Block 3 project tasks

Tasks:
- Custom CNN.
- Experiments.
- Interpretability.
- Transfer learning.
- Open project.

Task 1: Custom CNN

Create a CNN model on the [CIFAR10 dataset](). Then:

- Study memory requirements and computational load of each layer. Reason the differences between layers of different types.

Task 2: Experiments

- Using task 1 model, study the impact of:
  - Data augmentation.
  - Size of training batch.
  - Batch normalization.
  - Force overfit and solve it using any method to control the complexity of the model.

Note: Use train and validation curves and present the results using tables and plots.

Task 3: Interpretability

- Using:
  - Our custom CNN used in task 1 and 2.
  - A Pre trained model: [VGG16](VGG16)
  - The CIFAR 10 dataset.
- Visualize
  - Filters.
  - Activations.
- Get top k-samples per unit.
- Show t-SNE plot on each of the Dense/Linear/Fully Connected layer. Give semantic interpretation.

Task 4: Transfer learning

- Train a custom CNN over [Terrassa 900 dataset](#) (v.2019) (use 70% train and 30% validation).
  - Report any issue you find.
  - Do not spend too much time on improving the model.
- Feature extractor: Train a custom CNN over CIFAR-10 (get a decent accuracy) then:
  - Remove output layer.
  - Freeze all the model layers.
  - Train a new output layer over Terrassa 900 dataset. (Observation: The "output layer" can be any classification model like an SVM)
  - Test it on the validation.
- Fine tuning:
  - Take a VGG16 model and replace last layers with new layers.
  - Train the model freezing the layers closer to the input layer.
  - Retrain the not frozen layers and the new ones over Terrassa 900 dataset.
  - Test it on the validation.
- More fine tuning:
  - Take a VGG16 model.
  - Replace last layers with a new small network.
  - Train the model freezing part of the layers closer to the input layer on a building dataset (e.g: [Zurich buildings database](#), [the paris dataset](#), [oxford buildings](#)) + Terrassa 900 dataset.
  - Test it on the validation.

Add to the report a subsection for each of the parts of the task 4 with details about the results and their interpretation.

Task 5: Open project

- Choose a dataset from the list given in the block 3 deliverable guidelines. Then:
  - Explore the data.
  - Take any action (preprocessing) needed to use the data with a CNN.
  - Perform a resampling protocol adequate for DL. Hint: Check this [video](#).
  - Create a CNN model and improve it to obtain a good score.
  - Use interpretability techniques presented in class and try to give semantic meaning to the model.
  - Test the model on unseen data. Study the obtained results using a confusion matrix.
  - Perform a post modeling analysis, e.g: which are the hardest classes for our model? why? Is there any bias on the predictions?
  - Conclusions.

This task report is expected to be similar to the block 2 project report.

Rubric modifications (I)

Because we are going to work with images some parts of the rubric need to be modified (new version available at the Raco):

- Quality of the preprocessing - Minor modifications:
  - No NA or dummy variables are possible.
- Quality of the data exploration - Minor modifications:
  - Description of the variables becomes a description of the images and the categories.
- Resampling - Minor modifications:
  - CV is no longer feasible, use an adequate DL protocol.
  - Choose an adequate technique for finding good hyperparameter values.

Rubric modifications (II)

- Experimental design - Minor changes:
    - Statistical tests no longer needed
- Quality of research - Minor changes:
    - An out of the box solution is encouraged (for example use of technique from a paper not presented in class)
- Quality of conclusions - No changes.
- Interpretability - New item:
    - Evaluates the use of different methods / techniques in order to understand the model.

AML: Project dates

- December 11th:
  - Project introduction on laboratory session.
- December 17th:
  - Proposal deadline (upload proposal to the Raco).
- January 14th:
  - Block 3 deliverable.