Saving the World's Beer: Applications of Deep Learning to Identify Disease in *Humulus lupulus*

Tyler Southworth
University of North Carolina at Charlotte,
Department of Bioinformatics

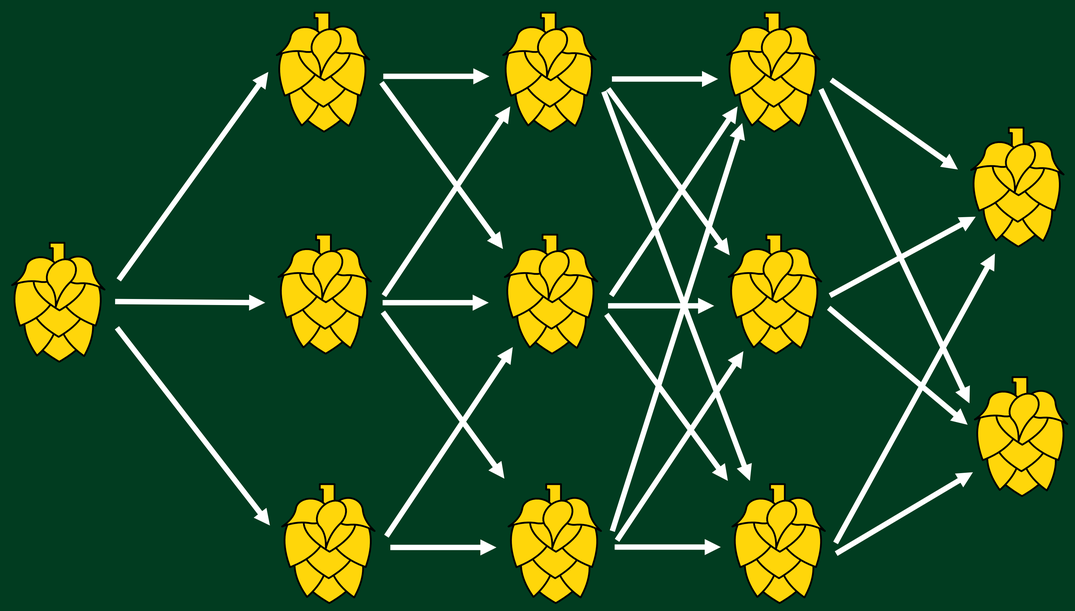
Introduction:

- Agriculture is responsible for 4% of the world's gross domestic product and is threatened by widespread disease.
- Deep learning methods such as a convolutional neural network (CNN) provide accurate and swift diagnosis of disease in plants (Marzougui et al. 2020).
- Accuracy rates of diagnosis range from 88.8% to 98.96% (Marzougui et al. 2020; Shrestha et al. 2020).
- *Humulus lupulus*, also known as the common hop, had a global trade value of $707 million in 2020.
- Several diseases threaten hop crops, however application of CNNs to solve this problem is largely absent from the literature.
- Identifying diseased regions of plant anatomy and diagnosing specific diseases can be accomplished using a CNN.

Methods:

- Images of healthy and diseased *Humulus lupulus* leaves are downloaded and split into training and testing datasets stored as NumPy arrays.
- Convolutional neural network is built including layers to rescale images before being passed through convolution and pooling layers.
- The model categorizes images as healthy or having one of several different diseases while tracking accuracy and loss during training and testing.
- Performance of the model is visualized by plotting the accuracy and loss over iterations of training and testing.

Convolutional Neural Networks allow swift classification of **pathogenic** threats to crop production impacting **world economics**.



UNIVERSITY OF NORTH CAROLINA
CHARLOTTE

Adapted from "A Deep CNN Approach for Plant Disease Detection", Marzougui et al. 2020

S.NO	LEAF IMAGE	ACCURACY	LOSS	DISEASE PREDICTED
1.		0.9534	0.1091	Black Rot
2.		0.9725	0.0755	Bacterial blight
3.		0.9658	0.0882	Cercospora leaf spot
4.		0.9478	0.1212	Black Rot
5.		0.9667	0.0818	Bacterial blight
6.		0.9600	0.0996	Anthraconse

Sourced from "Plant Disease Detection and Classification using CNN Model with Optimized Activation Function", Yadhav et al. 2020