Bryan Wong

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Research Interests

My research builds multimodal and agentic AI systems that reason over gigapixel-scale images, with applications in medical diagnosis, visual question answering, and evidence grounding.

Education

Korea Advanced Institute of Science and Technology (KAIST) — Daejeon, South Korea
Ph.D., Data Science (GPA: 4.02 / 4.3) [Transcript] — *Aug. 2023 – Aug. 2027*

Korea Advanced Institute of Science and Technology (KAIST) — Daejeon, South Korea
M.S., Data Science (GPA: 3.98 / 4.3) [Transcript] [Diploma] — *Aug. 2021 – Aug. 2023*

National Taiwan University of Science and Technology (NTUST) — Taipei, Taiwan
B.S., Computer Science (GPA: 3.87 / 4.3) [Transcript] [Diploma] — *Sep. 2018 – June 2021*

Research Experience

Institute of Advanced Intelligence and Computing (IAIC), A*STAR — Singapore, Singapore
Visiting Ph.D. Researcher (Supervisor: Dr. Xun Xu, Dr. Huazhu Fu) — *Jun. 2026 – Present*

- Awarded the **A*STAR Research Attachment Programme (ARAP)** fellowship, a competitive 14.5-month visiting research appointment.
- Proposed **BEACON** (Preprint, 2026), a training-free Bayesian evidence acquisition framework that reformulates agentic patch selection in gigapixel-scale image reasoning as sequential belief updating, reducing diagnostic uncertainty and improving reasoning efficiency.

Knowledge Information Research Center (KIRC), KAIST — Daejeon, South Korea
Graduate Research Assistant (Advisor: Prof. Mun Yong Yi) — *Aug. 2023 – May 2026*

- Proposed **HiVE-MIL** (NeurIPS 2025), a hierarchical vision-language multiple instance learning framework that models cross- and intra-scale alignment for label-efficient, few-shot classification of gigapixel-scale medical images.
- Proposed **MicroMIL** (MICCAI 2025), a graph-based contextual multiple-instance learning framework that reduces patch redundancy and models spatial context for robust, weakly supervised diagnosis from microscopy images.

Publications & Preprints

P03 Beyond Relevance: Bayesian Evidence Acquisition for Agentic Whole-Slide Image Reasoning [PDF] [Code]

Bryan Wong, Xun Xu, Huazhu Fu, Nancy F. Chen, and Mun Yong Yi

Preprint, 2026.

TL;DR: We reformulate agentic reasoning over gigapixel-scale images as Bayesian evidence acquisition, where an agent tracks beliefs over competing diagnoses to efficiently select the most informative regions to examine, without requiring additional training.

C09 Reasoning Trace Divergence: An Empirical Signal for Trustworthy Black-Box MLLMs in Histopathology Classification [PDF] [Code]

Anastasiia Kazmina, Constantin Venhoff, **Bryan Wong**, Sungrae Hong, Yutong Xie, and Mun Yong Yi

29th International Conference on Medical Image Computing and Computer Assisted Intervention **(MICCAI)**, 2026.

TL;DR: We introduce Reasoning Trace Divergence (RTD), a black-box uncertainty signal that probes reasoning stability under visual perturbations to expose latent hallucinations, improving classification reliability for trustworthy medical AI.

C08 Few-Shot Learning from Gigapixel Images via Hierarchical Vision-Language Alignment and Modeling [PDF] [Code] [OpenReview, Poster, Slide & Video]

Bryan Wong*, Jongwoo Kim*, Huazhu Fu, and Mun Yong Yi

The Thirty-Ninth Annual Conference on Neural Information Processing Systems **(NeurIPS)**, 2025.

*(Acceptance rate: 5,290 / 21,575 = **24.52%**)*

TL;DR: We introduce HiVE-MIL, a hierarchical vision-language multiple instance learning framework for gigapixel-scale images that models cross- and intra-scale vision-language interactions, enabling efficient diagnosis with interpretable predictions.

C07 Not All Options Are Created Equal: Textual Option Weighting for Token-Efficient LLM-Based Knowledge Tracing [PDF] [Code] [Poster]

Jongwoo Kim*, SeongYeub Chu*, **Bryan Wong**, and Mun Yong Yi

Conference on Empirical Methods in Natural Language Processing **(EMNLP Findings)**, 2025.

TL;DR: We present LOKT, an LLM-based knowledge tracing framework that converts learner option selections into textual weights, enabling token-efficient and interpretable prediction of student performance.

C06 Leveraging Multi-Facet Paths for Heterogeneous Graph Representation Learning [PDF] [Code]

Jongwoo Kim, SeongYeub Chu, Hyeongmin Park, **Bryan Wong**, Keejun Han, and Mun Yong Yi

34th ACM International Conference on Information and Knowledge Management **(CIKM)**, 2025.

*(Acceptance rate: 443 / 1,627 = **27%**)*

TL;DR: We introduce MF2Vec, a heterogeneous graph representation framework that leverages dynamic, fine-grained multi-facet paths instead of rigid meta-paths to learn robust node embeddings.

C05 MicroMIL: Graph-based Contextual Multiple Instance Learning for Patient Diagnosis Using Microscopy Images [PDF] [Code] [Poster]

Jongwoo Kim*, **Bryan Wong***, Huazhu Fu, Willmer Rafell Quiñones Robles, Young Sin Ko, and Mun Yong Yi

28th International Conference on Medical Image Computing and Computer Assisted Intervention **(MICCAI)**, 2025.

*(Acceptance rate: 1,014 / 3,447 = **29%**)*

TL;DR: We propose MicroMIL, a graph-based multiple instance learning framework that dynamically reduces redundancy and models contextual relationships among microscopy images for robust weakly supervised diagnosis.

P02 Leveraging Spatial Context for Positive Pair Sampling in Histopathology Image Representation Learning [PDF]

Willmer Rafell Quiñones Robles, Sakonporn Noree, Youngsin Ko, **Bryan Wong**, Jongwoo Kim, and Mun Yong Yi

Preprint, 2025.

TL;DR: We propose a spatial context-driven sampling strategy for self-supervised learning in pathology that leverages spatial coherence among adjacent patches in gigapixel pathology images (WSIs).

C04 Rationale Behind Essay Scores: Enhancing S-LLM's Multi-Trait Essay Scoring with Rationale Generated by LLMs [PDF] [Code] [Poster]

SeongYeub Chu*, Jongwoo Kim*, **Bryan Wong**, and Mun Yong Yi

Annual Conference of the North American Chapter of the Association for Computational Linguistics **(NAACL Findings)**, 2025.

TL;DR: We introduce RMTS, a multi-trait essay scoring framework that integrates LLM-generated trait-specific rationales with a fine-tuned S-LLM to improve scoring accuracy and interpretability.

C03 Rethinking Pre-Trained Feature Extractor Selection in Multiple Instance Learning for Whole Slide Image Classification [PDF] [Code] [Poster]

Bryan Wong, Sungrae Hong, and Mun Yong Yi

IEEE International Symposium on Biomedical Imaging **(ISBI)**, 2025.

TL;DR: We evaluate how pre-trained feature extractor selection, considering dataset size and diversity, backbone architecture, and pre-training method, affects multiple instance learning performance on gigapixel pathology images (WSIs).

C02 Towards Classifying Histopathological Microscope Images as Time Series Data [PDF] [Poster]

Sungrae Hong, Hyeong Min Park, Youngsin Ko, Sol Lee, **Bryan Wong**, and Mun Yong Yi

IEEE International Symposium on Biomedical Imaging **(ISBI)**, 2025.

TL;DR: We recast pathology microscope images as time-series sequences and use dynamic time warping with attention-based pooling to stabilize classification across varying acquisition lengths.

P01 PreMix: Label-Efficient Multiple Instance Learning via Non-Contrastive Pre-Training and Feature Mixing [PDF] [Code]

Bryan Wong and Mun Yong Yi

Preprint, 2024.

TL;DR: We propose PreMix, a label-efficient multiple instance learning framework that combines non-contrastive pre-training and feature mixing to improve WSI classification with limited labeled data.

J01 A Predicted-Loss Based Active Learning Approach for Robust Cancer Pathology Image Analysis in the Workplace [PDF]

Mujin Kim, Willmer Rafell Quiñones Robles, Youngsin Ko, **Bryan Wong**, Sol Lee, and Mun Yong Yi

BMC Medical Imaging, 2024.

TL;DR: We introduce a predicted-loss-based active learning method that dynamically filters noisy patches and selects informative ones, enabling robust and accurate pathology image classification.

C01 Analyzing Gender Pay Gap in STEM Fields by Life Trajectory [PDF] [Poster]

Wenchao Dong, **Bryan Wong**, Hasnain Irshad Bhatti, Lanu Kim, and Meeyoung Cha

8th International Conference on Computational Social Science **(IC2S2)** and *Korea Computer Congress* **(KCC)**, 2022.

TL;DR: We analyze gender pay disparities in STEM through life-trajectory modeling, highlighting career dynamics that contribute to the observed pay gap.

Work Experience

Data Engineer Intern [Certificate] Oct 2020 – Aug 2021

Commerce Connector by PriceSpider *Taipei, Taiwan*

- Designed and implemented web crawling pipelines to collect and compare product pricing data across single-store (Buy Now Online) and multi-store (Buy Now In Stores) sources.
- Migrated ParseHub workflows to an enterprise-scale crawling environment, improving scalability and processing efficiency.
- Integrated PriceSpider's crawler via API-based subscriptions, an EC2 receiver, AWS Lambda processing, and Amazon S3 storage for structured data feeds.
- Led the Data Engineering team, running monthly strategy meetings to improve data collection and processing workflows.

Back End Engineer Intern [Certificate] July 2020 – Sep 2020

Aurora Tech *Taipei, Taiwan*

- Designed and implemented RESTful APIs in Go (IRIS framework) to support communication between backend services.
- Integrated multiple game providers, supporting user authentication, balance retrieval, deposits/withdrawals, and settlement of game results.
- Refactored and optimized game provider modules to improve system efficiency, maintainability, and scalability.

Scholarships & Awards

- **A*STAR Research Attachment Programme (ARAP) (2026.06–2027.08)** [Link]: Awarded competitive research funding of up to SGD 67,085 for a 14.5-month visiting Ph.D. research appointment at A*STAR IAIC, Singapore.
- **Outstanding Award (Best Runner-up), GSDS, KAIST (2026.01)**: Selected as a top-performing doctoral student at the Graduate School of Data Science (GSDS), KAIST, based on the 2025 annual research performance evaluation.
- **Daewoong Foundation Global Scholarship Program (2025.11–2026.02)** [Certificate]: Awarded a scholarship totaling KRW 1,500,000 by the Daewoong Foundation to support outstanding international students enrolled at universities in South Korea.
- **KAIST International Graduate Scholarship (Master & PhD) (2021.08–2027.08)** [Certificate]: Fully funded Master & PhD scholarship covering tuition fees and living expenses.
- **ICATI Jakarta Scholarship Award (2021.02)** [Certificate]: Awarded by the Indonesian Taiwan Alumni Association (ICATI) for outstanding academic performance in 2020.
- **Minister's Award, Republic of China (Taiwan) (2020.12)** [Certificate]: Awarded by the Overseas Community Affairs Council (Taiwan) for outstanding academic performance and dedication.

Summer School

- **Oxford Machine Learning (OxML 2024)** [Certificate]: Selected participant in the MLx Health & Bio, MLx Representation Learning, and Generative AI tracks.

Social Service

- **Member of Project Let's Go (2020)** **[Photos]**: Taught English and STEAM subjects at Chishang Junior High School, Taiwan, through hands-on experiments and coding sessions.

References

Prof. Mun Yong Yi *Daejeon, South Korea*
Ph.D. Advisor (KAIST) *2023.08–*
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Dr. Xun Xu *Singapore, Singapore*
Ph.D. Supervisor (A*STAR IAIC, CFAR) *2026.06–*
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Dr. Huazhu Fu *Singapore, Singapore*
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