# MANAS VASHISTHA

*Mail* ◇ *LinkedIn* ◇ *Github* ◇ *Webpage*[*]

## EDUCATION

**Indian Institute of Technology Bombay**, *Mumbai, India* July '17 - July '22
*Dual Degree (B.Tech + M.Tech)* in *Electrical Engineering*
*Specialization: Communication & Signal Processing*
*GPA:* **8.28**

**Central Board of Secondary Education**, *Delhi, India*
*CBSE Intermediate, Percentage:* **94.8**% 2016-2017
*CBSE Matriculation, CPI:* **10/10** 2014-2015

## EXPERIENCE

**MADA-SS** | *Adversarial Learning & Computer Vision* *Summer 2021 - Summer 2022*
*Guide: Prof. Biplab Banerjee* *EE, IIT Bombay*

- Designed a novel architecture *MADA-SS* based on the **Multiple Adversarial Domain Adaptation** approach with UNet & ResNet as the baseline segmentation models and multiple fully connected discriminators.
- Trained & tested the model on **ISPRS Vaihingen & Postdam** datasets of high-resolution satellite images as the source and target domains respectively. Trained the model using the adversarial learning approach.
- Achieved an overall accuracy of **85%** and an average mIoU score of **0.81** on the target domain.

**Creating interactive stories in Augmented Reality** | *AR* *Summer 2020*
*Guide: Prof. Misha Sra* *Perceptual Engineering Lab, UCSB*

- Developed an application in **Unity** with **Google ARCore** & Poly Toolkit API to place 3D models in AR
- Implemented functionalities that can be linked with an AR asset to make it interact with surrounding assets
- Designed **android interface** to create simple logical stories using AR assets & functionalities linked to them

**Incremental Learning for resource constrained devices** | *IoT* *Summer 2019*
*Guide: Prof. Cecilia Mascolo* *University of Cambridge*

- Did extensive literature survey of existing techniques on incremental learning for constrained devices
- Designed a model in **Android Studio** with **DL4J** to classify human activities using Deep Learning
- Worked towards implementing optimizing algorithms like **LaRank** on mobile device applications

## RESEARCH PROJECTS

**Co-Segmentation using Mutual Information** | *Computer Vision* *Spring 2021*
*Guide: Prof. Biplab Banerjee* *EE, IIT Bombay*

- Worked on developing an architecture of **zero-shot** co-segmentation using **Mutual Information** framework
- Ran baseline tests for Co-segmentation model with **DeepLabv2** architecture on **PASCAL VOC Dataset**

**Improving adversarial robustness of Machine Learning models** | *Adversarial Learning* *Fall 2020*
*Guide: Prof. Biplab Banerjee* *EE, IIT Bombay*

- Designed a novel model to distinguish adversarial samples from natural samples using UNet architecture
- Utilised **top-k principal components**, same for original and adversarial images, for classification task
- Tested various algorithms which can make Machine Learning models robust against adversarial samples

## KEY PROJECTS

**CUDA Accelerated Eigen Face Recognition System** | *Parallel Computing* *Spring 2021*
*Guide: Prof. Shivasubramanian Gopalakrishnan* *ME, IIT Bombay*

- Implemented quick face recognition & reconstruction using **eigen faces** obtained from **PCA** & **SVD**
- Used **MPI** & **CUDA** to parallelize the implementation and compared their performances for **ORL Dataset**
- Achieved 30x improvement in time using CUDA for SVD and reported the bottleneck observed for PCA

[*]Use URL www.manasv09.github.io in case hyperlinks don't work

**Tic-Tac-Toe Learning Environment** | *Reinforcement Learning* *Fall 2020*
*Guide: Prof. Amit Sethi* *EE, IIT Bombay*

- Wrote an open-source framework for testing reinforcement learning algorithms on simple tic-tac-toe games
- Implemented **Deep Q Networks** and some classic learning algorithms like **minimax** and **alphabeta** search
- Used WebSockets communication and web GUI for better human interaction with the agents while playing

**Genre Classification** | *Speech Signal Processing* *Fall 2020*
*Guide: Prof. Preeti Rao* *EE, IIT Bombay*

- Used logistic regression to classify audio samples from the **GTZAN** dataset on the basis of genre
- Identified the audio features which majorly contribute in the classification task like lower order **MFCCs**
- Reported the effect of changing the clip length of the audio samples and the effect of including tempo

**Image Inpainting with Deep Image Priors** | *Image Processing* *Fall 2019*
*Guide: Prof. Ajit Rajwade* *CSE, IIT Bombay*

- Formulated **image inpainting** as a Maximum Likelihood Estimation problem and exploited the property of **CNNs** as **universal function approximators** to use it as a prior for **zero-shot** image reconstruction
- Developed an **hour-glass** (Encoder-Decoder) architecture with skip connections to maximize the likelihood term, subsequently producing the near original image even when 80% of random pixels are removed

**Maze Solver** | *Markov Decision Processes* *Fall 2020*
*Guide: Prof. Shivaram Kalyanakrishnan* *CSE, IIT Bombay*

- Modeled a maze as an MDP instance by defining the environment, the actions of the agent & the rewards
- Used various algorithms like **Value Iteration Algorithm, Linear Programming & Howard's Policy Iteration** to find the optimal value function and optimal policy hence, determining the shortest path

**ChordIt — Chord Sequence Extraction from Music** | *Machine Learning* *Spring 2019*
*Guide: Prof. Biplab Banerjee* *CSRE, IIT Bombay*

- Processed audio files to retrieve $\mathbb{R}^{12}$ **Pitch Class Profile** vectors using **optimized Fourier Transform**
- Analyzed various NN configurations with **Additive** $\chi^2$ kernel & **SVM** for **Out-of-score Learning**
- Used **Butterworth filter** for creating a band pass filter to smoothen the function for better sampling

## SCHOLASTIC ACHIEVEMENTS

- Secured **All India Rank 270** in **JEE Advanced 2017** among 200,000 candidates
- Awarded **AP Grade** (**top 1%** out of 470 students) in Chemistry Laboratory
- Achieved **99.7 percentile** in **JEE Main 2017** among 1.2 million candidates
- Bagged **State Rank 59** in **UP State Entrance Exam 2017** among 142,000 candidates

## POSITIONS OF RESPONSIBILITY

**Teaching Assistant** | *Digital Signal Processing Lab* *Spring 2022*
*Guide: Prof. Preeti Rao* *EE, IIT Bombay*
Prepared lab assignment solutions, conducted weekly lab vivas, and checked assignments of 15 students

**Teaching Assistant** | *Control Systems Lab* *Fall 2021*
*Guide: Prof. Madhu N. Belur* *EE, IIT Bombay*
Responsible for checking assignment reports & conducting weekly lab vivas of a batch of 15 students

**Teaching Assistant** | *Introduction to Machine Learning* *Spring 2021*
*Guide: Prof. Biplab Banerjee* *C-MInDS, IIT Bombay*
Created jupyter notebooks on topics taught in the class and published them on course gitpage

**Volunteer** | *Annual Social Fest* *Spring 2018*
*Abhyuday* *IIT Bombay*
Maintained a database of visitors & performers during Annual Social Fest 2018 as an NCC Volunteer

## OTHER PROJECTS

**SAT Solver** | *DPLL Algorithm* *Fall 2019*
*Guide: Prof. Virendra Singh* *EE, IIT Bombay*

- Implemented the NP-Complete problem of **SAT Solver** which takes **CNF** and gives a solution
- Used **DPLL algorithm**, a famous backtracking algorithm to find a solution for the given CNF

**Multi-Cycle (RISC) Processor** | *Processor Design* *Fall 2019*
*Guide: Prof. Virendra Singh* *EE, IIT Bombay*

- Developed & tested the architecture of a basic computer which follows a predefined set of instructions
- Created an FSM (for implementation of the developed architecture) by assigning specific tasks to each state
- Tested the design in VHDL on a new sequence of instructions by looping over all the instructions in the set

**Maze Solver** | *Robotics* *Spring 2018*
*Electronics & Robotics Club* *IIT Bombay*

- Implemented *optimal algorithms* and techniques to obtain the *solution path* for the maze
- Analysed and mapped the maze using **Ultrasonic ranging module** and stored maze path data

**Line Follower** | *Robotics* *Spring 2018*
*Electronics & Robotics Club* *IIT Bombay*

- Assembled a sensor array using **IR Tx-Rx** pair to detect white line on black background
- Utilised **optimal threshold** value for sensors to calculate distance of the line from the center
- Employed **Proportional Integral Derivative** controller to ensure smooth motion in correct direction

**Grab Circuit** | *Digital Logic Design* *Spring 2018*
*Guide: Prof. Subhananda Chakrabarti* *EE, IIT Bombay*

- Devised a quiz buzzer system ascertaining the player with the *fastest reaction time* and the *reaction time*
- Implemented and interfaced the buzzer circuit with the timer circuit using D flip-flops and latches
- *Reaction time resolution* (*10ms* by default) can be varied easily & it can be extended to more players too

**Heart Rate Monitor** | *Analog Circuit Design* *Fall 2018*
*Guide: Prof. Siddharth Tallur* *EE, IIT Bombay*

- Implemented reflective Photoplethysmography and analysed the heartbeat wave-form to measure heart-rate

## TECHNICAL SKILLS

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|---|---|
| **Programming Languages** | Python, C++, Java, bash, HTML, Javascript, MATLAB, Octave |
| **Libraries** | PyTorch, Tensorflow, Keras, OpenCV, SciPy, DL4J, BeautifulSoup |
| **Softwares** | Linux, Git, GitHub, LaTeX, Android Studio, UnityAR, SQLite, Redis |

## RELEVANT COURSES

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|---|---|
| **CSE, ML & CV** | Foundations of Intelligent & Learning Agents, High-Performance Scientific Computing, Advanced Machine Learning, Speech Processing, Machine Learning for Remote Sensing, Remote Sensing & Image Processing, Fundamentals of Digital Image Processing, Computer Programming & Utilisation |
| **Electrical Engineering** | Data Analysis & Interpretation, Microprocessors, Signals & Systems, Network Theory, An Introduction to Number Theory & Cryptography, Probability & Random Processes, Advanced Probability & Random Processes for Engineers, Advanced Machine Learning, Speech Processing |
| **Other Courses** | Optimization for Engineering Design, A First Course in Optimization, Multivariable & Vector Calculus, Linear Algebra, Differential Equations, Complex Analysis, Basics of Electricity & Magnetism, Quantum Physics & Application, Economics, Sociology |

## EXTRACURRICULAR ACTIVITIES

- Participated in **AI Village CTF** and finished on **Rank 161** on the leaderboard (2022)
- Participated in **VisDA-2022 NeurIPS challenge** hosted by **Boston University** (2022)
- Participated in **International Olympiad in Cryptography NSUCRYPTO** (2021)
- Participated in **Hacktoberfest**, a month-long celebration of open source software (2018)
- Participated in **Codefundo++**, a tech challenge across disciplines, organised by Microsoft (2018)
- Successfully completed 1 year of training under **National Cadet Corps (NCC) IIT Bombay** (2018)
- Participated in the **Annual Republic Day Parade** held at IIT Bombay on 26th Jan 2018 (2018)
- Attended the 10 day **Annual Training Camp** at IIT Bombay organized by *NCC IIT Bombay* (2017)