Vinay Agrawal

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Education

Year	Degree/Certificate	Institute	CPI/%
2022-Present	**M.Tech/Computer Science & Engg.**	**Indian Institute of Technology, Kanpur**	**9.14/10**
2018-2022	B.Tech/Computer Science & Engg.	Bhilai Institute of Technology, Durg	9.54/10
2018	CBSE(XII)	Krishna Public School, Bhilai	89.80%
2016	CBSE(X)	Krishna Public School, Bhilai	10/10

Research Experience

- **RADAR-based Autonomous Smart Streetlight Systems** (M.Tech Thesis) (*Mar'23 - Present*)
  Guides: Prof. Amitangshu Pal & Prof. Priyanka Bagade
  - The objective is to develop a RADAR-based smart streetlight system that enhances energy efficiency and ensures road safety.
  - Integrated the **IMD 2000 radar sensor** for **real-time vehicle velocity detection**.
  - Designed **communication protocols** to enable **inter-streetlight communication** for dynamic adjustment of lights.
  - Developing a **multi-label classification model** for real-time predictions of multiple moving objects using RADAR.
  - Exploring **Deep Learning techniques** for differentiating between vehicles and objects on the road.
  - **Research Areas :** IoT (Internet-of-Things), Multi-class Prediction, Feature Engineering.

Projects

- **Blockchain based Recruitment Management System(DApp)** | (CS731) Guide: Prof. Angshuman Karmakar (*Jan'23 - Apr'23*)
  Solidity, Hardhat, MetaMask, HTML, CSS, React, Node.js, MySQL
  - Developed a **decentralized application(DApp)** using **Ethereum Smart Contracts** to streamline the recruitment process.
  - Ensured public job offers **remain irrevocable on the blockchain**, ensuring transparency, non-repudiation, and verifiability.
  - **Received 110/100 (Bonus marks) for the project**.
- **Interactive Restaurant Profiling: Big-Data Visualization Platform** | (CS661) Guide: Prof. Soumya Dutta (*Jan'23 - Apr'23*)
  Apache ECharts, HTML, CSS, JavaScript
  - **Cleaned and processed a large Zomato dataset** of restaurants in Bangalore for more accurate and data-driven insights.
  - Created interactive custom visualizations such as **stacked charts** for new businesses, **dynamic cartesian heatmaps** for existing establishments, and **preference trees** for customers, deriving behavioral insights.
- **Program Analysis, Verification and Testing** (CS639) | Guide: Prof. Subhajit Roy (*Aug'22 - Nov'22*)
  Kachua Framework, Python
  - Created **Control Flow Graph** of program using IR and performed **Data Flow Analysis** to generate **optimized program IR**.
  - Implemented the custom **mutation operator** and **coverage metric operator** for **fuzzer** to maximize program's coverage.
  - Synthesized unknown constants in a program using **Symbolic Execution** to make two programs semantically equivalent.
  - Implemented a tool to verify the correctness of a turtle program using **Abstract Interpretation** with interval domain.
- **Exploiting Security of Vulnerable IoT Devices** (CS666) | Guide: Prof. Urbi Chatterjee (*Aug'22 - Nov'22*)
  Verilog, Python
  - Designed various hardware modules including, LFSRs (Linear Feedback Shift Registers), S-boxes, and others using **Verilog**.
  - Implemented **Correlation Power Attack** on **AES** to recover target key-byte using power consumption traces of last round.
  - Implemented a **Difference of Mean Attack** to **recover 2 bytes of secret key** using power traces of one AES execution.
  - Executed **Differential Fault Attack** on **AES** to **recover 1st column of round-10 key** using pairs of correct-faulty ciphertext.
- **Big Data Visual Analytics** (CS661) | Guide: Prof. Soumya Dutta (Jan'23 - Apr'23)
  VTK, Plotly, SciPy, ParaView, Python
  - Loaded & processed 2D uniform grid data in **VtkImageData** format, extracted cell details, and visualized the extracted cell.
  - Extracted **2D-isocontour** from uniform grids & executed advanced **volume rendering** with Phong Shading.
  - Designed an interactive platform using **Plotly** and **Jupyter Widgets** for **dynamic Isosurface visualization** and **histogram analysis**, enhanced by real-time user adjustments.
  - Implemented **random sampling** on volume data, followed by **reconstruction of volume data** from sampled points.
- **Hand Sign Recognition & Mouse Control Using Hand Gestures** | (CS724) Guide: Prof. Amitangshu Pal (*Aug'22 - Nov'22*)
  OpenCV, MediaPipe, PyAutoGUI, Numpy, Keras, scikit-learn, Python
  - Developed a camera-driven HCI system that uses **computer vision** and translates **hand movements** into **cursor actions**.
  - Implemented a real-time finger spelling-based **Sign Language Translator** with **95.7% accuracy** rate.
- **DeCAPTCHA: Breaking CAPTCHA Using ML** | (CS771) Guide: Prof. Purushottam Kar (Aug'22 - Nov'22)
  OpenCV, scikit-learn, Python
  - Utilized **OpenCV** and **HSV model** for image preprocessing & clearing obfuscations from a large dataset of CAPTCHA images.
  - Implemented **brightness thresholding** to distinguish and segment individual characters from images.
  - Developed and trained a **multiclass SVM model** with **linear kernel**, achieving **100% character recognition accuracy**.
- **Breaking 3-XOR PUF** | (CS771) Guide: Prof. Purushottam Kar (Aug'22 - Nov'22)
  SciPy, Python
  - Derived **mathematical mapping** of binary digits to signs and vice-versa, unveiling the product nature of the XOR function.
  - Constructed a linear model from scratch using **hinge loss with stochastic gradient descent**, breaking the security of 3-XOR-PUF with **100% accuracy**.
- **Code Corrector: Error Classification for Program Repair** | (CS771) Guide: Prof. Purushottam Kar (Aug'22 - Nov'2)
  Imblearn, scikit-learn, Python

- Utilized the **SMOTE technique** to rectify significant class imbalances in the dataset, enhancing model prediction accuracy.
- Explored various classification techniques, including **One-vs-All**, **Decision Trees**, and **Logistic Regression**.
- Conducted rigorous model evaluations using metrics prec@k and mprec@k (with k varying from 1 to 5).
- Attained **97.4% accuracy** on the prec@5 metric through strategic tuning of the hyperparameters in logistic regression.

- **Escaping the Caves (Breaking Cryptosystems)** (CS641) | Guide: Prof. Manindra Agrawal (Jan'23 - Apr'23)
  Scripting, Python
  - **Analysed and decoded** various cryptosystems namely, **Substitution cipher, Vigenere cipher, Substitution-Permutation cipher(SPN Structure), DES, EAEAE, and AES**.
  - Exploited above cryptosystems using different cryptanalysis techniques like **frequency analysis, differential cryptanalysis, lattice-based techniques & brute force**.

SKILLS

- **Languages :** C, C++, Python, JavaScript, Solidity, Verilog, SQL, HTML, CSS
- **Frameworks/Tools/Libraries :** Node.js, React, Hardhat, NumPy, Pandas, Scikit-learn, VTK, Plotly, SciPy, Apache ECharts, OpenCV, Keras, MediaPipe, PyAutoGUI, Matplotlib, Kachua Framework
- **Utilities/Softwares :** Git, Github, LaTeX, MetaMask, Paraview, Jupyter Notebook, VS Code
- **OS :** Windows, Linux

ACADEMIC ACHIEVEMENTS

- Secured **All India Rank 199** in **GATE CS 2022** amongst 77257 candidates.
- Secured **All India Rank 1748** in **GATE CS 2021** in 3^{rd} year of undergraduate amongst 101922 candidates.
- Secured a Rank of **113** in **Chhattisgarh Pre-Engineering Test**(CGPET) 2018.
- Received **Honors** in Undergraduate studies at CSVTU.

RELEVANT COURSES

- **Postgraduate :**

  Program Analysis, Verification & Testing(CS639)*
  Big Data Visual Analytics(CS661)*
  Hardware Security For Internet-Of-Things(CS666)
  Introduction to ML(CS771)
  Blockchain Technology & Applications(CS731)
  Modern Cryptology(CS641)
  Sensing, Communication & Networking For Smart Wireless Devices(CS724)*

- **Undergraduate :**

  Data Structures*
  Operating System*
  Database Management System*
  Object Oriented Concepts & Programming Using C++*
  Analysis & Design of Algorithms*
  Computer Networks*
  Compiler Design*

(*) - Received the highest possible grade out of 10

POSITIONS OF RESPONSIBILITY

- **Teaching Assistant :** Mathematics for Computer Science. (CS201) (*Aug'23 - Present*)
- **Teaching Assistant :** Fundamentals of Computing - 1 & 2. (ESC111/112) (*Nov'22 - Jul '23*)

  Evaluated course and lab assignments, helped undergraduates in resolving doubts, and ensured smooth course management in collaboration with the instructor.