Rohan Rajesh Kalbag
Electrical Engineering
Indian Institute of Technology Bombay

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B.Tech.
Gender: Male
DOB: 11/7/2002

Examination	University	Institute	Year	CPI / %
Graduation	IIT Bombay	IIT Bombay	2024	
Intermediate	CBSE	CMR National Public School	2020	98.00%
Matriculation	CBSE	CMR National Public School	2018	96.80%

Pursuing **Minor** in **Computer Science and Engineering** and **Artificial Intelligence and Data Science**

Scholastic Achievements

- Awarded **Change of Branch/Major** to **B.Tech. Electrical Engineering** for outstanding academic performance *(2021)*
- Secured **All India Rank 26** in **Karnataka Common Entrance Test** (KCET) among **150 thousand** candidates *(2020)*
- Scored **99.89%** percentile in **Joint Entrance Examination Advanced** among **180 thousand** eligible candidates *(2020)*
- Achieved **99.48%** percentile in **Joint Entrance Examination Main** among **1.3 million** participating candidates *(2020)*
- Recipient of **Top 0.1% Merit Certificate** by **CBSE** for Computer Science, Physics, Chemistry in **12th Boards** *(2020)*

Key Projects

The Humanoid Project | Institute Technical Council, IIT Bombay *(Mar 2022 - Present)*

Artificial Intelligence and Perception Subsystem

An all-student technical group designing a social humanoid robot to be deployed in the Library/Lecture Halls of the IIT Bombay campus

- Sourced **10k+** training images of **interactable objects** from camera/web crawling and **annotated** them with **LabelImg**
- Trained a **YOLOv5** architecture to **detect** books, cups and other objects from the bot's camera feed with $>$ **75%** confidence
- Utilised **RASA** framework to develop a **conversational wrapper** for the bot to invoke custom actions for text commands
- Used **spaCy** to **decompose text paragraphs** for sequential execution by using conjunctions and punctuations as delimiters
- Employed **PyAudio**, **Mozilla DeepSpeech** to issue **voice commands** to the bot to **locate** a supported object in its view

Competitive Programming | Seasons of Code | Web and Coding Club, IIT Bombay *(Summer 2022)*

- Participated in **10+ rated** competitive programming contests held on online platforms over **1.5 months** to explore the field
- Explored **time complexity** and concepts from **Data Structures and Algorithms** for improved problem-solving intuition
- Studied effectual usage of **C++ STL**, creation of **generic code templates** for **faster implementation** during contests

Predictive Model for Decline in Cognitive Abilities in Alzheimer's Patients *(Mar 2022 - Present)*

Undergraduate Research Project | **Guide: Prof. Azizuddin Khan** | **Department of Humanities and Social Sciences**

- Examined research papers, journals about **Alzheimer's Disease** to identify significant factors for **neurocognitive decline**
- Identified **drawbacks** of existing clinical tests like **MMSE** and **MoCA** for their applicability to the **Indian** patient populace
- Currently constructing a **neurocognitive ability test** to survey patients to procure training data for the predictive model

Autoencoder Architecture for Image Colourisation and Noise Reduction *(Spring 2022)*

Course Project | **Guide: Prof. Biplab Banerjee** | **Center for Machine Intelligence and Data Science**

- Trained a CNN-based **autoencoder** on grayscale **CIFAR-10** images to generate colourised versions with **RMSE** of **0.052**
- Compared performance of autoencoders and **PCA** for **gaussian**, **salt pepper** noise reduction trained on **MNIST** images
- Qualitatively explained the **data specificity** of autoencoders by train-testing the same model on different image classes

Analysis of Different University Ranking Systems *(Autumn 2021)*

Course Project | **Guide: Prof. Amit Sethi** | **Center for Machine Intelligence and Data Science**

- Performed preprocessing, **exploratory data analysis** for the overall category of the **QS**, **Shanghai** and **NIRF** rankings
- Identified general trends and studied the **correlations** of the **overall score** with the **individual ranking parameters**
- Compared **Decision Tree, Random Forest, SVM, Lasso, Ridge**, **Linear** regression to **predict** rankings for future years
- Predicted the **NIRF** overall rankings for 2021 using **Random Forest Regression** with a test data $\mathbf{R^2}$ **score** of **0.987**

Mood Indigo App | 51st Edition of Mood Indigo *(Jul 2021 - Jan 2022)*

- Developed the official app of **Asia's Largest College Cultural Festival** with **100k+** viewership, **10k+** Play Store downloads
- Implemented the **Navbar**, **CCP Scoreboard**, **Profile** and **Blog** pages using **Flutter SDK** from provided **UI** specifications
- Generated **Posts, Banners, Survey, Weekly Task** widgets using **JSON** data fetched from **Django REST** API endpoints

Lasso Game *(Spring 2021)*

Course Project | **Guide: Prof. Bhaskaran Raman** | **Department of Computer Science and Engineering**

- Developed a **C++ video game** of catching coins, avoiding bombs with a **keyboard-controlled lasso** for **Ubuntu 20.04**
- Created **encapsulated classes**, followed **code modularity** practices and **documented developmental stages** via **Git**
- Included features like **interactive GUI**, game over screen, **randomized sprite paths**, leaderboards via **file management**

Multicycle Reduced Instruction Set Computer *(Spring 2022)*

Course Project | Guide: Prof. Virendra Singh | Department of Electrical Engineering

- Designed a **16-bit processor** with **8** general purpose registers capable of **17** arithmetic, logical, branching instructions
- Constructed the **hardware flowchart**, **datapath**, **control words**, **decoding logic** and a **27-state FSM** for the given **ISA**
- Simulated all instructions by loading them into memory and verified the generated waveforms using **GHDL** and **GTKWave**

Design of Digital Systems *(Autumn 2021)*

Laboratory Course Projects | Guide: Prof. Maryam Baghini | Department of Electrical Engineering

- **Word Detection** : Created a **mealy FSM** capable of **trigger word detection** and displaying its letters on a **16x2 LCD**
- **Fibonacci Generator** : Designed a **sequential** circuit to iteratively obtain the **n^{th} Fibonacci** term from a **4-bit** input for n
- **Updown Counter** : Structurally constructed a **2-bit bidirectional counter** with enable, up-down select using **D flipflops**
- Verified the designs for all input combinations using **virtual JTAG scan chain** method on **Krypton** (Intel MAX V CPLD)

Logarithmic Amplifier Implementation *(Spring 2022)*

Laboratory Course Project | Guide: Prof. Anil Kottantharayil | Department of Electrical Engineering

- Performed **linear regression** on actual **IN4148** I-V characteristic data points to estimate its theoretical parameters **I_S** and **n**
- Simulated the amplifier circuit using the **spice models** for the diode and **TL084 IC** on **NGSPICE** to verify its correctness
- Utilising components tuned to estimated parameters, **physically assembled** the circuit to obtain **nearly theoretical results**

Microcontroller Interfacing and Programming *(Spring 2022)*

Laboratory Course Projects | Guide: Prof. Saravanan Vijaykumaran | Department of Electrical Engineering

- **Music Generator**: Used **8051 timer interrupts** to generate square waves to play notes of specific frequencies on a speaker
- **4-bit PAM Wave**: Created periodic **pulse amplitude modulated** waves of custom levels from nibbles stored in memory
- **Thermometer**: Interfaced **8051** with **LM-35** sensor connected to **MCP3008** ADC using **SPI** to measure temperature
- **ATM**: Implemented **user login**, **balance display** and **fund withdrawal**, interfaced input/output on a computer with **UART**
- Used **Keil μVision** for debugging, simulation and verified the generated **.hex** files by testing on **Pt-51** (AT89C5131)

Smart Farm Irrigation System *(Spring 2021)*

Course Project | Guide: Prof. Shireesh Kedare | Department of Energy Science and Engineering

- Designed a **queue scheduled irrigator** for **water intensive crops** using sprinklers activated by **low soil moisture** levels
- Used **capacitive soil moisture sensors**, 230 V **solenoid valves** integrated with **Arduino MEGA** using 5 V **relay switches**

Self Learning Projects

- **Simon Says Snake**: Created using **pygame**, controlled the snake's motion from **audio input** using **speech-to-text** API
- **Stone Paper Scissor**: Developed an **ANN** using **EMG** sensor data to predict the winning move with **F_1** score of **0.92**
- **ChatterBox**: Devised a library for **automated repetitive messaging** tasks on WhatsApp Desktop using **PyAutoGUI**
- **Solar Cooker**: Constructed an adjustable lid box type cooker, plotted its heating curve using **LM-35** and **Arduino UNO**

Positions of Responsibility

Web Activity Associate | National Service Scheme, IIT Bombay *(June 2021 - May 2022)*

- Developed a **web portal** to organise **crypt hunt** competitions with **user authentication**, **live leaderboards** using **PHP**
- Added **announcement banners**, revamped backend to **Django** for better scalability, audience outreach of the homepage

Key Courses Undertaken

Computer Science	Computer Programming and Utilization, Introduction to Machine Learning
Data Science	Programming for Data Science, PH526x - Python For Research*
Mathematics	Calculus, Linear Algebra, Complex Analysis, Differential Equations, Probability & Random Process
Electrical	Microprocessors, Digital Systems, Analog Circuits, Electronic Devices, Signal Processing Control Systems, Power Electronics, Power Engineering, Communication Systems†, EM Waves†

**MOOCs* *†to be completed by Nov 2022*

Technical Skills

Languages	C++, python, C, LaTeX, MATLAB, Java, Dart, bash, VHDL, Embedded C, Assembly
Development	Git, Django, Django REST, PHP, Flutter, mySQL, Firebase, HTML, CSS, JavaScript, Markdown
Python Frameworks	YOLOv5, RASA, scikit-learn, NumPy, pandas, OpenCV, TensorFlow, PyTorch, spaCy, tkinter
Software	LabelImg, XAMPP, Intel Quartus, Xilinx ISE, GHDL, RealTerm, Keil μVision, GTKWave, NGSPICE
Hardware	Arduino, ESP32, 8051, Pt-51 (AT89C51), Krypton (Intel Max V CPLD), Xilinx Spartan 6 FPGA

Extracurriculars

Technical	• Contributed to an application project challenge by **Deepgram** during **Hack Cambridge Atlas 2022** • Completed **Technical Summer School** in **LaTeX** and **Flutter** offered by **UGAC, IIT Bombay**
Volunteering	• Dedicated **100+** hours to create educational videos & audio articles under **NSS Educational Outreach** • Organised a charitable competitive programming contest titled **"society.serve()"** for **NSS Flare 2021**
Cultural	• Directed and acted in the skit titled **"Operation Reboot"** to spotlight the issue of **climate change**