UNIVERSITAT DE BARCELONA

Introduction to Machine Learning

Master in Artificial Intelligence

UPC, UB, URV

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Week 1 – Information of the course:

Introduction to Machine Learning (IML)

Course 2024-2025

Dr. Maria Salamó
maria.salamo@ub.edu
Dept. Mathematics and Informatics,
Faculty of Mathematics and Informatics,
University of Barcelona

Brief description

- This course provides an **introduction on Machine Learning**

- It gives an overview of many concepts, techniques and algorithms in machine learning, beginning with topics such as **classification** and **linear regression** and ending up with more recent topics such **support vector machines** and **recommender systems**

Brief description

- The course is divided into three main topics:
  - supervised learning, unsupervised learning, and machine learning theory
- Topics include:
  - (i) **Supervised learning** (linear decision, non linear decision)
  - (ii) **Unsupervised learning** (clustering, factor analysis, and visualization)
  - (iii) **Learning theory** (bias/variance theory, empirical risk minimization)
  - (iv) **Machine learning in practice**
- The course will also draw from numerous case studies and applications, so that you'll also learn how to apply learning algorithms to computer vision, medical informatics, and signal analysis

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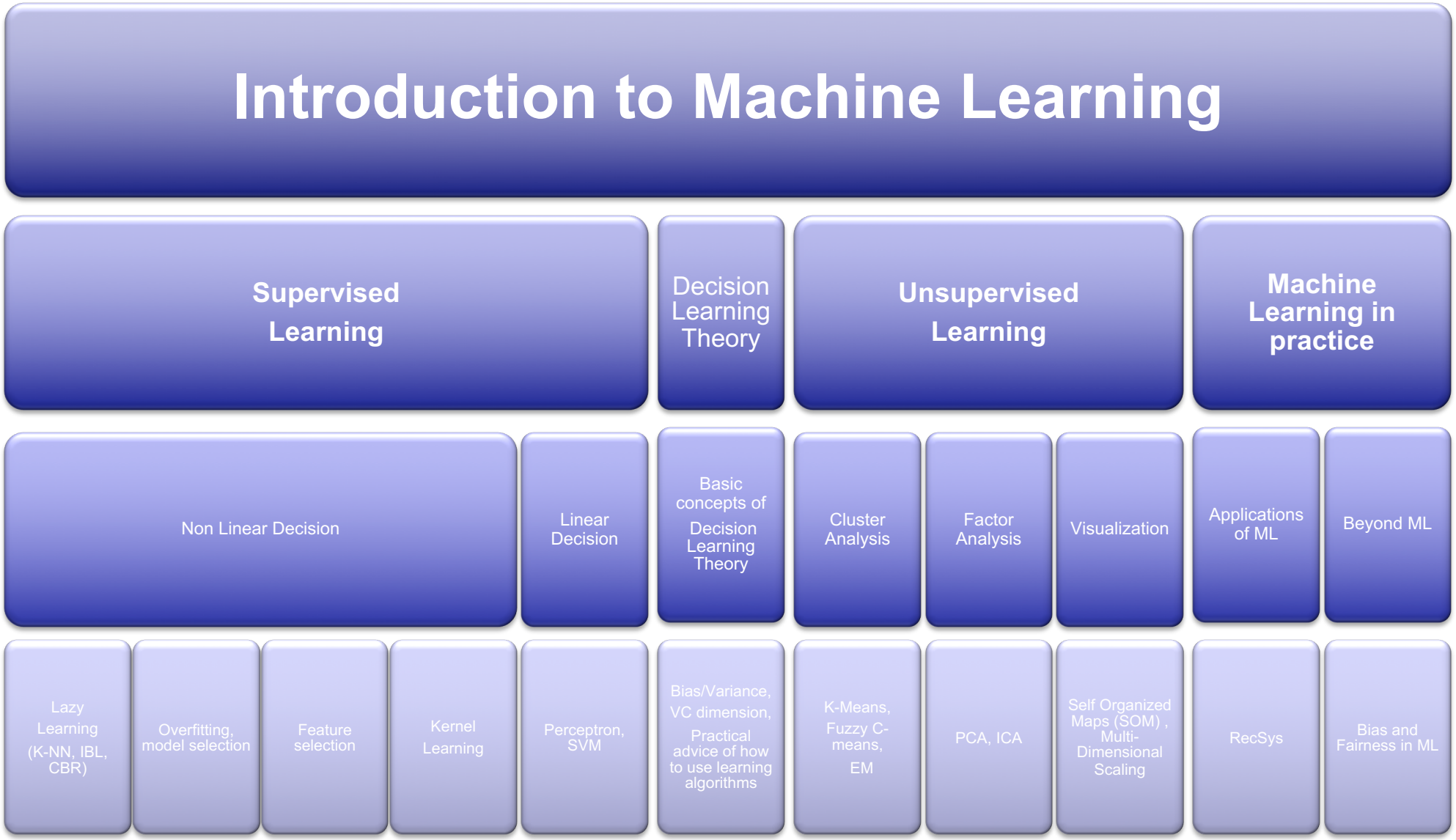
Summary



Contents

Contents

5. Feature Selection

- Description of Wrappers, Filters, and embedded
- Feature Selection Perspectives (Search directions, Search Strategies)
- Measures for making the selection (based on information, distance, dependence, consistency, accuracy)

6. Model Selection

- Introduction to Model evaluation (performance metrics, confusion matrix, ROC curves, etc.)
- Model evaluation (hold-out, cross-validation, overfitting and underfitting, bias vs variance, regularization, etc.)

Contents

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Contents

11. Recommender Systems

- Introduction to recommendation techniques
- An overview of Collaborative Filtering
- An overview of Content-based Filtering
- Conversational Recommenders

12. Bias and Fairness issues in ML

- Introduction to bias and fairness in AI and ML
- Bias and Fairness in Recommender Systems
- Examples of bias and fairness
- Hands on Bias in Recommender Systems

Organization of the course

Face-to-face scenario

- **Theoretical teaching** (Tuesday 10:00 to 12:00 room B2 at UB)
  - In-person activities

- **Theory/Practical**
  - In-person activities
  - **Face-to-face Theory/Practical** (Tuesday 12:00 to 13:00 room ID Group 1)
  - **Face-to-face Theory/Practical** (Tuesday 13:00 to 14:00 room ID Group 2)

Organization of the course

Face-to-face scenario

Theory/Practical Sessions

1. Teacher Maria Salamó (maria.salamo@ub.edu)
2. The time will be devoted to explain the **description** and **support material** for doing the practical exercises and solving doubts about these exercises.
3. **IMPORTANT No recordings of the face-to-face class will be performed**

Theoretical Sessions

1. Teacher Maria Salamó (maria.salamo@ub.edu)
2. The time will be devoted to:
    1. Summarize (30 to 60 minutes) the theory blocks of this week
    2. Perform question and answer sessions about theory
3. **IMPORTANT the support material explained in the face-to-face class will not be recorded**
4. The student may ask questions or may formulate a specific doubt about a topic. The teacher may repeat specific explanations to clarify or to provide support.
5. Short videos or additional material will be shared in the campus virtual by the teacher in case of specific common doubts to all students

Organization of the course

Face-to-face scenario

Campus Virtual (https://campusvirtual.ub.edu)

1. Provisional calendar
2. Theory – Slides of the course
   - Slides with the theory
   - Videos in specific theory blocks if necessary
3. Practical - Exercise text and instructions
   - Support slides for the practical
   - Description of the practical exercise in a pdf
   - Deliverable link in which the student will upload the code and the report of the practical exercise
4. Forum
   - Tool in which the student will write questions to the teacher. It allows to share the doubt and the answer to all the students, to avoid to repeat explanations.
   - Do not hesitate to use it! Other students might have the same doubt as you.
   - In addition, you can also help your mates by answering their questions if you have the answer.

Organization of the course

Face-to-face scenario

Common doubts?

1. Am I obliged to attend the face-to-face session?
   - No, you are not obliged, however it is recommended
     - The support material will be available in the campus virtual and is sufficient.
     - Beware! No face-to-face video will be shared, and forum will answer to specific doubts
     - A week questionnaire will be solved in these sessions

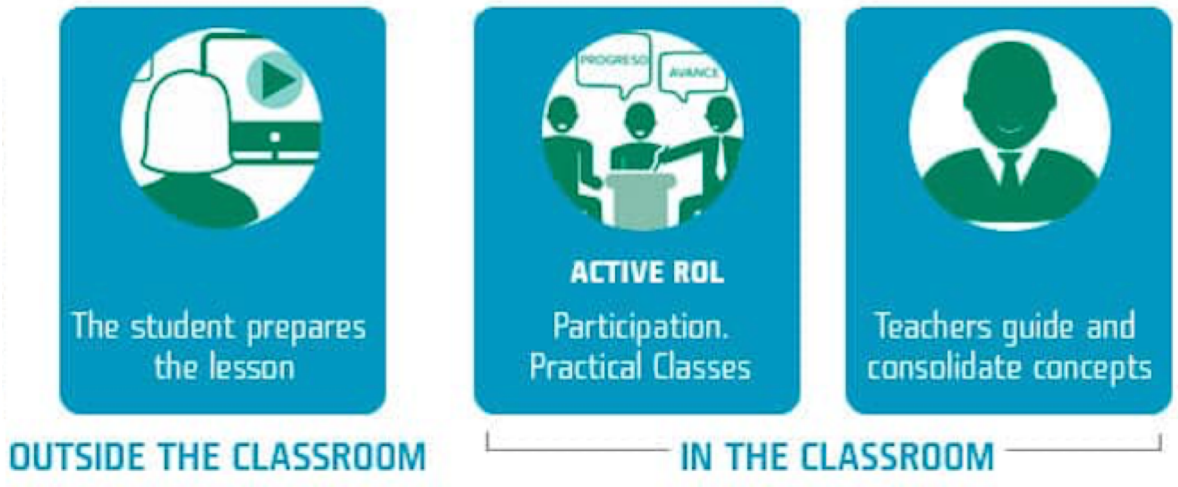
2. Am I obliged to attend practical sessions?
   - No, you are not obliged, however it is recommended
     - The teaching material will be available in the campus virtual and is sufficient.
     - Beware! No theory video will be shared every week, and practical sessions and forum will answer to specific doubts (question/answer) of the practical exercises

Organization of the course

Methodology

- Every week the corresponding theoretical lesson will appear in several blocks in campus virtual
  - Every Tuesday you will have the new lesson available on campus virtual
- During one week students prepare the lesson
- Next Tuesday **the theoretical session** will be devoted to summarize, discuss the contents of the lesson and question/answering
- A theoretical questionnaire will be done in the face-to-face theoretical class
- The practical exercises are done in the **face-to-face theoretical/practical classes** and are related to several lessons

It is very important your active role and to follow every week the theoretical lessons



Activities – work deliveries

- Work 1 – (W1)
  - Initial exercise (mandatory)
- Work 2 – (W2)
  - Lazy Learning exercise
- Work 3 – (W3)
  - Clustering exercise
- Work 4 – (W4)
  - Factor Analysis exercise

This year work is done in groups of four

Evaluation

- The course is divided into two parts:
  - **Exam**: an exam at the end of the term
  - **Work**: Work deliveries during the semester

Mark = a x Exam + b x Work if exam>=3,5 and Work>= 4,5

This year **a** and **b** will be established as: *a = 0,4 and b = 0,6*

Exam = a final exam at the end of the term (14th January 2025)

Work = 0,3 x W2 + 0,3 x W3 + 0,2 x W4 + 0,2 x Tests

- Some Works may have an exam after the delivery. The mark will be a part of the Wx.
- **Tests** are the weekly theoretical questionnaires

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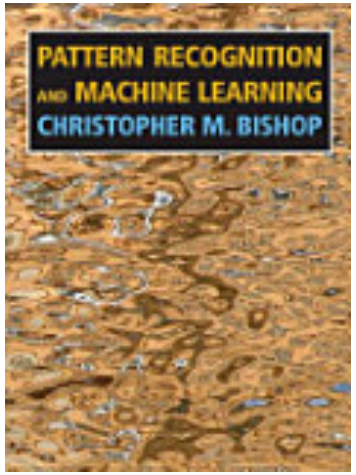
Calendar (2nd version)

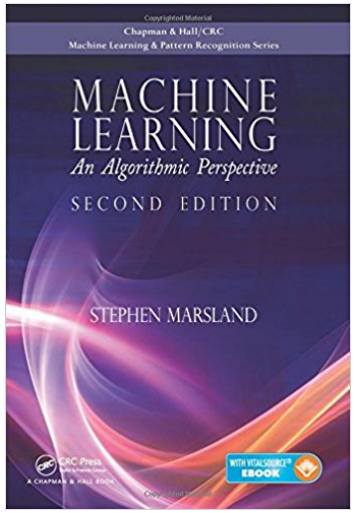
Week	Month	Tue	Publish Theory Block	Theoretical class	Evaluation	Theoretical/Practical class
0	Sep	10	T1. Introduction to ML	none	none	none
1		17	T2. Introduction to Supervised Learning	Information of the course and T1	none	W1. A practical exercise (deliver W1)
		24	NO CLASS bank holiday	none	none	NO CLASS bank holiday
2	Oct	1	T3. Lazy Learning	T2	none	W2. Lazy learning and SVM (Session 1)
3		8	T4. Model Selection	T3	T1, T2	W2. Lazy learning and SVM (Session 2)
4		15	T5. SVM and Kernels	T4	none	none
5		22	T6. Feature Selection	T5	T3, T4	W2. Lazy learning and SVM (Session 3)
6		29	T7. Clustering: Part 1	T6	T5	W2. Lazy learning and SVM (Session 4) (deliver W3)
	Nov	5	NO CLASS MID-term exams	none	none	NO CLASS MID-term exams
7		12	T8. Clustering: Part 2	T7	T6	W3. Clustering (Session 1)
8		19	T9. Factor Analysis: PCA and ICA	T8	T7	W3. Clustering (Session 2)
9		26	T10. Visualization: SOM & MDS	T9	T8	W3. Clustering (Session 3)
10	Dec	3	T11. Recommender Systems	T10	T9	W3. Clustering (Session 4) (deliver W3)
11		10	T12. Bias and Fairness	T11	T10	W4. A gentle introduction to PCA and visualization (Session 1)
12		17		T12	T11	W4. A gentle introduction to PCA and visualization (Session 2) (deliver W4)
	Jan	14	Final EXAM		EXAM	

Remarks

- All the information of the course will be in Campus Virtual https://campusvirtual.ub.edu
  - **You have access or you will obtain soon, meantime, I will use racó** https://**raco.fib.upc.edu/**
- Work is in groups of 4 but the score is individual for each student
  - An individual questionnaire is done after each delivery, that will be used to weight the mark obtained by each member of the group
- Bring your own laptop computer (face-to-face classes)
  - Install previously **Python 3.8** and **Pycharm IDE**
- **Deliveries should be in Python in a PyCharm project**
  - **Late deliveries**: work or projects submitted late will mean the deduction of 1 point per day (out of 10) from the final mark
  - **Copy of deliveries**: all the groups involved will obtain 0 points

Bibliography





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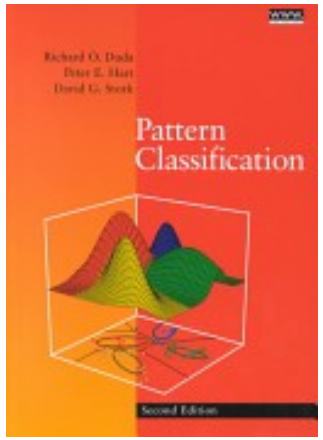
- Marsland, Stephen, *Machine Learning: An algorithmic Perspective*, 2nd ed. CRC Press, 2015. ISBN: 978-1-466-58328-3

Bibliography



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- Tom Mitchell, *Machine Learning*. McGraw-Hill. ISBN 0-07-042807-7

Tools

- Python

  https://www.python.org/

  http://scikit-learn.org/

- PyCharm

  https://www.jetbrains.com/pycharm/

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Survey

I want to know you a bit,

PLEASE fill this survey

- **It is not an exam, so there are not good or bad answers,**
- **It is not anonymous since … It is intended to just know more about yourself, what do you like/love, and what do you expect from this course,**
- **According to your interests I can adapt much better the course for you**

https://forms.gle/V89G8DMvpCokLyZ2A