

# Mainak Pal

## PhD Student, Purdue University

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📍 MSEE 239, Purdue University, West Lafayette, IN, USA

## Education

<b>Present</b> Aug 2022	<b>Purdue University</b> PhD, Electrical & Computer Engineering (Automatic Control) <i>Advisor: Prof. Vijay Gupta</i>	<b>West Lafayette, US</b>
<b>Jun 2021</b> Jul 2017	<b>Jadavpur University</b> B.E. (Hons.), Electronics & Telecommunication Engineering	<b>Kolkata, India</b>

## Research Experience

<b>Present</b> Aug 2022	<b>School of Electrical and Computer Engineering   Purdue University</b> <i>Graduate Research Assistant   Advisor: Prof. Vijay Gupta</i> Working on developing algorithms for human-autonomy teaming in uncertain environments.	<b>West Lafayette, US</b>
<b>Jun 2021</b> Apr 2019	<b>Artificial Intelligence Laboratory   Jadavpur University</b> <i>Undergraduate Research Assistant   Advisor: Prof. Amit Konar</i> Worked on exploring Visual Cognition with generative models and adversarial attacks. Experimented on various Brain-Computer Interface tasks and developed efficient computational models.	<b>Kolkata, India</b>
<b>Sep 2020</b> May 2020	<b>Serre Lab   Brown University</b> [🌐] <i>Summer Research Intern   Advisor: Prof. Thomas Serre</i> Worked on developing computational models of vision. Developed autoregressive models to perform unsupervised activity recognition of animal locomotion.	<b>Providence, USA</b>
<b>Jul 2019</b> May 2019	<b>Visual and Image Processing Lab   IIT Bombay</b> [🌐] <i>Summer Research Intern   Advisor: Prof. Biplab Banerjee</i> Explored zero-shot learning application on various domains. Worked on various generative and discriminative models to achieve better latent layer representation of multimodal visual feature space.	<b>Mumbai, India</b>
<b>May 2019</b> Aug 2018	<b>NLP Lab   Jadavpur University</b> <i>Undergraduate Research Assistant   Advisor: Prof. Sudip Kumar Naskar</i> Worked on sentiment analysis of tweets and participated at task 6 on SemEval-2019.	<b>Kolkata, India</b>

## Work Experience

<b>Aug 2022</b> Aug 2021	<b>Analytics and Insights Team   Tata Steel</b> [🌐] Data Scientist, Tech & QA Worked on reinforcement learning-based process control for the smooth operation of the plant.	<b>Kolkata, India</b>
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## Publications

(\* = Equal Contribution)

### Resilient Multi-agent Reinforcement Learning with Function Approximation

Lintao Ye, Martin Figura, Yixuan Lin, [Mainak Pal](#), Pranoy Das, Ji Liu, and Vijay Gupta  
Submitted to *IEEE Transactions on Automatic Control* [Jan 2024]

### A Generative Model Based Approach for Zero-shot Breast Cancer Segmentation Explaining Pixels' Contribution to the Model's Prediction

 [🌐]

Preeti Mukherjee\*, [Mainak Pal](#)\*, Lidia Ghosh, Amit Konar  
*Interpretable Artificial Intelligence - A Perspective of Granular Computing, Springer* [March 2021]

### Generative Model-driven Structure Aligning Discriminative Embeddings for Transductive Zero-shot Learning

 [🌐]

Omkar Gune, [Mainak Pal](#)\*, Preeti Mukherjee\*, Biplab Banerjee, Subhasis Chaudhuri  
*Arxiv* [May 2020]

### Multi-resolution Hierarchical Clustering by Vector Quantization

 [🌐]

[Mainak Pal](#)\*, Preeti Mukherjee\*, Amit Konar  
*International Conference on Cybernetics, Cognition and Machine Learning Applications, Goa, India (ICCCMLA 2019)* [Aug 2019]

## Efficient Machine Learning and Neural Network Approaches for Identifying and Categorizing Offensive Language in Tweets [🔗]

Preeti Mukherjee\*, Mainak Pal\*, Somnath Banerjee, Sudip Kumar Naskar

Proceedings of the 13th International Workshop on Semantic Evaluation (SemEval-2019), Minneapolis, USA [June 2019]

## Selected Research Projects

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### Operator Learning for Robust Reinforcement Learning

Dec. 2023 - Present

Advisor: Prof. Vijay Gupta

- > Trained neural operator to solve HJB equation. Solution maps from state functional space to action functional space.
- > Experimented on perturbed system to analyse performance of adapted policy.
- > Extending it to solve HJB and FP simultaneously in coupled system.

### Proactive Team Support in Human Robot Teaming

Aug. 2022 - Present

Advisor: Prof. Vijay Gupta

- > Designed a Bayesian Model for intention prediction in Human Robot team.
- > Working on developing policy for the assistive robot based on inferred intention.
- > Collaborated with Laurel Riek's group at UCSD to explore application in Healthcare scenario.

### Resilient Multi-agent Reinforcement Learning

Aug. 2023 - Jan. 2024

Advisor: Prof. Vijay Gupta

- > Worked on designing a resilient consensus-based actor-critic algorithm to bound the impact of Byzantine agents on cooperative networks in multi-agent reinforcement learning.
- > Enhanced the simulation to compare with current state-of-the-art.

### Enhancing Generalizability and Robustness of BCI Tasks Using Generative Networks

Aug. 2020 - May 2021

Bachelor Thesis | Advisor: Prof. Amit Konar

- > Designed a generative network to generate synthetic fNIRS data that are very similar to original data.
- > Designed an end-to-end paradigm to perform classification based on the image biomarkers for finger tapping tasks.

### Automatic Behavioral Analysis of C.Elegans Locomotion

May. 2020 - Sep 2020

Advisor: Prof. Thomas Serre

- > Implemented autoregressive HMM and other statistical models to quantify and analyze worm locomotion.
- > Worked on various recurrent neural models to automate behavioral analysis of C.Elegans locomotion.

### Domain Adaptation in Cryo-electron Tomography [🔗]

Jan. 2020 - May. 2020

Advisor: Prof. Min Xu

- > Incorporated a Wasserstein distance based metric and a domain critic to leverage adversarial domain adaptation in Cryo-ET data of different SNR levels.
- > Exploring various methods to extract information from tomographic data.

### Zero-shot Breast Cancer Segmentation [📄]

Nov. 2019 - Mar. 2020

Advisor: Prof. Amit Konar

- > Trained the BiGan model on healthy data so that the trained model can construct nearest healthy samples from unhealthy data.
- > Based on RISE model, we proposed a novel architecture for automatic segmentation of the tumor region from our previous understandings.
- > Our approach is capable of segmenting tumors without using any unhealthy samples while training.

### Transductive Zero-shot Learning [📄]

May. 2019 - Jul. 2019

Advisor: Prof. Biplab Banerjee

- > Worked on the Transductive extension of Structure Aligning Discriminative Latent Embedding for Zero-Shot Learning.
- > Explored zero-shot application on various domains.
- > Explored implementation of various autoencoders on latent space and semantic space.

### Identifying and Categorizing Offensive Language in Social Media [📄] [🔗]

Sep. 2018 - Feb. 2019

Advisor: Prof. Sudip Kumar Naskar

- > Sentiment analysis on a set of tweets. Automatic identification of offensive tweets and target of offence.
- > Explored multiprocessing and implemented different techniques of machine learning (like Logistic Regression, Linear SVC, LinearSVC with L1-based feature selection, Multinomial NB, Bernoulli NB etc.)
- > Implemented several Deep Learning networks like CNN-word2vec, attention based Bi-RNN with LSTM.

## Skill-sets

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- > **Operating Systems:** Linux • Windows
- > **Programming Languages:** Python • C++ • Julia • C • Matlab
- > **Data Science Libraries:** Numpy • Scikit-learn • SciPy • Matplotlib • Pandas • Gensim
- > **Deep Learning Libraries:** Pytorch • Keras • Tensorflow
- > **Reinforcement Learning Frameworks:** ROS • OpenAI Gym • MuJoCo • dm-control • PyBullet
- > **Web Development:** HTML • JavaScript • CSS • Node.js • React
- > **Typesetting Tools:**  $\text{\LaTeX}$  • Markdown
- > **Version Control:** Git

## Relevant Courses

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Lumped System and Theory, Random Variables and Signals, Probability Theory, Machine Learning Theory, Reinforcement Learning Theory and Algorithm, Convex and Stochastic Optimization and Applications, Applied Optimal Control, Robotics.

## Responsibilities

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**IEEE Computer Society Student Chapter, Jadavpur University** *Founder and Chairperson* Mar. 2019 - Aug. 2020

- > The Computer Society of the JU, IEEE student branch aims to to be a leading provider of technical information, community services, and personalized services to the world's computer professionals. It is our goal to integrate our activities beyond the realms of competitive coding into the broader aspects of Computer Science.

**IEEE Jadavpur University Student's Branch** *Webmaster and Technical Lead* [🌐] [🌐] Feb. 2019 - Aug. 2020

- > The Jadavpur University IEEE student branch, founded in 2010, belongs to the Kolkata section of Region 10 of the organization.
- > Developed and maintained the website of the student branch. [🌐] [🌐]
- > Lead the technical team of 12 members. Technical team of the student branch is responsible for providing any kind of technical assistance during events.

## Extracurricular

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**IEEE TechX Congress: Eastern India Techno-Leadership Summit 2020** *Technical co-lead* [🌐] Feb. 2020

- > Managed the technical team of 18 members.
- > Developed and maintained the website for aforesaid event. [🌐]

**ML Accelerator Summit** *Head Coordinator* [🌐] Oct. 2019

- > ML Summit is a tiny step to help students, engineers and tech enthusiasts live the AI dream.
- > Developed and maintained the website for aforesaid event. [🌐]

**Think.AI : The IEEE Machine Learning Summit'19** *Head Coordinator* [🌐] Apr. 2019

- > Two day workshop on Machine Learning organised by IEEE CS, Jadavpur University.
- > Developed and maintained the website for aforesaid event. [🌐]

**Electrophoria'18** *Core Member of Web Development Team* [🌐] Oct. 2018

- > Departmental freshers' - ETCE, Jadavpur University.
- > Developed and maintained the website for aforesaid event. [🌐]

## References

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### Dr. Vijay Gupta

*Professor*

ECE, Purdue University, USA

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### Dr. Biplab Banerjee

*Assistant Professor*

CSRE, IIT Bombay, India

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### Dr. Amit Konar

*Professor*

ETCE, Jadavpur University, India

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### Dr. Thomas Serre

*Associate Professor*

CLPS, Brown University, USA

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