

Abhiram Singh

RESEARCH SCHOLAR · DEEP/MACHINE LEARNING, COMPUTER NETWORKS, BRAIN COMPUTER INTERFACE

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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% success 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.
- Shown 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*, Under review 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 ACM International Symposium on Computer Architecture (ISCA 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)
- Abhiram Singh, Sidharth Sharma and Ashwin Gumaste, *LeSQnet: A Holistic and Expressive Tool using Least Squares for Network Verification*, Under review in 19th USENIX Symposium on Networked Systems Design and Implementation (NSDI 2022).

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