George Matheos

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Education

University of California, Berkeley — **Berkeley, CA**
- BA, Mathematics & Computer Science. GPA: 3.986. — 08/2018-05/2020
- Graduate courses (year-long): probability theory, analysis/topology/functional Analysis — 08/2021-12/2022
- Advanced undergraduate courses (semester-long): machine learning, algorithms, compilers, mathematical logic, CS theory, complex analysis, algebraic topology.

Experience

Undergraduate Artificial Intelligence Researcher, UC Berkeley — **Berkeley, CA**
- Advised by Professor Stuart Russell. — 11/2019 – 05/2020
- Conducting research in the area of probabilistic programming. — 08/2021– Present
- Developed the SMCP3 family of sequential Bayesian inference algorithms, and an automated implementation of SMCP3 in the probabilistic programming language Gen. (Paper under review.)
- Developed the "backward particle Gibbs" algorithm for Bayesian inference in state-space models. This corrects mistakes in inferences from time-series data by processing data in the backwards order to avoid "garden-pathing" induced by the forward order used initially. (Not yet published.)
- Developing a new SMC inference algorithm for more automated inference in factored dynamic open-universe probabilistic models (one application is multi-object-tracking). (Not yet published).

Visiting Student Artificial Intelligence Researcher, MIT — **Cambridge, MA**
- Advised by Vikash Mansinghka, PI of the MIT Probabilistic Computing Project. — 05/2020 – 08/2021
- Developed the GenWorldModels probabilistic programming language. This extends the Gen probabilistic programming system withs support for "open-universe" probabilistic programs (OUPPs), with an inference-programming DSL for open-universe models. (Paper at AABI'20.)
- Developed new algorithm & data structures for efficient functional updates of OUPP latent states.
- Contributed to development of the Gen probabilistic programming system. Developed new inference-programming DSL, new "update specification" semantics for inference programming.
- Developed a new computational neuroscience theory explaining how brain-like spiking neural networks can implement scalable Monte Carlo inference in multivariate probabilistic models. Introduced the "Dynamically Weighted Spiking Code". Developed a compiler from probabilistic programs to spiking neural networks which run Bayesian inference in the given probabilistic model. Developed arguably the first biologically plausible models of neural circuits for 3D depth perception from 2D retinal data. (PNAS paper in prep.; poster presented at CSHL in Aug 2022.)

Data Science & Machine Learning Intern, SpaceMaker AI (now acquired by AutoDesk) — **Cambridge, MA**
- Developed novel "progressive-bicycle GAN" architecture. Applied this to generate realistic architectural proposals for apartment sites based on post-processed satellite data. — 06/2019 – 08/2019

Publications

Papers

Alexander K. Lew*, **George Matheos***, Matin Ghavamizadeh, Nishad Gothoskar, Stuart Russell, Vikash K Mansinghka. "SMCP3: SMC with Probabilistic Program Proposals". Under review.

George Matheos*, **Alexander K. Lew***, Matin Ghavamizadeh, Stuart Russell, Marco Cusumano-Towner, Vikash K Mansinghka. "Transforming Worlds: Automated Involutive MCMC in Open Universe Probabilistic Models". At Advances in Approximate Bayesian Inference 2020.

Posters

George Matheos *, **Andrew D. Bolton***, McCoy Becker, Cameron Freer, Vikash K Mansinghka. "Brain computation as fast spiking neural Monte Carlo inference in probabilistic programs". At "From Neuroscience to Artificially Intelligent Systems" conference at the Cold Spring Harbor Laboratory, August 2022.

*Equal contribution

Misc.

Honors & Awards Cox Medal, Phillips Exeter Academy, 2018. Awarded to 5 students with highest academic rank in class of over 300.

Programming languages Python, C, Java, Julia, OCaml, Haskell, Javascript, HTML/CSS, Lisp.