COMPUTER SCIENCE AND ENGINEERING

ARTIFICIAL NEURAL NETWORKS & DEEP LEARNING

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POLITECNICO
MILANO 1863

HOMEWORK 1

IMAGE CLASSIFICATION

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SUMMARY

1. INTRODUCTION

This is the first Homework of the Artificial Neural Networks and Deep Learning course.

In this homework the groups are required to **classify images of leaves**, which are divided into categories according to the species of the plant to which they belong. Being a classification problem, given an image, the goal is to predict the correct class label.

Figure 1: an example of leaf images

2. DATASET

The dataset provided by the competition's promoters is a **folder containing 17 728 files**, grouped into several categories. In particular, there are **14 different types of leaves** with whom is possible to classify the images (Tomato, Orange, Soybean, Grape, Corn, Apple, Peach, Pepper, Potato, Strawberry, Cherry, Squash, Blueberry, Raspberry).

2.1 CLASS-IMBALANCE PROBLEM

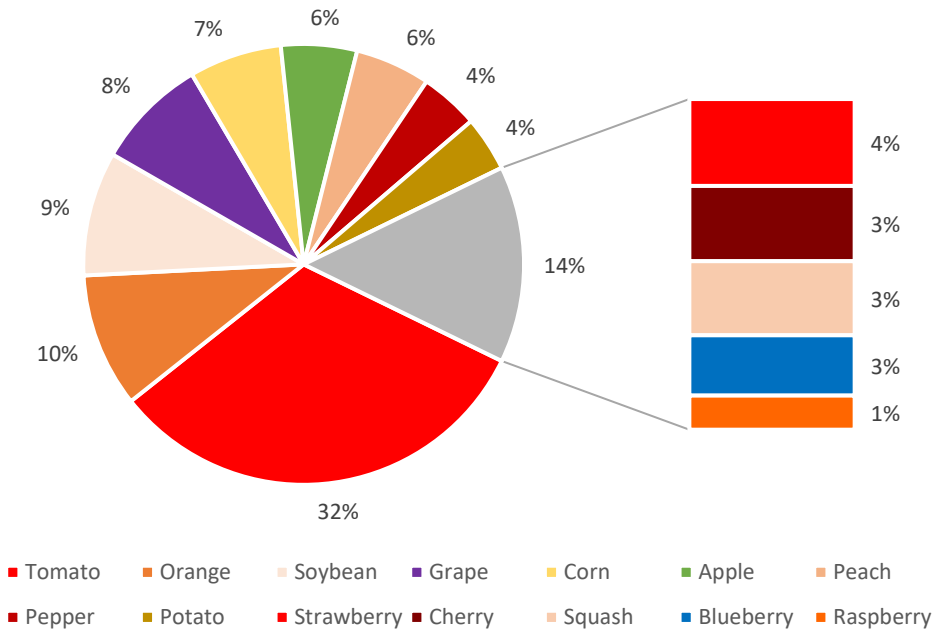

Table 1: the class-imbalance problem

As is shown in *Table 1: the class-imbalance problem*, some classes contain **much more images than the others**. In particular, the sum of Tomato, Orange and Soybean represents more than the half of the entire distribution.

This problem is known as **class-imbalance**. Due to this, the fitted model tends to be **biased** towards the majority class data, which leads to **lower accuracy** during the testing phase.

2.1.1 UNDER-SAMPLING

One of the most used techniques to **bring the required balance** in the data is called **under-sampling**. In particular, for this homework was used under-sampling to partially solve the problem by removing some files in larger classes .

2.2 IMAGE DATA AUGMENTATION

Image data **augmentation** is a technique that can be used to artificially **expand the size of a training dataset** by creating modified versions of images in the dataset.

Training models on more data can result in more skilful models, and the augmentation techniques can create **variations of the images** that can improve the ability of the fit models to **generalize** what they have learned to new images.

For this homework were used the 4 image data augmentation types:

```
# Create an instance of ImageDataGenerator with Data Augmentation
train_data_gen = ImageDataGenerator(rotation_range=30,
                                    height_shift_range=50,
                                    width_shift_range=50,
                                    zoom_range=0.3,
                                    horizontal_flip=True,
                                    vertical_flip=True,)
```

Figure 2: the ImageDataGenerator object with augmentation techniques

2.2.1 HORIZONTAL AND VERTICAL SHIFT AUGMENTATION

A shift to an image means moving all pixels of the image in one direction, such as horizontally or vertically, while keeping the image dimensions the same.

2.2.2 HORIZONTAL AND VERTICAL FLIP AUGMENTATION

An image flip means reversing the rows or columns of pixels in the case of a vertical or horizontal flip respectively.

2.2.3 RANDOM ROTATION AUGMENTATION

A rotation augmentation randomly rotates the image clockwise by a given number of degrees from 0 to 360. The rotation will rotate pixels out of the image frame and leave areas of the frame with no pixel data, that were filled using black.

2.2.4 RANDOM ZOOM AUGMENTATION

A zoom augmentation randomly zooms the image in and either adds new pixel values around the image or interpolates pixel values respectively.

2.3 SOME USEFUL OBSERVATION