

Birzeit University
Department of Electrical & Computer Engineering
First Semester, 2024/2025
ENCS5343 Computer Vision
Course Project
Due Date January 15, 2025

1. Objectives:

Use deep learning techniques to solve the problem given in the second assignment.

2. Tasks:

The assignment contains four main tasks defined as following:

Task 1: Build and train a custom CNN network. To build custom CNN, you need to define the following:

- Architecture:
 - Number of layers: The depth of the network, typically starting with 1 to 2 convolutional layers and gradually increasing for more complex tasks.
 - Types of layers: Convolutional layers, pooling layers (max, average, global), fully connected layers, and potentially other specialized layers (e.g., dropout, batch normalization).
 - Activation functions: ReLU (common choice), sigmoid, tanh, or others for specific needs.
- Convolutional Layer Parameters:
 - Number of filters: Controls the number of feature maps extracted at each layer. More filters can capture more features but increase computational cost.
 - Filter size: Determines the receptive field of the filters, often starting with 3x3 or 5x5 and increasing in deeper layers.
 - Stride: The step size of the filter movement, affecting the output size and computational complexity.
 - Padding: Zero-padding input images to preserve spatial dimensions and capture edge features.
- Pooling Layer Parameters:
 - Pool size: The size of the pooling window, common choices being 2x2 or 3x3.
 - Pool type: Max pooling or average pooling, each with different effects on feature preservation.
- Fully Connected Layer Parameters:
 - Number of neurons: Related to the complexity of the task and the number of classes for classification.
- Training Hyperparameters:
 - Learning rate: Controls how much the model's weights are updated during training.

- Batch size: The number of samples processed per training step, affecting gradient updates and convergence speed.
- Epochs: The number of times the model trains on the entire dataset.
- Optimizer: Algorithm for updating model weights (e.g., Adam, SGD, RMSprop).
- Regularization: Techniques to prevent overfitting (e.g., dropout, L1/L2 regularization).

For this task,

1. You must design and train various networks with hyperparameter tuning before selecting the simplest network that produces the best results.
2. For each model you trained, plot the Loss vs. Epoch number as well as the model's accuracy.

Task 2: Retrain the network selected from Task 1 after doing data augmentation.

Data augmentation is a powerful technique for enhancing the diversity and size of your training data without the need for additional data collection. By applying various transformations to existing data points, you can train models that generalize better to unseen examples and improve their overall performance.

In this task, you need to choose data augmentation techniques that are relevant to the data set provided and the task.

Plot the Loss vs. Epoch number as well as the model's accuracy. Compare the results obtained with the results of task 1.

Task 3: Choose a CNN network from well-known and published CNN architecture and train it with data augmentation. Plot the Loss vs. Epoch number as well as the model's accuracy. Compare the results obtained with the results of task 2.

Task 4: Use a pre-trained CNN network on similar tasks and choose the appropriate transfer learning method to fine tune the pretrained network on the given dataset. Plot the Loss vs. Epoch number as well as the model's accuracy. Compare the results obtained with the results of task 3.

3. Report

Write a comprehensive report that include the following:

1. Introduction

2. Experimental Setup and results

- Describe the evaluation methodology, including the datasets used, evaluation metrics, and experimental setup.
- Present the results of the evaluation, including accuracy and loss curve
- Analyze the effectiveness of using data augmentation, published CNN network, and the use of pretrained network.
- Results visualization, comparisons, discussion

3. Conclusion

- Summarize the key findings and achievements of the project
- Future work