Nosotros lo hacemos en estas fechas

June-July Exam session Projects List

Objectives

The goal of the project is to tackle one of the proposed topics in the field of Computer Vision, developing non-trivial solutions. Students should explore the problem from an original perspective, applying methods that go beyond conventional solutions and demonstrating critical thinking and problem-solving skills.

Lines of conduct

- **Student groups:** The project can be carried out by a group, each consisting of a maximum of 3 people. Projects can also be completed by individual students, but we suggest to work in team.
- **Notebook format:** The project must be implemented using a notebook (e.g., Google Colab, Kaggle) or with an IDE (e.g., VSCode, PyCharm). The code should be optimized to support GPU usage and run without any error. The delivered code must follow the structure outlined below:
  - *Imports*: all the needed packages (for the notebook format)
  - *Globals*: useful variables on the whole code
  - *Utils*: code support functions
  - *Data*: everything related to data management
  - *Network*: code to structure the neural network
  - *Train*: part containing the training cycle elements
  - *Evaluation*: tests needed for the trained network

  You can find a sample template at this link. Try to maintain as much as possible this conceptual structure.
- **Deep learning framework:** All projects **MUST** be done in Python via the Pytorch framework.
- **Project assignment:** You are required to choose a project through this Google Form. In this form, you will provide information about your team and the project, and include the link to the project's GitHub repository. In this repository you have to upload:
  - Code (or notebook) implementing the project
  - Dataset (or a link to it)
  - Project presentation
  - Detailed README to provide a quick overview of the project and instructions on how to run it
- **Project submission:** The project must be presented on one of the exam dates. It can be presented at a different time than the written exam. Both the written exam and the project MUST be completed within the academic year (i.e., between the June 2025 session and the March 2026 session).

  October and March session are reserved to "categories of students referred to in Article 40, paragraph 6, of the General Study Manifesto, and out-of-school students enrolled for the A.Y. 2024-2025 in the third year of a Bachelor's degree and in the second year of a Master's degree".
- **Plagiarism:** Any attempt to plagiarize, whether by copying other students' work, directly replicating code from online resources, or submitting content highly retrived from generative AI models, will be strictly penalized. This course values originality and personal effort; therefore, students must submit independently developed solutions. On the other hand, it is acceptable to consult external resources for inspiration or guidance.

Project 11: Uncertainty-Aware Road Obstacle Identification

Abstract: Reliable road obstacle identification is a critical requirement for the safe operation of autonomous driving systems. Traditional object detection methods often struggle to recognize unexpected or unknown obstacles, as they are typically limited to predefined categories. The ability to detect obstacles beyond known classes, particularly in dynamic and complex environments, is essential for the safety of autonomous vehicles. Recent advancements in semantic segmentation, anomaly detection, and uncertainty quantification offer new avenues to improve detection accuracy and reliability, enabling systems to recognize both known and unknown road obstacles. Such uncertainty-aware methods provide formal statistical guarantees on the reliability of predictions, a crucial aspect for ensuring safe and robust decision-making in real-world driving conditions.

Dataset: Cityscapes, LostAndFound, Fishyscapes

Task: The aim of this project is to develop a general, model-agnostic framework for road obstacle identification, starting from the outputs of any semantic segmentation network. The system will focus on anomaly-aware semantic segmentation to detect obstacles outside the predefined classes. This will allow for the identification of unknown obstacles as part of the segmentation output. To ensure that each identification is accompanied by a reliable measure of confidence, the framework will integrate uncertainty quantification through Conformal Prediction methods. By combining these components, the system will not only recognize potential obstacles but also provide formal statistical guarantees regarding the reliability of its predictions.

Main objectives:

- *Anomaly-Aware Obstacle Segmentation:* Integrate into a semantic segmentation model techniques to detect obstacles that fall outside known classes.
- *Statistical Uncertainty Quantification:* obtain semantic segmentation outputs and obstacle proposals guarantees on detection reliability.
- *Comprehensive Evaluation:* Benchmark the system using both detection performance metrics and uncertainty metrics.

References:

1. Noguchi, C., Ohgushi, T., & Yamanaka, M. (2024). Road Obstacle Detection based on Unknown Objectness Scores. arXiv [Cs.CV].
2. Mossina, L., Dalmau, J., & Andéol, L. (2024). Conformal Semantic Image Segmentation: Post-hoc Quantification of Predictive Uncertainty. arXiv [Cs.CV].
3. Angelopoulos, A. N., & Bates, S. (2022). A Gentle Introduction to Conformal Prediction and Distribution-Free Uncertainty Quantification. arXiv [Cs.LG].