Intro To Deep Learning

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Land Cover Classification using Deep Neural Networks

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Overview

General Explanation:

This project is based on deep neural networks from the field of deep learning. The goal of the project is to build and train a ConvNet model to classify satellite images according to land type, with 10 possible classifications. Within the framework of the project, several CNN models were trained, and finally, the model with the best performance was selected.

Data:

27,000 images of size 64x64x3 (each pixel = 10 meters)
Images were taken from the EuroSAT dataset

Part A of the Project:

- Training several different models using images from the EuroSAT dataset.
- Selecting the model with the best performance.

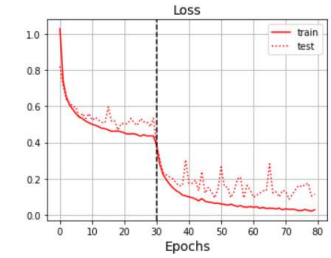
Part B of the Project:

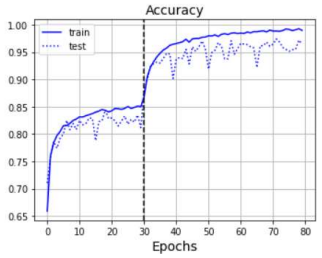
Dividing a satellite image of the city of Caesarea (704x704x3) into 64x64x3 patches, classifying them using the model, and producing two outputs: An image showing the classification of each patch relative to the original image. Images showing the probability of each classification relative to the original image.

Models' Results

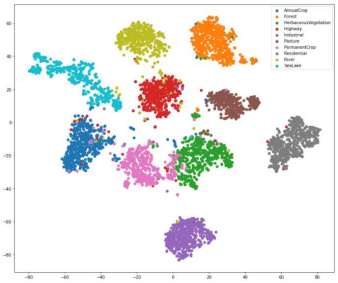
Model	Epochs	Train accuracy	Test accuracy	Notes
CNN - m1 Model	50	97.24%	90.59%	Overfitted
VGG 16+transfer learning - m2 Model	50	94.56%	88.05%	
VGG16 + Data augmentation + Transfer learning + Fine tuning -m3 Model	80	98.95%	96.46%	Best Results

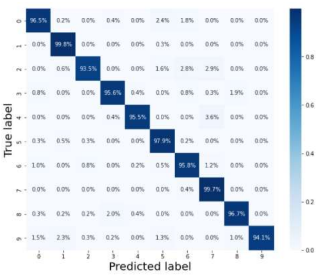
Third Model's Performance





Confusion Matrix





Stages of Work

Part A:

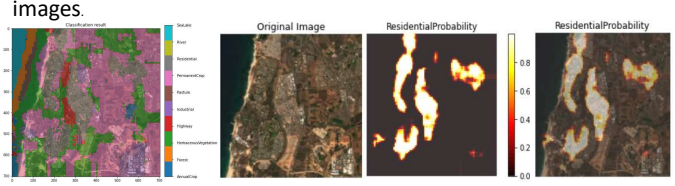
1. Downloaded EuroSAT training images, normalized them, and split data into 80% training and 20% validation.
2. Built and trained three ConvNet models:

- **ConvNet**: A model with 3 blocks + Dense layer with Softmax for 10-category classification. Parameters: epochs=50, batch_size=64, optimizer='adam'.
- **VGG16 + Transfer Learning**: Used pre-trained VGG16, modified input to 64x64x3, froze weights, removed original TOP layer, and added a custom TOP layer for classification. Parameters: epochs=50, batch_size=64, optimizer='adam'.
- **VGG16 + Data Augmentation + Transfer Learning + Fine Tuning**: Added augmentation layer to prevent overfitting, used modified VGG16 (64x64x3 input, custom TOP layer). Trained in two stages:
  Stage 1: Transfer Learning with frozen VGG16 weights for 30 epochs, batch_size=64.
  Stage 2: Unfroze VGG16 weights, trained for 50 epochs, batch_size=64, learning_rate=0.00001.

Model 3 was selected as the best classifier after result analysis.

Part B

Imported a 704x704x3 satellite image of Caesarea and prepared it for Model 3 classification.
Divided the image into 64x64x3 patches with overlap (step=8).
Sent each patch to Model 3 for classification and class probabilities.
Reassembled patches to create a full classification image.
Generated probability images for each class at the original image size.
Visualized the original image, classification image, and probability images.



Sources:

https://www.youtube.com/watch?v=LM9yisNYfyw
https://www.youtube.com/watch?v=jvZm8REF2KY
https://www.kaggle.com/nilesh789/land-cover-classification-with-eurosat-dataset#Land-Cover-Classification-with-EuroSAT-Dataset