In [111]:
```
import matplotlib.pyplot as plt
%matplotlib inline
import pprint as pp

import os
import glob
import numpy as np
import tensorflow as tf

import keras
from keras.layers import (Flatten,Dropout,Dense)
from keras.models import Sequential, Model
from sklearn.preprocessing import normalize
from sklearn.model_selection import train_test_split


import matplotlib.pyplot as plt
import matplotlib.image as mpimg
from PIL import Image
import numpy as np
```

In [112]:
```
from tensorflow.python.client import device_lib
print(device_lib.list_local_devices())
```

```
[name: "/device:CPU:0"
device_type: "CPU"
memory_limit: 268435456
locality {
}
incarnation: 4035397293525778052
, name: "/device:GPU:0"
device_type: "GPU"
memory_limit: 11286285517
locality {
  bus_id: 1
  links {
  }
}
incarnation: 1706585838172810432
physical_device_desc: "device: 0, name: Tesla K80, pci bus id: 0000:00:1e.0, compute capability: 3.7"
]
```

In [113]:
```
def img_to_hist(img_path, channels='rgb'):
    # load image
    img = Image.open(img_path)
    img.resize(size=(512,512))
    img = np.array(img)


    # channels
    red_channel = img[:,:,0]
    blue_channel = img[:,:,1]
    green_channel = img[:,:,2]
    # hists

    hist = np.histogram(red_channel, bins=256)[0]
    hist = np.concatenate([hist, np.histogram(blue_channel, bins=256)[0]])
    hist = np.concatenate([hist, np.histogram(green_channel, bins=256)[0]])

    return hist
```

In [114]:
```
# Load image data
image_limit=2000
filtered_images_path= glob.glob('/mnt/efs/filters_to_images/nash_images/*')[:image_limit]
unfiltered_imgs_path=glob.glob('/mnt/efs/filters_to_images/unfiltered_images/*')[:image_limit]
```

In [115]:
```
hist_list=[]
for image_path in (filtered_images_path+unfiltered_imgs_path):
    try:
        hist_list.append(img_to_hist(image_path))
    except:
        print(image_path)
X=np.array(hist_list)

X=normalize(X)
```

```
/mnt/efs/filters_to_images/nash_images/test
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00038978.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00043930.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00028144.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00016723.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00008380.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00039511.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00044920.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2013_val_00000756.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00012745.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00018091.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00032275.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00014293.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00040070.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00043659.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00019674.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00036909.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00019854.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00001028.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00026298.JPEG
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00028953.JPEG
```

In [116]:
```
X.shape
```

Out[116]: (3979, 768)

In [122]:
```
filtered_labels=np.full((len(filtered_images_path),2),(1,0),np.bool)
unfiltered_labels=np.full((len(unfiltered_imgs_path),2),(0,1),np.bool)[0:X.shape[0]-image_limit]
y=np.concatenate([filtered_labels,unfiltered_labels])
type(y)
```

Out[122]: numpy.ndarray

In [123]:
```
y.shape
```

Out[123]: (3979, 2)

In [124]:
```
test_split=0.2
X_train,X_val,y_train,y_val=train_test_split(X,y,test_size=test_split, shuffle=True )
```

In [150]:
```
model = Sequential()
model.add(Dense((3*256), activation='relu'))
model.add(Dense((4*256), activation='relu'))
model.add(Dense((3*256), activation='relu'))
model.add(Dense(2, activation='softmax'))
```

In [151]:
```
model.compile(loss='binary_crossentropy', optimizer=keras.optimizers.SGD(lr=0.0001, momentum=0.4), metrics=['accuracy'])
```

In [152]:
```
history = model.fit(X_train,y_train,epochs=150, batch_size=10,validation_data=(X_val, y_val))
```

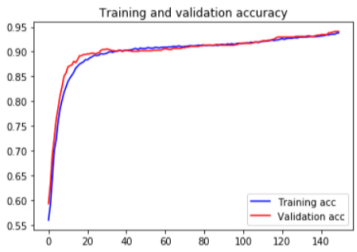
```
Train on 3183 samples, validate on 796 samples
Epoch 1/150
3183/3183 [==============================] - 2s 767us/step - loss: 0.6917 - acc: 0.5598 - val_loss: 0.6908 - val_acc: 0.5930
Epoch 2/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.6907 - acc: 0.5910 - val_loss: 0.6898 - val_acc: 0.6332
Epoch 3/150
3183/3183 [==============================] - 2s 558us/step - loss: 0.6897 - acc: 0.6456 - val_loss: 0.6887 - val_acc: 0.6922
Epoch 4/150
3183/3183 [==============================] - 2s 572us/step - loss: 0.6886 - acc: 0.7006 - val_loss: 0.6877 - val_acc: 0.7261
Epoch 5/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6876 - acc: 0.7232 - val_loss: 0.6866 - val_acc: 0.7626
Epoch 6/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.6866 - acc: 0.7590 - val_loss: 0.6856 - val_acc: 0.7864
Epoch 7/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6857 - acc: 0.7848 - val_loss: 0.6846 - val_acc: 0.8116
Epoch 8/150
3183/3183 [==============================] - 2s 545us/step - loss: 0.6847 - acc: 0.8021 - val_loss: 0.6837 - val_acc: 0.8291
Epoch 9/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6838 - acc: 0.8178 - val_loss: 0.6827 - val_acc: 0.8505
Epoch 10/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.6828 - acc: 0.8288 - val_loss: 0.6818 - val_acc: 0.8568
Epoch 11/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6819 - acc: 0.8398 - val_loss: 0.6808 - val_acc: 0.8693
Epoch 12/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6810 - acc: 0.8467 - val_loss: 0.6799 - val_acc: 0.8719
Epoch 13/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6801 - acc: 0.8523 - val_loss: 0.6790 - val_acc: 0.8731
Epoch 14/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.6792 - acc: 0.8586 - val_loss: 0.6780 - val_acc: 0.8807
Epoch 15/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.6782 - acc: 0.8668 - val_loss: 0.6770 - val_acc: 0.8781
Epoch 16/150
3183/3183 [==============================] - 2s 545us/step - loss: 0.6773 - acc: 0.8709 - val_loss: 0.6761 - val_acc: 0.8844
Epoch 17/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.6764 - acc: 0.8753 - val_loss: 0.6751 - val_acc: 0.8920
Epoch 18/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.6754 - acc: 0.8775 - val_loss: 0.6741 - val_acc: 0.8920
Epoch 19/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6744 - acc: 0.8797 - val_loss: 0.6731 - val_acc: 0.8945
Epoch 20/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6735 - acc: 0.8841 - val_loss: 0.6721 - val_acc: 0.8945
Epoch 21/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6725 - acc: 0.8838 - val_loss: 0.6711 - val_acc: 0.8957
Epoch 22/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6715 - acc: 0.8869 - val_loss: 0.6701 - val_acc: 0.8957
Epoch 23/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6704 - acc: 0.8891 - val_loss: 0.6691 - val_acc: 0.8970
Epoch 24/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.6694 - acc: 0.8916 - val_loss: 0.6680 - val_acc: 0.8970
Epoch 25/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6684 - acc: 0.8929 - val_loss: 0.6669 - val_acc: 0.8957
Epoch 26/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6673 - acc: 0.8922 - val_loss: 0.6658 - val_acc: 0.8970
Epoch 27/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6662 - acc: 0.8935 - val_loss: 0.6647 - val_acc: 0.8982
Epoch 28/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6651 - acc: 0.8963 - val_loss: 0.6636 - val_acc: 0.9033
Epoch 29/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6640 - acc: 0.8954 - val_loss: 0.6624 - val_acc: 0.9045
Epoch 30/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6629 - acc: 0.8960 - val_loss: 0.6612 - val_acc: 0.9045
Epoch 31/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6617 - acc: 0.8970 - val_loss: 0.6600 - val_acc: 0.9058
Epoch 32/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6606 - acc: 0.8995 - val_loss: 0.6588 - val_acc: 0.9045
Epoch 33/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6594 - acc: 0.9001 - val_loss: 0.6576 - val_acc: 0.9033
Epoch 34/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.6582 - acc: 0.8988 - val_loss: 0.6563 - val_acc: 0.9020
Epoch 35/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6569 - acc: 0.9007 - val_loss: 0.6551 - val_acc: 0.9020
Epoch 36/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.6557 - acc: 0.9010 - val_loss: 0.6538 - val_acc: 0.9008
Epoch 37/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6544 - acc: 0.9020 - val_loss: 0.6524 - val_acc: 0.9033
Epoch 38/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6531 - acc: 0.9029 - val_loss: 0.6511 - val_acc: 0.9020
Epoch 39/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6517 - acc: 0.9017 - val_loss: 0.6497 - val_acc: 0.9008
Epoch 40/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6504 - acc: 0.9029 - val_loss: 0.6483 - val_acc: 0.9020
Epoch 41/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6490 - acc: 0.9032 - val_loss: 0.6469 - val_acc: 0.9033
Epoch 42/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6476 - acc: 0.9032 - val_loss: 0.6454 - val_acc: 0.9020
Epoch 43/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6462 - acc: 0.9039 - val_loss: 0.6439 - val_acc: 0.9020
Epoch 44/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6447 - acc: 0.9042 - val_loss: 0.6424 - val_acc: 0.9008
Epoch 45/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6432 - acc: 0.9061 - val_loss: 0.6409 - val_acc: 0.9008
Epoch 46/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6417 - acc: 0.9064 - val_loss: 0.6393 - val_acc: 0.9008
Epoch 47/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6402 - acc: 0.9045 - val_loss: 0.6377 - val_acc: 0.9008
Epoch 48/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6386 - acc: 0.9073 - val_loss: 0.6360 - val_acc: 0.9020
Epoch 49/150
3183/3183 [==============================] - 2s 545us/step - loss: 0.6370 - acc: 0.9067 - val_loss: 0.6344 - val_acc: 0.9020
Epoch 50/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6353 - acc: 0.9061 - val_loss: 0.6326 - val_acc: 0.9020
Epoch 51/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6336 - acc: 0.9067 - val_loss: 0.6309 - val_acc: 0.9020
Epoch 52/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6319 - acc: 0.9083 - val_loss: 0.6291 - val_acc: 0.9020
Epoch 53/150
3183/3183 [==============================] - 2s 546us/step - loss: 0.6301 - acc: 0.9076 - val_loss: 0.6272 - val_acc: 0.9020
Epoch 54/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6282 - acc: 0.9070 - val_loss: 0.6253 - val_acc: 0.9020
Epoch 55/150
```

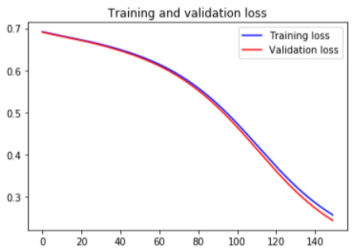
```
3183/3183 [==============================] - 2s 543us/step - loss: 0.6264 - acc: 0.9076 - val_loss: 0.6234 - val_acc: 0.9033
Epoch 56/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.6245 - acc: 0.9089 - val_loss: 0.6214 - val_acc: 0.9033
Epoch 57/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6225 - acc: 0.9083 - val_loss: 0.6194 - val_acc: 0.9033
Epoch 58/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6205 - acc: 0.9076 - val_loss: 0.6173 - val_acc: 0.9033
Epoch 59/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6184 - acc: 0.9089 - val_loss: 0.6151 - val_acc: 0.9033
Epoch 60/150

3183/3183 [==============================] - 2s 541us/step - loss: 0.6163 - acc: 0.9092 - val_loss: 0.6130 - val_acc: 0.9058
Epoch 61/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6142 - acc: 0.9092 - val_loss: 0.6107 - val_acc: 0.9058
Epoch 62/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.6120 - acc: 0.9092 - val_loss: 0.6084 - val_acc: 0.9058
Epoch 63/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6097 - acc: 0.9098 - val_loss: 0.6061 - val_acc: 0.9045
Epoch 64/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.6074 - acc: 0.9095 - val_loss: 0.6036 - val_acc: 0.9045
Epoch 65/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6050 - acc: 0.9111 - val_loss: 0.6012 - val_acc: 0.9070
Epoch 66/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6025 - acc: 0.9105 - val_loss: 0.5986 - val_acc: 0.9070
Epoch 67/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.6000 - acc: 0.9108 - val_loss: 0.5960 - val_acc: 0.9070
Epoch 68/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5975 - acc: 0.9120 - val_loss: 0.5934 - val_acc: 0.9070
Epoch 69/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5948 - acc: 0.9105 - val_loss: 0.5907 - val_acc: 0.9070
Epoch 70/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5921 - acc: 0.9101 - val_loss: 0.5879 - val_acc: 0.9083
Epoch 71/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.5894 - acc: 0.9108 - val_loss: 0.5850 - val_acc: 0.9083
Epoch 72/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.5866 - acc: 0.9111 - val_loss: 0.5821 - val_acc: 0.9095
Epoch 73/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5837 - acc: 0.9117 - val_loss: 0.5791 - val_acc: 0.9095
Epoch 74/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.5807 - acc: 0.9123 - val_loss: 0.5760 - val_acc: 0.9108
Epoch 75/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.5777 - acc: 0.9117 - val_loss: 0.5729 - val_acc: 0.9108
Epoch 76/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.5746 - acc: 0.9120 - val_loss: 0.5696 - val_acc: 0.9108
Epoch 77/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5714 - acc: 0.9123 - val_loss: 0.5664 - val_acc: 0.9108
Epoch 78/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5682 - acc: 0.9133 - val_loss: 0.5630 - val_acc: 0.9108
Epoch 79/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5648 - acc: 0.9127 - val_loss: 0.5595 - val_acc: 0.9121
Epoch 80/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.5614 - acc: 0.9136 - val_loss: 0.5560 - val_acc: 0.9121
Epoch 81/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.5580 - acc: 0.9133 - val_loss: 0.5524 - val_acc: 0.9133
Epoch 82/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5544 - acc: 0.9127 - val_loss: 0.5488 - val_acc: 0.9133
Epoch 83/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.5508 - acc: 0.9133 - val_loss: 0.5451 - val_acc: 0.9133
Epoch 84/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.5472 - acc: 0.9133 - val_loss: 0.5412 - val_acc: 0.9133
Epoch 85/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5434 - acc: 0.9130 - val_loss: 0.5374 - val_acc: 0.9133
Epoch 86/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.5396 - acc: 0.9130 - val_loss: 0.5334 - val_acc: 0.9133
Epoch 87/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.5357 - acc: 0.9133 - val_loss: 0.5294 - val_acc: 0.9146
Epoch 88/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5317 - acc: 0.9127 - val_loss: 0.5252 - val_acc: 0.9146
Epoch 89/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5277 - acc: 0.9142 - val_loss: 0.5210 - val_acc: 0.9133
Epoch 90/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.5235 - acc: 0.9149 - val_loss: 0.5168 - val_acc: 0.9133
Epoch 91/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.5193 - acc: 0.9145 - val_loss: 0.5124 - val_acc: 0.9133
Epoch 92/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.5150 - acc: 0.9142 - val_loss: 0.5080 - val_acc: 0.9133
Epoch 93/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.5107 - acc: 0.9158 - val_loss: 0.5035 - val_acc: 0.9133
Epoch 94/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.5063 - acc: 0.9149 - val_loss: 0.4989 - val_acc: 0.9133
Epoch 95/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.5018 - acc: 0.9161 - val_loss: 0.4943 - val_acc: 0.9133
Epoch 96/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.4972 - acc: 0.9152 - val_loss: 0.4896 - val_acc: 0.9133
Epoch 97/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.4926 - acc: 0.9155 - val_loss: 0.4848 - val_acc: 0.9146
Epoch 98/150
3183/3183 [==============================] - 2s 539us/step - loss: 0.4879 - acc: 0.9167 - val_loss: 0.4800 - val_acc: 0.9146
Epoch 99/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.4832 - acc: 0.9171 - val_loss: 0.4751 - val_acc: 0.9171
Epoch 100/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.4784 - acc: 0.9167 - val_loss: 0.4702 - val_acc: 0.9171
Epoch 101/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.4735 - acc: 0.9174 - val_loss: 0.4652 - val_acc: 0.9171
Epoch 102/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.4686 - acc: 0.9174 - val_loss: 0.4601 - val_acc: 0.9171
Epoch 103/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.4636 - acc: 0.9180 - val_loss: 0.4550 - val_acc: 0.9171
Epoch 104/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.4587 - acc: 0.9177 - val_loss: 0.4499 - val_acc: 0.9171
Epoch 105/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.4536 - acc: 0.9193 - val_loss: 0.4447 - val_acc: 0.9171
Epoch 106/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.4485 - acc: 0.9186 - val_loss: 0.4395 - val_acc: 0.9183
Epoch 107/150
3183/3183 [==============================] - 2s 548us/step - loss: 0.4435 - acc: 0.9193 - val_loss: 0.4343 - val_acc: 0.9196
Epoch 108/150
3183/3183 [==============================] - 2s 572us/step - loss: 0.4384 - acc: 0.9193 - val_loss: 0.4290 - val_acc: 0.9196
Epoch 109/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.4332 - acc: 0.9186 - val_loss: 0.4238 - val_acc: 0.9196
Epoch 110/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.4281 - acc: 0.9205 - val_loss: 0.4185 - val_acc: 0.9209
Epoch 111/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.4229 - acc: 0.9208 - val_loss: 0.4132 - val_acc: 0.9221
Epoch 112/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.4177 - acc: 0.9211 - val_loss: 0.4079 - val_acc: 0.9221
Epoch 113/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.4126 - acc: 0.9215 - val_loss: 0.4026 - val_acc: 0.9221
Epoch 114/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.4074 - acc: 0.9221 - val_loss: 0.3973 - val_acc: 0.9234
Epoch 115/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.4022 - acc: 0.9230 - val_loss: 0.3920 - val_acc: 0.9234
Epoch 116/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.3971 - acc: 0.9233 - val_loss: 0.3867 - val_acc: 0.9246
Epoch 117/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.3920 - acc: 0.9227 - val_loss: 0.3815 - val_acc: 0.9259
```

```
Epoch 118/150
3183/3183 [==============================] - 2s 545us/step - loss: 0.3869 - acc: 0.9237 - val_loss: 0.3763 - val_acc: 0.9284
Epoch 119/150

3183/3183 [==============================] - 2s 542us/step - loss: 0.3818 - acc: 0.9243 - val_loss: 0.3711 - val_acc: 0.9296
Epoch 120/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.3768 - acc: 0.9252 - val_loss: 0.3659 - val_acc: 0.9296
Epoch 121/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.3718 - acc: 0.9268 - val_loss: 0.3608 - val_acc: 0.9296
Epoch 122/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.3668 - acc: 0.9249 - val_loss: 0.3558 - val_acc: 0.9296
Epoch 123/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.3619 - acc: 0.9265 - val_loss: 0.3508 - val_acc: 0.9296
Epoch 124/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.3571 - acc: 0.9271 - val_loss: 0.3458 - val_acc: 0.9296
Epoch 125/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.3523 - acc: 0.9274 - val_loss: 0.3409 - val_acc: 0.9296
Epoch 126/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.3476 - acc: 0.9271 - val_loss: 0.3361 - val_acc: 0.9296
Epoch 127/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.3429 - acc: 0.9284 - val_loss: 0.3313 - val_acc: 0.9296
Epoch 128/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.3383 - acc: 0.9281 - val_loss: 0.3266 - val_acc: 0.9309
Epoch 129/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.3337 - acc: 0.9281 - val_loss: 0.3220 - val_acc: 0.9309
Epoch 130/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.3293 - acc: 0.9296 - val_loss: 0.3175 - val_acc: 0.9309
Epoch 131/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.3249 - acc: 0.9293 - val_loss: 0.3130 - val_acc: 0.9309
Epoch 132/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.3206 - acc: 0.9296 - val_loss: 0.3086 - val_acc: 0.9309
Epoch 133/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.3164 - acc: 0.9296 - val_loss: 0.3043 - val_acc: 0.9309
Epoch 134/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.3122 - acc: 0.9299 - val_loss: 0.3001 - val_acc: 0.9322
Epoch 135/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.3081 - acc: 0.9306 - val_loss: 0.2959 - val_acc: 0.9322
Epoch 136/150
3183/3183 [==============================] - 2s 544us/step - loss: 0.3041 - acc: 0.9306 - val_loss: 0.2918 - val_acc: 0.9309
Epoch 137/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.3002 - acc: 0.9306 - val_loss: 0.2878 - val_acc: 0.9309
Epoch 138/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.2964 - acc: 0.9306 - val_loss: 0.2839 - val_acc: 0.9322
Epoch 139/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.2927 - acc: 0.9309 - val_loss: 0.2801 - val_acc: 0.9334
Epoch 140/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.2890 - acc: 0.9312 - val_loss: 0.2764 - val_acc: 0.9334
Epoch 141/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.2854 - acc: 0.9318 - val_loss: 0.2727 - val_acc: 0.9347
Epoch 142/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.2819 - acc: 0.9325 - val_loss: 0.2692 - val_acc: 0.9347
Epoch 143/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.2785 - acc: 0.9331 - val_loss: 0.2657 - val_acc: 0.9347
Epoch 144/150
3183/3183 [==============================] - 2s 542us/step - loss: 0.2752 - acc: 0.9343 - val_loss: 0.2623 - val_acc: 0.9347
Epoch 145/150
3183/3183 [==============================] - 2s 543us/step - loss: 0.2719 - acc: 0.9340 - val_loss: 0.2590 - val_acc: 0.9384
Epoch 146/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.2687 - acc: 0.9353 - val_loss: 0.2557 - val_acc: 0.9384
Epoch 147/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.2656 - acc: 0.9353 - val_loss: 0.2526 - val_acc: 0.9397
Epoch 148/150
3183/3183 [==============================] - 2s 540us/step - loss: 0.2626 - acc: 0.9356 - val_loss: 0.2495 - val_acc: 0.9410
Epoch 149/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.2596 - acc: 0.9375 - val_loss: 0.2465 - val_acc: 0.9410
Epoch 150/150
3183/3183 [==============================] - 2s 541us/step - loss: 0.2568 - acc: 0.9381 - val_loss: 0.2436 - val_acc: 0.9410
```

In [153]:
```
acc = history.history['acc']
val_acc = history.history['val_acc']
loss = history.history['loss']
val_loss = history.history['val_loss']

epochs = range(len(acc))

plt.plot(epochs, acc, 'b', label='Training acc')
plt.plot(epochs, val_acc, 'r', label='Validation acc')
plt.title('Training and validation accuracy')
plt.legend()

plt.figure()

plt.plot(epochs, loss, 'b', label='Training loss')
plt.plot(epochs, val_loss, 'r', label='Validation loss')
plt.title('Training and validation loss')
plt.legend()
```

Out[153]:
```
<matplotlib.legend.Legend at 0x7f2f72a04128>
```





In [129]:
```
model.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
```

```
dense_50 (Dense)             (None, 768)               590592
_________________________________________________________________
dense_51 (Dense)             (None, 1024)              787456
_________________________________________________________________
dense_52 (Dense)             (None, 768)               787200
_________________________________________________________________
dense_53 (Dense)             (None, 2)                 1538
=================================================================
Total params: 2,166,786
Trainable params: 2,166,786
Non-trainable params: 0
_________________________________________________________________
```

In [154]:
```
# load image data
test_image=100
filtered_images_path= glob.glob('/mnt/efs/filters_to_images/nash_images/test/*')[0:test_image]
unfiltered_imgs_path=glob.glob('/mnt/efs/filters_to_images/unfiltered_images/*')[15000:15000+test_image]
```

In [155]:
```
hist_list=[]
for image_path in (filtered_images_path+unfiltered_imgs_path):
    try:
        hist_list.append(img_to_hist(image_path))
    except:
        print(image_path)
X_test=np.array(hist_list)

X_test=normalize(X_test)
```

```
/mnt/efs/filters_to_images/unfiltered_images/ILSVRC2012_val_00003760.JPEG
```

In [156]:
```
X_test.shape
```

Out[156]:
```
(199, 768)
```

In [157]:
```
filtered_labels=np.full((len(filtered_images_path),2),(1,0),np.bool)
unfiltered_labels=np.full((len(unfiltered_imgs_path),2),(0,1),np.bool)[0:X_test.shape[0]-test_image]
y_test=np.concatenate([filtered_labels,unfiltered_labels])
y_test.shape
```

Out[157]:
```
(199, 2)
```

In [158]:
```
x=np.expand_dims(X_val[15], axis=0)
model.predict(x)
```

Out[158]:
```
array([[0.9357413 , 0.06425868]], dtype=float32)
```

In [159]:
```
for x in X_test[100:200]:
    x=np.expand_dims(x, axis=0)
    print(model.predict(x))
```

```
[[0.10583858 0.89416146]]
[[0.14660178 0.8533982 ]]
[[0.28179926 0.7182007 ]]
[[0.17315161 0.8268483 ]]
[[0.12026056 0.87973946]]
[[0.1494761 0.8505239]]
[[0.44022167 0.5597783 ]]
[[0.15047936 0.8495207 ]]
[[0.11522503 0.884775  ]]
[[0.11566543 0.8843346 ]]
[[0.17425762 0.8257424 ]]
[[0.1296515 0.8703485]]
[[0.13710463 0.86289537]]
[[0.1314284 0.8685716]]
[[0.12384032 0.8761597 ]]
[[0.12682235 0.87317765]]
[[0.13352467 0.86647534]]
[[0.2737842 0.7262158]]
[[0.20661195 0.79338807]]
[[0.41179425 0.58820575]]
[[0.12721616 0.87278384]]
[[0.13198477 0.8680153 ]]
[[0.10635015 0.8936499 ]]
[[0.11872929 0.8812707 ]]
[[0.11076867 0.8892313 ]]
[[0.1294594 0.8705406]]
[[0.1163788  0.88362116]]
[[0.15513715 0.8448629 ]]
[[0.36298445 0.6370155 ]]
[[0.24344152 0.7565584 ]]
[[0.55579793 0.44420204]]
[[0.11660314 0.8833969 ]]
[[0.4204881  0.57951194]]
[[0.36302602 0.6369739 ]]
[[0.4188786  0.58112144]]
[[0.2967483 0.7032517]]
[[0.10827409 0.8917259 ]]
[[0.39076743 0.60923254]]
[[0.14331199 0.85668796]]
[[0.16327995 0.83672005]]
[[0.19103171 0.8089683 ]]
[[0.10227633 0.8977236 ]]
[[0.14551906 0.854481  ]]
[[0.13441667 0.86558336]]
[[0.10422058 0.89577943]]
[[0.19762547 0.8023746 ]]
[[0.17236964 0.82763034]]
[[0.20062011 0.7993799 ]]
[[0.12502271 0.87497735]]
[[0.39999965 0.6000004 ]]
[[0.09516864 0.90483135]]
[[0.14022154 0.85977846]]
[[0.11751936 0.8824807 ]]
[[0.16387229 0.83612776]]
[[0.09963131 0.9003687 ]]
[[0.20939429 0.7906057 ]]
[[0.32935768 0.6706423 ]]
[[0.23597476 0.7640252 ]]
[[0.17204781 0.8279522 ]]
[[0.19516577 0.8048342 ]]
[[0.40136823 0.5986318 ]]
[[0.11594513 0.8840549 ]]
[[0.09914193 0.90085804]]
[[0.35066506 0.6493349 ]]
[[0.10646348 0.89353645]]
[[0.15907499 0.84092504]]
[[0.22549702 0.774503  ]]
[[0.12981163 0.87018836]]
[[0.11543492 0.88456506]]
[[0.11550026 0.8844997 ]]
[[0.1457189  0.85428107]]
[[0.41113508 0.5888649 ]]
```

```
[[0.20105028 0.7989497 ]]
[[0.18859106 0.8114089 ]]
[[0.24283288 0.7571671 ]]
[[0.13479343 0.86520654]]
[[0.22944556 0.77055436]]
[[0.13782452 0.86217546]]
[[0.15050681 0.8494932 ]]
[[0.21761934 0.78238064]]
[[0.2927177 0.7072823]]
[[0.22939332 0.77060664]]
[[0.15969945 0.84030056]]
[[0.37747708 0.6225229 ]]
[[0.21366553 0.78633446]]
[[0.36949643 0.6305036 ]]
[[0.27932736 0.72067267]]
[[0.13965562 0.86034435]]
[[0.44278407 0.5572159 ]]
[[0.16142277 0.8385772 ]]
[[0.23823301 0.761767  ]]
[[0.15221024 0.8477898 ]]
[[0.21157807 0.788422  ]]
[[0.12570474 0.8742953 ]]
[[0.14232065 0.8576793 ]]
[[0.47923735 0.5207627 ]]
[[0.34125307 0.65874696]]
[[0.30388457 0.6961154 ]]
[[0.17742997 0.82257   ]]
```

In [160]:
```
model.evaluate(X_test, y_test, )
```

```
199/199 [==============================] - 0s 76us/step
```

Out[160]:
```
[0.25192081014714646, 0.9346733668341709]
```

In [ ]:
```
```