FINAL PROJECT – FUNDAMENTALS OF DEEP LEARNING
March 2024

PART 1 – PREDICTING ACCIDENT SEVERITY

Road accidents are a significant global concern, causing immense human and economic losses. Accurately predicting accident severity plays a crucial role in emergency response, resource allocation, and accident prevention strategies.

In this project you will deliver a functional deep learning model capable of predicting accident severity from images with high accuracy. This type of model can potentially be integrated into existing systems, supporting stakeholders like emergency services, insurance companies, and transportation agencies in their efforts to improve road safety and mitigate the consequences of accidents.

This project will involve the following key steps:

Specific requirements:

1. **MLP + CONVOLUTIONAL NEURAL NETWORKS**
    - **a.** Load the dataset **Accident-Severity** and process the data (if required) in terms of normalization, no. of color channels, etc.
    - **b.** Train three different Multi-layer perceptron networks, explain the procedure and decisions taken to define the architectures. Show the number of parameters estimated and compare the results in terms of performance and architecture. (No. of layers, parameters, etc.)
    - **c.** Create ConvNets to explore:
        - **i.** Run different experiments to find a good CNN. (Consider processing limitations and accuracy performance) Explain the procedure and decisions taken to define the best network settings. Consider the best practices explained in class. Compare loss and accuracy for the different models and train vs. test sets.
        - ii. Perform data augmentation and train again a CNN. Explain your procedure. (You can use image preprocessing layers from keras or create a customized data augmentation. You can apply the preprocessing layers to the dataset or include the preprocessing layer as part of the model)
        - iii. Use two interpretability techniques to explain the decisions of your best performing model. You can include techniques not covered during the class example. Reference https://arxiv.org/pdf/2004.14545.pdf
    - **d.** Use transfer learning to create a new model. Please explain the reasons why you chose a certain model and the adjustments you have made. (You can use one of the pretrained models from keras: https://keras.io/api/applications/)
    - **e.** Make a conclusion comparing your results (MLP, CNN's and each variation).

PART 2 - EXPLORING RNNS & CNNS FOR A SEQUENCE PREDICTION TASK

This project delves into the application of two prominent deep learning architectures: Recurrent Neural Networks (RNNs) and Convolutional Neural Networks (CNNs). We aim to explore their suitability for a specific sequence prediction task using a chosen dataset.

a. **Dataset and RNN Selection:** Find a Dataset where you can apply RNN's.
   Dataset: Specify the chosen dataset, with details of **description**, **source**, **task category**, and explain **why it is appropriate to apply RNN's** in this case
   Note: Task Type falls under the category of many-to-many, one-to-many, etc.

b. **RNN Experimentation and Attention:** Conduct experiments by training and evaluating various RNN architectures, including LSTMs and GRUs, with different hyperparameter configurations (e.g., number of layers, units per layer). Apply attention and memory to the best performing model. Compare the results and show how the attention mechanism is working (examples).

c. **CNN Comparison:** Develop and train a relevant CNN architecture appropriate for the same dataset. Compare the performance of the best-performing RNN model with the CNN and Explain the differences in the architecture.

Deliverables:

- Notebook including all the code to support your results and conclusions.
    - You should provide all the code required to be able to replicate the experiments and sufficient documentation to understand the steps and choices you made.

- A detailed report:
    - Include plots, examples and all the information you consider relevant to support your results.
    - Describe the steps and motivation of the choices you made in developing the various models.
    - There is no page limit to your report, but it should be both concise and sufficient.

Hand-in: 5th April 2024

Don't forget to include all the sources and references used during the project.

Follow the IESEG ANTI-PLAGIARISM POLICY - An adapted version for an Age of Generative Artificial Intelligence