Analysis of Senior Project Design

Please provide the following information regarding your Senior Project and submit to your advisor along with your final report. Attach additional sheets for your responses to the questions below.

Project Title: Development of a Flexible, Instruction-Less Hardware Architecture for Inference of Neural Networks

Quarter / Year Submitted: Spring 2025

Student: (Print Name) Ashwin Rajesh **(Sign)** 

Advisor: (Print Name) Maria Pantoja **(Initial) MP** **Date: 06/14/2025**

Summary of Functional Requirements

The outcome of this project is a program that parses pretrained neural network models and produces a hardware design that is optimized for running inference on said models. The underlying architecture is instruction-less to minimize overhead during inference.

Primary Constraints

Due to a lack of an instruction set, designing and managing the flow of data throughout the design proved to be difficult. Thorough analysis of waveforms from testing was required to successfully design and implement a control module to perform this task.

Economic

There are no costs associated with this project, as the deliverable is software. The estimated time for completion was originally set at roughly 30 hours; the actual development time was close to 50.

If manufactured on a commercial basis:

N/A, there is no tangible part of the product to manufacture.

Environmental

The project aims to reduce the environmental impact left by large-language models like ChatGPT which draw a significant amount of power during inference. The hardware design is intended to maximize efficiency and minimize waste, thereby reducing power usage.

Manufacturability

There are no manufacturable parts to this project.

Sustainability

The software may be occasionally maintained if need arises. Further improvements can be made to support additional neural network layer types and cover a wider array of neural network layouts.

Ethical

The program and hardware design remain independent of the design, data collection and training associated with the neural network itself.

Health and Safety

There are no health/safety concerns as the project is software and therefore intangible.

Social and Political

As mentioned above, the project remains independent of the potential social or political intentions or biases of the neural network's design.

- **Development**

  While I had worked with Keras and SystemVerilog in the past, I discovered new features that made the project more feasible to complete, such as generate blocks and module parameters. Additionally, I learned about the HDF5 format standard and appreciated the simplicity in its representation of trained neural network models.