

SHANKA SUBHRA MONDAL

smondal@princeton.edu; <https://shanka123.github.io/>

EDUCATION

Princeton University	<i>2019 - Present (expected graduation: 9/2025)</i>
PhD in Electrical & Computer Engineering	GPA: 3.91/4
Indian Institute of Technology, Kharagpur	<i>2015 - 2019</i>
BTech in Electronics & Electrical Communications Engineering	GPA: 9.51/10

WORK EXPERIENCE

Microsoft Research, New York	<i>Summer 2023, 2024</i>
PhD Research Intern Mentor: Ida Momennejad	
Improved multi-step planning in LLMs. (paper under review)	
<ul style="list-style-type: none">• Developed a novel black box multi-agentic and modular architecture using LLMs inspired by specialized prefrontal cortex modules in the human brain• Finetuned GPT-4 via Microsoft Azure API to function as specialized modules (e.g. error detection, determining whether goal is achieved)• Studied transfer generalization in multi-step reasoning tasks of different LLM-based reasoning agents• Ideas incorporated into Microsoft products• Collaborated with the office of Microsoft's CTO team	
Adobe Research, Bangalore, India	<i>Summer 2018</i>
Research Intern Mentors: Subrata Mitra, Ramanuja Simha	
Developed a deep reinforcement learning based scheduler to optimize resource utilization and application performance. (AAAI 2021)	

RESEARCH EXPERIENCE

Princeton University	<i>2019 - Present</i>
Graduate Researcher, Princeton Neuroscience Institute PhD Advisor: Jonathan D. Cohen	
My PhD work uses insights from cognitive science and neuroscience to design neural networks with human-like systematic and sample-efficient generalization.	
<ul style="list-style-type: none">• Integrated relational inductive biases with object-centric representations for abstract visual reasoning tasks. Developed novel architectures using slot attention, pairwise relational operator, transformers, and Abstractors. (NeurIPS 2023, ICML 2024)• Object-centric representations for abstract visual reasoning. Developed a novel architecture combining slot attention with a transformer based reasoning module. (ICLR 2023)• Determinantal point process inspired attention over biologically inspired structured embeddings (grid cells) of sensory information (eLife 2023)	
Princeton University	<i>2019 - 2021</i>
Graduate Researcher Advisor: Tom Griffiths	
Developed neural network models with improved generalization, robustness to adversarial attacks.	
Princeton University	<i>2019 - 2021</i>
Graduate Researcher Advisor: Sebastian Seung	
Studied semantic segmentation in electron microscopy images, 3d point clouds, and meshes.	

Indian Institute of Technology, Kharagpur

2018 - 2019

Undergraduate Researcher | Advisor: Debdoot Sheet

Developed a multi-task deep learning model to predict tool and phase information in surgical videos.

Indian Statistical Institute, Kolkata

Summer 2017

Summer Intern, Machine Intelligence Unit | Advisor: Sushmita Mitra

Implemented spikeprop and spike timing dependent plasticity algorithm for neural networks.

PUBLICATIONS

Mondal, S.S.*, Webb, T.W.*, Momennejad, I. (2024). Improving Planning with Large Language Models: A Modular Agentic Architecture. *Under Review*.

Mondal, S.S., Cohen, J.D., Webb, T.W. (2024). Slot Abstractors: Toward Scalable Abstract Visual Reasoning. *In Proceedings of the 41st International Conference on Machine Learning (ICML)*.

Mondal, S.S.*, Webb, T.W.*, Cohen, J.D. (2023). Systematic Visual Reasoning through Object-Centric Relational Abstraction. *Advances in Neural Information Processing Systems (NeurIPS)*.

Mondal, S.S., Frankland, S.M., Webb, T.W., Cohen, J.D. (2023). Determinantal point process attention over grid cell code supports out of distribution generalization. *eLife*. <https://doi.org/10.7554/eLife.89911.3>

Mondal, S.S.*, Webb, T.W.*, Cohen, J.D. (2023). Learning to reason over visual objects. *In Proceedings of the 11th International Conference on Learning Representations (ICLR)*.

Mondal, S.S.*, Sheoran, N.*, Mitra, S. (2021). Scheduling of time-varying workloads using reinforcement learning. *In Proceedings of the 35th AAAI Conference on Artificial Intelligence*.

Mitra, S., Sheoran, N., Simha, R., **Mondal, S.S.**, Dhake, N., Nehra, R. (2020). Self-learning scheduler for application orchestration on shared compute cluster. *US Patent*.

Mitra, S., **Mondal, S.S.**, Sheoran, N., Dhake, N., Nehra, R., Simha, R. (2019). Deepplace: Learning to place applications in multi-tenant clusters. *In Proceedings of the 10th ACM SIGOPS Asia-Pacific Workshop on Systems*.

Nandy, A., **Mondal, S.S.** (2019). Kinship verification using deep siamese convolutional neural network. *In proceedings of the 14th IEEE International Conference on Automatic Face and Gesture Recognition (FG) Workshop*.

Mondal, S.S., Sathish, R., Sheet, D. (2018). Multitask learning of temporal connectionism in convolutional networks using a joint distribution loss function to simultaneously identify tools and phase in surgical videos. *In Proceedings of the 5th MedImage Workshop at 11th Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP)*.

CONFERENCE AND WORKSHOP PRESENTATIONS

- Slot Abstractors: Toward Scalable Abstract Visual Reasoning. Poster presented at the 41st International Conference on Machine Learning (ICML), Vienna, Austria, 2024.
- Object-Centric Abstract Reasoning. Talk presented at the Workshop on Abstraction and Relational Reasoning, Yale University, 2023.
- Systematic Visual Reasoning through Object-Centric Relational Abstraction. Talk recorded and poster presented at the 37th Conference on Neural Information Processing Systems (NeurIPS), New Orleans, 2023.
- Learning to reason over visual objects. Talk recorded and poster presented at the 11th International Conference on Learning Representations (ICLR), Kigali, Rwanda, 2023.

- Scheduling of time-varying workloads using reinforcement learning. Talk recorded and poster presented at the 35th AAAI Conference on Artificial Intelligence, 2021.
- Multitask learning of temporal connectionism in convolutional networks using a joint distribution loss function to simultaneously identify tools and phase in surgical videos. Talk and poster presented at the 5th MedImage Workshop of 11th Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP), IIIT Hyderabad, 2018.
- Surgical Workflow Analysis Challenge. Solution was presented at the International Conference on Medical Image Computing and Computer Assisted Interventions (MICCAI), 2018 for winning competition.
- Investment Ranking Challenge. Presented 3rd ranked solution at IEEE Data Science Workshop, EPFL, Switzerland, 2018.

AWARDS AND HONORS

- **NeurIPS Scholar Award** *2023*
- **Karl Storz Endoscopic Workflow Award, MICCAI** *2018*
- **Goralal Syngal Memorial Scholarship, IIT Kharagpur** *2017 - 2018*

SERVICE

- **Teaching Assistant**, Princeton University, Department of Statistics and Machine Learning
Modern Data Science Methods, Spring 2023 & 2024
- **Reviewer** (NeurIPS, ICLR)

SKILLS AND KNOWLEDGE

Courses: Computer Vision, Large scale Data Optimization, Biomedical Imaging, Mathematical Foundations of Reinforcement Learning, Matrix Algebra, Probability and Stochastic Processes, Programming and Data Structures, Algorithms, Network Theory, Intelligent Game Design, Signals and Systems, Econometric Analysis, Digital Signal Processing, Computer Architecture, Operating Systems, Digital Image Processing, Neural Networks, Artificial Intelligence, Machine Intelligence and Expert Systems, Deep learning, Advanced Machine Learning, Pattern Recognition.

Programming Languages: Python, C/C++, MATLAB, C#, Java, Verilog HDL.

Software & Tools: Pytorch, Deepspeed, Tensorflow, Keras, MxNet, Scikit-Learn, Matplotlib, Xilinx, Simulink, Arduino, Unity 3D, Pspice, Android Studio, SolidWorks.