COGNITION AND COMPUTATION

Prof. Marco Zorzi, Dr. Alberto Testolin

Guidelines for preparing the individual project

General notes:

1. Please report your full name, student ID and date on the first page of the project file.
2. Please do not submit PDF reports of your project: you should directly submit a self-contained Python notebook (make sure you properly describe your results using text boxes and embedding output figures in the notebook). The notebook file must be submitted through the course Moodle at least one day before the chosen exam date.
3. The project is individual, which means that plagiarism and collaborative writing are strongly discouraged (code and reports will be automatically checked for plagiarism by the Moodle submission tool).

Objective:

Implement simulations to explore computational models of visual concept learning. The easiest approach would be to base your simulations on the Python code presented during the Lab practices; however, you might also explore you own ideas and implementations (get in touch with the instructors by email for feedback). It would be good to perform some hyperparameters tuning and to explore different model architectures to find a suitable solution.

As training / testing datasets you could use one or more of the following:

- EMNIST [https://github.com/aurelienduarte/emnist]
  (NB: use letters, not only digits otherwise it would be the same we have seen in the Labs)
- Fashion-MNST [https://www.kaggle.com/datasets/zalando-research/fashionmnist]
- Omniglot [https://github.com/brendenlake/omniglot]
- Caltech 256 [https://drive.google.com/drive/folders/1qOzlH1hAcOLKBEouDHd_jdviOJmz6sxS/]
- Feel free to explore other datasets, keeping in mind that large datasets might require more computational resources.

The maximum score for the individual project will be **10 points**, divided according to the following tasks:

- Perform linear read-outs at different levels of the model hierarchy to investigate whether sensory representations become increasingly more disentangled at the deepest layers of the network [**2 points**].
- Analyze the internal representations developed by the model by exploiting hierarchical clustering and feature visualization (receptive fields) analysis [**2 points**].
- Visualize confusion matrices and psychometric curves to investigate the kind of errors made by the model; psychometric curves can be created by adding an increasing amount of noise to the test data [**2 points**].
- Explore the response to adversarial attacks (and potential defenses) and/or the capability of few-shot learning [**2 points**].
- Clearly explain the details of your implementation (e.g., model architecture, training and testing methodology), motivating your choices and critically discussing the results with respect to the topics covered during the course [**2 points**].