Prakhar Kulshreshtha

https://ankuprk.github.io/

Email : ankuprk@gmail.com
Mobile : +91-775-491-6024

Research Interests

Computer Vision, Image and Video processing, Multimedia content analysis, Online Learning

Education

- **Indian Institute of Technology Kanpur** — Kanpur, India
  *B.Tech. in Electrical Engineering; GPA: **9.0**/10.0*
  minor in Artificial Intelligence and Linguistic Theory — *Jul. 2013 – May. 2017*
- **Maa Bharati Sr. Sec. School** — Kota, India
  Class XII (CBSE Board); Percentage: 93.0% — *May. 2012 – Apr. 2013*
- **Dungarpur Public School** — Dungarpur, India
  Class X (CBSE Board); CGPA: 10.0/10.0 — *May. 2010 – Apr. 2011*

Publications

- **Prakhar Kulshreshtha** and Tanaya Guha, "An Online Algorithm for Constrained Face Clustering in Videos" In IEEE International Conference on Image Processing (ICIP) 2018, Athens, Oct 2018.
- **Prakhar Kulshreshtha** and Tanaya Guha, "Building Character Interaction Graph via Online Face Clustering for Movie Analysis", ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM) [under review]

Experience

- **Samsung Research Institute Bangalore** — Researcher
  Advanced Technology Lab — *Jul'17 - present*
  - **Creative-Lab**: After winning 'SRI-B C-Lab Ideation Contest' for our idea 'Automatic Grain Assaying' (2 ideas selected out of 240 submitted) our team of 3 'intrapreneurs' got an opportunity to work on a POC and demo for 6 months.
  - **Multimedia and Depth Technology**: I was in Samsung-Keyboard team before getting selected for the C-Lab, where initially I implemented a Minimum Jerk Theory(MJT) based swipe generation algorithm for training Keyboard Swipe engine with generated data. After that I was selected for a business travel for 6 weeks to headquarters in Seoul, South-Korea where I worked on designing and implementing a fast, optimized N-gram based language-model for Indian languages in Samsung Keyboard. My solution provided 90% improvement in loading time, 89% improvement in suggestion generation time, while maintaining the same prediction rate, when compared to existing solution. The solution is commercialized and shipped into SamsungKeyboard - NeuralBeta version.
- **Signal and Multimedia Processing Lab (SiMPL), IIT-Kanpur** — Undergraduate Researcher
  Dr. Tanaya Guha, Dept. of EE, IIT Kanpur — *Dec'16 - Apr'17*
  - **Character Interaction Graphs via Online Face Clustering for Movie Ananlysis**: We build Character Interaction Graph (CIG) from a video using the temporal dynamics of the clusters formed via Online Face Clustering. We demonstrate the usefulness of the CIG for two movie analysis tasks: (i) segmentation of a movie into its high level semantic structures (acts), and (ii) retrieval of the major characters in a movie. Performance of our approach on these tasks is evaluated on a database of six full-length Hollywood movies comparing our CIG-based results with relevant past work and human annotated ground truth. Our approach achieves highly accurate results for both the tasks. The work is under review in ACM TOMM journal.
  - **Online Face Clustering**: Designed an online clustering algorithm that processes data sequentially in short segments of variable length. Our algorithm uses several spatio-temporal constraints, and a convolutional neural network (CNN) to obtain a robust representation of the faces in order to achieve high clustering accuracy on two benchmark video databases (82.1% and 93.8%). Despite being an online method (usually known to have lower accuracy), our algorithm achieves comparable or better results than state-of-the-art offline and online methods. The work is accepted in ICIP 2018.

Selected Projects

- **MRI Image Reconstruction From Undersampled K-Space Data** — Course project [link]
  Dr. Tanaya Guha,Dept. of EE, IIT Kanpur — *Jan'17 - Apr17*
  - Explored and reviewed Compressed Sensing based reconstruction methods for undersampled MR data like Projection onto Convex Sets (POCS), SparseMRI (David L. Donoho et. al) and Adaptive Dictionary Learning (DictMRI).
  - '**Best Three Projects**' among 15 projects.
- **Online Single Index Model Learning** — CS773A project [link]
  Dr. Purushottam Kar,Dept. of CSE, IIT Kanpur — *Jan'17 - Apr17*
  - Came up with an interesting problem of Online SIM Learning, and utilised SLISOTRON to make a Follow The Leader (FTL) based online algorithm SLISOTRON-FTL

- Proposed a proof for the realizable, noiseless setting. Also showed how the problem of Online Isotonic Regression for 1-Lipschitz function extends into our problem of Online SIM Learning.

- **Stochastic Variational Inference for Heirarchical Poisson Matrix Factorisation** CS698S project [link]
  Dr. Piyush Rai,Dept. of CSE, IIT Kanpur *Jan'17 - Apr17*
  - Surveyed literature on Stochastic Variational Inference(SVI) and then analyzed the Poisson Matrix Factorization via Variational Bayes (VB) along with its SVI version
  - Formulated and implemented SVI version of Hierarchical Poisson Matrix Factorization [Gopalan et al., 2015], while the paper only had batch VB updates, resulting in an SVI-HPMF model which is scalable to large datasets.

- **Modifying Stacked Attention Networks Architecture For VQA** CS698N project [here]
  Dr. Gaurav Sharma ,Dept. of CSE, IIT Kanpur *Aug'16 - Dec16*
  - We modified the architecture introduced in "Stacked Attention Networks(SANs) for Image Question Answering" [Z. Yang et. al], which proposes multi step reasoning via attention layers which utilize image-features to project attention on query-vector for the problem of Image QA.
  - Despite applying the attention-layers differently on image features and query vector, three of the models performed on par with the original model proposed in paper.

- **Automatic Wheat Grain Quality Estimation** EE604A project [link]
  Dr. Tanaya Guha,Dept. of EE, IIT Kanpur *Aug'16 - Dec16*
  - The project aimed to introduce automatic grain quality assessment from an image of spread out sample of grain. We created our own grain image dataset for training and evaluation.
  - Our solution segments out each particle from the image of spread out wheat grain sample and then classifies it as grain or impurity to give an overall quality estimate. Our model is able to distinguish between grain and impurities with a validation accuracy of 88%.
  - awarded **Best three Projects** out of around 25 projects.

Industrial Internships

- **Samsung Research Institute-Bangalore** Summer 2016 Internship
  Mentor: Mr. Vasu Kakkirala, Senior-Engineer, SRI-Bangalore *May'16 - Jul'16*
  - Worked on Tizen OS based VR Engine Core, intended to be embedded in Web Browser for various Samsung Devices like GearVR
  - Contributed in profiling of VR pipeline, analysis of Rendering, bug fixes and in refining the VR-Engine interface layer

- **Khitchdee Technologies-Allahabad** Summer 2015 Internship
  Mentor: Mr. Rohit Agrawal, CEO, Khitchdee Technologies *May'15 - Jun'15*
  - Developed a Windows-app that detects percussive beats in the music and displays synchronized 3D graphics

Other Projects

- **Identification of unique characters in a movie clip via Online GMM Modeling**:
  Online face clustering by dividing a movie clip into shots and then extracting facetracks from each shot in an online fashion to create and update clusters, each cluster being a Gaussian Mixture Model (GMM), and the similarity between facetracks features and GMM cluster being the log likelihood to the GMM.
- **Classification of Emotional state in speech in spoken Hindi [code] [report] [poster]**:
  Discrete emotional state classification on IIT-KGP SEHSC (Simulated Emotion Hindi Speech Corpus) dataset using 126 features obtained from MFCC (Mel Frequency Cepstral Coefficients) and SSC (Spectral Subband Centroids). Evaluated the many classifiers like SVM, Random Forest, ANN, KNN, etc
- **PET: Pi Enabled Tracking Bot [video] [wiki] [report]**:
  Raspberry-Pi based Atmega-controlled robot-toy-car, which has two seperate modes:
  Surveillance: Camera streaming via Wi-Fi and same Wi-Fi signal can be used to wirelessly control the bot using the same or a different laptop.
  Object-Tracking: HSV color range based object tracking.

Achievements

- Winner of **SRI-B C-Lab Ideation Contest** (Top-2 out of 244 ideas submitted) and led a team of '**intrapreneurs**' to work full-time on the idea for 6 months.
- Selected for business travel (6 weeks) to headquarters in Seoul, South-Korea for software development as a Point-of-Contact between Seoul and SRI-B.
- Recipient of Merit-Cum-Means (MCM) scholarship for Academic Excellence for 6 semesters.
- A* grade (Outstanding Performance) in EE604A (Digital Image Processing) course and ESC101 (Fundamentals of Computing) course, IIT Kanpur
- All India Rank 465 in JEE-Advanced 2013 out of 1.4m candidates (top 0.03%)

Relevant Courses

- **Computer Vision**: Recent Advances in Computer Vision, Digital Image Processing, Image Modelling Tools and Techniques, UGP
- **Machine Learning**: Bayesian Machine Learning, Online Learning and Optimisation, Introduction to Artificial Intelligence
- **Programming**: Data Structures and Algorithms, Fundamentals of Computing
- **Mathematics**: Linear Algebra, Probability and Statistics, Complex Analysis, Differential Equations, Partial Differential Equations, Single and Multi-Variate Calculus
- **Signal Processing**: Signals, Systems & Networks, Principles of Communication, Digital Signal Processing, Statistical Signal Processing

Technical Skills

- **Programming Languages**: C, C++, Python, Java, MATLAB
- **Libraries**: TensorFlow, OpenCV, NLTK, Scikit-Learn
- **Development Tools**: Android-Studio, Visual Studio, Arduino IDE
- **Hardware**: Raspberry-Pi, Atmel Micro-Controllers, Arduino

Volunteer Positions

- **Volunteer at Prayas, IIT Kanpur**:
  Gave Maths and Science tuitions to four Class-5 students from underprivileged families from a nearby village
- **Coordinator, ECDC(Electronics Circuit Design Challenge) events, Techkriti-15**:
  Designed and organised the ECDC events (200 participants) during the annual college tech-fest, Techkriti
- **Academic-Mentor, Electrodynamics (PHY103) course, IIT Kanpur**:
  Assisted 1st-year students academically by conducting lectures and doubt-clearing sessions
- **Secretary, Electronics-Club IIT Kanpur**:
  Conducted workshops(attended by around 150 students), hostel-level lectures and provided mentorship to 20 first-year students in Winter-School, teaching them about Arduino, USART and sensors