

Deep Learning – homework 2

- התרגיל יבוצע בזוגות. את התוצרים יעלה רק אחד מבני הזוג בציון שמות + ת.ז. של שותפי ההגשה.
 - תוצרי התרגיל הינם קוד בפיתון + מסמך PDF / WORD
 - תוצרי הפרויקט יועלו ל MOODLE
 - הפתרון המצטיין יפורסם לכלל הסטודנטים
 - ניתן להשתמש במודלי AI לצורך הפתרון וכתובת הקוד. ניתן להיעזר בסטודנטים אחרים. **אין להעתיק**
-

1. Suppose you are training a neural network for binary classification with a sigmoid activation function in the output layer and Binary Cross-Entropy (BCE) as the loss function.

- Derive the gradient of the BCE loss function with respect to the weights of the output layer.
- Explain how the gradient is influenced by the magnitude of the predictions (close to 0 or 1).

2. Given the following confusion matrix for a multi-class classification problem with three classes (A, B, and C):

	Predicted: A	Predicted: B	Predicted: C
Actual: A	50	5	10
Actual: B	7	60	8
Actual: C	4	6	80

- Calculate the accuracy, precision, recall, and F1-score for each class.
- Provide the overall accuracy and the weighted average F1-score for the model.

3. Write a Python program to:

- Build and train a fully connected neural network for binary classification on the [Breast Cancer Wisconsin dataset](#).
- Use ReLU activation in the hidden layers and sigmoid activation in the output layer.
- Evaluate the model using accuracy and the confusion matrix.
- Plot the training and validation loss over epochs.

4. Construct a dataset containing 20 rows (objects) and 3 features (columns) filled with random numbers in the range [0, 1]. Randomly apply labels (0 or 1) to each row.

- Write python program to build and train fully connected NN for binary classification on this dataset.
- Evaluate the accuracy of the model and plot the loss over epochs.
- Change the dataset to demonstrate the problem of overfitting (you can add / delete rows or change the values of the dataset or add / delete columns).

- Change the dataset to demonstrate the problem of underfitting (you can add / delete rows or change the values of the dataset or add / delete columns).
- Discuss how the model complexity contributes to the overfitting. Demonstrate your claims.
- Compare and contrast dropout and L2 regularization in addressing overfitting. Explain scenarios where one technique might be preferred over the other.