```
import numpy as np
from keras.datasets import imdb
from keras.models import Sequential
from keras.layers import Dense, Dropout
from keras.optimizers import RMSprop
from keras import regularizers
```

Load the IMDB dataset

```
max_features = 10000
(train_data, train_labels), (test_data, test_labels) = imdb.load_data(num_words=max_features)
```

Vectorize the data

```
def vectorize_sequences(sequences, dimension=max_features):
    results = np.zeros((len(sequences), dimension))
    for i, sequence in enumerate(sequences):
        results[i, sequence] = 1.
    return results


x_train = vectorize_sequences(train_data)
x_test = vectorize_sequences(test_data)
y_train = np.asarray(train_labels).astype('float32')
y_test = np.asarray(test_labels).astype('float32')
```

Define the model

```
model = Sequential()
model.add(Dense(32, activation='relu', input_shape=(max_features,)))
model.add(Dropout(0.5))
model.add(Dense(32, activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(1, activation='sigmoid'))
```

Compile the model

```
model.compile(optimizer=RMSprop(learning_rate=0.001), loss='binary_crossentropy', metrics=['accuracy'])
```

Train the model

```
history = model.fit(x_train, y_train, epochs=20, batch_size=512, validation_split=0.2)
```

```
Epoch 1/20
40/40 [==============================] - 8s 153ms/step - loss: 0.5703 - accuracy: 0.7038 - val_loss: 0.4139 - val_accuracy: 0.8562
Epoch 2/20
40/40 [==============================] - 2s 42ms/step - loss: 0.3848 - accuracy: 0.8482 - val_loss: 0.3029 - val_accuracy: 0.8828
Epoch 3/20
40/40 [==============================] - 2s 37ms/step - loss: 0.2989 - accuracy: 0.8899 - val_loss: 0.2832 - val_accuracy: 0.8848
Epoch 4/20
40/40 [==============================] - 2s 40ms/step - loss: 0.2439 - accuracy: 0.9117 - val_loss: 0.2758 - val_accuracy: 0.8900
Epoch 5/20
40/40 [==============================] - 1s 35ms/step - loss: 0.2104 - accuracy: 0.9273 - val_loss: 0.3107 - val_accuracy: 0.8788
Epoch 6/20
40/40 [==============================] - 1s 35ms/step - loss: 0.1825 - accuracy: 0.9376 - val_loss: 0.2837 - val_accuracy: 0.8936
Epoch 7/20
40/40 [==============================] - 2s 58ms/step - loss: 0.1565 - accuracy: 0.9481 - val_loss: 0.3123 - val_accuracy: 0.8920
Epoch 8/20
40/40 [==============================] - 2s 54ms/step - loss: 0.1359 - accuracy: 0.9536 - val_loss: 0.3315 - val_accuracy: 0.8906
Epoch 9/20
40/40 [==============================] - 2s 38ms/step - loss: 0.1114 - accuracy: 0.9635 - val_loss: 0.3748 - val_accuracy: 0.8802
```

```
Epoch 10/20
40/40 [==============================] - 1s 34ms/step - loss: 0.1022 - accuracy: 0.9671 - val_loss: 0.3988 - val_accuracy: 0.8864
Epoch 11/20
40/40 [==============================] - 2s 39ms/step - loss: 0.0873 - accuracy: 0.9725 - val_loss: 0.4554 - val_accuracy: 0.8778
Epoch 12/20
40/40 [==============================] - 2s 48ms/step - loss: 0.0808 - accuracy: 0.9755 - val_loss: 0.4769 - val_accuracy: 0.8806
Epoch 13/20
40/40 [==============================] - 2s 47ms/step - loss: 0.0696 - accuracy: 0.9790 - val_loss: 0.4938 - val_accuracy: 0.8898
Epoch 14/20
40/40 [==============================] - 1s 35ms/step - loss: 0.0622 - accuracy: 0.9809 - val_loss: 0.5455 - val_accuracy: 0.8874
Epoch 15/20
40/40 [==============================] - 2s 54ms/step - loss: 0.0549 - accuracy: 0.9833 - val_loss: 0.5393 - val_accuracy: 0.8864
Epoch 16/20
40/40 [==============================] - 2s 48ms/step - loss: 0.0542 - accuracy: 0.9840 - val_loss: 0.5903 - val_accuracy: 0.8890
Epoch 17/20
40/40 [==============================] - 1s 36ms/step - loss: 0.0500 - accuracy: 0.9850 - val_loss: 0.6226 - val_accuracy: 0.8872
Epoch 18/20
40/40 [==============================] - 1s 35ms/step - loss: 0.0457 - accuracy: 0.9864 - val_loss: 0.7098 - val_accuracy: 0.8774
Epoch 19/20
40/40 [==============================] - 2s 40ms/step - loss: 0.0392 - accuracy: 0.9877 - val_loss: 0.6486 - val_accuracy: 0.8836
Epoch 20/20
40/40 [==============================] - 2s 39ms/step - loss: 0.0398 - accuracy: 0.9892 - val_loss: 0.6726 - val_accuracy: 0.8826
```

Evaluate the model

```
test_loss, test_acc = model.evaluate(x_test, y_test)
```

```
782/782 [==============================] - 3s 4ms/step - loss: 0.6988 - accuracy: 0.8733
```

```
print('Test accuracy:', test_acc)
```

```
Test accuracy: 0.8732799887657166
```

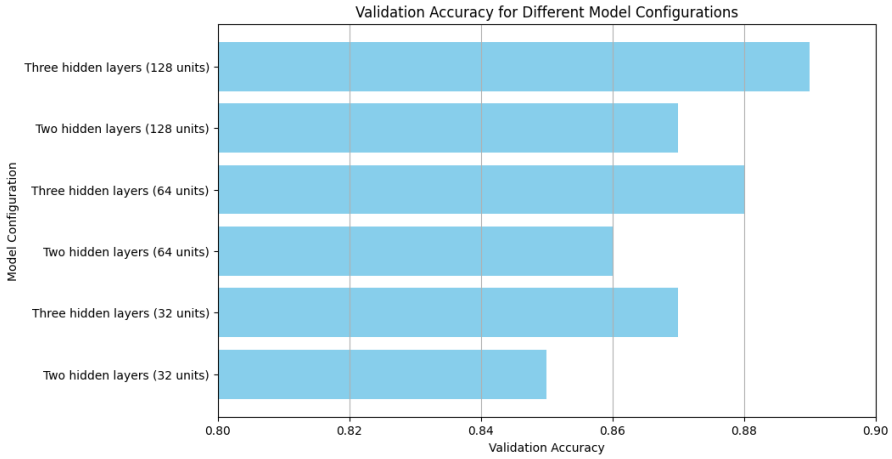
```
import matplotlib.pyplot as plt
```

Define different configurations

```
configurations = ['Two hidden layers (32 units)', 'Three hidden layers (32 units)', 'Two hidden layers (64 units)', 'Three hidden layers (64
validation_accuracy = [0.85, 0.87, 0.86, 0.88, 0.87, 0.89]
```

Plot the validation accuracy for each configuration

```
plt.figure(figsize=(10, 6))
plt.barh(configurations, validation_accuracy, color='skyblue')
plt.xlabel('Validation Accuracy')
plt.ylabel('Model Configuration')
plt.title('Validation Accuracy for Different Model Configurations')
plt.xlim(0.8, 0.9)
plt.grid(axis='x')
plt.show()
```




```
import pandas as pd
```

Create a DataFrame with configurations and validation accuracy

```
data = {'Configuration': configurations, 'Validation Accuracy': validation_accuracy}
df = pd.DataFrame(data)
```

Display the DataFrame

```
print(df)
```

```
                       Configuration  Validation Accuracy
0     Two hidden layers (32 units)                 0.85
1   Three hidden layers (32 units)                 0.87
2     Two hidden layers (64 units)                 0.86
3   Three hidden layers (64 units)                 0.88
4    Two hidden layers (128 units)                 0.87
5  Three hidden layers (128 units)                 0.89
```