CS 529 Introduction to Machine Learning
Project 3 Report

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A brief view into Logistic regression:

-Definition as given by Google

Logistic regression definition is given by "It models the relationship between a dependent and one or more independent variables, and allows us to look at the fit of the model as well as at the significance of the relationships (between dependent and independent variables) that we are modeling."

Types of Logistic Regression:

There are two types of logistic regression where one of the parameters is a binary, then there will be only two outputs and we refer to it as binomial logistic regression. But if the dependent variable is not a binary parameter instead has a number of various outcomes possible then it is considered as a multinomial logistic regression. Currently in this case we are dealing with multinomial logistic regression. So there are two forms of this multinomial logistic regression, the first form is for Y = y1,y2,y3…..,yk-1

Forms of multinomial logistic regression

$$P(Y = y_k|X) = \frac{\exp(w_{k0} + \sum_{i=1}^{n} w_{ki}X_i)}{1 + \sum_{j=1}^{K-1} \exp(w_{j0} + \sum_{i=1}^{n} w_{ji}X_i)}$$

and for Y= yk,

$$P(Y = y_K|X) = \frac{1}{1 + \sum_{j=1}^{K-1} \exp(w_{j0} + \sum_{i=1}^{n} w_{ji}X_i)}$$

(from Tom Mitchell)

Gradient Descent:

As we select the songs in the genres and process them I have used gradient descent to update the weights. Gradient descent has been ideal option as it is a very convenient way to check the effect of minor changes in the weights that are effecting the program. Gradient descent allows its users to observe carefully in minute detail of the changes that happen. Also it is a very smooth curve that helps in convergence of weights, so that user can understand where to stop the testing. As gradient descent uses small steps to converge the weights, there will not be a case of a plateau creation which is a major set back to the weight updating.

a)

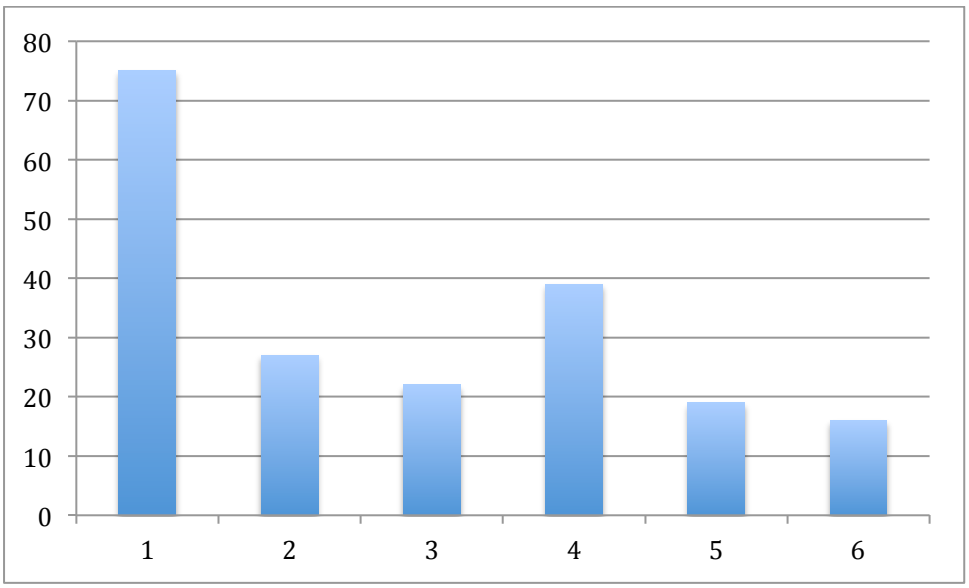
Confusion Matrix:

The columns denote the predicted class
The rows denote Actual Class
1: Classical 2: Jazz 3: Country 4: Pop 5: Rock 6: Metal

77	6	8	3	3	3
51	23	8	6	6	6
50	12	22	4	8	4
27	14	10	30	10	9
35	15	12	8	19	11
20	14	21	7	18	20

Best Accuracy:
43.3%

Average Accuracy:
31.8%



The classifier is more biased towards classical files. The reasons is as follows. Here the FFT values have been extracted to analyze the song and we have selected only first 1000 FFT components. The first 1000 FFT components are unique to classical songs compared to others hence the classifier may have been biased towards classical songs. Looking at the rest of the genres the accuracy is almost same for the rest of the classes.

b)

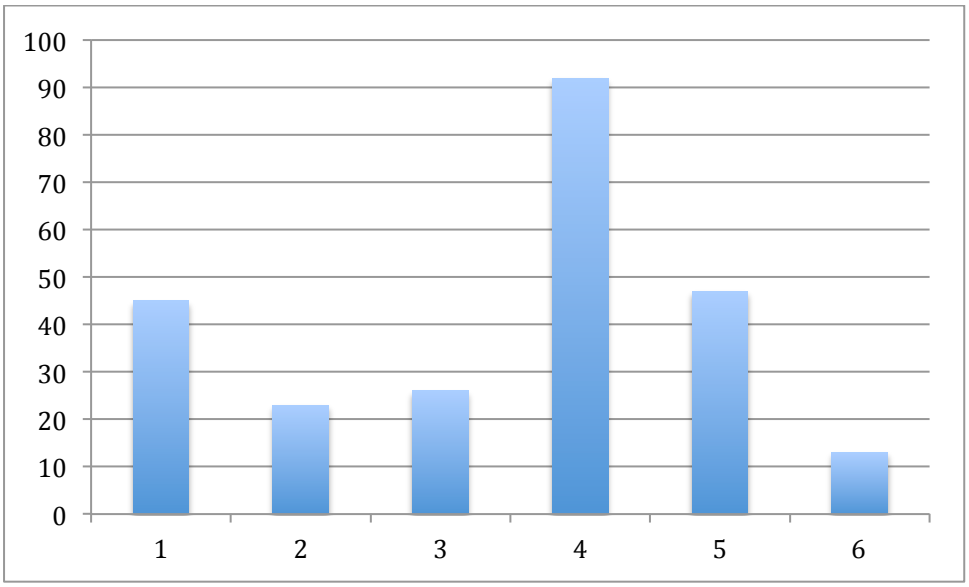
I have selected variance as a ranking method for the features. I have calculated the standard deviation of the features for each class. The variance value has been used to rank each feature. Based on the outcome of the ranking I have selected best features.

Confusion Matrix:

The columns denote the predicted class
The rows denote Actual Class
1: Classical 2: Jazz 3: Country 4: Pop 5: Rock 6: Metal

1	62	16	10	5	6
3	32	13	23	15	14
3	39	21	12	12	13
3	30	5	24	14	24
3	19	20	9	30	19
10	28	8	15	17	22

Best: Accuracy 35%
Average Accuracy: 21%



Even though the best features have been selected the accuracy has reduces than compared to previous method. This is because the size of the input data has reduced. Hence the classifier performs poor job in training no matter what the epochs are. Also as the best features have been selected to train the classifier there is a danger of over fitting during the training,

The classifier is more biased towards metal songs. The reason is as follows. The input data for the classifier is the best 20 features of each class based on the variance of the features. Based on that the features selected for the metal songs bring out the important features. Hence the classifier is more biased towards metal.

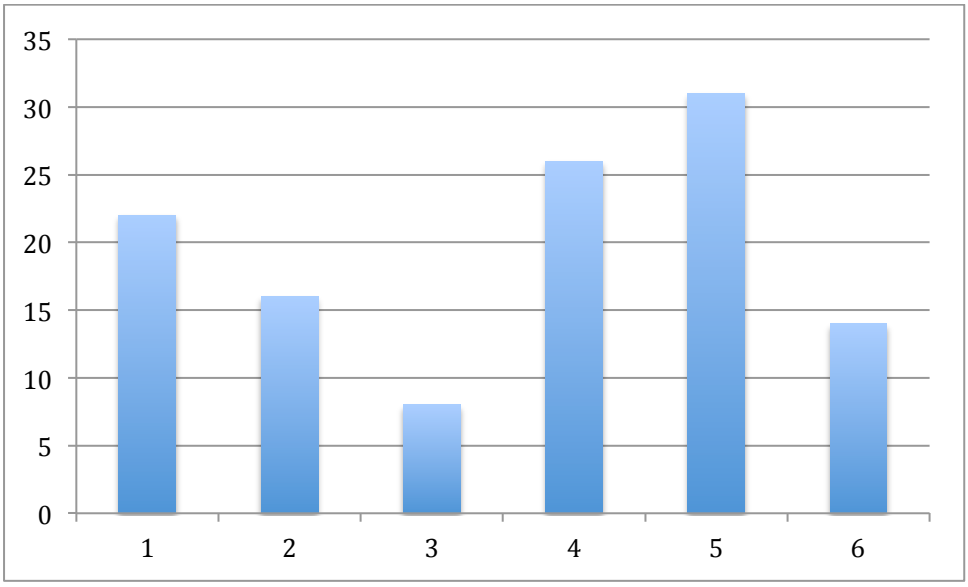
c)

Confusion Matrix:

The columns denote the predicted class
The rows denote Actual Class
1: Classical 2: Jazz 3: Country 4: Pop 5: Rock 6: Metal

53	7	10	13	12	5
1	24	11	37	14	13
5	10	26	35	16	8
0	2	0	93	4	1
1	1	1	44	51	2
3	7	4	57	12	17

Best Accuracy: 60%
Average Accuracy: 44%



The classifier based on the MFCC data of the songs seems to perform much better than FFT. Though the classifier is more biased towards pop. The classifier has done a good job in classifying the classical, metal genres also.