Viraj Nadkarni *nadkarniv4198@gmail.com*
B.Tech, Electrical Engineering **Undergraduate Fourth Year**
Indian Institute of Technology, Bombay **Mumbai, India**

Qualifications

Pursuing a B.Tech Major (with Honors) in Electrical Engineering with a Minor in Computer Science. *(Current CGPA : 9.6 / 10)*

Research Projects

Burst-Error Length analysis and minimization in wireless interfaces *[May - July 2019]*
Guest researcher, Aalborg University *Guides : Prof. Jimmy Jessen Nielsen, Israel Levya-Mayorga*

- Worked on extending a journal paper on the analysis of burst error in the use of interface diversity in ultra-reliable wireless communication *(Link to a previous version).*
- Came up with policies to decrease the cost of using multiple interfaces while keeping the burst error characteristics the same.
- Modelled the problem of minimising the cost of using interface diversity while minimising burst error as a Markov Decision Process and used the Q-learning algorithm to come up with a policy to predict burst errors in interfaces and hence pro-actively switch interfaces to avoid them.
- Modelled and simulated the multiple interface system as a Discrete-Time Markov Chain in order to aid the burst error length analysis of the same.

Multi-armed Bandit problem with externalities *[Spring 2019 - present]*
Final year project *Guide : Prof. D. Manjunath, Prof. S. Moharir, IIT Bombay*

- Came up with a variant of the Multi-armed bandit recommendation problem with user preferences and a mechanism for changing user preferences based on the recommendations.
- Simulated and analyzed the behaviour of the user population for various recommendation policies.
- Came up with a novel algorithm to minimize long-term regret by swaying the user population to prefer the arm with the highest reward.
- Currently working on analyzing the model by casting it as a generalized Polya urn problem.

Recommendations using social networks *[Winter 2018 - Spring 2019]*
Research and Development project *Guide : Prof. D. Manjunath, IIT Bombay*

- Came up with a variant of the Multi-armed bandit recommendation problem with multiple users and the availability of side information about arm rewards through a graph of users.
- Reviewed the existing literature on the regret analysis of the UCB and the Thompson sampling algorithms to compare the two.
- Simulated and analyzed the regret accrued over time using the UCB algorithm and the Thompson sampling algorithm and confirmed the analytical results on regret.

Autonomous Underwater Vehicle *[Autumn 2016 - Autumn 2018]*
Technical team *IIT Bombay*
Was a part of the 39 member team which participates in the annual Robosub competition held in San Diego, California by the US Office of Naval Research where it stood second (2016) and seventh (2018) worldwide and first nationwide.

- Implemented an elbow and shoulder controlling printed circuit board and software controller for a robotic arm in the AUV.
- Implemented CAN(Controller Area Network) microcontroller communication protocol and designed a higher level protocol based on that so as to prioritize higher importance messages on the intra-vehicle bus.
- Implemented a software controlled Battery Management System for the AUV's electrical subsystem.
- Designed and implemented a GPIO(General Purpose Input/Output) circuit as a modular interface between the on-board computer, microcontroller, sensors, thrusters and torpedos.
- Was responsible for implementing a Data Acquisition and Filtering unit for the hydrophones (used in underwater sound reception) in the AUV.

Scholastic Achievements

- Recipient of the KVPY Fellowship from the Department of Science and Technology, Government of India with an All India Rank of 66. *[2015]*
- Awarded Institute Technical Special Mention Award for technical contributions at the IIT Bombay Gymkhana awards. *[2018]*
- Awarded an AP(Advanced Performer) grade (awarded to top 1-2 students out of 140) for exceptional performance in the courses : Optimization, Data Analysis and Interpretation, Network Theory, Analog Circuits Lab and Biology. *[2018]*
- Awarded a Gold medal in Indian National Physics Olympiad and a Gold medal in Indian National Chemistry Olympiad and was among the top 35 students selected from all over India for the training camp for the respective international olympiads (IPhO and IChO) held at HBCSE(TIFR) in Mumbai. *[2016]*

Key Course Projects

Solving Non-Stationary Bandit problems with Kalman filter *[Autumn 2019]*
Guide: Prof. Debraj Chakraborty | Estimation and Identification *IIT Bombay*

- Implemented an algorithm based on the Kalman filter to solve the non-stationary multi-armed bandit problem.
- Reviewed and presented a report on the regret analysis of this algorithm and its comparison to other methods.

Adversarial attacks on neural networks *[Autumn 2019]*
Guide: Prof. Amit Sethi | Advanced Machine Learning *IIT Bombay*

- Demonstrated three types of adversarial attacks on fully-connected and convolutional neural networks: Poisoning attacks, Adversarial perturbations and exploratory attacks.
- Demonstrated certified defenses against the attacks mentioned above.

Texture synthesis and completion in images *[Autumn 2019]*
Guide: Prof. Suyash Awate, Prof. Ajit Rajwade | Digital Image Processing *IIT Bombay*

- Implemented an algorithm to generate and extend repeated texture patterns in images.
- Also tested the algorithm in image restoration applications to restore images with damaged pixels near outer edges.

A more efficient Kalman filter *[Spring 2019]*
Guide: Prof. Vikram Gadre | Digital Signal Processing *IIT Bombay*

- Designed an application specific digital circuit to implement the Kalman filter algorithm in $\mathcal{O}(n)$ time instead of the usual $\mathcal{O}(n^3)$ time it takes in software.
- Was among the top five best projects among the 37 groups that presented their work in this course.

RSA encryption *[Autumn 2016]*
Guide: Prof. Bernard Menezes | Computer Programming and Utilization *IIT Bombay*

- Implemented public and private key cryptographic methods (RSA encryption and decryption) to encode and decode long integers in a C++ code.
- Used the Baby-Step-Giant-Step algorithm to efficiently compute the discrete logarithm of a given integer modulo another integer.

Digitally programmable analog computer *[Spring 2019]*
Guide: Prof. Mukul Chandorkar | Electronic Design Lab *IIT Bombay*

- Designed and implemented an analog computer capable of solving nonlinear differential equation systems of upto five state variables.
- Interfaced the analog circuit with a programmable microprocessor to offer control signals.

Pipelined processor design *[Autumn 2018]*
Guide: Prof. Virendra Singh | Microprocessors *IIT Bombay*

- Designed a 16-bit pipelined microprocessor for a given instruction set architecture capable of basic arithmetic operations, loading, storing, executing conditionals and loops.
- Implemented the design using VHDL and verified all instructions by RTL simulation.

Technical Skills

Programming	C++ , Python (including TensorFlow and Pytorch) , C , Java
Software	MATLAB , SciLab, LaTeX, Eagle CAD

Positions of Responsibility

Electrical sub-division head, AUV-IITB *[Autumn 2018]*

Was the head of the electrical subdivision in the Autonomous Underwater Vehicle team.

- Recruited two new batches of first year students for the team by setting and correcting written papers and conducting interviews for over a 100 freshmen.
- Trained the freshmen and oversaw work distribution among the sophomores for completing the Matsya-5 autonomous underwater vehicle.

Teaching Assistant, IIT Bombay *[Spring 2018]*

Selected for a TA team of about 25 students under Prof. Kantimay Dasgupta for the course : Electromagnetism (PH-108)

- Conducted weekly tutorials to clear concepts and discuss solutions to problems for a batch of 45 freshmen at IIT Bombay.
- Responsible for the assessment of examination papers of the students for the above course.

Courses Undertaken

Key Courses	Optimization , Advanced Machine Learning , Information Theory, Stochastic modelling , Estimation and Identification , Digital Image processing , Digital Signal processing, Probability and Random processes , Number theory and cryptography , Computer and network security
Mathematics	Real Analysis , Linear Algebra , Complex Analysis , Differential Equations , Data Analysis and Interpretation

Extracurriculars and other interests

- Completed 12 km swimming (nonstop) in 6 hrs as a part of the Annual Swimathon Competition organised at the Olympic-sized IIT Bombay Swimming pool.
- Awarded 'A' grade by the Maharashtra state government in the Elementary drawing examination.
- Represented high-school in swimming and gymnastics competitions.
- Enjoys playing cricket, football (soccer) and kabaddi.