Master in
Computer Vision
Barcelona

Module: M2 – Optimization and inference techniques for Computer Vision

Lecture 0: Presentation

October 5th, 2021

Contact information

- Module M2 Coordinator: Coloma Ballester coloma.ballester@upf.edu
- Project M2 Coordinator: Karim Lekadir karim.lekadir@upf.edu

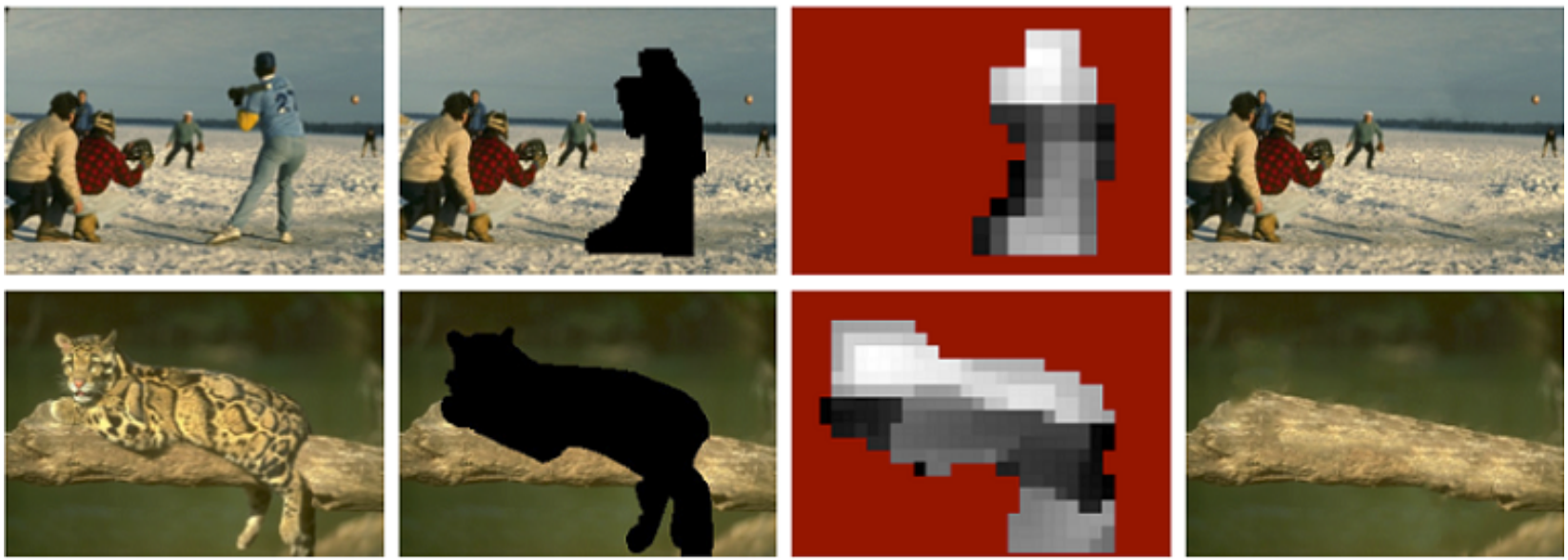
- **Lecturers:**
  - Juan Francisco Garamendi jfgaramendi@gmail.com
  - Pablo Arias pablo.arias@upf.edu
  - Coloma Ballester coloma.ballester@upf.edu
  - Karim Lekadir karim.lekadir@upf.edu
  - Oriol Ramos Oriol.Ramos@uab.cat

Main goals of the module

1. **Theoretical aspects:**
   - Learn about the optimization algorithms and inference techniques that are behind many tasks in computer vision.
   - Main concepts: energy formulation and minimization, numerical techniques for variational problems, gradient descent optimization algorithms and tools useful for deep learning strategies. convex optimization, and graphical models.
   - Special emphasis on the formulation of the optimization problem and its resolution.
   - The tools learnt along this module and project are generic and present in a majority of computer vision applications (as found in other modules, e.g. M3, M4, M6).
   - Exercises to practice and deliver.
     - More exercises: previous exams in the 'Evaluation' section.

Main goals of the module

2. **Practical aspects:**
   - The techniques will be applied in the context of image segmentation and inpainting.
   - More detailed information on Thursday at 18:00h this week (room 52.S31 of UPF-Poblenou campus).



Schedule

Academic Year 2021-2022 / M2 Student Guide [here]

Week	Date	Time	Lecture	Lecturer	University	Building	Room
1	Tue. Oct. 5th	16:00 -18:00	Introduction to optimization problems and energy minimization methods. Exemples and overview of variational formulations. Numerical techniques for variational problems (I).	Juan Fco. Garamendi	UPF		collaborate room - aula global UPF
	Thu. Oct. 7th	16:00 -18:00	Numerical techniques for variational problems (II): Gateaux derivative, Euler-Lagrange equation and gradient methods. Applications: denoising, image inpainting and Poisson editing. Review of numerical linear algebra (I).	Juan Fco. Garamendi	UPF		52.S31
	Thu. Oct. 7th	18:00 - 19:00	Project Introduction	Karim Lekadir	UPF		52.S31
2	Tue. Oct. 12th		HOLIDAY				
	Thu. Oct. 14th	16:00 -18:00	Review of numerical linear algebra (II): least squares methods, singular value decomposition and applications. The Backpropagation strategy for gradient computation.	Juan Fco. Garamendi	UPF		52.S31
	Thu. Oct. 14th	18:00 - 19:00	Project follow-up	Karim Lekadir	UPF		52.S31
3	Tue. Oct. 19th	16:00 -18:00	Gradient descent optimization algorithms useful for deep learning strategies.	Pablo Arias	UPF		collaborate room - aula global UPF
	Thu. Oct. 21st	16:00 -18:00	Convex optimization (I). Unconstrained and constrained optimization. Segmentation with variational models. The Mumford and Shah Functional and the Level sets frameworks.	Pablo Arias / Karim Lekadir	UPF		52.S31
	Thu. Oct. 21st	18:00 - 19:00	Project follow-up	Karim Lekadir	UPF		52.S31
4	Tue. Oct. 26th	16:00 -18:00	Convex optimization (II). Constrained optimization. Duality principles and methods.	Pablo Arias / Coloma Ballester	UPF		collaborate room - aula global UPF
	Thu. Oct. 28th		HOMEWORK				
5	Tue. Nov. 2nd	16:00 -18:00	Convex optimization (III): Duality principles and methods. Subgradient methods. Interior point methods. Applications. Non-convex problems and convex relaxation.	Coloma Ballester	UPF		collaborate room - aula global UPF
	Thu. Nov. 4th	16:00 - 18:00	Bayesian networks and MRFs. Inference types. Main inference algorithms. Examples: stereo, denoising.	Oriol Ramos	UPF		52.S31
	Thu. Nov. 4th	18:00 - 19:00	Project follow-up	Karim Lekadir	UPF		52.S31
6	Tue. Nov. 9th	16:00 -18:00	Belief propagation: message passing, loopy belief propagation. Applications in the context of some deep learning strategies. Exercise: inference for segmentation.	Oriol Ramos	UPF		collaborate room - aula global UPF
	Thu. Nov. 11th	16:00 -18:00	Sampling methods: Particle-based methods, Markov Chain Monte Carlo, Gibbs Sampling.	Oriol Ramos	UPF		52.S31
	Thu. Nov. 11th	18:00 - 19:00	Project follow-up	Karim Lekadir	UPF		52.S31
7	Thu. Nov. 18th	16:00-19:00	Project Presentations	Karim Lekadir	UPF		52.S31
8	Tue. Nov. 23rd		HOMEWORK				
	Thu. Nov. 25th		HOMEWORK				
9	Thu.Dec. 2nd	16:00 -19:00	EXAM	Coloma Ballester	UPF		52.217