ASSIGNMENT 8: REGRESSION

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(a) Brief Summary of the Project:

In this project, we have to implement different regression methods to classify a given image as face or background. There are two datasets consisting of both face and background images which we have to use for training and testing. Regression is a statistical process of estimating relationships among variables. Different regression models should be implemented for classifying the images. Also, for each method, we need to learn the parameters from the training dataset and infer the label of test images (face or background).

(b) Outline of the algorithmic approach:

We have to implement different regression models as following for the detection process:

1. Logistic Regression: First we perform the Logistic Regression, where the output is characterized as a function of the input images with corresponding weights as coefficients to these images. One or more elements determine this output. We have to generate a matrix of all the face and background images and determine the phi vector. We have to infer the classification of the test images using these phi values.

2. Bayesian Logistic Regression: Next method is same as the logistic regression, in addition, a prior probability distribution for the phi is considered and then the conditional probability of phi is represented with a normal pdf to employ Laplace approximation. After learning the phi values, the inference is made possible.

3. Dual Logistic Regression: Here, the value of phi is factorized into a product of X and psi, where psi has a dimension of the length of the input images whereas phi is of length of pixels in each input image. Using psi, we can handle input images which are very big in size and have complex calculations.

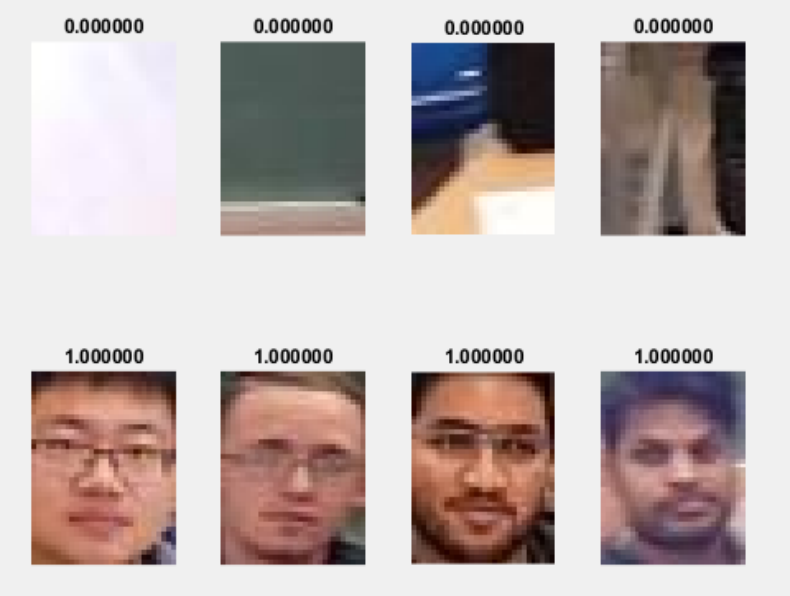
4. Dual Bayesian Logistic Regression: In the next task, we have to find the coefficients to get the inference on test images. For this, we combine the prior and the psi approach.

5. Kernel Logistic Regression: In this approach, we need to find the kernel. Using Logistic Regression, we compute the dot product of input image with itself.

6. Relevance Vector Logistic Regression: Here again use the previous technique along with an additional parameter nu. Later the predictions are used to classify the images.

(c) Pictures of intermediate or final results

The Miss Detection values of the regression models should be closer to zero for better classification and accordingly the performance of the Dual Logistic and Bayesian Logistic regressions should be better than the logistic regression. But as you can see from the output results, the miss detection value of Bayesian is worse than Logistic Regression and that of Dual approach is almost the same as Logistic Regression. The reason behind it might be due to the zero initializated Psi.

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Logistic Regression
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Miss Detection Rate: 0.025126
False Alarm Rate: 0.156977
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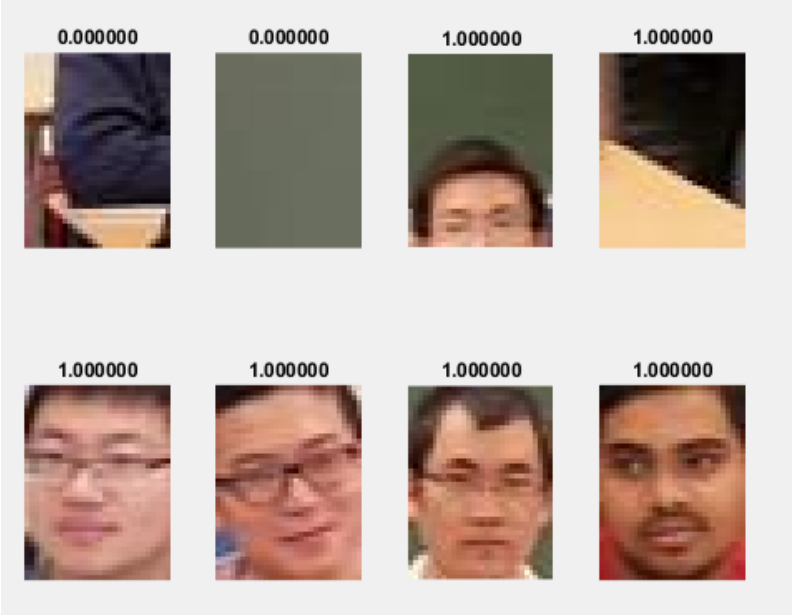
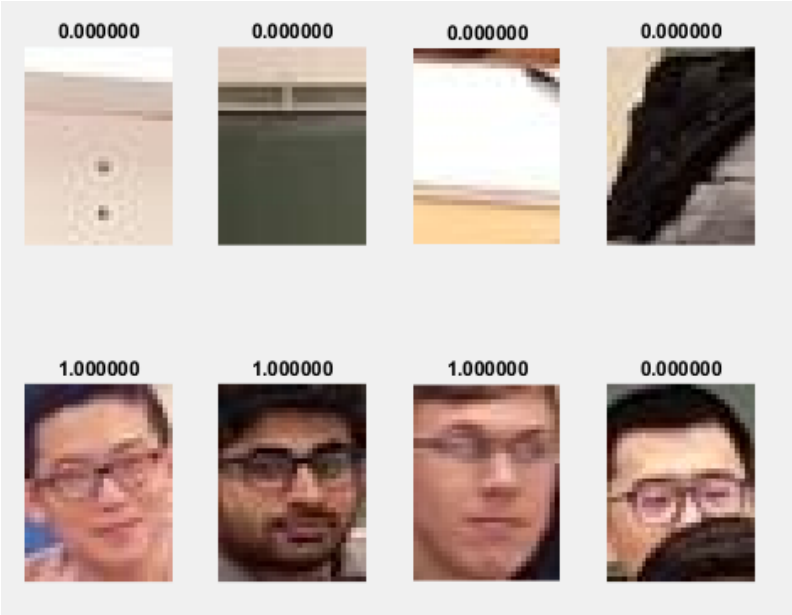


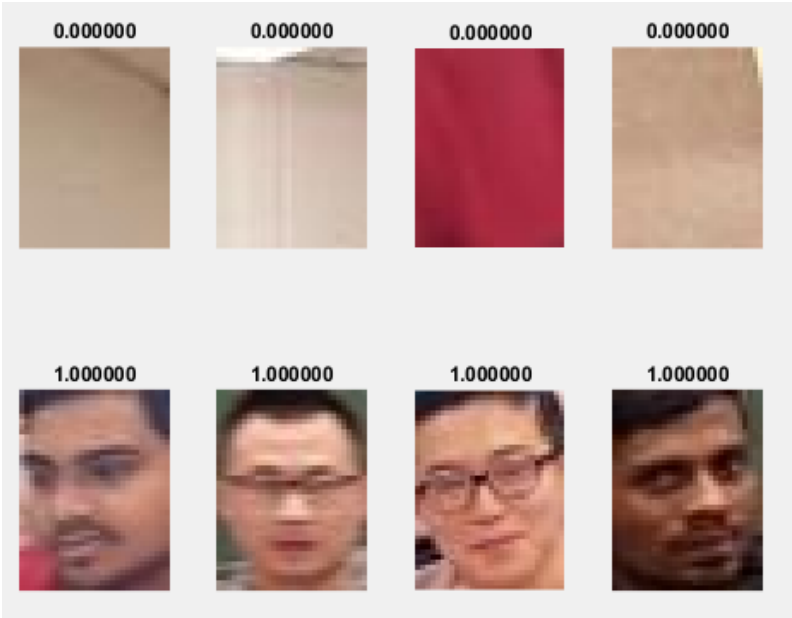
Bayesian Logistic Regression

Miss Detection Rate: 0.050251
False Alarm Rate: 0.203488



Dual Logistic Regression

Miss Detection Rate: 0.025126
False Alarm Rate: 0.162791

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Dual Bayesian Logistic Regression
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Miss Detection Rate: 0.025126
False Alarm Rate: 0.156977
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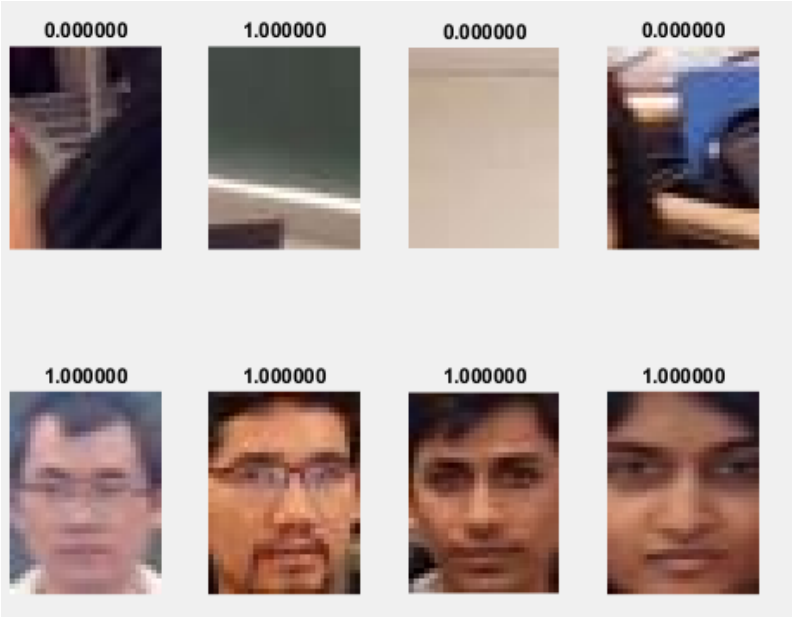


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Kernel Logistic Regression
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Miss Detection Rate: 0.040201
False Alarm Rate: 0.313953
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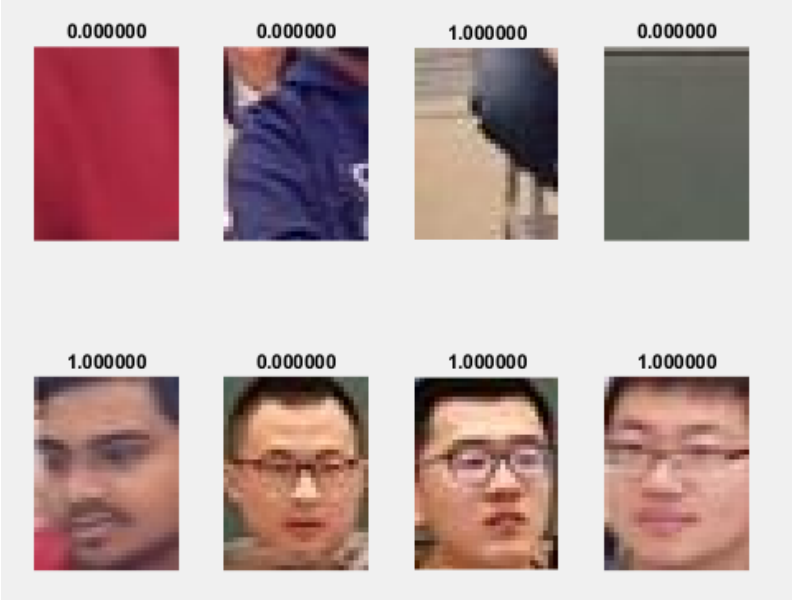


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Relevance Vector Logistic Regression
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Miss Detection Rate: 0.256281
False Alarm Rate: 0.151163
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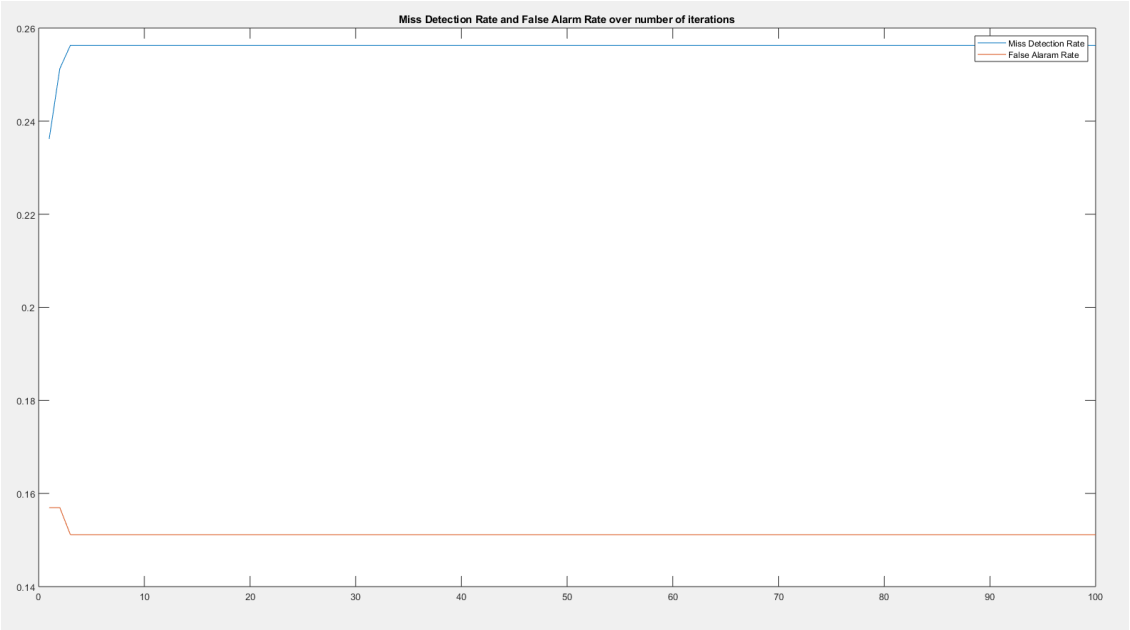

Figure: Miss Detection and False Alarm vs. Iterations

Observation:

As the number of iterations increase the miss detection and false alarm values initially start low but later increase and then stabilize. I have tried the last experiment with variable lambda and nu values and I have observed the same pattern in all the cases!