In [1]:
```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.metrics import accuracy_score, confusion_matrix
import matplotlib.pyplot as plt
plt.style.use('ggplot')
#Read the data
train_df = pd.read_csv('train.csv', delimiter="\t")
test_df = pd.read_csv('test.csv', delimiter="\t")
test_label_df = pd.read_csv('sample_submission.csv')
```

先 import 需要用到的套件，接著利用 pandas 套件將資料讀取進來，讀取 train.csv、test.csv 和 sample_submission.csv，train.csv、test.csv 利用分割符號切割、建立 train & test 之 DataFrame

In [2]:
```
#畫圖
def plot_history(history):
    acc = history.history['accuracy']
    val_acc = history.history['val_accuracy']
    loss = history.history['loss']
    val_loss = history.history['val_loss']
    x = range(1, len(acc) + 1)

    plt.figure(figsize=(12, 5))
    plt.subplot(1, 2, 1)
    plt.plot(x, acc, 'b', label='Training acc')
    plt.plot(x, val_acc, 'r', label='Validation acc')
    plt.title('Training and validation accuracy')
    plt.legend()
    plt.subplot(1, 2, 2)
    plt.plot(x, loss, 'b', label='Training loss')
    plt.plot(x, val_loss, 'r', label='Validation loss')
    plt.title('Training and validation loss')
    plt.legend()
```

因為要 plot 出訓練過程中的 Accuracy 與 Loss 值變化，先寫畫圖的 function

In [3]:
```
new_train_df = train_df['text'].values
new_test_df = test_df['text'].values
# Change the labels
train_df.loc[(train_df['label'] == 'label') , ['label']] = '0'
#train_df['label'] = pd.to_numeric(train_df['label'])
train_label = train_df['label'].values
#test_label_df['label'] = pd.to_numeric(test_label_df['label'])
test_label = test_label_df['label'].values
```

因為 train.csv 的 label 中有一筆資料的值為 label，故我直接將值改為 0；利用.values 將原本 Pandas Series object 改成 a NumPy array

In [4]:
```
# from sklearn.feature_extraction.text import CountVectorizer

# vectorizer = CountVectorizer()
# vectorizer.fit(new_train_df)

# X_train = vectorizer.transform(new_train_df)
# X_test  = vectorizer.transform(new_test_df)
from keras.preprocessing.text import Tokenizer

tokenizer = Tokenizer(num_words=5000)
tokenizer.fit_on_texts(new_train_df)

new_X_train = tokenizer.texts_to_sequences(new_train_df)
new_X_test = tokenizer.texts_to_sequences(new_test_df)

vocab_size = len(tokenizer.word_index) + 1  # Adding 1 because of reserved 0 index

print(new_train_df[2])
print(new_X_train[2])
#去除停頓詞stop words
#文字探勘前處理，將文字轉換成向量，方法為tf-idf
#Initialize a TfidfVectorizer
# tfidf_vectorizer = TfidfVectorizer(stop_words='english', max_df=0.7)
# #Fit and transform train set, transform test set
# tfidf_train = tfidf_vectorizer.fit_transform(new_train_df)
# tfidf_test = tfidf_vectorizer.transform(new_test_df)
# #向量轉成陣列
# tfidf_train_weight = tfidf_train.toarray()
# tfidf_test_weight = tfidf_test.toarray()
# tfidf_train_weight.shape[1]
```

利用 Tokenizer(是一個用於向量化文字，或將文字轉換為序列（即單詞在字典中的下標構成的列表，從 1 算起）)轉換原本的文字為序列；先建立一個 5000 字的字典，讀取所有資料，依照每個英文字在訓練資料出現的次數進行排序，前 5000 名的英文單字會加進字典中，透過 texts_to_sequences 將訓練和測試集資料中的文字轉換為數字 list

```
It’s safe to say that Instagram Stories has far surpassed its competitor Snapchat in popularity since it’s inception two years ago—and your favorite celebrities have hopped on the social media trend. Unlike a highly curated photo feed, Instagram Stories is where celebrities seem to be comfortable enough to be raw and open.  Need something to do while you’re waiting in line or on a short break? Take a peek at these celebrities’ Instagram Stories for some surprisingly engaging entertainment.  Busy Philipps, @busyphilipps  A fantastic story teller, Busy was dubbed by The New Yorker as “the breakout star of Instagram Stories”. She captures everything from morning workouts to paparazzi run-ins and everything in between. If it isn’t on Busy’s story, I am assuming it didn’t happen.  Mandy Moore, @mandymooremm  Following Mandy Moore for her many This is Us behind-the-scenes stories is worth it alone! She also InstaStoried her home being built and decorated, her Mount Kilimanjaro climb, and the preparation behind all the Hollywood red carpet events she’s recently attended.  Chrissy Teigen, @chrissyteigen  Because if you follow and love her on Twitter and Snapchat, why wouldn’t you watch her Instagram Stories for more of her humor, cooking, and adorable daughter Luna?  Reese Witherspoon, @reesewitherspoon  Reese may be one of the biggest stars in the world, but she is a down-to-earth breath of fresh air on her Instagram stories!  Sarah Hyland, @sarahhyland  Somehow the Modern Family star makes eating dinner solo while watching The Bachelor interesting enough to keep watching.  Candace Cameron Bure, @candacecbure  I’ve had a soft spot for Candace since growing up with her on Full House, and I am living for the resurgence of her career! Follow Candace for Instagram Stories about fashion, family, workouts, and the behind-the-scenes of her on movie and TV sets.  Eva Chen, @evachen212  Though she may be biased about using the platform since becoming Director of Fashion Partnerships at Instagram, she’s still one to watch! Eva chronicles her daily life from early mornings with her adorable kids to international fashion week events.  Jessica Alba, @jessicaalba  This new mama of three adorably shows how she juggles her home and work life. And now that she is preparing to be back on TV, there’s sure to be some behind-the-scenes sneak peeks!  Kristin Cavallari, @kristincavallari  From reality TV to cookbook author and fashion designer, Kristin shares her own recipes and has just opened her first brick-and-mortar  for her fashion and home design line, Uncommon James.  Spencer Pratt, @spencerpratt  Hear me out! The Hills alum may have a villainous bad rap from his 15 minutes of fame, but his Instagram stories highlight his  family life with his 6-month-old son Gunner and wife Heidi. His many obsessions include hummingbirds, working out, coffee, and Taylor Swift.

[115, 1305, 3, 158, 7, 183, 571, 29, 542, 134, 2353, 6, 4186, 136, 115, 67, 76, 81, 751, 1071, 23, 8, 1, 338, 199, 4881, 3093, 4, 1993, 170, 183, 571, 13, 114, 1071, 1182, 3, 24, 2407, 610, 3, 24, 2, 655, 293, 224, 3, 70, 83, 737, 1744, 6, 484, 60, 8, 4, 887, 684, 173, 4, 18, 165, 183, 571, 9, 86, 641, 1909, 4, 3112, 180, 1909, 11, 26, 1, 48, 4631, 17, 358, 4584, 105, 5, 183, 14, 415, 27, 531, 3, 2580, 632, 2, 415, 6, 260, 69, 16, 1043, 8, 180, 15, 330, 16, 400, 880, 4632, 1955, 279, 4632, 1955, 9, 10, 153, 25, 13, 87, 554, 1, 1415, 571, 13, 837, 16, 1133, 14, 52, 10, 168, 106, 2519, 2, 10, 2, 1, 554, 43, 1, 269, 455, 1160, 1024, 304, 445, 802, 3168, 2724, 82, 69, 22, 1008, 2, 90, 10, 8, 202, 2, 2353, 248, 1662, 22, 437, 10, 183, 571, 9, 54, 5, 10, 3598, 2, 2036, 259, 4837, 2790, 1552, 2790, 101, 24, 42, 5, 1, 956, 457, 6, 1, 135, 28, 14, 13, 4, 140, 3, 2075, 5, 2480, 771, 8, 10, 183, 571, 1025, 3012, 1, 2076, 94, 105, 626, 2202, 1009, 1102, 83, 1019, 1, 1547, 1881, 610, 3, 410, 1019, 2925, 776, 39, 4, 4226, 1855, 9, 136, 1437, 41, 12, 10, 8, 466, 213, 2, 15, 330, 719, 9, 1, 5, 10, 365, 1008, 9, 183, 571, 35, 464, 94, 2, 1, 554, 1, 1415, 5, 10, 8, 282, 2, 285, 2814, 4396, 289, 14, 101, 24, 35, 838, 1, 2354, 136, 1137, 518, 5, 464, 18, 183, 304, 144, 42, 3, 437, 4396, 10, 768, 92, 27, 355, 12, 10, 2036, 361, 3, 717, 464, 227, 1024, 1262, 25, 48, 3969, 5, 151, 514, 96, 14, 10, 168, 2, 159, 92, 2, 71, 7, 14, 13, 3707, 3, 24, 85, 8, 285, 731, 449, 3, 24, 86, 554, 1, 1415, 4633, 27, 412, 285, 3, 2217, 2, 464, 1450, 4633, 1583, 10, 189, 2, 29, 58, 974, 10, 56, 2, 9, 10, 464, 2, 168, 1683, 484, 574, 2696, 2618, 937, 65, 45, 1, 1237, 3113, 101, 23, 4, 576, 2447, 27, 20, 262, 1046, 5, 1172, 28, 20, 183, 571, 20, 94, 92, 12, 20, 267, 329, 122, 406, 2, 284, 3399, 20, 153, 1082, 367, 45, 3442, 2, 528, 699]
```

In [5]:
```
from keras.preprocessing.sequence import pad_sequences
max_len = 100
new_X_train = pad_sequences(new_X_train, padding='post', maxlen=max_len)
new_X_test = pad_sequences(new_X_test, padding='post', maxlen=max_len)
print(new_X_train[0, :])
```

```
[2498  704  184  218    6  414  920    2   20  107  284 1887 2046  265
    4  303  247   78   22   55   11 1203   26 2055  144    1   67 1313
   39  565    1  545 1854  149  276    4   90    5  271  172   20 2833
   11  142  886    1   27 3111   46   15   11  208  920   38    6    7
  322    2   19   11 3578    3 4395  798 1062   60   60 1788   15   58
 1314   11 1068  127 2055  984   43  172    2   15   64   24 1600   74
   91    7   53 2758  312    1  858  395   53  211  599  181 1008 4630
    8  202]
```

進行深度學習模型訓練時長度必須固定，長度小於 100 的，前面的數字補 0，長度大於 100 的，截去前面的數字

In [6]:
```
train_label = pd.get_dummies(train_label).values
test_label = pd.get_dummies(test_label).values
```

In [7]:
```
print(new_X_train.shape)
print(train_label.shape)
print(new_X_test.shape)
print(test_label.shape)
```

```
(4987, 100)
(4987, 2)
(1247, 100)
(1247, 2)
```

In [8]:
```
from keras.models import Sequential
from keras.layers.core import Dense, Dropout, Activation, Flatten
from keras.layers.embeddings import Embedding
from keras.layers.recurrent import SimpleRNN
input_dim = vocab_size
modelRNN = Sequential()
modelRNN.add(Embedding( output_dim=32,
                        input_dim = vocab_size,
                        input_length=new_X_train.shape[1]))
#建立16個神經元的RNN層
modelRNN.add(Dropout(0.2))
modelRNN.add(SimpleRNN(units=16))
# 建立隱藏層
# 建立256個神經元的隱藏層
# ReLU激活函數
modelRNN.add(Dense(256 ,activation='relu'))
modelRNN.add(Dropout(0.7))
#建立輸出層
#建立一個神經元的輸出層
#Sigmoid激活函數
modelRNN.add(Dense(units=2,activation='sigmoid'))
modelRNN.summary()
#定義訓練模型
modelRNN.compile(loss='binary_crossentropy',
                 optimizer='adam',
                 metrics=['accuracy'])
```

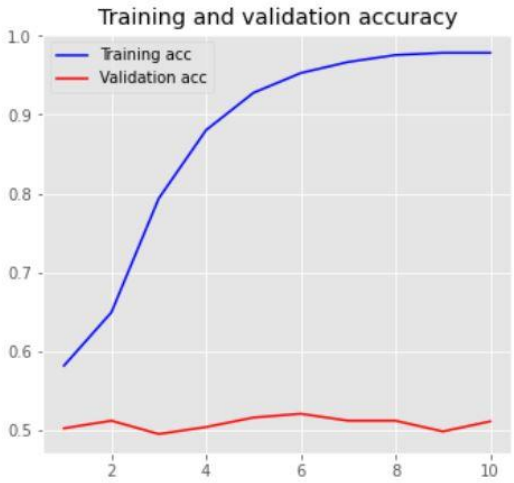
```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 32)           2681344
_________________________________________________________________
dropout (Dropout)            (None, 100, 32)           0
_________________________________________________________________
simple_rnn (SimpleRNN)       (None, 16)                784
_________________________________________________________________
dense (Dense)                (None, 256)               4352
_________________________________________________________________
dropout_1 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_1 (Dense)              (None, 2)                 514
=================================================================
Total params: 2,686,994
Trainable params: 2,686,994
Non-trainable params: 0
_________________________________________________________________
```

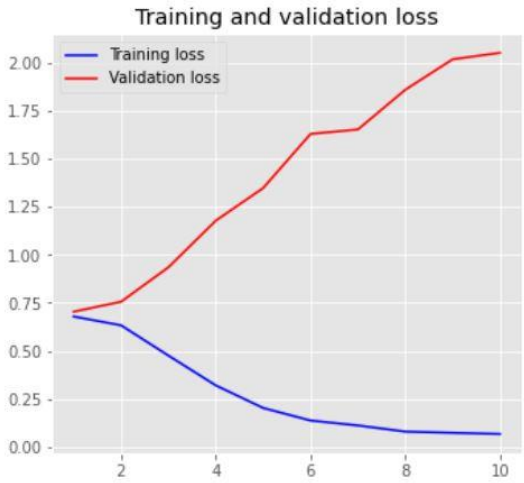
(RNN)Embedding 層將「數字 list」轉換成「向量 list」；隨機在神經網路中放棄 20%的神經元，避免 overfitting；建立 16 個神經元的 RNN 層；建立 256 個神經元的隱藏層，使用 ReLU 激活函數；隨機在神經網路中放棄 70%的神經元；建立兩個神經元的輸出層，使用 Sigmoid 激活函數；最後定義訓練模型。

In [11]:
```
# from keras import backend as K #转换为张量
# X_train1 = K.cast_to_floatx(X_train)
# train_label1 = K.cast_to_floatx(train_label)
# X_test1 = K.cast_to_floatx(X_test)
# test_label1 = K.cast_to_floatx(test_label)
new_X_train = new_X_train.astype('float64')
new_X_test = new_X_test.astype('float64')
train_label = train_label.astype('float64')
test_label = test_label.astype('float64')
print(new_X_train.shape, new_X_train.dtype)
print(train_label.shape, train_label.dtype)
print(new_X_test.shape, new_X_test.dtype)
print(test_label.shape, test_label.dtype)
history = modelRNN.fit(new_X_train, train_label,
                       epochs=10,
                       batch_size=100,
                       validation_data=(new_X_test, test_label),
                       verbose=2)
loss, accuracy = modelRNN.evaluate(new_X_train, train_label, verbose=False)
print("Training Accuracy: {:.4f}".format(accuracy))
loss, accuracy = modelRNN.evaluate(new_X_test, test_label, verbose=False)
print("Testing Accuracy:  {:.4f}".format(accuracy))
plot_history(history)
```

```
(4987, 100) float64
(4987, 2) float64
(1247, 100) float64
(1247, 2) float64
Epoch 1/10
50/50 - 2s - loss: 0.6790 - accuracy: 0.5815 - val_loss: 0.7044 - val_accuracy: 0.5020
Epoch 2/10
50/50 - 2s - loss: 0.6332 - accuracy: 0.6491 - val_loss: 0.7561 - val_accuracy: 0.5116
Epoch 3/10
50/50 - 2s - loss: 0.4756 - accuracy: 0.7937 - val_loss: 0.9357 - val_accuracy: 0.4948
Epoch 4/10
50/50 - 2s - loss: 0.3202 - accuracy: 0.8805 - val_loss: 1.1787 - val_accuracy: 0.5036
Epoch 5/10
50/50 - 2s - loss: 0.2026 - accuracy: 0.9278 - val_loss: 1.3486 - val_accuracy: 0.5156
Epoch 6/10
50/50 - 2s - loss: 0.1372 - accuracy: 0.9529 - val_loss: 1.6304 - val_accuracy: 0.5204
Epoch 7/10
50/50 - 2s - loss: 0.1115 - accuracy: 0.9669 - val_loss: 1.6536 - val_accuracy: 0.5116
Epoch 8/10
50/50 - 2s - loss: 0.0796 - accuracy: 0.9757 - val_loss: 1.8604 - val_accuracy: 0.5116
Epoch 9/10
50/50 - 2s - loss: 0.0732 - accuracy: 0.9785 - val_loss: 2.0193 - val_accuracy: 0.4980
Epoch 10/10
50/50 - 2s - loss: 0.0670 - accuracy: 0.9785 - val_loss: 2.0531 - val_accuracy: 0.5108
Training Accuracy: 0.9840
Testing Accuracy:  0.5108
```

執行 10 次訓練週期，每一批次訓練 100 筆資料





plot 出訓練過程中的 Accuracy 與 Loss 值變化，可看出此模型尚有 overfitting 的問題。

In [12]:
```
from keras.layers import LSTM, SpatialDropout1D
model = Sequential()
model.add(Embedding(output_dim=32,
                    input_dim = vocab_size,
                    input_length=new_X_train.shape[1]))
model.add(SpatialDropout1D(0.2))
model.add(LSTM(100, dropout=0.2, recurrent_dropout=0.2))
model.add(Dense(2, activation='softmax'))
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
print(model.summary())
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_1 (Embedding)      (None, 100, 32)           2681344
_________________________________________________________________
spatial_dropout1d (SpatialDr (None, 100, 32)           0
_________________________________________________________________
lstm (LSTM)                  (None, 100)               53200
_________________________________________________________________
dense_2 (Dense)              (None, 2)                 202
=================================================================
Total params: 2,734,746
Trainable params: 2,734,746
Non-trainable params: 0
_________________________________________________________________
None
```

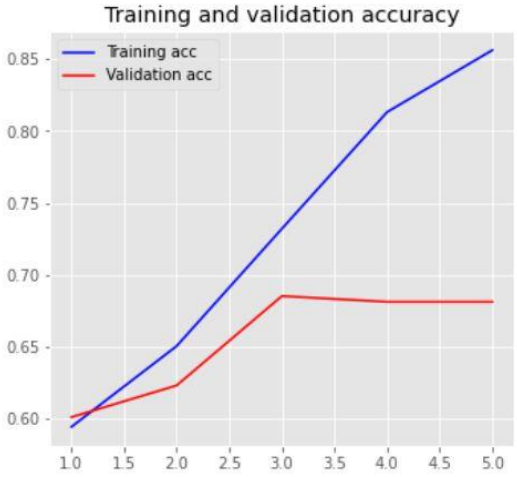
(LSTM)Embedding 層將「數字 list」轉換成「向量 list」；隨機在神經網路中放棄 20%的神經元，避免 overfitting；建立 100 個神經元的 LSTM 層；建立兩個神經元的輸出層，使用 Softmax 激活函數；最後定義訓練模型。

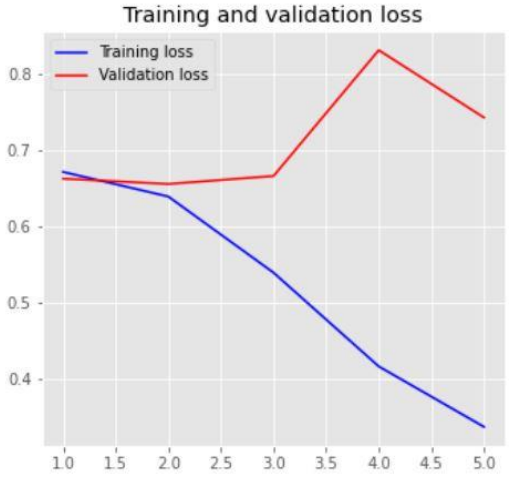
In [13]:
```
from keras.callbacks import EarlyStopping
epochs = 5
batch_size = 64

history = model.fit(new_X_train, train_label, epochs=epochs, batch_size=batch_size,validation_split=0.1,callbacks=[EarlyStopping(
plot_history(history)
```

```
Epoch 1/5
71/71 [==============================] - 9s 132ms/step - loss: 0.6715 - accuracy: 0.5945 - val_loss: 0.6626 - val_accuracy: 0.6
012
Epoch 2/5
71/71 [==============================] - 9s 126ms/step - loss: 0.6392 - accuracy: 0.6506 - val_loss: 0.6556 - val_accuracy: 0.6
232
Epoch 3/5
71/71 [==============================] - 9s 120ms/step - loss: 0.5391 - accuracy: 0.7322 - val_loss: 0.6661 - val_accuracy: 0.6
854
Epoch 4/5
71/71 [==============================] - 9s 125ms/step - loss: 0.4157 - accuracy: 0.8133 - val_loss: 0.8317 - val_accuracy: 0.6
814
Epoch 5/5
71/71 [==============================] - 9s 121ms/step - loss: 0.3363 - accuracy: 0.8563 - val_loss: 0.7430 - val_accuracy: 0.6
814
```

執行 5 次訓練週期，每一批次訓練 64 筆資料





plot 出訓練過程中的 Accuracy 與 Loss 值變化，可看出此模型後來還是有 overfitting 的問題。