Internship Project Report

**Handwritten Digit Recognition using Deep Learning**

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**Objective**

The objective of this project was to build a deep learning model that can classify handwritten digits (0–9) using the MNIST dataset. The goal was to get hands-on experience with neural networks using PyTorch and to understand the process of training, testing, and evaluating a model.

**Introduction**

This project focuses on building an AI model to recognize handwritten digits using the MNIST dataset. MNIST contains 70,000 images of digits (0–9), each 28x28 pixels in size. The aim is to train a deep learning model that can accurately classify these digits. This helped me understand core AI concepts like neural networks, training, and evaluation using tools such as PyTorch.

**Difference between Image Classification in Machine Learning and Deep Learning**

In traditional **Machine Learning (ML)**, image classification relies on manually engineered features such as edges, textures, or color histograms, which are then passed to classifiers like SVM or k-NN. In contrast, **Deep Learning (DL)** approaches like Feed Forward Network automatically learn hierarchical features directly from raw pixel data. While ML works well with smaller datasets and simpler models, DL offers superior performance on complex tasks but requires large datasets and higher computational resources.

**Tools & Technologies Used**

- Python  
- PyTorch  
- Visual Studio 2022  
- Torchvision  
- Matplotlib  
- TensorBoard

**Project Workflow**

During this project, I followed these main steps:

1. 1. Imported the MNIST dataset using torchvision.datasets
2. Enabled GPU support for faster training
3. Built a Feed Forward Neural Network with Hidden layers, ReLu Activation Layer and 10 Output Layers (0-9)
4. Trained the model using the Adam optimizer and CrossEntropyLoss
5. Validated the model on the test set
6. Achieved 96%+ test accuracy
7. Saved the Model for future use
8. Visualized training performance using TensorBoard
9. Load the Model
10. Use our own data to analyze the model
11. Achieved 95%+ accuracy

**Output / Result**

- Final Test Accuracy: ~96%  
- The model successfully classified most digits with high confidence.  
- I visualized correct and incorrect predictions to understand model behavior.

**Skills Gained**

- Learned how Deep Learning models work and how to build one from scratch  
- Understood training loops, forward/backward pass in PyTorch  
- Learned model evaluation techniques  
- Got hands-on experience working in Visual Studio 2022 with GPU support

**Conclusion**

This internship project helped me understand the real-world application of deep learning. I now feel confident in building and training basic deep learning models, and this experience has motivated me to continue learning about AI and neural networks.

**References**

- PyTorch Documentation  
- MNIST Dataset  
- YouTube:

Patrick Loeber : <https://youtu.be/c36lUUr864M?si=lYbQiktLjh-uer-u>

freeCodeCamp.org: <https://youtu.be/VyWAvY2CF9c?si=9mSJwwFYtZ7t_QKP>

3Blue1Brown : <https://www.youtube.com/watch?v=aircAruvnKk&list=PLZHQObOWTQDNU6R1_67000Dx_ZCJB-3pi>

- ChatGPT , GitHub Copilot