In [14]:
```
from keras.datasets import reuters
import numpy as np
from keras import models
from keras import layers
import matplotlib.pyplot as plt

(train_data, train_labels), (test_data, test_labels) = reuters.load_data(num_w
ords = 10000)
```

In [4]:
```
print('Train: ',len(train_data))

print('Test: ',len(test_data))
```

```
Train:  8982
Test:  2246
```

In [5]:
```
word_index = reuters.get_word_index()
reverse_word_index = dict(
    [(value, key) for (key, value) in word_index.items()])
decoded_newswire = ' '.join(
    [reverse_word_index.get(i - 3, '?') for i in train_data[0]])
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-data
sets/reuters_word_index.json
557056/550378 [==============================] - 0s 0us/step
```

In [8]:
```
decoded_newswire
```

Out[8]:
```
'? ? ? said as a result of its december acquisition of space co it expects ea
rnings per share in 1987 of 1 15 to 1 30 dlrs per share up from 70 cts in 198
6 the company said pretax net should rise to nine to 10 mln dlrs from six mln
dlrs in 1986 and rental operation revenues to 19 to 22 mln dlrs from 12 5 mln
dlrs it said cash flow per share this year should be 2 50 to three dlrs reute
r 3'
```

In [12]:
```
def vectorize_sequences(sequences, dimension = 10000):
    results = np.zeros((len(sequences), dimension))
    for i, sequence in enumerate(sequences):
        results[i, sequence] = 1.
    return results

def to_one_hot(labels, dimension = 46):
    results = np.zeros((len(labels), dimension))
    for i, label in enumerate(labels):
        results[i, label] = 1.
    return results

x_train = vectorize_sequences(train_data)
x_test = vectorize_sequences(test_data)

one_hot_train_labels = to_one_hot(train_labels)
one_hot_test_labels = to_one_hot(test_labels)
```

In [16]:
```
model = models.Sequential()
model.add(layers.Dense(64, activation = 'relu', input_shape = (10000,)))
model.add(layers.Dense(64, activation = 'relu'))
model.add(layers.Dense(46, activation = 'softmax'))

model.compile(optimizer = 'rmsprop', loss = 'categorical_crossentropy', metric
s = ['accuracy'])
```

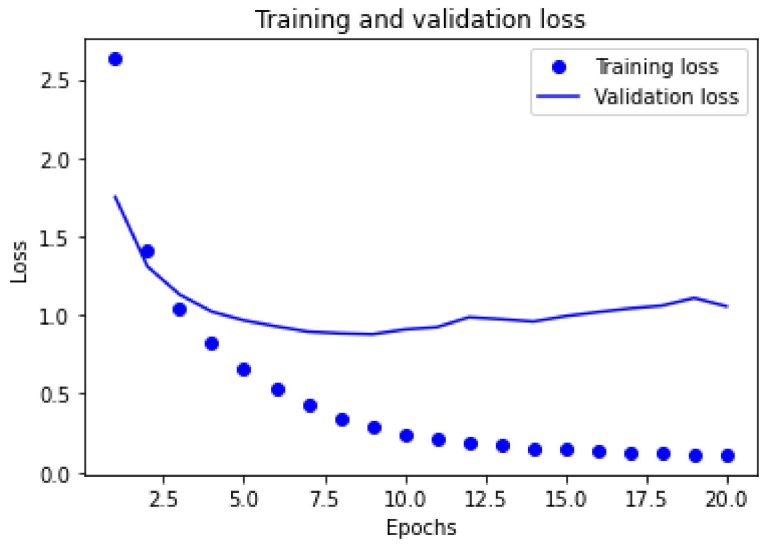
In [17]:
```
x_val = x_train[:1000]
partial_x_train = x_train[1000:]

y_val = one_hot_train_labels[:1000]
partial_y_train = one_hot_train_labels[1000:]
```

In [18]:
```
history = model.fit(partial_x_train,
                    partial_y_train,
                    epochs = 20,
                    batch_size = 512,
                    validation_data = (x_val, y_val))
```

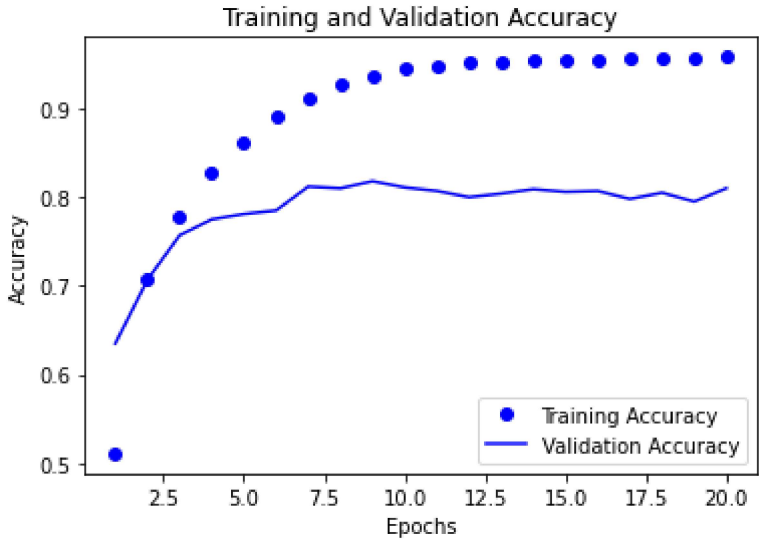
```
Epoch 1/20
16/16 [==============================] - 1s 35ms/step - loss: 2.6319 - accura
cy: 0.5112 - val_loss: 1.7511 - val_accuracy: 0.6350
Epoch 2/20
16/16 [==============================] - 0s 21ms/step - loss: 1.4160 - accura
cy: 0.7075 - val_loss: 1.3091 - val_accuracy: 0.7070
Epoch 3/20
16/16 [==============================] - 0s 21ms/step - loss: 1.0413 - accura
cy: 0.7790 - val_loss: 1.1312 - val_accuracy: 0.7570
Epoch 4/20
16/16 [==============================] - 0s 19ms/step - loss: 0.8198 - accura
cy: 0.8287 - val_loss: 1.0224 - val_accuracy: 0.7750
Epoch 5/20
16/16 [==============================] - 0s 19ms/step - loss: 0.6551 - accura
cy: 0.8621 - val_loss: 0.9668 - val_accuracy: 0.7810
Epoch 6/20
16/16 [==============================] - 0s 20ms/step - loss: 0.5267 - accura
cy: 0.8910 - val_loss: 0.9287 - val_accuracy: 0.7850
Epoch 7/20
16/16 [==============================] - 0s 19ms/step - loss: 0.4265 - accura
cy: 0.9123 - val_loss: 0.8946 - val_accuracy: 0.8120
Epoch 8/20
16/16 [==============================] - 0s 19ms/step - loss: 0.3468 - accura
cy: 0.9282 - val_loss: 0.8842 - val_accuracy: 0.8100
Epoch 9/20
16/16 [==============================] - 0s 19ms/step - loss: 0.2903 - accura
cy: 0.9366 - val_loss: 0.8786 - val_accuracy: 0.8180
Epoch 10/20
16/16 [==============================] - 0s 19ms/step - loss: 0.2445 - accura
cy: 0.9450 - val_loss: 0.9089 - val_accuracy: 0.8110
Epoch 11/20
16/16 [==============================] - 0s 20ms/step - loss: 0.2119 - accura
cy: 0.9481 - val_loss: 0.9233 - val_accuracy: 0.8070
Epoch 12/20
16/16 [==============================] - 0s 21ms/step - loss: 0.1869 - accura
cy: 0.9518 - val_loss: 0.9870 - val_accuracy: 0.8000
Epoch 13/20
16/16 [==============================] - 0s 16ms/step - loss: 0.1704 - accura
cy: 0.9529 - val_loss: 0.9743 - val_accuracy: 0.8040
Epoch 14/20
16/16 [==============================] - 0s 17ms/step - loss: 0.1525 - accura
cy: 0.9545 - val_loss: 0.9593 - val_accuracy: 0.8090
Epoch 15/20
16/16 [==============================] - 0s 19ms/step - loss: 0.1486 - accura
cy: 0.9543 - val_loss: 0.9938 - val_accuracy: 0.8060
Epoch 16/20
16/16 [==============================] - 0s 20ms/step - loss: 0.1324 - accura
cy: 0.9544 - val_loss: 1.0194 - val_accuracy: 0.8070
Epoch 17/20
16/16 [==============================] - 0s 19ms/step - loss: 0.1294 - accura
cy: 0.9569 - val_loss: 1.0424 - val_accuracy: 0.7980
Epoch 18/20
16/16 [==============================] - 0s 14ms/step - loss: 0.1216 - accura
cy: 0.9565 - val_loss: 1.0606 - val_accuracy: 0.8050
Epoch 19/20
16/16 [==============================] - 0s 16ms/step - loss: 0.1163 - accura
cy: 0.9577 - val_loss: 1.1092 - val_accuracy: 0.7950
```

```
Epoch 20/20
16/16 [==============================] - 0s 16ms/step - loss: 0.1121 - accura
cy: 0.9583 - val_loss: 1.0563 - val_accuracy: 0.8100
```

In [26]:
```
loss = history.history['loss']
val_loss = history.history['val_loss']
binary_accuracy = history.history['accuracy']
val_binary_accuracy = history.history['val_accuracy']

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

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()
```



In [27]:
```
plt.clf()

plt.plot(epochs, binary_accuracy, 'bo', label = 'Training Accuracy')
plt.plot(epochs, val_binary_accuracy, 'b', label = 'Validation Accuracy')
plt.title('Training and Validation Accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()

plt.show()
```



In [29]:
```
model = models.Sequential()
model.add(layers.Dense(64, activation = 'relu', input_shape = (10000,)))
model.add(layers.Dense(64, activation = 'relu'))
model.add(layers.Dense(46, activation = 'softmax'))

model.compile(optimizer = 'rmsprop', loss = 'categorical_crossentropy', metric
s = ['accuracy'])

model.fit(partial_x_train,
                  partial_y_train,
                  epochs = 9,
                  batch_size = 512,
                  validation_data = (x_val, y_val))
results = model.evaluate(x_test, one_hot_test_labels)
```

```
Epoch 1/9
16/16 [==============================] - 0s 21ms/step - loss: 2.9684 - accura
cy: 0.5030 - val_loss: 1.9646 - val_accuracy: 0.6330
Epoch 2/9
16/16 [==============================] - 0s 20ms/step - loss: 1.5661 - accura
cy: 0.6984 - val_loss: 1.3667 - val_accuracy: 0.6980
Epoch 3/9
16/16 [==============================] - 0s 19ms/step - loss: 1.1053 - accura
cy: 0.7646 - val_loss: 1.1419 - val_accuracy: 0.7460
Epoch 4/9
16/16 [==============================] - 0s 18ms/step - loss: 0.8592 - accura
cy: 0.8183 - val_loss: 1.0671 - val_accuracy: 0.7650
Epoch 5/9
16/16 [==============================] - 0s 18ms/step - loss: 0.6832 - accura
cy: 0.8586 - val_loss: 0.9632 - val_accuracy: 0.7990
Epoch 6/9
16/16 [==============================] - 0s 19ms/step - loss: 0.5473 - accura
cy: 0.8879 - val_loss: 0.9210 - val_accuracy: 0.8110
Epoch 7/9
16/16 [==============================] - 0s 22ms/step - loss: 0.4398 - accura
cy: 0.9094 - val_loss: 0.8974 - val_accuracy: 0.8110
Epoch 8/9
16/16 [==============================] - 0s 17ms/step - loss: 0.3563 - accura
cy: 0.9260 - val_loss: 0.9412 - val_accuracy: 0.8000
Epoch 9/9
16/16 [==============================] - 0s 17ms/step - loss: 0.2995 - accura
cy: 0.9360 - val_loss: 0.9107 - val_accuracy: 0.8170
71/71 [==============================] - 0s 2ms/step - loss: 1.0143 - accurac
y: 0.7885
```

In [30]:
```
results
```

Out[30]:
```
[1.0142701864242554, 0.7885128855705261]
```

In [31]:
```
predictions = model.predict(x_test)
```

In [32]:
```
predictions[0].shape
```

Out[32]:
```
(46,)
```

In [33]:
```
np.sum(predictions[0])
```

Out[33]:
```
0.9999998
```

In [34]:
```
np.argmax(predictions[0])
```

Out[34]:
```
3
```

In [35]:
```
model = models.Sequential()
model.add(layers.Dense(64, activation = 'relu', input_shape = (10000,)))
model.add(layers.Dense(4, activation = 'relu'))
model.add(layers.Dense(46, activation = 'softmax'))

model.compile(optimizer = 'rmsprop', loss = 'categorical_crossentropy', metric
s = ['accuracy'])

model.fit(partial_x_train,
                  partial_y_train,
                  epochs = 20,
                  batch_size = 128,
                  validation_data = (x_val, y_val))
results = model.evaluate(x_test, one_hot_test_labels)
```

```
Epoch 1/20
63/63 [==============================] - 1s 11ms/step - loss: 2.9092 - accura
cy: 0.2835 - val_loss: 2.1372 - val_accuracy: 0.5440
Epoch 2/20
63/63 [==============================] - 0s 7ms/step - loss: 1.7951 - accurac
y: 0.5412 - val_loss: 1.6751 - val_accuracy: 0.5450
Epoch 3/20
63/63 [==============================] - 0s 8ms/step - loss: 1.4852 - accurac
y: 0.5604 - val_loss: 1.5169 - val_accuracy: 0.5990
Epoch 4/20
63/63 [==============================] - 0s 7ms/step - loss: 1.3132 - accurac
y: 0.6548 - val_loss: 1.4507 - val_accuracy: 0.6400
Epoch 5/20
63/63 [==============================] - 1s 9ms/step - loss: 1.1988 - accurac
y: 0.6972 - val_loss: 1.4213 - val_accuracy: 0.6670
Epoch 6/20
63/63 [==============================] - 1s 9ms/step - loss: 1.1127 - accurac
y: 0.7234 - val_loss: 1.4221 - val_accuracy: 0.6740
Epoch 7/20
63/63 [==============================] - 0s 8ms/step - loss: 1.0439 - accurac
y: 0.7321 - val_loss: 1.3949 - val_accuracy: 0.6780
Epoch 8/20
63/63 [==============================] - 1s 8ms/step - loss: 0.9868 - accurac
y: 0.7423 - val_loss: 1.4418 - val_accuracy: 0.6830
Epoch 9/20
63/63 [==============================] - 1s 8ms/step - loss: 0.9384 - accurac
y: 0.7528 - val_loss: 1.4403 - val_accuracy: 0.6860
Epoch 10/20
63/63 [==============================] - 0s 8ms/step - loss: 0.8973 - accurac
y: 0.7587 - val_loss: 1.4614 - val_accuracy: 0.6870
Epoch 11/20
63/63 [==============================] - 0s 8ms/step - loss: 0.8561 - accurac
y: 0.7686 - val_loss: 1.5401 - val_accuracy: 0.6930
Epoch 12/20
63/63 [==============================] - 0s 8ms/step - loss: 0.8235 - accurac
y: 0.7784 - val_loss: 1.5587 - val_accuracy: 0.6920
Epoch 13/20
63/63 [==============================] - 1s 8ms/step - loss: 0.7923 - accurac
y: 0.7836 - val_loss: 1.5643 - val_accuracy: 0.6920
Epoch 14/20
63/63 [==============================] - 1s 8ms/step - loss: 0.7679 - accurac
y: 0.7856 - val_loss: 1.6182 - val_accuracy: 0.6890
Epoch 15/20
63/63 [==============================] - 1s 8ms/step - loss: 0.7434 - accurac
y: 0.7884 - val_loss: 1.6877 - val_accuracy: 0.6890
Epoch 16/20
63/63 [==============================] - 0s 8ms/step - loss: 0.7230 - accurac
y: 0.7905 - val_loss: 1.7060 - val_accuracy: 0.6890
Epoch 17/20
63/63 [==============================] - 0s 7ms/step - loss: 0.7028 - accurac
y: 0.7993 - val_loss: 1.7653 - val_accuracy: 0.6860
Epoch 18/20
63/63 [==============================] - 0s 8ms/step - loss: 0.6863 - accurac
y: 0.8052 - val_loss: 1.7639 - val_accuracy: 0.6900
Epoch 19/20
63/63 [==============================] - 0s 7ms/step - loss: 0.6691 - accurac
y: 0.8081 - val_loss: 1.8461 - val_accuracy: 0.6860
```

```
Epoch 20/20
63/63 [==============================] - 0s 7ms/step - loss: 0.6546 - accurac
y: 0.8116 - val_loss: 1.8952 - val_accuracy: 0.6840
71/71 [==============================] - 0s 2ms/step - loss: 2.2311 - accurac
y: 0.6465
```

In [ ]: