# Ionatan J. Kuperwajs                                    *Curriculum Vitae*

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**Research Interests**

My research interests lie at the intersection of cognitive science and computer science. I primarily use tools from artificial intelligence and reinforcement learning to infer what algorithms people use to plan sequences of actions in complex environments.

**Education**

**Ph.D. Candidate in Neural Science**           2018-Present
*New York University (New York, NY)*
Systems, Cognition, and Computation Track

**B.A. in Neuroscience, Computer Science, & Mathematics**    2014-2018
*Macalester College (St. Paul, MN)*
Honors in Mathematics, Magna Cum Laude

**Summer Schools**

**IBRO-Simons Computational Neuroscience Imbizo**       2018
*Cape Town, South Africa*

**Research Experience**

**Graduate Research: Human planning in large state spaces**
*Center for Neural Science, New York University*
Advisor: Wei Ji Ma                               2019-Present
Investigating the cognitive processes underlying sequential planning by collecting large-scale behavioral data in a combinatorial game of intermediate complexity. Particular focus on developing theoretical models for integration between prospective and retrospective decision-making and training deep neural networks to reproduce human play.

**Eigen-distortions of stacked, local gain control**
*Lab for Computational Vision, New York University*
Advisor: Eero P. Simoncelli                             2018-2019
Trained an optimized end-to-end image compression model based on the concept of divisive normalization in biological systems. Then identified the eigenvalues corresponding to the model-predicted most and least noticeable image distortions, testing the model's ability to mimic human perceptual sensitivity.

**Lightweight, flexible visualization and analysis of FreeSurfer surfaces**
*Computational Visual Neuroscience Lab, University of Minnesota*
Advisor: Kendrick N. Kay                             2016-2018
Developed statistical and image processing tools for visualization and analysis of high-resolution fMRI data, utilizing FreeSurfer to analyze preprocessed cortical surfaces and decode fine-scale neural activity.

**Bayesian inference of neural activity and connectivity from all-optical interrogation of a neural circuit**

*Janelia Research Campus, Howard Hughes Medical Institute*
Advisor: Srinivas C. Turaga                                                    Summer 2017
Worked on a variational autoencoder-based framework for mapping neural connectivity from population activity measurements by calcium imaging combined with cellular resolution optogenetic activity perturbations.

### Dynamic network model and attractor states of the C. elegans connectome
*LINK-Group, Semmelweis University*
Advisor: Péter Csermely                                                        Spring 2017
Built a network model to simulate global activity states of the C. elegans nervous system to search for stable attractor states and map those to distinct behavioral patterns.

### Neural processing of the optic flow field
*Computational Neurogimaging Lab, New York University*
Advisor: David J. Heeger                                                        Summer 2016
Implemented a novel perceptual model for optic flow based on motion without movement to determine that the human visual system estimates heading direction and angular velocity from the evolution of the optic flow field over time.

**Publications**      **Conference articles and abstracts**
- **Kuperwajs, I.**, van Opheusden, B., & Ma, W.J. (2019). Prospective planning and retrospective learning in a large-scale combinatorial game. *Cognitive Computational Neuroscience*. pdf

**Honors & Awards**      **National Science Foundation Graduate Research Fellowship**      2020-2023
*Computational Psychology*
Three years of NSF financial support for outstanding graduate students in research-based STEM disciplines.

**Trainee Travel Grant**                                                        2019
*Cognitive Computational Neuroscience (CCN)*
National Science Foundation funding for highly-rated submissions.

**Henry Mitchell McCracken Fellowship**                                         2018
*Graduate School of Arts and Sciences, New York University*
Multi-year full funding support for doctoral students.

**National Honor Society Member**                                               2018
*Epsilon of Minnesota, Phi Beta Kappa*
Inducted students have a GPA in the upper 12 percent of their graduating class, a commitment to liberal studies, and knowledge of mathematics and a foreign language.

**Outstanding Graduate Award**                                                  2018
*Neuroscience Department, Macalester College*
Awarded by faculty to the graduating senior with the highest achievement and promise in the field.

**Undergraduate Travel Grant**                                                  2018
*Computational and Systems Neuroscience (Cosyne)*
Coverage of travel and meeting attendance costs for undergraduate students with a strong interest in neuroscience.

**Dean's List** 2014-2018
*Macalester College*
Awarded to full-time students with a semester GPA of at least 3.75.

**Undergraduate Scholars Program** 2017
*Janelia Research Campus, Howard Hughes Medical Institute*
10-week summer program aimed at well-prepared, independent, and committed undergraduate students with significant research experience.

**Men's Soccer Academic All-Conference Team** 2015-2017
*Minnesota Intercollegiate Athletic Conference*
Awarded to student-athletes with a minimum career GPA of 3.5 who meet sport-specific athletic requirements.

**National Science Foundation Undergraduate Research Program** 2016
*Center for Neural Science, New York University*
10-week summer program for undergraduates with a strong interest in neuroscience and a research-centered career.

**DeWitt Wallace Distinguished Scholar** 2014
*Macalester College*
4-year merit scholarship ($64,000) awarded to academically excellent applicants.

**Teaching Experience**

**Teaching Assistant, New York University**
- Mathematical Tools for Neural and Cognitive Science (NEURL-GA 2201)  F 19

**Teaching Assistant, Macalester College**
- Algorithm Design and Analysis (COMP 221)  F 17, S 18
- Brain, Mind, and Behavior (PSYC 180)  F 16
- Core Concepts in Computer Science (COMP 123)  S 16, F 16

**Talks**

- Model-based and model-free decision-making in a complex planning task
  *CNS Lab Talks*  February 2020
  Center for Neural Science, New York University
- Prospective and retrospective mechanisms in complex sequential decision-making
  *First Year Talk*  December 2019
  Center for Neural Science, New York University
- Human planning in large state spaces
  *Concepts and Categories Seminar Series*  November 2019
  Department of Psychology, New York University
- Combinatorial planning
  *Artificial and Biological Computation Lab Meeting*  June 2019
  Center for Neural Science, New York University
- Visualization and analysis of high-resolution fMRI
  *Honors Thesis Defense*  May 2018
  Department of Mathematics, Macalester College
- Bayesian inference of neural circuit properties from calcium imaging data
  *J-Theory Meeting*  August 2017
  Janelia Research Campus, Howard Hughes Medical Institute
- A dynamic network model for the C. elegans connectome
  *Link-Group Meeting*  May 2017
  Department of Medical Chemistry, Semmelweis University

- Neural processing of the optic flow field
  *SURP Symposium*                                              July 2016
  Center for Neural Science, New York University

**Poster Presentations**

- Prospective planning and retrospective learning in a large-scale combinatorial game
  *Workshop on Big Data in Cognitive Science*              December 2019
  Princeton, New Jersey
- Prospective planning and retrospective learning in a large-scale combinatorial game
  *Cognitive Computational Neuroscience*                  September 2019
  Berlin, Germany

**Technical Skills**

**Programming:** Comfortable in Python and MATLAB. Familiar with R, Java, C, C++, HTML/CSS, and bash.

**Coursework:** Graduate-level courses in mathematical tools for neuroscience, machine learning, Bayesian and cognitive modeling, and cellular and systems neuroscience.

**Methodologies:** Behavioral modeling, reinforcement learning, statistical inference, deep learning.

**Lab:** Experience with human psychophysics and fMRI.

**Other Skills:** Experience with object-oriented programming, parallel programming, computer vision, network science.

**Languages:** Fully proficient in English, Spanish, and Hebrew.

**Service & Activities**

- **Scientist Action and Advocacy Network (ScAAN)**        2018-Present
  President of a pro-bono science group. Work typically consists of evidence-based reports and data analysis/visualization for partner non-profit organizations.
- **Commencement Speaker Selection Committee**                  2018
  One of four student representatives nominated to select the Macalester College commencement speaker.
- **Macalester Software Development Organization (MacHack)**   2015-2018
  Hosted events and gatherings for students interested in programming.
- **Macalester College Varsity Men's Soccer Team**            2014-2018
  Member of the nationally-ranked men's soccer team, won conference title and made an NCAA tournament appearance in 2015.