

Assignment 2

In the files for this assignment you will find the skeleton of a code for a classifier, as well as a text file containing the results of simulated neural inputs. Each sample is a list of neural inputs (some excitatory and some inhibitory). The label of each sample is 1 if the inputs caused an action potential and -1 otherwise.

Go over the code skeleton and its functions carefully, notice how features and labels are separated, a bias is inserted artificially into the list of features, and how the data is separated into a training set and a test set. Additionally, notice what values are defined inside the parameters variable.

You will fill in the contents of 3 sub-functions: `train_model`, `predict_y` & `evaluate_model`.

- 1) A) Fill the missing parts of the `train_model` function, the training will be done for 500 epochs with hinge loss and $\alpha=0.1$
B) Fill in the `predict_y` and `evaluate_model` functions to use the trained weights and predict y values for the test set and compare your prediction to the labels of the test set.
C) read about the `rng` function in the following [link](#), why is this important when debugging machine learning algorithms? Explain. You may try changing the seed, or running the algorithm without the `rng` function and describe the results.
- 2) A) Train your model using different hyperparameter values: try running the algorithm with α set to 0.001, 0.01, 0.05, 0.1, 0.5, 1, 5 and 50 while listing both training and test error (normalized to % accuracy). Explain your results, use the terms we learned in class, if something doesn't fit your expectations, try to explain why.
B) setting α back to 0.1, change the max number of epochs. Attempt 50, 2000 and values between them. When is a good place to stop? Is this different then changing the value of α ? Explain
- 3) Using the answers to question 2, suggest a new stopping criteria that maximizes the accuracy for the test set. Implement your idea in the code.

- 4) A) Add a regularization term to the error and weight update, add $\lambda = 0.2$ to the parameters. List the training and test errors, explain your results
B) change the value of λ , set values between 0.001 and 5 when running the algorithm, demonstrate how this changes the results, explain.
- 5) Bonus: Change the error function and the weight updates to the log sigmoid error we learned in class (logistic regression). Use $\alpha=0.1$ and 500 iterations. Explain how the training process changes in comparison to hinge loss. Hint: data labels need to be changed from -1 to 0. (save this as a different function)

Administration

In your report, only include figures that are required to aid in your explanations.

Exercises requiring submission are done in groups of three-four and should be emailed to the TA by the deadline. Submission should include **One file only**:

RAR / ZIP file containing all matlab code files required by the exercise and a DOC / DOCX / PDF file including full answers, graphs and reports required by the exercise.

Hand-written pages that are placed in order in the file and scanned in high quality are allowed.

Code submitted must run and produce all figures presented in your report.

Figures should have a title, labels for axes, and a short explanation of the information in the figure, and the conclusions derived from it

Email title should include #assignment, and the submitting students full name and ID

For example, Email subject: "Assignment 3, submitted by Eric Kandel 01234787485 and Mitch Hedberg 06487693241 ".

Assignments handed in not following these instructions will have their grades reduced.