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Nilesh Kulkarni

Curriculum Vitae

Interests

Artificial Intelligence, Machine Learning, Distributed & Parallel Computing, Autonomous Unmanned Systems

Education

2012–2015 **B.Tech in Computer Science and Engineering with Honors and Minor in Electrical Engineering**, *Indian Institute of Technology*, Bombay,
8.64/10 *after 6 semesters*.

2011 **Higher Secondary Examination**, *Thakur College of Science & Commerce*, Mumbai,
90.33%.

Internships and Research Experience

Ongoing **Distributed Inference & Learning**,
Undergraduate Dissertation, IIT Bombay.
Guide: *Prof. Ganesh Ramakrishnan*

We are working on an problem to optimize and implement distributed learning and inference for structured data. Currently we have framework based on Thorsten Joachims Latent SVM's to optimize Multivariate Performance measures. Computation of model for the problem with non-decomposable loss functions like F_1 score is expensive. In my thesis I, advised by Prof. Ganesh Ramakrishnan, am working on algorithms to improve the speed and accuracy of the algorithm by using Asynchronous Alternating Direction Method of Multipliers (ADMM) and its variates. We are trying to incorporate ADMM in two phase of our problem namely Learning and Inference stages. This distributed approach is expected to make evaluation faster while adapting to non-decomposability of loss.[Report]

Ongoing **Shape Analysis on Kendell Spaces**,
Undergraduate Research Project, IIT Bombay.
Guide: *Prof. Suyash Awate*

Principal Nested Spheres(PNS) is proposed to be a dimensionality reduction technique much different in approach as compared to Principal Geodesic Analysis (PGA) and Principal Component Analysis (PCA). The main idea behind PNS is its ability to find subspaces instead of modes of variation. PNS works best with data distributed on hyper-spheres(higher dimensional spheres). We have done modifications to the algorithm which gives better initialization. Currently we have implemented and tested PCA, PGA, PNS on hand and heart data set.[Report]

Summer 2014 **Machine Learning on Big Data**, *Samsung Electronics, Suwon*.
Guide: *Choonoh Lee, Senior Engineer*

Worked on a project on distributed machine learning. My task was to explore the possibilities for distributed learning with decision trees. We successfully designed and implemented the algorithm on a Hadoop Ver. 2 cluster. Also, we improved Mahouts implementation of K-Means Clustering, and produced results with better execution time: speed up $6\times$ in Pre-processing and maximum of $1.8\times$ per Iteration. This lead to publishing of a white paper on achieving speeds up for algorithms on Map-Reduce frameworks with detailed analysis of memory, computation, network resources.

Summer 2013 **On-line Triangulation and Navigation Using a Swarm of Simple Robots**, *Technische Universitat*, Braunschweig, Germany.
Guide: *Prof. Sandor Fekete*

Researched on Maximum Area Triangulation with K Agents(Robots) & Minimum Robot Area Triangulation. These are approximate algorithms and I contributed to practical aspects of real life problems involving minimizing overall error in navigation and localization with given minimum sensing capabilities of these robots. I was working on the R-One Robots developed at Rice University by Prof James Macklurin.

July 2012-Ongoing **Matsya, Autonomous Underwater Vehicle(AUV)**, *Research & Development Project, IIT Bombay*.
Guide: *Prof. Leena Vachhani & Prof. Hemandra Arya*

AUV-IITB is an all student team working on the design and development of an AUV; An autonomous underwater vehicle capable of navigating and performing pre-defined tasks based on the feedback from **cameras, IMU (Inertial Measurement Unit), pressure sensor and Doppler Velocity Log**. Matsya series of AUVs compete at the world's largest Underwater Robotics Competition, Robosub, conducted by the AUVSI Foundation in Association with US Office of Naval Research

- **Team Leader, 2014** Leading a 40 member team comprising of three divisions: Electronics, Software & Mechanical. Managing operations, logistics, recruitments and knowledge transfer in a four-tier cross functional team. Leading projects with **Naval Research Board, Defense and Research Organization, India** on DVL based AUV Localization for locating Underwater Acoustic Sources. Currently spent budget for the project is *$10000* .
- **Software Lead, 2013** Leading a sub-division of 5 members. Designed a modular architecture for navigation along with dynamic mission planners. We have incorporated various sensors and are using Markov Localization with Visual & Acoustic Feedback for SLAM.

Semi-Finalist at Robosub 2012, 2013 & 2014.[Website][Technical Description Paper]

Honors and Awards

Academic

- Secured **All India Rank 77** in IIT-JEE,among 0.5 million students *2011*
- Awarded **Institute Technical Color** (9 of 7000), 2014 and **Institute Technical Special Mention**(15 of 7000), 2013 for outstanding contribution towards Robotics & Technical activities on campus *2012-2014*
- Certified as among **Top 1%** (300 students) in India, to appear for Indian National Chemistry Olympiad (INChO), 2011 and the Indian National Physics Olympiad (INPhO), 2011

Seminars

October 2014 **Generalization and Stability of Learning Algorithms**, Guide: *Prof. Saketh Nath J*, [Slides].

Gave a talk on a paper, "Generalization & Stability", by Olivier Bousquet & Andr Elisseeff. We discussed about stability of algorithms under Statistical Inference Learning, the key point of discussion being "How sensitive are your algorithms to the data sets?".

March 2014 **Applications of Kalman Filters in Robot Localization**, Guide: *Prof. Pushpak Bhattacharyya*, [Slides].

Introduced Kalman Filters and then discussed its application specifically in Robot Localization and Navigation

February 2014 **Introduction to ROS: Robot Operating System**, [Slides].

This was an introductory talk about Robot Operating System. The primary focus was to develop clean software for autonomous systems. This talked also discussed the current software architecture of Matsya 3.0

Projects

Autumn 2014 **Texture Classification** .

Guide: *Prof. Suyash Awate*

Designed and implemented image categorization and segmentation based on visual textures through a texton-based learning approach to model and represent visual textures. Supervised Learning performed using SVM's and Decision Tress to create model for the database [Report] [Code]

Spring 2014 **Virtual Memory for Experimental OS**.

Guide: *Prof. Dhananjay M. Dhamdhere*

We designed and implemented effective data structures and algorithms for handling process memory allocation, swap space management, with process swap in and out on Input Output Operations for Pranali, a virtual OS built on top of Linux.[Report] [Code]

Autumn 2013 **TeamFlowy: Team Management Webapp** .

Guide: *Prof. Umesh Bellur*

Developed webapp to manage teams that supports calendar view of tasks, blogs & reminders. We conceptualized the ER model, normalized the 70+ relations and deployed the system on a Django framework after rigorous testing and optimization using additional indices.[Code]

Autumn 2013 **Sequence Alignment on GPU's**.

Guide: *Prof. Bernard Menezes*

Implemented a Sequence Alignment problem on GPU's with parallel version of Needleman-Wunsch algorithm. Investigated Parallel Prefix and Diagonal based approach to solve the problem. Achieved $O(n)$ complexity as compared to $O(n^2)$ in the Serial Version.[Report][Code]

Autumn 2012 **N Body Simulation**.

Guide: *Prof. Varsha Apte*

Designed a simulation showing the interaction between different particles under the effect of intermolecular forces like gravity, electrostatic and nuclear. We used the famous Barnes-Hut Algorithm to optimize computation.[Code]

Mentorship, Teaching & Positions of Responsibility

2014-2015 **Department Academic Mentor**.
Department of Computer Science and Engineering, IIT Bombay

- Responsible for mentoring a group of 9 sophomores of Computer Science and Engineering department regarding their various academic as well as general concerns
- Helping academically struggling students, who are a part of the Academic Rehabilitation Programme, in coping with the curriculum

2013 **Teaching Assistant**.
GPA -2014

- Among few undergraduates to be a TA for GPU Programming and Applications Workshop (GPA)-2014
- Guided over 300 enthusiastic learners in a 3 day long hands-on workshop conducted by NVIDIA in association with CUDA Center of Excellence, IIT Bombay

2012-2013 **Coordinator** .
Electronics Club, IIT Bombay

- Electronics Club is an institute club which caters to interest of students for hobby electronics

2013-2014 **Technical Mentor**.
Institute Technical Summer Projects (ITSP)

- Guided and mentored 4 teams (each with 3-4 students) for doing technical projects on campus
- Guided on converting a prototype to product with intricacies and aesthetics involved in development

Extracurricular Activities

Technical

- Represented the hostel in the inter-hostel programming general championship, contested by 16 hostels, IIT Bombay *2012-2014*
- Built a line following robot for an intra-college competition *2011-2012*

References

- Prof. Sándor P. Fekete
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