

Strawberry Classification Using Deep Learning

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Abstract: *Rosaceae*, the rose family of flowering plants (order Rosales), composed of some 2,500 species in more than 90 genera. The family is primarily found in the north temperate zone and occurs in a wide variety of habitats. They're an excellent source of vitamin C and manganese and also contain decent amounts of folate (vitamin B9) and potassium. Strawberries are very rich in antioxidants and plant compounds, which may have benefits for heart health and blood sugar control. Strawberries' carbs consists mainly of fibers and simple sugars. They have a relatively low GI and should not cause big spikes in blood sugar levels. In this paper, machine learning based approach is presented for identifying type Strawberry with a dataset that contains 2,306 images use 1,212 images for training, 520 images for validation and 574 images for testing. A deep learning technique that extensively applied to image recognition was used. use 70% from image for training and 30% from image for validation. Our trained model achieved an accuracy of 100% on a held-out test set, demonstrating the feasibility of this approach.

Keywords: Type Strawberry, Deep Learning, Classification, Detection.

Introduction

Rosaceae, the rose family of flowering plants (order Rosales), composed of some 2,500 species in more than 90 genera. The family is primarily found in the north temperate zone and occurs in a wide variety of habitats. A number of species are of economic importance as food crops, including apples, almonds, cherries, pears, raspberries, and strawberries; some, such as the rose, are grown as ornamentals.

Members of Rosaceae are generally woody plants, mostly shrubs or small to medium-size trees, some of which are armed with thorns, spines, or prickles to discourage herbivores. The genus *Rubus* (e.g., blackberries and raspberries) chiefly contains arching shrubs or scramblers of irregular, often tangled appearance. Herbaceous perennials are found in several genera, most notably strawberries (*Fragaria*), cinquefoil (*Potentilla*), avens (*Geum*), and goatsbeard (*Aruncus*). Most species in the family have alternate leaves, and small leaflike structures called stipules are routinely present at the base of the leaf stalks.[2]

Interesting Peach Facts : [3]

1. Strawberries are the first fruit to ripen each spring.
Because they just know we can't wait too long for their pure fruity goodness.
2. THERE ARE 200 SEEDS ON AN AVERAGE STRAWBERRY.
Plus, they're the only fruit to wear their seeds on the outside.
3. Despite their name, strawberries aren't technically berries—they're accessory fruits.
While we're getting technical—berries should have seeds inside. Strawberries are really in a group of their own since they don't come from a single ovary.
4. The seeds can grow into new strawberry plants, but most instead reproduce through runners.
5. According to the u.s. department of agriculture, Americans eat an average of 3.4 pounds of fresh strawberries every year.
If you count frozen strawberries, that number is closer to five pounds.
6. California produces 75 percent of strawberry crops in the US
All over 23,000 acres of land, used just for strawberry production.
7. Stop and smell the strawberries! Considered members of the rose family, they give off a sweet fragrance as they grow on bushes.
8. Considered a perennial, strawberry plants will grow back year after year.
Although they don't always grow fruit immediately, once they do, the plants can last up to 5 years.
9. The lesser-known tabletop method of cultivation, where strawberries hang from the ceiling in containers, is gaining in popularity for its practicality.

Keeping strawberries off the ground keeps them away from pests and soil-borne diseases.

10. Ancient romans believed strawberries had medicinal powers.
They were used to treat everything from depression to fever and sore throats.

11. Native Americans were also among the earliest people to eat strawberries.
They even introduced European settlers to the fruit.

12. There are three different types of strawberries: June-bearing, overbearing and day neutral.
But June-bearing are the most flavorful berries.

13. Don't rinse cut strawberries under water until you're ready to eat them—it speeds up spoiling.

14. May 21-27 is strawberry week in Delaware. And yes, it's celebrated annually.

15. There is a museum in Belgium dedicated to strawberries.
It should be at the top of any fruit lover's travel bucket list.

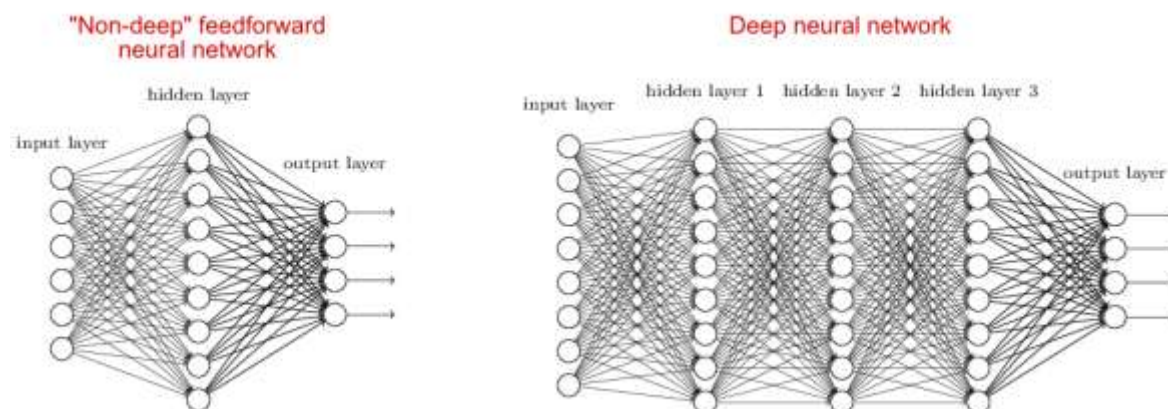
16. Strawberries are grown in every single US state and Canadian province.

Deep Learning is an Artificial Intelligence (AI) subfield that imitates the works of a human brain in processing data and producing patterns for use in decision making. Deep learning is a subset of machine learning in artificial intelligence that has networks the skills of learning from data that is unlabeled or unstructured.

In this work, we show that a Deep Convolutional Neural Network (CNN) does well in classifying peach type. In computer vision, CNNs have been known to be powerful visual models that yield hierarchies of features enabling accurate segmentation. They are also known to perform predictions relatively faster than other algorithms while maintaining competitive performance at the same time [4].

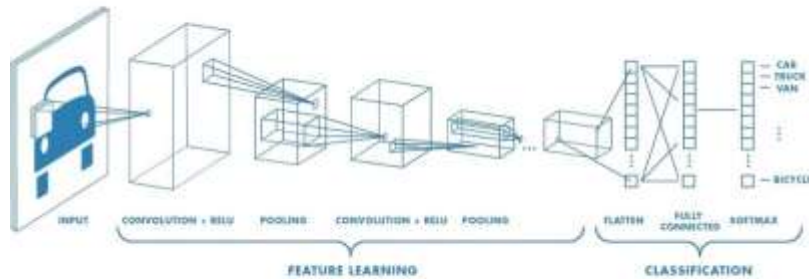
DEEP LEARNING

Deep learning (also known as deep structured learning or hierarchical learning) is part of a broader family of machine learning methods based on learning data representations, as opposed to task-specific algorithms. Learning can be supervised, semi-supervised or unsupervised [5]-[6]. In deep learning, each level learns to transform its input data into a slightly more abstract and composite representation. In an image recognition application, the raw input may be a matrix of pixels; the first representational layer may abstract the pixels and encode edges; the second layer may compose and encode arrangements of edges; the third layer may encode a nose and eyes; and the fourth layer may recognize that the image contains a face. Importantly, a deep learning process can learn which features to optimally place in which level on its own. (Of course, this does not completely obviate the need for hand-tuning; for example, varying numbers of layers and layer sizes can provide different degrees of abstraction) [5],[7].



CONVOLUTIONAL NEURAL NETWORK

In deep learning, a convolutional neural network (CNN, or ConvNet) is a class of deep neural networks, most commonly applied to analyzing visual imagery. CNNs use a variation of multilayer perceptron's designed to require minimal preprocessing. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared- weights architecture and translation invariance characteristics [8].

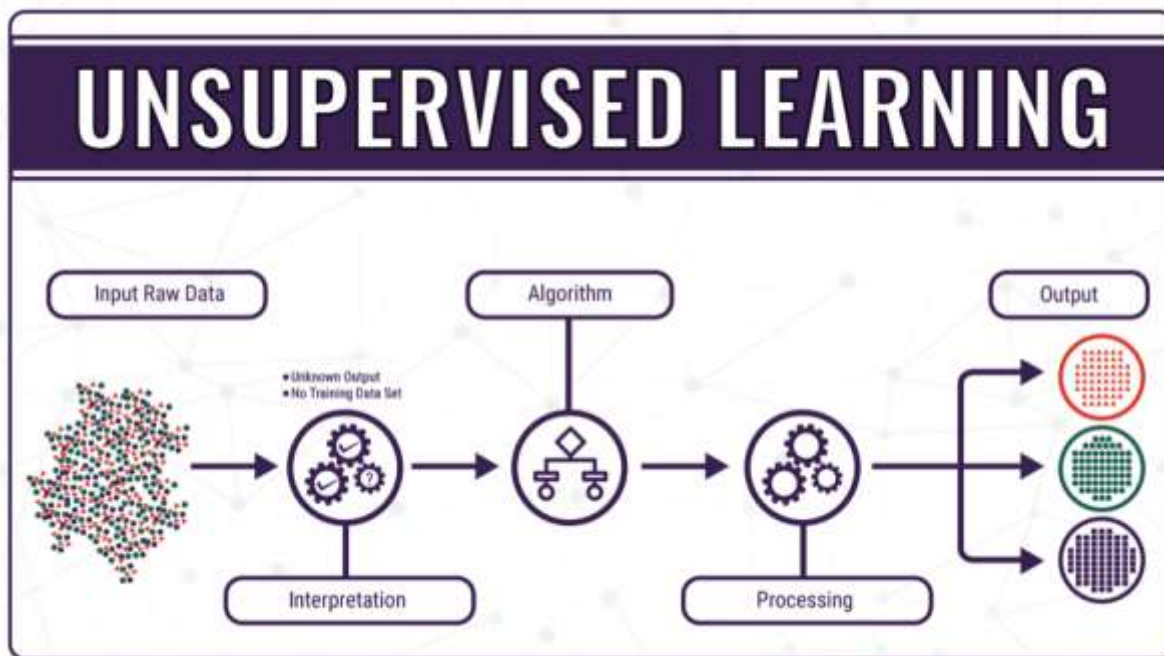


TYPES OF MACHINE LEARNING ALGORITHMS

There some variations of how to define the types of Machine Learning Algorithms but commonly they can be divided into categories according to their purpose and the main categories are the following [9]:

Supervised learning

Supervised learning is a learning model built to make prediction, given an unforeseen input instance. A supervised learning algorithm takes a known set of input dataset and its known responses to the data (output) to learn the regression/classification model. A learning algorithm then trains a model to generate a prediction for the response to new data or the test dataset [10].



STUDY OBJECTIVES

- 1- Demonstrating the feasibility of using deep convolutional neural networks to classify Type of Strawberry .
- 2- Developing a model that can be used by developer to create smartphones application or web site to detect Type of Strawberry .

DATASET

The dataset used, provided by Kaggle, contains a set of 8,554 images use 4,488 images for training, 1,928 images for validation and 2,138 images for testing belonging to 13 species from Strawberry . See Fig. 1 for types Strawberry .

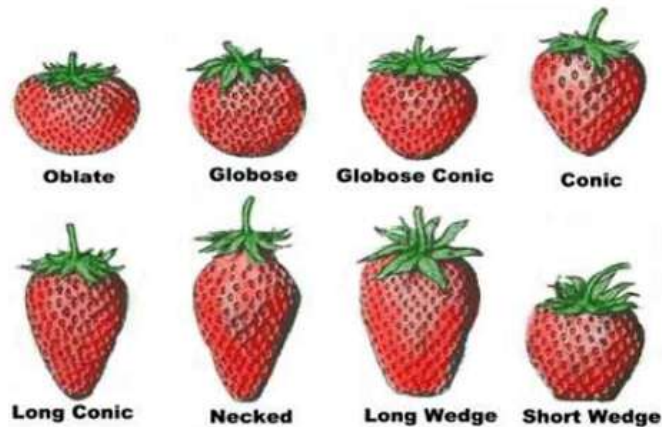


Figure 1: Dataset Samples

The output 2 classes as follow:

- class (0): Strawberry conic.
- class (1): Strawberry wedge.

The images were resized into 150×150 for faster computations but without compromising the quality of the data.

METHODOLOGY

In this section we describe the proposed solution as selected convolutional network (ConvNet) architecture and discuss associated design choices and implementation aspects.

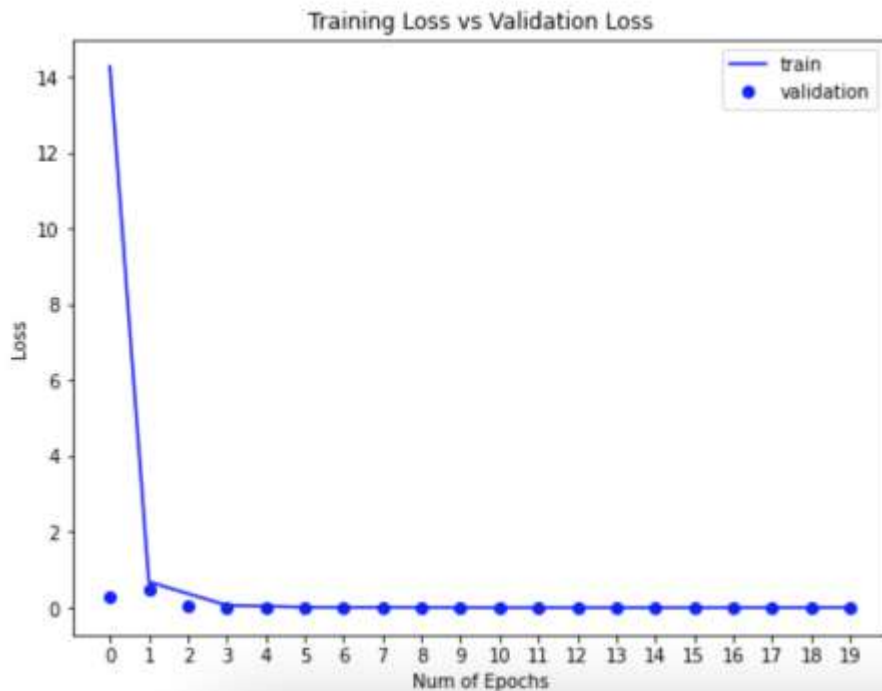
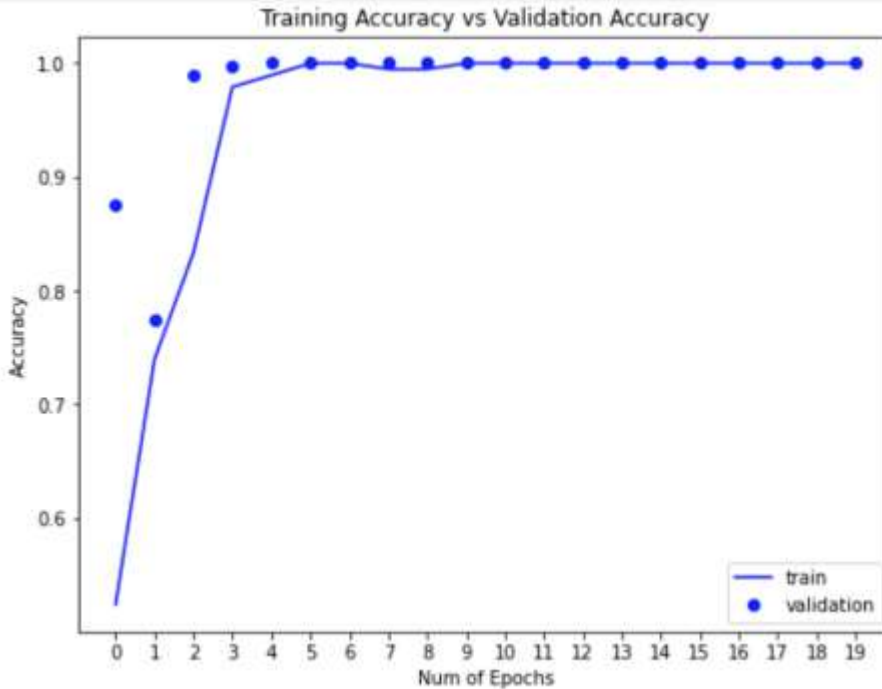
MODEL

Our model takes raw images as an input, so we used Convolutional Neural Networks (CNNs) to extract features, in result the model would consist from (features extraction), which was the same for full-color approach and gray-scale approach, it consist of 4 Convolutional layers with Relu activation function, each followed by Max Pooling layer.

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	(None, 256, 256, 3)	0
block1_conv1 (Conv2D)	(None, 256, 256, 64)	1792
block1_conv2 (Conv2D)	(None, 256, 256, 64)	36928
block1_pool (MaxPooling2D)	(None, 128, 128, 64)	0
block2_conv1 (Conv2D)	(None, 128, 128, 128)	73856
block2_conv2 (Conv2D)	(None, 128, 128, 128)	147584
block2_pool (MaxPooling2D)	(None, 64, 64, 128)	0
block3_conv1 (Conv2D)	(None, 64, 64, 256)	295168
block3_conv2 (Conv2D)	(None, 64, 64, 256)	590080
block3_conv3 (Conv2D)	(None, 64, 64, 256)	590080
block3_pool (MaxPooling2D)	(None, 32, 32, 256)	0
block4_conv1 (Conv2D)	(None, 32, 32, 512)	1180160
block4_conv2 (Conv2D)	(None, 32, 32, 512)	2359808
block4_conv3 (Conv2D)	(None, 32, 32, 512)	2359808
block4_pool (MaxPooling2D)	(None, 16, 16, 512)	0
block5_conv1 (Conv2D)	(None, 16, 16, 512)	2359808
block5_conv2 (Conv2D)	(None, 16, 16, 512)	2359808
block5_conv3 (Conv2D)	(None, 16, 16, 512)	2359808
block5_pool (MaxPooling2D)	(None, 8, 8, 512)	0
global_max_pooling2d_1 (Glob	(None, 512)	0
dense_1 (Dense)	(None, 2)	1026

SYSTEM EVALUATION

We used the original Strawberry dataset and we divided the data into training (70%), validation (30%). The training accuracy was 99.99% and the validation accuracy was 100%.



CONCLUSION

We proposed a solution to help people determine the type of Strawberry more accurately, 100% accurately for your best model, builds a model using deep learning convolutional neural networks and uses this model to predict the type of (previously unseen) images of Strawberry with a network from 4 layers and a dropout of 0.2, that takes Strawberry images with 2 different species as an input.

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