At Stanford, I participated in the Army High Performance Computing Research Center program where I learned about high performance computing. My research experience was working on the Xbox Kinect for object classification. The main motive under this research was to probe the capabilities of the Kinect. The reason is that depending on the capabilities, the Kinect could be used for applications beyond consumer gaming. One specific example is that they could be put on small rovers and take them to places to scan for objects. The sensors for this purpose are very expensive so using a Kinect would significantly reduce the cost.

We used an open source program to scan a set of 3D shapes. We put the point clouds of each shape into a library where each shape had its own 3D histogram. We used two methods for object classification: distance method and quadratic form distance. With each method, we would compare both methods and scan an unknown object and see what the unknown object's 3D histogram would resemble the most in the shape library. The one that had the least error when comparing all the shapes' histograms in the library would the shape that resembled the unknown object the most. At the end, the Kinect would be able to scan objects that could be modeled very well in the cartesian coordinate system. Objects that looked like cubes and rectangular prisms were classified correctly with high accuracy. However, objects that looked like cylinders or spheres had horrible accuracy due to how it scans. Thus, objects that are not easy to be modeled in the Cartesian system had horrible accuracy. Overall, the Kinect is pretty good for the price, but for complex scanning, it still needs improvements. Thus, the Kinect would not be ideal if the army wanted to use them for robots maneuvering around detecting objects, just like the turtlebot.

At the end of this program we made a 10 minute presentation to the Army on our findings and recommendations.

Under Dr. Laura Boucheron, I have conducted interdisciplinary research at my previous university. My research involved developing new digital image processing methods for astronomical data. The astronomical data were solar images of the chromosphere that were taken in the hydrogen-alpha wavelength. Using these solar images of the H-alpha wavelength, the first task was to deblur the images.

For this task, I investigated how to use blind deconvolution to see how I could improve the quality of the solar images because we had no ground truth to verify so blind deconvolution was the best approach. Looking at papers, they had recommended for my problem that a good solution would be the Lucy-Richardson algorithm. To validate this algorithm, we used blind image quality metrics and saw that the ideal point spread function from the algorithm would fluctuate from the different times due to the atmospheric turbulence since the images were taken from a ground based telescope.

After working on debluring, my role was to use support vector machines and relevance vector machines on the data to create a model to accurately predict the next solar flare by using an imbalanced data set and cross validation. This work could provide predictive models that would benefit individuals concerned with space weather. For instance, the astronauts in the International Space Station would benefit because if a solar flare is erupting and given enough time, they can prepare themselves from the onset of potentially dangerous solar radiation. The same situation applies to satellites since the radiation can degrade or destroy the electrical components, which results in mission failure for the satellites.