CS3807 – Deep Learning Lab

Lab Assignment 3

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Objective

To build and train a neural network classifier using PyTorch to compare the effect of different regularizers (L1, L2, and Dropout) on model performance for binary classification. The goal is to analyze how these regularizers affect overfitting, convergence, and generalization.

Dataset Used

A synthetic binary classification dataset with:
- 1000 rows
- 20 numerical input features
- 1 binary target label (0 or 1)

All input features were normalized using StandardScaler, and the dataset was split into training (80%) and testing (20%) sets.

Model Architecture

Model Type: PyTorch nn.Sequential model — layers stacked in order from input to output.
Layer 1: Dense, 64 neurons, ReLU activation
Layer 2: Dense, 32 neurons, ReLU activation
Output Layer: 1 neuron, Sigmoid activation (for binary classification)
Loss: Binary Cross Entropy

Epochs: 5

Regularization Techniques Applied

- No Regularization
- L1 Regularization (manual penalty added to loss)
- L2 Regularization (via weight_decay in optimizer)
- Dropout (layer added to network)

Training and Validation Loss Plot

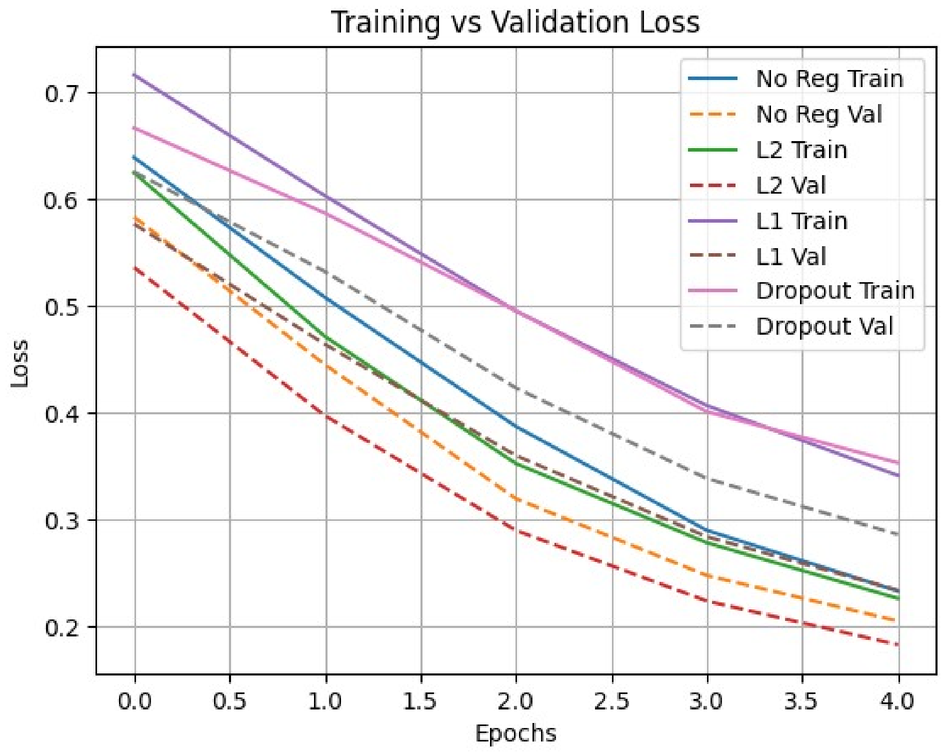

Figure: Training vs Validation Loss for different regularization methods

Observations

From the training and validation loss plots, we observe:
- L2 Regularization yields the lowest validation loss, indicating the best generalization.
- L1 Regularization also performs well but is slightly less

stable.
- Dropout results in higher losses, potentially due to underfitting.
- No Regularization leads to overfitting as evident by the increasing gap between training and validation loss.

Conclusion

Among the methods tested, L2 regularization was the most effective in improving generalization performance on the validation set. L1 and Dropout also helped control overfitting but were not as effective as L2. Regularization is essential to reduce overfitting and ensure that the model performs well on unseen data.