Classifying cover crops using Convolutional Neural Network

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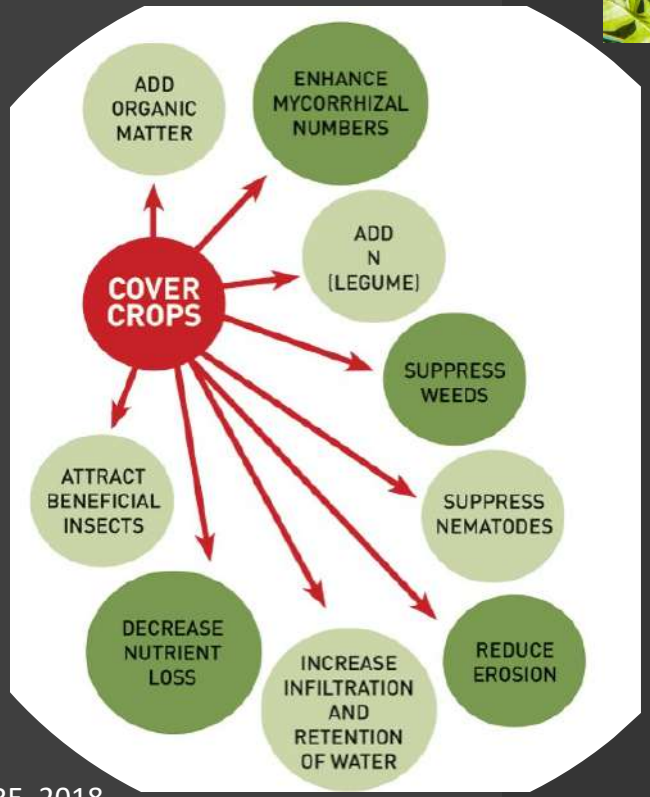
Israel Gallindo, SARA, 2018

Introduction/Motivation

- Cover crop planted to address specific on-farm problem
- Mixes used to stack multiple benefits of cover crops
- Number of species in a single mix can range from 2-20
- more species = more diversity
- Pushed heavily by agribusiness leaders, USDA/NRCS, and conservation agriculture organizations
- Often include expensive seeds
- Assuming even distribution of seeds and germination

SARE, 2018



SARE, 2018

SARE, 2018

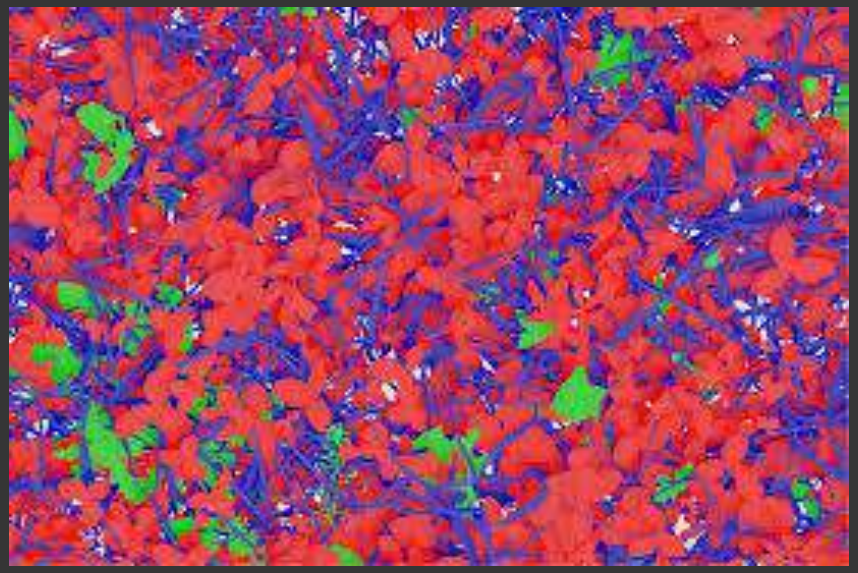
Hypothesis

A convolutional neural network can be used to classify cover crops

Svensson, 2019

Goal

Take the first step in mapping individual cover crop species within a mix.



Svensson, 2019

Objective

Classify five species of cover crops

Classes include:

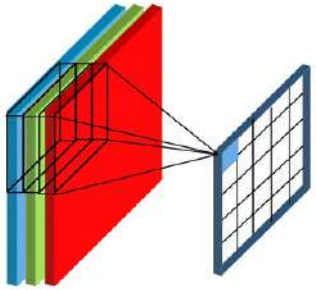
1. Weed (Bermuda grass)
2. Sunnhemp
3. Daikon Radish
4. Buckwheat
5. Sudan Grass

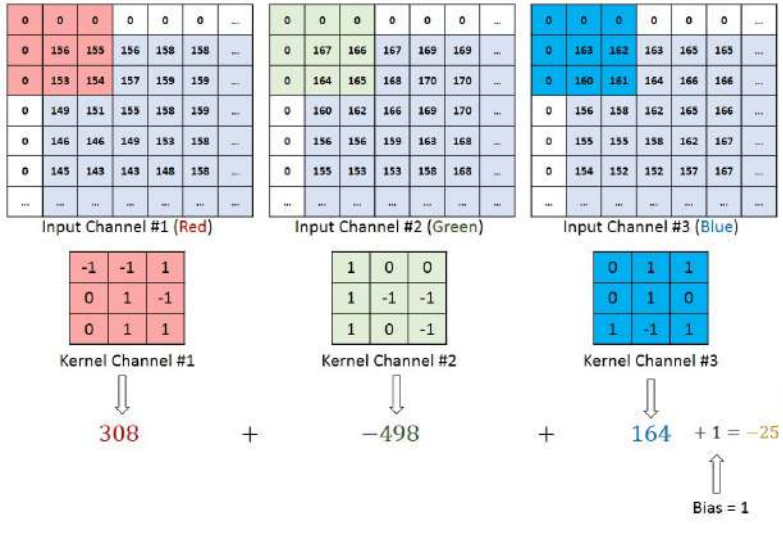
Convolutional Neural Network

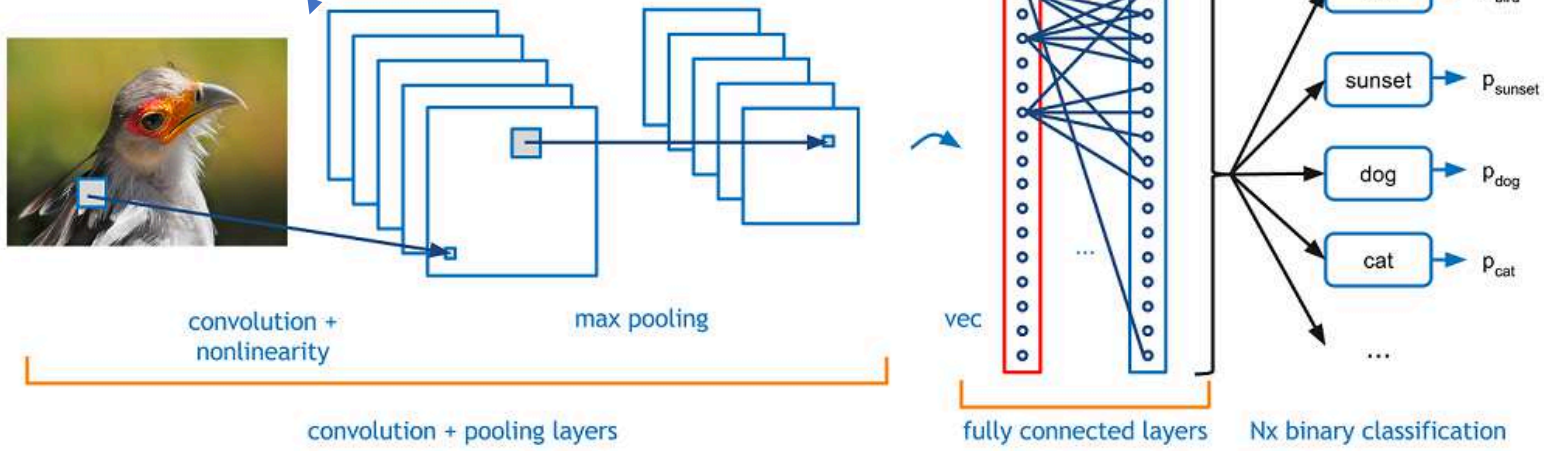
- Why Neural networks?
  Structured vs unstructured data
- Convolutional Neural Network for images

1. Convolve filters to extract features
2. Compare them with true values
3. Classify and back propagate depending on result

- Using vectorization
- Packages include numpy, tensorflow2, keras, scikit-learn

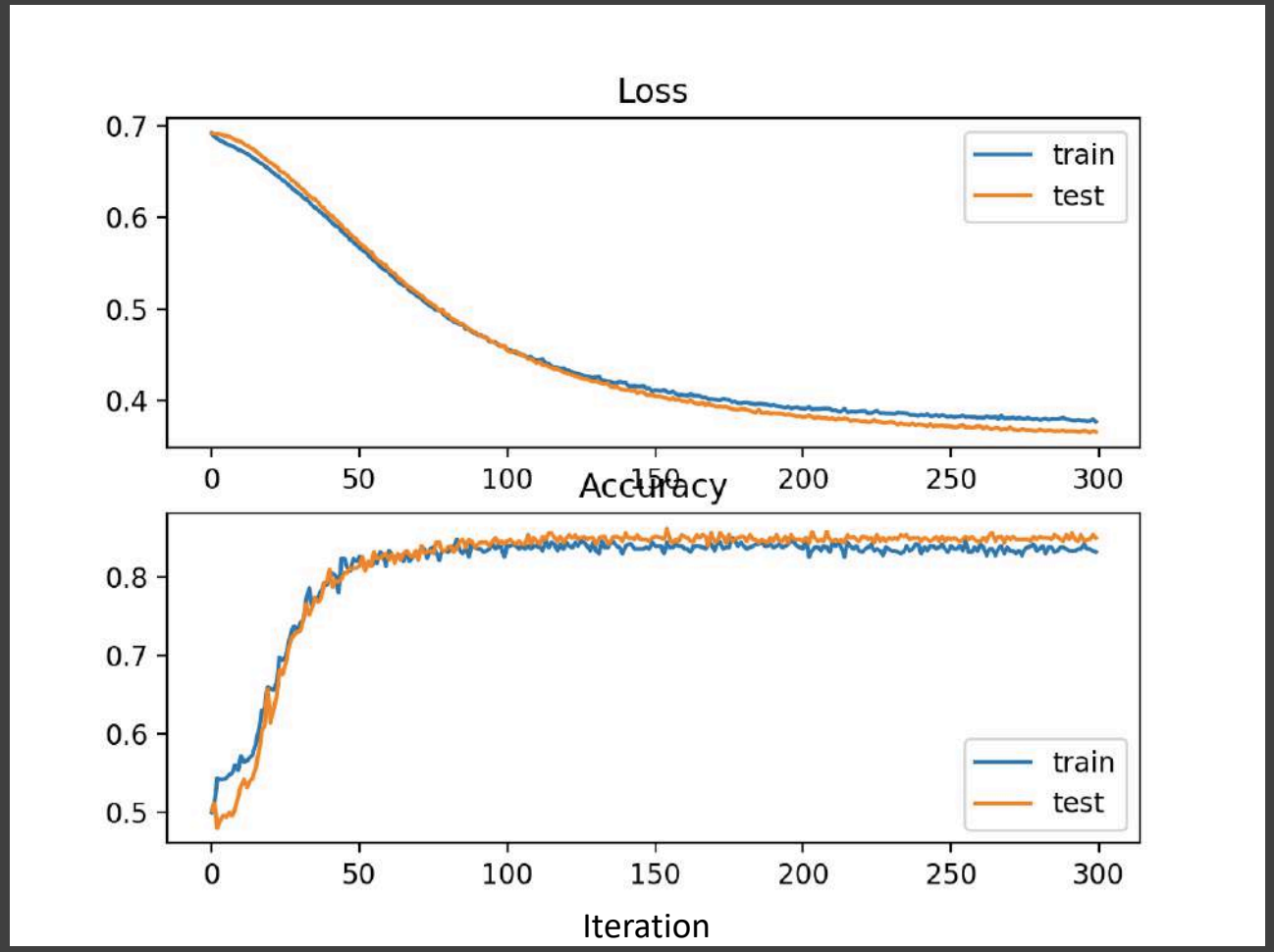






Error Analysis

- Accuracy - % of pixels that are correctly classified
- Loss – summation of errors made for each example in training or testing sets
- Precision – of all labeled cover crops, which one were actually cover crops? (TP / TP + FP)
- Recall (sensitivity) – Of all cover crops, how many did we actually label correctly? (TP / TP + FN)
- F1 Score – weighted average of precisión and recall. Useful if you have uneven class distribution.



J. Brownlee, 2019

		Predicted class	
Actual Class		Class = Yes	Class = No
	Class = Yes	True Positive	False Negative
	Class = No	False Positive	True Negative

Renuka Joshi, 2016

Broader Impact

- First step in using CNNs to evaluate conservation agriculture practices
- First instance of CNNs being used to evaluate cover crop mix efficacy in grain systems
- Helps researchers and farmers understand relationship among various species in order to create effective mixes

Israel Gallindo, SARA, 2018