Vipul Bajaj

Fourth Year Undergraduate
Bachelor of Technology, Electrical Engineering
Double Major, Computer Science and Engineering

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Academic Qualifications

Year	Degree	Institute	CPI/%
2016-2021(exp.)	B.Tech	Indian Institute of Technology Kanpur	**9.6/10**
2016	Senior Secondary	Sawan Sr. Sec. School, Sirsa (CBSE)	95%
2014	Secondary	St. Xavier's Sr. Sec. School, Sirsa (CBSE)	10/10

Research Interests

- Computer vision, Abstractive Summarization (NLP), Multimodal generation, Causal Inference, Incremental Learning, Anomaly Detection, Reasoning & Interpretability of deep learning models.

Publications

- Vinod Kurmi, **Vipul Bajaj**, KS Venkatesh, Vinay P Namboodiri "Curriculum based Dropout Discriminator for Domain Adaptation", *British Machine Vision Conference 2019* (**BMVC'19**).
- Vinod Kurmi*, **Vipul Bajaj***, Vinay P Namboodiri "Correlation vs Causation: Answered via Cross-modal generation using Causal Inference", *2019 ICCV Workshop on Interpreting and Explaining Visual Artificial Intelligence Models* (**ICCV'19**).
- Vinod Kurmi*, **Vipul Bajaj***, Preethi Jyothi, Vinay P Namboodiri "Learning to Generate Joint Audio-Visual Sequences**", *International Conference on Acoustics, Speech, and Signal Processing 2020* (**ICASSP'20**).

** Equal contribution* *** Under-review*

Internships

- Machine Learning Research Intern, **National University of Singapore(NUS), Singapore** (*Nov '19-Present*)
  Causal Anomaly Detection
  - Developed causal graphical models to solve the problem of anomaly detection in multivariate time series data.
  - Identified Granger Causal Relationships among various variables and used them to explain and infer hidden anomalies.
  - Improved existing performance on **SWaT** and **WADI** datasets in an interpretable and scalable manner.
- Data Science and Product Management Intern, **Gartner Inc., Gurugram** (*May '19-Jul '19*)
  Predictive Reviewer Profiling ▶ presentation
  - Developed a machine learning model to predict the credibility of new users on **Gartner's Peer Insights** platform.
  - **Improved efficiency** of the review moderation process by ∼**47%** leading to reduction in costs.
  - Conceptualized **badging** of the reviewers based on their **credentials** and the **quality** of reviews written by them.
  - Identified **strategic** clusters of users for targeted campaigning using **Jensen - Shannon divergence**.
- Computer Vision Research Intern, **SURGE, Delta Lab, IIT Kanpur** (*May '18-Jul '18*)
  Joint Audio-Visual Generation and Discrimination, Supervisor: Prof.Vinay P. Namboodiri, IIT Kanpur github report
  - Developed a multimodal **dataset-CAMP-MNIST** of size **0.5 million** for combined generation of audio, video & text.
  - Improved appearance of generated images by incorporating a **GAN learnt latent space** combining **GANs** and **VAEs**.
  - Conceptualized and designed an **architecture** for conditional **cross-modal generation & alignment** in PyTorch.
  - Analyzed variants of our model by varying **convolution dimensions**, softmax temperature, kernel size, architecture depth & hyper-parameters and tested it on the **URMP dataset**.
- Data Science Intern, **Auquan Inc., Bangalore** (*Jan '18-May '18*)
  Predicting Stock Prices to Develop Trading Strategies for different stock market indices github report
  - Developed predictive models for **stock prices** in Python using the fundamentals of quantitative finance research.
  - Designed, back-tested and optimized a data-driven **quantitative trading strategy** on **real-world data** in python.
  - Developed an **intra-day** mean reversion strategy to give >**30% return on capital(RoC)** using **Hurst** and **ARIMA**.
  - Learnt basic and advanced concepts of quantitative finance and trading.
- Machine Learning Intern, **Kritsnam Technologies Pvt. Ltd., Kanpur** (*Nov '17-Jan '18*)
  Applying Machine Learning to estimate water quality accurately github ▶ presentation
  - Applied Machine Learning models to detect equipment malfunctions and **anomalies/outliers** in sensor data.
  - Processed data pipeline to fill **communication gaps** in transmission of data for water quality measurement.
  - Built a consistent and unified framework to **forecast** sensor parameters and measure **uncertainty** in them.

Projects

- **Adversarial Progressive Learning using Histogram Loss** (*Aug '19-Nov '19*)
  Supervisor : Prof.Vipul Arora, IIT Kanpur
  - Solved the problem of classification in case of class imbalance using deep embeddings in audio data.
  - Improved accuracy for data streaming in online fashion by training deep embeddings with histogram loss .
  - Obtained **significant improvements** over other SoTA methods for progressive learning for data in an online fashion.
- **Multimodal Generation based on Triangle GAN** (*Jan '19-Apr '19*)
  Supervisors : Prof.Preethi Jyothi, IIT Bombay github ▶ presentation report
  : Prof.Vinay P. Namboodiri, IIT Kanpur
  - Used **cross-modal** relationships to generate audio-video using a GAN framework similar to Triangle GAN.
  - Deployed **1D convolutions** for audio stream and **twin discriminators** for alignment of video signal .
  - Obtained **significant improvements** over MoCoGAN for video generation and over WaveGAN for audio generation.
- **Model Zoo for Unsupervised Transfer Learning**(*Course Project*) (*Feb '19-Apr '19*)
  Supervisor: Prof.Vinay P. Namboodiri, IIT Kanpur ▶ presentation report
  - Developed a model zoo of **unsupervised learning** algorithms on a vehicle dataset from surveillance cameras at IITK.
  - Implemented Object Detection, Object Classification, Image Segmentation, Object Tracking, Pose Detection, Super Resolution and Future Frame prediction in an unsupervised manner.
- **Curriculum based Dropout Discriminator for Domain Adaptation(CD^3A)** (*Nov '18-Jan '19*)
  Supervisor: Prof.Vinay P. Namboodiri, IIT Kanpur arxiv github project
  - Proposed a curriculum based approach for an **ensemble** of discriminators sampled from a Bernoulli distribution.
  - Analyzed **scalability of ensembles** and showed that our method is extremely scalable compared to other SoTA models.
  - Thoroughly analyzed the method (statistical significance, discrepancy distance, etc.) and compared against **SoTA**.
- **Cross-Modal Generation using Causal Relationships** (*Aug '18-Nov '18*)
  Supervisors : Prof.Vinay P. Namboodiri, IIT Kanpur github ▶ presentation report
  : Prof.Ketan Rajawat, IIT Kanpur
  - Proposed a **novel** causal inference approach for **multimodal** generation involving audio & video modalities.
  - Employed Neural Causation Coefficient(**NCC**) to check for causal signals in the data points.
  - Generated video-conditioned audio and audio-conditioned video through **adversarial methods**.
- **Explanable Machine Learning**(*Course Project*) (*Aug '18 - Nov '18*)
  Supervisor: Prof. Piyush Rai, IIT Kanpur github ▶ presentation report
  - Developed a web application to **explain the prediction** of any classifier on the users dataset using LIME.
  - Implemented **feature visualization** using matrix factorisation by generating adversarial examples using BFGS method.
  - Explored state of the art techniques for visualizing CNNs using **Lucid and neuron group methods**.
- **Abstractive Summarization using Semantic Representation** (*Nov '17-Jan '18*)
  Supervisor: Prof. Harish Karnick, IIT Kanpur github report
  - Investigated several state of the art models for Abstractive Summarization(build an **internal semantic representation** and use NLG techniques to create a summary that is closer to what a human might express)its evaluation techniques.
  - Programmed AMRs(a **single rooted, directed graph** which include PropBank semantic roles, within-sentence coreference, namedentities and types, modality, negation, questions, quantities,etc.) for semantic representations.
  - Implemented **graph-to-graph transformation** that reduces the source semantic graph into a summary graph. The selection of a sum-mary subgraph from the source graph is posed as a structured prediction problem.
- **Prosthetic Arm**, *Won the award for* ***Best Social Project*** (*May '17-July '17*)
  Robotics Club, IIT Kanpur github ▶ presentation report
  - Engineered an **artificial gripper** on the concept of **prosthetics** using 3D printing and communication via **Bluetooth**.
  - Employed **micro-controllers**(Arduino ATmega and Nano) to communicate with an auxilliary glove having **flex sensors**.

Fellowships, Awards, & Recognition

- Served as a **reviewer** for one of the top peer reviewed computer vision conferences -**WACV'20**.
- **Grand Prize Winner** at Deloitte TechnoUtsav 2.0 - Cash Award of **Rs. 5 Lacs** and a **PPO** at US-India Deloitte.
- **Winner**, Microsoft Code.Fun.Do 2018, IIT Kanpur for an NLP based academic platform **acadAI**.
- **Top 20 Award**, among 1235 participants in *3rd Summer School On Machine Learning* at IIIT Hyderabad.
- Awarded Sri Bishamber Gupta Scholarship by IIT Kanpur for **the best B.Tech third year student in EE**.
- Awarded prestigous **Summer Undergraduate Research Grant for Excellence** (SURGE) for the year 2018.
- Awarded **Academic Excellence Award** for year 2016,2017 & 2018 and **A*** grade for exceptional performance in **3 courses**.
- Selected for **Panasonic Ratti Chhatr** scholarship, awarded to **30** students from **23 IITs** for development and innovation.
- Awarded the prestigous **OPJEMS** scholarship for **academic and entrepreneurial excellence**.
- Won **AME Freshers Award** for best all-round performance in 1st year of undergraduate studies.
- Secured **AIR 147** in **Kishore Vaigyanik Protsahan Yojana** fellowship, Dept. of Science & Technology, Govt. of India.
- **Top 1% Nationwide** in **NSEP** and **NSEC** (National Standard Examinations in Physics and Chemistry.)
- Secured **AIR 729** in **JEE(Mains) 2016** & **AIR 1115** in **JEE(Advanced) 2016** amongst 1.5 million candidates.

Technical Skills

- **Languages:** C/C++, Python, R, Shell(bash), MATLAB/Octave, HTML, CSS, PHP, SQL, Verilog, ReactJS, NodeJS
- **Frameworks:** PyTorch, Tensorflow, Caffe, Keras
- **Utilities:** Git, LaTeX, Docker, Apache, NLTK, Scikit-Learn, Numpy, Pandas, PowerBI, SolidWorks, Adobe Premiere Pro

Entrepreneurial activities

- **acadAI: An NLP based web app to automate examination process** ▶ video
  - Built a Django based web application named acadAI which leverages the power of Artificial Intelligence to help the academic community all over the world.
  - The application consist of 3 modules-
    - **Question Paper Generator**: It can generate a question paper of the desired level of difficulty from the desired chapters given in pdf format using Overgeneration and Ranking Models. .
    - **Answer Generator**: Takes a PDF format textbook and a natural language question(in regard to text)as input and returns the most relevant answer from the textbook using Facebook's DrQA machinery. .
    - **Evaluator**: Takes two natural language answers in PDF format(one given by student and the other according to answer key), evaluates semantic similarity through smatch score by constructing AMRs and awards scores.
  - **Winner** of Microsoft Code.Fun.Do 2018, **2nd Position** in **"Pitch your Product"**, **2nd Position** in **"Pitch Prime"** at E-Summit IIT Kanpur 2018 and **3rd Position** in **"Upstart Socha"** 2018.

Relevant Coursework

*On-going Courses, **MOOC

Visual Recognition	A	Machine Learning	A	Probabilistic Machine Learning	**
Fundamentals of Computing	A	Data Structures and Algorithms	A	ML for Signal Processing	*
Complex Variables	A*	Probability and Statistics	A	Time Series Analysis	*
Introduction to Real Analysis	A	Computer Organization	A	Operating system	*
Theory of Computation	*	Algorithms-II	*	Natural Language Processing	**

A* = Outstanding

Voluntary Work

- **Teaching Assistant, ESC 101:** *Assisted Prof. Nisheeth Srivastava in the course on Intro to Computing* (*Dec '19-Present*)
  - Tutored 35 students on various concepts in C programming and prepared question papers for various exams.
- **Teaching Assistant, ESO 207:** *Assisted Prof. Sumit Ganguly in the course on DS & Algorithms* (*July '19-Nov '19*)
  - Prepared question papers for various assignments, quizzes, and other exams and evaluated students' answer sheets.
- **Project Mentor, ACA:** *Mentored 4 project groups having 2 students each* (*Jan '19-July '19*)
  - The projects ranged from Explanable Machine Learning, Multimodal generation to Causal Inference.
- **Head Finance**, Electrical Engineering Association IITK: *Digitized and managed finances of ∼5L rupees* (*Aug '17-Aug '18*)
  - Organized, analyzed and optimized expenditure for Fresher's Night, Farewell, etc. having an audience of approx 900
- **Academic Mentor**, Counselling Service, IITK: *Electrodynamics(PHY103)* (*Aug '17-July '18*)
  - Took institute level remedial classes, hall-level doubt clearing sessions and provided one to one mentoring to weak students
- **BloodConnect: Technical Executive and Camp Coordinator**: *Raktarpan* (*Aug '16-July '18*)
  - Collaborated with Data Analytics and Management team to manage data of ∼ 10,000 blood donors all across the country.