Exam session 24 July 2023

509486 - Machine Learning, Atificial Neural Networks and Deep Learning

[L-31] Artificial Intelligence

NAME:

SURNAME:

STUDENT NUMBER:

—

We are given a dataset of RGB images containing images of three different animals, e.g. $a1$, $a2$, $a3$, with the following characteristics:

1. Each image is a 3-dimensional tensor of shape (224, 224, 3). The last dimension denotes the number of input channels;

   - The numerosity of each class is 65, 65, 65 labelled samples;
   - Values in each tensor entry are integers in $[0, 255]$;

2. For each image we are also provided a coordinate vector, $(c1, c2, c3, c4)$, representing the bottom-left $(c1, c2)$ and the top-right corners of the bounding rectangle cointaining the animal within the image. Each component of the vector is in $[0, 1]$, representing the fraction of the width and of the height respectively. $c1 = 0$(resp. 1) means the bottom-left corner of box lies on the left (resp. right) border of the figure;

3. Further, we have some additional labelled images which have no bounding box information, respectively 26, 2, and 0 for $a1$, $a2$ and $a3$ classes.

ASSIGNMENT
Design a deep neural network model trained to predict:

1. The class of the image (which animal it contains among $a1$, $a2$, $a3$), assuming any image contains just one of these three animals;

2. The location of the bounding box, intended as a vector of 4 coordinates, as described above.

Take 5 MINUTES to think about the problem, then provide a clear SKETCH (BRIEF description) of each of the following points. Write in a READABLE way.

1. MODEL: Which architecture you consider more appropriate for this task, and WHY.

2. INPUT:

   - How to (if) preprocess input data and which data would you retain/use;
   - Which is the input of the model, and how is it represented;

3. OUTPUT: How would you design the output layer and why;

4. LOSS: Which loss function would you use to train your model and why;

5. MODEL CONFIGURATION:

   - Model composition: composition of layers, regardless their number, or their dimension, which can be object of tuning
   - Which activation functions would you use;
   - How (if) would you regularize/initialize your model
   - On which hyperparameters would you perform the model selection (just list them)

6. MODEL EVALUATION: How would you assess (in which setting) the generalization capabilties of the model on unseen data.

When necessary, BRIEFLY motivate your choices.

Dedicate an answer to each of the points above (1-6), maintaining the same numbering and sub-items.

LEAVE space among answers.

After the exam, you have time till August 5th, 23:59, to upload the implementation of your solution in a Jupyter notebook. On the course webpage, at the link https://elearning.unipv.it/mod/assign/view.php?id=130987, you will find the instructions on how to submit your solution. There you will also find the data to be used, described above.

If no file is uploaded, the exam is considered as rejected. In case of problems in uploading your solution, write for the teacher BEFORE the above-mentioned dealine for delivering.