Abhiram **Singh**

Research Scholar · Deep/Machine Learning, Computer Networks, Brain Computer Interface

SIC 210, Gigabit Networking Laboratory, Kresit Building, CSE Department, IIT Bombay, India - 400076

(+91) 7053601960 | abhiram@cse.iitb.ac.in | abhiramsingh0.github.io/ | abhiramsingh0 | abhiram-singh

Education

CSE	**Doctor of Philosophy (Ph.D.),** Indian Institute of Technology Bombay (IIT Bombay)	*2016 - Present*
CSE	**Master of Technology (M.Tech),** National Institute of Technology Hamirpur (NIT Hamirpur)	*2012 - 2014*
CSE	**Bachelor of Engineering (B.E.),** Oriental Institute of Science and Technology Bhopal (OIST Bhopal)	*2008 - 2012*

Skills

Programming	Python, C/C++, MatLab, LaTeX
ML Framework	Tensorflow, Scikit-learn
Simulators	Simpy, Omnet++, Simple-scalar
Languages	Hindi, English

Projects

IIT Bombay (Prof. Ashwin Gumaste)

Powai, Mumbai, India

Ph.D Project 1 — *Jan 2019 - PRESENT*

- The project aims to eliminate the requirement of the forwarding tables from the routers.
- Formulated a deep learning model (Grafnet) to predict the output ports directly based on the destination IP address contained in the packets.
- Implemented Grafnet in Tensorflow and shown that Grafnet predicts correct output ports on a large network with millions of IP addresses.
- Designed a reinforcement learning model that learns to forward packets when IP addresses are dynamically allocated to routers.
- Created a machine learning model for finding the memory location of a rule in a forwarding table based on the destination IP address of a packet. The proposed model significantly decreased the search space in the forwarding table containing one million entries and achieved the lookup time within a microsecond.

IIT Bombay (Prof. Ashwin Gumaste)

Powai, Mumbai, India

Ph.D Project 2 — *Jan. 2020 - PRESENT*

- Aim of project is to solve the network verification problem in a fast and scalable manner.
- Formulated a linear algebra based solution (LeSQnet) to find the set of reachable IP addresses between two nodes, detect loops and packet drops, model packet header transformations and ACL rules.
- Implemented LeSQnet in python and shown that after a rule update, LeSQnet checks for reachability within a millisecond on different networks containing millions of forwarding rules. LeSQnet is also shown to improve the complexity bounds for checking reachability.

IIT Bombay (Prof. Ashwin Gumaste)

Powai, Mumbai, India

Ph.D Project 3 — *Jan. 2017 - Jan. 2019*

- Aim of project is to generate words that user speaks in mind without moving any body parts.
- Tested various features and machine learning models to classify a group of words based on their complexity. Used Python Scikit-learn framework to develop machine learning models and shown up to 11% performance improvement in correctly identifying imagined words over state-of-the-art methods on publicly available datasets.
- Designed graphics user interface using Python Tkinter library and integrated it with trained brain thought classifier to simulate real-time detection of brain thoughts.

IIT Bombay (Prof. Virendra Singh)

Powai, Mumbai, India

Course Project — *Oct 2016 – Nov 2016*

- Researched and implemented different branch predictors using Simple-scalar simulator written in C.
- Compared performance of implemented predictors with built in branch predictors on different benchmark programs provided with simulator.
- Shown that perceptron branch predictor outperformed other predictors with an average margin of 2-4% in miss prediction rate.

IIT Bombay (Prof. Ganesh Ramakrishnan)

Powai, Mumbai, India

Course Project — *Sept 2016 – Nov 2016*

- Researched the problem of predicting answer of a question after learning from a set of sentences or from paragraphs.
- Implemented Multilayer Perceptron(MLP), Recurrent Neural Network(LSTM) and Memory based neural network(Memn2n) in python using Tensorflow framework and used Data-set from Facebook bAbI project to train and test the models.
- Shown that Memn2n models outperforms other models in the task with 99% sucess rate on test data.

IIT Bombay (Prof. Bhaskaran Raman)

Powai, Mumbai, India

Course Project — *Mar 2016 – Apr 2016*

- Researched different ways to predict the data transmission rate (TX rate) of a Wi-Fi device.
- Implemented Deep Learning model (in MatLab) to predict the behaviour of Operating System implemented algorithm for TX rate estimation.
- Showed that implemented model was able to achieve same performance in 60-65% cases to which data-rate prediction algorithm will converge.

IIT Bombay (Prof. Ashwin Gumaste) *Powai, Mumbai, India*

Course Project *Sept 2016 – Nov 2016*

- Researched problem to find average packet latency in a switch and measure switch throughput as a function of packet size.
- Did Switch simulation of 16 port (port rate of 10Gbps each) in python using Simpy simulator and found that on increasing packet size, switch throughput increased and on the other hand average packet latency decreased.
- Did observed a considerable difference in average port to port latency of 0.6ms for packet size of 2000 Bytes and 250 Bytes.

NIT Hamirpur (Prof. T. P. Sharma) *Hamirpur, Himachal Pradesh, India*

M.Tech Project *Jul 2013 - Jul 2014*

- Formulated an area coverage scheme in Wireless Sensor Network (WSN) to obtain full coverage of target area by providing 3 way connectivity of sensor nodes and simultaneously minimizing number of active sensor nodes.
- Showed that the proposed approach can also provide network routing of data packets by providing tree structure among active sensor nodes.
- Implemented all the functionalities in Omnet++ simulator and obtained state-of-the-art performance in the field.

Publications

Machine Learning

- Abhiram Singh, Sidharth Sharma and Ashwin Gumaste, *Grafnet: Using Graph Neural Networks to Create Table-Less Routers*, Accepted in IEEE Transactions on Network Science and Engineering (TNSE)
- Abhiram Singh, Sidharth Sharma and Ashwin Gumaste, *Using Deep Reinforcement Learning for Routing in IP Networks*, Published in International Conference on Computer Communications and Networks (ICCCN 2021)
- Abhiram Singh, Aniruddha Kushwaha and Ashwin Gumaste, *TAP-IN: Table Address Prediction using Intelligent Learning for SDN Networks*, to be submitted in IEEE International Conference on Dependable Systems and Networks (DSN 2022)
- Abhiram Singh and Ashwin Gumaste, *Decoding Imagined Speech and Computer Control using Brain Waves*, arXiv preprint arXiv:1911.04255, Published in Elsevier Journal of Neuroscience Methods (JNM 2021)
- Abhiram Singh and Ashwin Gumaste, *Interpreting Imagined Speech Waves with Machine Learning techniques*, arXiv preprint arXiv:2010.03360, to be submitted in Elsevier Journal of Neuroscience Methods

Computer Networks

- Abhiram Singh and T. P. Sharma, *Position and Hop-count Assisted Full Coverage Control in Dense Sensor Networks*, Published in Springer Journal of Wireless Networks 2015
- Abhiram Singh and T. P. Sharma, *A survey on area coverage in wireless sensor networks*, Published in International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT 2014)

Patent Applications

- Abhiram Singh, Sidharth Sharma and Ashwin Gumaste, *Grafnet: Using Graph Neural Networks to Create Table-Less Routers*, USPTO Publication Number: US-2021-0297324-A1.

National Examinations Cleared

2012	**All India Rank: 1115,** The Graduate Aptitude Test in Engineering (GATE)-Computer Science	*India*
2013	**All India Rank: 528,** The Graduate Aptitude Test in Engineering (GATE)-Computer Science	*India*
Jun 2013	**Assistant Professorship,** National Eligibility Test (NET)-Computer Science and Applications	*India*
Dec 2013	**Assistant Professorship,** National Eligibility Test (NET)-Computer Science and Applications	*India*
Dec 2013	**Junior Research Fellowship (JRF),** National Eligibility Test (NET)-Computer Science and Applications	*India*

Experience

Teaching Assistant IIT Bombay, Mumbai, Jan 2016 – Present

Software Engineer Aricent, Gurgaon, Oct 2014 – Aug 2015

Teaching Assistant NIT Hamirpur, Himachal Pradesh, July 2012 – Aug 2014