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**Lab 02 How Neural Networks Learn**

**L03 ITAI 2376**

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**How Neural Networks Learn**

**Introduction:**

**Brief Overview:** This lab I implemented a simple neural network with multiple layers, specifically a multilayer perception (MLP), and analyzed its training process. I was also able to introduce dropout layers to prevent overfitting of the neural network.

**Purpose**: The main purpose of this reflection is to explore the key learnings and personal growth achieved through this lab, discuss the significance of implementing dropout layers, and highlight how this experience relates to theoretical knowledge from the class and resources provided.

**Description of Experience:**

**Background Information**: A multiplayer perception (MLP) is the simplest feed forward neural network architecture, characterized by multiple layers of fully connected neurons. The MLP we used in the lab consist of an input layer, hidden layers, and an output layer trained using backpropagation.

**Specific Details:** The main task involved building a classifier using PyTorch that maps grayscale images from the Fashion-MNIST dataset to their respective categories. The dataset comprises 28x28 pixel images divided into ten categories, with 6,000 training images and 1,000 test images per category.

**Personal Reflection:**

**Thoughts and Feelings:** Originally the thought of building and training a neural network seemed intimidating since I have only completed an exercise like this only one time. The hands on approach made the learning experience rewarding and less complex.

**Analysis and Interpretation:** I realized the importance of regularization techniques like dropout layers to combat overfitting. Dropping a percentage of neurons randomly during training helps prevent neurons from coadapting and enhances the generalization capability of the model.

**Connections of Theoretical Knowledge**: This lab directly relates to the theoretical concepts of neural networks and regularization covered in the provided PowerPoint. Understanding the backpropagation algorithm and the significance of dropout layers was crucial in completing the lab successfully.

**Critical Thinking:** The initial implementation of the MLP without dropout layers resulted in overfitting, as evident from the high training accuracy but low test accuracy. Adding dropout layers significantly improved the test accuracy, highlighting the importance of this technique. In hindsight, experimenting with different dropout rates earlier in the process could have yielded even better results.

**Discussion of Improvements and Learning:**

**Personal Growth:** This lab experience has significantly enhanced my understanding of neural networks and the importance of regularization techniques. I feel more confident in my ability to implement and fine-tune neural network models.

**Skilled Developed:** I developed practical skills in using PyTorch to define, train and evaluate neural network models. Additionally, I gained insight into the importance of preventing overfitting and the practical application of dropout layers. Lastly, learned how to train a neural network.

**Future Application:** What I learned in the lab will be invaluable in future projects involving computer visions and how cars self drive, facial recognition and medical image diagnostics. Understanding how to effectively implement and regularize neural networks is a critical skills in the field of machine learning.

**Conclusion:**

Reflecting on this lab, I appreciate the comprehensive and hands-on approach to building and training a multilayer perceptron (MLP). Initially, the process seemed intimidating due to my limited experience, but it quickly became a rewarding learning journey. Implementing dropout layers proved to be a critical step in enhancing the neural network's generalization capability and preventing overfitting.

Overall, this lab has contributed to my personal and academic growth, instilling greater confidence in my ability to tackle complex machine learning tasks. The lessons learned and insights gained will serve as a solid foundation for future endeavors in the field of machine learning.