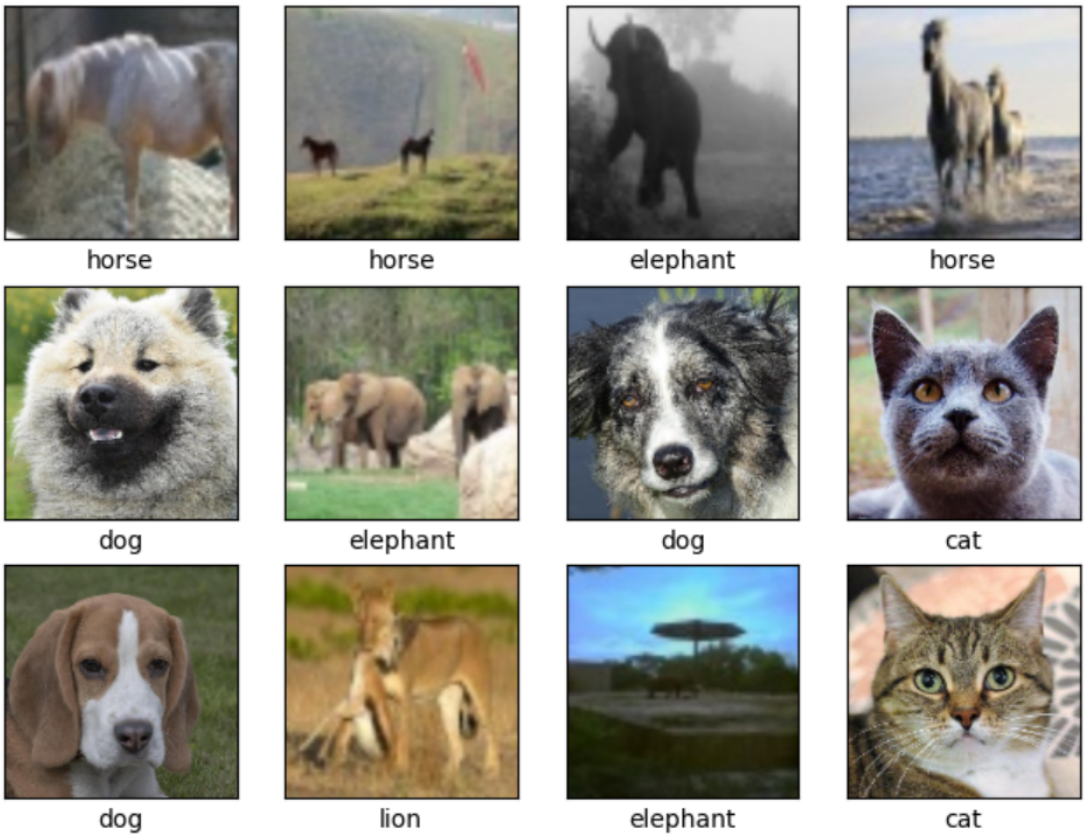
UNIVERSIDADE DA CORUÑA USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA Universidade Vigo

# Deep Learning (Master's degree in AI)

# Practice 1 - CNNs (2023-2024)

**INSTRUCTIONS:**

- **Deadline:** March 07, 15:30.
- **Objectives**
  - In this practice we will develop several convolutional neural network (CNNs) models trying to predict an animal given its image.
- **Dataset**
  - We will use the "Animals dataset" that contains about 15K pictures of five types of animals : cats, dogs, elephants, horses & lions.
  - The original dataset can be downloaded from here: `https://www.kaggle.com/datasets/antobenedetti/animals/data`.



- **Tasks to be carried out**

  1. **Preprocess the dataset**.
     - The dataset is already divided into `train` (13K images) and `val` (1.5K images) parts.
     - The `val` part of the dataset should be left as a test set in order to compare the generalization capability of the different models.
     - It is advisable to further subdivide the `train` dataset into a "training" part (for training) and a "validation" part (for hyperparameter tuning).
     - Perform other preprocessing techniques such as standardizing image size, transforming the labels to categorical, normalizing the values, etc.
     - Most of these actions can be performed using the `keras.utils` function `image_dataset_from_directory()`, that returns a `tf.data.Dataset` object, as seen in the lecture notes.
  2. **Develop a custom convolutional model for the classification problem.**
     - Do not use pretrained models or models already created in external libraries for this part.
     - Determine the best architecture of the model (convolutional layers, pooling layers, number of filters, size of kernels, etc.).
     - Use the validation dataset for hyperparameter tunning and avoid overfitting regularizing the model if necessary (data augmentation, dropout, weight regularization, etc.).
     - Consider the use of deeper and more complex models such as Residual, Inception or Xception networks.
  3. **Pretrained models**.
     - Consider the use of pretrained models to obtain better results.
     - Decide the best strategy for this type of models: feature extraction or fine tunning.
  4. **Compare the results**.
     - Comment the results of each model developed.
     - Made a reasoned comparison of all the results obtained.
     - Comment advantages, disadvantages of the different approches and elements of interests.

- **Practice groups**

  - The practice will preferably be done in pairs (it can be done also alone) and both members of the group will be responsible and should know everything that is delivered on their behalf.
  - No change of practice group will be made during the course. The group can be undone but its members will continue to carry out the practices alone.

- **Submission**

  - The exercises will be developed using Jupyter Notebooks.
  - Create one or several notebooks to carry out the different tasks.

- **Each notebook should include**:
  - The first cell of each notebook must be the full names of the authors.
  - The code for each of the models developed should be included and it should be a complete ML process: data loading and manipulation, network creation, training and results.
  - The notebook will be saved with the results of its execution included.
  - The code shall be accompanied by text cells with an explanatory report containing a description of the process followed, detailing the problems encountered and justifying the decisions taken.
- **Submission process**
  - If you have several notebooks put all of them together in a ZIP file prior submission.
  - The exercises will be submitted using the virtual campus of each university:
    - Universidade da Coruña: `https://campusvirtual.udc.gal/`
    - Universidade de Vigo: `https://moovi.uvigo.gal/`
    - Universidade de Santiago de Compostela: `https://cv.usc.es/`
  - Each member of the practice group must submit the notebook in their corresponding Moodle task.
  - There is a strict deadline for each assignment. Past due submissions will be rejected.

- **Evaluation criteria**
  - Quality of the classifications obtained.
    - Classification accuracy on the test set of the custom model and of the pretrained ones.
    - Do not discard intermediate models, show us the different alternatives that you have been trying to reach the best final model, at least the most relevant ones.
  - Quality of the design.
    - The network design follows the recommendations on how to create the different types of convolutional networks.
    - The regularization measures proposed are appropriate.
  - Quality of explanations:
    - The process is sufficiently detailed and the decisions taken are justified.
    - The results are commented and interpreted correctly.