POLITECNICO
MILANO 1863

Artificial Neural Networks and Deep Learning

- Introduction to the course -

Prof. Matteo Matteucci – *matteo.matteucci@polimi.it*

Eng. Francesco Lattari – francesco.lattari@polimi.it

but also …

Prof. Giacomo Boracchi – *giacomo.boracchi@polimi.it*

Eng. Eugenio Lomurno – eugenio.lomurno@polimi.it

«Me, Myself, and I»

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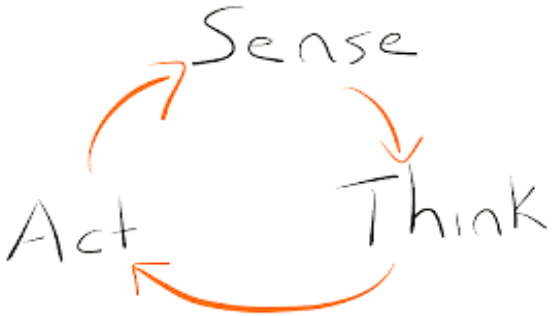
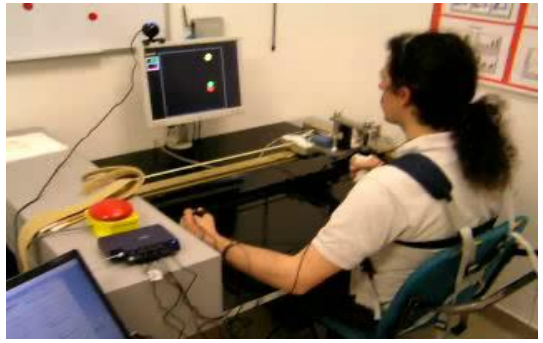
My research interests

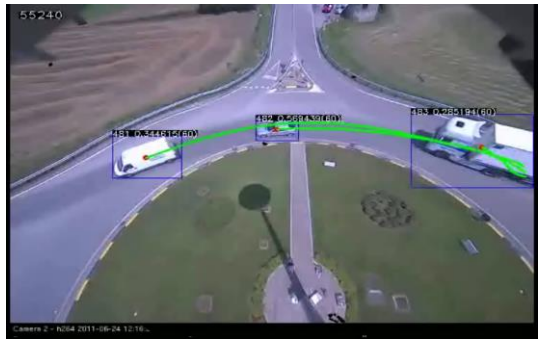
- Robotics & Autonomous Systems
- Machine Learning
- Pattern Recognition
- Computer Vision & Perception

Courses I teach

- Robotics (BS+MS)
- Machine Learning (MS)
- Deep Learning (MS+PhD)
- Cognitive Robotics (MS)



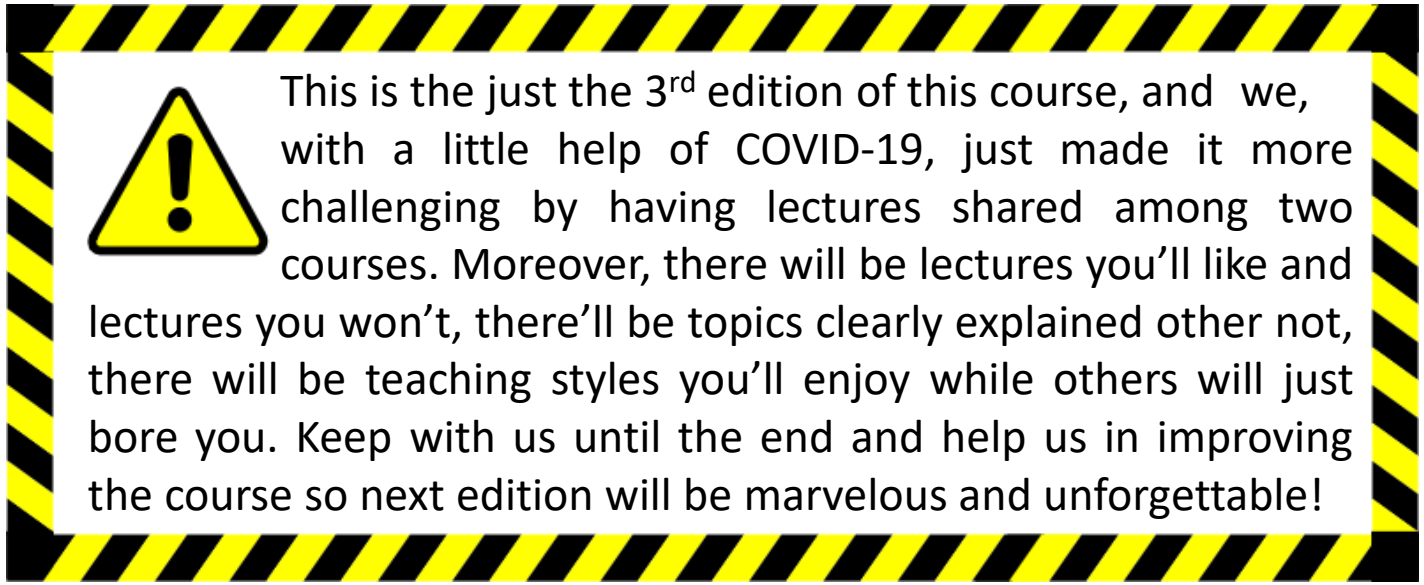




Enable physical and software autonomous systems to perceive, plan, and act without human intervention in the real world

Course Objectives

"The course major goal is to provide students with the theoretical background and the practical skills to understand and use Neural Networks, and, at the same time, become familiar and with Deep Learning for solving complex engineering problems … especially in vision tasks"



A Course with Code Sharing

This course is offered to Computer Science and Engineering students

- 054307 - ARTIFICIAL NEURAL NETWORKS AND DEEP LEARNING - 5 CFU
- Prof. Matteo Matteucci, Eng. Francesco Lattari

… equivalent course for Bioen matical Engineering

- 056869 - ARTIFICIAL NEURAL NE ND DEE
- Prof. Giacomo Boracchi, Eng. Eugenio Lomurno

… just kidding you can stay ☺

Bio & Mathematical Engineering students can leave now …

The same teachers will teach the same topics to both classes, but you need to be enrolled in the right course and attend the right lectures …

The Teachers

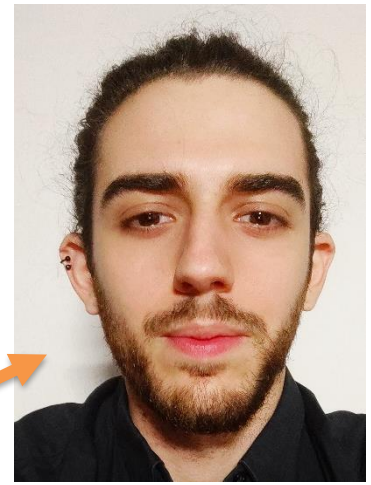
Official teacher, please refer to me for bureaucratic stuff!

Prof. Matteo Matteucci

- Neural Networks
- Deep Learning
- Sequence Learning

Prof. Giacomo Boracchi

- Computer vision
- Deep models for vision



Francesco Lattari and Eugenio Lomurno

- Programming with Keras (python)

A detailed schedule is published on the course website don't panic!

A Google Calendar for you!

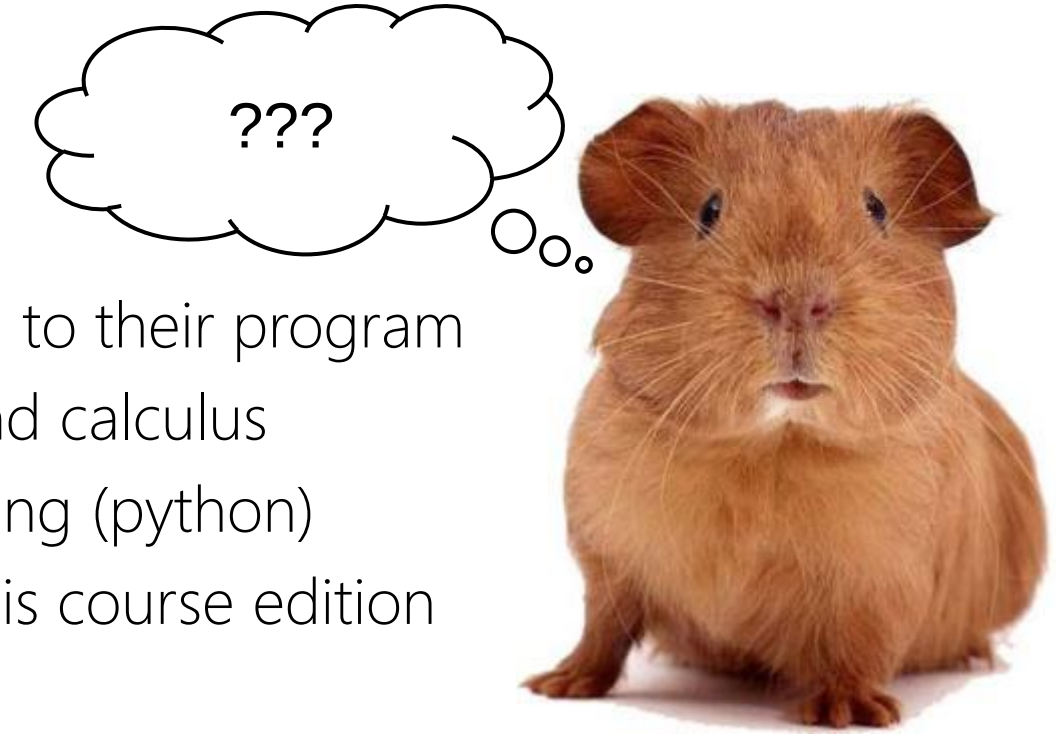
https://boracchi.faculty.polimi.it/teaching/AN2DLCalendar.htm

Each event includes

- Teacher
- Room / online
- Webex link to connect
- Links to video recordings

Also this link is published on the course website!

The Students



Students are expected to:

- To attend the proper classes according to their program
- Feel confortable with basic statistics and calculus
- Feel confortable with basic programming (python)
- Be ready to act as «guinea pigs» for this course edition
- Be curious and willing to learn …

Students are not expected to:

- Know more than what is usually tought in basic engineerig courses
- Know already about machine learning (althought it doesn't hurt)
- Be hyper-skilled python hackers (you'll not need it)
- …

Course syllabus

Introduction to Neural Network and Deep Learning

- From the Perceptron to neural networks
- Backpropagation and neural networks training
- Best practices in neural network training
- Recurrent architectures
- Autoencoders and long short-term memories

~25h lectures

Image classification with neural networks

- Image Classification and Convolutional Neural Networks
- CNN Training Tricks and Best Practices
- CNN for Advanced Vision Tasks (Segmentation, Detection,…)

~22h lectures

ANN and Deep Learning Coding (with Keras)

~14h practicals

Course Website and Detailed Schedule

All details and info are on the course website

https://chrome.deib.polimi.it/index.php?title=Artificial_Neural_Networks_and_Deep_Learning

How to get there?

- Goto https://chrome.deib.polimi.it
- Select "Artificial Neural Network and Deep Learning" on the left

What do you find there:

- Detailed schedule !!!
- Last minute announcements
- Slides, notes, references, lectures recordings …

Lectures Schedule and Timings

Classes (there is no real distinction between lectures and exercises):

- Wednesday, 15:15 – 17:15, in T.2.1 (starts at 15:30) Team 1 (odd codice persona)
- Wednesday, 17:15 – 19:15, in T.2.1 (starts at 17:30) Team 2 (even codice persona)
- Thursday, 16:15 – 19:15, on webex (starts at 16:30 some weeks could be 2h only)
- ~~Saturday is there just in case we cannot reach the proper number of hours~~
- ~~Thursday in presence is there just in case we go fully in presence~~

Check the teacher who will be in class on the detailed schedule

- Connect to proper teacher webex room in case you need to attend remotely
- Use your POLIMI credentials, we will not admit external students
- Lectures will be recorded and made available afterwards
- Interaction is prioritized for in presence room students

Course Evaluation

Grading comprises a theoretical part and a practical part:

- Written examination covering the whole program up to 22/30
- Home project in the form of 2 coding challenges up to 08/30
- Final score will be the sum of the grades of the two 30/30

Comments and notes about the grading

- 11 points of the theoretical part will be given by Prof. Matteucci
- 11 points of the theoretical part will be given by Prof Boracchi
- 4 points for each homework challenge are given by Lattari and Lomurno
- Homework challenges are not repeated, they are just run once a year
- Laude is given to particularly active students and for optional parts

Challenges are graded based on what you do, not based on the position in the rank!

Course Evaluation

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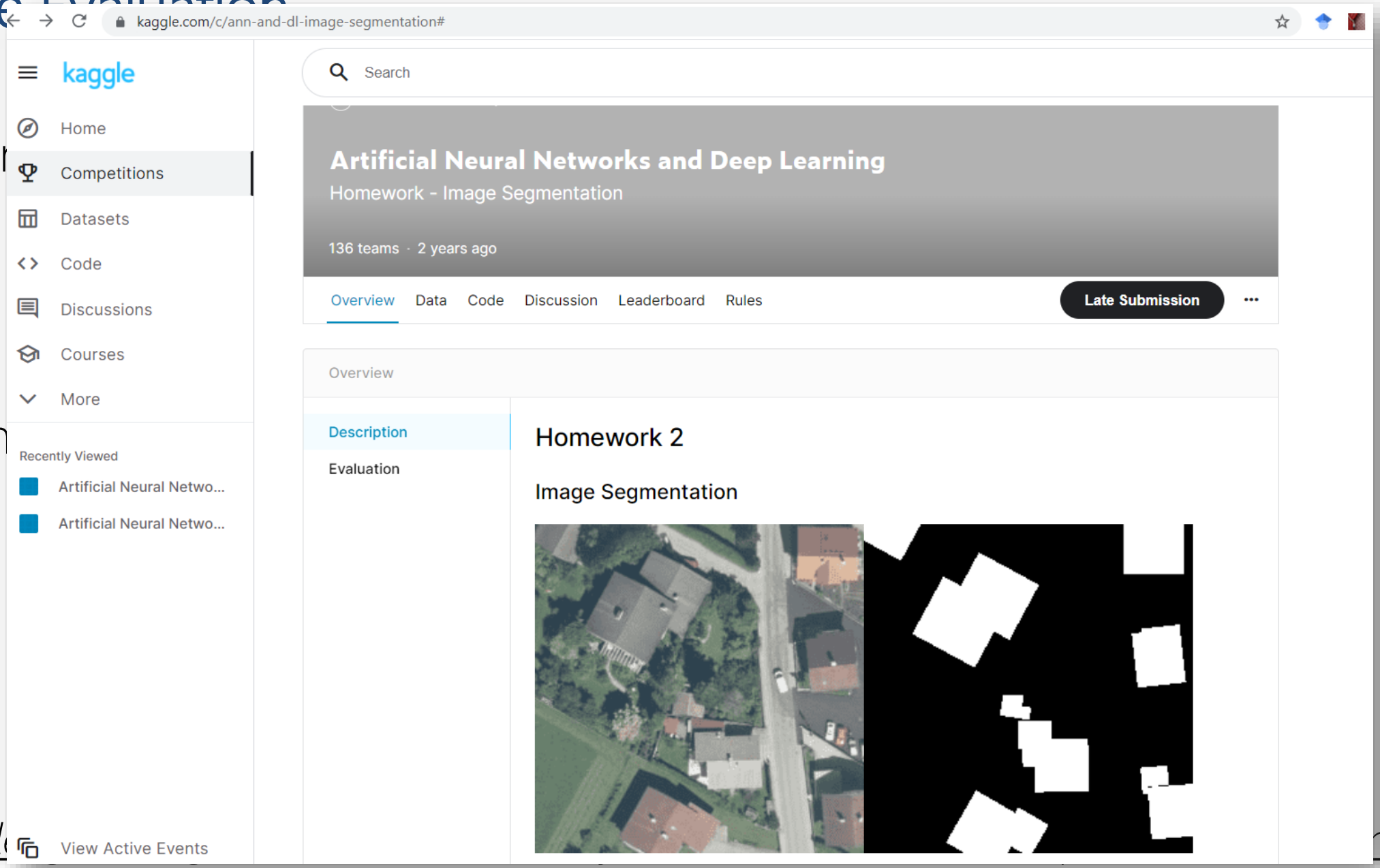

Synergies with Other Courses

AN2DL is a course on machine learnin… courses on the same topic, but it has b… …ith:

Even taking them all the overlap ends up to be at most 10h (<20%)

- *Machine Learnig*: there you see classical machine learning tools, some concepts such as generalization, overfitting, and crossvalidation might be similar …

  Machine Learnig: up 4-5h out of 60h (< 10%)

- *Uncertainty in Artificial Intelligence*: neural networks have been removed from this course and they have been replaced by Bayesian Networks and Graphical Models …

  Uncertainty in AI: up 0h out of 60h (0%)

- *Image Analysis and Computer Vision*: the feature learning part has been removed from Image and Computer Vision , there is just a shared background on image filtering…

  Image Analysis: up 2h out of 60h (< 4%)

- *Data Mining and text Mining*: does not cover neural networks and it is mostly based on unsupervised methods

  Data Mining and Text Mining: up to 4-5h out of 60h (< 10%)

Ironing out the kinks …

Some details have not been sorted out yet, we are working on those ..

- WeBeep Use (?)
- Projects/Competitions:
  - How many people per group (?)
  - When the competition will be out (?)
- Practical evaluation of challenges:
  - Not doing it scores up to 0 points
  - Doing it with basic tools present in class up to 2 points (?)
  - Doing it with passion and in a propositive manner up to 4 points (?)
  - Automated scoring / code plagiarism check (?)

Frequently Asked Question (up to now)

I cannot attend all classes, do you follow a book?

You can find all covered topics on the Deep Learning book, but we are going to present the course in a personalized manner. We suggest you to attend and follow our material then check the book to complete your preparation. Slides will be made available as well as lecture recordings.

I am not a computer scientist (e.g., automation engineer or physics engineer), will I be able to do the competition?

We are going to use simple libraries, we expect with basic competencies in programming you should be able to do it autonomously at least to a minimum level

I have overlaps can I attend a different team?

Teams have been defined as to balance the classes and do COVID contact tracing. It is not up to me to check who should not be there, but it is my responsibility to check class capacity. Right now please attend with your team, we might do some rebalancng or room exchange in case we manage.

Other questions?