# Xuan Wang

xuw009@ucsd.edu / 858-263-8287                                    github.com/Xuan-Wang-Summer

## Education

**University of California, San Diego**

*Ph.D.* in Computer Science and Engineering                                    *Expected 2028*

Advisor: Prof. Tajana Rosing

**University of California, San Diego (Double Major)  (Cum Laude)**          **GPA: 3.857 / 4.0**

*B.S* in Computer Engineering (Major GPA: 3.894 / 4.0)                         *Jun. 2023*

*B.S* in Applied Mathematics (Major GPA: 3.976 / 4.0)                          *Jun. 2023*

## Publication

- Behnam Khaleghi, Xiaofan Yu, Jaeyoung Kang, **Xuan Wang**, Tajana Rosing, "Private and Efficient Learning at the Edge with Hyperdimensional Computing", *in submission.*

- Minxuan Zhou\*, **Xuan Wang\***, Tajana Rosing, "**OverlaPIM**: Overlap Optimization for Processing In-Memory Neural Network Acceleration"*, Design, Automation, and Test in Europe (DATE'2023).*
  *\* Co-first authors.*

- **Xuan Wang**, Minxuan Zhou, Tajana Rosing, "**Fast-OverlaPIM**: A Fast Overlap-driven Mapping Framework for Processing In-Memory Neural Network Acceleration", *to be submitted.*

## Research Experience

**Domain-Specific Acceleration with Fully Homomorphic Encryption**              *Oct. 2023- Present*

*SEE Lab, UC San Diego (Advisor: Prof. Tajana Simunic Rosing)*

- Investigating fully homomorphic encryption for bioinformatics applications with hardware accelerations.

**OverlaPIM: Overlap Optimization for PIM NN Acceleration**

*SEE Lab, UC San Diego (Advisor: Prof. Tajana Simunic Rosing)*                  *Apr. 2021- Present*

- Developed **OverlaPIM**, a DNN mapping framework on PIM, produced **2.10x to 4.11x** faster mappings through input-output computational overlap and transformation in C++ with baseline Timeloop.

- Optimized framework to evaluate whole DNN model in design space instead of a single layer.

- Achieved up to **24.45x** speedup by designing and implementing priority-based search algorithm for **OverlaPIM-Fast.**

- Proposed fine-grained analytical overlap analysis algorithm to achieve **3.38x to 323.11x** runtime speedup.

- Co-designed between architecture constrains and framework to generate better mapping in **OverlaPIM(-Fast)**.

- Implemented a toolkit in Python to generate architecture and mapping constrains for NN acceleration analysis.

**Private Hyperdimensional Computing**

*SEE Lab, UC San Diego (Advisor: Prof. Tajana Simunic Rosing)*                  *May. 2023- Sept. 2023*

- Experimented non-private and private training and inference attack for HD computing on MINIST, CIFAR10 and CIFAR100 using ResNet50.

- Evaluated the per-stage decoding time and evaluated the per epoch training time on CPU and GPU.

**Genomics Pairwise Sequence Alignment Acceleration**

Turakhia Lab, UC San Diego (Advisor: Prof. Yatish Turakhia)                    *Apr.2022 - Sept.2022*

- Implemented PEs and SRAMs ASIC design for genomics pairwise sequence alignment acceleration in System Verilog.
- Collected ALUTs resources, registers, and Fmax data by synthesizing on Vivado.

**BASEDNet: Baseline Detection for Historical Documents**

Berg Lab, UC San Diego (Advisor: Prof. Taylor Berg-Kirkpatrick)                                    *Oct. 2020 – Jun.2021*

- 1 of 49 students chosen for CSE Early Research Scholars Program and earned the highest grade out of 14 research groups on group research proposal.
- Optimized historical document transcription quality using of convolution network and gradient search algorithm.
- Implemented BASEDNet, a DNN model in Tensorflow and evaluated using the IoU formula.
- Achieved **97%** accuracy in baseline scoring with BASEDNet + dhSegment.

## Technical Skills/Selected Coursework

- **Technical Language**: **C++**, **Python**, **C**, **System Verilog**, Java, **Julia**, SageMath, Markdown ARM assembly, HTML.
- **Tools and Skills**: **OpenGL**, **Cuda**, **PyTorch**, **MATLAB**, Vivado, LTspice, LaTeX, Unix/Linux, Git, VS Code, Visual Studio, Bash, GitHub, TensorFlow, Docker, NumPy, Jupyter Notebook.
- **CS Coursework**: **Computer Architecture**, **Parallel Computing**, **Operating System**, **Digital System Design**, Circuit Design, Artificial Intelligence, Data Mining, Data Structure, Algorithm, Prob & Stats, Signal & System.
- **Mathematics Coursework**: **Linear & Nonlinear Optimization**, **Graph Theory**, **Combinatorics**, Geometric Computer Graphics, Real Analysis, Advanced Linear Algebra, Calculus.

## Selected Projects

**Heart Rate Prediction, UC San Diego**                                                               *Dec.2022*

- Trained a model for heart rate prediction and achieved 90.14% accuracy by testing different feature usages in PyTorch.
- Analyzed and visualized the given dataset in Python and composed a report.

**Trotting Horse Lamp, UC San Diego**                                                                *Dec.2022*

- Animated an OpenGL scene for trotting horse lamp in C++.
- Implemented keyboard controls to allow mode changes of the scene.

**SHA256 and Bitcoin, UC San Diego**                                                                 *Mar.2022*

- Implemented SHA256 and Bitcoin cryptography algorithm in System Verilog.
- Optimized the system using parallel processing and bit reducing strategies.

**Information Theory and Game Wordle, UC San Diego**                                                  *Mar.2022*

- Introduced Information Theory, Entropy, and Game Wordle in Python with mathematical proof and reasoning.
- Implemented Information Theory and Entropy to solve the Game Wordle automatically in Julia.

## Honors and Awards

- **TRELS** (Triton Research & Experimental Learning Scholars) Quarterly Awards (WI23)
- **Tau Beta Pi** Engineering Honor Society (2021-present)
- Thurgood Marshall College Honor Program (2021-2023)
- **Provost Honors:** FA19, WI20, SP20, WI21, SP21, FA21, WI22, SP22.
- Provincial Second Prize in National Chemistry Olympiad (2018).