Jineon Baek

Curriculum Vitae

Education

2024–now **Postdoctoral Researcher, Mathematics**, *Yonsei University*

2016–2024 **Ph.D., Mathematics**, *University of Michigan–Ann Arbor*

• Leave of absence from June 2017 to July 2021 due to military service and pandemic.

2012–2016 **B.S., Mathematics**, *POSTECH, Pohang, Korea*

Research Interests

Extremal Combinatorics, Geometric Optimization, Enumerative Combinatorics, Experimental Mathematics, Formalization of Mathematics

Publications – Mathematics

2024 **An equilateral triangle of side $> n$ cannot be covered by n^2+1 unit equilateral triangles homothetic to it**, *American Mathematical Monthly*, November 1-9, with Seewoo Lee.

2024 **On the Erdős-Tuza-Valtr conjeture**, *European Journal of Combinatorics*, 124

2019 **Johnson's bijections and their application to counting simultaneous core partitions**, *European Journal of Combinatorics*, 75: 43-54, with Hayan Nam and Myungjun Yu.

2018 **A bijective proof of Amdeberhan's conjecture on the number of $(s, s+2)$-core partitions with distinct parts**, *Discrete Mathematics*, 341(5): 1294-1300, with Hayan Nam and Myungjun Yu.

2012 **Insertion-of-factors-property on nilpotent elements**, *Bulletin of the Korean Mathematical Society*, 49(2): 381–394, with Wooyoung Chin, Jiwoong Choi, Taehyun Eom, Youngcheol Jeon, and Yang Lee.

Preprints

2024 **Optimality of Gerver's Sofa**, *Preprint.*

• Resolves the *moving sofa problem*, a 58-year old geometric optimization problem.

2024 **A note on the Erdős conjecture about square packing**, *Preprint*, with Junnosuke Koizumi and Takahiro Ueoro.

2024 **The Erdős–Szekeres theorem for split polygons**, *Preprint*, with Martin Balko.

2023 **Formalizing Mason–Stothers Theorem and its corollaries in Lean 4**, *Preprint*, with Seewoo Lee.

Publications – Artificial Intelligence

Journal Papers

2019 **Unpaired image denoising using a GAN in X-ray CT**, *IEEE Access*, 7: 110414-110425
Hyoung Suk Park, **Jineon Baek**, Sun Kyoung You, Jae Kyu Choi, Jin Keun Seo

Conference Papers

2021 **Condensed Discriminative Question Set for Reliable Exam Score Prediction**, *Artificial Intelligence in Education*, 2021: 446-450
JungHoon Kim, **Jineon Baek**, Chanyou Hwang, Chan Bae, Juneyoung Park

2021 **Recommendation for Effective Standardized Exam Preparation**, *Learning Analytics and Knowledge*, 2021: 397-404
Hyunbin Loh, Dongmin Shin, Seewoo Lee, **Jineon Baek**, Chanyou Hwang, Youngnam Lee, Yeongmin Cha, Soonwoo Kwon, Juneyoung Park, Youngduck Choi

2020 **EdNet: A Large-Scale Hierarchical Dataset in Education**, *Artificial Intelligence in Education*, 2020: 69-73
Youngduck Choi, Youngnam Lee, Dongmin Shin, Junghyun Cho, Seoyon Park, Seewoo Lee, **Jineon Baek**, Chan Bae, Byungsoo Kim, Jaewe Heo

2020 **Deep Attentive Study Session Dropout Prediction in Mobile Learning Environment**, *CSEDU*, 2020: 26-35
Youngnam Lee, Dongmin Shin, Hyunbin Loh, Jaemin Lee, Piljae Chae, Junghyun Cho, Seoyon Park, Jinhwan Lee, **Jineon Baek**, Byungsoo Kim, Youngduck Choi

2020 **Prescribing Deep Attentive Score Prediction Attracts Improved Student Engagement**, *Educational Data Mining*
Youngnam Lee, Byungsoo Kim, Dongmin Shin, JungHoon Kim, **Jineon Baek**, Jinhwan Lee, Youngduck Choi

2020 **Towards an Appropriate Query, Key, and Value Computation for Knowledge Tracing**, *Learning at Scale*, 2020: 341-344
Youngduck Choi, Youngnam Lee, Junghyun Cho, **Jineon Baek**, Byungsoo Kim, Yeongmin Cha, Dongmin Shin, Chan Bae, Jaewe Heo

Presentations

Invited

Dec 2024 **Special Events**, *University of California–Davis*
Title: Optimality of Gerver's Sofa

Dec 2024 **Algebra, Combinatorics and Geometry Seminar**, *University of Pittsburgh*
Title: Optimality of Gerver's Sofa

Apr 2024 **Mathematics Seminar**, *Rutgers University—Camden*
Title: On the moving sofa problem

Mar 2024 **Combinatorics Seminar**, *University of Michigan–Ann Arbor*
Title: On the moving sofa problem

Feb 2024 **Algebra, Combinatorics and Geometry Seminar**, *University of Pittsburgh*
Title: On the moving sofa problem

Oct 2022 **Combinatorics Seminar**, *University of Michigan–Ann Arbor*
Title: On the Erdős-Tuza-Valtr conjecture

May 2022 **Algebra and Discrete Mathematics Seminar**, *University of California–Davis*
Title: On the Erdős-Tuza-Valtr conjecture

Sep 2018 **KAIST Discrete Math Seminar**, *KAIST, Daejeon, Korea*
Title: On the off-diagonal Erdős-Szekeres convex polygon problem

Sep 2018 **The 89th KPPY Combinatorics Seminar**, *Pusan National University, Busan, Korea*
Title: On the off-diagonal Erdős-Szekeres convex polygon problem

Contributed

Oct 2024 **Korean Mathematical Society Annual Meeting**, *Sungkyunkwan University, Seoul, Korea*
Title: Optimality of Gerver's Sofa

Aug 2023 **Combinatorics Workshop**, *Yonsei University, Seoul, Korea*
Title: $n^2 + 1$ unit equilateral triangles cannot cover an equilateral triangle of side $> n$ if all triangles have parallel sides

Feb 2023 **London Learning Lean**, *Imperial College, London*
Title: On the Erdős-Tuza-Valtr Conjecture

Aug 2018 **Combinatorics Workshop**, *Seoul National University, Seoul, Korea*
Title: On the off-diagonal Erdős-Szekeres convex polygon problem

Honors and Awards

2023 **Arthur H. Copeland Memorial Award**
Department of Mathematics, University of Michigan–Ann Arbor

2022 **Edward Simpson and Amanda Cowen Everett Memorial Scholarship**
Department of Mathematics, University of Michigan–Ann Arbor

2016 **Overseas Ph.D. Scholarship**
Korea Foundation for Advanced Studies

Professional Activities

Teaching Experience

2016–2017, 2021–present **University of Michigan**, *Graduate Student Instructor*, *Ann Arbor, MI*
- Math 105 (Precalculus), 2016 Fall
- Math 115 (Calculus I), 2017 Winter, 2021 Fall
- Math 116 (Calculus II), 2022 Fall, 2023 Fall
- Math 216 (Differential Equations), 2022 Winter

Refereeing Services

- Computing in Geometry and Topology
- Discrete Mathematics

Public Services

2017–2023 **Donga Science**, *Problemsetter and Student Mentor*, *Seoul, Korea*
- Posted monthly challenging math problems over six years on *Donga Science Polymath*, a website for gifted Korean students from elementary to high school.
- Mentored gifted students in-person.

Work Experiences

Skills

Fields: Artifical Intelligence, Data Analysis, Neural Networks, Formal Proofs
Languages: C++, Python, Mathematica (Working/Proficient), Lean, Haskell, JavaScript (Novice)
Tools used: Pandas, NumPy, PyTorch, Google OR-Tools, SAT Solvers (Kissat/CaDiCaL)

Military Service

I gained industrial experiences in artificial intelligence, data analysis and software development during my military service from June 2017 to July 2021 in Korea.

Aug 2019 –Jul 2021 **Riiid! Inc.**, *AI Research Scientist*, *Seoul, Korea*

- Organized an AAAI'21 workshop on Artificial Intelligence in Education and a paired Kaggle data analysis challenge on student performance prediction.
- Collaboratively developed and deployed a student performance prediction model serving more than 3 million users worldwide.
- Sped up inference of a Transformer prediction model by a factor of ∼100 by algorithmically optimizing tensor calculations.
- Improved prediction accuracy by ensembling with a new model, and mathematically proved that the new model satisfies desirable properties for interactive education.

Jun 2017 –Jul 2019 **National Institute for Mathematical Sciences**, *Research Scientist*, *Daejeon, Korea*

- Proposed an unsupervised GAN framework that improves the quality of medical CT images from unpaired low-quality/high-quality image database.

Freelance

Jul 2022 –Aug 2022 **Cryptolab Inc.**, *Research Engineer*, *Seoul, Korea*

- Homomorphic encryption of matrix operations and ONNX neural network models.

Dec 2020 –Feb 2021 **Team Samoyed**, *Freelancer*, *Seoul, Korea*

- Developed an enemy AI for *Teamfight Managers*, an e-sports team simulation game.
- Designed and trained an attention-based custom neural network that can predict the outcome of multi-to-multi combat situations with high accuracy.
- The model is minimal and capable of running in CPUs, suitable for being deployed in games.
- Users reported a steep increase in difficulty and improved game-play with the new enemy AI.

Personal

2022–present **mdmath**, *Developer*

- Markdown to LaTeX transpiler written in Haskell for personal use.