Facial Emotion Recognition Using Decision Trees

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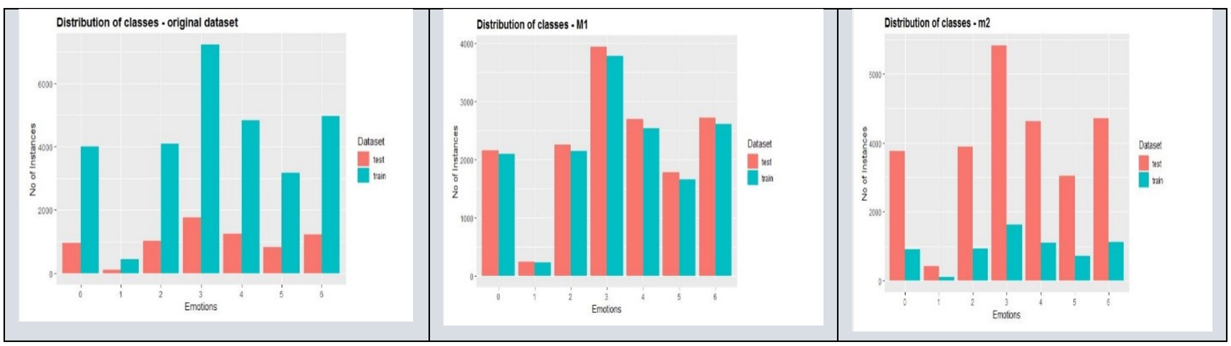
Introduction

The instances are first split to 2305 features. The analysis has been performed in R and weka.

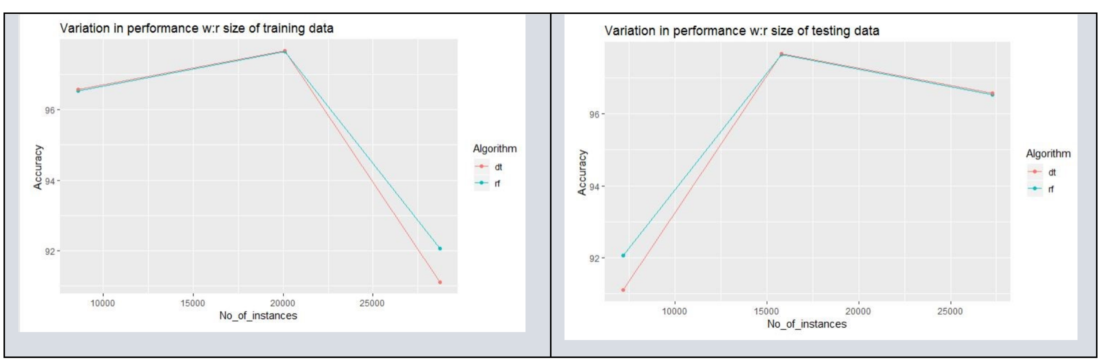
- In R, All the images in the train, as well as test sets, are first rotated, cropped, centred and scaled. Then we performed PCA on the processed datasets for reducing dimensions. The decision tree algorithm from the rpart package and ensemble algorithm of decision trees from the random forest are used for comparison in part I

VARIATION IN PERFORMANCE WITH THE SIZE - TRAIN AND TEST SETS

Three main datasets have been used for comparison. The distribution of classes in each of the datasets are shown in the fig below. The number of instances in the train is higher than test in the original dataset whereas it is lower in the other two.



The variation in the overall accuracy with respect to the size of training and testing data are plotted in the figures below. Accuracy is higher when the relative size of the train and test sets is similar whereas it deteriorates when the difference in sizes of train and test sets grows. The fig (r1) shows that other metrics such as sensitivity also increases with the reduction in the size difference.

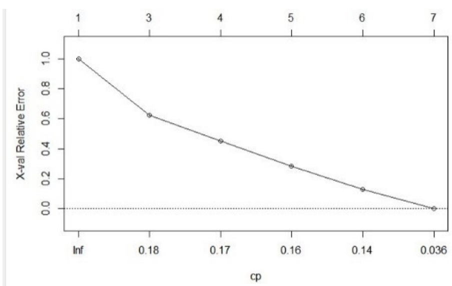


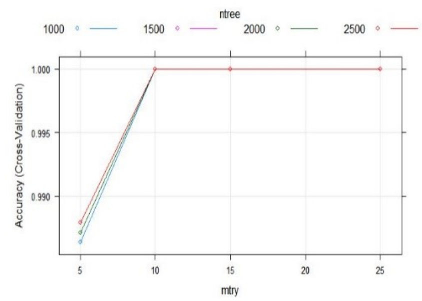
VARIATION IN PERFORMANCE WITH THE CHANGE IN LEARNING ALGORITHMS

The outputs from learning algorithms (i) decision tree (ii) random forest (iii) Convolutional Neural Networks by training models for the original dataset can be compared below.

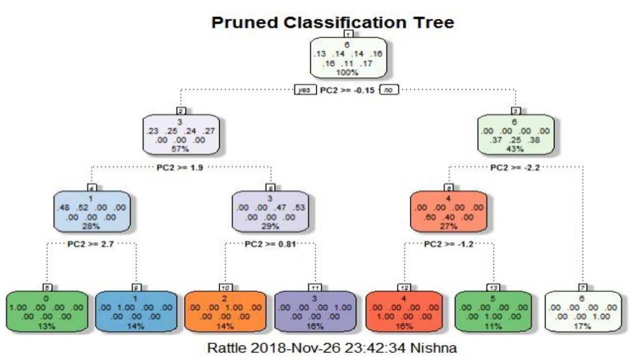
VARIATION IN PERFORMANCE WITH VARYING PARAMETERS IN DT

(i) Complexity parameter , cp – The variation in Relative Error with respect to variation in cp is illustrated in the plot below. The least error is observed for 0.036





(ii) Pruning – Fig shows the classification tree after pruning.



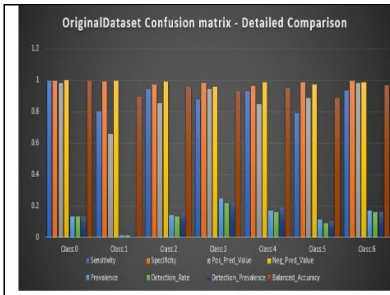
(iii) Mtry, ntree – Variation in accuracy of the random forest models with different values of mtry(No of features randomly sampled[1]) and ntree(No of trees to grow[2]) is given in the plot above. The best tune model is the one with mtry = 10 and ntree = 1000.

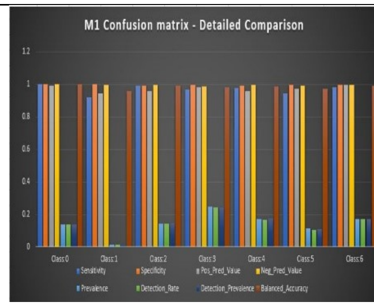
VARIATION IN PERFORMANCE WITH VARYING PARAMETERS IN NN

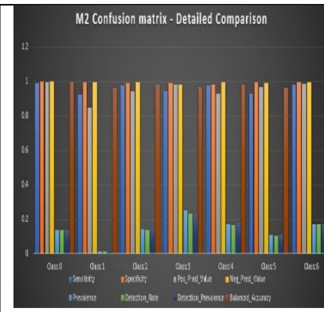
VARIATION IN PERFORMANCE ACCORDING TO DIFFERENT METRICES

Decision Trees

The detailed comparison of the performance metrics obtained for the three datasets is as shown in the plots below.







Highest overall accuracy is observed for the DT model for the m1 dataset. Class 0[Angry] which has the highest sensitivity is the most easily detected class whereas class 4 [] which recorded the least specificity is the most wrongly predicted emotion. Balanced Accuracy, which gives you the predictive quality of the model [], says that the most accurately predicted emotion is Angry.

RESEARCH QUESTION

Impact of preprocessing & balancing classes in a biased dataset

The original training dataset fer_training is an imbalanced class with the distribution as shown in fig 1 . A bench mark decision tree classifier trained with this dataset as such gives us a maximum accuracy of 26.65%.as seen in fig below. The performance of the model can be improved by 3 steps.

(i) Preprocessing - Rotation, Cropping, Centering, Scaling
(ii) Dimensionality Reduction -PCA
(iii) Balance the classes – SMOTE minority class & Under sample majority class

Sample image original image, rotated and cropped is given below.



tSNE visualization of the distribution of classes is given in the figures a,b,c & d. From these, it is clear that classification can be done dramatically better after the steps above.

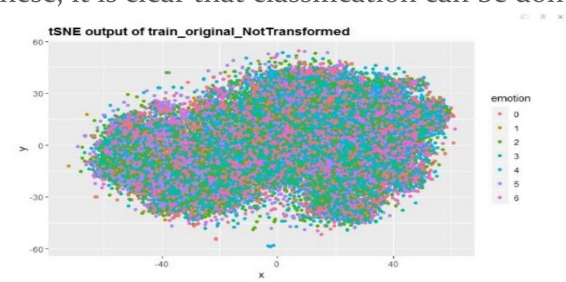


Fig a : Original dataset

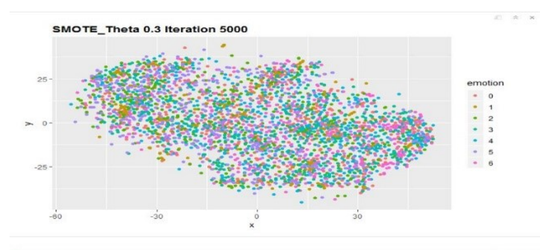


Fig b : Original Dataset – SMOTE

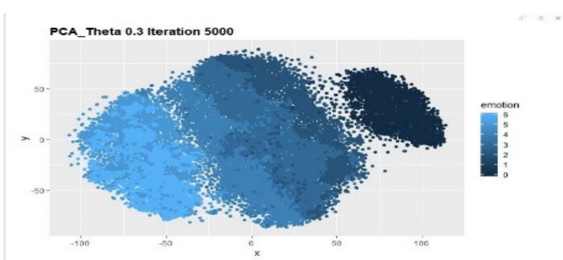


Fig c – PCA Transformed dataset

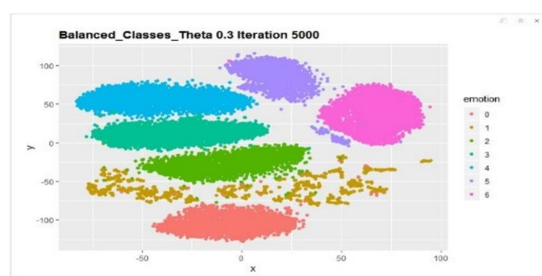


Fig d – PCA Transformed after SMOTE and under sampling

The performance metrics of the final classifier output is shown in the table below.

	Class:0	Class:1	Class:2	Class:3	Class:4	Class:5	Class:6
Sensitivity	0.9958	0.8018	0.9463	0.8777	0.9302	0.79182	0.9351
Specificity	0.9976	0.99349	0.9725	0.9824	0.9646	0.98661	0.997
Balanced Accuracy	0.9967	0.89765	0.9594	0.93	0.9474	0.88921	0.966