

# Vision and Perception

## Exam A

January 2024

Name, Surname, Student ID [please compile here]:

The exam has to be carried out in 1 hour and 40 minutes.  
In order to pass the exam you need to get 18 and a minimum of 8 points in each of the two parts. The exam consists in 6 exercises.  
**Write the answers for the two respective parts on two separate sheets.**

### 1 Part 1

- **Exercise 1** Given an image  $Im$  and a filter  $f_1$ , shows the intermediate passages and the the resulting image  $g$  after applying the convolution operator between  $Im$  and  $f_1$ . Use the following coordinates (2,2), (3,3), (4,3) with zero padding. [4 points]

$$Im = \begin{bmatrix} 2 & 2 & 1 & 0 \\ 0 & 3 & 2 & 1 \\ 4 & 0 & 1 & 2 \\ 7 & 1 & 0 & 2 \end{bmatrix} \quad f_1 = \begin{bmatrix} 0 & 3 & 0 \\ 1 & 0 & 2 \\ 2 & 1 & 2 \end{bmatrix}$$

- **Exercise 2.a** Why is a Gaussian filter preferred to a box filter? Describe both of them.  
**Exercise 2.b** What do you do to sharpen an image? [6 points]
- **Exercise 3.a** Describe the procedure to match image features like SIFT. What are outliers and how to deal with them?  
**Exercise 3.b** Describe two possible use case of image matching. [6 points]



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## 2 Part 2

- **Exercise 4** Show the sequence of transformations which brings a 3D  $X$  point, expressed in world coordinates, to a 2D  $x$  point in camera coordinates, when working with a standard camera model. [6 points]
- **Exercise 5** In a two-view geometry, given an image point  $x$  in the first view and the corresponding  $x'$  image point in the second view, which formula links  $x$  to  $x'$ ? Is  $x'$  position subjected to any constraint? [6 points]
- **Exercise 6** Briefly describe how a Generative Adversarial Network works and on which tasks can be exploited. [4 points]