



Deep Karkhanis

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Education

Indian Institute of Technology, Bombay

July '16 - Aug '20

- B.Tech (with Honors) in **Computer Science** and Engineering
- Core GPA : **9.58**/10.0 ○ Honors GPA : **10.0**/10.0
- Minor Degree in Applied Statistics and Informatics

Work Experience

Research Fellow

Microsoft Research Lab, India

Since Aug '20

Co-Founder and CTO

Kwikpic Tech Services [www.kwikpic.in]

Since June '20

Publication

- Krishnendu Chatterjee, Martin Chmelík, **Deep Karkhanis**, Petr Novotný and Amélie Royer, "Multiple-Environment Markov Decision Processes: Efficient Analysis and Applications", **ICAPS 2020**, Nancy, France [[AAAI Link](#)]

Research Internships

Software Verification and Modelling Group

Prof. Dr. Ir. Joost-Pieter Katoen

RWTH Aachen, Germany

May '19 - July '19

Chatterjee Group

Prof. Krishnendu Chatterjee

IST Austria

May '18 - July '18

Research Experience

Microsoft Research Fellowship.....

Graph based Indices for Fast & High Accuracy k-Nearest Neighbour Search

MSR India

Received Letters of Recommendation

- Designing a system for **>98%** accuracy kNN search on datasets with **> 10⁶ points** & **> 100 dimensions** with high-rate of inserts and deletes
- Employed a **hybrid model** which performs incremental **Vamana Indexing** (Microsoft DiskANN) on top of streaming **FAISS clustering** (Facebook)
- Improving the system to provide high QPS on low (**<5MB**) **memory** servers suffering from high pre-emption rates and limited disk access (**no SSDs**)
- The expected number of distance calculations are **50% less** than current state of the art low memory solutions

Bachelor's Thesis.....

Tractable Policy Iteration for POMDPs [BTP Report]

IIT Bombay

Prof. Shivaram Kalyanakrishnan | Undergraduate Research Award | Received Recommendation

- Made policy iteration in POMDPs more controllable by regulating the update of Finite-State Controllers (FSCs)
- Designed algorithms to **combine multiple FSCs** & improve **arbitrary subsets** of FSC-nodes while ensuring Policy Improvement
- Solver found policies with **20%** higher rewards to show superiority over Value Iter & MCTS on complex infinite-horizon problems

Internships.....

Bounded Model Checking in MDPs

RWTH Aachen, Germany

Prof. Dr. Ir. Joost-Pieter Katoen | Received Letters of Recommendation

May '19 - July '19

- Combined concepts of Stochastic Model Checking & **Counting-SAT** to compute Bounded Reachability Probabilities in MDPs
- Achieved **10x faster** solving by designing a succinct CNF encoding for Markov Chains using the transition probabilities **BDD**

Multiple Environment MDPs (MEMDPs)

IST Austria

Prof. Krishnendu Chatterjee | Published at ICAPS 2020 | Received Recommendations

May '18 - July '18

- Improved the **POMCP** algorithm to create an online MEMDP solver and established its superiority over POMDP solvers

- o Exploited the sparse transitions in MEMDPs to have faster belief updates [$O(n)$ as opposed to $O(n^2)$]
- o Solver was **50x** faster & a **20x** better environment detector with higher success & **crash-less** navigation on Hallway benchmarks

Awards and Scholastic Achievements

- o Conferred the **Institute Academic Excellence Award** by the Dean for securing **Institute Rank 1** at the end of 1st year
- o Received the **Undergraduate Research Award**, IIT Bombay for distinguished research in POMDP solvers
- o Secured a Perfect **10/10 GPA** in *3 out of 7 semesters*. Only student (1 of 950) with 10.0 GPA in both Freshman semesters
- o Awarded **3 AP grades** (Advanced Performer) for having the best performance in Linear Algebra, Biology and Env. Engineering
- o Awarded the **DAAD scholarship** by the *German Federal Ministry* for pursuing advanced research in Germany

Start-Up

Co-Founder and CTO, Kwikpic.in [<https://kwikpic.in/>]

- o Adopted leading **face-recognition** technologies to create an automatic service to instantly identify and deliver photos in which the user is present
- o Optimized the algorithm on Indian faces to handle varied lighting conditions thus achieving an accuracy of **>98%** for indoor & **>95%** for night events
- o Established a **stable revenue stream within one month** of registering the firm by securing contracts with wedding and corporate event planners without the need for external funding
- o Single-handedly developed the full-stack of the web application on AWS. **Managing a team of 6** developers thus handling **>10** live events per month

Academic and Research Projects

Temporal Data Support for SQL

Prof. S. Sudarshan

- o Extended open-source **PostgreSQL codebase** to add a new '*valid-time*' attribute: stores time frame for which data was valid
- o Designed syntax for declaring **temporal relations**, which are relations having a valid time attribute
- o Supported "*natural and theta joins*" among relations, irrespective of them being temporal or non-temporal

Language Processor for a subset of C

Prof. Uday Khedkar

- o Designed a **compiler and interpreter** from scratch for processing a C style language
- o Built support for **multiple variable scopes** and datatypes, along with control-flow, conditional and arithmetic statements
- o Implemented support for "*recursion*" and user-defined functions with multiple return-types

Restoring degraded Cave-Paintings using Deep-Image Priors

Prof. Masaaki Nagahara

- o Optimized image **inpainting** methods using deep-image priors & **denoising** to identify and restore damaged parts of paintings
- o Successfully restored the depicted ornaments & facial features of people and deities in paintings from **Ajanta Caves, Mumbai**

Leadership and Mentorship Experience

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|---|--|
| Teaching Assistant | <ul style="list-style-type: none"> o CS252, CS224: Computer Networks, MA106: Linear Algebra, MA108: Differential Equations o Mentored 200+ UG's, conducted weekly tutorials, created assignments and code testers |
| Institute Web Nominee, Academic Council | Web Secretary |
| <ul style="list-style-type: none"> o Search optimized UGAC website for Google Search o Managed portals used by 3000+ students, 100+ professors | <ul style="list-style-type: none"> o Received Organizational Color Award for exceptional work o Developed website & app, conducted digitization of hostel |

Relevant Coursework

Artificial Intelligence and ML, Advanced Machine Learning, Probability Theory, Statistical Inference, Regression Analysis, Derivative Pricing, Digital Image Processing, Understanding Design (UI-UX), Advanced Remote Sensing, System Dynamics

Software & Programming Skills

C/C++, Python, Matlab, Advanced Web Development, Scheme, L^AT_EX, QGIS, Java, VHDL, Prolog, Clingo, Android Studio, SolidWorks

Other Key Academic Projects

- o *Natural Language Processing* : QnA website using **Bayesian Taggers** for tagging/grouping questions
- o *Simulating Bokeh Effect in Videos* : Grab-Cut for getting foreground, emulating Lens Blur for **simulating Bokeh**
- o *Intel SGX Programming* : Coded **Accountable Decryption**, used Merkel-Trees for decryption-requests log
- o *Diagonal Parity* : Designed an algorithm for "*2-bit error correction*" using parity along 3 directions

- o *FPGA Railway Signal* : Used VHDL based **FPGA**-boards for 8-way junctions, **USB and UART** connections with server
- o **GO Playing Bot** : Developed a DFS-based **territory counting** algorithm, used MCTS with UCT for move selection

Extra Curricular Activities

Sports.....

- o *Rifle Shooting* : 1st Place in National Cadet Corps (NCC) Camp (.22 Calibre Rifle), Perfect Score in all rounds
- o *Cricket* : 3rd Place in District Level Tournaments with 2 Man-of-the-Match Awards in the tournaments
- o *Swimming* : 1st position in the Summer of Sports Swimming Camp, at IIT-B

Community Service.....

- o *National Cadet Corps (NCC)* - Participated in the Good Samaritan Mission, Vijay Ashram supporting 1800+ destitutes
- Organized cloth donation (100+ kg) and blood-donation (60+ litres) camps
- o *Daily Dosage Tracker* : Created a universal band to help patients easily track their medicine doses

Institute Bodies.....

- o *Entrepreneurship Cell* : Organized job fair for 1k+ students and 30+ companies at E-Summit
- o *Innovation Cell (UMIC)* : Significant contributions to the award winning Quad-Copter and Line-Following bots

Other Awards.....

- o *Organizational Color Award* : For exceptional work as Web and Computer Secretary at Hostel 7, IIT Bombay
- o *Master Laureate* : Awarded for leading overall record in High School