

Dong He

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Education

University of Washington

Sep 2019 – Jun 2024 (expected)

PhD in Computer Science, advised by [Prof. Magdalena Balazinska](#)

Seattle, WA

- Dissertation Topic: **Improving Data Management Systems: For and Through Machine Learning**

Fudan University

Sep 2015 – Jul 2019

BSc in Computer Science (Honors)

Shanghai

- Graduated with Highest Distinction (6 out of 118)

Work Experience

Snowflake

PhD Intern, SQL Team

Oct 2023 – present, remote

- Research collaboration between UW and Snowflake on workload analysis and optimization with LLMs.

Software Engineer Intern, Machine Learning Platform Team

Jun 2023 – Sep 2023, Bellevue, WA

- **Created Snowflake's Distributed Model Trainer (SLT):** Led the design and implementation (in Python) of the first distributed PyTorch training solution within Snowflake. My work automates the model training process and creates a user-friendly interface that hides underlying complexities, enabling users to train deep models with their data inside Snowflake effortlessly.
- **Demonstrated Multi-Modal Support of SLT:**
 - **MLP Training with Tabular Data:** Trained a multi-layer perceptron using tabular data stored in Snowflake.
 - **ResNet Training with Images:** Trained an image classification model with image data stored in Snowflake.
 - **LLM Finetuning with Text:** Finetuned a large language model (stablelm-base-alpha-3b) using text data stored in Snowflake.

Microsoft

Jun 2021 – Sep 2021

Research Intern, [Microsoft Jim Gray Systems Lab](#) led by [Prof. Raghu Ramakrishnan](#)

Remote

- **Created Tensor Query Processor (TQP):** Led the design and implementation (in Python & C++) of the industry's first query processor that compiles SQL queries into PyTorch programs and executes them on various hardware (CPUs, GPUs, TPUs, etc.).
- **Full TPC-H 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, BlazingSQL) and providing acceleration for a 9x speedup for queries containing ML inference.
- **Recognized Excellence:** First-authored a VLDB paper on TQP and won the **Best Demo Award** at VLDB 2022 (top academic conference in databases). TQP was **featured by Azure CTO** at Microsoft Build 2023.

Goldman Sachs

Jul 2018 – Sep 2018

Summer Analyst, Engineering

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

- **Best Demo Award**, 48th International Conference on Very Large Databases (VLDB) 2022
- **Madrona Prize**, for the most commercializable research project, Madrona Venture & UW [[GeekWire](#)] [[BusinessWire](#)] 2022
- Paul G. Allen Fellowship, University of Washington 2019 – 2020
- Wangdao Scholar, Undergraduate Research Opportunities Program, Fudan University 2018
- Silver Medal, ACM International Collegiate Programming Contest (ACM-ICPC), Asia Regional 2015 – 2016
- Silver Medal (Top 100 in China), National Olympiad in Informatics (NOI), China National Finals 2014
- First Prizes, National Olympiad in Informatics in Provinces (NOIP) 2009 – 2014

Selected Projects

Tensor Query Processing

May 2021 – Jun 2022

Project owner & lead

Microsoft, University of Washington

- **Created Tensor Query Processor (TQP):** Led the design and implementation (in Python & C++) of the world's first query processor, TQP, that compiles SQL queries into tensor programs and executes them on various hardware (CPUs, GPUs, TPUs).
- **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 execution time for TPC-H queries by 10x over specialized CPU and GPU systems such as DuckDB and HeavyDB, and achieved a 9x speedup over CPU baselines when ML inference is used with SQL queries.
- **Recognized Excellence:** The demo of TQP won the **Best Demo Award** at VLDB 2022. TQP was also **featured by Azure CTO** at Microsoft Build 2023.

Data Management Systems for Model Explanation and Exploration

Oct 2019 – present

Project owner & lead

University of Washington

• MaskSearch: Querying Image Masks at Scale

- **Created MaskSearch:** Led the design and implementation (in Python) of a system, MaskSearch, that accelerates image retrieval queries based on properties of mask annotations of the images by designing a novel indexing technique and an efficient filter-verification query execution framework. These queries are essential for a variety of applications such as identifying spurious correlations learned by ML models and detecting maliciously manipulated images.
- **Achieved Excellent Empirical Performance:** MaskSearch accelerates individual queries by up to 100x, using indexes only 5% the size of the original data, and consistently outperforms existing methods in various multi-query workloads.
- **DeepEverest: Accelerating Interpretation by Example Queries** [[Website](#)]
 - **Created DeepEverest:** Designed and implemented a system (in C++ & Python), DeepEverest, for efficiently executing *interpretation by example* queries that identify examples based on activation patterns in neural networks, by designing an efficient indexing technique and a theoretically-proven instance-optimal query execution algorithm with empirical optimizations.
 - **Optimized Storage and Query Performance:** DeepEverest accelerates individual *interpretation by example* queries by up to 63x while reducing storage to less than 20% of full materialization and consistently outperforms baselines in various multi-query workloads that simulate model explanation processes.

VisualWorld Video Data Management Project [[Website](#)]

Apr 2020 – Sep 2023

Project contributor

University of Washington

- **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. Musmann, B. Haynes, R. Krishna, M. Balazinska. VLDB 2024 (to appear).

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

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

Query Processing on Tensor Computation Runtimes. [Paper][Talk][Keynote by Microsoft Azure CTO][MarkTechPost][SyncedReview] **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** (Demonstration of *Query Processing on Tensor Computation Runtimes*).

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

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| • 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 Jim Gray Systems Lab, Query Processing on Tensor Computation Runtimes | Sep 2021 |

Teaching & Service

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| • 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, Lightning, PEFT, 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, DuckDB, Spark, Hadoop, Hive, Google Cloud, AWS, Snowflake, Databricks, Docker, Selenium, LaTeX, Git, SVN, ...