

My Research Interest

My interest in astronomy grew from the hours of relentless backyard stargazing at home to the multitude of observation sessions that I organized in college. What fascinates me is the magnitude of what we are and what we can observe, compared to the scales of the universe and the profundity of what we can infer from it.

My foray into the field of machine learning is through coursework. I took courses in machine learning and deep learning, which contained many exciting projects. I developed a new technique to reconstruct an X-ray spectrum using an iterative algorithm based on denoising auto-encoders.

My master's work in machine learning pans the X-ray regime of astronomy. In my work, I developed a LightGBM-based classifier that gives class membership probabilities to the X-ray point sources available in the Chandra Source catalog. We used properties from multiwavelength properties as input to the model. With the model, we studied the population distribution of NGC-104 globular cluster. My algorithm identified the classes of about 15,000 previously unidentified variable sources. This will lead to an extensive catalog of classified sources, which may serve as a starting point for several upcoming research in this field.

Astronomy has much to gain from data science. A field that is primarily governed by statistical analysis of data obtained from a myriad of telescopes and observatories worldwide will significantly benefit from the newer, more innovative methods of classification, research, and inference machine learning has to offer. My interest is in using Machine learning methods for a multi-wavelength study of astronomical sources. We can leverage the Bayesian algorithms to identify the sources and use their feature-importance study to characterize their intrinsic behavior. Currently, off-the-shelf ML algorithms are being used in astronomy which limits the capability of the models. To this end, I want to explore and develop methods for a maximal infusion of the available astrophysical models and the domain knowledge in machine learning algorithms.

Research in astronomy is a journey of discovery of new systems and phenomena. On the other hand, machine learning is the field of innovation, creating new methods to solve existing problems effectively. There is creativity within the challenge of designing a new architecture. The amalgamation of these two perceptions piques my interest in using innovation for discovery.

Shivam Kumaran