Arijit Pramanik

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Interests

Compressive Sensing, Networked Systems, Computer Vision, Machine Learning

Education

Indian Institute of Technology, Bombay *(Bachelor of Technology with Honors)* ***Graduating 2019***

- Major : Computer Science and Engineering GPA : 9.21/10.0
- Minor : Applied Statistics and Informatics

National University of Singapore *(Semester Exchange)* ***Spring 2018***

Central Board of Secondary Education, India *(Higher Secondary Education)* 97.4%

Submissions and Patents

- K.Chawla, H.Singh, **A. Pramanik**, M.Kumar, B.V.Srinivasan "Generating summaries tailored to target characteristics" *International Conference on Computational Linguistics and Intelligent Text Processing, 2019*
- **Arijit Pramanik**, Sudip K. Deb, Ajit Rajwade "Compressive Reconstruction in Raman Hyperspectral Imaging using Pixel Undersampling" *IEEE International Conference on Image Processing, 2019* (Under Submission)
- **A. Pramanik**, H.Singh, M.Kumar, B.V.Srinivasan, K.Chawla, "Generating Summary Content tuned to a target characteristic using a Word Generation Model", Filed at *United States Patent and Trademark Office*

Research Experience

Imaging Techniques with Raman Spectroscopy **IIT Bombay**

Prof. Ajit Rajwade *Autumn'18–Ongoing*

- Typical Raman spectroscopy takes a very long acquisition time and is used for diagnosing critical diseases like cancer. The aim of this project is to reduce the acquisition time without compromising on quality
- Learning a compact representation of paraffin subspace for spectral separation of biopsy sample using **Non-negative Sparse Coding**, employing **Blind Dictionary Learning** with **PCA** for signal and noise separation
- Performing **inpainting** to enable *compressed sensing* of Raman spectral images, to speedup image acquisition
- Currently working towards implementing deep neural networks for inpainting, and super-resolution for lower resolution Raman images with specific sampling heuristics

Benchmarking of Software Switches **IIT Bombay**

Prof. Mythili Vutukuru *Autumn'18*

- **VPP** and **Open vSwitch** are currently the fastest *DPDK*-based software switches out there. The aim was to determine the minimal resources required for optimal performance of a switch for different use cases
- Conducted experiments for testing *latency*, *throughput*, efficiency in terms of *cycles per packet* with increasing cores, routing table entries and hierarchical cache sizes using uniform and skewed traffic loads of 10 Gbps
- Analyzed VPP's **batch packet processing paradigm** and tested batch size as a function of different parameters
- Explored **Cisco Express Forwarding** implemented using *multiway prefix trees* (patented by Cisco) in VPP

Optimizing Performance of Model-counting Algorithms **NUS**

Prof. Kuldeep Meel *Spring'18*

- The task involved a study of different model-counting algorithms, which enumerate solutions to a boolean formula. The aim was to identify performance bottlenecks in the implemented model for optimization
- Performed a critical study of **SPARSE-COUNT** algorithm and extended the same using *GMP, MPFR* libraries to support arbitrarily large number of variables and multi-precision computations
- Adapted the above to **ApproxMC** framework for approximate discrete integration, using $\theta(logn)$ low-density parity constraints with tolerance guarantees for results within a specified confidence interval
- Validated the above modified algorithm using **IJCAI'16-CMV** benchmarks

Characteristics-Tailored Summary Generation **Adobe Research Labs**
Dr. Balaji Srinivasan, Kushal Chawla *Summer'18*

- Unlike typical abstractive text summarisation, the aim was to tune our summaries to characteristics like being more formal as required by news agencies or focus on financial aspects as desired by corporate organisations.
- Adapted Facebook AI Research's **Convolutional seq2seq** model for translation to characteristic-driven text generation with modified **attention layers** to focus on specific input embeddings for topic-tuned summaries
- Altered **beam search paradigm** for tweaking decoder state probability distributions, thus enhancing word-level features like descriptiveness with **token-based learning** for length based summarisation
- Incorporated a **Reinforcement Learning** term in loss function and achieved a 6.4% increase in ROUGE scores
- Implemented the above insights on *pointer-generator framework* and submitted the same to **AAAI 2019**

Domain-specific Customer Care Chatbot **Philips Research Division**
Dr. Rajendra Singh Sisodia *Summer'17*

- Modern chatbots perform well in conversations comprising simple question-answer pairs. The aim was to develop a semantic control algorithm to track context switches to predict favourable next steps in the conversation
- Designed a chatbot leveraging *word2vec, Latent Semantic Indexing*, *Latent Dirichlet Allocation* for topics relevant to user query with **Tf-idf** weighted **word n-grams** for improving accuracy
- Incorporated **probabilistic finite automata** to model conversation state changes, guided by sentiment scores
- Built an emotion classifier **SVM**, and **ontologies** from RDF sources with **SPARQL** queries for fetching data

Scholastic Achievements

- Awarded the **Institute Academic Excellence Award**, 2018 - A prestigious award for securing **Dept. Rank 1** in a batch of 120+ students in 3^{rd} Year along with a GPA of **10.0/10.0** in 6^{th} and 7^{th} semesters
- Secured an **A+ grade** at NUS in *Information Retrieval* and **Advanced Performer (AP) grade** in *Optimisation, Numerical Analysis, Physical Chemistry* and *Environmental Studies* (given to only top 1% of class)
- Received a Letter of Appreciation from the Human Resource Development Minister for exceptional performance(**top 0.1%**) in Higher Secondary Education, securing **100/100** in Chemistry and Computer Science
- Awarded the prestigious National Talent Search Examination (NTSE) scholarship by National Council of Educational Research and Training, awarded to top 500 students in the country studying in Class X
- Secured **All India Rank 111** in Kishore Vaigyanik Protsahan Yojana (KVPY) - coveted fellowship by Department of Science and Technology, Govt. of India awarded to 500 students across the country studying in Grade XI
- Selected among **top 300** students for Indian National Olympiads in Physics and Chemistry

Key Projects

Stereo Image Reconstruction using Energy Minimization **NUS**
Prof. Cheong Loong Fah, Prof. Feng Jiashi *Spring '18*

- Implemented **normalized graphcuts** with α-expansion for image segmentation and denoising using *multilabel 8-connected Markov Random Fields*, and compared the same with **mean-shift algorithm**
- Employed **PatchMatch** algorithm to establish patch correspondences, for better alignment for **homography**
- Obtained dense correspondences using *KLT tracker*, to estimate **Fundamental matrix** by **8-point algorithm**

TetrisBot **NUS**
Prof. Zick Yair *Spring '18*

- Designed a *utility-based* agent based on **genetic algorithms**, using a set of 10 state-dependent features
- Leveraged **single-point crossing over** heuristic and *multithreaded training* with independent block sequences
- Employed **particle swarm optimization** for optimal convergence of weights, clearing over **856,000 rows**
- Implemented an *auto-encoder approach* with **Q-learning** for a low dimensional game state representation

A Java-like Compiler for OCaml **NUS**
Prof. Chin Wei Ngan, Prof. Razvan Voicu *Spring '18*

- Designed the **abstract syntax tree**, VM instruction **interpreter** with **Hindley Milner** *type inference* system
- Incorporated conditionals, functions, applications, let constructs, **tail recursion** and contiguous stack frames

Legal Case Retrieval System **NUS**
Prof. Zhao Jin *Spring '18*

- Designed a freetext search engine leveraging NLTK to rank legal case judgments, finishing 2^{nd}**/33 teams**
- Implemented **positional indices** for proximity search, and *zone* and *field indices* like court hierarchy and date
- Enhanced F_1 score using **query expansion** - **pseudo-relevance feedback** with **Rocchio formula**, WordNet synonyms and corpus generated co-occurrence thesaurus with tf-idf model to support boolean, phrasal queries

Generation of Nintendo Entertainment System Game layouts **IIT Bombay**
Prof. Ganesh Ramakrishnan *Autumn '17*

- Built a **Deep Convolutional GAN** model on *pytorch* for generating new game levels from previous layouts
- Leveraged *Leaky ReLU* for generator and discriminator with **Adam Optimizer** for stochastic gradient descent

Image Quilting for Texture Synthesis and Transfer **IIT Bombay**
Prof. Ajit Rajwade, Prof. Suyash Awate *Autumn '18*

- Employed **Efros & Leung algorithm** to synthesize textures, with *correspondence maps* for texture transfer
- Leveraged **minimal error boundary cut** using dynamic programming to avoid *block-seam artifacts*

OpenGL based 3D Animation Film **NUS**
Prof. Cheng Ho-lun Alan *Spring '18*

- Used **Phong illumination** model, camera transformations like *dolly zoom* with motion along **Bezier** curves
- Added transparency, soft shadows using **Ray tracing**, with **Phong shading** and **texture mapping** for modeling

Extracurricular Achievements

- Awarded **Telegraph Award for All Round Excellence(Honour)** by esteemed daily *The Telegraph* 2014
- Awarded **Best Senior All-Rounder** award for exemplary all-round performance throughout school 2015

Aquatics

- Awarded **Institute Sports Citation** (best outgoing swimmer) for exemplary contribution to sports 2015-19
- Awarded **Institute Sports Color** (awarded only once) for excellent performance in sports in first year 2016
- **Current overall record holder** for swimming 31.4 km in 12 hrs at a stretch in Swimmathon 2016
- Former holder of the **Inter IIT Record** in **4 X 100 m Medley Relay** 2016
- Member of Inter-IIT Aquatics Contingent and won **4 gold, 5 silver** and **11 bronze medals** at 4 consecutive *Inter-IIT Aquatics Meet* in swimming and Water Polo 2015-18
- Participated in the finals of *CBSE National Aquatics Meet* **4 times** (top 2 swimmers from state) 2011-2014
- Recipient of **Player of the Aquatics General Championship** 2 times 2015,2018
- Awarded **Hostel Color** for exemplary contribution towards hostel in inter-hostel General Championships 2017

Arts and Music

- **Senior Diploma Final** in Fine Arts. Obtained a *First class* in the exam with *distinction in Practical* 2010
- **Junior Diploma** in Tabla. Obtained a *First class* in the exam with *distinction in Practical* 2008

Miscellaneous

- *State Topper* and *National Finalist* in **Vidyarthi Vigyan Manthan** - a nation-wide talent search exam 2015
- Attended National **Vijyoshi Camp**, organised by Indian Institute of Science, Bangalore 2014
- Amongst *top 25* in Mathematics Talent Reward Programme, organized by **Indian Statistical Institute** 2014

Positions of Responsibility

Undergraduate Teaching Assistant Spring '19, Autumn '18, Spring '17

- Computer Programming and Utilization, Prof. Ganesh Ramakrishnan : Designing and evaluating weekly labs
- Computer Architecture, Prof. Bernard Menezes : Designing and evaluating lab assignments and projects
- Introduction to Biology, Prof. Ambarish Kunwar : Conducted weekly tutorials and evaluated exam papers

Institute Aquatics Captain Apr '18–Present
Leading a team of 30+ members for various competitions including Inter IIT Aquatics Meet, incorporating circuit

training sessions and video analysis of swimming strokes and waterpolo matches

Department Placement Coordinator Apr '18–Present
Representing the department of Computer Science in the institute placement team, responsible for conducting preparatory tests, buddy talks and mock interviews for upcoming placements

Relevant Course Work

Machine Learning : Computer Vision, Computer Graphics, Digital Image Processing, Machine Learning, Artificial Intelligence, Information Retrieval
Systems : Operating Systems, Networks, Computer Architecture, Compilers, Databases and Information Systems
Statistics : Regression Analysis, Statistical Inference, Probability Theory, Derivatives Pricing

Professional Experience

Assessment of Retail Customer Database **Mumbai**
GetFocus: Contextual Marketing through Retail Analytics *Winter'17*
- Leveraged topic-modeling and *word2vec similarity scores* for customer segmentation and retail-affinity estimation
- Implemented **probabilistic graphical models** based recommendation engine, contributing to *pgmpy* on github
- Created a new query language utilizing **EBNF grammar rules** on *pyparsing*, with sync to **neo4j** database

Automated Timetable Generation **Mumbai**
OliveSync, Zone Startups India *Winter'16*
- Designed a **genetic algorithm** based agent to generate the best fit timetable obeying all constraints
- Employed **Gale-Shapley algorithm** for alloting time slot priorities and *MySQL* database sync to track courses

Other Academic Projects

Body Fat Estimation using Regression Analysis (Guide : Prof. Chan Yiu Man) Spring '18
- Estimated body fat mass using **stepwise** regression with statistical tests to check for **multicollinearity**, **lack of fit**, **outliers** and **influential points** derived from cook's distance, dffits, dfbetas, studentised residuals implemented in R. Validated the same with **F-test** and **Durbin-Watson test** for independence of residuals

PokeDB : A Pokemon RPG Game (Guide : Prof S Sudarshan) Autumn '17
- Built a multiplayer Pokemon game on **PostgreSQL** backend with **JDBC API** from *pokeAPI JSON data* with *over 14,000 tuples*. Added online gym battles, navigable maps with probability models for capturing wild pokemon and evolution of pokemon with battle experience

LDAP Authenticated Chat Application (Guide : Prof. Varsha Apte) Spring '17
- Built an *X11*-based server-client GUI model using **Socket programming**, with **LDAP Authentication** using *openLDAP*. Added functionality for group chats, offline inbox via hashmaps and multimedia message exchange.

Ethernet enabled ATM Controller (Guide : Prof. Supratik Chakraborty) Spring '17
- Developed an ethernet-enabled **FPGA** module on **VHDL** to dispense cash leveraging *greedy algorithm* in *Xilinx ISE*, with **Tiny Encryption algorithm** to provide secure exchange of user data. Enforced insufficient balance, incorrect pin and **frontend caching** of last 5 transactions to protect against server crashes

Sudoku Gameplay Software (Guide : Prof. Amitabha Sanyal) Spring '17
- Built a GUI based solver on **MIT Scheme** with features like Undo, Auto-solve, and filters for seeding games of varying difficulty levels. Employed **backtracking algorithm** to solve any given initial configuration

Feed'er : An all-purpose Academic App (Guide : Prof. Sharat Chandran) Autumn '16
- Developed an **integrated Android and Django based web app** for displaying submission deadlines, exam dates and other important reminders via push-notifications. Implemented **automatic sync** and **signup** with social logins, with security measures against **XSS, CSRF** etc.

Text processor (Guide : Prof. Varsha Apte) Autumn '15
- Built a class for enumeration of characters, words with support for Find and Replace using **Knuth Morris Pratt algorithm**, regular expressions, **LZW compression** and encryption and decryption via **Caesar cipher**

References

Up to 4 references available on request