

# Masahiro Nakahara

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## SUMMARY

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Mathematician with 5 years of experience in academic research and programming. My research and projects range from arithmetic statistics, data analysis, probability, and machine learning.

## WORK EXPERIENCE

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### Postdoctoral Scholar, University of Washington

Sep 2020 - present

- Published 10 research papers including work on arithmetic statistics of geometric surfaces in top peer-reviewed mathematics journals such as *Math. Ann.*, *Adv. in Math*, *Proc. of the LMS*, etc.
- Presented research in over 20 international mathematical conferences and expository talks to general audiences.
- Instructed 12 undergraduate courses with up to 80 students such as multivariate calculus and linear algebra.

### Research Associate, University of Bath

Jul 2018 - Jun 2020

- Developed Magma code for collecting geometric data on thousands of surfaces and performed statistical analysis of them. Work is now published in *Math. Ann.*

## SKILLS

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Languages and Platforms: Python, R, C++, SQL, Magma, Sage, LaTeX  
Python Libraries: Numpy, Pandas, Scikit-learn, Statsmodels, Pytorch, TensorFlow, Matplotlib  
Data Science: Regression, Time series analysis, Deep learning, Reinforcement learning

## EDUCATION

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<b>Rice University</b>	PhD, Mathematics	2012 - 2018
<b>University of Florida</b>	BS, Mathematics and Statistics	2008 - 2012

## ACADEMIC PUBLICATIONS

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The elliptic sieve and Brauer groups (w/ S. Bhakta, D. Loughran, S. L. Rydin Myerson)  
*Proceedings of the London Mathematical Society*, to appear, [arXiv:2109.03746](#).

Uniform potential density for rational points on algebraic groups and elliptic K3 surfaces (w/ K.-W. Lai)  
*International Mathematics Research Notices* **2022**, no. 28, 18541–18588.

Bijjective Cremona transformations of the plane (w/ S. Asgarli, K.-W. Lai, S. Zimmermann)  
*Selecta Mathematica* **28** (2022), no. 3, Paper No. 53, 58 pp.

Quantitative arithmetic of diagonal degree 2 K3 surfaces (w/ D. Gvartz, D. Loughran)  
*Mathematische Annalen* **384** (2022), no. 1-2, 135–209.

Weak approximation and the Hilbert property for Campana points (w/ S. Streeter)  
*Michigan Mathematics Journal*, to appear, [arXiv:2010.12555](#).

Rational points on conic bundles over elliptic curves. (w/ J. Berg)  
*Mathematische Zeitschrift* **300** (2022), no. 3, 2429–2449.

Index of fibrations and Brauer classes that never obstruct the Hasse principle.  
*Advances in Mathematics*, **348** (2019), 512–522.

Brauer–Manin obstructions on degree 2 K3 surfaces. (w/ P. Corn)  
*Research in Number Theory* **4** (2018), no. 3, Art. 33, 16 pp.

Weak approximation on Châtelet surfaces (w/ S. Roven)  
*submitted for publication* [arXiv:2206.10556](#).

## MACHINE LEARNING PROJECTS

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### **Billiards AI** (Python+Pytorch+XGBoost, Regression, Deep learning, Computer vision)

[Github](#)

- A tool that teaches beginning to advanced billiard players how to improve their position play. Using a combination of neuron networks and gradient boosted decision trees, the model can choose to play the best shot option given the ball positions on a billiards table.
- The models were trained on a dataset of 5 million billiards shots from various positions and angles simulated using Python.
- Created an accompanying computer vision tool by fine-tuning a YOLOv8 model that can determine the coordinate locations of the balls simply from a picture of a billiards table.
- Assessed performance by generating random games to which the AI had over a 10% better score on position play, as evaluated by an independent model, compared to baseline strategy of taking constant shots.

### **Predicting myopia** (Python+TensorFlow, Machine learning, Deep learning, Statistical analysis)

[Github](#)

- Developed a model for predicting the likelihood of children incurring myopia in the future using a dataset provided by Orinda Longitudinal Study of Myopia.
- The model achieved an F1 score of 0.771 on the test set using various supervised learning techniques such as gradient boosted trees and SMOTE to synthesize new training examples to combat imbalance.
- A random forest classifier identified the spherical size of the eye to be the best predictor for future myopia.

### **Customizable song recommendation** (Python, Machine learning, Natural language processing)

[Github](#)

- Used Spotify API to obtain data on 2.2 million songs to build a song recommendation model that is customizable according to the user needs to help build transparency and ease of use. Customizability options include acousticness, danceability, tempo, etc.
- Used a fuzzy k-clustering algorithm to rank songs based on feature similarity. Base model was improved by leveraging natural language processing to analyze lyrics sentiment, which increased the accuracy of the naive model by 3-fold.

## CERTIFICATIONS

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### **The Erdős Institute** Data Science Boot Camp

2023

- Completed coursework on data visualization and data science.
- Completed the project “Customizable song recommendation” described above.

## AWARDS

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### AMS–Simons Travel Grant

2021-2023

### USA Mathematical Talent Search Silver Medal

2007