

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 6%) on the Physics StackExchange forum, and impacted over 180,000 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 at Vicarious Inc.

2017 – now

Machine learning / Artificial Intelligence, Graphical models: inference and learning

- ★ Working towards improved generative models for images through learning generalizable inductive biases
- ★ Augmenting the neuroscience-inspired 'Recursive Cortical Network' to form an improved vision system

GRADUATE STUDENT RESEARCHER at The University of Texas at Austin

2011 – 2017

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

- ★ 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 suiting efficient computations
 - Using 'alternating minimization' like technique to compute optimal tensors for the network
- ★ Analyzing phase transitions during clustering using the deterministic annealing algorithm. Using this as a platform to identify connections between deep learning and renormalization group flow.
- ★ Theoretical models applied to particle physics phenomenology
 - Proposed a novel mechanism to generate 'Secretly Asymmetric Dark Matter' concurrently with baryonic matter, consistently explaining various experimental observations pertaining to dark matter.
 - Demonstrated high-temperature symmetry restoration in Standard Model extensions solving the finetuning problem with a pseudo-Nambu-Goldstone Higgs boson, overturning previous claims to the contrary.
- ★ Theoretical analysis of the holographic emergence of spacetime from quantum mechanics
 - Compared the causal structure of information flow under coarse-graining of high-dimensional quantum systems, with the emergent spacetime description, to propose a novel generalization of 'MERA' tensor networks for defect conformal field theories.

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: C/C++, Julia, Mathematica, Matlab, Python.
- ★ 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, 'Practical deep learning for coders' by `fast.ai`

SELECTED EXTRA-VOCATIONAL ACTIVITY

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.

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