Sivaramakrishnan Swaminathan

Education

Ph.D., Physics, *The University of Texas at Austin,* USA *2011 – 2017*

- ⋆ Perimeter Institute Visiting Graduate Fellowship (2016)
- ⋆ Dean's Excellence Fellowship (2012)
- ⋆ Communicated physics as an active contributor (top 4%) on the Physics StackExchange forum, impacting over 300k people so far

B.Tech., Electrical Engineering, *Indian Institute of Technology (IIT) Madras,* India *2007 – 2011*

- ⋆ Winner of *'How Things Work'*, India's leading technical quiz competition, combining engineering and creative problem solving (2009)

Work experience

Researcher & Team Lead at Vicarious Inc. *2017 – now*

Machine learning / Artificial Intelligence, Graphical models: inference and learning, 2D & 3D Computer Vision, Computational Geometry, Graphics

- ⋆ Using the inverse graphics perspective to build 3d computer vision algorithms for robotics (and leading the team responsible for the same)
  - Bundle adjustment, structure from motion, volumetric carving and meshing. Variational optimization for mesh refinement through multi-view stereo.
  - Differentiable rendering for 3d modeling, leveraging implicit neural representations and random Fourier features for improved performance.
  - Non-rigid registration of meshes; generating skeletal structure from object models, for simulating and rendering deformations.
  - BRDF estimation to model optical reflectance properties of object surfaces.
- ⋆ Augmenting the neuroscience-inspired 'Recursive Cortical Network' to form an improved vision system
  - Exploiting the geometry of 6d pose space to create a fast and robust coarse-to-fine inference algorithm.
- ⋆ Learning (domain-specific) graphical models for images, with generalizable inductive biases

Graduate Student Researcher at The University of Texas at Austin *2011 – 2017*

Particle Physics, Holographic Quantum Gravity & Tensor Networks, Physics ↔Machine Learning

- ⋆ Particle physics models applied to explaining early-universe cosmology, and the origin and properties of dark matter.
- ⋆ Analysis of the holographic emergence of spacetime from quantum mechanics, based on the causal structure of information flow under recursive coarse-graining of high-dimensional systems, leading to a novel variational ansatz ('Rayed MERA') consistent with the symmetries.
- ⋆ Implemented a program to algorithmically 'learn' the ground state of a critical quantum system, exploiting sparsity in entanglement to represent the state as a 'MERA' tensor network data structure, optimized using an 'alternating minimization' like technique.

Classroom Instructor at The University of Texas at Austin *2014 – 2016*

Physical Sciences

- ⋆ Taught a course aimed at introducing liberal arts majors to scientific and quantitative thinking.
  - Independently managed end-to-end, from designing curriculum to assigning grades; successfully graduated approx. 250 students to date.
  - Received extremely positive reviews for initiating an innovative curriculum to communicate mathematical modeling concepts such as exponential growth, statistics, and data analysis, to students with minimal quantitative proficiency and a resigned distaste towards math.

Knowledge and skills

- ⋆ Programming: Python, Julia, C/C++, Mathematica, Matlab; basic familiarity with Lisp/Racket, Haskell.
- ⋆ Math/Physics/Engineering: Abstract algebra, Linear algebra, Probability and stochastic processes, Statistical mechanics, Quantum field theory, Nonlinear dynamics, Quantum information and quantum computation, Analog and digital signal processing, Statistical signal processing, Control systems, Numerical methods
- ⋆ Machine Learning: Graduate course on Machine Learning; self-taught on a range of topics (eg: graphical models, variational inference, message passing, probabilistic programming).

Selected extra-vocational / volunteer activity

Research paper reviewer *2019-now*

- ⋆ For workshops at Neural Information Processing Systems (NeurIPS), a premier machine learning conference.

Co-founder and convener, *IIT Madras Astronomy Club* *2007 – 2011*

- ⋆ Organized a four day astronomy workshop for over a thousand participants.
- ⋆ Actively mentored future leaders, to ensure sustained growth of the club over the past ten years.

Active public speaker, *at various clubs, discussion groups and meetings* *2007 – now*

Startup consultant, *Texas Venture Labs practicum* *Jan-Apr 2016*

- ⋆ Led a team of 4 people to direct the social-media platforms diversification strategy for a 'conversational commerce' startup.
- ⋆ Delivered the highest scored practicum project presentation among twelve teams.

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