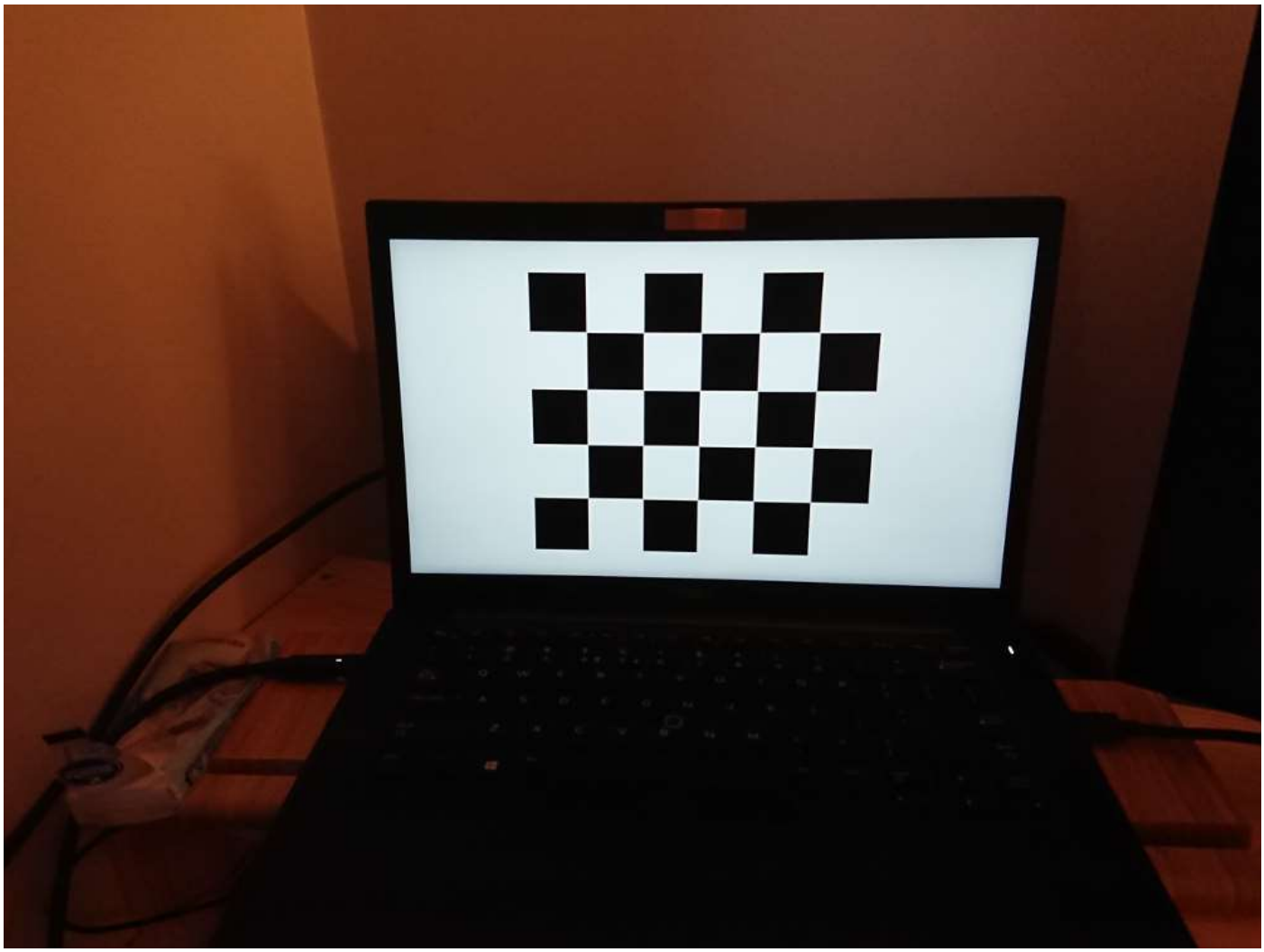
1130-EMARO-MSA-1006 # Computer Vision

T1: Camera geometry

Camera calibration

In this task you will use the camera in your phone to measure the distance to the object of known size. First, you have to calibrate the camera in your phone. To do this you need a chessboard, that is either displayed on the screen or printed. In both cases you have to measure the size of a single square to know its actual size. If you are going to use the displayed version, make sure you display the image fullscreen, so that the pattern is as big as possible. During the process of data acquisition (taking photos) make sure, that all the camera parameters are as stable as possible (don't change the focus or zoom level, as it will change the focal length between the pictures). Take photos covering the whole area of sensor, from different distances.



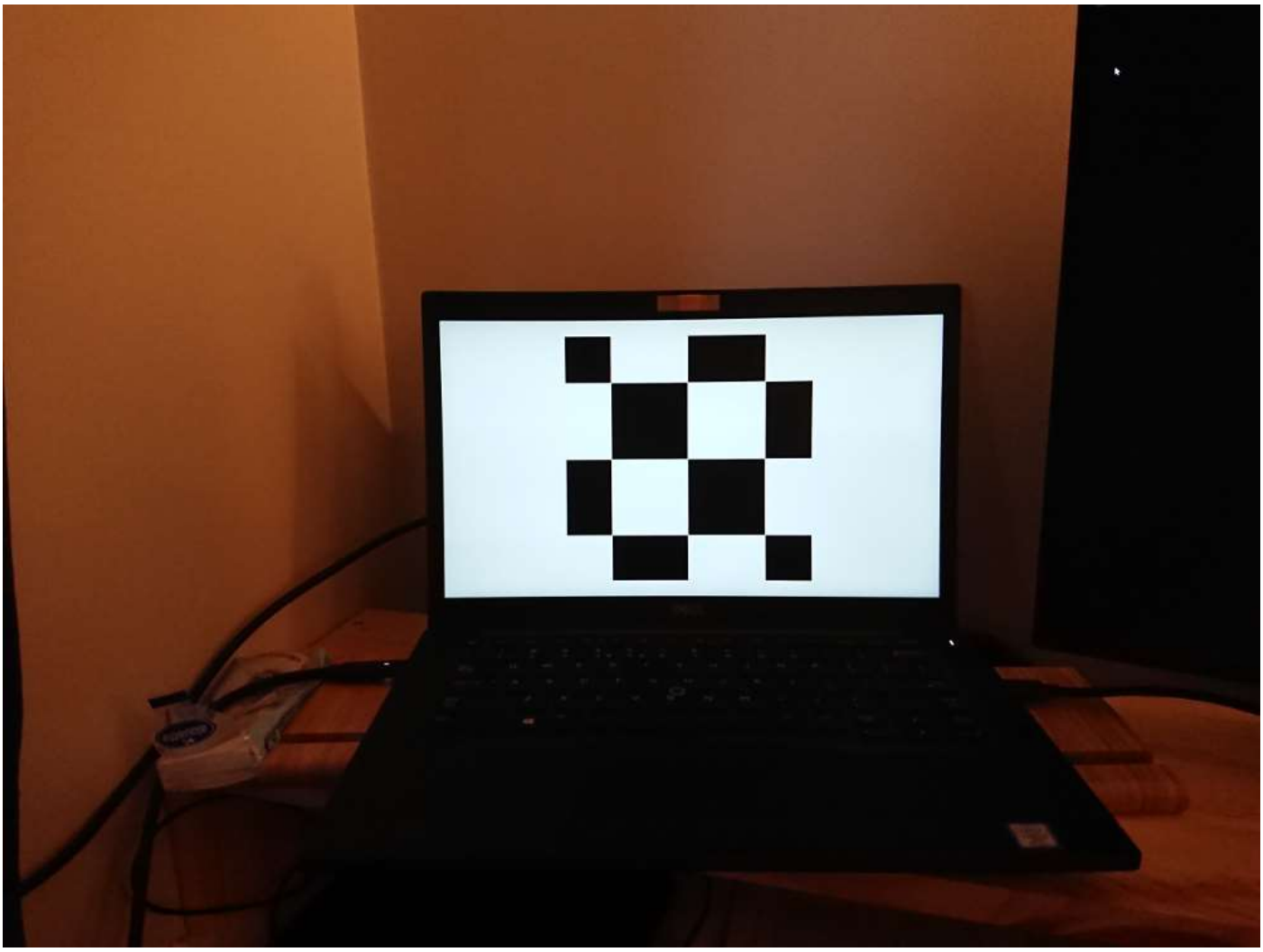
Note: usually the pictures gathered with a phone are already preprocessed by the software and most distortions are removed. The important parameters for the following task are the focal length(s) and principal point.

Important intrinsic equations

$u = f_x \cdot \frac{x}{z} + c_x$

$$v = f_y \cdot \frac{y}{z} + c_y$$

calculate the distance to test object based on known camera parameters, real size and pixel size of the object.



Note: In this task you are working with line lengths, not absolute object coordinates. To get final equation for distance (*Z*) you have to modify intrinsic equations appropriately.

To measure pixel size of the object use `imtool` (available also as `Image viewer` in `Apps`).

Submission

For this task you have to submit a written report (single PDF file), which should contain:

1. Calibration section
   - maker and model of the phone/camera used
   - picture information (resolution, camera settings used etc.)
   - miniatures of the calibration photos
   - screenshot from the calibrator app or the calibration code
   - final camera calibration parameters
2. Distance measurement section
   - equation used for distance measurement (with the whole derivation method explained/shown)
   - pictures of the target pattern and measured pattern size (in centimetres)
   - table with results (measured pattern size in pixels, measured distance to the pattern, calculated distance to the pattern, relative and absolute error)
   - calculation of the measurement error impact on the final calculation for each case (what is the difference if you measure one pixel more)