V Pramodh Gopalan

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Academic Details

Examination	Institute	Year	CPI/%
Graduation	IIT Kanpur	2023	9.2/10.0
High School, CBSE	Ryan International School, Mumbai	2019	96.2
Secondary School, CBSE	Delhi Public School, Mumbai	2017	10/10

Research Interests: Statistics, Privacy and Security of Machine Learning, Stochastic Optimization, Scientific Computing.

Scholastic Achievements

- **Academic Excellence Award** for exceptional performance in Academics at IIT Kanpur for two consecutive years. *(2020, 2021)*
- Secured **All India Rank 217** in **JEE Advanced 2019** among 230K eligible aspirants. *(2019)*
- Secured **All India Rank 217** in **JEE Mains 2019** among 1.1 Million candidates. *(2019)*
- Awarded the prestigious **KVPY fellowship** by Dept. of Science and Technology, Govt. of India. *(2019)*
- Amongst the top students across the country to appear for the nation-level olympiads in Physics and Astronomy, **INPhO** and **INAO** respectively. *(2019)*
- Participated in a training camp for appearing in **INMO**(Indian National Math Olympiad). *(2018)*
- Recipient of the **National Talent Search (NTSE) scholarship** awarded by the NCERT. *(2017)*

Research Projects and Internships

Retrospective Approximation *Code Here*
[May 2022 - Jul 2022]

MITACS research intern | Prof Fabian Bastin — *Université de Montréal*

- Examined usage of **retrospective approximation** in **stochastic optimization** to improve upon **SGD** and **L-BFGS**
- Constructed statistical stopping tests based on **common random numbers** for automated termination of the algorithm
- Tested the retrospective algorithm on **synthetic datasets** with **custom L-BFGS** solver written in **julia**
- Concluded that the algorithm **outperforms** L-BFGS with the number of gradient calls as a metric

Stochastic Gradient Barker Descent(SGBD) *Code Here*
[Jan 2022 - May 2022]

Undergraduate Research Project | Prof Dootika Vats — *IIT Kanpur*

- Developed a novel, approximate MCMC technique robust to tuning parameters while being effective as **SOTA methods**
- Evaluated SGBD on the **arrhythmia dataset** and **constrained support systems**; Inferred it outperforms **SGLD** when used in **non-optimal** settings, with **kernel stein discrepancy** and **effective sample size** as metrics

Adversarial Training defends against Poisoning Attacks
[Jan 2022 - May 2022]

Course Project, Deep learning for Computer Vision | Prof. Priyanka Bagade — *IIT Kanpur*

- Examined usage of adversarial training against attacks like BadNets and Clean Label Backdoor attack on MNIST and CIFAR-10.
- For Clean label attack, Adversarial Training increased test accuracy on images from 1.39% to 90.68% in MNIST.
- For the BadNets Attack, the method increased the test accuracy on images with backdoor from 1.17% to 91.71% on MNIST and from 8.64% to 54.86% on CIFAR-10.

Defending against Poisoning Attacks in Machine Learning
[May 2021-May 2022]

Research Intern | Prof. Alina Oprea & Prof. Battista Biggio — *NDS2 Lab, Northeastern University*

- Working on Creating **Defenses** against **Poisoning** Attacks in **ML**, using **Ensembles** of models.
- **Extended** existing **implementations** of attacks to accomodate **Drebin** and **MNIST** Datasets, and tested the attack efficacy on them.
- Formulated a **theoretical framework**, and derived a **lower bound** on the **effectiveness** of the defense.
- Carried out **experiments** to validate the **theoretical** claims, and **visualized** the results **interactively** using libraries like **Pluto.jl** and **Makie.jl**.
- A **report** can be found *here*.

Decentralised Mechanism Design using Blockchains *Code Here* *[Oct 2020 - Nov 2020]*
Course Project CS711 | Prof Swaprava Nath *IIT Kanpur*

- Implemented various **Sealed-Bid Auction Mechanisms** using Blockchains.
- Learned about various problems in Blockchains related to **privacy** and tackling them using modern Cryptographic Primitives like **Secure MPC**.
- Modelled a game theoretic version of privacy problem in Blockchain as **Normal Form Game** and inferred various **equilibriums** that may be present according to different applications.
- Presented an analysis of how effective the current Enigma Protocol is, and proposed an **alternative better approach** for a particular step by using **VCG Mechanisms.**

Key Projects

Model Zoo: A study in GANs *Code Here* *[Summer 2020]*
Summer Project | Programming Club *IIT Kanpur*

- Learned about Convolutional Neural Networks in depth and implemented architectures like **ResNET** and **VGG** using **Pytorch**.
- Carried out a literature review on GANs and implemented basic **GAN** and **DCGAN** on **MNIST** and **CIFAR-10** Datasets.
- Read papers on **Context Encoders** and implemented it using Pytorch.
- Studied **Audio Generation** using **WaveGAN**.
- Created **Blogs** mentioning related Literature, along with **Results** and **Architectures**.

Cross Validated *[Summer 2021]*
Summer Project | Stamatics Club *IIT Kanpur*

- Explored various sampling methods like **Inverse Transform**,**Accept-Reject**, **Bernoulli Factories**, **Importance Sampling**, **Box-Muller** and **Ratio of Uniforms** used in Monte Carlo Algorithms.
- Studied optimization methods like **SGD**, **Newton-Raphson**, **MM** and **EM** algorithms used in estimation of parameters.
- Implemented **Probit Regression** model in **Julia** on the titanic dataset to estimate chances of survival.
- Introduced to **MCMC** and **MH** algorithms and topics in Bayesian Modelling such as **Bayesian Linear and Logistic Regression**

Technical Skills

- **Programming & Scripting Languages:** C++, C, Python, Julia, Bash, R
- **Libraries and Frameworks:** Pandas, NumPy, seaborn, scikit-learn, PyTorch, PyTorch-Lightning, Flux.jl, Tensorflow/Keras(familiar).
- **Utilities:** Git, LaTeX gcov, gtest, Markdown, Docker

Relevant Coursework

Operating Systems	Parallel Programming	Deep Learning for Computer Vision
Programming for Performance	Probabilistic ML	Data Structures and Algorithms
Introduction to Machine Learning	Bayesian Analysis	Statistical Simulation and Data Analysis
Advanced Algorithms	Software Development and Operations	Computer Organization

Positions

Secretary, Programming Club *[May 2020 - Apr 2021]*
Programming Club, IITK *IIT Kanpur*

- Part of a team of 20 students responsible for holding various events to the campus community of more than over 8000 students
- Responsible for managing a Competitive Programming Competition for students of the institute for a month.
- Hold

Mentor - Julia for Machine Learning *[Apr 2021 - Jul 2021]*
Association for Computing Activities, IITK *IIT Kanpur*

- Introduced Julia, A High Performance Language to about a group of 30 students.
- Delivered Lectures on various aspects of Julia, Such as Multiple Dispatch, Type Inference, Meta-programming and Loop Fusion.
- Introduced them to fundamental concepts in Machine Learning such as Probability and Statistics, Different modes in Automatic Differentiation, Gradient Descent.

Student Guide *[Nov 2021-May 2021]*
Counseling Service *IIT Kanpur*

- Mentored six freshmen throughout their first year and exposed them to academic and extracurricular opportunities available in the Institute.