SANIT GUPTA

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EDUCATION

Indian Institute of Technology Bombay, *Mumbai, India* *Jul '16 - Present*
B.Tech in Mechanical Engineering (*Minor* in Computer Science & Engineering)
Major GPA: 8.6/10 (Computer Science GPA: **9.5/10**)

Thesis: **Developing and Analyzing Algorithms for the Multi-Armed Bandit** *Aug '18 - Present*
(under *Prof. Shivaram Kalyanakrishnan*)
In the MAB problem, resources must be dynamically allocated between competing choices. We are developing and analyzing algorithms for the regular setting and a "batch-sampling" setting in multi-armed bandits, in which a batch of b $>$ 1 pulls must be executed before the outcomes of the pulls are available. For the regular setting, we introduce an element of greediness called 'persistence' into any bandit algorithm. We have proved that 'persistence' improves ϵ-greedy and are now extending our proof to other algorithms. Also, we have empirically demonstrated improvements over baselines in both settings and have made substantial progress towards proving formal guarantees on their performance.

RESEARCH INTERESTS

My primary interest is in the domain of artificial intelligence with a focus on reinforcement learning and bandits. I am also fascinated by various other fields including distributed computing, deep learning, and optimization.

PUBLICATIONS

- How do people learn how to plan?
  Y.R. Jain, ***S. Gupta****, V. Rakesh, P. Dayan, F. Callaway, F. Lieder*
  CCN 2019

RESEARCH AND PROFESSIONAL EXPERIENCE

Reverse engineering how people learn to plan *May '19 - Jul '19*
Guide: Falk Lieder *Max Planck Institute for Intelligent Systems, Germany*

- Attempted to reverse-engineer the human brain's underlying learning mechanisms with some success
- Developed multiple computational models of rational strategy selection learning
- Designed **bayesian reinforcement learning** agents controlling reward signal to reflect human biases
- Trained & evaluated several candidate models of planning on various metrics of closeness to humans

PAC-Optimal Reinforcement Learning with a simulator *Sept '19 - Present*
Guide: Shivaram Kalyanakrishnan *Dept. of Computer Science & Engineering, IIT Bombay*

- In PAC-Optimal RL, a near-optimal policy needs to be learnt with theoretical guarantees on its correctness
- Developing and analyzing novel algorithms for the setting with a near perfect simulator of the environment
- Designing sample efficient algorithms inspired from literature on the best arm identification problem in bandits
- To this end, designing Markov chain sampling strategies for quick and accurate policy evaluation

Parallel Computing for the Laplace Equation on Unstructured Grids *May '17 - Present*
Guide: Shivasubramanian Gopalakrishnan *Dept. of Mechanical Engineering, IIT Bombay*

- Solving the laplace gives us the steady state temperatures of any object given boundary conditions
- Developed a solver to iteratively compute the solution to the laplacian for arbitrarily shaped objects
- Designed parallel versions with **MPI**, distributing parts of the problem among processors and performing communication between them to speed up the solution, achieving **11x** speed-up with 16 cores
- Used graph partitioning algorithms to minimize communication volume and maximize efficiency
- Preparing a manuscript for this to be submitted for publication

E-Commerce Product Classification incorporating human feedback *May '18 - Jul '18*
Data Science Intern *Lymbyc, Bangalore*

- Built an **ML pipeline** to classify e-commerce products, introduced an **active learning** component
- Impact: Active learning by **Pool-based Entropy Sampling** increased accuracy from **89.2%** to **98%**

SCHOLASTIC ACHIEVEMENTS

- Awarded the **Undergraduate Research Award** in recognition of exceptional research *'19*
- Achieved **All India Rank 567** in JEE (Advanced) and **99.6 percentile** in JEE (Main) *'16*
- **All India Rank 104** in KVPY, accepted into **Indian Institute of Science, Bangalore** *'16*
- Acquired **All India Rank 6** in VITEEE among 210,000 candidates *'16*
- One of 300 students in the country selected for the Indian National Physics Olympiad (INPhO) *'16*
- Cleared National Standard Examination in Physics (NSEP), also among the **National Top 1%** *'16*
- Achieved a perfect score in Chemistry in All India Senior School Certificate Exam *'16*
- Bagged **State Rank 4** in Jammu & Kashmir in National Talent Search Examination (NTSE) *'14*
- Secured **All India Rank 27** in National Cyber Olympiad (NCO) *'11*

OTHER KEY PROJECTS

Distributed Mixed Integer Optimization *Spring 2019*
HPC with Shivasubramanian Gopalakrishnan and Prof. Avinash Bhardawaj

- Developed a solver for mixed integer programs implementing the **Branch-And-Bound** algorithm
- Reduced runtime from **exponential** to **linear** by developing a version that could run on multiple cores

Optimal Bidding *Dec '17 - Jan '18*
6th Annual Inter-IIT Tech Meet, IIT Madras

- Solved a stochastic optimisation problem to minimize electricity bill for a gated community
- Implemented the solutions using **Particle Swarm Optimization** and **Dynamic Programming**

Playing Pong with Reinforcement Learning *Spring 2018*
Hobby Project

- Developed and trained an intelligent agent to play Pong using **Reinforcement Learning**
- Trained the agent by **Policy Gradient** with only the pixels and whether it scored/lost a point as input

End-to-end Translator Models *May '18 - Jul '18*
Web and Coding Club, IIT Bombay

- Conducted a literature survey on **seq2seq** models used for program synthesis using text and vice versa
- Built an encoder-decoder model using PyTorch for English to French translation

Social Action Projects:
Smart Irrigation Control *Jan '17 - May '17*
National Innovation Club, IIT Bombay

- Designed a circuit to sense the soil moisture level and operate irrigation systems accordingly
- Developed a user-friendly Android App for the farmers to input the threshold moisture value

Mitticool Refrigerator *Jul '16 - Nov' 16*
National Innovation Club, IIT Bombay

- Documented for smooth replication and accessibility across India including a helpful FAQ
- Implemented improvements including using an opaque door and using a finned structure for the walls

RELEVANT COURSES & TECHNICAL SKILLS

Math & Computer Science	Machine Learning, Data Structures & Algorithms, Stochastic Models*, High Performance Scientific Computing, Logic for Computer Science*, Data Analysis and Interpretation, Computer Programming & Utilization, Multivariable Calculus, Linear Algebra, Differential Equations, Real Analysis, Numerical Analysis
Miscellaneous	Industrial Engineering and Operations Research, Microprocessors & Automatic Control, Kinematics and Dynamics of Machines, Operations Analysis*, Economics, Philosophy
Programming Languages	C++, Python, R, Java, WebPPL, mySQL, HTML, CSS
Programming Packages	Keras, PyTorch, OpenMP, MPI, Tensorflow, SciKit Learn, NetworkX
Software & Tools	GIT, LaTeX, MATLAB, Arduino, Visual Studio, AutoCAD, SolidWorks

POSITIONS OF RESPONSIBILITY

Institute Student Mentor *Jul '19 - Present*
Institute Student Mentorship Program, IIT Bombay

- Selected from a pool of 300+ applicants via a procedure comprising of SOP, peer reviews and interviews
- Guiding a group of **12 freshmen** in their academic & co-curricular endeavours in the institute

Department Academic Mentor *Jul '18 - Apr '19*
Dept. of Mechanical Engineering, IIT Bombay

- Selected from a pool of 85+ applicants on the basis of rigorous interviews and peer reviews
- Mentored a group of **10 sophomores** to ensure their smooth transition into the department

EXTRACURRICULAR

- Ranked **1st** (out of 147) in IIT-B in **American Express's AnalyzeThis**, a data science competition *'17*
- Part of Hostel 9's team, secured **2nd** position in IIT Bombay's Coding General Championship *'18*
- Achieved **3rd** rank in IIT Bombay's Logic General Championship *'19*
- Awarded the Hostel **Tech Special Mention** for contribution to Hostel Technical Culture *'19*
- Won the zonal level of the **Pi Quiz**, a quiz meant to test unconventional thinking, and was selected for the final round to be held at **IIM Indore** during their management and cultural festival *'15*
- Led the school team to victory in the zonal round of **Robotryst Junior** and the team was invited to participate in the final round to be held at **IIT Delhi** as a part of their technical festival *'14*
- Volunteered to be a part of **Cured**, an initiative by Techfest IIT Bombay, to conduct a mass diabetes check, successfully screening more than 100,000 people at 170+ camps across 10 states *'16*
- Completed a three year beginners' course in French having taken it as a third language *'09-'12*

REFERENCES

Shivaram Kalyanakrishnan
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