Task

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Fusion for Classification

Objective: The objective of this task is to use a fusion strategy to improve the classification result on a synthetic dataset.

Fusion for Classification

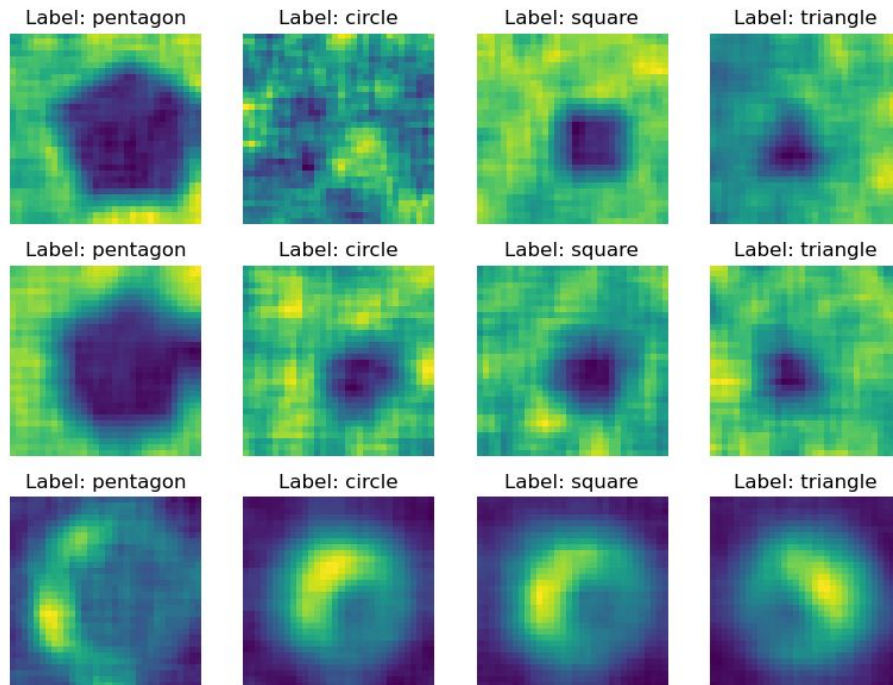The synthetic dataset consists 1000 Instances.

Every Instance consists of three 32x32 images depicting one of four geometric shapes (pentagon, circle, square, triangle).

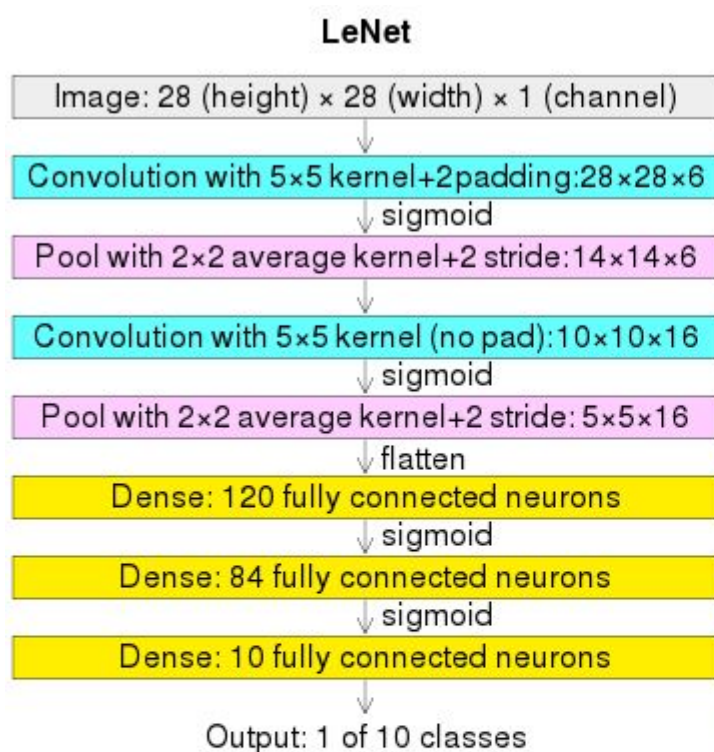Image 1 - gradient background
Image 2 - noise background
Image 3 - spotlight background

The challenge is to correctly classify these shapes, which provides a good opportunity to gain deeper insights into image processing and machine learning.

Label: pentagon   Label: circle   Label: square   Label: triangle

Label: pentagon   Label: circle   Label: square   Label: triangle

Label: pentagon   Label: circle   Label: square   Label: triangle

Fusion for Classification

LeNet-5 consists of several layers, alternating between convolutional layers and subsampling or pooling layers, followed by fully connected layers and an output layer.

LeNet

Image: 28 (height) × 28 (width) × 1 (channel)

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Convolution with 5×5 kernel+2padding:28×28×6

↓ sigmoid

Pool with 2×2 average kernel+2 stride:14×14×6

↓

Convolution with 5×5 kernel (no pad):10×10×16

↓ sigmoid

Pool with 2×2 average kernel+2 stride: 5×5×16

↓ flatten

Dense: 120 fully connected neurons

↓ sigmoid

Dense: 84 fully connected neurons

↓ sigmoid

| Dense: 10 fully connected neurons |
| --- |

↓

Output: 1 of 10 classes

1. Step - Change LeNet

Change the Hyperparameters of LeNet such that it can handle 32x32 Images and classify for 4 classes (pentagon, circle, square, triangle).

2. Step - Train and Evaluate LeNet without Fusion

First train without LeNet without data fusion on all three image folders separately.

This performance will be used as benchmark to evaluate the improvement by fusion.

Confusion Matrix - LeNet on img1
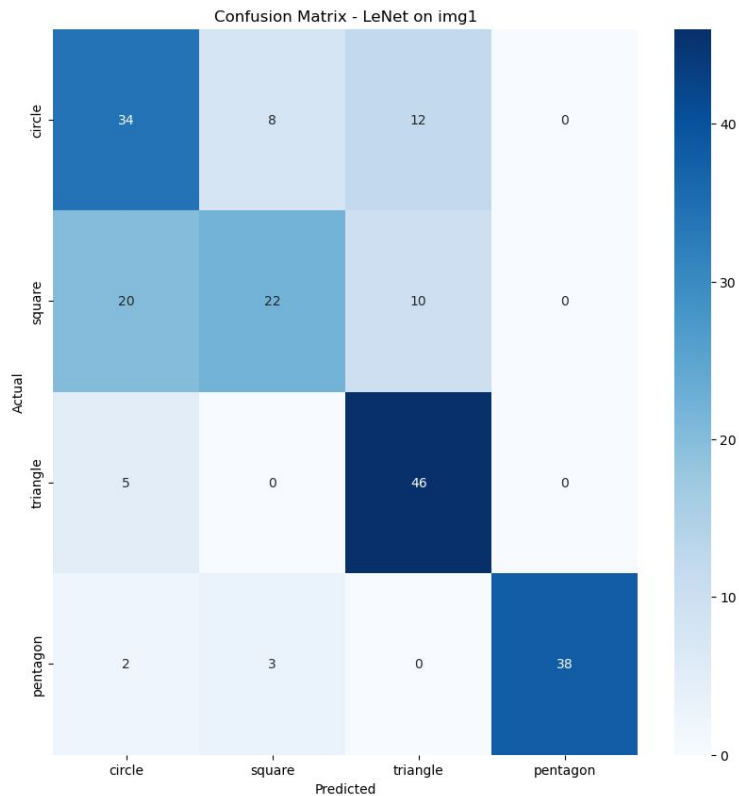
3. Step - Fusion

Implement these Fusion Strategies:

- Low-Level Fusion
- High-Level Fusion

Alternatively you implement:

- Mid-Level Fusion

What strategy you use is up to you. But you have to implement either Low AND High Level Fusion OR alternatively you implement a Mid-Level Fusion.

4. Step - Train and Evaluate LeNet with Fusion

Train LeNet with your fusion strategy using both image folders.

Compare the classification performance using fusion with the performance of Step 2.

Confusion Matrix - Low Level
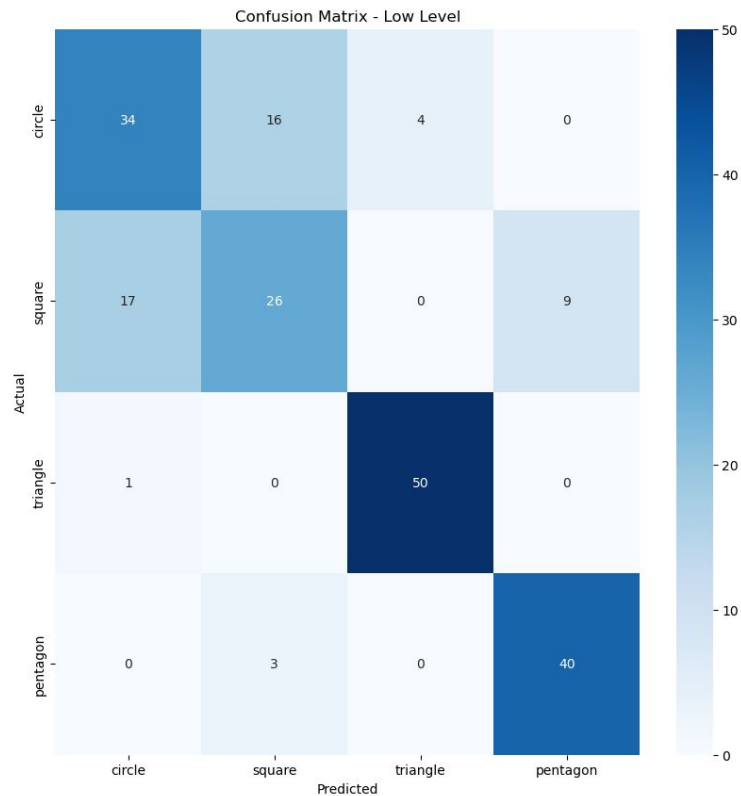
5. Step - Documentation

Documentation:

Analyze the accuracy of your classificators.

Document your methodology, including the chosen fusion strategies.

Discuss possible improvements and enhancements for your implementation.

Submission

You have to submit:

- Jupyter Notebook script - containing all your python methods, with a detailed description of your defined functions, classes and so on.
- Weights file - Containing the weights of your trained networks.
- Report - Describing the theoretical background of your fusion method and the discussion of the results. Max. 5 Pages - Everything beyond page 5 will not be read.
- Zip this in one file containing the jupyter notebook script and the report.

You have to submit this task till 01. July 2024.