

Deep Learning & Applied AI

Introduction

Emanuele Rodolà
rodola@di.uniroma1.it



SAPIENZA
UNIVERSITÀ DI ROMA

2nd semester a.y. 2023/2024 · February 26, 2024

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- **Lecturer:** Prof. Emanuele Rodolà
- **Assistants:** Donato Crisostomi
based on material by Luca Moschella and Antonio Norelli
Coding sessions, project support, technicalities

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- **Office Hours:** Drop me an email, or use Discord! (see next slide)

24/7 playground

Please join the discord server of the course:

<https://discord.gg/AmwYXS8Y>

This will be our meeting place for the lab sessions.

You can use it at any time for the entire semester to organize meetings, collaborate on the lab assignments, etc.

The TAs and myself will be always online during the lab lectures, and will check it daily even on non-lecture days.

Repository

Official website: <https://erodola.github.io/DLAI-s2-2024/>

Check frequently for **news** and **material** (code, papers, ...)!

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The course is hosted on Github at the url:

<https://github.com/erodola/DLAI-s2-2024>

Note: Webpage, repository and Discord server are your main source of information, and replace completely the need for a mailing list. Check them often!

Disclaimer

We are at the **fifth edition** of a popular course.

- We will mostly follow the same material as the previous edition, with additions (e.g. representation learning) and simplifications
- The exam will have the same format (written + project)

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- You **must** know some Python, calculus and algebra!
- The course is **challenging**

A good grade at other ML courses will not guarantee success.

Failure cases from past exams

It is **not** advised to:

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- **Postpone study**

New lectures usually assume knowledge from the previous lectures.

Recipe for success

Try to **enjoy** the course!

Take this as an opportunity to learn **in depth** a topic that will reshape our future.

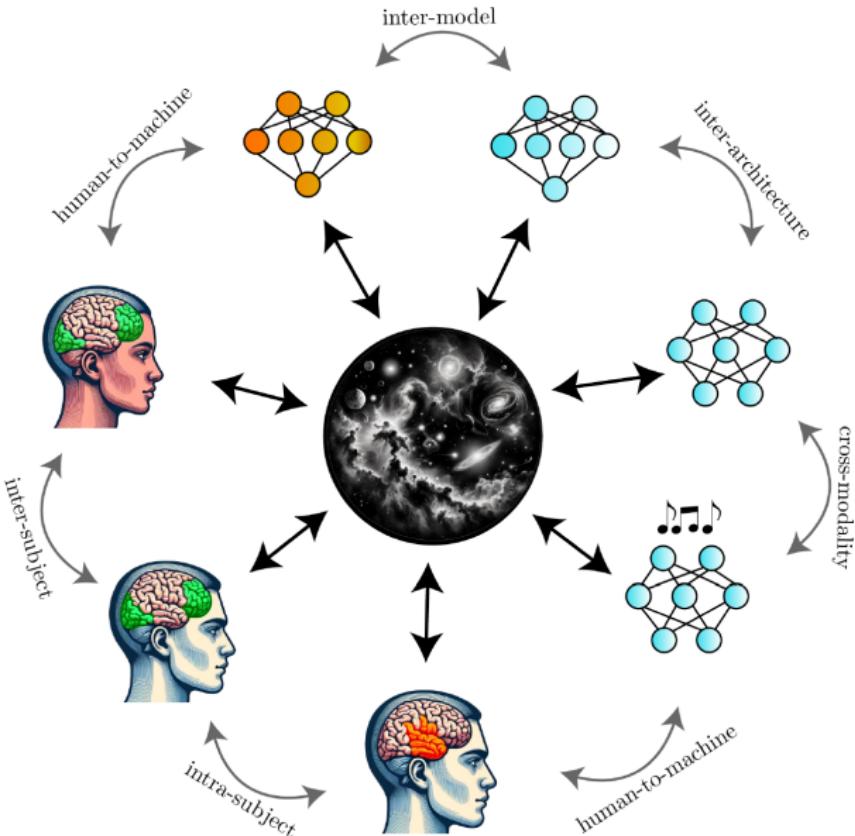
Ask questions when in doubt.

Who am I?

- Had research positions at U Tokyo, TU Munich, U Lugano and visiting positions at Harvard, Stanford, Ecole polytechnique, Technion among others
- Fellow of ELLIS and the Young Academy of Europe
- Research: representation learning, geometry, ML for audio
- Team: ~25 members from physics, engineering, computer science
GLADIA group of Geometry, Audio, Learning and AI
- Approach us for projects / theses!



European Research Council
Established by the European Commission



Notable Top 5% at ICLR 2023

Pre-requisites and reading material

No official textbook.

Specific references will be given throughout the course in the form of book chapters and scientific articles.



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Pre-requisites:

- **Programming fundamentals.** We will use **Python**
- Linear algebra, calculus

Pre-requisites and reading material

Main source: specialized conferences and journals:

NeurIPS, ICML, ICLR, JMLR, CVPR, etc.

The image displays two side-by-side browser windows. The left window shows a Google search results page for 'neurips'. The right window shows the homepage of the NIPS Proceedings website.

Google Search Results (Left Window):

- Search term: neurips
- Results: About 617,000 results (0.48 seconds)
- Top result: nips.cc - NeurIPS @ Vancouver: The Thirty-fourth Annual Conference on Neural Information Processing Systems. Vancouver Convention Center ...
- Sub-links from top result:
 - Full Schedule**: Full Schedule (mobile friendly) · Multitrack Schedule ...
 - Dates**: Call for Papers · Call for Tutorials · Call for Workshops · Hotels · ...
 - NeurIPS 2019 Schedule**: NeurIPS | 2019, Thirty-third Conference on Neural ... Dates ...
 - More results from nips.cc »

NIPS Proceedings Website (Right Window):

- Page title: NIPS Proceedings® Books
- Search bar: search
- Section: Electronic Proceedings of the [Neural Information Processing Systems Conference](#)
- List of proceedings:
 - [Advances in Neural Information Processing Systems 32 \(NIPS 2019\) are proceedings](#)
 - [Advances in Neural Information Processing Systems 31 \(NIPS 2018\)](#)
 - [Advances in Neural Information Processing Systems 30 \(NIPS 2017\)](#)
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- Text: The Conference Neural Information Processing Systems Foundation is a non-profit organization.

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Applications: we'll mostly illustrate things in the areas of computer vision, geometry processing, graphics, social networks, audio.

Grading

- ① Midterm self-evaluation (*not graded*)

When: first half of April

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In class, be prepared:

- Download/print the slides beforehand
- Take notes: not everything will be on the slides
- Bring your laptop: we'll do live coding sessions

Overall objective

What will you get out of this course?
(if you study)

- You will acquire **solid fundamental skills** for understanding, analyzing, and designing deep learning models

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- You will acquire solid fundamental skills for understanding, analyzing, and designing deep learning models
- You will be able to grasp and elaborate on more advanced topics published in the top machine learning venues
- You will get practical development expertise on applied problems



Google DeepMind

SONY  **Meta** 

Mathematical tools

- Linear algebra
- Calculus
- Optimization
- Discrete mathematics
- Probability & statistics
- Metric and differential geometry

This is not an easy course, but results will speak for themselves.

We will have to develop ways to **evaluate**, **visualize**, and **quantify** what we are doing. Going blind-folded and regarding learning models as black boxes will not bring us very far!

ARTIFICIAL INTELLIGENCE

Early artificial intelligence stirs excitement.



MACHINE LEARNING

Machine learning begins to flourish.



DEEP LEARNING

Deep learning breakthroughs drive AI boom.



1950's

1960's

1970's

1980's

1990's

2000's

2010's

Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Image: Michael Copeland, NVIDIA

Deep learning is
everywhere!

enses Other

question Answering

on
on
Image-to-Image
e Generation

Generation

D
on

Answering

Models 521,547

Filter by name

 google/gemma-7b

Text Generation • Updated 3 days ago • ↓ 188 • ❤ 1.23k

 ByteDance/SDXL-Lightning

Text-to-Image • Updated 1 day ago • ↓ 2.2k • ❤ 512

 google/gemma-2b

Text Generation • Updated 3 days ago • ↓ 780 • ❤ 363

 BioMistral/BioMistral-7B

Text Generation • Updated 3 days ago • ↓ 891 • ❤ 233

 mistralai/Mixtral-8x7B-Instruct-v0.1

Text Generation • Updated 3 days ago • ↓ 1.15M • ❤ 3.01k

 stabilityai/stable-video-diffusion-img2vid-xt

Image-to-Video • Updated 9 days ago • ↓ 225k • ❤ 1.81k

 openai/whisper-large-v3

Automatic Speech Recognition • Updated 17 days ago • ↓ 921k • ❤ 1.75k

 google/gemma-7b-it

Text Generation • Updated 2 da

 stabilityai/stable-c

Text-to-Image • Updated 6 day

 google/gemma-2b-it

Text Generation • Updated 1 da

 briaai/RMBG-1.4

Image-to-Image • Updated 12 da

 CohereForAI/ayा-101

Text2Text Generation • Update

 meta-llama/Llama-2-7

Text Generation • Updated Nov

 stabilityai/stable-d

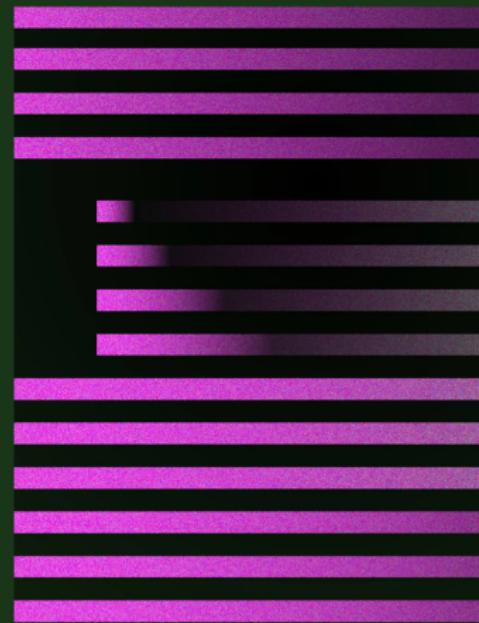
Text-to-Image • Updated Oct 30



Blog

Introducing ChatGPT

We've trained a model called ChatGPT which interacts in a conversational way. The dialogue format makes it possible for ChatGPT to answer followup questions, admit its mistakes, challenge incorrect premises, and reject inappropriate requests.



 ✓ BOT Midjourney Bot archaeopteryx in a cartoon cel from the golden age of animation by walt disney studios drawn by walt disney 

Midjourney Bot ✓ BOT Oggi alle 08:50

archaeopteryx in a cartoon cel from the golden age of animation by walt disney studios drawn by walt disney circa 1939
--ar 16:9 --no close up, zoom in --s 20 - Image #4 @gabagool6



 Upscale (Subtle)

 Upscale (Creative)

 Vary (Subtle)

 Vary (Strong)

 Vary (Region)

 Zoom Out 2x

 Zoom Out 1.5x

 Custom Zoom

 Make Square



Web 

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Midjourney Bot ✓ BOT Oggi alle 08:50

Resurrect an ancient library from the ashes of a volcano.

Win \$100,000. Make History.

The Vesuvius Challenge is a machine learning and computer vision competition that in 2023 cracked the riddle of the Herculaneum Papyri & awarded over \$1,000,000 in prizes.

2024's challenge is to go from reading a few passages to entire scrolls.

2023 Grand Prize Won

[READ THE ANNOUNCEMENT →](#)



Read the Master Plan

[READ THE POST →](#)



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WHAT WOULD IT MEAN TO

Understand *What Whales are Saying*

THE ROADMAP

The CETI team collaborated to develop a scientific roadmap.

[Learn more](#)