1. Introduction

- This report summarizes the learning completed during the initial phase of the Deep Learning course.
- The objective was to build a strong conceptual and practical foundation in programming and machine learning.
- The course gradually progressed from Python basics to advanced deep learning architectures.
- Hands-on assignments and coding exercises reinforced theoretical understanding.

2. Week 0: Foundations

2.1 Python & Programming Environment

- Learned Python syntax including variables, loops, conditionals, and functions.
- Practiced working with lists, tuples, dictionaries, and sets.
- Focused on writing readable, modular, and efficient code.
- Used Google Colab for experimentation and assignment execution.

2.2 Numerical Computing and Data Manipulation

- Used NumPy for numerical operations on multi-dimensional arrays.
- Learned array slicing, indexing, reshaping, and broadcasting.
- Understood the importance of vectorized operations for performance.
- Applied Pandas for data cleaning, preprocessing, and feature selection.

2.3 Data Visualization

- Used Matplotlib to visualize datasets and trends.
- Plotted line graphs, scatter plots, bar charts, and histograms.
- Visualization helped in identifying outliers and data imbalance.

3. Week 1: Machine Learning Fundamentals & Neural Networks

3.1 Supervised and Unsupervised Learning

- Studied linear regression for predicting continuous values.
- Learned logistic regression for binary classification problems.
- Explored clustering methods for unsupervised learning.
- Understood cost functions and performance evaluation metrics.
- Analyzed gradient descent as the core optimization technique.

3.2 Fundamentals of Neural Networks

- Studied artificial neurons, weights, bias, and layered architectures.
- Learned activation functions such as Sigmoid, Tanh, and ReLU.
- Understood the role of non-linearity in deep learning models.

- Learned forward propagation and backpropagation mechanisms.

3.3 Optimization and Regularization

- Learned backpropagation for updating neural network parameters.
- Studied L1 and L2 regularization to control overfitting.
- Applied dropout to improve generalization.
- Explored optimizers such as SGD, RMSProp, and Adam.

4. Week 2: Deep Learning & Computer Vision

4.1 Convolutional Neural Networks (CNNs)

- Understood the motivation behind CNNs for image processing.
- Studied convolution layers for spatial feature extraction.
- Learned pooling layers for dimensionality reduction.
- Analyzed how CNNs preserve spatial hierarchy in images.

4.2 Advanced Techniques

- Learned batch normalization to stabilize and accelerate training.
- Explored feature visualization techniques for CNN interpretability.
- Understood the importance of normalization in deep networks.

5. Week 3 & 4: Sequence Models

5.1 Recurrent Neural Networks (RNNs)

- Studied RNN architecture for modeling sequential data.
- Understood hidden states and temporal dependencies.
- Analyzed limitations such as the vanishing gradient problem.

5.2 Advanced Sequence Models

- Learned LSTM architecture with input, forget, and output gates.
- Studied GRUs as a simplified alternative to LSTMs.
- Explored bidirectional RNNs for better context capture.
- Understood applications in time-series and language modeling.

6. Conclusion

- Developed a strong foundation in deep learning concepts.
- Gained practical understanding of CNNs and sequence models.
- Improved problem-solving and analytical skills through assignments.

- Prepared for advanced topics such as transformers and real-world applications.