Accident Anticipation

Determining whether dashboard camera video contains an accident

I use a hierchical recurrent neural network implementation, trained on a set of videos with and without accidents, to determine whether a new video contains an accident or not.

Load in necessary packages

```
In [60]:   ## we want any plots to show up in the notebook
           %matplotlib inline
           ## has the usual packages I use
           %run startup
           import numpy
           import os
           import re
           import pickle
           import timeit
           import glob
           import cv2

           import random
           import matplotlib
           from array import array
           import sys


           from skimage import transform
           import skimage
           from skimage import io

           import sklearn
           from sklearn.model_selection import train_test_split   ### import skl
           earn tool

           import keras
           from keras.preprocessing import image as image_utils
           from keras.callbacks import ModelCheckpoint

           matplotlib.rcdefaults()  ### set the defaults
           matplotlib.rc('font',family='Bitstream Vera Serif')   ### I like my p
           lots to look a certain way :)
```

```
ERROR:root:File `'startup.py'` not found.
```

```
In [61]: ### here is the function to load in a video from file for analysis

         def load_set(videofile):
             '''The input is the path to the video file - the training videos
          are 99 frames long and have resolution of 720x1248
                 This will be used for each video, individially, to turn the vi
         deo into a sequence/stack of frames as arrays
                 The shape returned (img) will be 99 (frames per video), 144 (p
         ixels per column), 256 (pixels per row))
             '''
             ### below, the video is loaded in using VideoCapture function
             vidcap = cv2.VideoCapture(videofile)
             ### now, read in the first frame
             success,image = vidcap.read()
             count = 0        ### start a counter at zero
             success = True   ### start "sucess" flag at True

             img = []         ### create an array to save each image as an arra
         y as its loaded
             while success:  ### e.g.: while success == True
                 success, image = vidcap.read()  ### if success is still true,
         attempt to read in next frame from vidcap video import
                 ### read in only if there is an image
                 ### (this won't be true at the end of the video, but we don't
         want to save an empty image)
                 if success:
                     image = cv2.resize(image,(256,144))   ### resize to 144,2
         56
                     image = skimage.color.rgb2gray(image)   ### convert to gr
         ayscale
                     #image = skimage.transform.downscale_local_mean(image,
          (5,5))   ### downsample the image to be a bit more usable
                     #print shape(image)   ### old print check
                     img.append(image)      ### save processed image to video s
         tack
                 count += 1     ### increase count, and repeat
             if(numpy.shape(img)[0]>99):
                 img=img[-99:]
                 print (numpy.shape(img))
                 return img ## return stack of processed, time-dependent image
         s from video
             elif(numpy.shape(img)[0]<99):
                 ### add extra frames or Zero frames
                 shape=(144,256)
                 zeroFrame=numpy.zeros(shape)
                 while(numpy.shape(img)[0]<99):
                     img.append(zeroFrame)
                 print (numpy.shape(img))
                 return img
             elif(numpy.shape(img)[0]==99):
                 print (numpy.shape(img))
                 return img
```

```
In [62]: img_filepath = 'D:/Workspace/__Workstation/4th year project/CrashCatc
         her-master/My work/' #### the filepath for the training video set
         neg_all = glob.glob(img_filepath + 'Negative/*.mp4')            ##
         ## negative examples
         pos_all = glob.glob(img_filepath + 'Positive/*.mp4')
         #### positive examples

         all_files = numpy.concatenate((pos_all, neg_all))
         print (len(neg_all), len(pos_all))
         #### print check
```

100 100

```
In [63]: def label_matrix(values):
             '''transforms labels for videos to one-hot encoding/dummy variabl
         es'''
             n_values = numpy.max(values) + 1    ### take max value (that woul
         d be 1, because it is a binary classification),
                                                 ### and create n+1 (that woul
         d be two) sized matrix
             return numpy.eye(n_values)[values]  ### return matrix with result
         s coded ... '1' in first column for no-accident, '1' in second for ac
         cident

         labels = numpy.concatenate(([1]*len(pos_all), [0]*len(neg_all[0:len(p
         os_all)])))  ### create the labels for the videos
         labels = label_matrix(labels)          ### make the labels into a ma
         trix for the HRNN training
```

```
In [64]: def make_dataset(rand):
             seq1 = numpy.zeros((len(rand), 99, 144, 256))   ### create an emp
         ty array to take in the data
             for i,fi in enumerate(rand):                     ### for each fil
         e...
                 print (i, fi)                                ### as we go thro
         ugh, print out each one
                 if fi[-4:] == '.mp4':
                     t = load_set(fi)                         ### load in the v
         ideo file using previously defined function if .mp4 file
                 elif fi[-4:]=='.pkl':
                     t = pickle.load(open(fi, 'rb'))          ### otherwise, if
         it's pickled data, load the pickle
                 if numpy.shape(t)==(99,144,256):             ### double
          check to make sure the shape is correct, and accept
                     seq1[i] = t                              ### save image st
         ack to array
                 else:# TypeError:
                     print ('ERROR')
                     #'Image has shape ', numpy.shape(t), 'but needs to be sha
         pe', numpy.shape(seq1[0]) ### if exception is raised, explain
                     pass                                     ### continue load
         ing data
             print (numpy.shape(seq1))
             return seq1
```

```
In [65]:  ##### split data into training and validation (sets and shuffle)ii
          x_train, x_t1, y_train, y_t1 = train_test_split(all_files, labels, te
          st_size=0.30, random_state=0)   ### split
          x_train = numpy.asarray(x_train); y_train = numpy.asarray(y_train)
          ### need to be arrays

          x_testA = numpy.asarray(x_t1[int(len(x_t1)/2):])
          y_testA = numpy.asarray(y_t1[int(len(y_t1)/2):])     #### test set

          ### valid set for model
          x_testB = numpy.asarray(x_t1[:int(len(x_t1)/2)])
          y_testB = numpy.asarray(y_t1[:int(len(y_t1)/2)])     ### need to be ar
          rays
          x_test = make_dataset(x_testB)
          y_test=y_testB
```

```
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_guardrail_019.mp4
(99, 144, 256)
1 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_071.mp4
(99, 144, 256)
2 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_008.mp4
(99, 144, 256)
3 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_099.mp4
(99, 144, 256)
4 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_078.mp4
(99, 144, 256)
5 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_083.mp4
(99, 144, 256)
6 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_guardrail_006.mp4
(99, 144, 256)
7 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_047.mp4
(99, 144, 256)
8 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_guardrail_013.mp4
(99, 144, 256)
9 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_053.mp4
(99, 144, 256)
10 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_062.mp4
(99, 144, 256)
11 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_026.mp4
(99, 144, 256)
12 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_081.mp4
(99, 144, 256)
13 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_055.mp4
(99, 144, 256)
14 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_081.mp4
(99, 144, 256)
15 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_guardrail_008.mp4
(99, 144, 256)
16 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_034.mp4
(99, 144, 256)
17 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_031.mp4
(99, 144, 256)
18 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_038.mp4
(99, 144, 256)
```

```
19 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_075.mp4
(99, 144, 256)
20 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_084.mp4
(99, 144, 256)
21 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_046.mp4
(99, 144, 256)
22 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_046.mp4
(99, 144, 256)
23 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_060.mp4
(99, 144, 256)
24 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_061.mp4
(99, 144, 256)
25 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_024.mp4
(99, 144, 256)
26 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_080.mp4
(99, 144, 256)
27 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_086.mp4
(99, 144, 256)
28 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_023.mp4
(99, 144, 256)
29 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_045.mp4
(99, 144, 256)
(30, 99, 144, 256)
```

In [46]:
```python
#### populate data as random numbers as a sanity check
#seq3 = zeros((60,99,144,256))
#for j in range(60):   ### for each file...
#    [np.random.random((244,256)) for i in range(99)]    ### save ima
ge stack to array
#print (shape(seq3))              ### print check

#x_train2, x_test2, y_train2, y_test2 = train_test_split(seq3, label
s, test_size=0.2, random_state=0)  ### split
#x_train2 = array(x_train2); y_train2 = array(y_train2)     ### need
 to be arrays
#x_test2 = array(x_test2); y_test2 = array(y_test2)        ### need
 to be arrays
```

```python
### the code is largely appropriated from the following resource
### https://github.com/fchollet/keras/blob/master/examples/mnist_hier
archical_rnn.py

"""HRNNs can learn across multiple levels of temporal hiearchy over a
complex sequence.
Usually, the first recurrent layer of an HRNN encodes a time-dependen
t video (e.g. set of images)
into a vector. The second recurrent layer then encodes those vectors
 (encoded by the first layer) into a second layer.
# References
    - [A Hierarchical Neural Autoencoder for Paragraphs and Document
s](https://arxiv.org/abs/1506.01057)
    - [Hierarchical recurrent neural network for skeleton based actio
n recognition](http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumbe
r=7298714)
The first LSTM layer first encodes every column of pixels of shape (2
40, 1) to a column vector of shape (128,).
The second LSTM layer encodes then these 240 column vectors of shape
 (240, 128) to a image vector representing the whole image.
A final Dense layer is added for prediction.
"""
import keras
from keras.models import Model
from keras.layers import Input, Dense, TimeDistributed
from keras.layers import LSTM

### set hyper-parameters
batch_size = 15
num_classes = 2
epochs = 30

### number of hidden layers in each NN
row_hidden = 128
col_hidden = 128

### print basic info
print ('x_train shape: '+ str(x_train.shape))
print (str(x_train.shape[0])+ ' train samples')
print (str(x_test.shape[0])+ ' test samples')

### get shape of rows/columns for each image
frame, row, col = (99, 144, 256)

### 4D input - for each 3-D sequence (of 2-D image) in each video (4t
h)
x = Input(shape=(frame, row, col))

encoded_rows = TimeDistributed(LSTM(row_hidden))(x)   ### encodes row
 of pixels using TimeDistributed Wrapper
encoded_columns = LSTM(col_hidden)(encoded_rows)       ### encodes colu
mns of encoded rows using previous layer

### set up prediction and compile the model
prediction = Dense(num_classes, activation='softmax')(encoded_columns
)
```

```python
model = Model(x, prediction)
model.compile(loss='categorical_crossentropy', ### loss choice for ca
tegory classification - computes probability error
              optimizer='NAdam',                ### NAdam optimization
              metrics=['accuracy'])             ### grade on accuracy
 during each epoch/pass

### create a filepath to save best results as we go - http://machinel
earningmastery.com/check-point-deep-learning-models-keras/
### because who wants to train this crazy stuff more than once??!
i=0; filepath='HRNN_Model_200Videos.hdf5'
checkpoint = ModelCheckpoint(filepath, monitor='val_acc', verbose=1,
save_best_only=True, mode='max')
callbacks_list = [checkpoint]


### now we actually train - because of my laptop memory issues, this
 means the training data cannot
### be loaded into memory all at once because python will crash. To g
et around this issue, we load in
### the whole dataset and loop through in batches of 15.
### However, each time we pass through the entire dataset, the order
 of the data needs to be randomized.
### So, we shuffle the list of files during each epoch, then split in
to batches of 15 videos
numpy.random.seed(18247)  ### set a random seed for repeatability

for i in range(0, 30):                ### number of epochs
    print('*'+str(i)+'/30*****************************************')
    c = list(zip(x_train, y_train))   ### bind the features and labels
together
    random.shuffle(c)                 ### shuffle the list
    x_shuff, y_shuff = zip(*c)        ### unzip list into shuffled fea
tures and labels
    x_shuff = numpy.asarray(x_shuff)
    y_shuff= numpy.asarray(y_shuff) ### back into arrays

    x_batch = [x_shuff[i:i + batch_size] for i in range(0, len(x_shuf
f), batch_size)] ### make features into batches of 15
    y_batch = [y_shuff[i:i + batch_size] for i in range(0, len(x_shuf
f), batch_size)] ### make labels into batches of 15

    for j,xb in enumerate(x_batch):  ### for each batch in the shuffl
ed list for this epoch
        xx = make_dataset(xb)        ### load the feature data into a
rrays
        yy = y_batch[j]              ### set the labels for the batch

        model.fit(xx, yy,                        ### fit training
data
                  batch_size=len(xx),            ### reiterate ba
tch size - in this case we already set up the batches
                  epochs=1,                      ### number of ti
mes to run through each batch
                  validation_data=(x_test, y_test),  ### validation s
et from up earlier in notebook
                  callbacks=callbacks_list)      ### save if bett
```

```
er than previous!

# evaluate
scores = model.evaluate(x_test, y_test, verbose=0)    ### score model
print('Test loss:', scores[0])                        ### test loss
print('Test accuracy:', scores[1])                    ### test accura
cy (ROC later)
```

```python
In [72]:  ### first, load and compile the saved model to make predictions
          model.load_weights("HRNN_Model_200Videos.hdf5")
          model.compile(loss='binary_crossentropy', optimizer='Nadam', metrics=
          ['accuracy'])

          ### make the holdout test dataset for prediction and comparison
          x_holdout = make_dataset(x_testA)
```

0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_guardrail_017.mp4
(99, 144, 256)
1 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_056.mp4
(99, 144, 256)
2 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_051.mp4
(99, 144, 256)
3 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_012.mp4
(99, 144, 256)
4 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_023.mp4
(99, 144, 256)
5 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_090.mp4
(99, 144, 256)
6 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_030.mp4
(99, 144, 256)
7 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_guardrail_005.mp4
(99, 144, 256)
8 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_084.mp4
(99, 144, 256)
9 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_007.mp4
(99, 144, 256)
10 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_035.mp4
(99, 144, 256)
11 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_067.mp4
(99, 144, 256)
12 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_027.mp4
(99, 144, 256)
13 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_014.mp4
(99, 144, 256)
14 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_069.mp4
(99, 144, 256)
15 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_064.mp4
(99, 144, 256)
16 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_guardrail_009.mp4
(99, 144, 256)
17 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_076.mp4
(99, 144, 256)
18 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_019.mp4
(99, 144, 256)

```
19 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_044.mp4
(99, 144, 256)
20 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_072.mp4
(99, 144, 256)
21 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_025.mp4
(99, 144, 256)
22 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_085.mp4
(99, 144, 256)
23 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_098.mp4
(99, 144, 256)
24 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_050.mp4
(99, 144, 256)
25 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_025.mp4
(99, 144, 256)
26 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_031.mp4
(99, 144, 256)
27 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_061.mp4
(99, 144, 256)
28 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_041.mp4
(99, 144, 256)
29 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_057.mp4
(99, 144, 256)
(30, 99, 144, 256)
```

```
In [73]: matplotlib.pyplot.plot([0,1],[0,1],'k:',alpha=0.5)
         ### plot the "by chance" line - the goal is to achieve better than ra
         ndom accuracy
         ys = [y_train, y_testB, y_testA]                        ### set up lab
         els to be iterated through
         labs = ['Train', 'Valid', 'Test']                      ### set up tag
         s to be iterated through
         col = ['#4881ea', 'darkgreen', 'maroon']               ### set up col
         ors to be iterated through
         preds = []                                             ### set up pre
         diction as empty array to populate
         for i,xset in enumerate([x_train, x_testB, x_testA]):  ### iterate th
         rough each set of data
             if i==0:
                 new_pred = []                                  ### for first
          dataset, need to iterate through each
                 for k in xset:                                 ### to save me
         mory (because we can't load the whole
                     d = make_dataset([k])                      ### thing at o
         nce)
                     new_pred.append(model.predict(d))          ### prediction
         s with loaded model for each in training set
                 new_pred = numpy.asarray(new_pred).reshape((len(new_pred),2))
             else:
                 d = make_dataset(xset)                         ### can load a
         ll of valid/test datasets at once in memory
                 new_pred = model.predict(d)                    ### prediction
         s with loaded model for each valid/test dataset
             preds.append(new_pred)
             fpr, tpr, threshs = sklearn.metrics.roc_curve(ys[i][:,1], new_pre
         d[:,1]) ### get the false pos rate and true pos rate
             matplotlib.pyplot.plot(fpr, tpr, '-', color=col[i], alpha=0.7, lw
         =1.5, label=labs[i])       ### plot the ROC curve with false pos rate
          and true pos rate

             print (labs[i])
             print (sklearn.metrics.auc(fpr, tpr))             ### print area
          under curve for each set
             print (sklearn.metrics.accuracy_score(ys[i][:,1], [round(j) for j
         in new_pred[:,1]]))   ### print accuracy for each set
             print (sklearn.metrics.confusion_matrix(ys[i][:,1], [round(j) for
         j in new_pred[:,1]])) ### print confusion matrix for each

         matplotlib.pyplot.xlabel('False Positive Rate'); matplotlib.pyplot.yl
         abel('True Positive Rate')
         matplotlib.pyplot.legend(fancybox=True, loc=4, prop={'size':10})
         matplotlib.pyplot.show()
```

0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_032.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_097.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_082.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_guardrail_020.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_054.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_093.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_055.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_064.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\Vehicle_vehicle_052.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_087.mp4
(99, 144, 256)
(1, 99, 144, 256)
0 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_040.mp4
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work/Negative\NoAccident_053.mp4
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10 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_062.mp4
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11 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_026.mp4
(99, 144, 256)
12 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_081.mp4
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13 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_055.mp4
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14 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_081.mp4
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work/Positive\vehicle_guardrail_008.mp4
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work/Positive\vehicle_vehicle_034.mp4
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17 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_031.mp4
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work/Positive\vehicle_vehicle_038.mp4
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work/Positive\vehicle_vehicle_075.mp4
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20 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_084.mp4
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work/Positive\vehicle_vehicle_046.mp4
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work/Negative\NoAccident_060.mp4
(99, 144, 256)
24 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_061.mp4
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25 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_024.mp4
(99, 144, 256)
26 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_080.mp4
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27 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_086.mp4
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28 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_023.mp4
(99, 144, 256)
29 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_045.mp4
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(30, 99, 144, 256)
Valid
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 [ 4  9]]
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work/Positive\vehicle_guardrail_017.mp4
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1 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_056.mp4
(99, 144, 256)
2 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_051.mp4
(99, 144, 256)
3 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_012.mp4
(99, 144, 256)
4 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_023.mp4
(99, 144, 256)
5 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_090.mp4
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6 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_030.mp4
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work/Positive\vehicle_guardrail_005.mp4
```

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8 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_084.mp4
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9 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_007.mp4
(99, 144, 256)
10 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_035.mp4
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14 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Negative\NoAccident_069.mp4
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15 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_064.mp4
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16 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_guardrail_009.mp4
(99, 144, 256)
17 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_076.mp4
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(99, 144, 256)
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20 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_072.mp4
(99, 144, 256)
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(99, 144, 256)
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(99, 144, 256)
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(99, 144, 256)
26 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My work/Positive\vehicle_vehicle_031.mp4

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(99, 144, 256)
27 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Negative\NoAccident_061.mp4
(99, 144, 256)
28 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_041.mp4
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29 D:/Workspace/__Workstation/4th year project/CrashCatcher-master/My
work/Positive\vehicle_vehicle_057.mp4
(99, 144, 256)
(30, 99, 144, 256)
Test
0.5625
0.5
[[10  4]
 [11  5]]

C:\Python36\lib\site-packages\matplotlib\font_manager.py:1316: UserWa
rning: findfont: Font family ['Bitstream Vera Serif'] not found. Fall
ing back to DejaVu Sans
  (prop.get_family(), self.defaultFamily[fontext]))
```
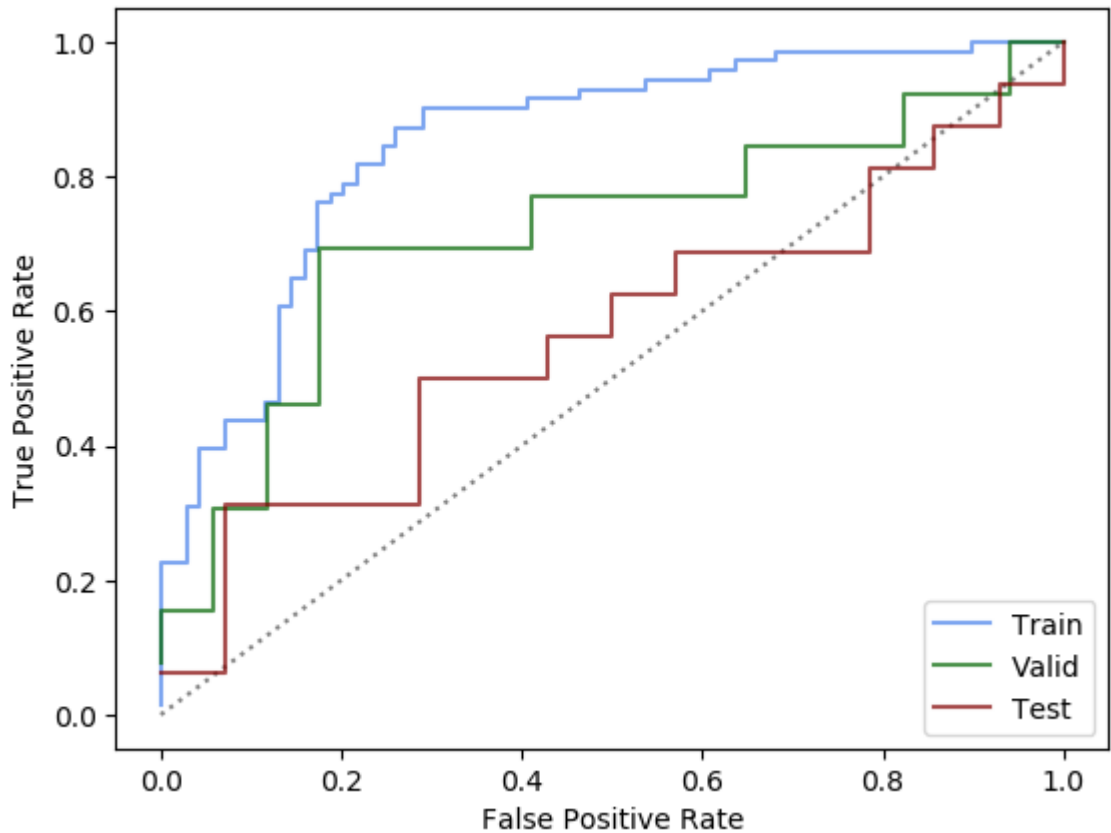
```
matplotlib.pyplot.plot([0,1],[0,1],'k:',alpha=0.5)                    #
## plot the "by chance" line - trying so hard to be better than thi
s...
for i,p in enumerate(preds):                     ### for each of the
calculated predictions, make a histogram
    matplotlib.pyplot.hist(p[:,1], bins = numpy.arange(0,1,0.05), his
ttype='stepfilled', color=col[i], alpha=0.7, label=labs[i])
matplotlib.pyplot.xlabel('False Positive Rate')
matplotlib.pyplot.ylabel('True Positive Rate')
matplotlib.pyplot.legend(fancybox=True, loc=2, prop={'size':10})
matplotlib.pyplot.show()
```

```
C:\Python36\lib\site-packages\matplotlib\font_manager.py:1316: UserWa
rning: findfont: Font family ['Bitstream Vera Serif'] not found. Fall
ing back to DejaVu Sans
  (prop.get_family(), self.defaultFamily[fontext]))
```