VISION FOR MULTIPLE OR MOVING CAMERAS

1. SYLLABUS INFORMATION

1.1. Course title
Deep Learning for Visual Signal Processing I

1.2. University
Universidad Autónoma de Madrid

1.3. Semester
2nd semester

2. COURSE DETAILS

2.1. Course nature
Compulsory

2.2. ECTS Credit allotment
6

2.3. Recommendations

2.4. Faculty data
Escuela Politécnica Superior

3. COMPETENCES AND LEARNING OUTCOMES

3.1. Course objectives
This course considers two main objectives:

- Ability to understand and use strategies for learning and transferring knowledge to diverse computer vision tasks.
- Ability to understand and implement diverse computer vision applications for both image and video analysis.

3.2. Course contents

The contents of this course are structured in three units as follows:

Unit I: Learning strategies for Computer Vision

- Supervised learning (recap and advanced concepts)
- Unsupervised and self-supervised learning
- Transfer learning and domain adaptation
- Continual and incremental learning
- Few-shot and semi-supervised learning

Unit II: Advanced Neural Architectures for Computer Vision

- Graph Neural Networks
- Diffusion Networks

Unit III: Deep Learning Applications for Computer Vision

- Image understanding
- Video understanding

PR1, PR2, PR3 and PR4 are four practical assignments related to Units I, II and III.

3.3. Course bibliography

Since there is currently no single book that covers all the course content, this course will be based on selected book chapters, articles in relevant journals and conferences.
Here you have a tentative list of selected items for the topics covered in the course:

Main bibliography:

- Goodfellow, I.,Bengio, Y.,and Courville,A.,Deep Learning, MIT Press, 2016,http://www.deeplearningbook.org
- Mahadevkar, S. V.,et al.A review on machine learning styles in computer vision—techniques andfuture directions. IEEEAccess, 10, 107293-107329.2022
- Liu,Li,etal.Deeplearningforgenericobjectdetection:Asurvey.InternationalJournalofComputerVision,2020,128(2):261-318.
- F.Lateef, et al.Survey on semantic segmentation using deep learningtechniques. Neurocomputing,2019,338:321-348.
- Ciaparrone, Gioele, et al.Deep learning in video multi-object tracking: A survey. Neurocomputing, 2020, 381:61-88.

Additional bibliography:

- Karpathy,Andrejetal,Large-scaleVideoClassificationwithConvolutionalNeuralNetworks.InProc.ofthe IEEE Conference on Computer Vision and Pattern Recognition(CVPR), 2014, pp. 1725-1732.
- Tian, Y., et al. Recent advances on loss functions in deep learning for computer vision.Neurocomputing,497, 129-158,2022
- Gui, J., et al. A Survey on Self-supervised Learning: Algorithms, Applications, and Future Trends.IEEE Trans. on Pattern Analysis and Machine Intelligence.2024
- Song, Y.,et al.A comprehensive survey of few-shot learning: Evolution, applications, challenges, and opportunities.ACM Computing Surveys,55(13s), 1-40.2023
- Wang, L., et al. A comprehensive survey of continual learning: theory, method and application. IEEETrans.on Pattern Analysis and Machine Intelligence. 2024
- Cao, H.,et al., A survey on generative diffusion models. IEEETrans. on Knowledge and Data Engineering,2024
- Wu, Li.et al,Graph Neural Networks: Foundations, Frontiers, and Applications, Springer Nature, 2022
- Nikolenko, S. I. (2021). Synthetic data for deep learning(Vol. 174). Springer Nature.
- Wu, Z.; et al. Deep learning for video classification and captioning. Frontiers of multimedia research. 2017. p. 3-29.
- García-García, A.; et al. A survey on deep learning techniques for image and video semantic segmentation. Applied Soft Computing, 2018, vol. 70, p. 41-65.

- Chalapathy, R.; Chawla, S.;Deep learning for anomaly detection: A survey. arXiv preprintarXiv:1901.03407,2019.

4. TEACHING-AND-LEARNING METHODOLOGIES AND STUDENT WORKLOAD

4.1. Contact hours

The presential requirements of this course are as follows:

Modality	Hours	Percentage
Face-to-face activities	42	28
Non-presential activities	108	72
Total	150[1]	100

[1]The total hours consider a total workload of the course (6 ECTS) of 150 hours (6 ECTS x25h/ECTS), as defined by UAM and EEAhttps://education.ec.europa.eu/sites/default/files/document-library-docs/ects-users-guide_es.pdf

4.2. List of training activities

The course involves lectures, programming assignments, and evaluation activities. The list of course activities is as follows:

Activity		Hours	%	Hours	%
Presential (face-to-face)	Lecture sessions	22	15%	42	28%
	Practical programming sessions	18	12%		
	Test and exams	2	1%		
Non-presential	Weekly individual study	24	16%	108	72%
	Practical work (programming and reporting)	60	40%		
	Preparation of Tests and exams	24	16%		
	TOTAL WORKLOAD	150[1]	100		

5. EVALUATION PROCEDURES AND WEIGHT OF COMPONENTS IN THE FINAL GRADE

5.1. Regular assessment

IMPORTANT: All evaluation items are graded according to the Spanish system, ranging from 0 (worst) to 10 (best).

Final grade (FG):

In the regular assessment period, we will consider the following continuous evaluation for getting the Final Grade (FG):

$$FG = 0.5*TE + 0.5*PR$$

In order to pass the course, it is necessary to have an FG grade equal to or greater than 5.0, as well as a grade equal to or greater than 4.0 in the two individual parts for Theory (TE) and Practice (PR). The grades of each parts, if above 4.0, are kept for the resit (extraordinary)assessment period of the same academic year.

If any evaluation activity is performed and the minimum attendance criteria are not met for both TE and PR, the Final Grade of this regular assessment period (FG) will be "NOT EVALUATED".

If the attendance criterion is not met only for TE, the Final Grade (FG) will be:

$$FG = 0.5*Min(3.5, TE) + 0.5*PR$$

If the attendance criterion is not met only for PR, the Final Grade (FG) will be:

$$FG = 0.5*TE + 0.5*Min(3.5, PR)$$

Students must do the resit evaluation for only the parts (TE, PR, or both) which do not meet the attendance criteria.

Theory (TE):
TE is the grade obtained from lectures and ranges from 0 (worst) to 10 (best). It is obtained as follows:

$$TE = 50\%TE1 + 50\%TE2$$

where TE1 andTE2 are two exams[1], each one corresponding to approximately half of the lectures. If any of the grades for TE1 and TE2 is lower than 4.0, then the theory grade TE will be obtained as follows:

$$TE = Min(TE1, TE2)$$

Programming assignments (PR):
PR is the grade obtained from four programming assignments. It is obtained as follows:

$$PR = 25\%PR1 + 25\%PR2 + 25\%PR3 + 25\%PR4$$

where PR1, PR2, PR4and PR4correspond to four programming assignments[2], each distributed along the course. This rule is only applied if all grades are equal to or greater than 4.0. If this is not the case, PR will be obtained as follows:

$$PR = Min(PR1, PR2, PR3, PR4)$$

5.2. List of evaluation activities

The list of evaluation activities for continuous evaluation is as follows:

Type	Evaluation activity	Percentage (over overall grade)
Theory	Exam TE1	25%
	Exam TE2	25%
Practice	Programming assignment PR1	12.5%
	Programming assignment PR2	12.5%
	Programming assignment PR3	12.5%
	Programming assignment PR4	12.5%