

Mini-assignment – Artificial Neural Network (ANN)

1. Title: Implementing and training an artificial neural network to solve the circle classification problem
2. Objective: The goal of this assignment is to implement a simple neural network with one hidden layer and use it to classify points as either inside or outside a circle. Students will apply the backpropagation algorithm to train the network on a provided dataset and evaluate its performance.
3. Problem Statement: Given a dataset (ANN_circle.csv) consisting of 100 points in a 2D space. Each point is labeled as either "1" (inside the circle) or "0" (outside the circle). The circle is centered at the origin (0, 0) with a radius $r = 1$. Your task is to:
 - a. Design and implement a neural network with:
 - i. An input layer with 2 neurons (corresponding to the x_1 and x_2 coordinates of a point).
 - ii. A hidden layer with a reasonable number of neurons (you may start with 2-4 neurons).
 - iii. An output layer with 1 neuron that predicts whether the point is inside or outside the circle.
 - b. Train the neural network using the provided dataset, applying the backpropagation algorithm to adjust the weights. Show all codes and equations
 - c. Visualize the decision boundary learned by the network. Compare it to the actual circular boundary. Show the figures or plots as necessary to best illustrate the decision boundary.
 - d. Evaluate the network's performance by testing it on new, unseen data points. Calculate the accuracy and discuss any potential sources of error.
4. Submission Requirements:
 - a. Source Code: Submit the complete source code used for training and visualizing the neural network.
 - b. Report: A brief report (2-3 pages) explaining your approach, challenges faced, results obtained, and any conclusions drawn. Report submits in pdf format. Codes to be placed in the report annex.
 - c. Visualization: Include plots of the data points, decision boundary, and any other relevant visualizations.
5. Bonus Challenge:
 - a. Experiment with different network architectures (e.g., adding more hidden layers, changing the number of neurons) and see how the network's performance changes.
 - b. Apply the neural network to solve a more complex non-linear classification problem.
6. Due Date: week 5, 14th September 2024, 2359. Submission file naming convention: StudentName_number_ANN.pdf

