PUMPKIN YIELD MAPS USING DRONES AND MACHINE LEARNING

Oct. 27, 2017
Raptor Maps

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Trick or treat! To celebrate the occasion, Raptor Maps is bringing machine learning to our favorite orange gourd. Pumpkins are in peak demand this time of year, and farmers need to provide an accurate assessment of crop counts to retailers (jack-o-lanterns) and processors (canned pumpkins). Harvest is also the time of year when farmers measure yields and make management decisions that will lower costs and increase yields in the following year.
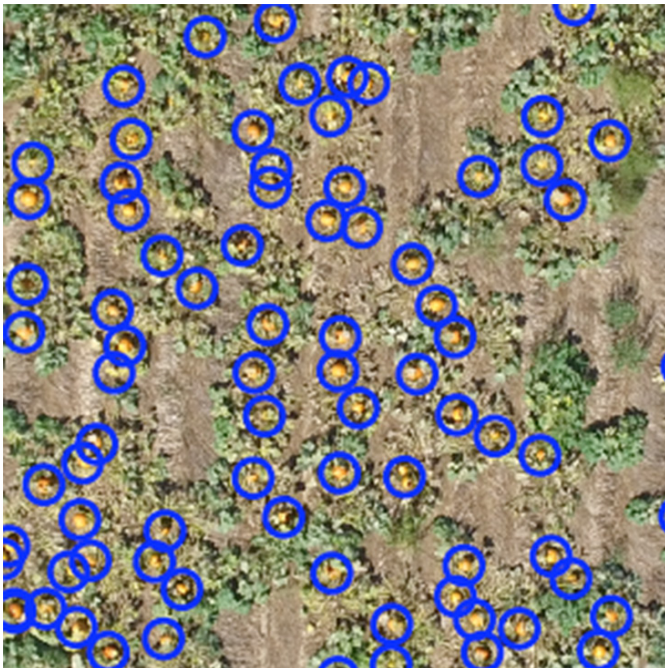
WHY COUNT PUMPKINS?

Deveron UAS Corp., a full-service drone data company based in Canada, is committed to helping farmers make optimal decisions. In order to help pumpkin (and other cucurbit) farmers market their crops, Deveron turned to Raptor Maps to apply machine learning to count pumpkins and create the world's first pumpkin yield map.

MACHINE LEARNING FOR DRONES

Drones are generating more data than we know what to do with. Every mission can generate thousands of images (or hours of video) that need analysis. With machine learning, we can teach algorithms to detect something we care about (e.g., leaf, soil, and pumpkin), classify it, and localize it in space. From there, we can do further processing, such as measuring the diameter and mapping the density. By incorporating additional data streams and decision-making capabilities, your machine learning becomes artificial intelligence (AI).

MACHINE LEARNING DEFINITION

Machine learning is the science of getting computers to act without being explicitly programmed. In the past decade, machine learning has given us self-driving cars, practical speech recognition, effective web search, and a vastly improved understanding of the human genome.

Andrew Ng | Professor, Stanford University

SUPERVISED LEARNING FOR PUMPKINS

Fortunately, there is still a role for humans. Raptor Maps fed the machine learning algorithm labeled examples of pumpkins ("positives"), as well as examples of vines and soil ("negatives"). The negative examples are important, since reflections on large, broad leaves would otherwise be flagged by the algorithm as "pumpkins" and result in an artificially higher count. As you can see in the map below, the pumpkins may occasionally be touching, so Raptor Maps had to ensure that the software could smartly identify this area as two separate pumpkins, instead of one large one.

This approach is known as supervised learning. The examples fed to the algorithm are the training data. And the category associated with each example is a label. Once this labeled training data has been generated, it's time to train our neural network.

NEURAL NETWORKS

There are many types of machine learning algorithms. In this case, Raptor Maps used a neural network. Neural networks are modeled after the human brain. Each arrow has a "weight" associated with it (how much input it takes from the previous

layer). With every training example, the weights are updated and the model improves. After millions of iterations, the neural network is trained. Popular libraries for neural networks include UC Berkeley's Caffe and Google's TensorFlow.
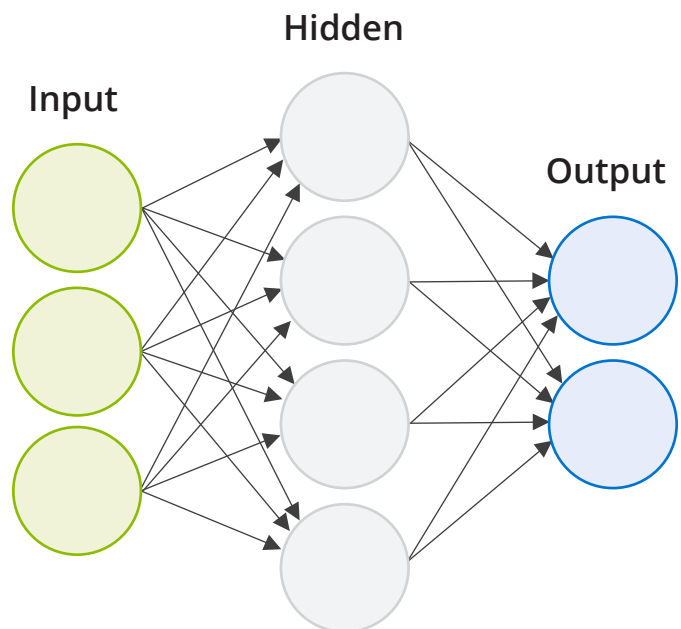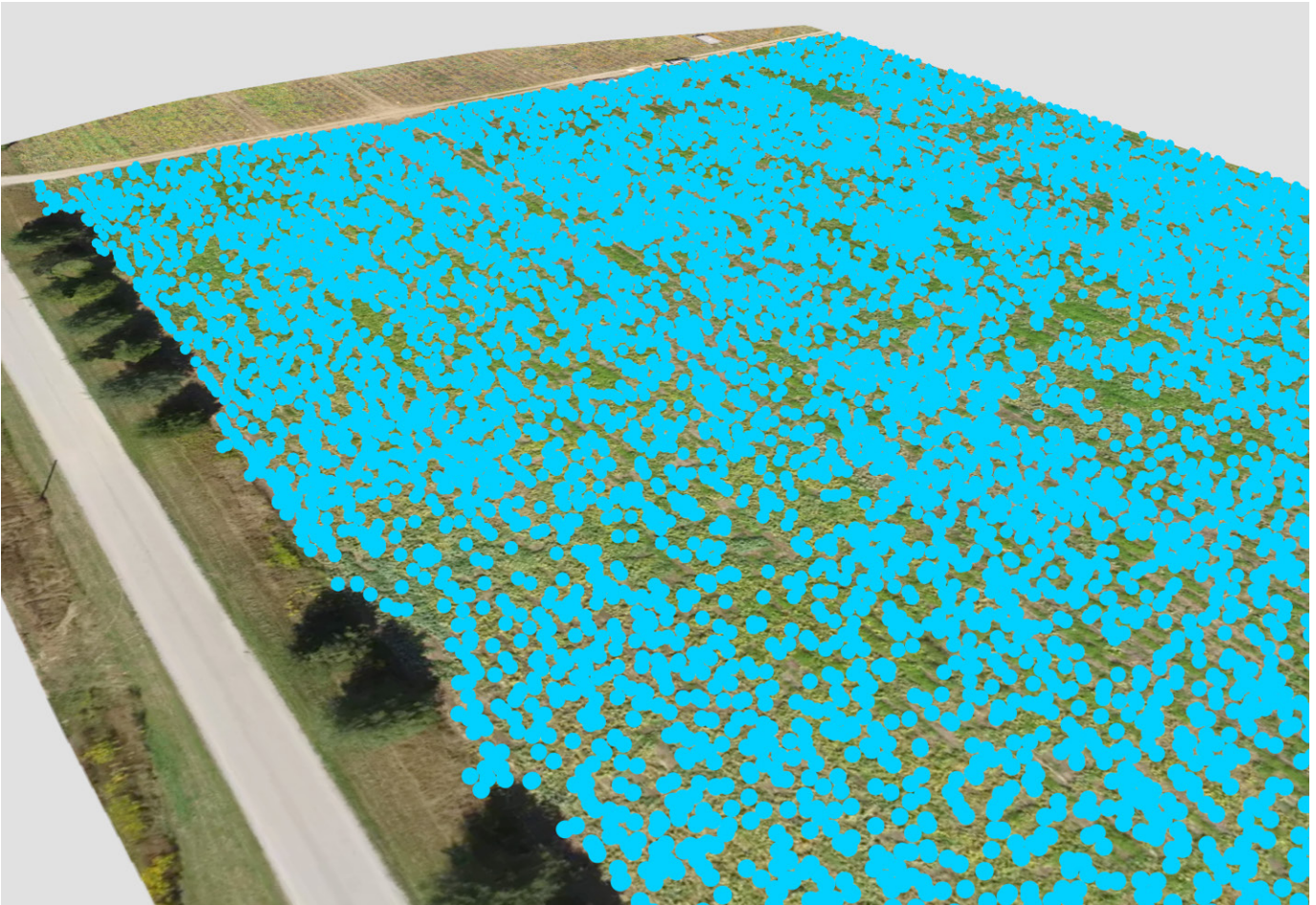

Diagram of a 1-layer neural network. The "weight" of each arrow is updated with every iteration as the network is trained.

How did the algorithm do? See for yourself using our 3D interface. Zoom, pan (left click), and rotate (right click) to move around the map.
https://raptormaps.com/case-study-identifying-pumpkins-drones-machine-learning/

POST-PROCESSING

As seen in the photo, each individual crop is given a unique identifier. This makes it easier to monitor and track individual crops during repeat inspections, even if they slightly shift over time. This type of approach brings the industry closer to analytics and management at the single-crop level.

Each pumpkin is given a unique ID

Once each pumpkin is identified, the yield map is created by dividing the field into pixels (in this case 1/32 acres). The resulting yield maps are shapefiles that are compatible with farm management software, such as the John Deere Operations Center, Case IH AFS, Climate FieldView, and FarmLogs.

MACHINE LEARNING FOR YOUR DATA

Raptor Maps leverages its expertise in machine learning to help companies like Deveron UAS provide farmers with accurate, variety-specific analytics. This approach works for other industries as well, including electrical utilities, oil and gas, insurance, and telecommunications. Whether you're counting pumpkins or detecting corrosion, Raptor Maps builds intelligent software to put your drone data to work.

Valuable insight from Raptor Maps is helping growers identify supply management challenges with unprecedented accuracy.

Norm Lamothe | Head, Agriculture, Deveron UAS