TSNE, Image generation with deep nets and DRL toy example

A) OBJECTIVES:

In this lab we focus on techniques that make use of different supervision strategies:

1. Understand the configuration and application of **TSNE** for visualization of a large set of features with high dimensionality
2. Generative models. Build and train variations of basic **autoencoders**
3. Generating images with DL to **fool your network** & visualize **saliency** maps
4. Understand and execute a simple Deep RL example to learn to play ATARI

B) INTRODUCTION: In this practical session we will analyze in more detail the learned features by the CNN you used in Lab 2. You'll also use your own tiny-dataset from Lab2. To do this we will use the unsupervised TSNE algorithm. We'll also practice with auto-encoders using data from previous labs (CIFAR10), image generation techniques and a DRL example

PREVIOUS TO THE SESSION: Compute deep learning based features for your toy-dataset from Lab2. You have helper code to do this in the template **Lab5_VisualizationTSNE.ipynb.**

C) EVALUATION: Submit your notebooks **to Moodle by the corresponding deadline.** To do this, just download the colab document as .ipynb and upload that to moodle. All your answers should be stored in the .ipynb. So please!! MAKE SURE the notebook saves the outputs of your cells. (If you didn't disable it, by default it's done this way. But you can download the notebook and make sure of it before closing your session).

The following will be evaluated:
- Correctness and extent of the work.
- Correctness in the use of technical terms in the answers.
- Analysis and discussion of the results.
- Organization and cleanliness of the code.

REMEMBER:
- You are **allowed 5 *late-days* in total for all the labs**. You can use them when you want, e.g. you can submit 1 day late each lab, or up to five days late one lab.
- **You have to submit <u>all the colab files for the following tasks (part D)</u>**

D) DESCRIPTION LAB5 TASKS:

For each task, **answer ALL the questions within the notebook, add the code to fill the gaps and run the requested subtasks**:

1. Unsupervised Dimensionality Reduction for visualization of *deep features*. Use notebook **Lab5_VisualizationTSNE.ipynb**

- 1.1. Get CNN features from your toy-dataset from Lab2 (e.g., the layer before the last of MobileNet before or after fine-tuning).
- 1.2. Run T-SNE and visualize how that feature space looks like

2. Intro to auto-encoders. Use notebook **Lab5_autoencoder.ipynb**

- 2.1. Understand the implementation of a basic autoencoder, fill up gaps/answer the questions.
- 2.2. Complete the implementation of a basic convolutional autoencoder. Fill up gaps/answer the questions, evaluate the results.
- 2.3. Autoencoders for anomaly detection

3. Generating images with gradient *ascent*. Use notebook **Lab5_VisualizationCNN.ipynb**

- 3.1. Analyze more carefully CNN gradients to generate saliency maps …
- 3.2. … and images to fool your CNN.

4. Deep RL. Use notebook **Lab5_DRL_Tutoria_2024l.ipynb**

- 4.1. Run and understand the given example in the notebook. Answer the required questions.
- 4.2. Edit, run and evaluate the proposed modification.