

Lingyu Gong
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25/August/2024

University of Groningen, Netherlands
Groningen, Netherlands

Motivation Letter - Application for the FPGA-Based Computing System Design

Dear Admissions Committee,

I am writing to express my strong interest in the "FPGA-Based Computing System Design" PhD programme at the University of Groningen. With a solid foundation in FPGA design and AI from both my undergraduate and master's studies, I believe I am well-equipped to contribute to and benefit from your esteemed programme.

During my undergraduate studies, I developed a comprehensive understanding of FPGA design through courses like Digital Logic Circuits, Principles of Computer Composition, and EDA Understanding and Practice. I engaged in hands-on projects, including the design of a pipelined CPU in Verilog and an FPGA-based Snake game, which deepened my knowledge of FPGA applications and hardware design processes.

In my master's program, I expanded my expertise into AI, particularly in the course "Deep Learning and Its Applications." My final project focused on Tumor Segmentation and Classification using deep learning, achieving an F1 score of 0.89. My master's thesis, "Enhancing On-Chip Network Predictions with Advanced AI Techniques," further cemented my interest in the intersection of AI and hardware design. I explored how AI can optimize complex hardware systems, specifically through the use of linear regression models to improve Network-on-Chip (NoC) design.

My research interests lie at the crossroads of embedded systems, AI, and hardware design, with a focus on creating efficient AI computing platforms through hardware acceleration strategies. I am particularly passionate about FPGA and ASIC-based computing systems and how these technologies can be tailored to enhance AI model performance.

The University of Groningen's focus on bridging performance gaps in FPGAs through customization, while maintaining flexibility and scalability, aligns perfectly with my research aspirations. I am eager to contribute my skills to the development of innovative hardware platforms that will support the next generation of AI applications.

Thank you for considering my application. I look forward to the opportunity to further discuss how my background and interests align with your programme.

Yours sincerely,
Lingyu Gong

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EDUCATIONAL BACKGROUND

Trinity College Dublin

Postgraduate Degree Programme

Dublin, Ireland

09.2023-Present

- **Programme:** MSc Electronic Information Engineering
- **Coursework:** Algorithms for Quantum Computing, Integrated Systems Design, Self Organising Technological Networks, Open Reconfigurable Networks, Deep Learning and Its Applications, etc.

Capital Normal University

Undergraduate Degree Programme

Beijing, China

09.2019-06.2023

- **Programme:** BSc Computer Science and Technology (Education)
- **GPA:** 3.51/5.0
- **Coursework:** Digital Logic Circuits, Principles of Computer Composition, EDA and its Practice, etc.

AI/FPGA-ORIENTED PROJECT EXPERIENCE

Enhancing NoC Network Predictions with Advanced AI Techniques

Project Holder/Researcher

Dublin, Ireland

12.2023-Present

- Apply cutting-edge AI techniques to significantly improve the efficiency and accuracy of network-on-chip (NoC) key parameter prediction, provide data support and intelligent guidance for NoC network design and optimization
- Build and simulate multiple NoC network scenarios utilising Booksim2 to generate datasets containing rich features and high-quality labels, providing a solid foundation for AI model training
- Perform strict data cleansing and preprocessing on the simulated dataset, and implement feature selection and extraction strategies to enhance the characterization ability of the dataset and improve the model training effect
- Select and apply appropriate machine learning algorithms according to the specific needs of NoC performance parameter prediction, especially linear regression models
- Train the linear regression model using the pre-processed dataset, run the test dataset with this model, and compare the predicted results of the trained model with the real results generated by the Booksim2 simulator

Tumor Segmentation and Classification

Project Holder/Researcher

Dublin, Ireland

10.2021-10.2022

- Collected medical imaging data containing various types of tumors, such as CT, MRI or PET scans, covering tumors of different sizes, shapes and locations
- Adopted convolutional neural network (CNN) or its variants, such as U-Net, Mask R-CNN, etc., for pixel-level segmentation of tumor regions; trained the model using labeled datasets, and adjusted the model parameters by back-propagation algorithm to minimize the segmentation error
- Extracted features such as shape, size, texture, and possible depth features (e.g., feature vectors extracted by CNN) based on the segmented tumor region; classified the tumor based on the extracted features using machine learning algorithms such as Support Vector Machines (SVMs), Random Forests, etc., and the F1 score for this result was 0.89

FPGA-Based Implementation of the VGA Gluttonous Snake Game

Project Holder/Developer

Beijing, China

10.2021-11.2021

- Utilized Quartus II and VGA technology to implement the classic Gluttonous Snake game on FPGA, including VGA display controller design, game logic design and input interface design, as well as tested and optimized on FPGA development boards
- Generated clock signals, line synchronization signals and field synchronization signals required for VGA, used FPGA internal RAM as frame buffer to store the pixel data of the game screen, and controlled the output of RGB signals according to the content of the frame buffer to display the game screen
- Wrote the game logic and defined the game states, including game start, game progress, game end, etc., designed the state machine to manage the transitions between these states, and completed the snake movement control, food generation and detection, collision detection, and score calculation and other functions
- Carried out functional simulation and debugging using Quartus II, downloaded compiled code to FPGA development board for real board testing, and performed continuous optimization of code and algorithms to improve frame rate and response speed of the game

Multi-Cycle CPU Design

Project Holder/Developer

Beijing, China

03.2021-04.2021

- Designed a multi-cycle CPU to implement arithmetic instructions (addition, subtraction, immediate number addition), logical instructions, shift instructions, compare instructions, memory read/write instructions, branch order and jump instruction, as well as designed and implemented a multi-cycle hard-wired controller (purely combinational circuits)
- Conducted functional testing using Logisim to verify the correctness of the design, implemented a fully functional multi-cycle CPU and successfully passed full instruction functionality testing

Continued

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AL/FPGA-ORIENTED PROJECT EXPERIENCE

Single-Cycle CPU Design

Beijing, China

Project Holder/Developer

02.2021-03.2021

- Determined the instruction set to be supported by the CPU, including arithmetic logic instructions, data transfer instructions, etc., and assigned opcodes and the necessary number of operands to each instruction
- Drew single-cycle MIPS CPU datapaths and utilized Verilog to write code for each module, including instruction memory modules, register bank modules, ALU modules, controller modules, etc.
- Simulated and tested the designed CPU using Logisim, debugged the code and fixed potential errors
- Downloaded the written hardware description language code to the FPGA development board, configured the FPGA chip, implemented the datapath and controller of a single-cycle MIPS CPU, as well as verified its functional integrity through a variety of test instructions

RESEARCH EXPERIENCE

Realisation of Laboratory Swipe Card Notation System

Beijing, China

Core Participant

07.2022-09.2022

- Designed a laboratory card system, achieved efficient and intelligent personnel registration and management through the integration of a variety of hardware components and software development, consisted the front-end display, back-end processing and hardware implementation
- Conducted PCB and hardware design, utilised magnetic cards, a RFID module, a Led display, a buzzer, and the ESP8266 development board to complete the design, as well as carried out system integration and testing

Design and Research of a 3D Modelling Course

Beijing, China

Team Leader

11.2020-04.2022

- Led the team to carry out in-depth design and research of 3D modeling courses, with a special focus on the use of Rhino modeling software, and explored how AI technology could enhance the teaching and learning process to improve modeling efficiency and innovation
- Explored how AI could assist the 3D modeling process, such as using machine learning algorithms to optimise model topology, automatically generating detailed textures, predicting design trends, etc., and introduced AI-assisted design plug-ins to improve modeling efficiency and creativity

PROFESSIONAL TRAINING

Institute of Computing Technology, Chinese Academy of Sciences

Beijing, China

Visiting Student

08.2022-05.2023

- Responsible for researching and implementing NoC modules, organizing project materials, attending group meetings, and participating in the relevant discussions regularly
- Enhanced information system development and programming skills and collaboration/problem-solving capacities

Massachusetts Institute of Technology

Boston, United States

Engineering, Design, Gaming and Entrepreneurship (EDGE) Program for STEM

08.2022-05.2023

- Studied the entire process of game making systematically, such as determining the users for the game, defining the meaning of making the game, determining the type and presentation, and building a system model
- Grasped the application of Tale Blazer and APP Inventor in game design and development
- Designed and developed a physics history popular science story game for all ages within the team

SELECTED AWARDS

- Title of Outstanding Graduation Thesis, 2023
- Beijing Merit Student, 2021-2022 Academic Year
- University-level Merit Student/Major First Class Scholarship, 2021-2022 Academic Year
- Major 2nd Class Scholarship, 2019-2020 Academic Year
- Irish Badminton Intervarsities Champions, 2023-2024 Academic Year
- Student Sport Ireland Badminton Cup Champions, 2023-2024 Academic Year
- Student Sport Ireland Badminton League Champions, 2023-2024 Academic Year

LEADERSHIP & EXTRACURRICULAR ACTIVITIES

- Beijing Winter Olympics Volunteer Regional Chief PROFESSIONAL, 2022
- Beijing Winter Paralympics KMS/BMS Mock Athlete, 2022
- President of the Student Union, Capital Normal University, 2020-2023

OTHER SKILLS & SELF-EVALUATION

- **Languages:** Mandarin (Native), English (Fluent)
- **Software Skills:** Proficient in C++, C, Verilog, Matlab, Python, MS Office, etc.
- **Self-Evaluation:** Target-oriented with passion and willpower, rational and logical with intellectual curiosity

Research Statement

Introduction

My research interests lie at the intersection of embedded systems, artificial intelligence (AI), and hardware design, focusing particularly on the development of FPGA-based computing systems. I am fascinated by the potential of AI-driven hardware acceleration to enhance computational efficiency and meet the increasing demands of advanced AI models. My previous academic work has laid a strong foundation in FPGA design and AI, and I am eager to further explore how these technologies can be synergized to create more efficient and powerful computing platforms.

Research Interests

My primary research interest is in FPGA-based computing system design, with a focus on the following areas:

Hardware Acceleration for AI: I am passionate about optimizing AI computing platforms through innovative hardware acceleration strategies. My goal is to explore and develop FPGA and ASIC-based systems that can significantly enhance the execution speed of AI models, thereby alleviating computational bottlenecks and improving overall system performance. I am particularly interested in designing customized hardware solutions that cater specifically to the needs of deep learning and other complex AI algorithms.

Embedded Systems and Hardware/Software Co-design: I aim to investigate the integration of AI algorithms with specialized hardware to create embedded AI systems that perform efficiently even in resource-constrained environments. My focus is on developing systems that can handle real-time data processing and parallel computation with high efficiency, which is crucial for a wide range of applications, from mobile computing to edge AI devices.

FPGA and ASIC-Based Computing Systems: I am keen on exploring the design of computing systems using programmable hardware like FPGAs and ASICs. The flexibility and reconfigurability of these technologies make them ideal for creating scalable and high-performance computing platforms. My interest lies in how these systems can be customized to meet the demands of next-generation AI applications, particularly in terms of speed, latency, and energy efficiency.

Previous Research Projects

FPGA Design and Implementation: During my undergraduate studies, I developed a strong foundation in FPGA design through a series of projects that included the design of a pipelined CPU and the implementation of a Snake game using Quartus II software. These projects involved extensive work with Verilog, a hardware description language, and provided me with practical experience in the entire FPGA design process, from schematic design to physical implementation.

Digital Logic Circuits and Computer Architecture: I explored the principles of digital logic circuits and computer architecture, culminating in the successful design of key components such as multiplexers, ALUs, and register files. These projects not only enhanced my understanding of hardware design but also equipped me with the skills to use tools like Logisim and ISE for simulation and verification.

EDA Understanding and Practice: I completed several projects that deepened my knowledge of electronic design automation (EDA) tools and FPGA applications. One of the most significant

projects was the design and implementation of a 12-bit binary counter and an 8-bit running light control system, which helped me understand the practical aspects of FPGA development.

AI and Deep Learning: In my master's program, I expanded my research focus to include AI, particularly deep learning. I conducted a series of experiments that built a comprehensive knowledge base in AI, including work on linear regression, logistic regression, binary classification, multi-classification, and convolutional neural networks (CNNs). These experiments were crucial in developing my understanding of how AI models can be applied to real-world problems.

Tumor Segmentation and Classification: My final project focused on the development of a deep learning model for tumor segmentation and classification in ultrasound scan data. The model achieved an F1 score of 0.89, demonstrating its effectiveness in identifying and localizing tumors. This project solidified my interest in applying AI techniques to complex problems and showcased my ability to design and implement AI models with practical applications.

Master's Thesis - Enhancing On-Chip Network Predictions With Advanced AI Techniques: My master's thesis represents the culmination of my research into the integration of AI and hardware design. The project aimed to improve the prediction accuracy of key parameters in Network-on-Chip (NoC) systems using advanced AI techniques. I explored the potential of linear regression models to optimize the design and performance of complex hardware systems, providing insights into how AI can be used to enhance traditional hardware design methodologies.

Future Research Directions

Looking forward, I am eager to delve deeper into the challenges and opportunities presented by the integration of AI and FPGA-based systems. I am particularly interested in:

Developing FPGA-accelerated AI models that can handle large-scale computations with low latency, which is critical for applications in autonomous systems, real-time processing, and high-frequency trading.

Exploring the use of hardware/software co-design approaches to create more efficient embedded AI systems that can operate effectively in environments with limited computational resources, such as IoT devices and edge computing platforms.

Investigating the potential of novel FPGA architectures and design methodologies to support the next generation of AI applications, particularly in areas where traditional computing paradigms fall short.

Conclusion

I am confident that my background in FPGA design and AI, combined with my research interests, aligns well with the objectives of the PhD programme in FPGA-Based Computing System Design at the University of Groningen. I am excited about the opportunity to contribute to and benefit from the cutting-edge research being conducted at your institution, and I am eager to explore new frontiers in the integration of AI and hardware design.

Thank you for considering my application. I look forward to the opportunity to discuss my research interests further.



Academic Transcript for Undergraduates

Name	GongLingYu	Student number	1191001006			College	College of Information Engineering					
Gender	Female	Specialty	Computer Science & Technology			Professional Direction	Computer Science & Technology (normal)					
Date of Birth	20010516	Date of Enrollment	20190901			Date of Graduation	20230621					
School Year	4-Year					Degree	ENGINEERING					
Course		Credit	Score	Times	Type	Date	Course	Credit	Score	Times	Type	Date
College Student Psychological Adaptability and Development		1	84	1	Required	2019Autumn	College students' academic planning and development	1	84	1	Required	2019Autumn
College English 1		4	89	1	Required	2019Autumn	College Chinese	2	90	1	Required	2019Autumn
Advanced Mathematics 1		5	68	1	Required	2019Autumn	The Military Course	2	79	1	Required	2019Autumn
Social History of the Republic of China		2	85	1	Elective	2019Autumn	General Introduction of World Civilizations	2	89	1	Elective	2019Autumn
The Ideological and Moral Cultivation and Legal Basics		3	80	1	Required	2019Autumn	Physical Education 1	1	92	1	Required	2019Autumn
Linear Algebra		3	64	1	Required	2019Autumn	Introduction to Information Science	3	78	1	Required	2019Autumn
Approaches to Chinese opera		2	96	1	Elective	2019Autumn	C Programming Language	4	78	1	Required	2020Spring
C Language Programming Experiments		1	77	1	Required	2020Spring	College English 2	4	93	1	Required	2020Spring
circuit analysis		3	88	1	Required	2020Spring	Advanced Mathematics 2	5	91	1	Required	2020Spring
Basic Economics		2	93	1	Elective	2020Spring	Photography : Art and Technology	2	86	1	Elective	2020Spring
Mathematical Logic		2	68	1	Required	2020Spring	Physical Education 2	1	83	1	Required	2020Spring
The current situation and policy		1	84	1	Required	2020Spring	The current situation and policy (Practical course)	1	70	1	Required	2020Spring
The course of the outline of Modern Chinese History		3	80	1	Required	2020Spring	Career Development and Employment Guidance for College Students	1	89	1	Required	2020Autumn
College English 3		4	88	1	Elective	2020Autumn	Circuit Experiments	1	80	1	Required	2020Autumn
Electronic Technology Practice		1	98	1	Required	2020Autumn	Advanced Mathematics 3	3	67	1	Required	2020Autumn
Assembly Language Programming		2	74	1	Required	2020Autumn	Topics and Anthropology of Education	2	95	1	Elective	2020Autumn
Educational Psychology		2	88	1	Required	2020Autumn	Educational Psychology Practice	0	88	1	Required	2020Autumn
Outline of Marxism Theory		3	90	1	Required	2020Autumn	CET-4	0	525	1	Elective	2020Autumn
Data Structure and Algorithm		4	81	1	Required	2020Autumn	Data Structure and Algorithm Experiments	1	81	1	Required	2020Autumn
Digital Logic Circuit		3	90	1	Required	2020Autumn	Digital Logic Circuit Experiments	0.5	excellent	1	Required	2020Autumn
Physical Education 3		1	97	1	Required	2020Autumn	Graph Theory	2	72	1	Required	2020Autumn
A History of Western University		2	95	1	Elective	2020Autumn	College Japanese I	2	91	1	Elective	2021Spring
Probability Theory and Statistics		3	69	1	Required	2021Spring	Computer Network Experiments	0.5	83	1	Required	2021Spring
Principles of Computer Network		3	80	1	Required	2021Spring	Principles of Computer Organization	4	80	1	Required	2021Spring
Computer Organization Experiments		1	90	1	Required	2021Spring	Teacher Professional Ethics	1	93	1	Required	2021Spring
The Basic Theory of Education		2	91	1	Required	2021Spring	The Internship of Basic Theory of Education	0	91	1	Required	2021Spring
Outline of Maoism and Theory of the Socialism with Chinese Characteristics		4	81	1	Required	2021Spring	Social Practice of Maoism and Theory of the Socialism with Chinese Characteristics	1	90	1	Required	2021Spring
Object-Oriented Programming Design		3	81	1	Required	2021Spring	Object-Oriented Program Design Experiments	1	good	1	Required	2021Spring
Physical Education 4		1	99	1	Required	2021Spring	Culture Experience and Communication	0.5	excellent	1	Required	2021Spring
Academic Audio--Visual&Speaking English		2	92	1	Elective	2021Spring	Operating System	4	91	1	Required	2021Autumn
Operating System Experiments		1	94	1	Required	2021Autumn	Program Comprehensive Practice	1.5	good	1	Required	2021Autumn
Big Data Fundamentals		2	88	1	Elective	2021Autumn	The History of Ideas in Teacher Education	2	86	1	Elective	2021Autumn
Instructional Design		2	97	1	Required	2021Autumn	Outline of Educational Research	2	85	1	Required	2021Autumn
Student Military Training		2	excellent	1	Required	2021Autumn	Principles of Artificial Intelligence	2	85	1	Elective	2021Autumn
Software Engineering Practice		3	81	1	Elective	2021Autumn	General Skills Practice of Student Teachers	0	good	1	Required	2021Autumn
Principles of Database		2	74	1	Required	2021Autumn	Digital System Comprehensive Practice	1.5	98	1	Required	2021Autumn
Xi Jinping's thought on socialism with Chinese characteristics for a New Era		1	93	1	Required	2021Autumn	Xi Jinping's Thought on socialism with Chinese characteristics for a new era practice	1	91	1	Required	2021Autumn
Modern Educational Technology and Application		2	95	1	Required	2021Autumn	Frontier of Information Discipline 1	2	96	1	Elective	2021Autumn
Total credits in All Academic Years		174	Overall credit				GPA		3.51			



Academic Transcript for Undergraduates

Name	GongLingYu	Student number	1191001006			College	College of Information Engineering						
Gender	Female	Specialty	Computer Science & Technology			Professional Direction	Computer Science & Technology (normal)						
Date of Birth	20010516	Date of Enrollment	20190901			Date of Graduation	20230621						
School Year	4-Year					Degree	ENGINEERING						
Course		Credit	Score	Times	Type	Date	Course		Credit	Score	Times	Type	Date
Design and development of learning resources		3	82	1	Elective	2021Autumn	Class Education and Class Management		1	92	1	Required	2022Spring
Principles of Compiling		3	92	1	Elective	2022Spring	Introduction to Internet of Things		2	93	1	Elective	2022Spring
Methodology of Information Technology Education		2	93	1	Required	2022Spring	Intern of Information Technology Education Methodology		0	95	1	Required	2022Spring
Techniques training for Creative education		2	96	1	Required	2022Autumn	Teaching Practice		0	94	1	Required	2022Autumn
Probation of after-school Practice Activities		0	pass	1	Required	2022Autumn	Techniques training for experimental teaching		2	92	1	Required	2022Autumn
Lectures on Frontiers of The Discipline		0.5	good	1	Required	2022Autumn	Teaching practice of online course		0	90	1	Required	2022Autumn
Graduation Thesis		4	excellent	1	Required	2023Spring	Arts practice		2	excellent	1	Required	2023Spring
Total credits in All Academic Years	174	Overall credit				GPA				3.51			



Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin

Ollscoil Átha Cliath | The University of Dublin

Visa Support Letter
Student ID: 23337765

23rd August 2024

To whom it may concern,

I wish to confirm that Ms Lingyu Gong is completing an MSc in Electronic Information Engineering within the Department of Electronic and Electrical Engineering Trinity College Dublin.

Ms Gong has successfully completed all taught modules on the course and has also submitted her final thesis for review.

Ms Gong's results will be ratified at the Court of Examiners meeting in September.

Please email me @ oriordmi@tcd.ie should you require any additional information.

Yours Faithfully

Michael O'Riordan



Michael O'Riordan

Executive Officer
Department of Electronic and Electrical
Engineering Trinity College Dublin

**Innealtóireacht Leictreonach
& Leictreach**

Arás an Phiarsaigh
Coláiste na Tríonóide
Baile Átha Cliath 2, Éire

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References List:

1. Shreejith Shanker shankers@tcd.ie
2. Libin Mathew Libin.Mathew@tcd.ie
3. Nicola Marchetti nicola.marchetti@tcd.ie