Cotton Field Detection Using Satellite Images and CNN

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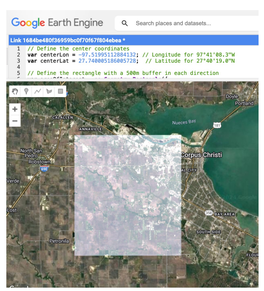
Project Overview

In collaboration with the Texas A&M Institute of Data Science and Texas A&M AgriLife Research, **we developed a cotton field identification tool within just 24 hours at the 2024 TAMU Datathon.** Utilizing multi-spectral satellite imagery and weather data of the year 2023, our model predicts cotton field presence with 83% accuracy over a 324-square-kilometer region in Corpus Christi. This baseline approach showcases strong potential for application to other crops, offering valuable insights into recent agricultural land distribution trends.

Data Collection

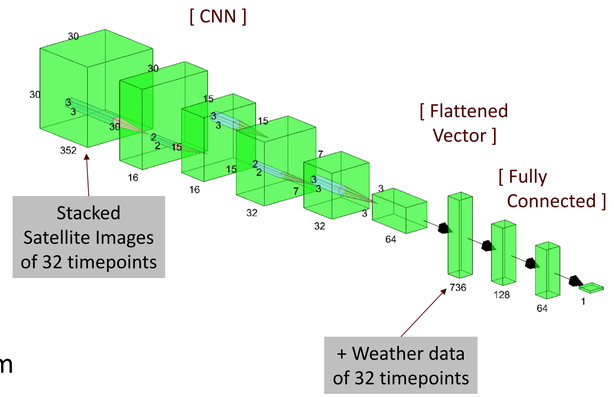
Our study targeted an 18 km x 18 km area in Nueces County, Corpus Christi. Satellite images were sourced from **Sentinel-2 through Google Earth Engine**, **weather data from the National Centers for Environmental Information**, and **ground-truth labels from the USDA Cropland Data Layer**. The Sentinel-2 imagery provided a spatial resolution of approximately 10 meters, while ground-truth data was at 30 meters. To ensure sufficient pixel density, we defined a 200-meter square as our input unit, with the model predicting cotton field presence for each square.

The model used **10 agriculturally relevant spectral bands out of 13, plus NDVI, yielding 11 bands** per image for analysis.



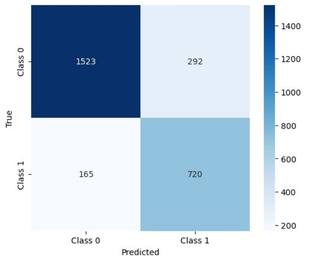
Model

We developed a **custom convolutional neural network (CNN) that processes satellite images and weather data from 32 time points throughout the year.** With an input size of 30x30 pixels, the CNN was designed with three convolutional layers followed by three fully connected layers, balancing complexity with performance. **Each input channel was normalized independently** using channel-wise global minimum and maximum values.

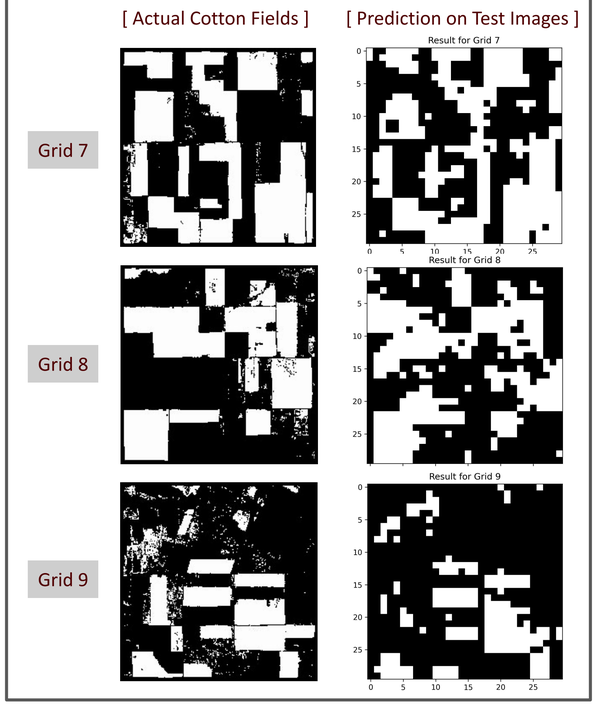


Training and Testing

Our dataset was divided into training, validation, and test sets in a 1:1:1 ratio, with 2,700 samples per set. The model was trained over 50 epochs with early stopping, reaching a **test accuracy of 83.07% and F1 score of 75.91%.**



Result



Observations and Discussion

Despite the lower resolution of satellite images compared to drone images, our model effectively detected cotton fields. **Considering this model was developed in just 24 hours with a limited dataset, it shows strong potential for accurately predicting various crops using only satellite images and weather data, which are publicly accessible.** This approach lays a strong foundation for expanding data science in agriculture.