

Exercises

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Surname, First name

Computer Vision (KEN4255)

Computer Vision Exam 2023/2024

1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	9	9	9	9	9	9
0	0	0	0	0	0	0

a	<input checked="" type="radio"/>	c	d	e	f	→ b
a	b	<input checked="" type="radio"/>	d	e	f	→ c
<input checked="" type="radio"/>	b	c	<input checked="" type="radio"/>	e	f	→ a

Answer multiple-choice questions as shown in the example.

Program: Master in Artificial Intelligence & Master in Data Science for Decision Making

Course code: KEN4255

Examiners: Dr. Mirela Popa

Date/time: Thursday 6th of June 2024, 13:00-15:00

Format: Closed book exam

Allowed aids: Pens, simple (non-programmable) calculator from the DACS list of allowed calculators.

Instructions to students:

- The exam consists of 4 questions on 16 pages.
- Fill in your name and student ID number on the cover page and tick the corresponding numerals of your student number in the table (top right cover page).
- Answer every question in the reserved space below the question. **Do not write outside the reserved space or on the back of pages, this will not be scanned and will NOT be graded!** As a last resort if you run out of space, use the extra answer space at the end of the exam.
- *In no circumstance write on or near the QR code at the bottom of the page!*
- Ensure that you properly motivate your answers.
- Only use black or dark blue pens, and write in a readable way. Do not use pencils.
- Answers that cannot be read easily cannot be graded and may therefore lower your grade.
- If you think a question is ambiguous, or even erroneous, and you cannot ask during the exam to clarify this, explain this in detail in the space reserved for the answer to the question.
- If you have not registered for the exam, your answers will not be graded, and thus handled as invalid.
- You are not allowed to have a communication device within your reach, nor to wear or use a watch.
- You have to return all pages of the exam. You are not allowed to take any sheets, even blank, home.
- Good luck!

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Question 1. Techniques for image processing

- 4p **1a** Discuss three challenges encountered when applying edge detection techniques on images and include at least one mitigation strategy for each of them.

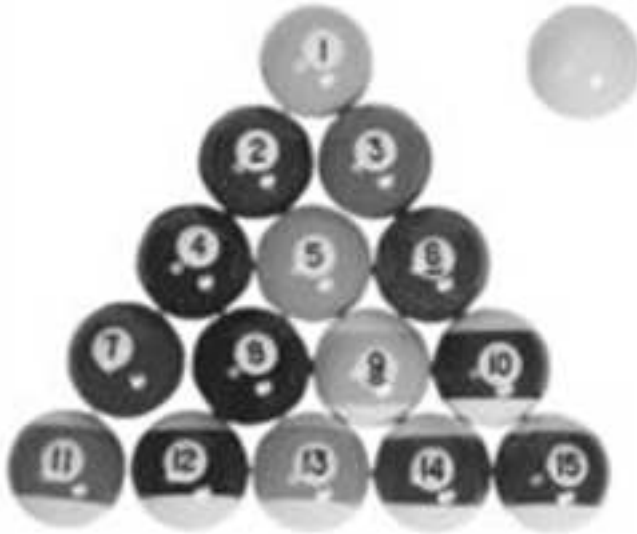
- 2.5p **1b** Design a 3D convolutional filter and explain in which cases it would be useful to apply it. Would it be a low-pass or a high-pass filter?



3p **1c** Describe which type of images would benefit of applying a band reject filter.



- 3p **1d** Which morphological operation(s) would be suitable to be applied on the image below for removing the numbers present on each ball? Provide a short argumentation for the proposed solution





Qu

3.5p

[illegible]

- 2.5p **2b** Briefly explain how the SIFT detector achieves scale invariance, as opposed to the Harris corner detector.

- 3.5p **2c** Which assumptions are used for dealing with the aperture problem in motion estimation? In which cases would these assumptions fail?



- 3p **2d** Which are the main improvements achieved in image segmentation by the Mean shift algorithm in comparison to K-Means? State also, one common challenge present in both algorithms.

Question 3. Object recognition, detection and tracking

4p

[illegible]

- 3p **3b** For a dedicated deep learning architecture, design a loss function to identify which people in the test set have undergone plastic surgery? You are provided with training facial data samples before and after a plastic surgery. If you are also provided with labeled facial landmarks, how would you modify the loss function for detecting the involved facial landmark(s) in each positive detection?

- 3p **3c** Describe one important difference between one-stage and two-stage object detection models and discuss the circumstances in which are each of these options better suited.

- 2.5p **3d** Briefly explain how are deep unsupervised learning techniques suitable at detecting outliers. Reason about the parameters or architectural details influencing this decision.



Question 4. Epipolar geometry

- 4p **4a** You need to recover the translation and rotation components of a camera calibration matrix, using a set of 3D points projected onto the 2D image plane. How many points are needed for an accurate estimation and which algorithm is better suited for this task? The provided explanation should be based on epipolar geometry concepts.

- 3p **4b** How many epipolar lines are associated with a pair of stereo images? Discuss an approach employed to reduce the number of associations between the two images.

- 3p **4c** How could you combine the fundamental matrix estimation from corresponding points in stereo images with RANSAC? In which cases would this approach fail?



- 2.5p **4d** How is the focal length affecting the size of a distant object? Characterize the relationship between the focal length and the size of the field of view. Describe a potential way of adjusting the focal length based on image properties.

Ext

5

[illegible]

Ext

- 6

[illegible]

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