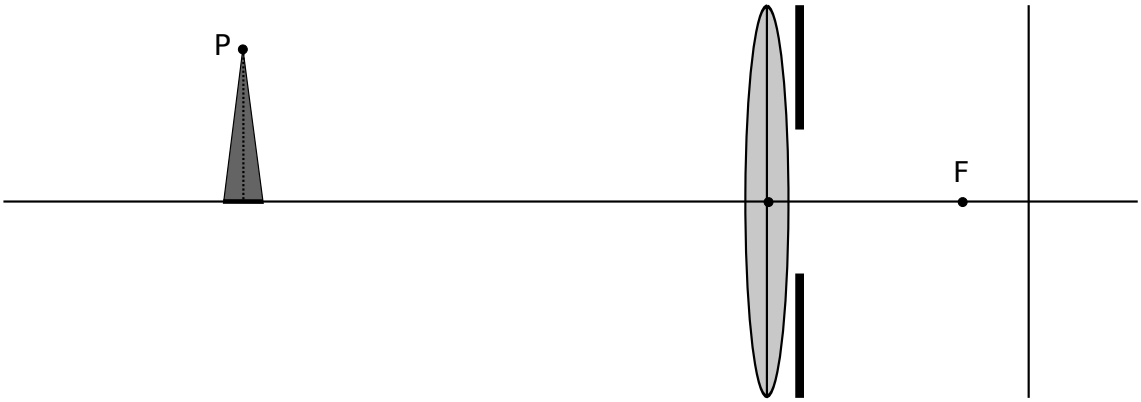
Assignment 2

Welcome to the second assignment of the lecture *2D Vision and Deep Learning*. **Please read all instructions carefully!** The goal of this assignment is to familiarize you with the basic concepts of cameras and their mathematical description.

Submission is due on Monday, November 16th , 2020 at 2pm. Please note that late assignments will receive zero (0) marks, so you are strongly encouraged to start the assignment early. If you have any questions please contact Tim Heußler (`theussle@students.uni-mainz.de`).

Exercise 1 (1 point)**.** Construct the diameter d of the blur circle that emerge by imaging the point $\mathbf{P}$ with the lens camera depicted below.



Exercise 2 (2 points)**.** Given the *camera calibration matrix*

$$\mathbf{K} = \begin{pmatrix} 2451.11 & 0 & 1032.52 \\ 0 & 2459.52 & 615.40 \\ 0 & 0 & 1 \end{pmatrix}$$

of a camera with a resolution of 2048×1536 pixel, whereas the image sensor has the size $5.27 \times 3.96 mm^2$. Determine the focal length of the camera.

Exercise 3 (3 points)**.** Given the *camera matrix*

$$\mathbf{P} = \begin{pmatrix} 490 & -390 & -1500 & 1300 \\ -590 & 1400 & -600 & 1300 \\ -0.5\sqrt{2} & -0.3\sqrt{2} & -0.4\sqrt{2} & 5 \end{pmatrix}.$$

1. Determine the position of the *optical center* of the related camera. 2. Determine the related *camera calibration matrix*. 3. Determine the *orientation* of the related camera.

Exercise 4 (5 points)**.** Write a simple python script that can calibrate a camera and rectify an input image (see e.g. `https://docs.opencv.org/master/dc/dbb/tutorial_py_calibration.html`). To validate your program, use the handsome gui-based *GML C++ Camera Calibration Toolkit* (see `http://graphics.cs.msu.ru/en/node/909`) to obtain a calibration corresponding to the data given in the file `calibrationImagesCheckerboard.zip`.