

# Mohit Kulkarni

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## EDUCATION

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|---|--|
| <b>Indian Institute of Technology, Kanpur</b><br><i>B.S., Mathematics and Computing</i>             | 2019-2023 ( <i>expected</i> )<br>CPI: 8.7/10.0 |
| <b>Vidyadham Junior, Aurangabad</b><br><i>Maharashtra State Board of Higher Secondary Education</i> | 2019<br>Score: 87.8 %                          |
| <b>Podar International School, Aurangabad</b><br><i>Indian Certificate of Secondary Education</i>   | 2017<br>Score: 95.6 %                          |

## RESEARCH INTERESTS

Dynamical Systems, Theoretical Neuroscience, Machine Learning, Neural Networks


## RESEARCH EXPERIENCE

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| <b>Visiting Researcher, Imperial College London</b><br>Prof. Dan Goodman and Dr. Friedemann Zenke(FMI, Basel)  | Jun 2021 – Sep 2021<br>SNUFA <a href="#">↗</a> |
| <ul style="list-style-type: none"><li>• Worked on creating 2 new datasets for a <b>Spiking Neural Network(SNN)</b> challenge, <b>SNUFA</b></li><li>• The datasets, derived from <b>LibriSpeech ASR Corpus</b>, are based on <b>spike trains</b> converted from auditory data</li><li>• The first challenge, SNUFA100, is a <b>word spotting</b> challenge, while the second challenge SNUFA100_sentences is based upon <b>keyword spotting</b></li><li>• Used <b>Surrogate gradient learning</b> based SNN models for our baseline</li></ul> |  |
| <b>Research Assistant, Svoboda Lab</b><br>Dr. Karel Svoboda and Dr. Kayvon Daie  | Sep 2020 – Present                             |
| <ul style="list-style-type: none"><li>• Working on <b>dynamics of learning and plasticity</b> in the Somatosensory cortex.</li><li>• Experimented with more biologically plausible learning algorithms such as <b>Feedback Alignment, localised hebbian learning</b> etc.</li><li>• Currently working with <b>recurrent and chaotic</b> models of learning(<b>FORCE</b> etc.)</li><li>• Data analysis techniques such as <b>PCA, GPFA, Correlation</b> analysis were used</li></ul>  |  |

## SELECTED PROJECTS

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| <b>Neural Turing Machines</b>   <i>Course Project, Computational Cognitive Science</i><br>Prof. Nisheeth Srivastava, <i>Dept. of Computer Science and Engineering, IIT Kanpur</i>  | <i>Documentation</i> <a href="#">↗</a> |
| <ul style="list-style-type: none"><li>• Explored Neural Turing Machine as a memory augmented neural network</li><li>• Conducted a <b>literature review</b> on models prior to NTM and those developed further due to NTM(For e.g. Differentiable Neural Computers(DNC))</li><li>• Built upon an existing open-source implementation to add <b>priority &amp; lexicographic sort</b> tasks and added GPU support. Also experimented with memory initialisation.</li></ul> |  |
| <b>The Omniglot Project</b><br>Brain and Cognitive Society, IIT Kanpur   | <i>Overview</i> <a href="#">↗</a>      |
| <ul style="list-style-type: none"><li>• This project was aimed at understanding and solving the problem of <b>one-shot learning</b> using the Omniglot Dataset of handwritten characters</li><li>• Implemented SOTA meta-learning models, such as MANN, to solve one-shot classification and generative problem.</li><li>• Used architectures like <b>GANs, VAEs, LSTMs and bayesian statistics</b> to develop models in PyTorch.</li></ul>                              |  |
| <b>Autonomous Humanoid(AUTOMI)</b><br>Team Humanoid, IIT Kanpur  | <i>Github</i> <a href="#">↗</a>        |
| <ul style="list-style-type: none"><li>• Involved in the development of a complete, highly optimised software stack for <b>AUTOMI</b></li><li>• AUTOMI v1 is designed for autonomous navigation in a static environment using techniques like <b>depth estimation, SLAM, object recognition, avoidance, lane detection</b> etc.</li><li>• The software stack is based on <b>ROS</b>, with image processing using <b>OpenCV</b>.</li></ul>                                 |  |

## 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

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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

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**Programming:** Python, C/C++, R


**Tools:**  $\text{\LaTeX}$ , Bash, Git

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

## TALKS AND MENTORSHIP

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**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

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**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

## CAMPS AND WORKSHOPS

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**Recurrent Neural Networks for Neuroscience** | *COSYNE Tutorial*

Feb 2021

**Neuromatch Academy**

July 2020

**Vijyoshi Camp 2019** | *IISER, Kolkata*

Dec 2019