

# 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

- Research Area: Data Management Systems and 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

Jun 2023 – Sep 2023

Software Engineer Intern, Machine Learning Platform Team

Bellevue, WA

- **Created Snowflake's Distributed Model Trainer:** Spearheaded the design and implementation (in Python) of the first distributed PyTorch training solution within Snowflake. My work automates the model training process and crafts a user-friendly interface that hides underlying complexities, empowering users to train models with their data inside Snowflake effortlessly.

### Microsoft

Jun 2021 – Sep 2021

Research Intern, [Microsoft Jim 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 acceleration 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

- [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
- 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

### 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 2024 (to appear).

**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.

**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.

**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

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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

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

## Professional Skills

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- **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, DuckDB, Spark, Hadoop, Hive, Google Cloud, AWS, Snowflake, Databricks, Docker, Selenium, LaTeX, Git, SVN, ...