Visual Intelligence – Project

Objective

This project aims to implement a 2D Convolutional Neural Network (CNN) and a ScatNet for image classification. You should compare the performance of these two models to understand which is the best for the task under analysis. After that, you must display and compare the filters extracted from the CNN (first convolutional layer) and the ScatNet. Then, you have to implement the eXplainable AI method assigned to you and extract the attribution maps for both models.

Guidelines to follow:

1. Send an email to us if you want to do the exam, and then we will assign you an eXplainable AI method to analyze
2. Split the dataset into train and test sets
3. Implement the Convolutional Neural Network
4. Perform k-fold cross validation to assess the model's generalization ability and compute the mean accuracy and the mean F1 score across the k-folds on the training set
5. Implement the ScatNet using the same classifier used for the CNN (e.g., if in the CNN you have defined three fully connected layers for the classifier, you have to use the same classifier also for the ScatNet. The number of input neurons could be different)
6. Perform k-fold cross validation also for the ScatNet like the point 3 for the CNN, and extract the mean accuracy and F1 score across the k-folds
7. Extract the filters from both models and compare them
8. Implement the eXplainable AI method from scratch
9. Extract the attribution maps using the implemented method and the same method from the Captum library
10. Comment the results you obtained

Dataset:

The dataset is publically available on Kaggle at this link:
https://www.kaggle.com/datasets/rm1000/lung-cancer-histopathological-images
The dataset contains images from three types of lung cancer (three classes). You must select only two classes in order to perform a binary classification: adenocarcinoma and benign.
FYI, the original dataset was published here:
https://arxiv.org/abs/1912.12142v1
https://github.com/tampapath/lung_colon_image_set

Other info

Send an email to us for the eXplainable AI method are:

- Prof. Gloria Menegaz: gloria.menegaz@univr.it
- Giorgio Dolci: giorgio.dolci@univr.it

Display, where necessary, the charts that are useful for interpreting the results (e.g., learning curves and filters).

You can choose to develop your project using Matlab or Python.

All implementation details are the student's choice (e.g., you should choose the architecture of the CNN, the classifier, etc.).

If the filters do not have good shapes, try to add data augmentation.

A classification performance of at least 70% in accuracy is required.

Report, code, and Presentation:

- You are required to write a report from 6 to 8 pages where you should discuss your implementation choice and the results obtained (in this report, you should also insert useful figures)
- Provide all the implemented code used in the project, and during the oral interview, will be required to test the code to assess that everything works
- You must create a presentation (max 18 minutes) for an interview where you should highlight the most important parts of the projects (implementation details and results). Additionally, some questions about the all-theory program can be requested during the oral interview

N.B.: The project can also be done in a group of up to 3 students.

N.B.: Produce the results, figure, and analysis thinking about the problem you are solving to produce valuable and meaningful outcomes (e.g., the learning curves should be in the same figure for the train and validation sets for a more straightforward comparison).

N.B.: The report, presentation, and code must be in English and well formatted. Organized sections in the presentation and report are mandatory, and unclear or disorganized code will not be evaluated. The guidelines for the report and presentation (e.g., the number of pages and minutes for the presentation) must be met, otherwise, the final grade will be penalized.