

My Summer Research Project was centred around using machine learning to distinguish *Helicoverpa armigera* moths from *Helicoverpa zea* moths. These two species, whilst similar in appearance, are quite different in nature - whilst both are agricultural pests, *H. armigera* is resistant to many pesticides. The recent invasion of *H. armigera* moths in South America and its subsequent hybridisation with *H. zea* moths has made it difficult for farmers to effectively manage pest populations. The purpose of my model was to aid farmers in distinguishing the two species, and thus better manage populations, without the long process of sending test samples to labs, instead using images of the moths' wings.

Upon receiving and processing the dataset, I used Python to extract as many wing features as I could, including area, circularity, aspect ratio, shape, and colour, among others. Over several weeks, I then trained various machine learning models and algorithms on said features, namely logistic regression, linear discriminant analysis, random forests, and neural networks. Whilst the logistic regression and linear discriminant analysis models were promising proofs of concept, the neural network model was the most successful after several optimisations, achieving a mean accuracy of 80.50%. However, I soon realised this was using an imbalanced dataset, with over 72% of the data being *H. armigera* moths, and thus I artificially balanced the dataset (giving a 33/33/33 split between *H. armigera*, *H. zea*, and hybrid moths), and retrained the neural network model, achieving a mean accuracy of 65.31%, much better than the 33.33% accuracy of a majority class/random guess. With this, I concluded that my model was successful in distinguishing between the two species and could therefore be used as an aid for farmers out in the field as originally intended.

Through this project, I have learnt a lot about the technical aspects of machine learning beyond the scope that I was previously familiar with, as well as how to apply said knowledge to real-world problems - a skill that will be very beneficial for any future career. I have also learnt about the scientific method, and how to approach and solve problems that may arise. On top of this, my time in the Zoology Department has taught me a lot about moths and other topics outside of my usual field, far beyond anything I knew before, and overall, I am very grateful for the opportunity to have worked on this project.