Mohit Kulkarni

↓ +91 940560 2576 |

<u>mohitmk@iitk.ac.in</u> |

<u>m2kulkarni</u> |

m2kulkarni.github.io

EDUCATION

Indian Institute of Technology, Kanpur

2019-2023 (expected)

B.S., Mathematics and Computing

CPI: 8.7/10.0

Vidyadham Junior, Aurangabad

2019

Maharashtra State Board of Higher Secondary Education

Score: 87.8 %

Podar International School, Aurangabad

2017

Indian Certificate of Secondary Education

Score: 95.6 %

Research Interests

Dynamical Systems, Theoretical Neuroscience, Machine Learning, Neural Networks, Fluid Mechanics

RESEARCH EXPERIENCE

Visiting Researcher, Imperial College London

Jun 2021 – Sep 2021

Prof. Dan Goodman and Dr. Friedemann Zenke(FMI, Basel)

SNUFA 🖸

- Worked on creating 2 new datasets for a Spiking Neural Network(SNN) challenge, SNUFA
- The datasets, derived from LibriSpeech ASR Corpus, are based on spike trains converted from auditory data
- The first challenge, SNUFA100, is a **word spotting** challenge, while the second challenge SNUFA100_sentences is based upon **keyword spotting**
- Used Surrogate gradient learning based SNN models for our baseline

Research Assistant, Svoboda Lab

Sep 2020 – Present

Dr. Karel Svoboda and Dr. Kayvon Daie

- Working on dynamics of learning and plasticity in the Somatosensory cortex.
- Experimented with more biologically plausible learning algorithms such as **Feedback Alignment**, **localised hebbian learning** etc.
- Currently working with **recurrent and chaotic** models of learning(**FORCE** etc.)
- Data analysis techniques such as PCA, GPFA, Correlation analysis were used

Selected Projects

Neural Turing Machines | Course Project, Computational Cognitive Science

Documentation 🗹

Prof. Nisheeth Srivastava, Dept. of Computer Science and Engineering, IIT Kanpur

- Explored Neural Turing Machine as a memory augmented neural network
- Conducted a **literature review** on models prior to NTM and those developed further due to NTM(For e.g. Differentiable Neural Computers(DNC))
- Built upon an existing open-source implementation to add **priority & lexicographic sort** tasks and added GPU support. Also experimented with memory initialisation.

The Omniglot Project

Overview 🖸

Brain and Cognitive Society, IIT Kanpur

- This project was aimed at understanding and solving the problem of **one-shot learning** using the Omniglot Dataset of handwritten characters
- Implemented SOTA meta-learning models, such as MANN, to solve one-shot classification and generative problem.
- Used architectures like GANs, VAEs, LSTMs and bayesian statistics to develop models in PyTorch.

Autonomous Humanoid(AUTOMI)

Github 🛂

Team Humanoid, IIT Kanpur

- Involved in the development of a complete, highly optimised software stack for AUTOMI
- AUTOMI v1 is designed for autonomous navigation in a static environment using techniques like **depth estimation**, **SLAM**, **object recognition**, **avoidance**, **lane detection** etc.
- The software stack is based on ROS, with image processing using OpenCV.

PETcat Github 🗹

Robotics Club, IIT Kanpur

- Aimed at developing a biologically inspired robotic cat.
- Simultaneous Localization and Planning Algorithms like **orb-SLAM**, **gmapping**, **roVIO** were implemented and benchmarked.
- Currently involved in optimization of software stack using storage optimization, multi-threading etc.

Relevant Courses

Linear Algebra, Analysis-I, Neurobiology, Several variable calculus and Differential geometry*, Probability and Statistics, Fluid Mechanics, Data Structures*, Computational Cognitive Science, Complex Analysis

* - ongoing courses

TECHNICAL SKILLS

Programming: Python, C/C++, R

Tools: LaTeX, Bash, Git

Libraries: Pytorch, Tensorflow, OpenCV, Numpy, Gazebo, ROS

Talks and Mentorship

Does the Brain do Backpropagation | BCS, IIT Kanpur

Recording and Slides

• Journal Club talk at BCS, IIT Kanpur, where we discussed biologically plausible learning rules and future directions the field can take.

Dynamics of Life | Stamatics, IIT Kanpur

Outline 🗹

- Mentored a group of 30 Freshman and Sophomores in a reading project on Nonlinear Dynamics and Chaos in Nature
- Primarily based on Steven Strogatz's Nonlinear Dynamics and Chaos.

Models of Memory | BCS, IIT Kanpur

Documentation and Poster

- · Looked at some classical memory retrieval methods like hopfield model and mean-field theory
- Also worked with a more realistic sequential neural network model for recall tasks(For eg, NTM, MANN etc)

EXTRA-CURRICULAR ACTIVITIES

Group Leader | Brain and Cognitive Society, IIT Kanpur

May 2021 - Present

- Overall Head for all activities BCS conducts such as Journal Clubs, Research Symposiums etc
- Conducted 7 projects related to Neuroscience and sister fields in the summer of 2021

Secretary | Robotics Club

Apr 2020 – Apr 2021

 Part of a 25 member team responsible to suggest and execute ideas to increase participation in robotics related activities.

Student Guide | Counselling Services

Nov 2020 – Present

• Helped 6 freshmen students get used to campus life and quickly adjust to college environment