Syamantak Kumar

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Indian Institute of Technology Bombay   **2016-2020**
Bachelors of Technology in Computer Science with Honours   *GPA : 9.32/10.0*

Research Interests

Statistical Modelling, Machine Learning, Computer Vision, Image processing

Publications

A comparison of open source libraries ready for 3D reconstruction of wounds [paper]
Syamantak Kumar, Dhruv Jaglan, Nagarajan Ganapathy and Thomas Deserno
Oral Presentation at Proceedings of SPIE Medical Imaging 2019, San Diego, California

Research Experience

Google Maps | Generative Model for User Contributions   **May-July 2019**
Guide: Rahul Sami & Palak Jain | Summer Internship   *Google, Bangalore*

User-Generated Content (UGC) moderation is a part of Google Maps and involves building machine learning (ML) models to moderate the user contributions published on Google Maps by segregating low-quality contributions to improve user experience.

- Built a **generative model** to predict the probability of users making a contribution to Maps
- Modelled user-contributions as a poisson process and performed estimation with **poisson regression**
- **Inferred labels** on unlabelled user edits by aggregating future contributions on each location
- Achieved an **improvement in the coverage of edits** (percentage of edits being labelled) while maintaining similar precision and recall as the original model

*Offered a **full-time position** for outstanding contributions during the course of the internship*

3D Reconstruction of Wounds | Assesment and Diagnosis   **May-July 2018**
Guide: Prof. Thomas Deserno | Summer Internship   *TU Braunschweig, Germany*

- Developed an android application to extract **3D point clouds** by scanning objects using **ARCore**, Google's platform for building augmented reality experiences on smartphones
- Experimented with Poisson, Alpha Complex, Point Crust, Delaunay Triangulation, Marching Cubes and Convex Hull algorithms for **surface reconstruction** from **sparse point clouds**
- Compared the results obtained from ARCore with the **Structure from Motion** (SfM) technique to review efficacy of smartphones in generating 3D models for wound assesment

Feature Extraction for Gaussian Process Regression   **July 2019 - Present**
Guide: Prof. Suyash Awate | Bachelor's Thesis   *IIT Bombay*

- Exploring the application of neural networks for feature extraction during Gaussian Process Regression
- Training end-to-end systems for optimisation of regression parameters using **Deep Kernel Learning**
- Posing cell-counting (counting cells in a slide image) as a GP regression problem and implementing different models for feature extraction, achieving an MAE of 8 on VGG cells dataset

Cell Segmentation and Stain Normalisation   **Jan-April 2019**
Guide: Prof. Suyash Awate | Research Project   *IIT Bombay*

- Implemented a **dictionary-learning** based technique for performing segmentation of malaria-infected cell images, using Pytorch alongwith Google Colab
- Modelled stain normalisation of whole-slide images as a dictionary-learning problem and used a **Huber-prior** to obtain smoother cell images, implemented in MATLAB

Awards and Scholastic Achievements

- Secured **All India Rank 30** in **JEE-Main** out of over 1.2 million candidates (2016)
- Achieved **All India Rank 370** in **IIT JEE-Advanced** out of over 140,000 candidates (2016)
- Awarded **AP grade** for excellent performance in **Quantum Physics** and **Physical Chemistry** (2016)
- Received **Gold Medal** for being placed among the **top 38** students in **INChO**, HBCSE (2016)
- Amongst the **top 300** students in **INPhO**, Indian National Physics Olympiad, HBCSE (2015,2016)
- Amongst the **top 300** students in **INAO**, Indian National Astronomy Olympiad, HBCSE (2016)
- Qualified for **INMO**, Indian National Mathematics Olympiad, conducted by HBCSE (2014,2015)
- Among the **top 47** students to attend the OCSC of International Junior Science Olympiad (2013)
- Awarded the prestigious **KVPY Fellowship** by DST, Govt. of India with **All India Rank 17** (2014)
- Awarded **NTSE** Fellowship by NCERT, Govt. of India with **All India Rank 29** (2012)

Teaching & Mentoring Experience

- **Institute Student Mentor** - Mentor to 12 freshmen students, helping them cope with the curriculum and focusing on their holistic development, selected via a rigorous procedure comprising of interviews
- **Department Academic Mentor** - Mentor to 6 sophomores for their academic & general concerns and helping them cope with the curriculum. Guiding 2 students as part of the **Academic Rehabiliation Programme** to help improve their academic performance
- **Teaching Assistant** - Among the **20 students** selected across all batches for teaching a class of **47** first-year students for the undergraduate course on Quantum Physics. Coordinated with the Physics Dept. to conduct regular **tutorial sessions** & **evaluate exam papers**

Notable Projects

Adversarial Examples for Keyword spotting
Guide: Prof. Preethi Jyothi | Course Project
July 2019 - Present
IIT Bombay

- Using **AdvGAN** to generate adversarial examples for keyword spotting by modifying training examples
- Enhancing the performance and robustness of **keyword spotting systems** by training on such examples

Top-k Tournament Ranking From Pairwise Preferences
Guide: Prof. Shivaram Kalyanakrishnan | Course Project
July 2019 - Present
IIT Bombay

- Designing and empirically evaluating algorithms for tournament ranking from pairwise preferences
- Exploring schemes for fully-sequential sampling by modelling it as a stochastic **multi-armed bandit**
- Theoretically proving correctness under the **Probably Approximately Correct** (PAC) framework

Artistic Style Transfer using Image Processing
Guide : Prof. Suyash Awate | Course Project
July-Nov 2018
IIT Bombay

- Implemented a **transfer technique for re-styling images** based on migrating the style from a given image to the content of another image
- Formulated the problem as an **expectation-maximization** optimisation, with alternating updates
- Used iterated reweighted least squares (IRLS) to approximate the exact solution and improve efficiency
- Achieved results comparable to the style-transfer by CNNs, using only **image processing paradigms**

Toonify - A Cartoonifying Application
Guide : Prof. Kavi Arya | Course Project
July-Nov 2017
IIT Bombay

- Designed an android-based application to perform basic **Image-Processing** operations including cartoonifying an input image, generating a pencil sketch, denoising an image and basic image editing
- Performed **Cel-Shading** for cartoonification using the **Canny-Edge Detection** algorithm for edge detection and **Bilateral Filtering** for smoothing the image with the help of OpenCV4Android
- Implemented an algorithm for generating a pencil sketch of an image using **Color-Dodge Blend**

Chinese Checkers AI   Jan-April 2018
Prof. Amitabha Sanyal | Course Project   IIT Bombay

- Used **minimax strategy** with **alpha-beta pruning** to develop an efficient AI for Chinese Checkers
- Developed a testing interface to conduct **AI vs AI matches** to check the efficacy of our algorithm

Compiler Design   Jan-April 2019
Prof. Supratim Biswas | Course Project   IIT Bombay

- Developed a **lexer** for a subset of C-language using flex (lexical analyser generator)
- Designed a **LALR(1) grammar** for the parser and generated Abstract Syntax Trees using yacc
- Generated three-address intermediate and MIPS assembly codes from **Control Flow Graphs**(CFG)

Meltdown | Analysis and Experiments   July-Nov 2018
Prof. Bernard Menezes | Course Project   IIT Bombay

- Demonstrated meltdown attacks on linux machines without KAISER (Kernel Address Isolation) support
- Exploited out-of-order execution to read arbitrary kernel-memory addresses and dump physical memory

Technical Skills

Programming   C++, C, Python, Java, Bash, MATLAB, Racket/Scheme, Prolog, VHDL, SQL
Web Development HTML, CSS, Javascript, PHP, Bootstrap
Software   Gnuplot, Git, LaTeX , OpenFST, AutoCAD, Android Studio, Xilinx ISE, Kaldi

Key Courses Undertaken

Data Science & ML Data Analysis & Interpretation, Fundamentals of Digital Image Processing, Artificial Intelligence and Machine Learning, Medical Image Computing, Automatic Speech Recognition, Fundamentals of Intelligent Learning Agents, Web Search & Information Retrieval, Computer Vision*, Advanced Machine Learning*

Computer Science Data Structures & Algorithms, Discrete Mathematics, Design & Analysis of Algorithms, Digital Logic Design, Database & Information Systems, Computer Architecture, Operating Systems, Cryptography and Network Security, Automata Theory, Interpretation of Programming Languages

Mathematics   Calculus, Linear Algebra, Differential Equations, Numerical Analysis

*to be completed by April 2020

Extracurriculars

- Attended **Vijyoshi camp** conducted by IISER, Kolkata which serves as a forum for interactions between bright young students and leading researchers in fields of science and mathematics
- Part of School **Table-Tennis** Team which **won** the **District-Level Tournament** conducted by the District Sports Organisation, Rajasthan
- Passed **Praveshika Pratham (Classical Music Examination)** with Distinction in Vocal Singing
- Stood **first** in the city finals of **Aqua-Regia - The Science Quiz** certified as the largest quiz at one location by the Guinness Book of World Records
- Secured **first** position in the Pushpa Jaipuria **Mathematics Olympiad** among the teams participating from the top 20 schools of the city