

# Michael Psenka

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## EDUCATION

Princeton University, Class of 2021

Bachelor's in **Mathematics**, certificates in **Applications of Computing and Applied Math**

- Undergrad CS coursework: *Algorithms and Data Structures, Programming Systems, Reasoning about Computation, Machine Learning and Pattern Recognition, Mathematical Machine Learning*
- Graduate CS coursework: *Deep Learning Theory, Complexity Theory, Information Theory, Reinforcement Learning*
- Math coursework: *Partial Differential Equations (Geometric PDE), Stochastic Differential Equations, Real Analysis (Integration Theory), Complex Analysis, Linear Algebra, Group Theory, Ring Theory, Representation Theory, Commutative Algebra, Probability & Stochastic Systems*
- GPA: 3.6

## MACHINE LEARNING RESEARCH

### Lottery ticket & pruned neural networks

Princeton, Nov. 2020

- Worked in a team of 4 to methodically study the expressivity and data dependency of various pruning methods for deep neural networks
- Established new findings and conclusions on important limitations for pruning methods at initialization, leading to deeper insight on the mechanisms behind pruning methods as well as inspiration for future improvement

### Multi-view point cloud reconstruction

Stanford (Guibas Lab), June 2020 – Present

- Working with Tolga Birdal on a novel approach to multi-view reconstruction in computer vision that completely bypasses the pairwise view registration step, which can be noisy and expensive
- Involves novel methods in non-Euclidean machine learning, optimal transport

## APPLIED MATHEMATICS RESEARCH

### Reduced order modeling

Princeton, Sept. 2020 – Present

- Working with Prof. Weinan E to study reduced order modeling from a theoretical and continuous perspective, encapsulating modern methods such as LSTM and transformers
- Employs techniques from dynamical systems theory and functional analysis

### Non-convex optimization over tensor manifolds

Princeton, June 2019-2020

- Worked with Prof. Nicolas Boumal to study second-order methods on problems over low-dimensional manifolds in high-order tensor spaces
- Found, proved, and coded a new second-order method over the Tensor Train format that provably beats the state-of-the-art in certain poorly conditioned problems

## PURE MATHEMATICS RESEARCH

### Spectral Geometry

Princeton, Mar. – Sept. 2020

- Worked in a group of 4 undergraduates under Prof. Javier Gómez-Serrano to study an open problem: proving the conjecture that the ratio of the first two eigenvalues of a triangle is maximized by the equilateral triangle
- Extended and improved upon previous analytic bounds on the problem, leading to a complete proof and solving the open problem

## PUBLICATIONS & WORKSHOP PROCEEDINGS

*Second-order optimization for tensors with fixed tensor-train rank.* **Michael Psenka**, Nicolas Boumal (1<sup>st</sup> author). [Link](#)

- Accepted to the OPT2020 NeurIPS workshop

*Reconstruction without Registration.* **Michael Psenka**, Tolga Birdal (1<sup>st</sup> author). [Link](#)

- Accepted to the IROS2020 geometric methods workshop

*A Proof of The Triangular Ashbaugh-Benguria-Payne-Pólya-Weinberger Inequality.* Ryan Arbon, Mohammad Mannan,

**Michael Psenka**, Seyoon Ragavan (co-1<sup>st</sup> author). [Link](#)

- Submitted to the Journal of Spectral Theory

## AWARDS

### Peter A. Greenberg '77 Memorial Prize

June 2020

- Awarded for outstanding accomplishments in Mathematics by juniors

**Manfred Pyka Memorial Prize***June 2018*

- Given to outstanding Physics undergraduates who have shown excellence in course work and promise in independent research

**HackPrinceton First Place***April 2018*

- *Won first place* for developing A.I.D.A.N. at HackPrinceton Spring 2018
- A.I.D.A.N. is a chatbot that, once you upload your dataset, has the capacity to do useful statistical analysis and machine learning on your dataset through voice commands. [Link](#)

**EXTRACURRICULARS**

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- **Princeton Pianist Ensemble**
  - *Publicist*: 2018
  - Group of around 40 pianists that perform school-wide bi-annually, with an emphasis on collaborative performance
  - Participated in performances for charity, e.g. showcasing for funded arts program for low-income schools
  - Performed in a virtual concert during quarantine. [Link to video](#)
- **Math Club**
- **Princeton Data Science**

**EMPLOYMENT**

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**Princeton University Department of Mathematics***June – Sept. 2019*

- Research under Prof. Nicolas Boumal (see non-convex optimization over tensor manifolds above) was funded by the National Science Foundation through award DMS-1719558

**Moovila Inc.***June – Aug. 2018, '17, '16*

- Worked closely with the dev team, participating in stand-up and sprints regularly
- Developed a machine learning algorithm for workplace analytics
- Mathematically modeled collision avoidance in network analysis animation
- Worked through a patent application for proprietary software
- Worked on improving the search engine for quicker and more robust search results
- Denormalized relational database to NoSQL, maximizing data access efficiency and cost-efficiency

**TECHNOLOGIES**

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- **Currently using w/ proficiency:** Python (PyTorch, NumPy), MATLAB
- **Extensive previous experience:** JavaScript, Java, C#, C
- **Previous experience:** AWS, Unix/Linux, Web3, HTML, CSS