Samarth Mishra

Curriculum Vitae

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Education

2013-2017 **Bachelor of Technology with Honors**, *Computer Science and Engineering*.
Indian Institute of Technology Bombay (IIT Bombay)
Minor in Electrical Engineering
Current Cumulative GPA: **9.49**/10
Minor GPA: 9.5/10

2013 **Higher Secondary Education**.
Delhi Public School, Bhilai
Percentage : 96.6%

2011 **Matriculation**.
Delhi Public School, Bhilai
CGPA: 10/10

Interests

Machine Learning.
I got interested in machine learning and artificial intelligence after taking an AI class in my third year. I am working on dictionary learning on image data(for applications in classification) for my undergraduate thesis. Also, I am currently doing courses on Advanced ML and Reinforcement Learning to explore different sub-domains.

Theory of Computation.
I have done two research projects in the field of Automata theory; one of them deals with games on automata. These, along with the courses I've done, have led me to be interested in the broad area of Theory of Computation.

Publications

ESOP '17 **Faster Algorithms for Weighted Recursive State Machines**.
K. Chatterjee, B. Kragl, S. Mishra, A. Pavlogiannis: To appear in the European Symposium on Programming, 2017

Research Projects

Ongoing — **Kernel Dictionary Learning on Riemannian Manifolds**.
Undergraduate Thesis, IIT Bombay   *Guided by: Prof. Suyash P. Awate*

Dictionary learning is a technique used to learn discriminative sparse representations of complex data. It originated as a problem in the Euclidean setting and algorithms for this problem have been extensively researched. However, many data sets have the property of data lying in a smaller, non-euclidean subspace of a larger Euclidean space. Exploiting this input space structure can lead to more discriminative feature representations.

We are exploring the applications of such techniques in problems where data lying on complex non-linear spaces can be mapped to simpler higher dimensional manifolds using kernel functions. Dictionary learning on this mapped data can lead to better feature representations as compared to Euclidean dictionary learning in the original input space.

Autumn 2015 — **Multiplayer Timed Games**.
R&D project, IIT Bombay   *Guided by: Prof. S. Krishna*

Timed automata are a well accepted formalism in modelling real time systems. In timed games, multiple players make a timed automaton run to fulfil their interests. We worked on non-competetive games, i.e., each player's objective is to minimize their cost. Different kinds of equillibria are defined in such a game scenario, each of which has a central principle of optimality under unilateral deviation from the game strategy.

We focused on 3 kinds of equillibria : Nash equillibrium, Stackelberg equillibrium and Incentive equillibrium . We proved that the problem of determining the existence of a cost bounded equillibrium of any of the above three kinds, is undecidable for a timed game with 2 players with 3 clocks and hence, is undecidable for more number of players or clocks.

Summer 2015 — **Recursive State Machines and Model Checking**.
Research Internship, IST Austria   *Guided by: Prof. Krishnendu Chatterjee*

Pushdown systems (PDS) and recursive state machines (RSMs), which are linearly equivalent, are standard models for interprocedural analysis. However, RSMs are more convenient because they model explicit function calls and returns and provide natural parameters for algorithmic analysis. I studied the tool jMoped which models java programs as pushdown systems, developed a Java implementation for RSMs and built a translator from PDS to RSM.

I also worked on designing, and implemented, an algorithm for abstract weighted reachability on RSM. The algorithm was experimentally found to perform better than jMoped's reachability computation on pushdown systems.

Work Experience

Summer 2016 — **Samsung HQ**.
Security Lab, Software R&D center

Studied the Tizen3.0 software architechture and worked on porting a Host Based Intrusion Detection System to the new platform. Developed a Tizen mobile application with a user friendly user interface, which could perform process monitoring via log parsing, using the tool. The application is capable of active response based on alerts generated and can be integrated into Samsung's Smart Home server to build a security system for the Smart Home devices.

Key Academic Projects

Spring 2017 **Medical Image Segmentation**.
Guided by: Prof. Suyash P. Awate
- Implemented Deepcut segmentation algorithm for segmentation of heart from human chest MR images.
- A convolutional neural network is trained on weak annotations provided by a user in the form of a bounding box.
- A dense CRF(Conditional Random Field) is employed to regularize this segmentation and hard segmentation is found using graph-cut.

Autumn 2016 **Reinforcement Learning : Carrom playing bot**.
Guided by: Prof. Shivaram Kalyanakrishnan
- Implemented and evaluated three different approaches to solving the problem of building a carrom playing bot
- The different approaches used were:
  - deep Q-learning on a quantized state and action space
  - deep deterministic policy gradient method using deep nets as actor and critic networks
  - hand coding different strategies for the bot

Autumn 2016 **Devnagri Character Recognition**.
Guided by: Prof. Sunita Sarawagi
- Designed a deep neural network and trained it for the task of devnagri character recognition, using Tensorflow library
- Analysed the effect of different activation functions, regularization techniques and number of nodes and hidden layers on the performance of the neural net

Spring 2016 **Compiler for a C-Subset**.
Guided by: Prof. Amitabha Sanyal
- Developed a compiler for a C-subset, using flexc++ and bisonc++, to generate MIPS assembly code runnable on a qtspim emulator
- Implemented a hybrid of short circuit evaluation and Sethi Ullman register allocation for expression evaluation

Spring 2016 **Multithreaded File Server**.
Guided by: Prof. Mythili Vutukuru
- Implemented a multithreaded TCP file server using C-socket programming
- Wrote a shell based client which supports basic bash shell commands, serial/parallel file downloads, commands run in foreground/background, etc.

Spring 2016 **Performance analysis of SRPT and PS scheduling algorithms**.
Guided by: Prof. Varsha Apte
- Experimentally verified by simulation and measurement, mathematical results showing that SRPT scheduling fairs better than PS in terms of mean response time when the system is not overloaded

Autumn 2015 **Online Academic Forum**.
Guided by: Prof. N. L. Sarda
- Developed a web database application for an online academic forum
- Integrated features like user profile, create and search course pages, search for other users, upload material, make posts, write comments, check user ratings, etc.

Autumn 2015 **Performance Analysis of B+ tree index creation**.
Guided by: Prof. N. L. Sarda
- Implemented B+ tree index creation via bulk loading and analysed the performance based on no. of seeks, transfers, space utilization ratios, and time taken for index creation

Honors and Achievements

Academic Distinctions and Awards

○ Awarded **Institute Academic Prize** by IIT Bombay for academic excellence, awarded to 10 students in a batch of 880 (2014)

○ Secured All India Rank **30** in JEE-Main, taken by **1.3 million** candidates (2013)

○ Awarded **AP grade** for exceptional performance in Computer Programming and Utilisation and Control and Communications courses (2013, 2015)

Olympiads and Scholarships

○ Awarded the **Kishore Vaigyanik Protsahan Yojana (KVPY)** Fellowship by Government of India, securing an All India Rank **27** (2012)

○ Awarded the **National Talent Search Examination (NTSE)** Scholarship (2009)

○ Among top 1% (300) students qualified for Indian National **Physics, Chemistry and Astronomy** Olympiads (2013)

○ Among top **35** students who attended the Orientation cum Selection Camp for **International Physics Olympiad** (2013)

Positions of Responsibility

2016-17 **Department Placement Coordinator, IIT Bombay**.
Organised and ensured smooth execution of department level placement preparation activities and assisted students at all stages of the placement procedure

Autumn 2015 **Teaching Assistant, Computer Programming and Utilisation, IIT Bombay**.
Responsible for designing problem statements for lab exercises and examinations, and for grading answer sheets for written examinations

Spring 2015 **Teaching Assistant, Linear Algebra, IIT Bombay**.
Responsible for teaching and evaluating a group of forty first-year students

Technical Skills

Proficient in: C/C++, Java, Matlab

Working knowledge of: Python, Bash scripting, LaTeX

Familiar with: MIPS and x86 assembly, Prolog, SQL, Javascript, HTML/CSS

References

○ Prof. Suyash P. Awate
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○ Prof. Krishnendu Chatterjee
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