fleeb@uw.edu
425 623 4026

FELIX LEEB - Curriculum Vitae

GOALS & INTERESTS

I am interested in studying **emergent behavior** in **ensembles** of agents to develop learning algorithms. Specifically, I would like to use the powerful tools in **Machine Learning** and **Statistical Mechanics** to solve **control tasks in robotics** by characterizing such complex behavior. Machine learning offers a host of versatile methods including **deep neural networks**, **self-supervised representation learning**, and **meta-learning**. Meanwhile, Statistical Mechanics provides a principled approach for understanding phenomena such as **emergent behavior**, **entropy**, and **nonlinear dynamics**.

EDUCATION

COMPUTER SCIENCE PHD EXPECTED SUMMER 2022

I am working towards a PhD degree in Computer Science at the MPI-IS mentored by Bernard Schölkopf and Stefan Bauer.

COMPUTER SCIENCE MASTER'S DEGREE JUNE 2019

I completed my Master's degree in Computer Science at the University of Washington under professor Dieter Fox.

TRIPLE BACHELOR OF SCIENCE FROM UW MARCH 2018

I earned a Bachelor of Science with a triple major in computer science, physics (comprehensive), and chemistry (ACS certified), in addition to a minor in philosophy from the University of Washington with a cumulative GPA of 3.71.

ASSOCIATE'S DEGREE WITH HIGH DISTINCTION JUNE 2015

In addition to graduating high school in 2015, I earned an Associate's degree at Bellevue College with high distinction through the Running Start program.

EMPLOYMENT

PHD STUDENT RESEARCHER AT MPI-IS SINCE SEP 2019

Since the Fall of 2019, I've been a PhD student working full-time at the Max Planck Institute for Intelligent Systems in the Empirical Inference department, led by Bernard Schölkopf. See ongoing projects below.

RESEARCH ASSISTANT IN UW RSE LAB JAN 2018 – JUNE 2019

While completing my M.S. and B.S. degree, I was a research assistant at the UW Robot State and Estimation lab, led by professor Dieter Fox. I worked closely with Arunkumar Byravan on several pose estimation and robotics tasks.

TEACHING ASSISTANT IN DEEP LEARNING CLASS FALL 2018

I am currently a TA for the Deep Learning class in the CSE department at UW. In additional to grading, and helping students at office hours, I also gave several lectures on deep reinforcement learning.

ACTIVE PROJECTS

STRUCTURING REPRESENTATIONS WITH AUTOENCODERS

SINCE FEBRUARY 2020

Currently, I am investigating how changes in the architecture of autoencoders enables and encourages implicit disentanglement to improve interpretability and transfer.

IMPROVING SAMPLING IN GENERATIVE MODELS DECEMBER 2019

Autoencoder based generative models use regularization to enable sampling. However, the learned representation never matches the prior perfectly which can lead to mode collapse and blurry samples. I developed a novel sampling strategy called Drop-in, which is based on treating the latent space as separate causal components and resampling each independently.

PUBLICATIONS

MOTION-NETS: 6D TRACKING OF UNSEEN OBJECTS FROM RGB

NOVEMBER 2019

Published at an IROS 2019 Workshop. Available on arXiv: 1910.13942

Full citation: Leeb, Felix, Arunkumar Byravan, and Dieter Fox. "Motion-Nets: 6D Tracking of Unknown Objects in Unseen Environments using RGB." *arXiv preprint arXiv:1910.13942* (2019).

SPATIALLY RESOLVING THE CONDENSING EFFECT OF CHOLESTEROL IN LIPID BILAYERS DECEMBER 2018

Featured on the cover of volume 115, issue 9. Available on arXiv: 1806.02468

Full citation: Leeb, F. & Maibaum L. (2018, December). Spatially Resolving the Condensing Effect of Cholesterol in Lipid Bilayers. In *Biophysical Journal*, doi: https://doi.org/10.1016/j.bpj.2018.10.024.

SE3-POSE-NETS: STRUCTURED DEEP DYNAMICS MODELS FOR VISUOMOTOR CONTROL MAY 2018

Available on arXiv: 1710.00489

Full citation: Byravan, A., Leeb, F., Meier, F., & Fox, D. (2018, May). SE3-Pose-Nets: Structured Deep Dynamics Models for Visuomotor Control. In *2018 IEEE International Conference on Robotics and Automation (ICRA)*. IEEE.

NOTABLE ACCOMPLISHMENTS & PAST PROJECTS

MOTION-NETS: 6D TRACKING OF UNSEEN OBJECTS FROM RGB

SINCE WINTER 2019

Building from several past projects in Dieter Fox's Robot and State Estimation Lab at the University of Washington, I worked with Arunkumar Bryavan to develop a novel tracking method of rigid objects based on RGB. This project connected the striking recent progress made in pose estimation and tracking research. Ultimately, this also became the focus of my Master's degree.

DYNAMICS-NETS: VISUOMOTOR CONTROL AND PLANNING USING DEEP MODELS SINCE SPRING 2018

Under the mentorship of Arunkumar Bryavan, Franziska Meier, and Dieter Fox, this work sits at the intersection of representation learning and control. This project involved training deep convolutional neural networks to learn a structured latent space of a system from RGBD input with minimal supervision. Then I trained a deep dynamics model in that latent space to use model predictive control to robustly solve dynamical robot manipulation tasks.

MOLECULAR DYNAMICS RESEARCH SUMMER 2016 – FALL 2018

After my first year a UW, I joined the Maibaum research group in the Chemistry department at UW. Our group investigated various biophysical mechanisms using statistical mechanics and computational molecular dynamics simulations. My work on the structure of biological membranes was published in the Biophysical Journal (see publications below), which is my first publication in a peer-reviewed journal.

SIMULATIONS OF TRAPPED IONS FOR QUANTUM COMPUTATION RESEARCH SPRING 2017 – FALL 2018

After learning about the fascinating field of quantum computation, I joined the Boris Blinov's research group at UW. In addition to studying quantum algorithms and circuits, I developed my own molecular dynamics simulator in Python and Julia to study the dynamics of trapped ions.

CLASSIFICATION AND GENERATION OF MUSIC FROM RAW AUDIO FALL 2018

Using state of the art deep learning techniques, I trained convolutional and recurrent networks to classify and generate music. This project involves comparing density estimation methods such as flow-generative models, generative adversarial networks, and variational autoencoders to develop a model that can generate short segments of music given a style or genre.

WON DISTINGUISHED RESEARCH AWARD IN CHEMISTRY MAY 2018

I won the Distinguished Research Award in Chemistry for my work with professor Maibaum on membrane structure.

RESEARCH COMPUTING CLUB OFFICER FALL 2017 – SPRING 2018

I was elected to be the Undergraduate Liaison for the Research Computing Club. I helped coordinate undergraduate students interested in pursuing research in scientific computing with graduate student mentors, and I answered questions about UW's supercomputer, Hyak.

PRESENTED RESEARCH AT THE BIOPHYSICAL SOCIETY CONFERENCE IN NEW ORLEANS FEBRUARY 2017

I went to the 61st Biophysical Society Conference in New Orleans to present my research on membrane structure with professor Maibaum. Everything, from hearing the cutting-edge research by others, to engaging with all the big names in the field about my own work and interests, at the conference was an unforgettable experience, and I'm eager to present at one again!

PRESENTED RESEARCH AT LOCAL SYMPOSIA SPRING 2017

In April, I gave a talk about my research on membrane structure at the ACS Undergraduate Research Symposium. In May, I also presented my research at the annual Undergraduate Symposium at the University of Washington. While neither of these events were as large as the Biophysical Society conference, I learnt a great deal sharing my findings and learning about the projects my peers are researching.

MEMBER OF THE PHI BETA KAPPA HONOR SOCIETY SPRING 2017

I joined the Phi Beta Kappa honor society for academic excellence.

MEMBER OF THE SIGMA PI SIGMA PHYSICS HONOR SOCIETY SPRING 2017

I joined the Sigma Pi Sigma physics honor society, which requires that I uphold a 3.8 GPA in physics classes.

ALLENE CHEMISTRY RESEARCH USING AB INITIO CALCULATIONS SPRING 2016

I studied the mechanism of a metal catalyzed allene reaction using ab initio calculations. First, I identified the key transition states and intermediates in the multistep reaction using density functional (DFT) calculations. By comparing the kinetics and thermodynamics of several different possible transition states, I proposed a mechanism for the reaction and I was able to explain experimental results with the computational calculations.

WON THE HYPERCUBE AWARD SPRING 2016

I was awarded the Hypercube Computational Chemistry Award for Excellence, because I was the top student in my computational chemistry class.

COMPUTER ARCHITECTURE ON AN FPGA SPRING 2015

I built a working 16-bit processor on an FPGA using the hardware development language Verilog. To run the processor, I developed an interface in Visual C# on my computer which would communicate with the processor over Serial. The interface would not only simulate the memory, but also the I/O, which included a keyboard, and a simple black and white screen. While the architecture worked perfectly in theory, in practice the processor only ran about 50 instructions per second because of some problems with the Serial interface, nevertheless, the project was an excellent opportunity to learn how a computer works from the logic gates upward.

PUBLISHED AN APP ON THE WINDOWS STORE SPRING 2015

For several years, I have been developing board game ideas with my friends and family. Two years ago, we decided to start a game company, called Vidulus Ludorum Inc., to publish our ideas as apps on mobile platforms. That Spring, we released the first game the abstract strategy game, DVX, available on the Windows Store since April 2015. I am chiefly in charge of the game design, developing all the graphics and animations, and designing the AI players.

VEX ROBOTICS CLUB FALL 2014 – SPRING 2015

In high school, I joined the VEX Robotics club and competed in several regional competitions. I specialized in programming our robot, implementing a simple PID control system, and programming the autonomous function. Our robot did exceptionally well in an autonomous skills competition, and we qualified for the state-wide competition.

TEACHING ASSISTANT IN HIGH SCHOOL CS CLASS FALL 2014 – SPRING 2015

In my senior year in high school, I became the TA for all three periods of the CSE class at Redmond High School. Aside, from teaching students basic circuitry and programing Arduinos, I was also in charge to maintaining the school's 3D printer. When our instructor took a leave of absence in the second semester for health reasons, I took charge of the class by instructing students and helping them with their individual projects.

REFERENCES Upon Request