

## Noam Brown

Noam Brown  
Computer Science Department  
Carnegie Mellon University  
5000 Forbes Ave  
Pittsburgh, PA 15213

Email: noamb@cs.cmu.edu  
Website: www.noambrown.com

### RESEARCH AREA

Artificial intelligence, game theory, machine learning, reinforcement learning, no-regret learning, equilibrium computation, extensive-form games, imperfect-information games.

### EDUCATION

**Ph.D.**, Computer Science  
**Carnegie Mellon University**

August 2014 – Present

**MS**, Robotics  
**Carnegie Mellon University**

August 2012 – August 2014

**BA**, Mathematics and Computer Science (*Summa Cum Laude*)  
**Rutgers University**  
Rutgers College Honors Program

September 2005 – December 2008

### PUBLICATIONS

#### Journal Papers

- **Superhuman AI for Heads-Up No-Limit Poker: Libratus Beats Top Professionals.** Noam Brown and Tuomas Sandholm. *Science*, 2017.

#### Highly Refereed Conference Papers

- **Safe and Nested Subgame Solving for Imperfect-Information Games.** Noam Brown and Tuomas Sandholm. *Neural Information Processing Systems (NIPS)*, 2017. **Best Paper Award.**
- **Reduced Space and Faster Convergence in Imperfect-Information Games via Pruning.** Noam Brown and Tuomas Sandholm. *International Conference on Machine Learning (ICML)*, 2017.
- **Dynamic Thresholding and Pruning for Regret Minimization.** Noam Brown, Christian Kroer, and Tuomas Sandholm. *Conference on Artificial Intelligence (AAAI)*, 2017.
- **Strategy-Based Warm Starting for Regret Minimization in Games.** Noam Brown and Tuomas Sandholm. *Conference on Artificial Intelligence (AAAI)*, 2016.
- **Regret-Based Pruning in Extensive-Form Games.** Noam Brown and Tuomas Sandholm. *Neural Information Processing Systems (NIPS)*, 2015.
- **Simultaneous Abstraction and Equilibrium Finding in Games.** Noam Brown and Tuomas Sandholm. *International Joint Conference on Artificial Intelligence (IJCAI)*, 2015.

- **Hierarchical Abstraction, Distributed Equilibrium Computation, and Post-Processing, with Application to a Champion No-Limit Texas Hold'em Agent.** Noam Brown, Sam Ganzfried, Tuomas Sandholm. *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2015.
- **Regret Transfer and Parameter Optimization.** Noam Brown and Tuomas Sandholm. *Conference on Artificial Intelligence (AAAI)*, 2014.

## Refereed Demonstrations

- ***Libratus*: Beating Top Humans in No-Limit Poker.** Noam Brown and Tuomas Sandholm. Demonstrations Program at *Neural Information Processing Systems (NIPS)*, 2017.
- ***Libratus*: The Superhuman AI for No-Limit Poker.** Noam Brown and Tuomas Sandholm. Demonstrations Program at the *International Joint Conference on Artificial Intelligence (IJCAI)*, 2017.
- **Baby Tartanian8: Winning Agent from the 2016 Annual Computer Poker Competition.** Noam Brown and Tuomas Sandholm. Demonstrations Program at the *International Joint Conference on Artificial Intelligence (IJCAI)*, 2016.
- **Claudico: The World's Strongest No-Limit Texas Hold'em Poker AI.** Noam Brown and Tuomas Sandholm. Demonstrations Program at *Neural Information Processing Systems (NIPS)*, 2015.
- **Tartanian7: A Champion Two-Player No-Limit Texas Hold'em Poker-Playing Program.** Noam Brown, Sam Ganzfried, Tuomas Sandholm. Demonstrations Program at the *AAAI Conference on Artificial Intelligence (AAAI)*, 2015.

## Additional Talks

- ***Libratus*: Beating Top Pros in No-Limit Poker.** Invited talk at: Facebook AI Research, OpenAI, MIT, Harvard, Princeton, Rutgers, University of Michigan, CMU, Hertz Fellowship Retreat, Cubist Systems, Jane Street Capital.
- **Simultaneous Abstraction and Equilibrium Finding in Games.** Noam Brown and Tuomas Sandholm. In: *INFORMS Annual Conference*, 2015. Invited talk, Optimization cluster.
- **Regret Transfer and Parameter Optimization.** Noam Brown and Tuomas Sandholm. In: *INFORMS Annual Conference*, 2015. Contributed presentations.

## HONORS AND AWARDS

- 2018 Allen Newell Award for Research Excellence (shared with Tuomas Sandholm)
- 2018 Tencent AI Lab Fellowship (one of five recipients)
- Best Paper Award at NIPS 2017
- *Libratus* (together with University of Alberta's *DeepStack*) selected as one of 12 finalists for Science Magazine's Scientific Breakthrough of the Year for 2017
- *Libratus* listed in *La Recherche* as one of the top ten scientific achievements of 2017
- *Libratus* won HPCWire's "Best Use of AI" Award for 2017
- Co-created *Libratus*, the first AI to defeat top humans in no-limit poker

- 1<sup>st</sup> place in the Annual Computer Poker Competition No-Limit Texas Hold'em Instant Runoff Event, 2014 - 2016
- 1<sup>st</sup> place in the Annual Computer Poker Competition No-Limit Texas Hold'em Total Bankroll Event, 2014 - 2016
- 2<sup>nd</sup> place in the 2013 Annual Computer Poker Competition Heads-Up No-Limit Texas Hold'em Total Bankroll Event
- NSF Graduate Research Fellowship Honorable Mention
- Rutgers Computer Science Department Highest Honors
- Rutgers College Scholarship Recipient

## WORK EXPERIENCE

<i>Carnegie Mellon University</i> , Pittsburgh, PA Research Assistant, Electronic Marketplaces Lab	August 2012 – Present
<i>Google DeepMind</i> , London, UK Research Intern	Summer 2017
<i>Freshplum</i> , Menlo Park, CA Software Engineer Intern	Summer 2012
<i>Federal Reserve Board of Governors</i> , Washington, DC Research Assistant, International Finance Division	April 2010 – May 2012
<i>MJM Trading Group</i> , Jersey City, NJ Algorithmic Trading Engineer	November 2006 – April 2010
<i>Merrill Lynch</i> , New York, NY Technology Analyst Intern	Summer 2008

## TEACHING EXPERIENCE

<i>Carnegie Mellon University</i>		
Teaching Assistant	Artificial Intelligence	Fall 2017
Teaching Assistant	Artificial Intelligence	Fall 2014
<i>Rutgers University</i>		
Recitation Instructor	Calculus I	Spring 2009
Recitation Instructor	Calculus I	Fall 2008
Recitation Instructor	Pre-Calculus	Spring 2008
Recitation Instructor	Pre-Calculus	Fall 2007
Peer Mentor	Calculus II	Spring 2007
Peer Mentor	Calculus II	Fall 2006
Teaching Assistant	Young Scholars Program	Summer 2006

## OUTREACH AND SERVICE TO THE ACADEMIC COMMUNITY

## **Outreach**

CMU Creative Technologies Nights 2015 – *Present*

- Introduce middle school girls to various technology-related topics in weekly presentations.

Rutgers Young Scholars Programs

Summers 2009 – 2016

- Presented lessons on game theory to gifted high school students.

Federal Reserve FedEd

2010 – 2012

- Taught financial literacy and monetary policy through guest lectures to D.C.-area high school students.

## **Reviewing**

Conferences: IJCAI 2015, AAMAS 2016, IJCAI 2016, NIPS 2017, AAI 2018

Journals: Artificial Intelligence, JAIR, Cognitive Science

## **Departmental Service**

CSD Immigration Course 2014, 2015, 2016, 2017

CSD Open House 2015, 2016, 2017

CMU Speakers Club 2017