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Motivation Letter - Application for the PhD Positions on Embedded and AI technology for biomedical applications

Dear Admissions Committee,

Following an exhaustive examination of the description for the "PhD Scholarship in Electronics and Informatics: Embedded and AI Technology for Biomedical Applications," I am persuaded that this programme aligns well with my academic interests and career objectives, and incites a profound desire for investigation. Thus, the following section provides a detailed account of my accumulated knowledge and skills in FPGA and AI, along with a rationale for my suitability for this programme.

At the undergraduate level, I comprehensively understood the fundamental principles of field-programmable gate array (FPGA) design and its diverse range of applications. This was achieved through an in-depth examination of a series of core courses, including *Digital Logic Circuits*, *Principles of Computer Composition*, and *EDA Understanding and Practice*. In the *Digital Logic Circuits* course, I began with an examination of semiconductor transistors and other fundamental semiconductor devices, proceeded with a comprehensive investigation of logic gate circuits, and then delved deeply into the analysis and design of combinational logic circuits and timing logic circuits. Utilizing NI Multisim software, I conducted comprehensive circuit design and simulation experiments, not only attaining expertise in the design and application of encoders, decoders, multiplexers, and other pivotal logic functional components, but also acquiring proficiency in downloading the designed programme to the circuit board for testing and debugging. This practical approach significantly enhanced my hands-on abilities to address practical challenges.

As for the *Principles of Computer Composition*, I employed the Logisim and ISE software tools to successfully realize the design of key components, including the multiplexer, ALU (Arithmetic Logic Unit), and register file, as well as completed the construction of a single-cycle CPU. Additionally, I developed the implementation code for the same function in Verilog, a hardware description language, to further enhance my comprehension of hardware design. Furthermore, I undertook the challenge of developing a multi-cycle CPU design in Verilog, ultimately completing a pipelined CPU design capable of supporting seven instructions. This process enhanced my proficiency in hardware design and markedly elevated my capability to utilize diverse design instruments and programming languages. Regarding *EDA Understanding and Practice*,

I comprehensively studied the essentials of EDA and completed several projects. These included the construction of a 12-bit binary counter, an 8-bit running light control system, and an FPGA-based music hardware performance system. These projects facilitated a more profound comprehension of FPGA applications, particularly in the final project, where I designed and implemented a comprehensive Snake game using Quartus II software through game logic design and a VGA interface implementation. This process enabled me to deeply comprehend the utilization of FPGA in intricate system design. In conclusion, my undergraduate studies have facilitated the comprehensive acquisition of theoretical and practical knowledge pertaining to FPGA hardware design. Additionally, I have gained expertise in the entirety of the hardware design process, encompassing schematic design and practical implementation. Furthermore, I possess proficiency in utilizing an array of design tools and programming languages for FPGA development.

While pursuing my master's degree, I undertook an in-depth study of the core principles and techniques of deep learning in the course *Deep Learning and Its Applications*. During this period, I conducted a series of well-designed experiments, including linear regression, logistic regression, binary classification, multi-classification, feed-forward neural networks, and convolutional neural networks for image categorization, etc. These experiments enabled me to gradually construct a comprehensive knowledge system on AI. In particular, my final project was centered on the topic of *Tumor Segmentation and Classification*, which entailed the precise identification and localization of tumors through the analysis of ultrasound scan data. To this end, I successfully constructed a model that accurately predicts the type of tumor (benign, malignant, or normal) in the scan results and segments the tumor region in MRI scans in the presence of a tumor. The F1 score for this result is 0.89, which is a clear indication of my proficiency and potential in AI and its applications.

Subsequently, my master's thesis, *Enhancing On-Chip Network Predictions With Advanced AI Techniques*, represents a further deepening of my research in the area of combining AI and hardware, driven by my keen interest in AI. The objective is to leverage advanced AI techniques to enhance the precision and efficacy of key parameter prediction in Network-on-Chip (NoC). In this research, I have not only mastered the entire process, from the generation of simulation data to the training and evaluation of models, but I have also examined the significant potential of AI techniques in the design optimization of complex hardware systems through the practical application of linear regression models.

In light of the foregoing, I possess a robust foundation in FPGA design and programming, complemented by extensive learning and practical experience in AI. My research experience in the integration of AI and hardware systems, exemplified by my work on network-on-chip (NoC) technology, renders me an ideal candidate for your PhD programme. Moreover, I am always passionate about exploring the unknown and eager to advance my knowledge in deep learning hardware security, especially innovative research at the intersection of FPGA and AI. I am confident that the excellent research environment at your university will provide me with an ideal setting to pursue these interests.

I select your PhD programme because of its outstanding academic reputation, cutting-edge research facilities, and exceptional faculty. I am aware that your university is at the forefront of research in FPGA and offers a plethora of international collaboration opportunities that will facilitate the expansion of my academic horizons and the enhancement of my research

capabilities. Through your PhD programme, I will be able to translate my skills and interests into tangible contributions to advance science and technology. Now, I am eagerly awaiting the opportunity to participate in your PhD programme, where I hope to contribute to the advancement of research in this cutting-edge field.

Thank you for spending time on reading my motivation letter. I am eager to have the chance to further discuss my application and demonstrate why I am an optimal candidate for your programme. Should you require further information or wish to schedule an interview, I would be happy to assist you.

I am grateful for your consideration and look forward to a favorable response.

Yours sincerely,

Lingyu Gong