Amir Arsalan Soltani

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EDUCATION

Brown University, *Providence, RI* **September 2020 - Present**
Doctor of Philosophy, Computer Science

State University of New York at Buffalo, *Buffalo, NY* **September 2013 - December 2015**
Master of Science, Computer Science | *Concentration: Machine Learning*

Islamic Azad University, *Najafabab, Iran* **September 2007 - May 2012**
Bachelor of Science, Computer Engineering
Awards: Ranked 19th overall in the nationwide entrance exam for B.Sc, Distinguished Student Award

SKILLS

AI and ML: Neural Networks, Graphical Models, Bayesian Optimization, Reinforcement Learning
Technical: PyTorch, Blender, MuJoCo, NVIDIA FleX, C++

EXPERIENCE

Brown University, PhD Student **September 2020 - Present**
The Department of Computer Science *Providence, RI*

- ***Endow agents with the ability to build causal models of the 3D world for high-level cognition and abstract reasoning***
  - **Novel unsupervised perception and action model for human-like abstract spatial reasoning in 3D**
    - Inspired by how Cognitive Map cells work in the brain, developed a model for active perception to enable agents ground a "causal" model of the 3D world in abstract space, from few consecutive egocentric visual observations
    - Used MuJoCo to generate datasets for the perception and action, goal representation and path integration models
    - Currently developing a path integrator for human-like abstract spatial reasoning that respects causal constraints
    - Proposed the idea, leading development, implemented all models, collaborating in a team of 3
  - **Novel unsupervised language grounding method for executing command-like instructions in 3D**
    - Developing an unsupervised language grounding model to interpret language commands such as "put the red box on the blue one" into compositional, causal representations of the 3D world
    - Used MoJuCo to create a dataset containing language instructions for manipulating objects in an environment
    - Proposed the idea, leading development, implemented all models, collaborated in a team of 3
  - **Developed a prototype for a novel unsupervised neural network physics engine for real-time soft body simulation**
    - Developed a model to encode implicit 3D object interactions abs abstract priors,to approximate the governing PDE
    - Showed how leveraging such abstract priors enable explaining unseen object interactions or simulate future
    - Used Blender to generated a dataset for interactions of soft body objects with random physics/object parameters
    - Developed a model learns an approximation to the underlying PDE; showed it can explain novel object dynamics
    - Proposed the idea, led its development, implemented core models, collaborated in a team of 3
  - **Unsupervised [re]localization of an agent in the 3D world using implicit scene representations**
    - Proposed the core idea, led development, modified and trained the GQN model, collaborated in a team of 3
    - Designed and trained a supervised localization model on GQN representations for novel scenes given an image
    - Achieved near-perfect localization accuracy as measured with MSE and mean structural similarity (SSIM) metrics
    - Worked on an unsupervised [re]localization method using Pyro to infer camera parameters

Massachusetts Institute of Technology, Research Assistant **April 2016 - August 2020**
PI: ***Joshua B. Tenenbaum****, Computational Cognitive Science Lab* *Cambridge, MA*

- ***Built human-like computational models of perception in 3D via inverse graphics***
  - **A computational model for zero-shot perception of objects draped by cloth (*in preparation for PNAS)***
    - Proposed a new theory for building human-like models of perception in collaboration in a team of 5
    - Contributions include model design, parts of analyses and implementation: stimuli generation with Blender and NVIDIA FleX and pipeline for all experiments and evaluation, including training baseline neural network models
    - Reached near-perfect recognition accuracy match with respect to human data :near chance for pre-trained neural networks and slightly above chance for fine-tuned neural network models
    - The model achieves trial-by-trial correlation with human performance (R~0.65) and their response time (R~0.79)
    - The proposed model beats SOTA neural network-based models in all aspects of our analyses
  - **A Bayesian model for face perception in novel contexts (*CogSci 2020 -- journal article in preparation*)**
    - Trained baseline neural network models by replicating the training pipeline in "Deep Face Recognition" paper
    - Participated in discussions for designing the model for perception of Mooney faces
    - Showed using natural illumination priors in our analysis-by-synthesis model results in performance and behavior that correlates better with humans data and while beating neural network models for face perception

- **Built a generative model for 3D objects by modeling depth maps or silhouettes (*CVPR 2017*)**
  - Trained a single model for objects from all ShapeNet categories capable to generate good-looking 3D object samples including for categories which had less than 50 training examples (e.g. headphones)
  - Showed results for out-of-sample generalization, view-consistent representations/reconstructions and obtained similar classification accuracy to some supervised methods

- ***Intuitive physical reasoning for objects draped with cloth in both children and adults***
  - **Effects of physically-implausible changes in perception of draped objects (*Psych Science -- under review*)**
    - Contributed to the development of the codebase for generating the stimuli using Blender and NVIDIA FleX
    - Finding: experiments suggest humans encode approximation to the true causal generative processes of physical reality as physically-implausible changes to cloth drapery degrades human ability to perceive draped objects
  - **Evaluating children's perception of objects draped with cloth (*CogSci 2019*)**
    - Prepared the stimuli used in the experiments using Blender and NVIDIA FleX
    - Finding: young children are able to perceive objects draped with cloth with similarities to adults, suggesting that we have a good intuitive understanding of how physics of cloth works from a young age

Research Assistant, State University of New York at Buffalo **September 2015 - December 2015**
Center for Unified Biometrics and Sensors *Buffalo, NY*

- **Built a LDA-based model for author name disambiguation for *BioXFEL.org* given one or few sample papers**
  - Fitted an LDA model via SVB on all Wikipedia content and a massive dataset of scientific papers from Thomson Reuters
  - Assigned papers to authors via computing the KLD of the inferred LDA parameters of sample papers and unassigned ones
- **Optimal battery charging time suggestion for hundreds of cellphone users with Hidden Markov Models**
  - Implemented the Baum–Welch algorithm for model fitting
  - Given a short behavioral pattern of a user, the model suggests a time that the user should recharge their phone

MANUSCRIPTS UNDER REVIEW

Wong, K. W., Bi, W., **Soltani, A. A**., Yildirim, I., & Scholl, B. "Seeing Soft Materials Draped Over Objects: A Case Study of Intuitive Physics in Perception, Attention, & Memory", Psychological Science

MANUSCRIPTS IN PREPARATION

Yildirim, I.*, Siegel, M.*, **Soltani, A. A**.*, Chaudhuri, S. & Tenenbaum, J. "Seeing 3D Shape Under Complete Occlusion: Evidence for the Use of Approximate Physics-Based Generative Models During Ongoing Perception"
Egger B., Siegel M., Arora R., **Soltani A. A**., Yildirim I. & Tenenbaum J. "A Computational Model for Unconstrained Face Perception" *(Working Title)*

PEER-REVIEWED PUBLICATIONS

Egger B., Siegel M., Arora R., **Soltani A. A**., Yildirim I. & Tenenbaum J. "Inverse Rendering Best Explains Face Perception Under Extreme Illuminations, "Abstract, CogSci 2020.
Ullman T., Kosoy E., Yildirim I., **Soltani A. A**., Siegel M., Tenenbaum J. & Spelke E. "Draping an Elephant: Uncovering Children's Reasoning About Cloth-Covered Objects," CogSci 2019.
Soltani, A. A., Huang, H., Wu, J., Kulkarni, T. & Tenenbaum, J. "Synthesizing 3D Shapes via Modeling Multi-View Depth Maps and Silhouettes with Deep Generative Networks," CVPR 2017.

INVITED TALKS

Vision Meets Cognition Workshop, CVPR, *Honolulu, HI* **July 2017**
MIT Vision Seminar, Massachusetts Institute of Technology, *Cambridge, MA* **October 2017**

REVIEWER

International Conference on Learning Representations (ICLR) **2021-Present**
International Conference on Machine Learning (ICML) **2021-Present**
Neural Information Processing Systems (NeurIPS) **2019-Present**
IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshops **2019-2020**

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COMMUNITY SERVICE

Science Teacher, Science is Elementary, *Buffalo, NY* **July - December 2015**

- Taught science lessons and visualized scientific and measurement concepts in an accessible way to more than 70 children from underrepresented communities at Westminster Community Charter School. Lessons ranged from measuring distances, to how magnets work in practice for Maglev and how magnets can be used to build high-speed trains.