Andrew J. Critch **Resume** **February, 2016**

CONTACT INFORMATION
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Summary

Quantitative talent:

- (2004) Ranked 2nd in Canada on the Euclid 12th grade mathematics competition.
- (2006) Ranked 5th in Canada on the Putnam mathematics competition during second year of college.
- (2006) Completed B.Sc. (Honours) in Pure Mathematics in 20 months.
- (2013) UC Berkeley PhD in mathematics completed.
- (2013) Awarded a 3-year research faculty position at the NSF-funded Mathematical Biosciences Institute (deferred).
- (2014-2015) Employed as an algorithmic stock trader at Jane Street Group in NYC.
- (2015-2016) Employed as a research fellow at the Machine Intelligence Research Institute.
- (2015-2016) Employed as a theoretical AI researcher at UC Berkeley (2017-present).

Technical skill:

- Extensive coding experience in OCaml, VBA, Bash, and Macaulay2, and some experience with R and Python, for business, trading, and mathematical computing applications.
- Published thesis on applications of algebraic geometry to Hidden Markov models.
- Experience analyzing EEG data using Bayesian network models.
- Developed a tensor manipulation package for Macaulay2.

Management and team project experience:

- Co-founded the Center for Applied Rationality (CFAR, http://rationality.org/), a non-profit which teaches workshops on improving decision-making by using recent advances in cognitive science, earning over $500K in admissions revenue to date, now with 9 full-time employees.
- Co-developed Werewolves social computer game for International House, Berkeley.
- Co-developed Credence Calibration game for CFAR.

Well-regarded as a speaker and consultant:

- Invited to present at diverse venues, including the 2017 Beneficial AI conference at Asilomar, 2016 Society for Risk Analysis annual meeting, 2016 Princeton Envision conference, 2016 Effective Altruism Global summit, 2015 Oxford University Future of Humanity graduate lecture series, 2014 Thiel Fundation Summit in San Francisco, Harvard Effective Altruism 2014 speaker series, Thiel 20 Under 20 Summit in New York City, TEDxYouth@Tallinn in Tallinn, Estonia, the 2013 Effective Altruism Summit, the Carnegie Mellon statistics seminar, the Duke University algebraic geometry seminar, the NCSU symbolic computation seminar, McGill University causal inference seminar, the 2013 Thiel Foundation Appathon, Griffiths cognitive science laboratory, and the Founders Fund 2012 annual business meeting in Maui, Hawaii.
- Consulted on decision processes and training for numerous companies, including Founders Fund venture capital, MetaMed research, the US Army's University of Foreign Military and Cultural Studies, Facebook, and Twitter.
- Advisor for startups NumerAI (homomorphically encrypted algorithmic stock prediction competition), AlphaSheets (multi-language spreadsheet IDE), Guesstimate (probabilistic programming spreadsheet interface), and Arbital (social media platform for navigating and scoring argument structures).

Details

Education

PhD in mathematics, UC Berkeley (May, 2013)
Visiting scholar in mathematics, Uni Roma Tre (January - July 2010)
M.Sc. in Mathematics, University of Toronto (August 2008)
B.Sc. (Hons) in Pure Mathematics, Memorial University (May 2006)
High school diploma, Clarenville High School (June 2004)

Research Interests

Shared ownership protocols for AI systems; game theory for artificial agents; optimal bounded reasoning; safety for highly advanced AI systems; algebraic statistics and other applications of algebraic geometry to machine learning and statistical modeling; human cognition and de-biasing; causal inference; hidden Markov models; graphical models; singular learning theory; tensor network models; parameter identifiability; financial market research.

Selected Publications

Toward negotiable reinforcement learning: shifting priorities in Pareto optimal sequential decision-making, (2016). arxiv.org:1701.01302

Logical Induction, with Scott Garrabrant, Tsvi Benson-Tilsen, Nate Soares, and Jessica Taylor (2016). arxiv.org:1609.03543.

Logical Inductors: Basic Properties, with Scott Garrabrant, Tsvi Benson-Tilsen, Nate Soares, and Jessica Taylor (2016). Submitted to Association for the Advancement of Artificial Intelligence (AAAI).

An Algorithm that Inductively Learns to Assign Well-Behaved Probabilities to Logical Sentences, with Scott Garrabrant, Tsvi Benson-Tilsen, Nate Soares, and Jessica Taylor (2016). Submitted to Innovations in Theoretical Computer Science (ITCS).

A bounded generalization of L"ob's theorem and robust cooperation for bounded agents (2016). arxiv:1602.04184. Submitted to Journal of Symbolic Logic (JSL).

Tensor representations of discrete data, with Shaowei Lin, Luca Weihs, and Piotr Zwiernik. In preparation.

Polynomial constraints on representing entangled qubits as matrix product states, with Jason Morton (2012). SIGMA 10 (2014), 095.

Binary hidden Markov models and varieties (2012). arXiv:1206.0500. Journal of algebraic Statistics, Vol 4, No 1 (2013): AS2012 Special Volume, part 2

A note on the proportionality between some consistency indices in the AHP, with M. Brunelli, and M. Fedrizzi (2010). arXiv:1203.6431v1. Applied Mathematics and Computation 219 (14) (2013), 7901-7906.

Resolving the Banach-Tarski paradox: inseparability of rigid bodies (2006). B.Sc. Honors thesis.

Pushing the limit (generalized limits and limit extrema) (2006), AEJM 1 no. 1, pp. 47-55.

Software

Robust Rental Harmony, with Jacob Tsimerman and Chelsea Voss (2015), a novel algorithm and on-line app for assigning envy-free prices to rooms in a shared house, in a way that is maximally robust to changes in preferences.

Tensors.m2, with Claudiu Raicu (2012), a Macaulay2 package for studying varieties of tensors and tensor networks.

Credence Game, with Alexei Andreev and Zachary Alethia (2012), a game for Windows, Mac, Android and iPhones for calibrating reported subjective credence levels to actual success rates.

Programming languages	OCaml (proficient)	
	VBA (proficient)	
	Bash (proficient)	
	Macaulay2 (proficient)	
	Python (some experience)	
	R statistical language (some experience)	
Invited Talks (selected)	University of Toronto CS department lecture on open source game theory	March 2017
	MIT CS department lecture on logical induction	December 2016
	OpenAI research seminar	September 2016
	Human Compatible AI research seminar	August 2016
	Oxford University Future of Humanity Graduate Lecture Series	November 2015
	Canadian IMO team Summer Camp	June, 2015
	Thiel Fundation Summit in San Francisco	June 2014
	Harvard Effective Altruism speaker series	April 2014
	TEDxYouth@Tallinn in Tallinn, Estonia	November 2013
	Thiel 20 Under 20 Summit in New York City	November 2013
	Effective Altruism Summit	July 2013
	Thiel Foundation Appathon	February 2013
	Carnegie Mellon statistics seminar	February 2013
	Duke University algebraic geometry seminar	January 2013
	NCSU symbolic computation seminar	January 2013
	McGill University causal inference seminar	December 2012
	UC Berkeley algebraic geometry seminar	November 2012
	Griffiths cognitive science laboratory	October 2012
	RTG Workshop on Tensors and their Geometry at UC Berkeley	September 2012
	York University statistics seminar	September 2012
	Queen's University algebraic geometry seminar	September 2012
	Autonomous electrical engineering and computer science seminar at UC Berkeley	August 2012
	Summer Program on Applied Rationality and Cognition in Berkeley	August 2012
	CFAR Westminster Retreat in Alamo, California	July 2012
	Center for Applied Rationality workshop in Berkeley, California	June 2012
	Algebraic Statistics in the Alleghenies at Pennsylvania State University	June 2012
	Center for Applied Rationality workshop in Pescadero, California	May 2012
	Founders Fund annual business meeting in Maui	May 2012
	Stanford student algebraic geometry seminar	February 2012
	COGS Causal Inference Symposium at UC Berkeley	February 2012
	UC Berkeley algebraic geometry seminar	January 2012
	Mathematicians Against Police Violence at UC Berkeley	November 2011
	UC Berkeley political psychology working group	September 2011

Professional Qualifications	FINRA Series 7 certified General Securities Respresentative
	FINRA Series 55 certified Equity Trader/Limited Representative
	Start-up experience (cofounded CFAR, http://rationality.org/)
	Management experience (as Chief Marketing Officer of CFAR)
	Freelance consulting experience (solicited by Founders Fund venture capital and MetaMed research)
	Trilingual fluency in English, French, and Italian.
	Bertini experience (numerical algebraic geometry package)

Honors and Awards

NSERC PDF Postdoctoral Fellowship – $80,000	March 2013
Outstanding Graduate Student Instructor Award	March 2012
DARPA Graduate Student Research grant – $24,000	January 2012
NSERC PGS-Doctoral Scholarship – $42,000	September 2008
NSERC CGS-Doctoral Scholarship – $105,000 (declined after 1 year)	September 2007
NSERC CGS-Masters Scholarship – $17,500	September 2006
NSERC Undergraduate Summer Research Assistantship – $6,000	May 2006
Governor General's Medal for Memorial University, awarded to the overall top undergraduate student across all faculties and departments.	May 2006
Memorial University Medal for Excellence in Mathematics	May 2006
Putnam mathematics competition – Honorable Mention ($\sim$ 5th in Canada)	December 2005
Centenary of Responsible Government Scholarship – $1,000	November 2005
Memorial University undergraduate mathematics competition – 1st Prize	October 2005
Memorial University Faculty of Science Dean's departmental prize, awarded annually to the top non-graduating mathematics student.	October 2005
APICS (Atlantic Provinces) mathematics team competition – 1st Prize	October 2005
Memorial University undergraduate mathematics competition – 1st Prize	January 2005
APICS (Atlantic Provinces) mathematics team competition – 1st Prize	October 2004
Memorial University Alumni Scholarship – $25,000	2004/09
Euclid 12th grade mathematics competition – 2nd in Canada	2004/05

Professional Service

Thiel Under 20 Fellowship mentor (Aug 2013 - present)

Lead curriculum developer for UC Berkeley's *Sense, Sensibility, and Science* course, under physics Nobel laureate Saul Perlmutter, philosophy professor John Campbell, and law professor Robert MacCoun (fall 2012 - spring 2013)

Cofounder and instructor for the Summer Program on Applied Rationality and Cognition (August 2012 - present)

Signatory for THINK at UC Berkeley, facilitating discussion and implementation of high-impact altruism (fall 2012 - present)

Cofounder and Curriculum Developer for the Center for Applied Rationality (spring 2012 - present)

Co-organizer for the UC Berkeley student algebraic geometry seminar, first with Charley Crissman, and later with Andrew Dudzik (spring 2011 - spring 2012)

Co-organizer for the COGS Causal Inference Symposium with psychology PhD student Michael Pacer (February, 2012)

Co-organizer for the UC Berkeley algebraic statistics seminar with Shaowei Lin (fall 2011)

Co-organizer for the Math, Productivity, Happiness and Decision-making seminar at UC Berkeley with Stanford mathematics PhD student Nisan Stiennon (fall 2011)

Co-organizer for the Many-Algebro-Geometrically Important Concepts seminar at UC Berkeley (spring 2009)

Employment History

Research Scientist — 2017/02 – present
Employer: UC Berkeley Center for Human Compatible AI — 40 hours per week
Work: researching methods to ensure beneficial human/AI interaction

Research Fellow — 2015/09 – present
Employer: Machine Intelligence Research Institute — 40 hours per week
Work: researching the theory of artificial agents

Algorithmic Trader — 2014/04 – 2015-08
Employer: Jane Street Capital — 50 hours per week
Work: researching, developing and supervising stock trading algorithms

Postodoctoral Research Fellow — 2013/09 (deferred)
Employer: Mathematical Biosciences Institute (NSF) — 40 hours per week
Work: researching applications of algebraic geometry to neuroscience and machine learning

Cofounder and Curriculum Developer — 2013/05 – 2014/04
Employer: Center for Applied Rationality — 60 hours per week
Work: Developing curriculum for statistical improvements in decision-making and cognitive debiasing.

Graduate Student Instructor — 2010/08 – 2011/12 and 2012/08 – 2013/05
Employer: UC Berkeley — 20 hours per week
Work: classroom instruction, office hours, and grading. — (except summer)

Graduate Student Researcher — 2012/01 - 2012/07
Employer: DARPA / UC Berkeley — 20 hours per week
Research on applications of algebraic geometry to machine learning models
under Professor Bernd Sturmfels

Graduate Student Instructor — 2008/08 – 2009/12
Employer: UC Berkeley — 10 hours per week
Work: classroom instruction, office hours, and grading. — (except summer)

Lecturer (vector calculus) — 2009/06 – 2009/08
Employer: UC Berkeley — 15-20 hours per week
Work: classroom instruction, office hours, and grading.

Teaching Assistantships — 2006/10 – 2008/05
Employer: University of Toronto — 5-10 hours per week
Work: tutorial classes, tutoring, and grading.

Research Assistantship (NSERC-USRA) — 2006/05 – 2006/08
Employer: NSERC / University of Toronto — full time
Work: researching division algorithms for analytic and quasi-analytic function classes
under Professor Edward Bierstone.

Mathematics Tutor — 2005/05 – 2006/05
Employer: Memorial's Undergraduate Career Experience Program (MUCEP) — variable hours
Work: Tutoring mathematics regularly to residents of Paton College
under Student Affairs and Services.

Problem Solver/Designer — 2003/06 - 2003/08
Employer: Student Work and Service Program (SWASP) — full time
Work: Creating, solving and typesetting problems for a contest training database
under Professor M. Parmenter.