
import seaborn as sns
from tqdm import tqdm
from sklearn.utils import shuffle
from tqdm import tqdm
from keras.layers import *
from keras.models import Model
from keras.preprocessing.text import Tokenizer
from keras.preprocessing.sequence import pad_sequences
```

```
data1 = bz2.BZ2File('/content/gdrive/MyDrive/train.ft.txt.bz2')
```

```
data1 = data1.readlines()
```

```
data = [x.decode('utf-8') for x in data1]
```

```
data = data[:200000]
```

```
train_labels = [0 if x.split(' ')[0] == '__label__1' else 1 for x in data]
train_sentences = [x.split(' ', 1)[1][:-1].lower() for x in data]
```

```
for i in range(len(train_sentences)):
    if 'www.' in train_sentences[i] or 'http:' in train_sentences[i] or 'https:' in train_
        train_sentences[i] = re.sub(r"([^ ]+(?<=\.[a-z]{3}))", "<url>", train_sentences[i]
```

```
data = pd.DataFrame(train_sentences, columns = ['review'])
data.head()
```

	review
0	stuning even for the non-gamer: this sound tra...
1	the best soundtrack ever to anything.: i'm rea...
2	amazing!: this soundtrack is my favorite music...
3	excellent soundtrack: i truly like this soundt...
4	remember, pull your jaw off the floor after he...

```
data['score'] = train_labels
data.head()
```

	review	score
0	stuning even for the non-gamer: this sound tra...	1
1	the best soundtrack ever to anything.: i'm rea...	1
2	amazing!: this soundtrack is my favorite music...	1
3	excellent soundtrack: i truly like this soundt...	1
4	remember, pull your jaw off the floor after he...	1

```
# De algemene info over de dataset
data.describe()
```

	score
count	200000.000000
mean	0.505830
std	0.499967
min	0.000000
25%	0.000000
50%	1.000000
75%	1.000000
max	1.000000

```
# De dimensies van de dataset
data.shape
```

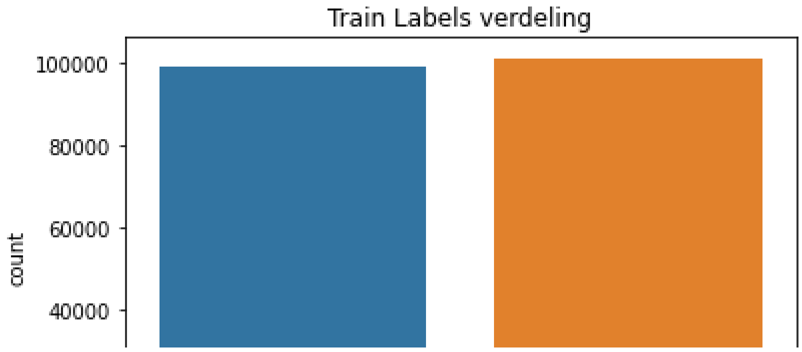
```
(200000, 2)
```

```
# Het aantal records
data.count()
```

```
review    200000
score     200000
dtype: int64
```

```
sns.countplot(train_labels)
plt.title('Train Labels verdeling')
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pas
  FutureWarning
Text(0.5, 1.0, 'Train Labels verdeling')
```



```
data['word_count'] = data['review'].apply(lambda x : len(x.split()))
data['char_count'] = data['review'].apply(lambda x : len(x.replace(" ","")))
data['word_density'] = data['word_count'] / (data['char_count'] + 1)
```

```
data.head()
```

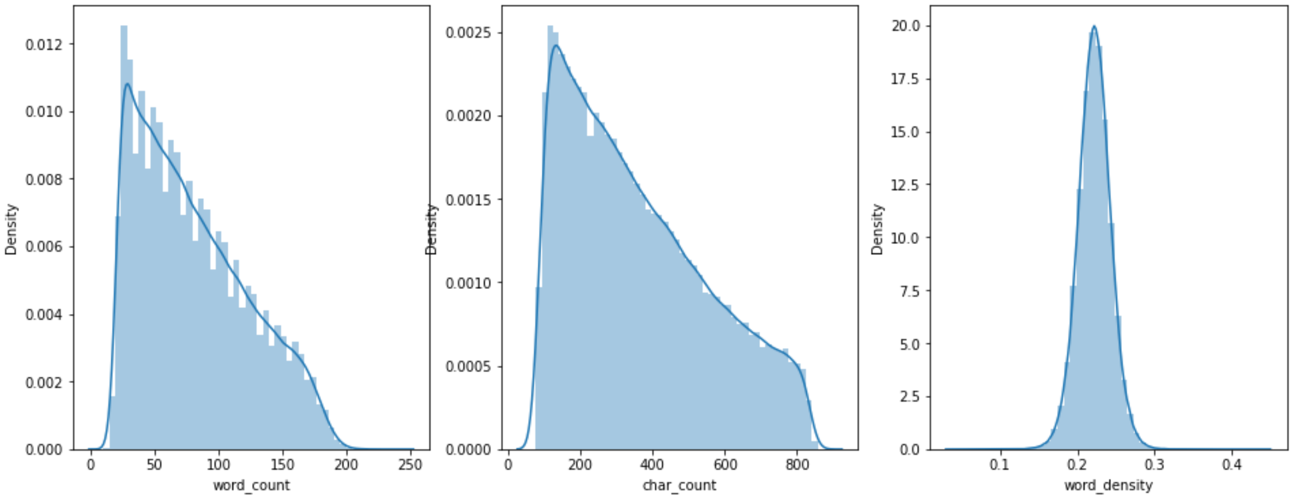
	review	score	word_count	char_count	word_density
0	stuning even for the non-gamer: this sound tra...	1	80	347	0.229885
1	the best soundtrack ever to anything.: i'm rea...	1	97	413	0.234300
2	amazing!: this soundtrack is my favorite music...	1	129	632	0.203791
	excellent soundtrack: i truly like this				

```
data.describe()
```

	score	word_count	char_count	word_density
count	200000.000000	200000.000000	200000.000000	200000.000000
mean	0.505830	80.092535	361.827595	0.222160
std	0.499967	43.251276	197.531975	0.021086
min	0.000000	10.000000	78.000000	0.035294
25%	0.000000	44.000000	194.000000	0.208556
50%	1.000000	72.000000	323.000000	0.222222
75%	1.000000	111.000000	500.000000	0.235669
max	1.000000	241.000000	873.000000	0.444444

```
fig, ax = plt.subplots(1, 3, figsize=(16, 6))
dp=sns.distplot(data['word_count'],ax=ax[0])
dp=sns.distplot(data['char_count'],ax=ax[1])
dp=sns.distplot(data['word_density'],ax=ax[2])
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2557: FutureWarning:
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2557: FutureWarning:
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2557: FutureWarning:
  warnings.warn(msg, FutureWarning)
```



```
# Het verwijderen van de stopwoorden
import nltk
nltk.download('stopwords')
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
import string
nltk.download('punkt')

def verwijderStopwoorden(text):
    stopwoorden = set(stopwords.words('english'))
    tokens = word_tokenize(text.lower())
    result = [x for x in tokens if x not in stopwoorden]
    seperator = ' '
    return seperator.join(result)

data['review'] = data['review'].map(verwijderStopwoorden)
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
```

```
data['review'].head()
```

```
0    stuning even non-gamer : sound track beautiful...
1    best soundtrack ever anything . : 'm reading l...
2    amazing ! : soundtrack favorite music time , h...
```

```
     3    excellent soundtrack : truly like soundtrack e...
     4    remember , pull jaw floor hearing : 've played...
     Name: review, dtype: object
```

```
dataRF = data
```

```
dataRF = dataRF.drop(['word_count', 'char_count','word_density'], axis=1)
```

```
try:
  %tensorflow_version 2.x
except Exception:
  pass

import tensorflow as tf
from tensorflow import keras

print(tf.__version__)

import numpy as np
import matplotlib.pyplot as plt
import sklearn as sk
import pandas as pd

seed = 2020
np.random.seed(seed)

import sklearn as sk
from sklearn.model_selection import train_test_split

from tensorflow.keras.datasets import mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Flatten, Embedding, Conv1D,  MaxPoolin
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.constraints import max_norm
from tensorflow.keras.models import load_model


import nltk
```

```
     2.4.1
```

```
def plot_history(history):
  plt.figure(figsize = (12,4))
  plt.subplot(1,2,1)

  plt.xlabel('Epoch')
  plt.ylabel('Nauwkeurigheid')
  plt.plot(history.epoch, np.array(history.history['accuracy']),'g-',
           label='Train dataset nauwkeurigheid')
  plt.plot(history.epoch, np.array(history.history['val_accuracy']),'r-',
           label = 'Validatie dataset nauwkeurigheid')
  plt.legend()
  plt.subplot(1,2,2)
  plt.xlabel('Epoch')
  plt.ylabel('Verlies')
  plt.plot(history.epoch, np.array(history.history['loss']),'g-',
           label='Train dataset verlies')
  plt.plot(history.epoch, np.array(history.history['val_loss']),'r-',
           label = 'Validatie dataset verlies')
  plt.legend()
```

```
# De lengte van de woorden in een nieuwe kolom
dataRF['numberOfWords'] = dataRF.review.str.split().apply(len)
dataRF.head()
```

	review	score	numberOfWords
0	stuning even non-gamer : sound track beautiful...	1	51
1	best soundtrack ever anything . : 'm reading l...	1	58
2	amazing ! : soundtrack favorite music time , h...	1	108
3	excellent soundtrack : truly like soundtrack e...	1	101
4	remember , pull jaw floor hearing : 've played...	1	68

```
dataRF['numberOfWords'].describe()
```

```
count    200000.000000
mean         53.914610
std          28.933542
min           7.000000
25%          30.000000
50%          48.000000
75%          74.000000
max         433.000000
Name: numberOfWords, dtype: float64
```

```
# Een training dataset opzetten
from sklearn.model_selection import train_test_split
X = dataRF.drop(['score','numberOfWords'],axis=1)
y = dataRF['score']
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.30)

X_train = np.asarray(X_train)
X_test = np.asarray(X_test)
```

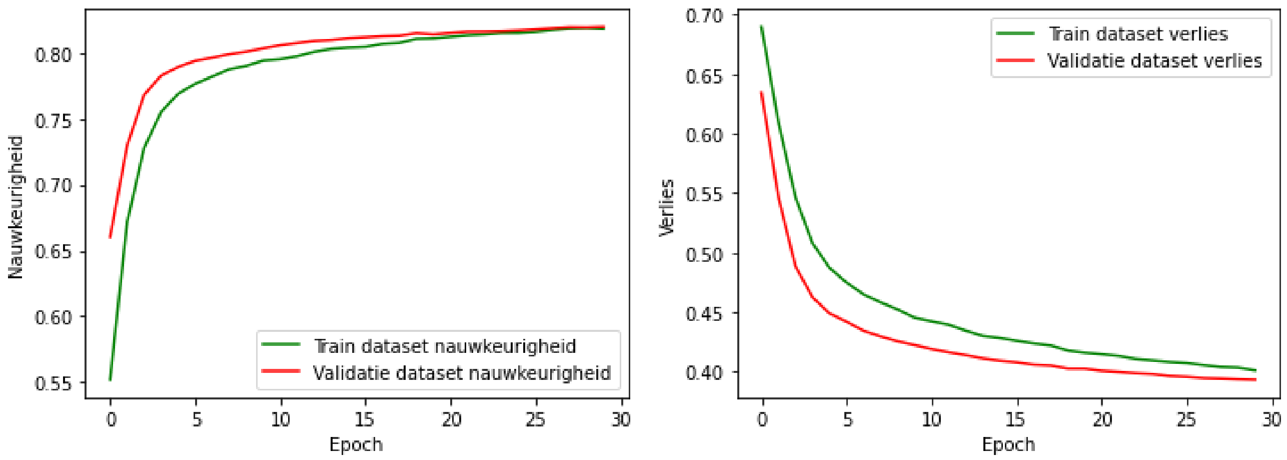
```
num_classes = 2
#De methode utils.to_categorical zet vectors om in binaire matrices
#De scores (0 of 1) worden omgezet naar een binaire matrix. Het aantal klassen is
#twee omdat er twee opties zijn: positief of negatief
y_train = keras.utils.to_categorical(y_train, num_classes)
y_test = keras.utils.to_categorical(y_test, num_classes)
```

```
from tensorflow.keras.layers.experimental.preprocessing import TextVectorization
#TextVectorization zet een lijst van strings om in een lijst van tokens
vectorizer = TextVectorization(max_tokens=20000, output_sequence_length=20)
text_ds = tf.data.Dataset.from_tensor_slices(X_train).batch(128)
vectorizer.adapt(text_ds)


voc = vectorizer.get_vocabulary()
word_index = dict(zip(voc, range(len(voc))))


#Glove staat voor Global Vector
glove_file = '/content/gdrive/My Drive/glove.6B.100d.txt'

#Glove-files bevatten woord vectors. De file die hier gebruikt wordt, bevat 400.000 vector
embeddings_index = {}
with open(glove_file) as f:
    for line in f:
      values = line.split()
      woord = values[0]
      coefs = np.asarray(values[1:], dtype='float32')
      embeddings_index[woord] = coefs


num_tokens = len(voc) + 2
embedding_dim = 100
missed_words = []

# Een embedding matrix aanmaken
embedding_matrix = np.zeros((num_tokens, embedding_dim))
for word, i in word_index.items():
    embedding_vector = embeddings_index.get(word)
    if embedding_vector is not None:
        embedding_matrix[i] = embedding_vector
    else:
        missed_words.append(word)




num_classes = 2
#Het model initialiseren
def initial_model():
    model = Sequential()

    model.add(Embedding(num_tokens, embedding_dim, embeddings_initializer=keras.initialize
    model.add(Conv1D(16,activation='relu',kernel_size=3))
    model.add(MaxPooling1D(3))
    model.add(Dropout(0.2))

    model.add(Conv1D(16,activation='relu',kernel_size=3))
    model.add(Dropout(0.2))

    model.add(Conv1D(16,activation='relu',kernel_size=3))
    model.add(GlobalMaxPooling1D())
    model.add(Dense(16, activation='relu', kernel_initializer='he_uniform'))
    model.add(Dropout(0.2))
    model.add(Dropout(0.2))
    model.add(Dense(num_classes, activation='softmax'))

#Categorical Crosssentropy berekent het cross-entropie verlies tussen de labels en de voor
#Dit is een optimalisator die het Adam-algoritme implementeert.
    model.compile(loss='categorical_crossentropy',
                  optimizer= tf.keras.optimizers.Adam(learning_rate = 0.0001),
                  metrics=['accuracy'])
    return model


#Het model verwacht een array, dus dit wordt hier omgezet
X_train_final = vectorizer(np.array([s for s in X_train])).numpy()
X_test_final = vectorizer(np.array([s for s in X_test])).numpy()

y_train_final = np.array(y_train)
y_test_final = np.array(y_test)


model_1 = initial_model()
model_1.summary()
batch_size = 128
epochs = 30

history_1 = model_1.fit(X_train_final, y_train_final,
                    batch_size=batch_size,
                    epochs=epochs,
                    verbose=1,
                    validation_data=(X_test_final, y_test_final)
                    )
```

```
Total params: 2,006,890
Trainable params: 6,690
Non-trainable params: 2,000,200
_________________________________________________________________
Epoch 1/30
1094/1094 [==============================] - 14s 12ms/step - loss: 0.7144 - accura
Epoch 2/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.6293 - accura
Epoch 3/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.5611 - accura
Epoch 4/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.5131 - accura
Epoch 5/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4926 - accura
Epoch 6/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4749 - accura
Epoch 7/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4654 - accura
Epoch 8/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4570 - accura
Epoch 9/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4544 - accura
Epoch 10/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4468 - accura
Epoch 11/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4456 - accura
Epoch 12/30
Epoch 12/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4400 - accura
Epoch 13/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4356 - accura
Epoch 14/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4315 - accura
Epoch 15/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4279 - accura
Epoch 16/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4252 - accura
Epoch 17/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4221 - accura
Epoch 18/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4219 - accura
Epoch 19/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4211 - accura
Epoch 20/30
1094/1094 [==============================] - 13s 12ms/step - loss: 0.4142 - accura
Epoch 21/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4173 - accura
Epoch 22/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4142 - accura
Epoch 23/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4096 - accura
Epoch 24/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4096 - accura
Epoch 25/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4104 - accura
Epoch 26/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4078 - accura
Epoch 27/30
1094/1094 [==============================] - 12s 11ms/step - loss: 0.4076 - accura
Epoch 28/30
```

```
#De resultaten visualiseren
[train_loss, train_accuracy] = model_1.evaluate(X_train_final, y_train_final, verbose=0)
print("Nauwkeurigheid training dataset:{:7.2f}".format(train_accuracy))
[val_loss, val_accuracy] = model_1.evaluate(X_test_final, y_test_final, verbose=0)
print("Nauwkeurigheid test dataset:{:7.2f}".format(val_accuracy))
plot_history(history_1)
```

```
Nauwkeurigheid training dataset:   0.83
Nauwkeurigheid test dataset:   0.82
```


Nauwkeurigheid
Epoch
Train dataset nauwkeurigheid
Validatie dataset nauwkeurigheid
Verlies
Train dataset verlies
Validatie dataset verlies