

Homework 5 solution

November, 2020

1 (a)

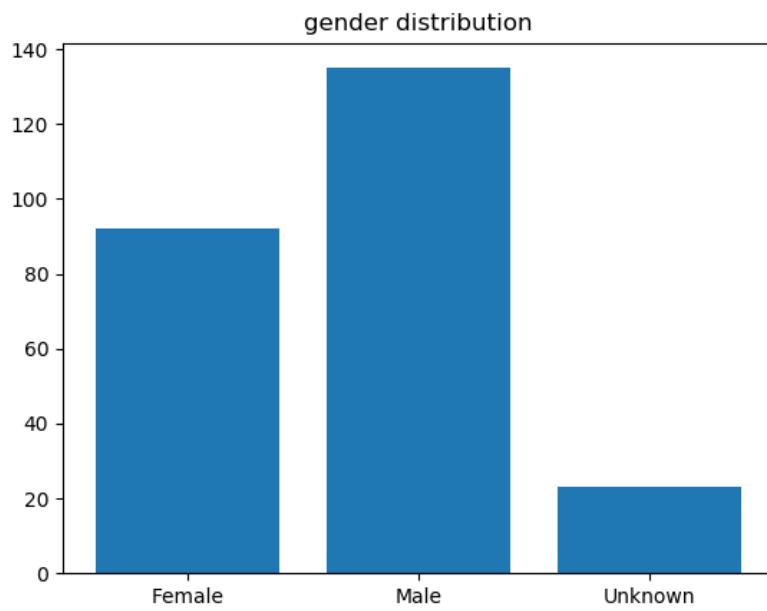
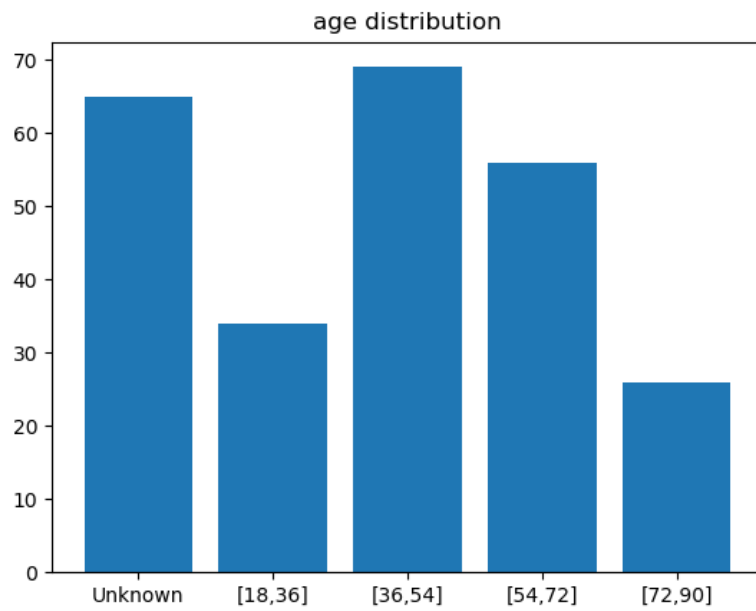
All the code is on https://github.com/Yipeng-LU/csce633_hw5.

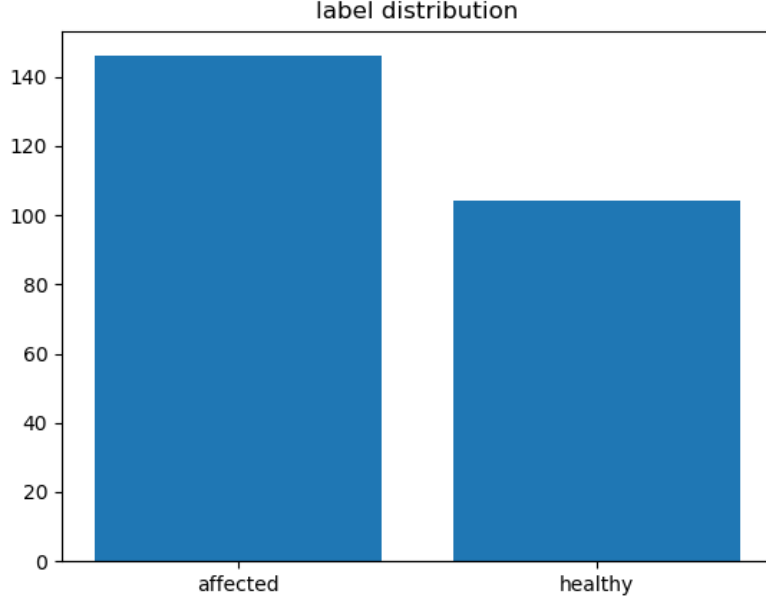
2 (b.i)

- (1) Gabor feature is especially suitable for edge detection and texture classification, thus might work well for the outcome of interest.
- (2) Prewitt feature contains horizontal and vertical edge information, thus might work well for the outcome of interest.
- (3) Grayscale Pixel feature just flattens the pixel value arrays of grayscale images.
- (4) HOG decomposes an image into small squared cells, computes an histogram of oriented gradients in each cell, normalizes the result using a block-wise pattern, and return a descriptor for each cell.

3 (b.ii)

The histograms of age, gender, and label are shown below.



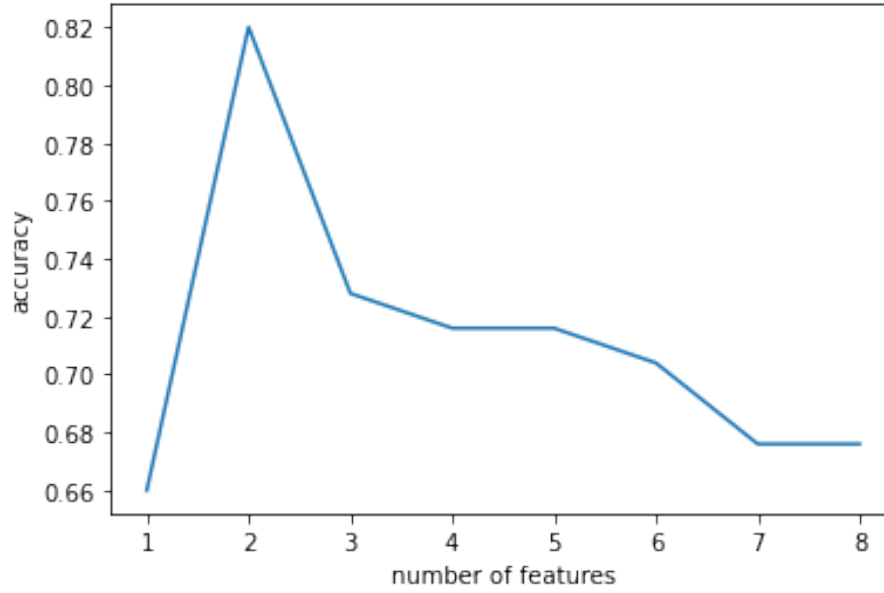


The fisher score of Gabor feature is 20369.003224988905.
 The fisher score of Hog feature is 14216.703563438341.
 The fisher score of Prewitt feature is 19786.13870552571.
 The fisher score of Grayscale Pixel feature is 13740.906502659298.
 The fisher score of Gender feature is 18544.99749880627.
 The fisher score of Location feature is 4921.891479833752.
 The fisher score of Age feature is 4131.613634563079.
 The fisher score of xrv feature is 45938.277309404526.

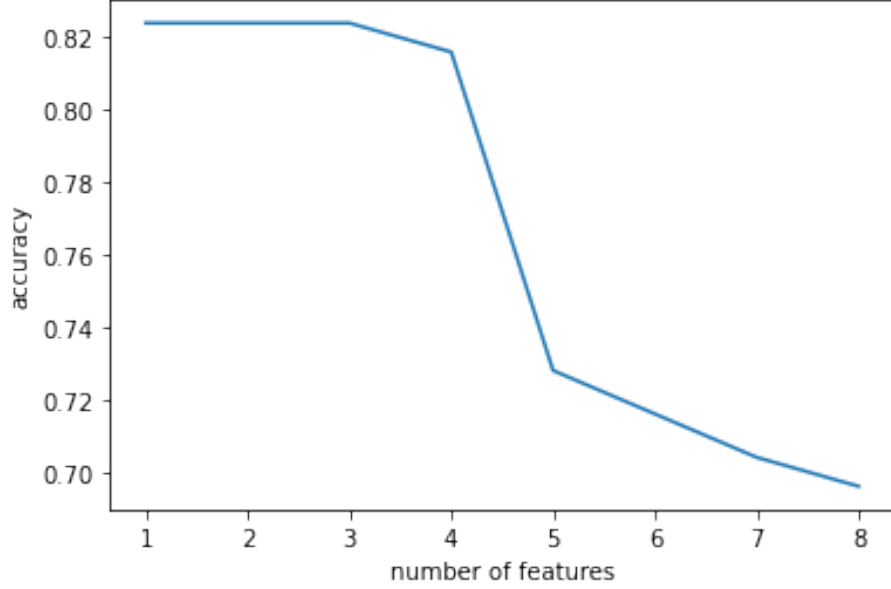
4 (b.iii)

The simple classifier is the linear svm. The c of each svm is tuned between 1 to 6.

For the filter category method, the feature evaluation metrics is fisher score. The sorted order of 8 features according to their informativeness for the outcome is: Age feature, Location feature, Grayscale Pixel feature, Hog feature, Gender feature, Prewitt feature, Gabor feature, xrv feature. The 5-fold accuracys for top1 to top8 combined features are: 0.6599999999999999, 0.82, 0.728, 0.716, 0.716, 0.7040000000000001, 0.6759999999999999, 0.6759999999999999. The total computational time is 875s. The plot of number of features vs. accuracy is shown below.



For the wrapper category method, I used sequential forward selection. The order of features to be selected is: Location feature, Age feature, xrv feature, Gender feature, Grayscale Pixel feature, Hog feature, Prewitt feature, Gabor feature. The 5-fold accuracys for top1 to top7 combined features are: 0.8240000000000001, 0.8240000000000001, 0.8240000000000001, 0.8160000000000001, 0.728, 0.716, 0.7040000000000001, 0.6960000000000001. The total computational time is 2303s. The plot of number of features vs. accuracy is shown below.



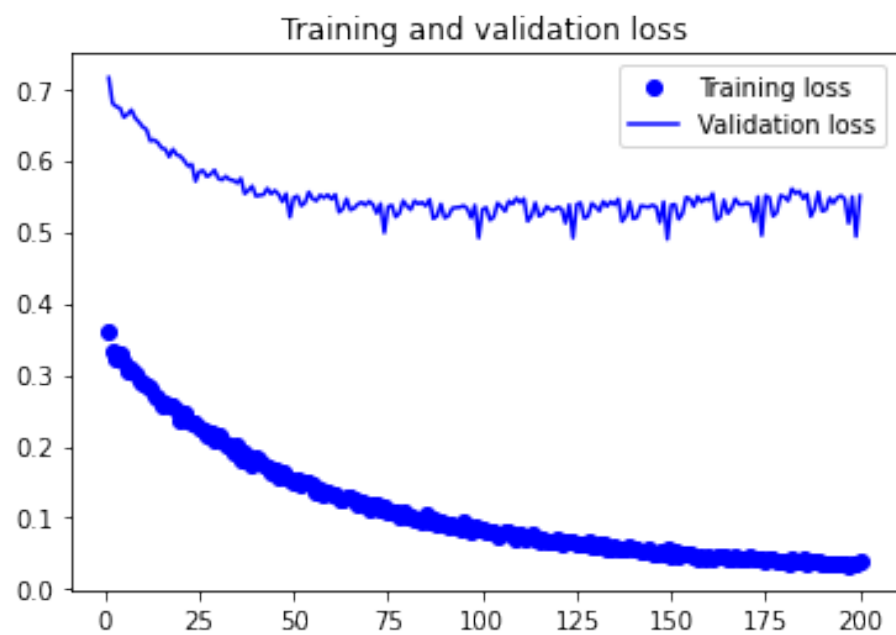
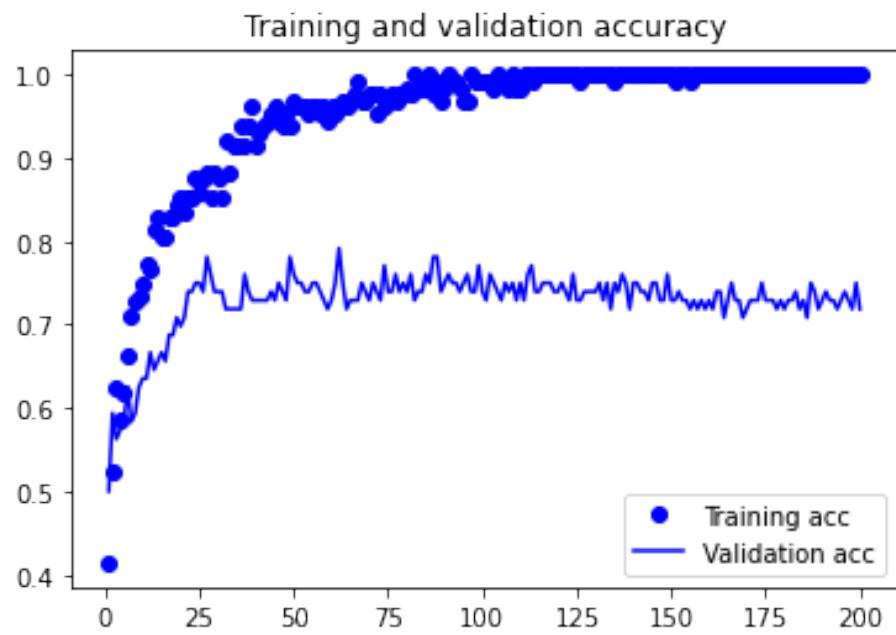
It could be observed that the filter category method is much faster than the wrapped category method, and the order of selecting features is different.

5 (b.iv)

All the features are used in this section. The adaboost classifier has 50 estimators at most, and a 1.0 learning rate. The 5-fold accuracy is 59.6%. The total computational time is 573s. Compared with feature selection, adaboost is less accurate.

6 (c)

We fine tune the VGG16 net. The top classifier is removed and a new classifier consists of two fully connected layers is added on the top. We rotate each training data by a random angle between -15 and 15 degrees before feeding into the network to reduce overfitting. The ratio of train-test split is set to 0.6:0.4. We choose adam optimizer and learning rate is set to $1e-5$. The weights of VGG16 convolution base are frozen. We trained the model for 200epochs, with a batch size of 25. The plots of training accuracy vs. validation accuracy, and training loss vs. validation loss are shown below. The validation loss reached its minimum at the 149th epochs, and the corresponding validation accuracy is 76.04%.



7 (e)

https://www.youtube.com/watch?v=JnYajYi9Z_A

8 (g)

Five reports are attached in the 'reports of other teams's work' folder.