Classify different data sets

Basic includes

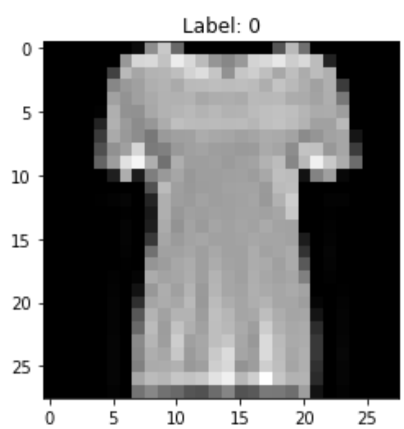
In [164]:
```python
# Using pandas to load the csv file
import pandas as pd

import numpy as np
import matplotlib.pyplot as plt

from keras import models
from keras import layers
from keras import callbacks
from keras.utils import to_categorical

# reuters and fashin mnist data set from keras
from keras.datasets import reuters
from keras.datasets import fashion_mnist

# needed to preprocess text
from keras.preprocessing.text import Tokenizer
```

Classify the Fashion Mnist

In [165]:
```python
(fashion_train_data, fashion_train_labels), (fashion_test_data, fashion_test_labels)

print(fashion_train_data.shape)

test_index = 10

plt.title("Label: " + str(fashion_train_labels[test_index]))
plt.imshow(fashion_train_data[test_index], cmap="gray")
```

```
(60000, 28, 28)
```

Out[165]:
```
<matplotlib.image.AxesImage at 0xb43422cf8>
```



TO DO: Preprocess the data

1. Normalize the input data set
2. Perform one hot encoding
3. Create a train, test, and validation set

TO DO: Define and train a network, then plot the accuracy of the training, validation, and testing

1. Use a validation set
2. Propose and train a network
3. Print the history of the training
4. Evaluate with a test set

In [166]:
```
fashion_train_data = fashion_train_data.reshape((60000, 28 * 28))# Normalizar datos
fashion_train_data = fashion_train_data.astype('float32') / 255# Normalizar datos
fashion_test_data = fashion_test_data.reshape((10000, 28 * 28))
fashion_test_data = fashion_test_data.astype('float32') / 255
```

In [167]:
```
fashion_train_labels = to_categorical(fashion_train_labels) #hot encoding
fashion_test_labels = to_categorical(fashion_test_labels)#hot encoding
```

In [168]:
```
validation_data = fashion_train_data[:30000] #Validación
validation_labels = fashion_train_labels[:30000] #Validación
x_data = fashion_train_data[30000:]
y_data = fashion_train_labels[30000:]
```

In [175]:
```
network = models.Sequential()
network.add(layers.Dense(128, activation='relu', input_shape= (28 * 28,)))
network.add(layers.Dropout(0.3))
network.add(layers.Dense(64, activation='relu'))
network.add(layers.Dropout(0.3))
network.add(layers.Dense(10, activation='softmax'))
network.summary()
early_stop = callbacks.EarlyStopping(monitor='val_loss', patience=2)
network.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accurac
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_59 (Dense)             (None, 128)               100480
_________________________________________________________________
dropout_41 (Dropout)         (None, 128)               0
_________________________________________________________________
dense_60 (Dense)             (None, 64)                8256
_________________________________________________________________
dropout_42 (Dropout)         (None, 64)                0
_________________________________________________________________
dense_61 (Dense)             (None, 10)                650
=================================================================
Total params: 109,386
Trainable params: 109,386
Non-trainable params: 0
_________________________________________________________________
```

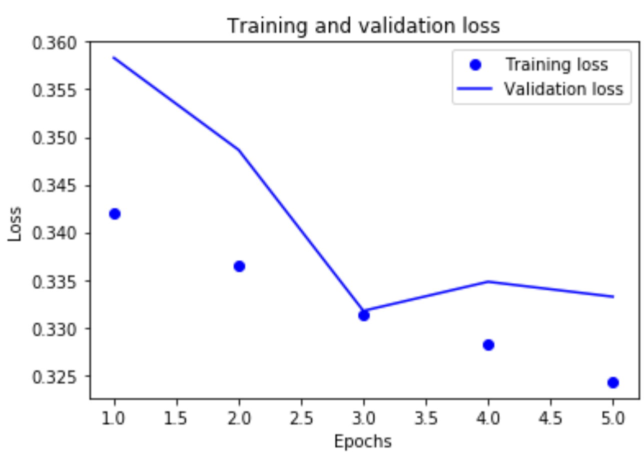
In [177]:
```
history = network.fit(x_data, y_data, epochs=25, validation_data = (validation_data,
```

```
Train on 30000 samples, validate on 30000 samples
Epoch 1/25
 - 6s - loss: 0.3419 - acc: 0.8757 - val_loss: 0.3583 - val_acc: 0.8728
Epoch 2/25
 - 5s - loss: 0.3365 - acc: 0.8765 - val_loss: 0.3486 - val_acc: 0.8762
Epoch 3/25
 - 5s - loss: 0.3312 - acc: 0.8765 - val_loss: 0.3317 - val_acc: 0.8812
Epoch 4/25
 - 4s - loss: 0.3283 - acc: 0.8797 - val_loss: 0.3348 - val_acc: 0.8810
Epoch 5/25
 - 5s - loss: 0.3243 - acc: 0.8799 - val_loss: 0.3332 - val_acc: 0.8814
```

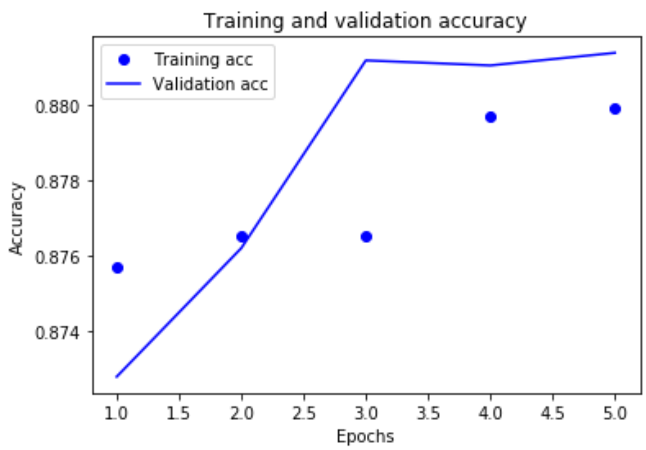
In [ ]:

In [179]:
```
test_loss, test_acc = network.evaluate(fashion_test_data, fashion_test_labels)

print("test loss: ", test_loss, "test accuracy: ", test_acc) #imprimir evaluación
history_dict = history.history
acc = history_dict['acc']
val_acc = history_dict['val_acc']
loss = history_dict['loss']
val_loss = history_dict['val_loss']

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

plt.plot(epochs, loss, 'bo', label='Training loss') #graficas
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()
```

```
10000/10000 [==============================] - 1s 63us/step
test loss:  0.36716508737802506 test accuracy:  0.8691
```



In [181]:
```
plt.clf()
plt.plot(epochs, acc, 'bo', label='Training acc') #Grñafica de entrenamiento
plt.plot(epochs, val_acc, 'b', label='Validation acc') #Gráfica de validación
plt.title('Training and validation accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()

plt.show()
```



Classifying newswires

Build a network to classify Reuters newswires into 46 different mutually-exclusive topics.

Load and review the data

In [182]:
```
(reuters_train_data, reuters_train_labels), (reuters_test_data, reuters_test_labels)

print(reuters_train_data.shape)
print(reuters_train_labels.shape)
print(reuters_train_data[0])
print(reuters_train_labels[0])

print(set(reuters_train_labels))
```

```
(8982,)
(8982,)
[1, 2, 2, 8, 43, 10, 447, 5, 25, 207, 270, 5, 3095, 111, 16, 369, 186, 90, 67, 7,
89, 5, 19, 102, 6, 19, 124, 15, 90, 67, 84, 22, 482, 26, 7, 48, 4, 49, 8, 864, 39,
209, 154, 6, 151, 6, 83, 11, 15, 22, 155, 11, 15, 7, 48, 9, 4579, 1005, 504, 6, 25
8, 6, 272, 11, 15, 22, 134, 44, 11, 15, 16, 8, 197, 1245, 90, 67, 52, 29, 209, 30,
32, 132, 6, 109, 15, 17, 12]
3
{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,
23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43
, 44, 45}
```

Load the word index to decode the train data.

In [183]:
```
word_index = reuters.get_word_index()

reverse_index = dict([(value+3, key) for (key, value) in word_index.items()])

reverse_index[0] = "<PAD>"
reverse_index[1] = "<START>"
reverse_index[2] = "<UNKNOWN>"  # unknown
reverse_index[3] = "<UNUSED>"

decoded_review = ' '.join([reverse_index.get(i,'?') for i in reuters_train_data[0]])

print(decoded_review)
```

```
<START> <UNKNOWN> <UNKNOWN> said as a result of its december acquisition of space
co it expects earnings per share in 1987 of 1 15 to 1 30 dlrs per share up from 70
cts in 1986 the company said pretax net should rise to nine to 10 mln dlrs from si
x mln dlrs in 1986 and rental operation revenues to 19 to 22 mln dlrs from 12 5 ml
n dlrs it said cash flow per share this year should be 2 50 to three dlrs reuter 3
```

TO DO: Preprocess the data

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In [186]:
```
tokenizer = Tokenizer(num_words=8982)
train_data_token = tokenizer.sequences_to_matrix(reuters_train_data, mode='binary')
test_data_token = tokenizer.sequences_to_matrix(reuters_test_data, mode='binary')
one_hot_train_labels = to_categorical(reuters_train_labels) #hot encoding
one_hot_test_labels = to_categorical(reuters_test_labels)
```

In [187]:
```
validation_data = train_data_token[:3000] #validación
validation_labels = one_hot_train_labels[:3000]
x_data = train_data_token[3000:]
y_data = one_hot_train_labels[3000:]
```

In [191]:
```
network = models.Sequential()
network.add(layers.Dense(92, activation='relu', input_shape= (8982,)))
network.add(layers.Dropout(0.3))
network.add(layers.Dense(46, activation='softmax'))
network.add(layers.Dropout(0.2))
network.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
dense_68 (Dense)             (None, 92)                826436    
_________________________________________________________________
dropout_49 (Dropout)         (None, 92)                0         
_________________________________________________________________
dense_69 (Dense)             (None, 46)                4278      
_________________________________________________________________
dropout_50 (Dropout)         (None, 46)                0         
=================================================================
Total params: 830,714
Trainable params: 830,714
Non-trainable params: 0
_________________________________________________________________
```

In [192]:
```
early_stop = callbacks.EarlyStopping(monitor='val_loss', patience=6)
network.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accurac
```

In [ ]:

In [194]:
```
history = network.fit(x_data, y_data, epochs=15, validation_data = (validation_data,
```

```
Train on 5982 samples, validate on 3000 samples
Epoch 1/15
 - 4s - loss: 3.3350 - acc: 0.7775 - val_loss: 0.9927 - val_acc: 0.8030
Epoch 2/15
 - 4s - loss: 3.3791 - acc: 0.7732 - val_loss: 1.0194 - val_acc: 0.8033
Epoch 3/15
 - 4s - loss: 3.1882 - acc: 0.7850 - val_loss: 1.0500 - val_acc: 0.8033
Epoch 4/15
 - 4s - loss: 3.3338 - acc: 0.7767 - val_loss: 1.0196 - val_acc: 0.8043
Epoch 5/15
 - 4s - loss: 3.3476 - acc: 0.7743 - val_loss: 1.0730 - val_acc: 0.8017
Epoch 6/15
 - 4s - loss: 3.3471 - acc: 0.7763 - val_loss: 1.0612 - val_acc: 0.8023
Epoch 7/15
 - 4s - loss: 3.3135 - acc: 0.7780 - val_loss: 1.0533 - val_acc: 0.8040
```

In [195]:
```
test_loss, test_acc = network.evaluate(test_data_token, one_hot_test_labels) #evalua
print("test loss: ", test_loss, "test accuracy: ", test_acc)
```

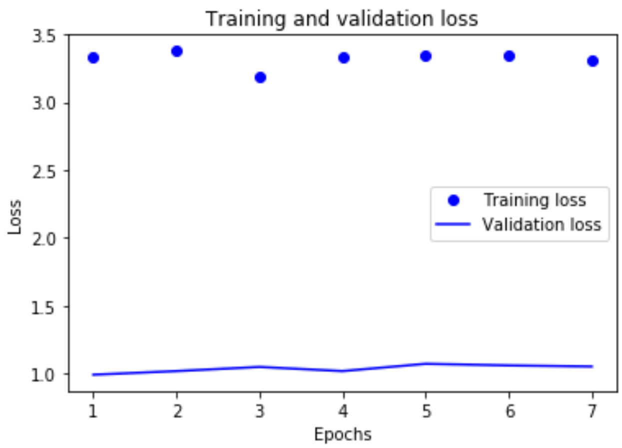
```
2246/2246 [==============================] - 1s 355us/step
test loss:  1.12112430473151 test accuracy:  0.7911843277202157
```

In [196]:

```
history_dict = history.history
acc = history_dict['acc']
val_acc = history_dict['val_acc']
loss = history_dict['loss']
val_loss = history_dict['val_loss']

epochs = range(1, len(acc) + 1)
```

In [197]:

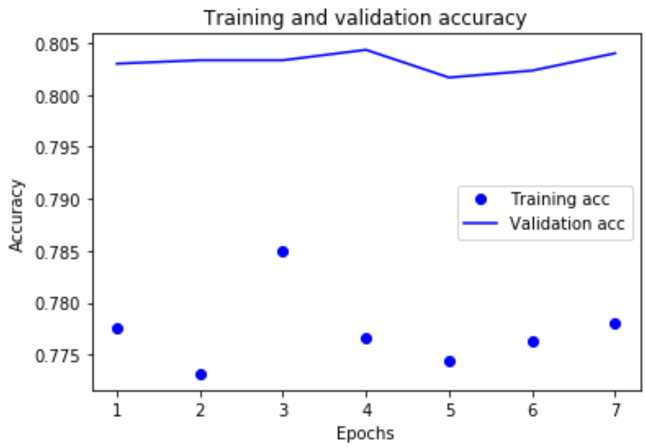
```

plt.plot(epochs, loss, 'bo', label='Training loss') #gráfica

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 [ ]:

In [199]:

```
plt.clf()

plt.plot(epochs, acc, 'bo', label='Training acc')
plt.plot(epochs, val_acc, 'b', label='Validation acc')
plt.title('Training and validation accuracy') #gráfica de validación
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()

plt.show()
```



In [ ]:

Predicting Student Admissions

Predict student admissions based on three pieces of data:

- GRE Scores
- GPA Scores
- Class rank

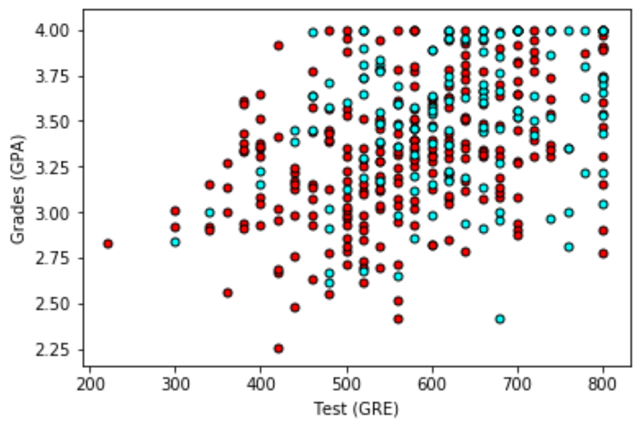
Load and visualize the data

In [232]:
```
student_data = pd.read_csv("data/student_data.csv") #se creo carpeta data
print(student_data)
```

```
     admit    gre   gpa  rank
0        0  380.0  3.61   3.0
1        1  660.0  3.67   3.0
2        1  800.0  4.00   1.0
3        1  640.0  3.19   4.0
4        0  520.0  2.93   4.0
5        1  760.0  3.00   2.0
6        1  560.0  2.98   1.0
7        0  400.0  3.08   2.0
8        1  540.0  3.39   3.0
9        0  700.0  3.92   2.0
10       0  800.0  4.00   4.0
11       0  440.0  3.22   1.0
12       1  760.0  4.00   1.0
13       0  700.0  3.08   2.0
14       1  700.0  4.00   1.0
15       0  480.0  3.44   3.0
16       0  780.0  3.87   4.0
17       0  360.0  2.56   3.0
18       0  800.0  3.75   2.0
19       1  540.0  3.81   1.0
20       0  500.0  3.17   3.0
21       1  660.0  3.63   2.0
22       0  600.0  2.82   4.0
23       0  680.0  3.19   4.0
24       1  760.0  3.35   2.0
25       1  800.0  3.66   1.0
26       1  620.0  3.61   1.0
27       1  520.0  3.74   4.0
28       1  780.0  3.22   2.0
29       0  520.0  3.29   1.0
..     ...    ...   ...   ...
370      1  540.0  3.77   2.0
371      1  680.0  3.76   3.0
372      1  680.0  2.42   1.0
373      1  620.0  3.37   1.0
374      0  560.0  3.78   2.0
375      0  560.0  3.49   4.0
376      0  620.0  3.63   2.0
377      1  800.0  4.00   2.0
378      0  640.0  3.12   3.0
379      0  540.0  2.70   2.0
380      0  700.0  3.65   2.0
381      1  540.0  3.49   2.0
382      0  540.0  3.51   2.0
383      0  660.0  4.00   1.0
384      1  480.0  2.62   2.0
385      0  420.0  3.02   1.0
386      1  740.0  3.86   2.0
387      0  580.0  3.36   2.0
388      0  640.0  3.17   2.0
389      0  640.0  3.51   2.0
390      1  800.0  3.05   2.0
391      1  660.0  3.88   2.0
392      1  600.0  3.38   3.0
393      1  620.0  3.75   2.0
394      1  460.0  3.99   3.0
395      0  620.0  4.00   2.0
396      0  560.0  3.04   3.0
397      0  460.0  2.63   2.0
```

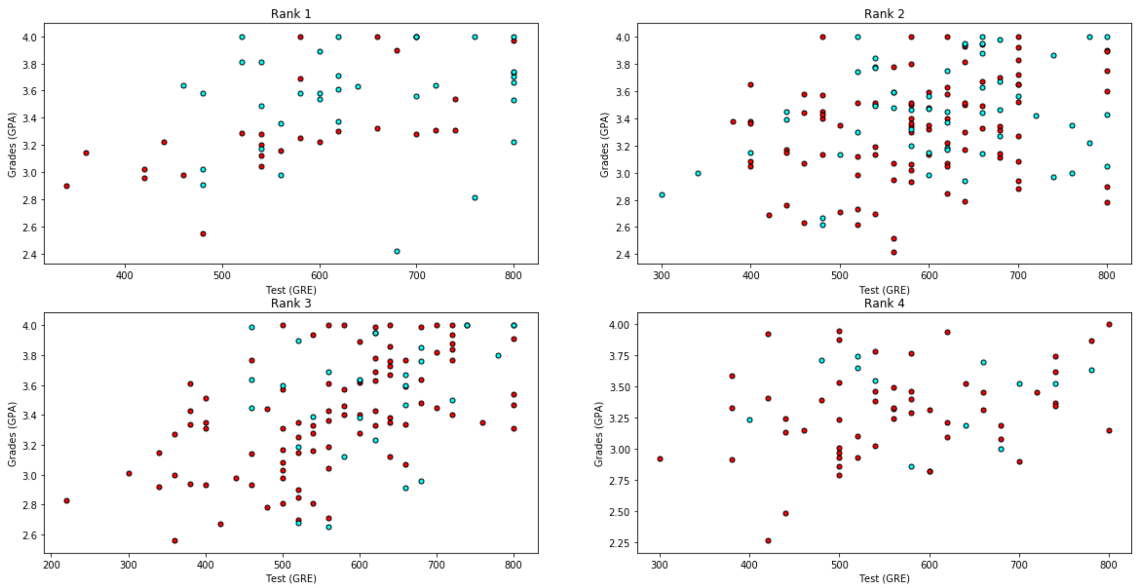
Plot of the GRE and the GPA from the data.

In [253]:
```
X = np.array(student_data[["gre","gpa"]])
y = np.array(student_data["admit"])
admitted = X[np.argwhere(y==1)]
rejected = X[np.argwhere(y==0)]
plt.scatter([s[0][0] for s in rejected], [s[0][1] for s in rejected], s = 25, color
plt.scatter([s[0][0] for s in admitted], [s[0][1] for s in admitted], s = 25, color
plt.xlabel('Test (GRE)')
plt.ylabel('Grades (GPA)')

plt.show()
```



Plot of the data by class rank.

In [254]:
```
f, plots = plt.subplots(2, 2, figsize=(20,10))
plots = [plot for sublist in plots for plot in sublist]

for idx, plot in enumerate(plots):
    data_rank = student_data[student_data["rank"]==idx+1]
    plot.set_title("Rank " + str(idx+1))
    X = np.array(data_rank[["gre","gpa"]])
    y = np.array(data_rank["admit"])
    admitted = X[np.argwhere(y==1)]
    rejected = X[np.argwhere(y==0)]
    plot.scatter([s[0][0] for s in rejected], [s[0][1] for s in rejected], s = 25, c
    plot.scatter([s[0][0] for s in admitted], [s[0][1] for s in admitted], s = 25, c
    plot.set_xlabel('Test (GRE)')
    plot.set_ylabel('Grades (GPA)')
```



TO DO: Preprocess the data

1. Normalize the input data set
2. Perform one hot encoding
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In [258]:
```
student_data = student_data.fillna(0)
normalized_student_data = pd.get_dummies(student_data, columns=['rank']) #normalizan
normalized_student_data["gre"] = normalized_student_data["gre"] / 800
normalized_student_data["gpa"] = normalized_student_data["gpa"] / 4
np.random.shuffle(normalized_student_data.values)

student_x = np.array(normalized_student_data)[:,1:]
student_x = student_x.astype('float32')
student_y = to_categorical(student_data["admit"])
```

In [259]:
```

student_validation_data = student_x[:100] #validando
student_validation_labels = student_y[:100]
student_x_data = student_x[100:]
student_y_data = student_y[100:]
```

In [269]:

```
student_NN_model = models.Sequential([
    layers.Dense(128, activation='relu', kernel_initializer='random_uniform', input_
    layers.Dropout(0.3),
    layers.Dense(64, activation='relu'),
    layers.Dropout(0.3),
    layers.Dense(32, activation='relu'),
    layers.Dense(2, activation='softmax')
    ])

student_NN_model.compile(optimizer='rmsprop',
              loss='categorical_crossentropy',
              metrics=['accuracy'])

student_NN_model.summary()

student_history = student_NN_model.fit(student_x_data, student_y_data, epochs=15, ba

student_results = student_NN_model.evaluate(student_x[80:200], student_y[80:200])

print('student Test accuracy:', student_results)
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
dense_83 (Dense)             (None, 128)               1024      
_________________________________________________________________
dropout_59 (Dropout)         (None, 128)               0         
_________________________________________________________________
dense_84 (Dense)             (None, 64)                8256      
_________________________________________________________________
dropout_60 (Dropout)         (None, 64)                0         
_________________________________________________________________
dense_85 (Dense)             (None, 32)                2080      
_________________________________________________________________
dense_86 (Dense)             (None, 2)                 66        
=================================================================
Total params: 11,426
Trainable params: 11,426
Non-trainable params: 0
_________________________________________________________________
Train on 300 samples, validate on 100 samples
Epoch 1/15
300/300 [==============================] - 7s 24ms/step - loss: 0.6897 - acc: 0.58
00 - val_loss: 0.6731 - val_acc: 0.6800
Epoch 2/15
300/300 [==============================] - 0s 204us/step - loss: 0.6625 - acc: 0.6
867 - val_loss: 0.6494 - val_acc: 0.6800
Epoch 3/15
300/300 [==============================] - 0s 147us/step - loss: 0.6425 - acc: 0.6
833 - val_loss: 0.6352 - val_acc: 0.6800
Epoch 4/15
300/300 [==============================] - 0s 359us/step - loss: 0.6332 - acc: 0.6
833 - val_loss: 0.6283 - val_acc: 0.6800
Epoch 5/15
300/300 [==============================] - 0s 340us/step - loss: 0.6195 - acc: 0.6
833 - val_loss: 0.6236 - val_acc: 0.6800
Epoch 6/15
300/300 [==============================] - 0s 190us/step - loss: 0.6177 - acc: 0.6
```

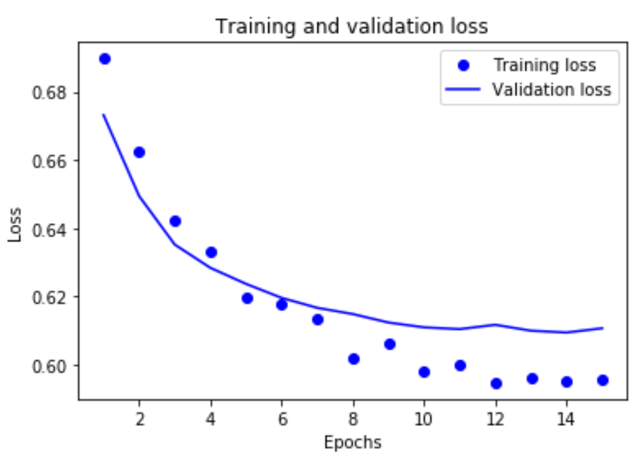
In [272]:

```
student_history_dict = student_history.history
print(student_history_dict.keys())


student_acc = student_history_dict['acc']
student_val_acc = student_history_dict['val_acc']
student_loss = student_history_dict['loss']
student_val_loss = student_history_dict['val_loss']

student_epochs = range(1, len(student_acc) + 1)
```

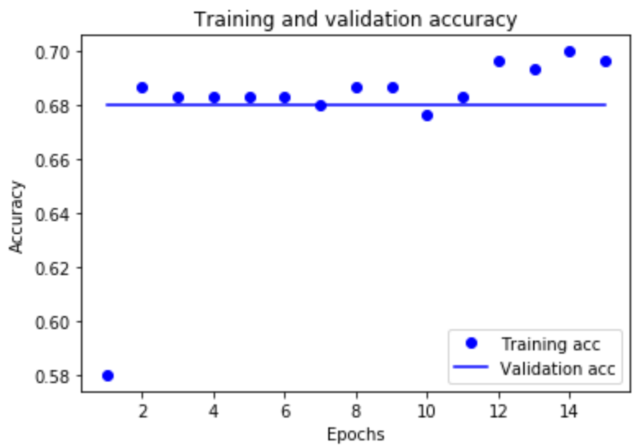
```
dict_keys(['val_loss', 'val_acc', 'loss', 'acc'])
```

In [274]:

```
plt.plot(student_epochs, student_loss, 'bo', label='Training loss')

plt.plot(student_epochs, student_val_loss, 'b', label='Validation loss')
plt.title('Training and validation loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()

plt.show()
```



In [275]:
```
plt.clf()

plt.plot(student_epochs, student_acc, 'bo', label='Training acc')
plt.plot(student_epochs, student_val_acc, 'b', label='Validation acc')
plt.title('Training and validation accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()

plt.show()
```



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