Deep Karkhanis

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Education

Carnegie Mellon University — **Pittsburgh, PA**
MS in Machine Learning — *Aug '21 - Dec '22*
- Current Courses: Advanced **Natural Language Processing**, Statistics, Machine Learning (ML) PhD

Indian Institute of Technology, Bombay (IIT Bombay) — **Mumbai, India**
B.Tech. with Honors in Computer Science and Engineering — *July '16 - May '20*
- Core GPA : **9.58**/10.0 - Honors GPA : **10.0**/10.0
- Minor in **Applied Statistics** and Informatics
- **Teaching Assistant** in Computer Networks, Linear Algebra, Differential Equations
- Key Courses: **Advanced Machine Learning**, Advanced Statistics, Derivative Pricing, Image Processing, Remote Sensing

Experience

Microsoft Research Lab — **Bangalore, India**
Microsoft Research Fellow — *Aug '20 - Aug '21*
- Upgraded Microsoft's DiskANN indexing algorithm to add semantic search in **MS Exchange** (**pending Patent** Application)
- The algorithm can host all Outlook/Exchange emails and is planned to be **shipped worldwide**. Currently deployed internally
- Improved the graph kNN algorithm to require **90% lesser** memory and achieve **>95%** recall with **half** the computational costs
- Added low-RAM (<20MB) support while supporting constantly changing datasets with **>1M** points, **>100** dimensions
- Developed prototype (kNN based) for a new **Bing Ad system** serving **all European Markets** in **all supported languages**
- Designed the **first graph ANN algorithm** which supports and optimizes for filter-based search directly in the index build phase

Kwikpic.in (StartUp) — **Mumbai, India**
Co-Founder and CTO — *May '20 - May '21*
- Adapted leading face recognition algorithms to work on **Indian faces** and built system to deliver to guests their event photos
- Optimized algorithm to handle varied lighting conditions to achieve accuracy of **>98%** for indoor & **>95%** for night events

RWTH Aachen University [Link] — **Aachen, Germany**
Scientific Research Intern | Prof. Joost-Pieter Katoen — *May '19 - July '19*
- Combined concepts of Stochastic Model Checking & **Counting-SAT** to compute Bounded Reachability Probabilities in MDPs
- Designed a **10x faster** solver by formulating a succinct CNF encoding for Markov Chains using the transition probabilities *BDD*

Institute of Science and Technology (IST) Austria — **Vienna, Austria**
Scientific Research Intern | Published in ICAPS 2020 [1] — *May '18 - July '18*
- Improved the *POMCP* algorithm to create an online UCT based MEMDP solver and proved its superiority over POMDP solvers
- Exploited the sparse transitions in Multiple Environment MDPs to get faster belief updates (**O(n)** as opposed to **O(n^2)**)
- Created solver which was **50x** faster, **20x** better environment detector and achieved **crash-less** navigation on Hallway benchmarks

Publication

- [1]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]

Awards and Scholastic Achievements

- Secured the **Undergraduate Research Award**, IIT Bombay for distinguished research in POMDP solvers (2019)
- Awarded the **DAAD scholarship** by the *German Federal Ministry* for pursuing advanced research in Germany (2019)
- Received the **Institute Academic Excellence Award** from the Dean for securing **Institute Rank 1** (2017)

Academic Research

Bachelor's Thesis [Link] — **IIT Bombay**
Undergraduate Research Award | Prof. Shivaram Kalyanakrishnan — *Aug '19 - May'20*
- Improved policy iteration in Partially Observable Markov Decision Processes by regulating Finite-State Controller (FSC) updates
- Designed algorithms to **combine multiple FSCs** & improve **arbitrary subsets** of FSC-nodes while ensuring Policy Improvement
- Created a solver which got **20%** higher rewards than Value Iteration & Monte Carlo Tree Search on infinite-horizon problems

Restoring degraded Cave-Paintings using Deep-Image Priors — **IIT Bombay | Sept '18 - Jan '19**
- Optimized image **inpainting** methods using deep-image priors & **denoising** to identify and restore damaged parts of paintings
- Successfully restored the depicted ornaments & facial features in some **1500 year old paintings** from Ajanta Caves, Mumbai

Temporal Data Support for SQL — **IIT Bombay | Aug '18 - Dec '18**
- Extended open-source **PostgreSQL codebase** to store time-range of data validity by adding new '*valid-time*' attributes
- Designed syntax and added support for **temporal relations** and implemented *"natural and theta joins"* among all relation types

Software & Programming Skills

C++/C, Python, MATLAB, Web Development, Java, Scheme, Android Studio, VHDL, Prolog, Clingo, Solidworks, LaTeX