

Dong He

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Education

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| University of Washington | Sep 2019 – Aug 2024 (expected) |
| PhD in Computer Science, advised by Prof. Magdalena Balazinska | Seattle, WA |
| • Research Area: Data Management Systems and Machine Learning. | |
| Fudan University | Sep 2015 – Jul 2019 |
| BSc in Computer Science (Honors) | Shanghai |
| • Major GPA: 3.83 / 4.0, Overall GPA: 3.6 / 4.0, School Rank: 6 / 118. | |

Work Experience

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| Snowflake | Jun 2023 – Sep 2023 (expected) |
| Software Engineer Intern, Machine Learning Platform Team | Bellevue, WA |
| • Created Snowpark Lightning Trainer (SLT): Spearheaded the design, implementation (in Python), and evaluation of the first distributed training solution for ML models within Snowflake. SLT automates the model training process and crafts a user-friendly interface that conceals underlying complexities, empowering users to train their models effortlessly. | |
| Microsoft | Jun 2021 – Sep 2021 |
| Research Intern, Azure Gray Systems Lab led by Prof. Raghu Ramakrishnan | Remote |
| • Pioneered Tensor Query Processor (TQP): Led the design and implementation (in Python & C++) of the world’s first query processor that compiles SQL queries into PyTorch programs and executes them on various hardware (CPUs, GPUs, TPUs, etc.). | |
| • Full Benchmark Support & Enhanced Performance: Enabled full TPC-H benchmark support with TQP (until 2021 no GPU database was able to support full TPC-H benchmark), improving query execution time by 10x over specialized CPU and GPU systems (DuckDB, HeavyDB, ...) and providing eacceleration for a 9x speedup for queries involving ML inference. | |
| • Recognized Excellence: First-authored a VLDB paper on TQP and won the Best Demo Award at VLDB 2022. | |
| Goldman Sachs | Jul 2018 – Sep 2018 |
| Summer Analyst, Engineering Division | Hong Kong |
| • Global Engineering Challenge Champion: Clinched the Global Winner title in the Intern Engineering Challenge. | |
| • Revamped Critical Financial Process: Redesigned and re-implemented the logic (in Java) for the true-up job reconciling estimated vs. actual profit and loss (PnL). Deployed enhancements led to 50% reduction in memory usage, significantly minimizing the risk of job failure. | |
| Tencent | Jan 2018 – Feb 2018 |
| Research Intern, YouTu X-Lab led by Prof. Jiaya Jia and Prof. Yu-Wing Tai | Shenzhen |
| • Optimized Neural Network Inference Efficiency: Analyzed node liveness and dependencies (in C++) in production-level deep neural networks, achieving up to 30% reduction in memory consumption through memory sharing. | |
| • Enhanced Data Collection and Annotation Process: Created tools (in Python) for gathering and annotating large-scale image data, streamlining the training process for image classification models. | |

Selected Awards

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| • Madrona Prize , Madrona Venture & UW CSE [GeekWire] [BusinessWire] | 2022 |
| • Best Demo Award , 48th International Conference on Very Large Databases (VLDB) | 2022 |
| • Paul G. Allen Fellowship, University of Washington | 2019 – 2020 |
| • Outstanding Undergraduate Graduate, Shanghai Region | 2019 |
| • Honors Student Award, Top Talent Undergraduate Program, Fudan University | 2019 |
| • Wangdao Scholar, Undergraduate Research Opportunities Program, Fudan University | 2018 |
| • Silver Medal, ACM International Collegiate Programming Contest (ACM-ICPC), Asia Regional | 2015 – 2016 |
| • Silver Medal, National Olympiad in Informatics (NOI), China National Finals | 2014 |
| • First Prizes, National Olympiad in Informatics in Provinces (NOIP), Guangdong Division | 2009 – 2014 |

Selected Projects

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| MaskSearch: Querying Image Masks at Scale | Jul 2022 – present |
| Project owner & leader | UW |

- **Developed MaskSearch:** Led the design and implementation (in Python) of a system that accelerates image retrieval queries based on mask annotations, which is essential for numerous applications such as identifying spurious correlations learned by ML models and detecting maliciously manipulated images.
- **Implemented Innovative Techniques:** Created a novel indexing technique and an efficient filter-verification query execution framework to streamline queries on mask properties.
- **Achieved Outstanding Results:** Accelerated individual queries by up to two orders of magnitude, using indexes only 5% the size of the original data, and consistently outperformed existing methods in various multi-query workloads.

Query Processing on Tensor Computation Runtimes

Jun 2021 – Jun 2022

Project owner & leader

Microsoft, UW

- **Pioneered Tensor Query Processor (TQP):** Led the design and implementation (in Python & C++) of the industry's first query processor operating on PyTorch, transforming SQL queries into tensor programs.
- **Full TPC-H Support & Hardware Adaptability:** enabled TQP to support the full TPC-H benchmark on various hardware with reduced development effort, demonstrating the tensor abstraction's capability to relational SQL queries.
- **Significant Speedups:** Improved query execution time by 10x over specialized CPU and GPU systems (DuckDB, HeavyDB, ...) and realized query acceleration for a 9x speedup over CPU baselines when ML model inference is used within SQL queries.

Accelerating Queries for Neural Network Interpretation [Website]

Oct 2019 – Apr 2021

Project owner & leader

UW

- **Led DeepEverest Development:** Designed and implemented a state-of-the-art system (in C++ & Python) for efficiently executing interpretation queries that identify examples based on deep neural network activation patterns, by designing an efficient indexing technique and an instance-optimal query execution algorithm with critical optimizations.
- **Optimized Storage and Performance:** Accelerated individual queries by up to 63x while reducing storage requirements to less than 20% of full materialization, consistently outperforming competing baselines in various multi-query workloads that simulate DNN interpretation processes.

VisualWorld Video Data Management Project [Website]

Oct 2019 – present

Project contributor

UW

- **VOCAL:** a set of video data management systems that support efficient data cleaning, exploration, and organization for large-scale video data, as well as processing complex compositional queries, even when no pretrained model exists.
- **TASM:** a video storage manager which enables spatial random access to encoded videos. TASM speeds up content retrieval queries by up to 94% and improves the throughput of the full scan phase of object detection queries by up to 2x.
- **VFS:** a system that decouples application design from video data's physical layout and compression optimizations, allowing developers to focus on their relevant functionality, while VFS handles the low-level details associated with video data persistence. VFS also improves read performance by up to 54% and reduces storage costs by up to 45%.

FPGA-Based Edge Computing for Accelerating Mobile Applications

Jul 2017 – Aug 2017

Project contributor

Peking University

- **Developed FPGA-Based Edge Computing Model:** Engineered a prototype (in C++ & Python) that minimizes response time and energy consumption for interactive mobile applications by offloading computation to an FPGA-based edge.
- **Proven Performance Improvements:** Achieved up to 3x/15x faster response times over CPU-based edge/cloud offloading and enhanced energy efficiency by up to 29.5%.

Publications

MaskSearch: Querying Image Masks at Scale. [Preprint] [Code] *D. He, J. Zhang, M. Daum, A. Ratner, M. Balazinska.*

VOCALExplore: Pay-as-You-Go Video Data Exploration and Model Building. [Preprint] [Code] *M. Daum, E. Zhang, D. He, S. Mussmann, B. Haynes, R. Krishna, M. Balazinska.* VLDB (accepted for publication).

EQUI-VOCAL: Synthesizing Queries for Compositional Video Events from Limited User Interactions. [Preprint] [Code] *E. Zhang, M. Daum, D. He, B. Haynes, R. Krishna, M. Balazinska.* VLDB 2023 (to appear).

EQUI-VOCAL Demonstration: Synthesizing Video Queries from User Interactions. *E. Zhang, M. Daum, D. He, M. Ganti, B. Haynes, R. Krishna, M. Balazinska.* VLDB 2023, Demo Track (to appear).

Query Processing on Tensor Computation Runtimes. [Paper] [MarkTechPost] [SyncedReview] [Talk] *D. He, S. Nakandala, D. Banda, R. Sen, K. Saur, K. Park, C. Curino, J. Camacho-Rodríguez, K. Karanasos, M. Interlandi.* VLDB 2022.

Share the Tensor Tea: How Databases can Leverage the Machine Learning Ecosystem. [Paper] *Y. Asada*, V. Fu*, A. Gandhi*, A. Gemawat*, L. Zhang*, D. He, V. Gupta, E. Nosakhare, D. Banda, R. Sen, M. Interlandi.* VLDB 2022. **Best Demo Award.**

DeepEverest: Accelerating Declarative Top-K Queries for Deep Neural Network Interpretation. [[Paper](#)] [[Extended Tech Report](#)] [[Website](#)] [[Code](#)] [[Talk](#)] *D. He, M. Daum, W. Cai, M. Balazinska.* VLDB 2022.

VOCAL: Video Organization and Interactive Compositional AnaLytics. [[Paper](#)] [[Website](#)] [[Talk](#)] *M. Daum^{*}, E. Zhang^{*}, D. He, M. Balazinska, B. Haynes, R. Krishna, A. Craig, A. Wirsing.* CIDR 2022.

VSS: A Storage System for Video Analytics. [[Paper](#)] [[Tech Report](#)] [[Code](#)] [[Talk](#)] *B. Haynes, M. Daum, D. He, A. Mazumdar, M. Balazinska, A. Cheung, L. Ceze.* SIGMOD 2021.

TASM: A Tile-Based Storage Manager for Video Analytics. [[Paper](#)] [[Code](#)] [[Talk](#)] *M. Daum, B. Haynes, D. He, A. Mazumdar, M. Balazinska.* ICDE 2021.

Accelerating Mobile Applications at the Network Edge with Software-Programmable FPGAs. [[Paper](#)] *S. Jiang, D. He, C. Yang, C. Xu, G. Luo, Y. Chen, Y. Liu, J. Jiang.* INFOCOM 2018.

Incorporating Location-Based Social Networks in the Prediction of Real-Time Taxi Demand with Deep Learning. [[Poster](#)] *D. He, Y. Chen.* CoNEXT 2018 Poster Session.

Invited Talks & Presentations

- Snowflake, Query Processing on PyTorch Jul 2023
- UW Madison, Data Management for Model Explanation and Exploration Apr 2023
- Huawei Cloud, Query Processing on Tensor Computation Runtimes Feb 2023
- UW CSE Affiliates Day, Data Management for Model Exploration and Debugging Nov 2022
- VLDB 2022, Accelerating Declarative Top-K Queries for Deep Neural Network Interpretation [[Video](#)] Sep 2022
- VLDB 2022, Query Processing on Tensor Computation Runtimes [[Video](#)] Sep 2022
- VLDB 2022, How Databases can Leverage the Machine Learning Ecosystem Sep 2022
- RelationalAI, Query Processing on Tensor Computation Runtimes Jun 2022
- Microsoft Gray Systems Lab, Query Processing on Tensor Computation Runtimes Sep 2021

Teaching & Service

- Teaching Assistant, UW CSEP 590A: Machine Learning for Big Data Spring 2022
- Head Teaching Assistant, UW CSED 516: Scalable Data Systems and Algorithms Fall 2021
- Student Volunteer, VLDB 2020 Sep 2020

Mentoring Experience

- Master / Undergraduate Students: Jason Li (2022-2023), Mona Gandhi (2022–2023), Tim Li (2022).
- Highschool Students: Parie Kumar (2022).

Professional Skills

- **Programming Languages:** C/C++, Python, Java, Pascal, Javascript, Matlab, ...
- **Machine Learning:** PyTorch, TensorFlow, Keras, Scikit-Learn, ...
- **Technical:** Database Systems (Query Optimization & Execution, Indexing Techniques), Algorithms & Data Structures, Machine Learning Systems (Software & Hardware), Video Analytics, Computer Vision, Natural Language Processing, ...
- **Other Tools:** MySQL, PostgreSQL, Snowflake, Databricks, Spark, Hadoop, Hive, Docker, Selenium, LaTeX, Git, SVN, ...