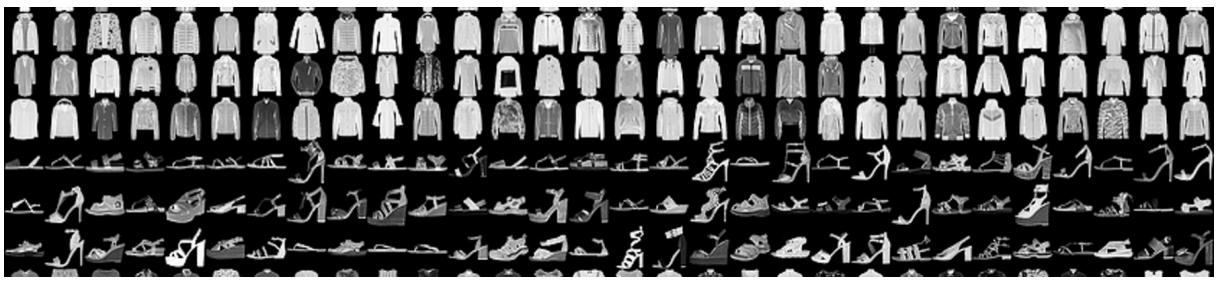
UNIVERSIDADE DA CORUÑA USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA Universidade Vigo

Quantum Computing and Machine Learning (614551008)

Practice 1.1 (2023-2024)
Classical Neural Networks

INSTRUCTIONS:

- **Deadline:** November 28, 23:59.
- **Objectives**
  - In this practice we will develop a classical neural network model for the Fashion-MNIST dataset.
- **Dataset**



  - Fashion-MNIST is a dataset of article images consisting of a training set of 60,000 examples and a test set of 10,000 examples.
  - Each example is a 28x28 grayscale image, associated with a label from the following 10 classes: (0) T-shirt/top, (1) Trouser, (2) Pullover, (3) Dress, (4) Coat, (5) Sandal, (6) Shirt, (7) Sneaker, (8) Bag and (9) Ankle boot.
  - The dataset can be easily downloaded from Keras using the following instructions:

```
from tensorflow.keras.datasets import fashion_mnist
(x_train, y_train), (x_test, y_test) = fashion_mnist.load_data()
```

- **Tasks to be carried out**

  1. **Preprocessing**.
     - Preprocess the dataset to prepare it to feed the neural network: flatten the images, convert integers to float values, encode the labels using the one-hot encoding, etc.
     - Divide the train data into train and validation, using this last one as a reference for hyperparameter tunning.
  2. **Develop a classical neural network to predict class of each image**.
     - Decide the structural hyperparameters of the network: layers, neurons per layer, activation functions, etc.
     - Decide the learning hyperparameters of the network: optimizer, learning rate, epochs, batch size, metrics, etc.
     - Justify the decisions made.
  3. **Regularization**.
     - Take some regularization techniques to avoid overfitting: dropout, batch normalization, weight regularization and initialization, etc.
  4. **Results**.
     - Comment the results obtained at each step.
     - Decide which metric would be more useful for the problem in hand.
  5. **Conclusions**.
     - Reach some final conclusions for the experiment carried out.

- **Submission**

  - The exercises will be developed using Jupyter Notebooks.
  - **The notebook should include**:
    - The practice can be carried out alone or in pairs, so the first cell of the notebook must be the full names of the authors.
    - Include all the code developed.
    - The code shall be accompanied by cells with an explanatory report containing a description of the process followed, detailing the results obtained and justifying the decisions taken.
    - The notebook will be saved with the results of its execution included.
  - **Submission process**
    - The exercises will be submitted shared with the professor (Eduardo Mosqueira Rey) using the Teams platform of the master's degree.
    - There is a strict deadline for each assignment. Past due submissions will be rejected.