Shankha Biswas

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Work Experience

Moloco — *Seattle, WA*
Data Infrastructure Intern *Summer 2023*
- Engineered new DataFlow pipelines for processing advertising data
- Migrated log parsing to Go, eliminating expensive gRPC calls
- Developed graph model to track unique users using noisy proxy labels

Amazon Research (Lab126) — *Sunnyvale, CA (remote)*
Applied Scientist Intern *Summer 2020*
- Developed low-runtime/memory algorithms to process time-series data for wearable devices
- Implemented latent variable models to decide when to **abstain from prediction** on time series data

Kensho — *Cambridge, MA*
Software Engineer: Graph Infrastructure Team *Jan – Aug 2018*
- Designed and implemented a **write-ahead log** backend to provide *atomicity* and *durability* for graph database transactions
- Developed compiler to generate optimized database queries to a graph database, agnostic to the underlying DBMS [github link]

D.E. Shaw Research — *New York, NY*
Scientific Associate Intern *Summer 2016*
- Approximated quantum mechanical forces by fitting computationally efficient classical models
- Developed techniques to characterize the structure of high dimensional functions using very few samples

Education

Massachusetts Institute of Technology

PhD in Theoretical Computer Science (GPA 5.0/5.0) *2018 – 2024*
Teaching Assistant: Multicore Programming, Algorithm Engineering (parallel algorithms), Randomness and Computation, Probability

Master of Engineering in EECS (GPA 5.0/5.0) *2016 – 2018*
Teaching Assistant: Design and Analysis of Algorithms, Fundamentals of Programming

Bachelor of Science in EECS, Minor in Physics & Mathematics (GPA 4.8/5.0) *2013 – 2017*

Projects and Initiatives

Full Scale Roller Coaster — *Cambridge, USA*
Design and Construction Lead *Summer 2015*
- Designed full-scale roller coaster with $20,000 budget
- Performed simulations to ensure safety of riders
- Led team of ∼20 people to complete construction of functioning ride

MIT-IIT Robotics Program — *Kharagpur, India*
Organizer and Instructor *Summer 2017*
- Conceived joint venture between **MIT International Science and Technology Initiatives** and **IIT Kharagpur**
- Developed and organized curriculum for workshop on programming, simulation, & control theory
- Raised $5000 funding from external sources
- Designed and fabricated ∼40 lab kits

Awards

International Olympiad in Informatics (IOI): *Bronze medal in 2012 and 2013*
MIT Presidential Fellowship
Big Georges Venture Fund Fellowship
MakeMIT hackathon: 1^{st} *place 2015*, 3^{rd} *place 2016*
Australian Mathematics Competition: *Medallist (4 years)*
Indian Institute of Technology Entrance Exam: *Ranked in top 0.05%*

Research and Publications

Average-Case Local Computation Algorithms [pdf]
Joint work with: Ruidi Cao, Ted Pyne, Ronitt Rubinfeld In Submission
- Generating fast local access to a sparse subgraph
- Bypassing existing lower bounds by using distributional assumptions on the input

Testing Tail Weight of a Distribution Via Hazard Rate [pdf]
Joint work with: Maryam Aliakbarpour, Ravichandran, Ronitt Rubinfeld ALT 2023
- Initiated property testing for continuous distributions

Developed algorithms for testing whether a distribution is heavy tailed with finitely many samples
Demonstrated impossibility of testing in the absence of assumptions

Local Access to Random Walks [pdf]
Joint work with: Edward Pyne, Ronitt Rubinfeld ITCS 2022
Implemented fast (sub-linear) query access to long random walks on arbitrary regular graphs

Massively Parallel Algorithms for Counting Triangles in Huge Graphs [pdf]
Joint work with: Talya Eden, Quanquan C. Liu, Slobodan Mitrović APPROX 2022
Obtained faster algorithms for counting triangles in the Massvely Parallel Computation (similar to MapReduce) model

Decomposition-Optimal Algorithm for Counting and Sampling Arbitrary Motifs in Sublinear Time [pdf]
Joint work with: Talya Eden, Ronitt Rubinfeld APPROX 2021
Presented faster algorithms to count motifs (subgraphs) in larger graphs in the sub-linear query model
Corresponding tight lower bounds based on the decomposition of the given motif

Faster Parallel Algorithms for Graph Spanners [pdf]
Joint work with: Slobodan Mitrović, Yasamin Nazari SPAA 2021
Obtained exponential improvement in parallel run-time with slightly sub-optimal stretch
Investigated trade-off between run-time (number of rounds) and stretch

Local Access to Huge Random Objects Through Partial Sampling [pdf]
Joint work with: Ronitt Rubinfeld, Anak Yodpinyanee ITCS 2020
Implemented **sub-linear time** local access to various types of random objects
Undirected graphs with independent edge probabilities: $G(n, p)$, Stochastic Block Model, etc.
Random Catalan objects: Dyck Paths, Bracket Expressions, Rooted Trees etc.
Random valid coloring of given input graph

Sublinear-Time Algorithms for Counting Star Subgraphs via Edge Sampling [pdf]
Joint work with: Maryam Aliakbarpour, Themis Gouleakis, John Peebles, Ronitt Rubinfeld, Anak Yodpinyanee Algorithmica 2018
Introduced new edge sampling model in the context of graph property testing
Formulated new algorithms for counting subgraphs, and deduced stronger lower bounds in this model

Efficient Origami Construction of Orthogonal Terrains [pdf]
Joint work with: Erik D. Demaine, Jason Ku 7OSME
Developed novel technique of constructing Origami structures using *time evolving cross-sections*
Used technique to obtain constant-factor optimal constructions of orthogonal terrains, and extruded polyhedra

Common Development of Prisms, Anti-Prisms, Tetrahedra, and Wedges [pdf]
Joint work with: Erik D. Demaine CCCG 2017
Constructed common unfoldings of a large number of convex polyhedra (largest known at times of publication)
Designed first non-trivial uncountable family of unfoldings

Aperiodic Bistable Auxetics
Designed aperiodic bi-stable auxetic linkage that can be fabricated efficiently from flat material
Aperiodicity results in varying amounts of area expansion, allowing transitions to any desired 2D surface