Assignment 04 on CNN

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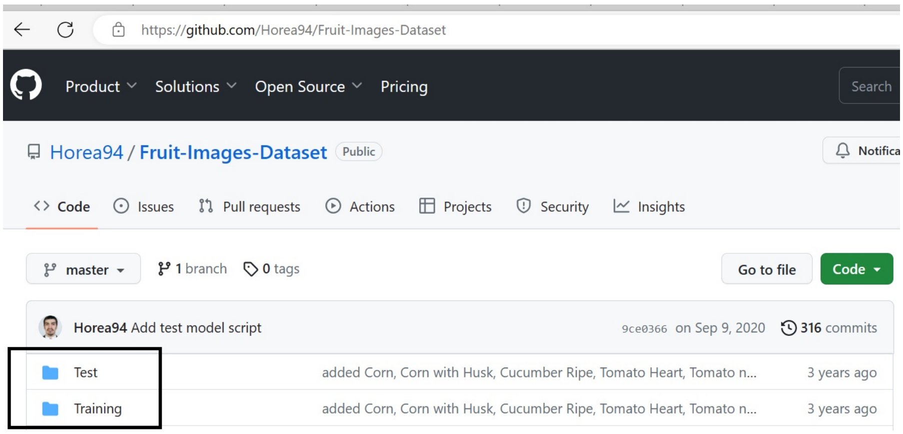
You are given a data-set of images containing different types of fruits such as apples, oranges, and bananas. Your task is to build a Convolutional Neural Network (CNN)-based image classifier that can classify the images into their respective fruit categories.
Dataset:
The dataset contains a total of 90483 images, containing fruits and vegetables:
You can download the dataset from this link: Fruit classification data-set.
The dataset contain many fruit and vegetable classes. To simplify the process, we are going to select three classes namely Apple (different varieties), Cherry (different varieties), Bananas (different varieties).

Requirements:

1. The data set is divide in to training and testing images ans stored in two folders namely "Test" and "Training" as shown in Fig. 1.



Horea94 Add test model script 9ce0366 on Sep 9, 2020 316 commits

Test	added Corn, Corn with Husk, Cucumber Ripe, Tomato Heart, Tomato n...	3 years ago
Training	added Corn, Corn with Husk, Cucumber Ripe, Tomato Heart, Tomato n...	3 years ago

Figure 1: Data-set arrangement.

Now, select 600 images for each class in training folder and 400 images in each classes in testing folder. You are free to select the images based on your choice. Now, select 200 images from the testing folder as test images and other 200 images as validation images (i.e., we have training, validation, and testing sets with the following ratios: 60% training, 20% validation, and 20% testing.)

2. Pre-processing

   - Preprocess the dataset by resizing the images to 64x64 pixels and normalizing the pixel values.

3. Build the CNN model: Design a CNN model architecture with multiple convolutional layers, pooling layers, and fully connected layers. Here, our objective is to classify the images into their respective fruit categories. The selection of hyperparameters in a CNN can have a significant impact on the performance of the network. For instance, the number of convolutional layers, kernel size, number of filters, pooling size, learning rate, dropout rate, batch size, and number of epochs

all affect the accuracy and generalization ability of the CNN for image classification tasks. In the following, important hyperparameters are listed. Discuss their impact to the performance of the CNN in your report. State your selected configuration for these hyperparameters with justifications[1]

- Number of convolutional layers
- Kernel size
- Number of filters in each convolutional layer
- Pooling size
- Learning rate
- Dropout rate
- Batch size
- Number of epochs
- Activation function (e.g., ReLU, sigmoid, and tanh)
- Optimizer (e.g., SGD, Adam, and RMSprop)

4. Train the CNN model using the training set with an appropriate optimizer and loss function. Monitor the training process using accuracy and loss metrics. Save the best model based on validation accuracy.

5. Fine-tune the model by adjusting the hyper-parameters or adding more layers to improve its performance. Save the best model based on validation accuracy.

6. Evaluate the model: Evaluate the trained model on the validation set using accuracy, precision, recall, and F1-score as evaluation metrics. Analyze the performance of the model and discuss the results.

7. Present the results: Test the final model on the testing set and prepare a report summarizing the CNN model architecture, training process, evaluation results, and any improvements made to the model. Include visualizations, such as accuracy and loss curves, and sample predictions to showcase and the performance of the model.

GitHub Profile

You must include the link to your GitHub (or some other SVN) profile, so that I can see that you have worked on this assignment over a reasonable duration. Therefore, make commits regularly. However, I will use only the pdf for grading to save time.

Submission

Upload a report (eight pages or less) named as your_index_a04.pdf. Include the index number and the name within the pdf as well. The report must include architecture of the DNN and explain why you used this architecture, the performance of the model and important parts of code. The interpretation of results and the discussion are important in the report. Extra-page penalty is 2 marks per page.

Additional resources

- MIT Deep Learning
  - Slides: MIT Introduction to deep learning

[1] Typically, a grid search or random search can be used to explore different hyperparameter values and configurations, while a validation set can be used to evaluate the performance of each configuration and avoid overfitting to the training data. Additionally, it is important to consider the size and complexity of the dataset when selecting hyperparameters. For instance, a larger dataset may require a deeper network with more filters, while a smaller dataset may require a shallower network with fewer filters to avoid overfitting.

  - Video: MIT Introduction to deep learning
  - Slides: MIT: Convolutional Neural Networks
  - Video: MIT: Convolutional Neural Networks

- Stanford-CNN for visual recognition

- Tensorflow tutorials