Ritwik K. Niyogi, PhD

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SUMMARY: I am an AI researcher with extensive hands-on experience in single cell biology, neuroscience and human clinical data for patient stratification. PhD in Machine Learning and Theoretical Neuroscience from the Gatsby Unit, University College London; fellowship from the Wellcome Trust; trained at the intersection of AI, data science, neural circuit science, drug discovery and psychiatry. I visualize data in real-time, use intuition and AI to reverse-engineer the underlying processes generating the data, and develop novel Machine Learning and mathematical models that better predict new data. I enjoy working in cross-functional teams and helping people collaborate effectively. I am innovative, independently driven and hungry for impact. I am currently working on methods for stratifying neuropsychiatric clinical populations (depression, Parkinson's, Huntington's). I am passionate about applying AI and Data Science to cellular and human patient data to link the two ends of the animal-to-human translational spectrum.

EDUCATION

Gatsby Computational Neuroscience Unit, University College London (UCL), *London, UK* *Oct 2009-Oct 2014*
PhD in **Machine Learning** and **Theoretical Neuroscience**

Dickinson College, *Carlisle, Pennsylvania, USA* *Aug 2005-May 2009*
Bachelor of Science, *Summa Cum Laude*: **Mathematics, Neuroscience, Physics.** Graduated with **Honors** in all 3 majors

EXPERIENCE

MediaTek Research, *Cambourne, UK* *Oct 2020-Present*
Senior Research Scientist | Senior Deep Learning Researcher
- Research in meta learning and representation learning; Technology development: Deep Reinforcement Learning for chip placement.
- Co-first authored paper on how to distribute data in meta learning; Led technology project on RL for chip placement

University College London*, London, UK* *Jan 2019-Sep 2020*
Wellcome Trust funded (GBP 250,000) Senior Research Fellow; Supervisors: **Dr. Robb Rutledge, Prof. Nathaniel Daw**
- Novel diagnostics for clinical depression & Parkinson's disease using AI, Bayesian Statistics and Econometrics.
- Longitudinally tracking and clustering >5000 individuals playing gamified Reinforcement Learning tasks on smartphone apps. Using Bayesian inference to identify early-on when at-risk individuals are likely to become clinically depressed.

University of Oxford*, Oxford, UK* *Oct 2018-Dec 2018*
Wellcome Trust funded Postdoctoral Research Fellow: Supervisors: **Dr. Mark Walton, Prof. Nathaniel Daw**
- Developed a novel, Reinforcement Learning model of vigor-anergia that links (i) behavioral data from human Parkinsonian and depressed patients, & (ii) cellular, pharmacological, electrochemical and behavioral data from animal neuroscience experiments. Trained in Bayesian & Deep Learning techniques, building a scalable version of the RL model.

University of North Carolina at Chapel Hill*, Chapel Hill, NC, USA* *Nov 2017-Oct 2018*
Wellcome Trust funded Postdoctoral Research Fellow: Supervisors: **Prof. Garret Stuber, Prof. Nathaniel Daw**
- Neuro-inspired AI: Tested causal hypotheses from RL models by manipulating neural activity in closed-loop. Visualized, wrangled, munged & analyzed data from >1000 neurons: PCA & clustering of cells; multi-linear regression.
- Learned 2photon imaging and single-cell transcriptomics, visualized and analyzed data from >1000 neurons.

Johns Hopkins University School of Medicine*, Baltimore, MD, USA* *Oct 2014-Oct 2017*
Wellcome Trust funded Postdoctoral Research Fellow: Supervisors: **Dr. Jeremiah Cohen, Prof. Nathaniel Daw**
- AI-inspired neuroscience: Statistically analyzed (time-series analyses, regressions) and modeled electrophysiological and behavioral data from animal experiments using RL, Hidden Markov Models and Bayesian State-Space Models.
- Developed, coded in C++ and tested novel, Reinforcement Learning-driven animal assay for Parkinson's/depression.
- Recruited and mentored 7 students—who won awards for this research: to execute Neuro-AI projects.

Gatsby Unit, University College London*, London, UK* *Mar 2010-Oct 2014*
PhD Research Student, Supervisor: **Prof. Peter Dayan, FRS**
- **Committee: Dr. David Silver (UCL/Google Deepmind), Prof Matthew Botvinick (Princeton/ Google Deepmind)**
- Developed the normative microscopic approach: a novel, Reinforcement Learning-based theoretical framework for *real-time* cost-benefit decision-making, which predicts what a human or animal *should do, at each moment in time*
- Analyzed and modeled the real-time behavior of animals using Bayesian and Reinforcement Learning approaches.
- Research project with David Silver: *Off-policy Multi-Agent Reinforcement Learning with temporally extended actions.*

***Princeton University**, Princeton, NJ, USA* *Jun 2009-Aug 2009, Jun 2008-Aug 2008*
Research Assistant, Supervisors: **Prof. Jonathan D. Cohen, Prof. Philip J. Holmes**

- Designed, collected, statistically analyzed (regression, auto-correlation, t-tests) and modeled data from decision-making experiments; Mathematically analyzed a spiking neural network of 2000 neurons using dynamical systems theory.

***Stanford University**, Stanford, CA, USA* *Jun 2007-Aug 2007*
Research Assistant, Supervisor: **Prof. James L. (Jay) McClelland**

- Extended a neural network model of sensory decision-making by incorporating time-varying reward biases.

***University of Pittsburgh Medical Center**, Pittsburgh, PA, USA* *Jun 2006-Aug 2006*
Research Assistant, Supervisor: **Prof. Raymond Y. Cho**

- Built a neural network model of cognitive control for flexible switching between tasks.

SELECTED HONOURS and AWARDS

• **Sir Henry Wellcome fellowship, GBP 250,000** • **Best Talk Award,** Society for Neuroeconomics • Faculty of Life Sciences Award, UCL • **Young Researchers' Award,** Bernstein Association • Phi Beta Kappa • Delaplaine McDaniel Prize

LEADERSHIP

• Recruited, led, managed and mentored a cross-functional team of 7 students to execute AI-neuroscience projects – students won awards for this research • Raised project funding and organized a council of advisers across AI, Data Science, Neuroscience, Drug Discovery, Healthcare and Business • Helped set up laboratory and led the development of computing infrastructure, Johns Hopkins University • Managed and led collaborative projects across UK, USA, Canada.

SELECTED PUBLICATIONS, CONFERENCE PROCEEDINGS, TALKS and TEACHING

• **Niyogi, R.K.**, Bedder, R., & Rutledge R.B. *The RNNEconomist: AI driven development of economic models*, in preparation.

• Nair, A.*, **Niyogi, R.K.***, Shang, FTabrizi, S. Rees, G., & Rutledge, R.B. *Opportunity cost determines free-operant action initiation latency and predicts apathy (PsyArxiv, 2020)*

• Ahilan, S., Solomon, R., Breton Y-A, Conover, K., **Niyogi, R.K.**, Shizgal P., Dayan, P. *Learning to use past evidence in a sophisticated world model.* PLoS Computational Biology 15(6): e1007093 (2019); BioArxiv 2018)

• **Niyogi, R.K,** Shizgal, P. & Dayan, P. *Some work and some play: microscopic and macroscopic approaches to labor and leisure*, PLoS Computational Biology 10(12): e1003894 (2014)

• **Niyogi, R.K.**, Breton Y-A, Solomon R.B, Conover, K., Shizgal, P. & Dayan, P. *Optimal indolence: how long to work and how long to play,* Journal of the Royal Society Interface,11, 969 (2013)

• **Niyogi, R.K.** & Wong-Lin, K-F, *Dynamic excitatory and inhibitory gain modulation can produce flexible, robust and optimal decision-making*, PLoS Computational Biology, 9(6): e1003099, (2013)

• Balci, F., Simen, P., **Niyogi, R.**, Saxe, A., Hughes, J.A., Holmes, P., & Cohen, J.D. *Acquisition of decision making criteria: accuracy ultimately loses the competition with reward rate*, Attention Perception Psychophysics, 73(2), 640-657 (2011)

• **Niyogi, R.K.** & English, L.Q. *Learning-rate-dependent clustering and self-development in a network of coupled phase oscillators*, *Physics Review E,* 80, 066213 (2009)

• Guez, A., **Niyogi, R.**, Bach, D., Dolan, R. & Dayan, P. *A normative theory of approach-avoidance conflicts during dynamic foraging in humans*. Reinforcement Learning and Decision Making 2013, Princeton, NJ

• **Talks** at: CogX, Harvard, Columbia, Princeton, NYU, UCSF, Oxford, UCL, Mt Sinai; Brain Conference, Neuroeconomics

TECHNICAL SKILLS

MACHINE LEARNING & STATISTICS: • Regression/classification • Dimensionality reduction, PCA, EM algorithm, Gibbs sampling, Bayesian non-parametrics • Reinforcement Learning • Bayesian inference, experiment design, hypothesis testing & model selection • Deep learning and recurrent neural networks

PROGRAMMING: • Python • TensorFlow • MATLAB • C++ • Closed-loop control technologies • UNIX Shell Scripting • High Performance Computing • Git • Igor Pro • Mathematica • Maple • XPPAUT • Arduino Microcontrollers • LabVIEW • Linux