

Artificial Intelligence

Advanced Topics in AI & ML

Introduction. Course logistics and syllabus. Deep Learning and Neural Nets

Aleksandr Petiushko

ML Research



Content

① Introduction

Content

- ➊ Introduction
- ➋ Course logistics and syllabus

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- ➌ Deep Learning and Neural Nets

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- ➍ AI vs ML vs DL

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- ➌ Deep Learning and Neural Nets
- ➍ AI vs ML vs DL
- ➎ Historic reference

About the lecturer¹

- Aleksandr Petiushko, PhD in theoretical CS (2016)
- Lecturer in Lomonosov MSU / MIPT for Machine Learning, Computer Vision, Deep Learning Theory, Python for an ML Researcher since 2019
- Former Huawei Chief Scientist (Scientific Expert), AIRI Director of Key Research Programs (Leading Scientific Researcher)
- Currently at Nuro, leading the ML Research



¹Homepage: <https://petiushko.info/>

Time to introduce yourselves: what are your hobbies, motivation in ML, etc.: please go into “**Module 1 Students Introduction**” thread

Sofia Plagiarism Policy

- It covers parts “*sourced from AI*”
 - ▶ Please read the “**Sofia Plagiarism Policy**” thread
 - ▶ **First offense:** students need to rewrite assignment
 - ▶ **Second offense:** students fail the course
 - ▶ **Third offense:** students re to be withdrawn from their program

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 - ▶ It can produce very different information in comparison to the source used to ask question (e.g., book chapter)

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- Only the answers with some non-trivial arguments that contradict the initial post will be considered as graded ones

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- Preliminary grading scale:

Grade	Percent accumulated
A	90-100 %
B	75-89 %
C	60-74 %

Late Submission Policy

Late submission deduction percent: **15% every day**;

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- It means that if you're **7 days late** than no need to submit: you'll get **0 score** anyway.

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Unless:

- A student has a serious medical condition, and this condition is validated by a hospital or licensed California physician (in English)
- The Student contacts in time Student Services (student.services@sofia.edu) and describes the situation and provides all the needed proofs
- The student notifies in time our chair (Donna Dulo) and Professor about the situation with the confirmation from Student Services

- Course page: <https://github.com/fatheral/sofia-aiml-2024>
- The professor's lectures will be uploaded there

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Natural Intelligence (human)

- Able to perceive the information, analyze it, make decisions based on this analysis

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Artificial Intelligence

- (Strong) The same as natural intelligence, but computer is instead of human
- (**Weak**) Algorithm which is able to train using the input data in order to do tasks afterward — instead of human

What is Machine Learning

In 1959 Arthur Samuel introduced the term “machine learning” into scientific use.

General definition

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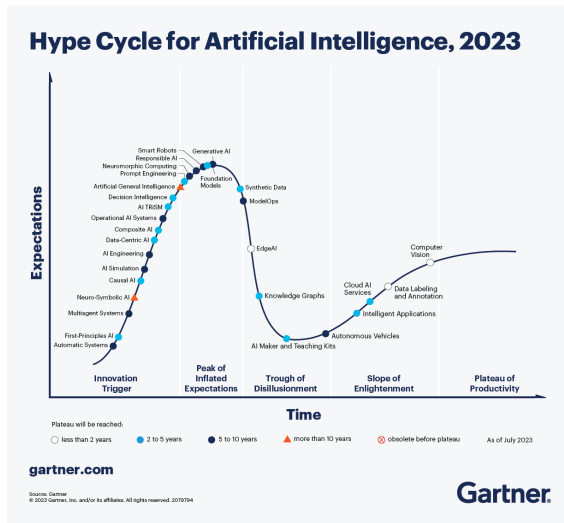
Machine Learning — the process leading computers to gain ability to show the behavior that wasn't explicitly programmed.

In 1997 Tom M. Mitchell introduced more formal definition of a machine learning algorithm.

Formal definition

A **computer program** is said **to learn** from examples E for some set of problems T and a quality metric P if its performance on problems from T , as measured by P , is improved by using examples E .

Broad concepts: AI Hype Cycle²



²www.gartner.com

Course content

- Deep Learning and Neural Nets
- Generative AI: Generative Adversarial Networks
- Generative AI: Diffusion
- Transformers: encoders and decoders
- LLMs: BERT, GPT
- Applications: Computer Vision
- Applications: Speech Recognition
- Multi-tasking
- Multi-modality
- Interpretability and Explainability
- Embodied AI: Self-Driving
- AI Ethics
- Robust ML

Deep Learning³ and Neural Nets

- Neural Net (NN): a (usually!) non-linear function mapping a (usually) multi-dimensional input to some output (which can be of the same dimension, or a bigger/smaller one)

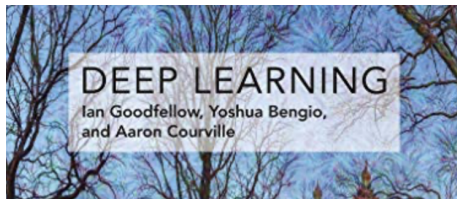
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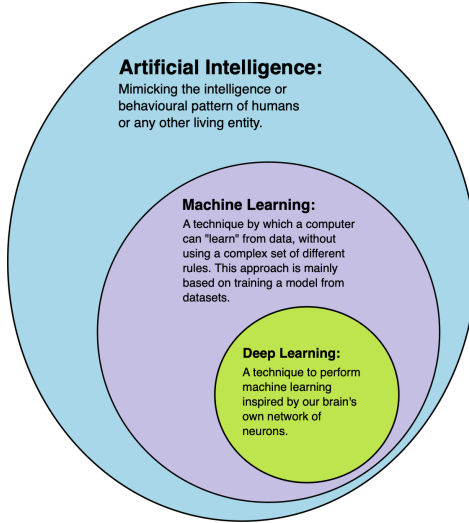
³Deep Learning Classical Book

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- Deep Learning: a NN consisting of more 2 layers of atomic operations (that's why deep) and the corresponding procedure of the training (“learning”) it weights using back propagation process



AI vs ML vs DL⁴



⁴Wiki

Deep Learning History II⁶

1990	Yann LeCun	introduced LeNet, showed the possibility of deep neural networks in practice
1997	Schuster & Paliwal	introduced Bidirectional Recurrent Neural Network
	Hochreiter & Schmidhuber	introduced LSTM, solved the problem of vanishing gradient in recurrent neural networks
2006	Geoffrey Hinton	introduced Deep Belief Networks, also introduced layer-wise pretraining technique, opened current deep learning era.
2009	Salakhutdinov & Hinton	introduced Deep Boltzmann Machines

- 2011: AlexNet — the first neural net winning the ImageNet challenge
- 2017: Invention of Transformer, the main architecture of LLM
- 2022: Invention of ChatGPT

⁶On the Origin of Deep Learning

More details on DL History and NN Architectures

Please read two links below:

- [Deep Learning in a Nutshell: Core Concepts](#)
- [Deep Learning in a Nutshell: History and Training](#)

Takeaway notes

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- ➌ Deep Learning is responsible for the most of the AI success today!
- ➍ Let's get our journey started!

Thank you!