COMPARATIVE STUDY BETWEEN DIFFERENT ARCHITECTURE OF CNN FOR POTATO DISEASES CLASSIFICATION

TEAM 4
Final PPT

IIT Madras

DEPARTMENT OF MATHEMATICS
APRIL,25,2023

Outline

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Introduction

- Agriculture is India's most important economic sector. Agriculture is the principal means of subsistence for approximately 70 percent of the world's inhabitants
- The process of diagnosing the illness before it worsens and extends to other plants across the field is a massive undertaking in and of itself.
- At the present, industry professionals are frequently required to identify potato infections directly, which is a process that is both time demanding and prone to errors
- It requires a significant amount of time and effort to examine each plant for illness and, if it does, to identify the specific type of illness that the plant is suffering from. In addition, not every form of illness can be accurately recognised by simply using a person's naked sight.
- As a result, we have recommended using artificial intelligence to diagnose plant diseases and to automate the complete system.
- An automated system that makes use of computer vision to provide producers with assistance in recognising plant illnesses

Motivation

Punjab: Late blight disease symptoms in potato crop, PAU issues advisory

A Punjab Agricultural University spokesperson said symptoms of the disease have been in fields across Hoshiarpur, Gurdaspur, and Ropar, and the most probable reason for this is intermittent rain, which has created favourable weather for late blight growth.

By: Express News Service
Ludhiana | Updated: December 17, 2019 17:12 IST

NewsGuard

Late blight attack has potato growers worried in Ambala

Cases of fungal infection reported from Jawahargarh, Halderi villages

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Updated At: Dec 25, 2019 08:03 AM (IST)

797

Plant peril: Much like Covid-19 pandemic, an outbreak of diseases among plants is also real

Plant pathogens usually do not infect humans directly, and the harm is generally in the form of food insecurity.

Written by Shubhangi Shah

January 22, 2023 01:30 IST

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Potato disease: Late blight attack worries growers; state govt sends team to 3 districts

By Oneindia Staff Correspondent | Published: Wednesday, January 22, 2020, 11:05 [IST]

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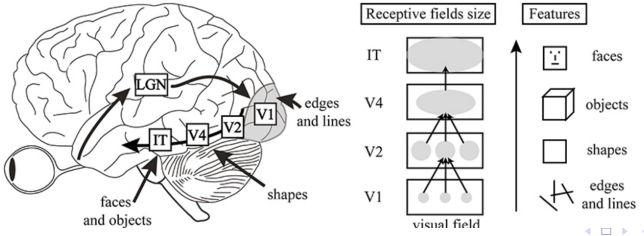
Deep Learning - CNN

- DL stands for deep learning and is a subfield of machine learning. Its primary applications are in the areas of picture categorization, object detection, and natural language processing.
- The multilayer perceptron, the CNN, and the recurrent neural network are the three most common kinds of networks used today.
- CNN stands for Convolutional Neural Network, which is a type of deep learning architecture commonly used for image recognition, classification, and other computer vision tasks.



Deep Learning - CNN

One of the key advantages of CNNs is that they can learn hierarchical representations of the input data, where lower-level features such as edges and corners are combined to form higher-level features such as shapes and textures. This allows CNNs to achieve high accuracy on image recognition tasks, often surpassing human performance.

Overview of process:

1. The first layer is typically a convolutional layer, which applies filters to the input image to extract features
2. The resulting feature maps are then passed through a pooling layer, which reduces their size by downsampling.
3. The process of applying convolutional and pooling layers is repeated several times to extract increasingly abstract and high-level features from the input image.
4. Finally, the feature maps are flattened and fed into one or more fully connected layers, which perform the classification or regression task.

Image Classification Problem

- Image classification is a popular task in deep learning, where the goal is to classify an input image into one of several predefined categories or classes.
- To solve an image classification problem, a deep learning model is trained on a labeled dataset of images, where each image is labeled with its corresponding class.
- The model learns to extract relevant features from the input image and use them to predict the correct class.
- Model is designed to automatically learn hierarchical representations of the input image, from low-level features such as edges and corners, to high-level features such as shapes and textures

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Objective

The research shows that CNNs have seen widespread application in the field of plant disease categorization, and a number of different architectures for CNNs have been suggested. On the other hand, to the best of our knowledge, there is a dearth of research on the comparative analysis of various CNN architectures for the categorization of potato diseases. Comparing the efficacy of Vgg-16 and AlexNet for potato illness classification is the focus of this research project, the overarching goal of which is to close this knowledge deficit. The purpose of this project, which is labelled "Comparative Study Between Different Architecture Of CNN For Potato Diseases Classification," is to investigate and evaluate the efficacy of a number of different convolutional neural network (CNN) architectures with regard to the categorization of potato illnesses.

Questions

The following items make up the particular goals of this project:

- **RQ1** Which is the better CNN architectures for classifying potato diseases VGG-16 or AlexNet?
- **RQ2** What is the behavior of each CNN architectures is it Overfit, Underfit or Goodfit?
- **RQ3** What is the advantage of using these computer vision techniques then tranditional techniques?

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Methodology

Below is the flowchart for the methodology used:

- Data collection
- Data preprocessing
- Model selection
- Evaluation
- Comparison
- Interpretation

Data Collection

The first thing that needs to be done is to gather a collection of potato disease pictures, which will later be used to both train and evaluate the CNN models. We have taken "PlantVillage" Dataset. It includes 2152 pictures that are divided into three categories, which are titled "Potato healthy," "Potato early blight," and "Potato late blight."

1. Training Dataset : that will be utilised during training for the object in question
2. Validation Dataset: A dataset that will be evaluated in comparison to the object being trained evaluate:
3. Test Dataset: that will be used to evaluate a model against after it has been trained.

Data Preprocessing

- The dataset should be preprocessed to ensure that the images are of the same size, and the background is removed.
- The images should also be normalized to ensure that they are in the same range of values.
- We will be using the Keras library to build model architecture of Vgg-16 and AlexNet.
- Data augmentation is implemented, To boosts the accuracy of our model by augmenting the data.

ALEXNET ARCHITECTURE

Architecture

The architecture of AlexNet consists of eight layers, including five convolutional layers and three fully connected layers. The convolutional layers use larger 11x11 filters with a stride of 4 pixels, which allows for the detection of larger and more complex features. The network also uses overlapping max-pooling layers after every two convolutional layers to reduce the spatial dimensions of the feature maps.

MAX POOLING LAYER

- The max pooling layer works by partitioning the input image into non-overlapping rectangular regions (also known as pooling regions or pooling windows), and then taking the maximum value within each region
- The main purpose of this operation is to reduce the spatial dimensionality of the input, while retaining the most important features.
- The output of the max pooling layer is a downsampled version of the input, it has fewer neurons and is computationally less expensive than the convolutional layer.

DROPOUT LAYER

- Dropout is a regularization technique used in neural networks to prevent overfitting. It works by randomly dropping out (setting to zero) a percentage of the neurons in a layer during each training iteration. The dropout layer is typically inserted after a fully connected layer, but can also be used after a convolutional layer.
- The purpose of dropout is to prevent overfitting by reducing the complex co-adaptations that can occur between neurons in a layer. By randomly dropping out neurons during training, the network is forced to learn more robust features that are not dependent on the presence of specific neurons.

VGG 16 ARCHITECTURE

Architecture

The architecture of VGG16 consists of 16 layers, including 13 convolutional layers and 3 fully connected layers. The convolutional layers have small 3x3 filters and the depth of the network increases gradually from 64 to 512 filters in the last few layers. The network also uses max-pooling layers after every two or three convolutional layers to reduce the spatial dimensions of the feature maps.

COMPARISON BETWEEN VGG16 AND ALEXNET

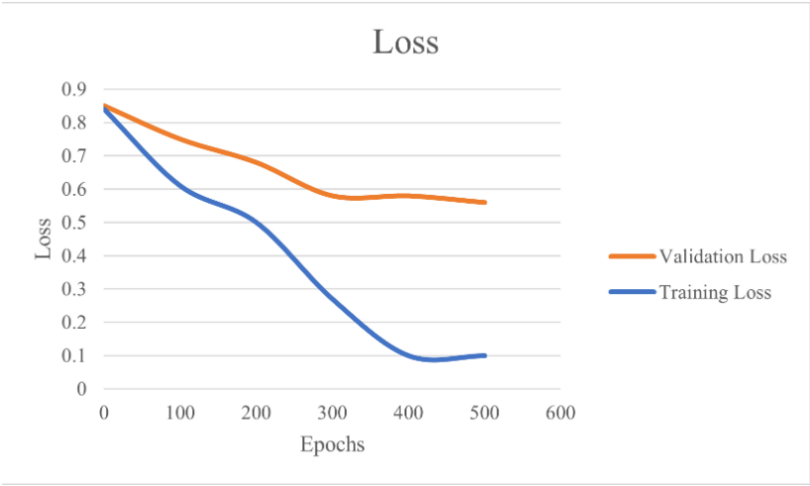
- VGG16 has a deeper architecture than AlexNet, with up to 16 layers, compared to AlexNet's 8 layers. The increased depth allows VGG to learn more complex features and relationships in the input images, which can lead to improved accuracy.
- VGG16 uses smaller filter sizes (3x3) compared to AlexNet (11x11). The smaller filter size allows VGG to learn more localized and discriminative features in the input images, which can lead to better performance.
- VGG16 uses a homogeneous architecture, with all layers consisting of the same filter size and the same padding, which makes the network easier to understand and optimize. In contrast, AlexNet uses a heterogeneous architecture, with different filter sizes and strides in different layers.

MODEL EVALUATION

- Learning curve is just a plot showing the progress over the experience of a specific metric related to learning during the training of a model. They are just a mathematical representation of the learning process.
- Training loss is a metric used to assess how a deep learning model fits the training data. That is to say, it assesses the error of the model on the training set.
- Validation Loss is a metric used to assess the performance of a deep learning model on the validation set. The validation loss is similar to the training loss and is calculated from a sum of the errors for each example in the validation set.

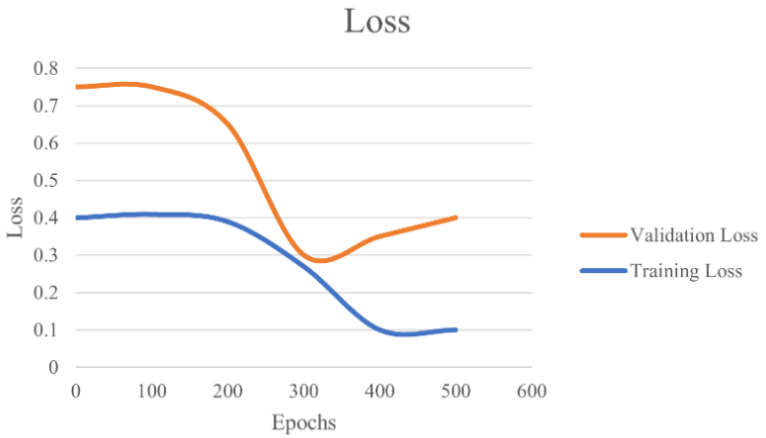
- **Under Fit Model**

  When the algorithm is not able to model either training data or new data, consistently

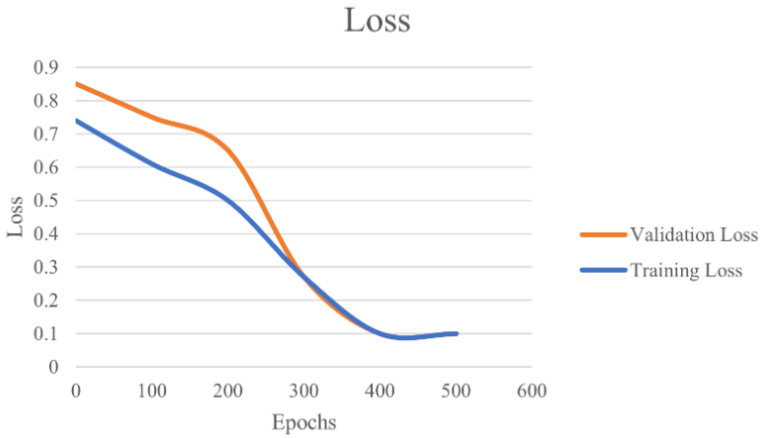


obtaining high error values that don't decrease over time

- **Over Fit Model**
  The algorithm captures well the training data, but it performs poorly on new data, so it's not able to generalize



- **Good Fit Model**
  The algorithm captures well the training data and on new data, so it's able to generalize



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Results

Using Standard GPU of 'Google Colab' we got,

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VGG16

- Run Time: 33min 4sec
- Accuracy:94.14 $\%$

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VGG16

- Run Time: 33min 4sec
- Accuracy:94.14 $\%$

AlexNet

- Run Time: 13min 29sec
- Accuracy: 62.11$\%$

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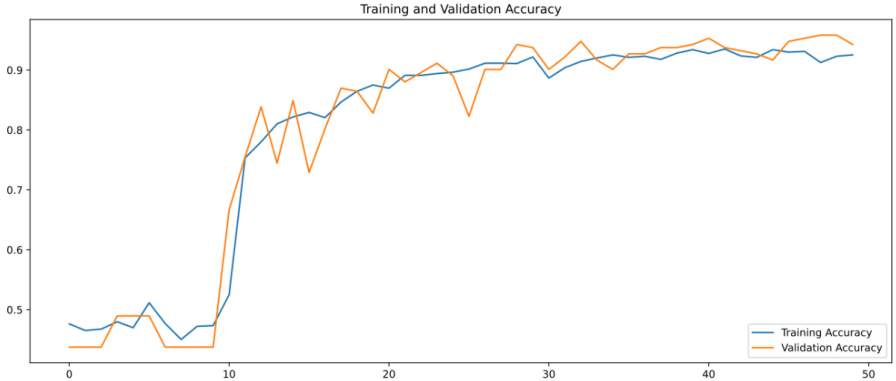
VGG16:Training vs Validation (Loss)

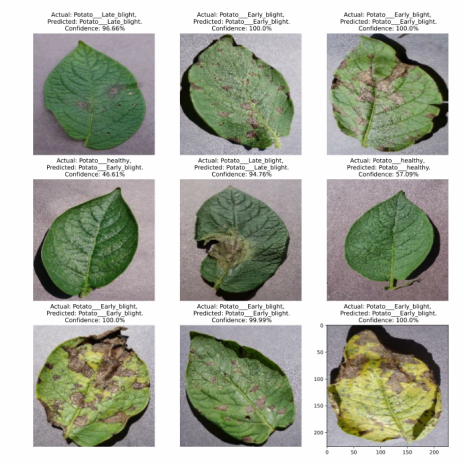
Training And Validation Loss

VGG16:Training vs Validation (Accuracy)



Training And Validation Accuracy

VGG16:Predictions

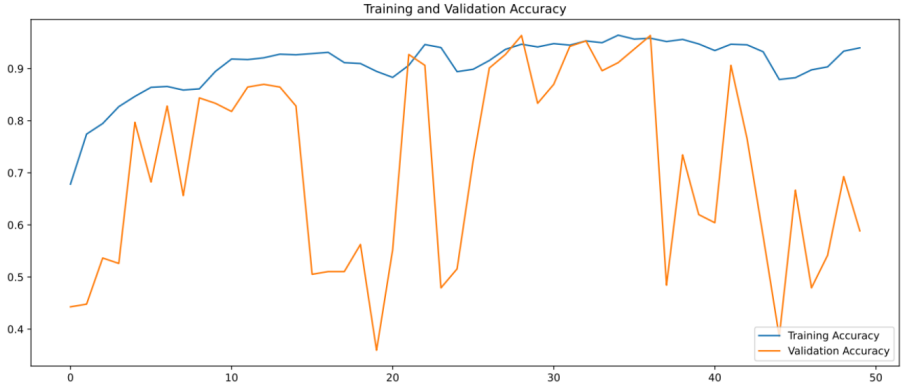


Actual vs predicted with model Confidence

AlexNet:Training vs Validation (Accuracy)

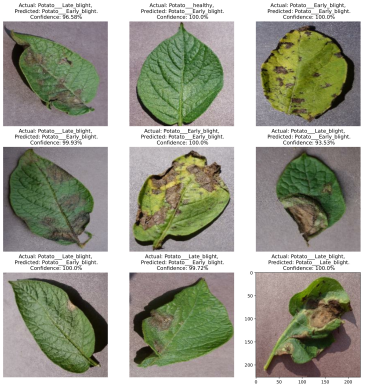
Training And Validation Loss

AlexNet:Training vs Validation (Accuracy)



Training And Validation Accuracy

AlexNet:Predictions



Actual vs predicted with model Confidence

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Conclusion

Thus this project provides the detailed analysis of the 2 models in CNN architectures considering the different parameters taken into consideration while predicting the output of the image. As discussed above in result section we get VGG16 outperform AlexNet in terms of accuracy. So, VGG16 is better for potato disease classification than AlexNet.

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AlexNet is Overfit model behaviour that is The algorithm captures well the training data, but it performs poorly on new data, so it's not able to generalize.
Computer vision techniques offer several advantages over traditional techniques, including speed, accuracy, consistency, adaptability, scalability, and cost-effectiveness, making them ideal for a wide range of applications in various industries.

[1] F. al Heeti, M. Ilyas. 2022 2nd International Conference on Computing and Machine Intelligence, ICMI 2022. Comparative analysis of convolutional neural network architectures for classification of plant leaf diseases. 2022 2nd International Conference on Computing and Machine Intelligence (ICMI), Istanbul, Turkey, 2022, pp. 1-5, doi: 10.1109/ICMI55296.2022.9873752.

[2] B. Chellapandi and S. Chopra, "Comparison of Pre-Trained Models Using Transfer Learning for Detecting Plant Disease," pp. 383–387, 2021. Computers and Electronics in Agriculture, vol. 145, pp. 311- 318, 2018. 3. K. P. Ferentinos, "Deep learning models for plant disease detection and diagnosis," Comput. Electron. Agric., vol. 145, no. September 2017, pp. 311–318, 2018, doi: 10.1016/j.compag.2018.01.009.

[3] K. P. Ferentinos, "Deep learning models for plant disease detection and diagnosis," Comput. Electron. Agric., vol. 145, no. September 2017, pp. 311–318, 2018, doi: 10.1016/j.compag.2018.01.009.

[4] X. Li, L. Rai, and I. Engineering, "Apple Leaf Disease Identification and Classification using ResNet Models," pp. 738–742, 2020.

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The End

THANK YOU