Assignment 5.1 - Perceptron Applications	
Course Code: CPE 019	**Program:** BSCpE
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Journal 1

Title: AutoMLP: A Framework for the Acceleration of Multi-Layer Perceptron Models on FPGAs for Real-Time Atrial Fibrillation Disease Detection

Author: Chao Chen, Bruno da Silva, Chenxi Yang, Caiyun Ma, Jianqing Li, Chengyu Liu

Date of the publication: July 26, 2023

Title of Publication: IEEE Transactions on Biomedical Circuits and Systems

What is the problem being solved in the research?

- The problem that is being solved in the research is accelerating multi-layer perceptrons on FPGAs for real-time detection of Atrial fibrillation disease due to the complex hardware design requirements. It is important to analyze the quality of the model so that there is less processing to make it faster and more efficient.

What is the proposed solution of the author/s?

- The solution that the researchers proposed is a framework that automates the evaluation of of MLP topology, data type, and bandwidth in order to generate parallel acceleration

How did the author/s solve the problem/s? Provide a summary of the methodology

- The methodology is divided into 4 parts: Topology analysis, bit-width simulation, profiling, and parallel optimization.
- The model topology analysis accessed the performance of the model. The structure of the model consisting of the number of hidden layers, nodes, and activation function affects the storage size and data processing engines that are needed on the FPGA.
- Bit-width simulation and profiling involves the identification and reduction of unnecessary bits on the FPGA in order to save resources and time latency.
- Parallel optimization is conducted after analyzing the model and identifying the most optimal model. This involves selecting different pipeline strategies in order to optimize the computation intensive operation on the FPGA and increase throughput.

Provide a summary of the results.

- Using the simulator and profiler, the framework evaluates the resource consumption, latency, and accuracy. The experiments conducted involved the modification of the number of bits of the fractional and integer part. Through the experiments it became possible to identify the optimal data format while minimizing the loss of accuracy. The results showed that the fully parallel architecture resulted in the reduction of latency since it is performing all the operations simultaneously which solves the problem of having a large number of layers and nodes since the more layers there are, the more latency and computation there is.

What is the conclusion of the author/s and provide your own recommendations on the paper.

- The researchers concluded that the objective of AutoMLP was met since the framework that they proposed should be able to accelerate the MLP models on FPGAs. AutoMLP selects the optimal data bit-widths and data formance in order to increase the performance of the model. The results that researchers got is that the data representation has a significant effect on the accuracy. A recommendation that I can give is the increase in data visualization to have an easier time understanding the analysis that they've conducted in the results part of the journal

Journal 2

Title: Multi-Layer Perceptron Model on Chip for Secure Diabetic Treatment

Author: Heena Rathore, Lothar Wenzel, Abdulla Khalid Al-Ali, Amr Mohamed, Xiaojiang Du, Mohsen Guizani

Date of the publication: July 10, 2018

Title of Publication: IEEE Access

What is the problem being solved in the research?

- The problem that is being solved in this research are cases in which insulin pumps, which is a medical device, are wirelessly being compromised. This case not only results in the malfunctioning of the device but also can be a potential threat to a human's life since the device that is being compromised is used for medical reasons.

What is the proposed solution of the author/s?

- The proposed solution of the researchers is to create an "on-chip neural system network for securing diabetic treatment". This is a multi-layer perceptron design for real-time security of medical devices.

How did the author/s solve the problem/s? Provide a summary of the methodology

- The methods that the researchers created consist of 3 parts: The model , FPGA implementations, and Network
- The multi-layer perceptron model is used and developed with 10 features namely, Age, Plasma glucose concentration, Diastolic blood pressure, Triceps skin fold thickness, 2 hour serum insulin, body mass index, diabetes pedigree function, date, time, and value. The researchers choose 2 hidden layers with an output of a single neuron that predicts the output if its either a fake or real dosage of insulin
- The researchers used FPGA as a computing platform in order to determine the processing performance, memory, and storage requirement
- The researchers used a Bayesian network that is capable of decision making under uncertainty.

Provide a summary of the results.

- After the simulations, the MLP managed to get 98.1907% accuracy.
- Out of 11733 genuine dosages, 215 were wrongly marked as fake and out of 1200 fake dosages, 19 were wrongly marked as real. This brings a total of 234 misclassifications

What is the conclusion of the author/s and provide your own recommendations on the paper.

- The researcher concluded that the MLP approach that they proposed reached a 99% accuracy of detecting whether it was a real or fake glucose dosage. The researchers emphasized on the importance of real-time security designs for medical devices and that the solution that they made is capable of achieving the goal. A recommendation that I can give is more data visualization and implementation to other medical devices to determine its accuracy and performance compared to other medical devices. Another performance evaluation can also be done by differentiating the performance of the proposed MLP design to other security devices that are available right now to check its performance compared to a larger variety of solutions.