Advanced Machine Learning

Group Projects – Introduction

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Advanced Machine Learning

Course Schedule

Week	Session	Wed 17-19h	Fri 15-17h	Theme	Theory	Practical
1	1	10 Sep		Adaptive and efficient learning	L1: Transfer learning	
	2		12 Sep			P1: Task transfer
2	3	17 Sep			L2: Knowledge distillation	
	4		19 Sep			P2: Knowledge distillation
3		24 Sep			No class (Festiu Bellaterra i Barcelona)	
	5		26 Sep			P2.5: Parameter-efficient adaptation
4	6	1 Oct			L3: Curriculum learning and semi-supervision	
	7		3 Oct			P3: Semi-supervised learning
5	8	8 Oct			L4: Self-supervised and contrastive learning	
	9		10 Oct			P4: Self-supervised learning
6	10	15 Oct			No class (huelga general)	
	11		17 Oct		L5: Multi-task and Meta-learning	
7	12	22 Oct				P5: Meta-learning
	13		24 Oct		Exam Review	
		27 Oct	18:00	Exams	**Partial Exam 1**	
8		29 Oct			No class (exam period)	
			31 Oct			
9		5 Nov				
	14		7 Nov	**Project**	**Project introduction**	
10	15	12 Nov		Adaptive and efficient learning	L6: Continual Learning	
	16		14 Nov			P6: Continual Learning
11	17	19 Nov		Trustworthy machine learning	L7: Explainability and Interpretability	
	18		21 Nov		**Project monitoring**	
12	19	26 Nov			L8: Security and adversarial robustness	
	20		28 Nov			P8: Adversarial attacks
13	21	3 Dec			L9: Private and federated learning	
	22		5 Dec			P9: Federated learning
14	23	10 Dec				P9.5: Privacy attacks
			12 Dec	**Project**	Project deliverable due date	No class (activitats campus)
15	24	17 Dec			**Project presentations 1**	
	25		19 Dec			**Project presentations 2**

		16 Jan	9:00	Exams	**Partial Exam 2**	
		28 Jan	9:00		**Recovery Exam**	

Group Projects
Introduction

- You will work in **groups of 2-3** to address a problem of considerable complexity within the domain of advanced machine learning.
- Groups will remain consistent throughout the project. You will be responsible for self-managing task planning, role distribution, resource management and conflict resolution.
- Part of the intended outcome is to demonstrate **teamwork** and an ability to work collaboratively over an extended period.

Group Projects
Problem Scope

- Approach a realistic ML problem by designing and implementing an algorithm appropriate to the topics covered in this AML module.
- That is, problems that involve resource constraints, or knowledge transfer between models/domains, adaptation of representations or modular architectures...
- The complexity should go beyond the toy examples we have worked with in the practicals, scaled up to more realistic models/datasets, or extensions of algorithms to more challenging settings.

Group Projects
Problem Scope

The choice of problem is yours, but some ideas:

- Take one of the algorithms we have implemented in the practical, read the **original paper** as well as its **extensions**, and analyse its performance experimentally in different settings
- Explore the '**further reading**' proposed in the lectures and choose an interesting algorithm/approach to implement from scratch, to solve a realistic problem
- Propose a problem of your own that could be solved with some **combination of the techniques** covered so far, implement this combination and report relevant findings

You should propose your specific project ideas to me and I can verify if they are of appropriate scope

Group Projects

Problem Scope

- Note: this project is assessed on the basis of the **advanced machine learning** techniques that you have applied and analysed.
- So if a large part of your project time is spent on overhead like data collection/cleaning/preprocessing, this might not be an efficient use of your time
- I specifically recommend **against** projects focused on *generative modelling* (GANs, diffusion, language autoregression) – these are tricky to optimise and it's difficult to get good results

  (but if you really want to, I recommend fine-tuning from existing models, e.g. with LoRA)

- Previous groups have worked on:
  - Domain adaptation between synthetic and real domains
  - Transfer learning from majority to minority languages
  - Developing new pretext tasks for sparsely annotated data
  - Applying meta-learning algorithms to continual learning problems

Group Projects

Tips and Resources

- Computational resources (cluster access) are available - once your groups are finalised, we will set up group accounts on the Enginyeria cluster
  - This cluster is shared with other classes, so there are sometimes political conflicts – be responsible!
  - You may find it easier to continue working with Colab/Kaggle at least for initial development, and this may even be sufficient overall depending on the scale of your problem.

- Unlike in the practicals, appropriate use of AI assistants like ChatGPT for technical work is **fine**
  - as with stackoverflow, re-used github code, reddit comments etc...
  - ... but you should still understand all the code that you implement, since you will need to explain the implementation at the end. Add citations where appropriate
  - You will be assessed on your understanding, so make sure you understand!

Group Projects

Feedback and Assessment

- On the 21st of November, a class slot is dedicated to reviewing the project progress and answering any questions
  - but I am always available throughout the project's duration to help with any conceptual or practical issues that arise
- Each project will be evaluated based on a **deliverable** and an **oral presentation** to the class.
- Active participation in both the preparation of the deliverable and the presentation is essential to receive a project grade.

Group Projects

Assessment: Deliverable Report

- The **deliverable** is 60% of the project grade. It should be in the form of a technical report of 5-10 pages (plus references, appendices etc.) that:
  - Introduce your chosen problem and its context
  - Describe your approach, its theoretical justification, and its technical implementation
  - Explain your results, analyse any experimental findings, and discuss extensions/limitations of the work
- The 10-page limit is strict – after those 10 pages, I will stop reading!

Group Projects

Assessment: Deliverable Report

- Unlike the practical submissions, which could be rough and approximate, the project deliverable is expected to be a serious work with proper structure, high-quality figures/tables and appropriate references.
- If you use AI assistants for improving writing quality or polishing English, fine, but details of technical implementation and discussion/analysis should be your own work.
  - I prefer imperfect English in your own voice that explains what you did exactly and why, instead of slick shiny ChatGPT English without substance ;)
- Reports are due on the 12th of December.

Group Projects

Assessment: Oral Presentation

- The **oral presentations** are worth 30% of the project grade.
- All group members are expected to participate in presenting your work as part of a presentation that follows the structure of your deliverable report.
- In the oral presentation, you should address the problem and solution at a high-level, favouring visual explanations and conceptual intuition, but also specific implementation details of note that you found to be important.
- Presentations will be on the 17th and 19th of December, the week after the reports are due.

Group Projects

Assessment: Self-Evaluation

- Lastly, 10% of the grade will be allocated by a self-evaluation completed following the end of the project presentations. This is designed to give fair credit to group members who contributed more of the project work.
- The procedure for this will be made available after the presentation dates.

Find your groups and start discussing ideas!