Assignment 1: Camera Calibration
Deadline: 28/03/2023

For this assignment, you will calibrate one of the Hikvision cameras in the CVIP laboratory.
The goal is to estimate:

1. The camera's intrinsic parameters (matrix K);
2. The pose of the camera;
3. The pixels in the acquired images corresponding to the floors.

To solve **point 1)** and calibrate your camera, you will have to implement **one of the two** following methods:

1. **DLT;**
2. **Zhang's calibration technique.**

To estimate the **matrix K,** you will acquire images of the calibration patterns (that you will prepare) **by one of the cameras** in the lab. By using your implementation of the selected method, you will estimate the camera K.

To solve **point 2)** after estimating the matrix K, you will have to compute the camera pose **[R, t]** (extrinsic parameters). (*For DLT, just use the reference system set on the cube. For Zhang, it may be enough to compute those of one of the images you acquired, or the camera pose with respect to a world coordinate system centered on the **red marker** on the floor at the center of the laboratory*).

To solve **point 3),** you will have to use the camera matrix P to compute the pixels corresponding to the floor in the images. You will have to set a world coordinate system centered on the **red marker** on the floor at the center of the laboratory.

Expected Results:
You will have to prepare a Jupiter notebook to solve each of the above tasks. The code must be properly commented, and implementation details clearly stated.

It is mandatory to include, in the proposed solution, an analysis of the achieved results:

a. for comparison purposes, **you must compare the parameters** of matrix K obtained by your method **with** the **parameters** estimated through the **calibration method included in OpenCV**.
   To this purpose, you will present a table reporting the **absolute difference** achieved for each parameter. Since the estimation accuracy depends on the number of used points (for DLT) or the number of images (for Zhang's method), you will show how the measured differences change when increasing the number of 2D-3D point correspondences or the number of images. In particular, results will have to be presented and compared using **6, 12, 24 points** when using DLT **or 4, 8, 16 images** when using Zhang's method.
b. For the selected camera, you will have to prepare images showing the pixel of the floor. These pixels are found reprojecting 3D points of the floor.
c. To assess the quality of the floor point reprojection, you will have to present the MSE computed over a set of test points over the floor. In particular, to estimate the camera pose, you will use a set of N points, with N>12. Use a **4-fold cross validation** technique to measure the average MSE over the 4 folds.

The assignment must be developed individually and submitted in a zip file (including also all data used to develop and test the method) via email by March 28, 2023.