For most tasks, researchers have very few hypotheses for how to model them. So, we generally give a model a large amount of data for autonomous learning. To make matters somewhat worse, supervised learning techniques require labels for such voluminous data, which are highly expensive to gather because they involve human evaluation.

For this reason, my research interests lie in learning from the least number of labels. One such example is using active learning. Active learning is interesting to me because it requires careful experimentation and design. There are three central questions: which data points should we query? How will queries be answered? Once we get the labels, what do we do with them?

**Hierarchical Safe Reinforcement Learning.** I started my interest in research during my undergrad at Purdue. During my junior year, I worked with Professor Suresh Jagannathan and his team on a reinforcement learning (RL) project for 3 semesters. Our goal was to develop a new algorithm to make RL model training efficient and safe. The solution has two levels: a high-level planner that creates a plan for the agent to complete the desired task, and a low-level controller that executes the planner's plan. The controller might deviate from the plan, and therefore, a Lyapunov neural network is employed to guarantee that an agent does not encounter an unsafe state. In this project, I was involved in writing the code for the high-level planner, running the hyperparameters, simulating experiments, collecting data, and benchmarking. Our paper was accepted at a workshop in AAAI, and I presented this work at the Purdue University Fall Research Expo.

I have interned at Cisco WebEx and Apple, and I returned to Cisco as a Software Engineer. While I value my time in industry, I found I immensely enjoy the unlimited possibilities and process of conducting research. Consequently, I pursued a research-oriented Master's degree at UIUC. I am fortunate to be offered a RA-ship in Professor Hanghang Tong's IDEA lab.

**Performative Neural Bandits for k-classification.** At UIUC, I continued with reinforcement learning – this time, more on the theoretical side. I worked with Professor Hanghang Tong and his team to develop a supervised multi-armed bandit training algorithm that is not only efficient resource- and label-wise, but also combines the benefits of exploitation and exploration. In this work, we work on the original input data (instead of transforming it into a long vector) and use a simple neural network of 2 layers. As mentioned earlier, this is also a label-efficient method because we employ active learning. We provide two methods for stream-based and pool-based active learning.

We are submitting this work to ICLR 2024, where I am a joint first author on this paper. I implemented all the algorithms, experimented/researched different strategies that will make our algorithm better, decided and researched the baselines, performed all the experiments, performed hyperparameter tuning, and wrote the 'Experiments' section of the paper.

We have experienced a few resubmissions in this work (ICML 2023, NeurIPS 2023). By improving this work more and more each time, I have learned not to be discouraged by rejections. Working with reviewers has helped me understand the rebuttal processes and has improved my writing.

**Concept-Shift Agnostic Graph Anomaly Detection.** I am leading another project on graph anomaly detection under Professor Hanghang Tong. We are developing an algorithm that will not only be able to learn the general pattern of anomalies but can also adapt to new kinds of

data with small retraining costs. This algorithm is label-efficient, and we make use of soft labels (corresponding to a human's confidence in their judgment).

To make the most out of labeling, we are experimenting with various techniques to augment the data. Anomalies are not just defined by the values of their features, but also the neighborhood structure they belong to. We aim to learn these structures via contrastive learning. Finally, we model this as a bilevel optimization problem in which each level learns each of the two components of this algorithm (a bulky model that will learn general patterns, and a lightweight classifier).

At UniversityName, I plan to continue my interests exploring the different applications and techniques of active learning.

Talk about three research works from this university and elaborate on ways you can take that work forward.

**Future Plans.** I plan to earn my Ph.D. in label-efficient deep machine learning. I am eagerly looking forward to having the opportunity to hone my research skills and develop new qualities to become the researcher I strive to be. My goals are to continue in academia as a professor where I can explore new related research domains and mentor other folks in relevant areas. Hopefully, I can provide the same excellent guidance that my advisors, mentors, and colleagues have provided me.

Conclusion. I want to contribute to making AI learn better models from less data with the bright minds at UniversityName.