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IIT Bombay

Computer Science & Engineering

4th Year Undergraduate

GPA : 9.65/10.0

INTERESTS

Hyperlinks at appropriate places

Computer Vision, Artificial Intelligence, Programming Languages and Formal Methods

PUBLICATIONS

[1] **Pushing The Envelope for Boolean Function Synthesis**^{*+}

S. Akshay, Supratik Chakraborty, Shubham Goel, Sumith Kulal, Shetal Shah

CSE IITB Technical Report (TR-CSE-2017-87)

Submitted to 30th International Conference on Computer Aided Verification (CAV), 2018

[2] **Computing Scores of Forwarding Schemes in Switched Networks with Probabilistic Faults**^{*}

Guy Avni, Shubham Goel, Thomas A. Henzinger, Guillermo Rodriguez-Navas

23rd International Conference on Tools & Algorithms for the Construction and Analysis of Systems (TACAS), 2017

^{*} Names of authors sorted alphabetically by last name.

⁺ Abridged version, full preprint available on request.

RESEARCH EXPERIENCE

Estimating Dense Correspondences on Wide Baseline Images

Ongoing since Autumn 2017

Guide: Prof. Arjun Jain, IIT Bombay

- Using data driven approaches for finding dense correspondences between images with scale and viewpoint changes
- Have taken a 2-step hierarchical approach by first predicting a coarse match, and then a fine one
- Use robust descriptors and a correlation volume encoding descriptor similarity between points and coarse regions in the first and second image respectively
- Preliminary experiments gave promising results, beating state-of-the-art tools like DeepMatching
- Currently working on reducing memory intensiveness and modifying network architecture to enforce geometric constraints

BFSS: Boolean Functional Synthesis

Ongoing since Spring 2017

Guide: Prof. Supratik Chakraborty, IIT Bombay

- Working on a CEGAR+AIG based state-of-the-art tool (BFSS) for the Boolean Functional Synthesis problem
- Devised an algorithm reducing the total number of refinements required at the cost of a few extra SAT calls
- Built a synchronous system wherein the solver runs in the background and pipelines counterexamples to BFSS; Cut-shorts on waiting time and provides probabilistic guarantees on correctness of the Skolem Functions
- Worked on writing a full length research paper which has been submitted to CAV 2018
- Currently working on improving the algorithm even further by exploiting AIG structure

Restoration of Manifold-Valued Images

Summer 2017

Guide: Prof. Stefan Roth, TU Darmstadt

- Worked on restoration (denoising and inpainting) of images that take values in Riemannian manifolds
- Explored the use of higher order differences and arbitrary filters in modeling the loss objective.
- Came up with a family of frameworks for applying arbitrary zero-sum filters to manifold valued patches; Provided flexibility and generalized previously defined first and second order differences over manifolds
- Implemented this framework, reproduced previous work and built an image denoiser in MATLAB that works with multiple arbitrary filters

Forwarding Schemes in Switched Networks with Probabilistic Faults

Summer 2016

Guide: Dr. Thomas Henzinger, IST Austria

- Assigned scores to forwarding schemes indicative of their robustness towards link crashes and faults
- Designed and implemented a reduction of the scoring problem to SAT counting
- Implemented different iterative and statistical approaches for scoring propositional rule based forwarding schemes
- Proved $\#P$ -completeness of the scoring problem, started work on complexity of approximate scoring algorithms
- Gave a talk at IST Austria regarding the same

SCHOLASTIC ACHIEVEMENTS

- Secured All India Rank **6** in IIT JEE Advanced 2014 among 150 thousand candidates
- Secured All India Rank **50** in IIT JEE Mains 2014 among over 1.3 million candidates
- Awarded the **AP Grade** for exceptional performance in courses Logic for CS, Digital Logic Design, Engineering Drawing and Biology
- Received the **Institute Academic Award**, IIT Bombay for exceptional academic performance in 2014-15

Olympiads & Scholarships

- **Silver Medalist** at the 46th International Chemistry Olympiad, Hanoi, Vietnam
- **Best Theorist and Experimentalist** at the Orientation cum Selection Camp for the 46th IChO
- Received the **Best Solution Award** at the National Selection Camp for the 54th IMO, Colombia
- Recipient of the **KVPY** (Kishore Vaigyanik Protsahan Yojna Fellowship) in 2013 by Govt. of India
- Awarded the **NTSE** (National Talent Search Examination) Scholarship in 2010 by N.C.E.R.T. New Delhi

ACADEMIC PROJECTS

Fiducial Marker Localization — *Computer Vision*

- Led a team of 6 students to finish 2nd in the Fiducial Localization track at the Inter-IIT Technical Meet 2018
- Built a tool to locate cylindrical Fiducial Markers (attached to human skull) from MRI/CT scan DICOM images
- Used a modified 3D template matching algorithm on a skull reconstruction to selectively locate markers of known size

Real-Time Tracking of Non-Rigid Objects — *Computer Vision*

- Implemented the mean shift algorithm for tracking non-rigid objects in a video sequence
- Extended the algorithm to handle huge scale changes
- Implementation was robust to blur, deformation and partial occlusions

Vector-Valued Image Regularization with PDEs — *Fundamentals of Digital Image Processing*

- Built an image regularization tool using techniques based on solutions to Oriented Laplacian PDEs
- Used a generic anisotropic diffusion equation which provides a simple interpretation of the regularization process in terms of local filtering with spatially adaptive Gaussian kernels
- Applied the solution for colour image smoothing, colour image inpainting, and flow visualization

tusSAT: A FPGA based SAT solver — *Digital Logic Design*

- Designed a VHDL package for representation of atomic variables, clauses and expressions
- Implemented a modification of the DPLL algorithm alongside heuristics for variables selection
- Testing suite built from DIMACS Implementation Challenge: Satisfiability
- Featured among other SAT Solvers on satlive.org

Movie Recommendation Engine — *Foundations of Machine Learning*

- Developed a movie recommendation engine in Python using popular collaborative filtering techniques
- Primarily based on the research done on Single Value Decomposition method during the Netflix Prize competition
- Implemented and tested other machine learning techniques like Baseline predictor and k-Nearest Neighbor Model

POSITIONS OF RESPONSIBILITY

Teaching Assistant, IIT Bombay

- MA 105 : Advanced Calculus under Prof. I.K.Rana Autumn '15
- CS 226 : Digital Logic Design under Prof. Supratik Chakraborty (Awarded **TA of the Month**) Spring '17, '18

Mentor, Institute Student Mentorship Programme

2017 - Ongoing

- Responsible for guiding 12 freshman, focussing on academics and holistic development
- Providing counsel and helping them adjust to campus life

Mentor, Department Academic Mentorship Programme

2017 - Ongoing

- Mentor to 6 students for their academic and general concerns, and helping them cope with the curriculum
- Mentor to additional 2 students in academic rehabilitation program (ARP), and helping them get back on track

Academic Resource Person, 46th IPhO, Mumbai

2015

- Responsible for grading the theory papers of participants from 87 Countries
- Responsible for moderation of marks with Leaders from participating countries

Web Convener, Student Technical Activity Body, IIT Bombay

2015-16

- Developed portals for documentation and registration of participants of STAB events
- Responsible for maintaining the STAB website, modifying content and improving functionality

TECHNICAL SKILLS

Programming Languages	Fluent in C++, Lua, Python; Familiar with Java, VHDL
Libraries	Pytorch, NumPy, TensorFlow, Scikit-Learn
Software Skills	git, MATLAB, GNU Octave, AutoCAD, L ^A T _E X, CMake
Web Development	HTML, CSS, JavaScript, PHP, Laravel (PHP), Django, MySQL, PostgreSQL

EXTRACURRICULARS

- Attended the Second Indian **SAT+SMT School** held at Infosys, Mysore in 2017
- Representing IIT Bombay and bagged the Silver mein the **Inter IIT Tech** meet to be held in Madras, India in January 2018.
- Ranked **14th** in ACM ICPC Chennai Onsite contest and **20th** in the Online Regionals in 2016
- **Winner** in Microsoft's code.fun.do Finalist Forum from amongst 53 teams across 15 colleges
- Qualified for the onsite finals of Microsoft's Build The Shield, a network security competition
- Won **Bronze** medal in Table Tennis General Championship, IIT Bombay in 2015
- Secured 4th position in an autonomous line-following bot making competition organized by Electronics Club, IITB
- Successfully completed a 1 year of social service under the **National Service Scheme** IIT Bombay
- Attended the **Vijyoshi National Science Camp** in 2013 organized by Indian Institute of Science, Bangalore
- Represented District Hisar at the **State Level Championship** in Inline Roller Skating in 2007,2008