

## Computer Vision (CV) (English) – Info and AC, Iasi, Master, Spring 2023

There are **4 home assignments (HAs)** roughly corresponding to 4 sessions of teaching and 40% in the final grade. Each HA has 8 topics that are weighted equally. The solutions to each HA should be sent as a single *pdf* by email at [radu.timofte@academic.tuiasi.ro](mailto:radu.timofte@academic.tuiasi.ro) no later than March 18 for HA1, April 8 for HA2, May 13 for HA3, and June 2 for HA4, respectively. Each student shall include with her/his email full name and the details of the study program. The Subject of the email should be of the form:

"CV 2023 HA[#home\_assignment] [master\_program] [lastname] [firstname]"

where [#home\_assignment] should be replaced with the number of the home assignment, the [master\_program] with the corresponding short abbreviated program (like DSWT, MIS1, MOC1, MSD1, guest) and [lastname] and [firstname] are the student's last name and first name, respectively.

The grades on the home assignments will be provided together with the final course grade.

Plagiarism and misconduct are not tolerated!

The grading of Computer Vision (taught in English) is as follows:

- **The final CV (Eng) grade (maximum 10)** is composed from: 30% - exercise sessions (laboratories), 30% - colloquium/exam (mandatory), **40% - home assignments** (10% per each assignment). ***To pass this class the exam is mandatory, and also it is mandatory to submit the solutions for at least one home assignment (or, equivalently, solutions to 8 home assignment tasks).***
- Up to **one extra bonus point** will be awarded for those attending the lectures.
- **Optional: one project** covering Computer Vision course topics can be used either to augment or to replace the **exam grade**. The exam is still mandatory. Teams composed of one up to three students can work together for a project. The details will be provided by the lab assistant.
- For **exam** the students are required to prepare the contents covered during the lectures, exercise sessions, home assignments and found on the provided slides and lab materials. Examples of potential exam topics are found in the HAs.

# Home assignment I

(due March 18<sup>th</sup>, 2023)

1. What is Computer Vision? Why is it important? How Computer Vision relates with Computer Graphics? Give the most important 3 applications of computer vision in your opinion and argument your selection and ranking.
2. What is light reflection? Can the angle of refraction be different than the angle of incidence? When and why? Justify your answers.
3. Describe the rainbow and the sunrise. Which phenomena, types of light interaction with matter, are involved in the creation of the rainbow and sunrise effects? Be as thorough as possible in your response and justify.
4. What is depth of field? If the focal length is assumed fixed, can aperture be adjusted to help in handling objects at far and near distance, respectively? When a small depth of field is desirable? Justify your answers.
5. The task is fabric classification into a couple of categories. The fabric image is captured with a camera facing a planar fabric. The fabric image shows a patch from the fabric and nothing else. It is known that the fabrics can come in all the colors and shapes, regardless their category. What color space and which channel(s) should be used? What features and descriptors would be the best for this task? Are these scale invariant? Justify your answers.
6. A gray image with pixel grey-level values is represented on 8 bits [0..255]. All the pixel values belong in fact to the range [33..58]. What is the minimum number of bits that can be used for representing the values in this image without loss of information/details? Given a budget of 3 bits devise a quantization procedure such that to minimize the quantization error. In what situation the uniform quantization is the best solution? Justify your answers.

7. Given a sequence 1, 3, 4, 7, 100, 3, 6, 2, 3 what are the results obtained by applying a mean filter, a median filter, a maximum filter, and a minimum filter, respectively. For each filter the support window is of length 3. If it is known that this sequence of values comes from a distribution with mean 3 and standard deviation 3, what is the “outlier” from the sequence? If this is a normal distribution and we can sample an infinite amount of values, what is the probability to have values above 25? Justify your answers.

8. For what types of noise median filtering is clearly preferable over Gaussian filtering? Justify your answer.

- a) Uniform noise, i.e. distributed by uniform distribution
- b) Gaussian noise, i.e. noise distributed by independent normal distribution
- c) Exponential noise model
- d) Salt and pepper noise
- e) Rayleigh noise