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Harnessing Satellite Observations and Deep Learning to Identify Irrigated Fields

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Introduction

Irrigation, or controlling the flow of water to objects such as crops or landscapes, is growing at an increased rate in our state. As irrigated acreage rises, having accurate irrigation data is critical to make efficient work of the water we that we use. Managing this increased water demand is likely to be one of the largest and most important challenges facing water resource management in the state.

Impact

Irrigation is essential to the profitability and efficiency of farms, making irrigation a major user of ground and surface waters. In the United States, agriculture accounts for approximately 80 percent of the Nation's consumptive water use[1]. The outcome of this project will be to enhance Alabama's irrigation survey, helping the state manage the water demand in the agriculture system and in turn improve farmland production.

Design

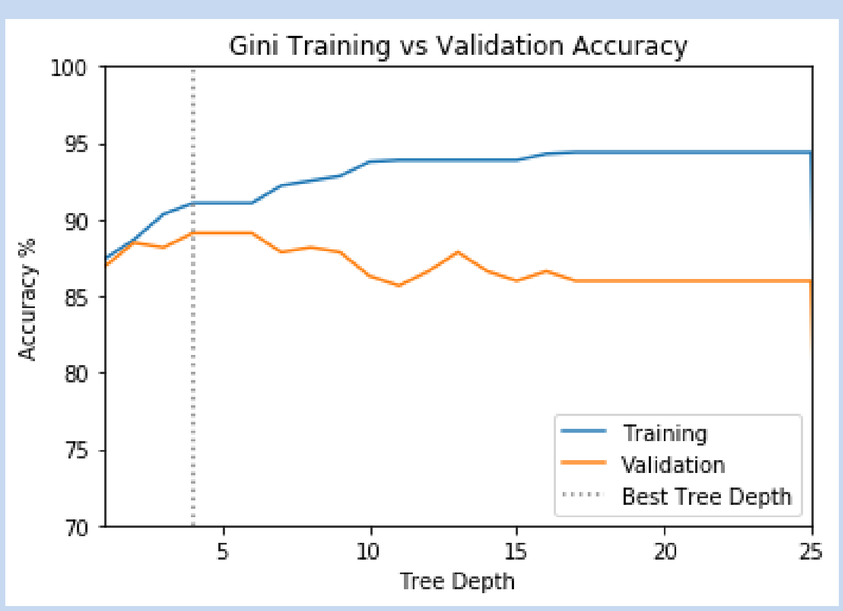
Efforts in place today highly rely on hand picking center pivot systems out of GIS images. This project's goal is to implement a Deep Learning approach to automatically identify irrigated plots solely with a neural network.

Satellite image of center pivot irrigation systems that were visually identified by hand

Typically, irrigated crops show a higher Enhanced Vegetation Index (EVI) during normal and drought conditions. Because of this, we can take the temporal anomaly of their values over years of satellite observations to find land that stays greener year-round. I iterated training a Binary Decision Tree Classifier using Gini Impurity, and by altering each iteration's max tree depth, the network finds the tree with the highest accuracy.

Results and Conclusion

Below is the plotted accuracies of each training iteration versus the accuracies of those trees when ran on the validation set. The best tree depth is found by the highest validation set accuracy. Then, that trained decision tree is used to predict the outcomes of the test set's accuracy.



The results look very promising and after running the experiment over multiple counties across the state, some of the statistics include:

- Accuracies averaging around 85-89%.
- Precision, Recall, and F1 Scores of 0.87 ±0.01.

Overall, this was a very successful project that has huge amounts of real-world applications if taken further to run across the whole state, or more, the whole nation.

References

1. **https://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use/background/**

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ESSC Earth System Science Center