ISTANBUL AREL UNIVERSITY
FACULTY OF ENGINEERING

EENL401-DEEP LEARNING AND CLASSIFICATION TECHNIQUES

PROJECT

Project Title: TRAFFIC SIGNS RECOGNITION

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1. INTRODUCTION

- **Objective:** The goal of this project is to develop a deep learning model capable of accurately recognizing traffic signs from the German Traffic Sign Recognition Benchmark (GTSRB) dataset. The model aims to assist autonomous driving and Advanced Driver Assistance Systems (ADAS) by interpreting traffic signs in real-time.

- **Motivation:** Automatic traffic sign recognition is crucial for improving road safety and reducing accidents caused by human error. It facilitates the development of autonomous vehicles and intelligent traffic systems, making roads safer and more efficient.

2. LITERATURE REVIEW

- Traditional methods for traffic sign recognition relied on handcrafted features and machine learning algorithms such as Support Vector Machines (SVMs) and k-

Nearest Neighbors (k-NN). However, these approaches struggled with complex variations in real-world data.

- Deep learning, particularly Convolutional Neural Networks (CNNs), has emerged as a superior approach for image recognition tasks. CNNs automatically extract hierarchical features, making them highly effective in recognizing traffic signs under varying conditions.

3. DATASET DESCRIPTION

- **Dataset Name**: German Traffic Sign Recognition Benchmark (GTSRB)
- **Source**: https://www.kaggle.com/datasets/meowmeowmeowmeowmeow/gtsrb-german-traffic-sign
  Example:
  More than 40 classes, 50,000 images in total,large, lifelike database
- **Features**: The dataset contains over 50,000 images classified into 43 traffic sign categories. Images vary in lighting, angle, and weather conditions, reflecting real-world challeng
- **Preprocessing:**
  Resizing: All images were resized to 30x30 pixels.
  Normalization: Pixel values were scaled to a range of 0 to 1.
  Data Augmentation: Techniques such as rotation, brightness adjustments, and zooming were applied to increase dataset diversity and improve model robustness.

4. METHODOLOGY

- **Model Selection**:
  A CNN architecture was chosen due to its ability to capture spatial hierarchies in image data.
- **Algorithms/Frameworks Used:**
  * TensorFlow and Keras for model implementation
  * Adam optimizer for training
  * Softmax activation for multi-class classification
- **Hyperparameters**:
  * *Batch size = 32*
  * *Learning rate = 0.001*
  * *Epochs = 20.*

5. CODE IMPLEMENTATION

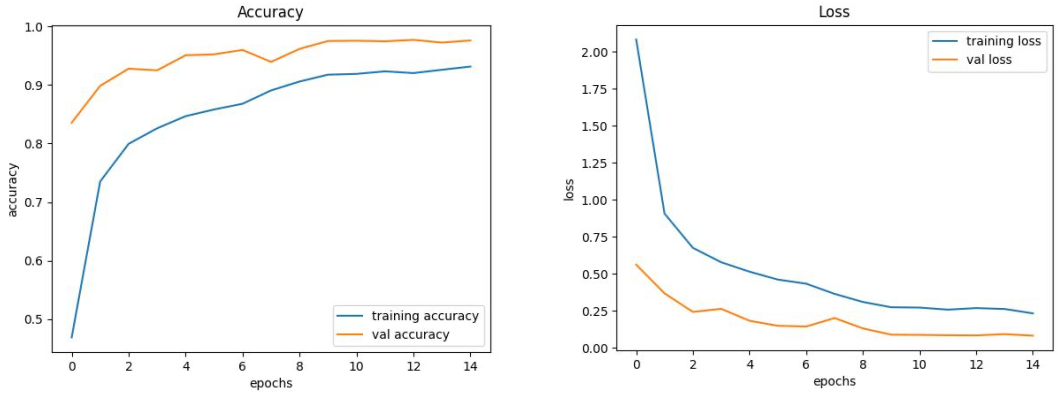
Main Sections of Code:

- **Data Loading and Preprocessing:**
  - Dataset imported and split into training, validation, and test sets.
  - Preprocessing steps applied to all subsets.
- **Model Definition and Compilation:**
  - CNN architecture defined with convolutional, pooling, and dropout layers.
  - Model compiled using categorical crossentropy loss and accuracy as a metric.
- **Model Training and Evaluation:**

- Model trained over 15 epochs with validation monitoring.
- Performance evaluated using the test set.

6. RESULTS and ANALYSIS

- **Accuracy and Loss Plots**: Training and validation accuracy steadily increased, while loss decreased over epochs, indicating effective learning and minimal overfitting.



- **Confusion Matrix**:
  * The confusion matrix showed high accuracy across most classes, with minor confusion between visually similar traffic signs.
  Example Predictions:
  *Correct Prediction: A 30 km/h speed limit sign was accurately classified.
  *Incorrect Prediction: A slight misclassification between a "No Entry" and "Yield" sign due to visual similarit

- **Summary:**
  *We successfully developed a CNN-based traffic sign recognition model with a user-friendly GUI for practical demonstration. Future work includes real-time video stream integration and multi-country traffic sign compatibility

7. DISCUSSION and CONCLUSION

- **Performance Evaluation**:
  * The model achieved high accuracy on the test set, demonstrating strong generalization. However, recognition under poor lighting conditions remains a challenge.
- **Challenges**:

- Handling class imbalances in the dataset.
- Distinguishing visually similar traffic signs.

- **Summarize your findings.**
  *We successfully developed a CNN-based traffic sign recognition model with a user-friendly GUI for practical demonstration. Future work includes real-time video stream integration and multi-country traffic sign compatibility.

9. REFERENCES

- German Traffic Sign Recognition Benchmark (GTSRB) Dataset: https://www.kaggle.com/datasets/meowmeowmeowmeowmeow/gtsrb-german-traffic-sign
- Deep Learning with Python by François Chollet
- TensorFlow Documentation: https://www.tensorflow.org/