

5. Create an RNN-based sentiment analysis system to classify text reviews (such as movie reviews or product reviews) into positive, negative, or neutral sentiments. Use datasets containing labeled text data for training and testing the model's accuracy in sentiment classification.

IMDB dataset from `tensorflow.keras.datasets` used.

```
In [81]: import numpy as np
import tensorflow as tf
from tensorflow.keras import Sequential # type: ignore
from tensorflow.keras.layers import Dense, Embedding, SimpleRNN, Dropout, LSTM, Bidirectional # type: ignore
from tensorflow.keras.datasets import imdb # type: ignore
from tensorflow.keras.preprocessing.sequence import pad_sequences # type: ignore
```

```
In [82]: max_words = 10000
max_len = 200
```

```
In [83]: (X_train, y_train), (X_test, y_test) = imdb.load_data(num_words=max_words)
```

```
In [84]: X_train = pad_sequences(X_train, maxlen=max_len)
X_test = pad_sequences(X_test, maxlen=max_len)
```

```
In [85]: model = Sequential([
    Embedding(input_dim=max_words, output_dim=128, input_length=max_len),
    Bidirectional(LSTM(8, return_sequences=False)),
    # SimpleRNN(64, activation='relu'),
    # Dropout(0.5),
    Dense(64, activation='relu'),
    Dense(1, activation='sigmoid')
])
```

```
In [86]: model.compile(
    optimizer='adam',
    loss='binary_crossentropy',
    metrics=['accuracy']
)
```

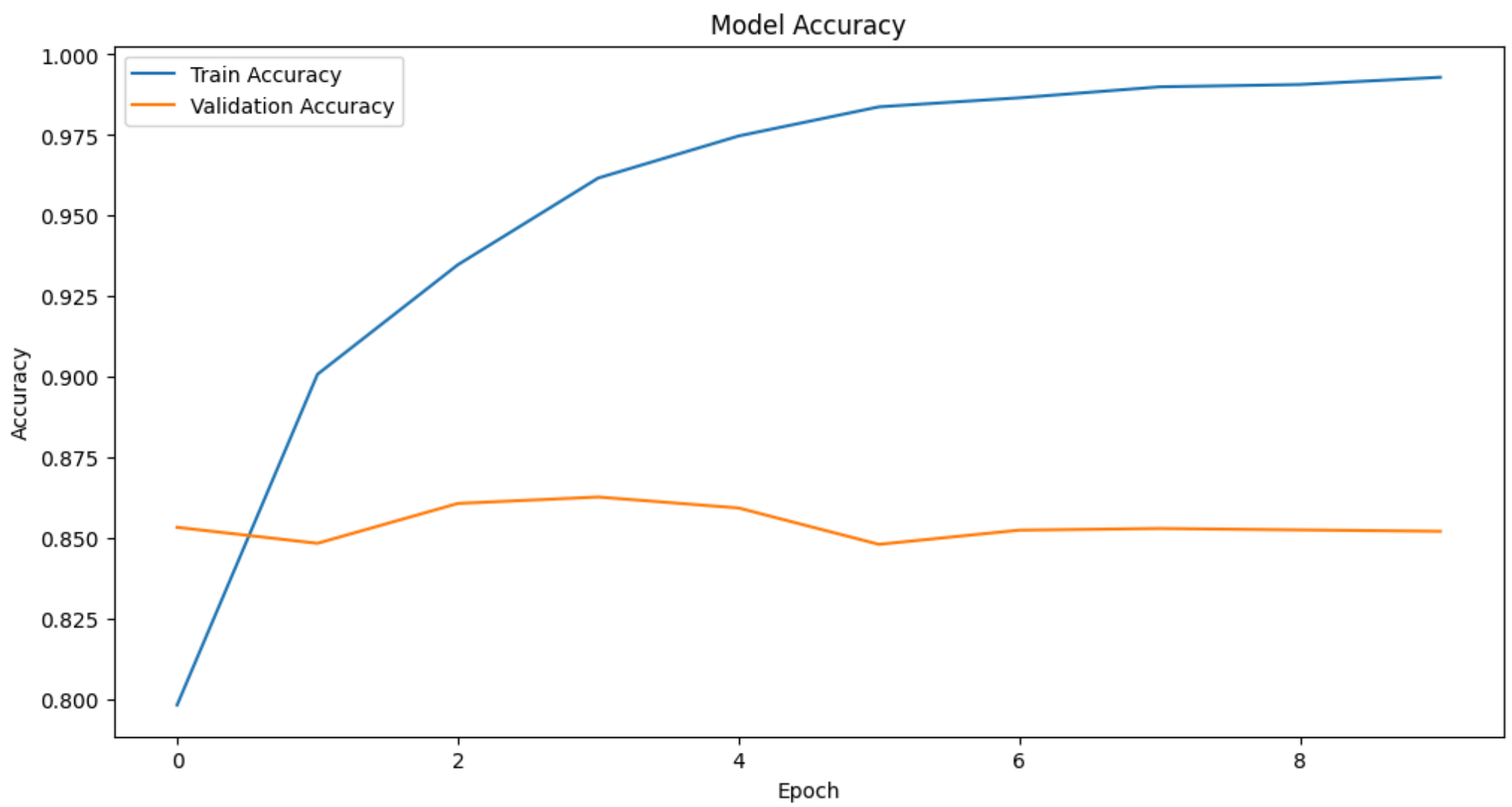
```
In [87]: history = model.fit(
    X_train, y_train,
    epochs=10,
    batch_size=64,
    validation_data=(X_test, y_test)
)
```

```
Epoch 1/10
391/391 [=====] - 34s 79ms/step - loss: 0.4394 - accuracy: 0.7983 - val_loss: 0.3526 - val_accuracy: 0.8534
Epoch 2/10
391/391 [=====] - 30s 77ms/step - loss: 0.2610 - accuracy: 0.9008 - val_loss: 0.3823 - val_accuracy: 0.8484
Epoch 3/10
391/391 [=====] - 30s 76ms/step - loss: 0.1805 - accuracy: 0.9348 - val_loss: 0.3493 - val_accuracy: 0.8608
Epoch 4/10
391/391 [=====] - 33s 85ms/step - loss: 0.1157 - accuracy: 0.9617 - val_loss: 0.4012 - val_accuracy: 0.8628
Epoch 5/10
391/391 [=====] - 34s 87ms/step - loss: 0.0781 - accuracy: 0.9747 - val_loss: 0.5124 - val_accuracy: 0.8594
Epoch 6/10
391/391 [=====] - 34s 87ms/step - loss: 0.0521 - accuracy: 0.9838 - val_loss: 0.5502 - val_accuracy: 0.8481
Epoch 7/10
391/391 [=====] - 33s 84ms/step - loss: 0.0400 - accuracy: 0.9866 - val_loss: 0.6300 - val_accuracy: 0.8525
Epoch 8/10
391/391 [=====] - 30s 76ms/step - loss: 0.0330 - accuracy: 0.9900 - val_loss: 0.6416 - val_accuracy: 0.8530
Epoch 9/10
391/391 [=====] - 30s 77ms/step - loss: 0.0321 - accuracy: 0.9907 - val_loss: 0.6172 - val_accuracy: 0.8526
Epoch 10/10
391/391 [=====] - 29s 74ms/step - loss: 0.0234 - accuracy: 0.9929 - val_loss: 0.7148 - val_accuracy: 0.8522
```

```
In [88]: test_loss, test_accuracy = model.evaluate(X_test, y_test)
print(f"Test Accuracy: {test_accuracy*100:.2f}%")
print(f"Test Loss: {test_loss}")
```

```
782/782 [=====] - 8s 10ms/step - loss: 0.7148 - accuracy: 0.8522
Test Accuracy: 85.22%
Test Loss: 0.7147612571716309
```

```
In [89]: import matplotlib.pyplot as plt
plt.figure(figsize=(12, 6))
plt.plot(history.history['accuracy'], label='Train Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Model Accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
plt.show()
```



```
In [90]: word_index = imdb.get_word_index()
reverse_word_index = {value : key for key, value in word_index.items()}
```

```
In [91]: def decode_review(encoded_review):
        """Convert an encoded review back into text"""
        return " ".join([reverse_word_index.get(i - 3, "?") for i in encoded_review])
```

```
In [92]: print("\nPredicting sentiments for sample reviews...")
predictions = model.predict(X_test[:5])
```

Predicting sentiments for sample reviews...
1/1 [=====] - 0s 467ms/step

```
In [93]: for i, pred in enumerate(predictions):
        decoded_review = decode_review(X_test[i])
        sentiment = "Positive" if pred >= 0.5 else "Negative"
        actual_sentiment = "Positive" if y_test[i] == 1 else "Negative"
        print(f"\nReview {i+1}: ")
        print(f"Text: {decoded_review}")
        print(f"Predicted Sentiment: {sentiment}, Actual Label: {actual_sentiment}")
```

Text: ?
? please g
ive this one a miss br br ? ? and the rest of the cast rendered terrible performances the show is flat flat flat br br i don't know how mich
ael madison could have allowed this one on his plate he almost seemed to know this wasn't going to work out and his performance was quite ?
so all you madison fans give this a miss

Predicted Sentiment: Negative, Actual Label: Negative

Text: psychological ? it's very interesting that robert altman directed this considering the style and structure of his other films still the trademark altman audio style is evident here and there i think what really makes this film work is the brilliant performance by sandy denn is it's definitely one of her darker characters but she plays it so perfectly and convincingly that it's scary michael burns does a good job as the mute young man regular altman player michael murphy has a small part the ? moody set fits the content of the story very well in short this movie is a powerful study of loneliness sexual ? and desperation be patient ? up the atmosphere and pay attention to the wonderfully written script br br i praise robert altman this is one of his many films that deals with unconventional fascinating subject matter this film is disturbing but it's sincere and it's sure to ? a strong emotional response from the viewer if you want to see an unusual film some might even say bizarre this is worth the time br br unfortunately it's very difficult to find in video stores you may have to buy it off the internet

Predicted Sentiment: Positive, Actual Label: Positive

Text: everyone's horror the ? promptly eats the mayor and then goes on a merry rampage ? citizens at random a title card ? reads news of the king's ? throughout the kingdom when the now terrified ? once more ? ? for help he loses his temper and ? their community with lightning ? t he moral of our story delivered by a hapless frog just before he is eaten is let well enough alone br br considering the time period when th is startling little film was made and considering the fact that it was made by a russian ? at the height of that ? country's civil war it wo uld be easy to see this as a ? about those events ? may or may not have had ? turmoil in mind when he made ? but whatever ? his choice of ma terial the film stands as a ? tale of universal ? ? could be the soviet union italy germany or japan in the 1930s or any country of any era that lets its guard down and is overwhelmed by ? it's a fascinating film even a charming one in its macabre way but its message is no joke
Predicted Sentiment: Negative, Actual Label: Positive

Text: ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? i generally love this type of movie however this time i found myself wanting to kick the screen since i can't do that i will just complain about it this was absolutely idiotic the things that happen with the dead kids are very cool but the alive people are absolute idiots i am a grown man pretty big and i can defend myself well however i would not do half the stuff the little girl does in this movie also the mother in this movie is reckless with her children to the point of neglect i wish i wasn't so angry about her and her actions because i would have otherwise enjoyed the flick what a number she was take my advise and fast forward through everything you see her do until the end also is anyone else getting sick of watching movies that are filmed so dark anymore one can hardly see what is being filmed as an audience we are ? involved with the actions on the screen so then why the hell can't we have night vision
Predicted Sentiment: Positive, Actual Label: Negative

Text: ?
? like some other people wrote i'm a die hard mario fan and i loved this game br br this g
ame starts slightly boring but trust me it's worth it as soon as you start your hooked the levels are fun and ? they will hook you ? your mi
nd turns to ? i'm not kidding this game is also ? and is beautifully done br br to keep this spoiler free i have to keep my mouth shut about
details but please try this game it'll be worth it br br story 9 9 action 10 1 it's that good ? 10 attention ? 10 average 10

Predicted Sentiment: Positive, **Actual Label:** Positive