In [56]:
```
import numpy as np
from nltk.tokenize import RegexpTokenizer
from keras.models import Sequential
from keras.layers import LSTM, Dense, Activation, Embedding
from keras.optimizers import RMSprop
from keras.callbacks import EarlyStopping
import matplotlib.pyplot as plt
import pickle
from keras.layers import Dropout
from tensorflow.keras import regularizers
```

In [19]:
```
path = '1661-0.txt'  # your file
with open(path, encoding='utf-8', errors='ignore') as f:
    text = f.read().lower()

print('corpus length:', len(text))
```

```
corpus length: 581888
```

In [20]:
```
tokenizer = RegexpTokenizer(r'\w+')
words = tokenizer.tokenize(text)
print('Total words:', len(words))
```

```
Total words: 109226
```

In [21]:
```
unique_words = np.unique(words)
unique_word_index = dict((c, i) for i, c in enumerate(unique_words))
```

In [22]:
```
WORD_LENGTH = 5  # sequence length
prev_words = []
next_words = []

for i in range(len(words) - WORD_LENGTH):
    prev_words.append(words[i:i + WORD_LENGTH])
    next_words.append(words[i + WORD_LENGTH])

print('Example input sequence:', prev_words[0])
print('Example target word:', next_words[0])
```

```
Example input sequence: ['project', 'gutenberg', 's', 'the', 'adventures']
Example target word: of
```

In [23]:
```
vocab = sorted(list(set(words)))
word_to_index = {w: i for i, w in enumerate(vocab)}
index_to_word = {i: w for i, w in enumerate(vocab)}
vocab_size = len(vocab)
print('Vocabulary size:', vocab_size)
```

```
Vocabulary size: 8201
```

In [24]:
```
X = np.zeros((len(prev_words), WORD_LENGTH), dtype=np.int32)
Y = np.zeros((len(prev_words), vocab_size), dtype=np.bool_)

for i, seq in enumerate(prev_words):
    X[i] = [word_to_index[w] for w in seq]
    Y[i, word_to_index[next_words[i]]] = 1
```

In [92]:
```
model = Sequential()
model.add(Embedding(input_dim=vocab_size, output_dim=50, input_length=WORD_LENGT
```

```
model.add(LSTM(64, dropout=0.2, recurrent_dropout=0.2))  # dropout added
model.add(Dense(vocab_size))
#model.add(Dense(vocab_size, kernel_regularizer=regularizers.l2(0.0005)))
model.add(Activation('softmax'))
```

In [93]:
```
optimizer = RMSprop(learning_rate=0.001)
model.compile(loss='categorical_crossentropy', optimizer=optimizer, metrics=['ac
model.summary()
```

Model: "sequential_8"

Layer (type)	Output Shape	
embedding_7 (Embedding)	?	
lstm_8 (LSTM)	?	
dense_11 (Dense)	?	
activation_8 (Activation)	?	

Total params: 0 (0.00 B)

Trainable params: 0 (0.00 B)

Non-trainable params: 0 (0.00 B)

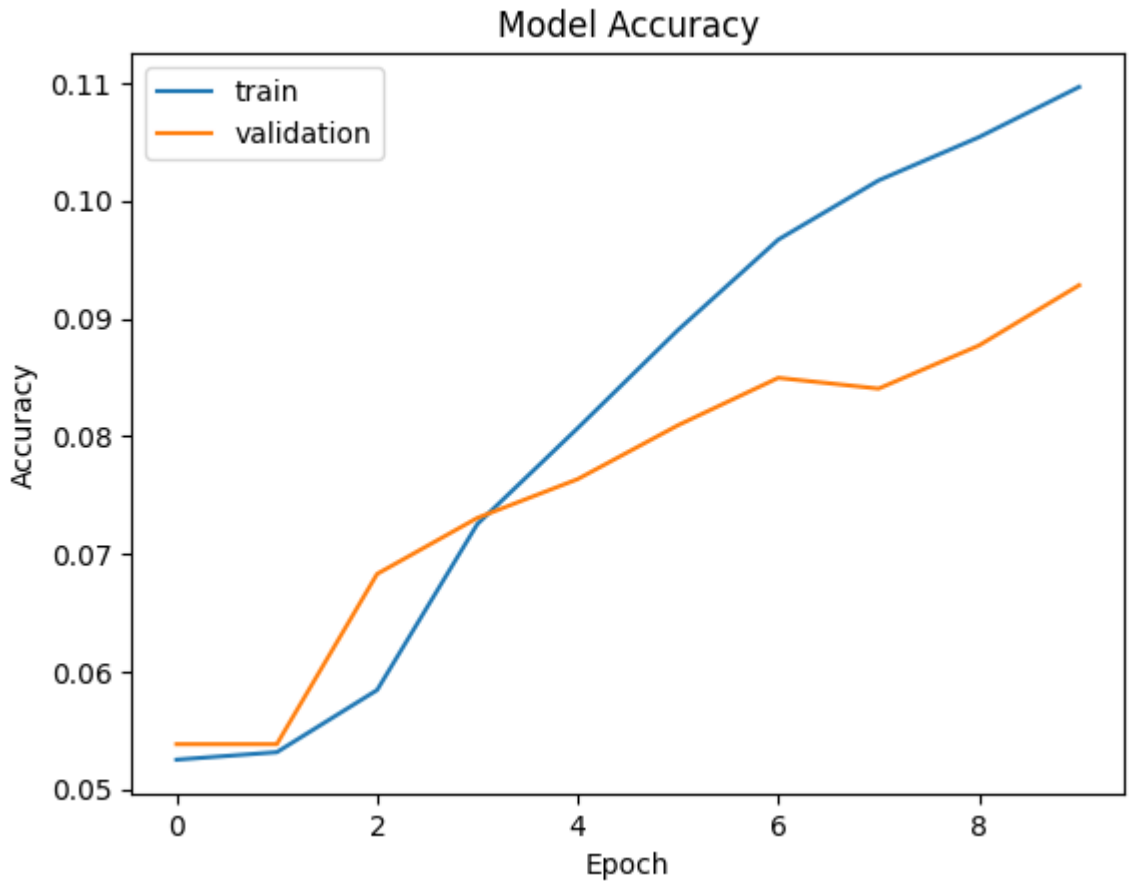
In [94]:
```
early_stop = EarlyStopping(monitor='val_loss', patience=5, restore_best_weights=

history = model.fit(
    X, Y,
    validation_split=0.05,
    batch_size=128,
    epochs=10,
    shuffle=True,
    callbacks=[early_stop]
).history
```

```
Epoch 1/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 39s 39ms/step - accuracy: 0.0503 - loss: 7.3208 - va
l_accuracy: 0.0538 - val_loss: 7.2610
Epoch 2/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 31s 38ms/step - accuracy: 0.0528 - loss: 6.5044 - va
l_accuracy: 0.0538 - val_loss: 7.1975
Epoch 3/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 40s 38ms/step - accuracy: 0.0548 - loss: 6.3380 - va
l_accuracy: 0.0683 - val_loss: 7.1117
Epoch 4/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 41s 38ms/step - accuracy: 0.0712 - loss: 6.2040 - va
l_accuracy: 0.0731 - val_loss: 7.0120
Epoch 5/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 32s 39ms/step - accuracy: 0.0782 - loss: 6.0858 - va
l_accuracy: 0.0763 - val_loss: 6.9431
Epoch 6/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 32s 40ms/step - accuracy: 0.0885 - loss: 6.0279 - va
l_accuracy: 0.0809 - val_loss: 6.9276
Epoch 7/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 41s 40ms/step - accuracy: 0.0949 - loss: 5.9853 - va
l_accuracy: 0.0850 - val_loss: 6.9002
Epoch 8/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 41s 40ms/step - accuracy: 0.1006 - loss: 5.9112 - va
l_accuracy: 0.0840 - val_loss: 6.8808
Epoch 9/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 39s 38ms/step - accuracy: 0.1053 - loss: 5.8877 - va
l_accuracy: 0.0877 - val_loss: 6.8359
Epoch 10/10
811/811 ━━━━━━━━━━━━━━━━━━━━ 33s 41ms/step - accuracy: 0.1087 - loss: 5.8237 - va
l_accuracy: 0.0928 - val_loss: 6.8361
```

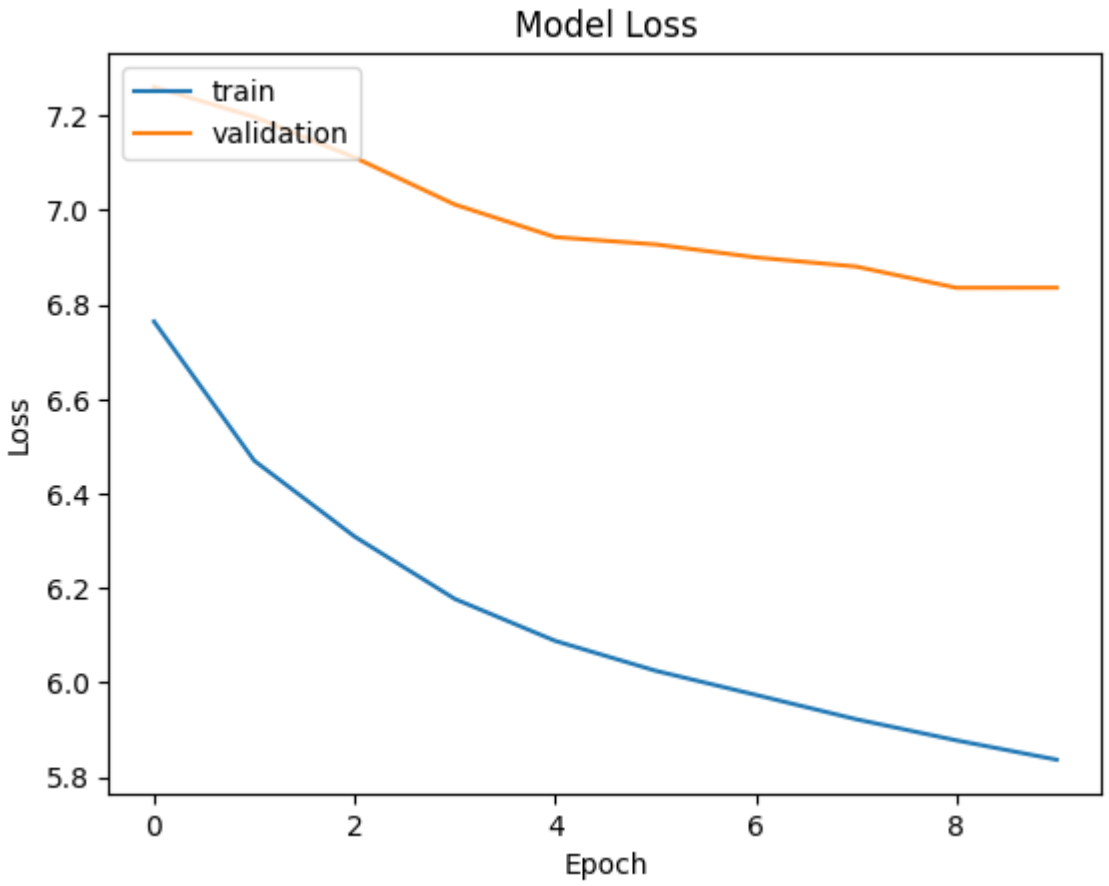
In [95]:
```
model.save('keras_next_word_model.h5')
pickle.dump(history, open("history.p", "wb"))
```

```
WARNING:absl:You are saving your model as an HDF5 file via `model.save()` or `ker
as.saving.save_model(model)`. This file format is considered legacy. We recommend
using instead the native Keras format, e.g. `model.save('my_model.keras')` or `ke
ras.saving.save_model(model, 'my_model.keras')`.
```

In [96]:
```
plt.plot(history['accuracy'])
plt.plot(history['val_accuracy'])
plt.title('Model Accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['train', 'validation'], loc='upper left')
plt.show()
```



In [97]:
```
plt.plot(history['loss'])
plt.plot(history['val_loss'])
plt.title('Model Loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['train', 'validation'], loc='upper left')
plt.show()
```



In [102…

```
def prepare_input(text):
    x = np.zeros((1, SEQUENCE_LENGTH, len(chars)))
    for t, char in enumerate(text):
        x[0, t, char_indices[char]] = 1.

    return x
```

In [108…

```
def predict_next_word_sampling(model, word_to_index, index_to_word, seed_text, W
    token_list = seed_text.lower().split()[-WORD_LENGTH:]
    X_pred = np.zeros((1, WORD_LENGTH), dtype=np.int32)
    for i, w in enumerate(token_list):
        X_pred[0, i] = word_to_index.get(w, 0)

    predicted_probs = model.predict(X_pred, verbose=0)[0]
    predicted_probs = np.log(predicted_probs + 1e-8) / temperature
    exp_preds = np.exp(predicted_probs)
    predicted_probs = exp_preds / np.sum(exp_preds)

    next_index = np.random.choice(len(predicted_probs), p=predicted_probs)
    return index_to_word[next_index]
```

In [109…

```
seed_text = "the adventures of sherlock"
next_word = predict_next_word(model, None, seed_text, word_to_index, index_to_wo
print(f"Seed text: '{seed_text}' → Predicted next word: '{next_word}'")
```

```
Seed text: 'the adventures of sherlock' → Predicted next word: 'and'
```