FAAI24 : Foundations and applications of artificial intelligence

FAAI24 program

Monday, October 28, 2024

Time	Event
13:15 - 13:30	Registration (badge collection) (Amphitheater I-3 UAIC): organizers
13:30 - 14:00	Welcome address (Amphitheater I-3 UAIC) - organizers
14:00 - 14:50	Deep Learning tutorial (1/4, part I) (Amphitheater I-3 UAIC) - Gabriel Turinici
14:50 - 15:00	Break
15:00 - 15:50	Deep Learning tutorial (1/4 part II) (Amphitheater I-3 UAIC)
15:50 - 16:10	Break
16:10 - 17:00	Deep Learning tutorial (2/4 part I): implementation session (Laborator L3 + Sala de conferinte, Facultatea de Matematica, UAIC) - Gabriel Turinici
17:00 - 17:10	Break
17:10 - 18:00	Deep Learning Tutorial (2/4, part II) : implementation session (Laborator L3 + Sala de conferinte, Facultatea de Matematica, UAIC)

Tuesday, October 29, 2024

Time	Event
14:00 - 14:50	Deep Learning tutorial (3/4, part I) (Amphitheater II-4 UAIC) - Gabriel Turinici
14:50 - 15:00	Break
15:00 - 15:50	Deep Learning tutorial (3/4, part II) (Amphitheater II-4 UAIC)
15:50 - 16:10	Break
16:10 - 17:00	Deep learning tutorial (4/4, part I) : implementation session (Laborator L3 + Sala de conferinte, Facultatea de Matematica, UAIC) - Gabriel Turinici
17:00 - 17:10	Break
17:10 - 18:00	Deep learning tutorial (4/4, part II) : implementation session (Laborator L3 + Sala de conferinte, Facultatea de Matematica, UAIC)

Wednesday, October 30, 2024

Time	Event
	Oral presentations 1/2 (Aula Academiei Filiala Iasi)
14:00 - 14:30	Dan Cristea "Towards neuro-symbolic AI"
14:30 - 15:00	*Stefana-Lucia Anita* "Convergence of a L2 regularized Policy Gradient Algorithm for the Multi Armed Bandit"
15:00 - 15:30	**Coffee Break (Main Hall, Filiala Academiei Iasi)**
	Oral presentations 2/2 (Aula Academiei Filiala Iasi)
15:30 - 16:00	*Corina Dimitriu* "Deep Learning for Creativity Emulation: The Paradigm of a Cycle Adversarial Stable Diffusion Model"
16:00 - 16:30	Gabriel Turinici "How to sample time in physics-informed neural networks ?"
16:30 - 17:00	**Poster session (Main Hall, Filiala Academiei Iasi)**
	Benoit Oriol "Covariance estimation in dynamic high dimensional setting: a linear shrinkage point of view"
	Amalia Postolache "Mental Health Screening Tool for Students with Intelligent Data Analysis"
	Cristian Simionescu, Cezar Tudor "Low Data Offline Route Time Estimation"

Venue

The workshop will take place in Iasi (Romania). The full event is on-site (see also below).

The tutorial will be held by Gabriel Turinici at the "Al. I. Cuza" university of Iasi.

The research sessions will be hosted at the Octav Mayer Institute (physical presence, on-site).

The amphitheaters “I-3” (Mon.), “II-4” (Tue.) and Computer Room "Laborator L3" (implementations on Mon. + Tue.) and “Sala de conferinte” are located in the main building of the Al. I. Cuza university, Bulevardul Carol I, Nr.11, 700506, Iaşi, România.

The "Aula Academiei" and “Main Hall” rooms are located in the Romanian Academy Iasi branch,Bulevardul Carol I, nr. 8 România, Iași, 700505.

Tutorial : introduction to deep learning

Gabriel Turinici*[1]

[1]CEREMADE, Université Paris Dauphine - PSL – Université Paris Dauphine - PSL – Place du Marechal de Lattre de Tassigny, 75116 PARIS, France

Abstract

Deep learning : from mathematical setting to python implementations

Content (if time allows):

1/ Deep learning: major applications, references, culture

2/ Types of approaches: supervised, reinforcement, unsupervised

3/ Neural networks: presentation of objects: neurons, operations, loss function, optimization, architecture

4/ Stochastic optimization algorithms and proof of convergence of SGD

5/ Gradient computation by back-propagation

6/ Implementation in "pure Python" of a dense layer network

7/ Convolutional networks (CNN): filters, layers, architectures.

8/ Keras implementation of a CNN.

9/ Techniques: regularization, hyperparameters

10/ Unsupervised deep learning: generative networks and generative AI (GAN, VAE), Stable diffusion, LLMs

Requirements : python programming
fair matematical knowledge of algebraic calculus and probability

Keywords: deep learning

*Speaker

Towards neuro-symbolic AI

Dan Cristea*†[1,2]

[1]Institutul de Informatică Teoretică, Filiala Iași a Academiei Române – Bulevardul Carol I, nr. 8 România, Iași, 700505, Romania, Romania

[2]Școala Doctorală a Facultății de Informatică, Universitatea "Alexandru Ioan Cuza" din Iași – Strada General Berthelot nr. 16, Cod Postal 700483, Iasi, Romania, Romania

Abstract

Artificial Intelligence is a syntagm which has turned 68 years since it was coined. Although not in its first age, the domain has gained tremendous popularity recently with the emergence of Large Language Models (LMMs). The increase in size of the pretrained transformers hosted by these models, made the OpenAI's series of ChatGPTs more and more used in a diversity of tasks. However, the intense practical usage also engaged a diversity of benchmarks that have intensively tested their capabilities to master natural language. The initial enthusiasm cooled down, scientists also begun to notice weaknesses, mainly induced by the neural networks' paradigm attaining its limits. Not all aspects of language-anchored human cognition seem to be reproduceable through a huge increase in the dimensionality of the trained networks. In this talk I will present a number of tests that will configure the necessity to augment LLMs with symbolic reasoning, much in the way of classical AI. The paradigm has recently been called *neuro-symbolic*.

Keywords: neuro symbolic AI

*Speaker

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Convergence of a L2 regularized Policy Gradient Algorithm for the Multi Armed Bandit

Stefana-Lucia Anita*[1] and Gabriel Turinici[2]

[1]'Octav Mayer' Institute of Mathematics of the Romanian Academy, Iasi – Romania
[2]CEREMADE, Université Paris Dauphine - PSL – Université Paris Dauphine - PSL – France

Abstract

Although Multi Armed Bandit (MAB) on one hand and the policy gradient approach on the other hand are among the most used frameworks of Reinforcement Learning, the theoretical properties of the policy gradient algorithm used for MAB have not been given enough attention. We investigate in this work the convergence of such a procedure for the situation when a L2 regularization term is present jointly with the 'softmax' parametrization. We prove convergence under appropriate technical hypotheses and test numerically the procedure including situations beyond the theoretical setting. The tests show that a time dependent regularized procedure can improve over the canonical approach especially when the initial guess is far from the solution.

*Speaker

Deep Learning for Creativity Emulation: The Paradigm of a Cycle Adversarial Stable Diffusion Model

Corina Dimitriu*[1]

[1]"Alexandru Ioan Cuza" University of Iasi - Faculty of Computer Science – Romania

Abstract

This paper investigates the creation of a novel deep generative paradigm, based on a blending between the Stable Diffusion model and the framework of Cycle-Consistent Generative Adversarial Networks, with the scope of building a hybrid which reduces the training computational effort of the former and adds expressivity to the latter. In the context of a reduced dataset and modest hardware capabilities, we target the use case of generating seemingly authentic samples, which we consider to be Monet-style paintings within the experiments. Moreover, in the setting provided by an extensive dataset and the same modest hardware capabilities, we aim at synthesizing additional related features for context enhancement. Lastly, in the realm of multimodal data, we focus on the artificial extension of one underrepresented modality, based on the matching it leverages against a different, more accessible modality. By relating to a common distribution, two generator networks intersect their paths of interchangeably creating one category from another (e.g., paintings from photos for one generator and photos from paintings for the other), let these categories be media contents, modalities or incomplete against inpainted artifacts. Starting from noise, both generators approach their target through the intermediate generation of the opposite target, while both targets are ensured to be made part of the same distribution. As the training advances for each generator, the synthesis of one category implicitly encourages the generation of the other until the middle of the chain, when the roles are switched and the latter category serves as a base for generating the former. As the experimental results confirm both objectively – in terms of the MiFID score and the training records – and subjectively – in terms of human feedback – this solution shows significant improvement compared to the vanilla Stable Diffusion model and mitigates the parameters' instability, inherent to using the classical Generative Adversarial Networks standalone. The computational effect of such an approach consists in the avoidance of the typical forward passes during the backward propagation step, as the two generators exchange their intermediate synthetic results. While traversing the thin line from imitation to innovation across the generated features and the entire samples, the less conventional architecture, together with the anticipated applications, prove the pipeline to be a promising landmark for future work on neural networks' interpretability and interdisciplinarity.

*Speaker

How to sample time in physics-informed neural networks ?

Gabriel Turinici*[1]

[1]CEntre de REcherches en MAthématiques de la DEcision – Université Paris Dauphine-PSL – Place du Maréchal de Lattre de Tassigny 75775 - Paris Cedex 16, France

Abstract

Time is not a dimension as the others. In Physics-Informed Neural Networks (PINN) several proposals attempted to adapt the time sampling or time weighting to take into account the specifics of this special dimension. But these proposals are not principled and need guidance to be used. We explain here theoretically why the Lyapunov exponents give actionable insights and propose a weighting scheme to automatically adapt to chaotic, periodic or stable dynamics. We characterize theoretically the best weighting scheme under computational constraints as a cumulative exponential integral of the local Lyapunov exponent estimators and show that it performs well in practice under the regimes mentioned above.
References :

Gabriel Turinici Lyapunov weights to convey the meaning of time in physics-informed neural networks,arXiv:2407.21642

Gabriel Turinici Optimal time sampling in physics-informed neural networks, arXiv:2404.18780

Keywords: PINN, physics informed neural networks, time sampling

*Speaker

Covariance estimation in dynamic high dimensional setting: a linear shrinkage point of view

Benoit Oriol*[1]

[1]CEntre de REcherches en MAthématiques de la DEcision – Université Paris Dauphine - Paris IX – Place du Maréchal de Lattre de Tassigny 75775, Paris Cedex 16, France, France

Abstract

Multi-target linear shrinkage is an extension of the standard single-target linear shrinkage for covariance estimation. We combine several constant matrices - the targets - with the sample covariance matrix. We derive the oracle and a bona fide multi-target linear shrinkage estimator with exact and empirical mean. In both settings, we proved its convergence towards the oracle under Kolmogorov asymptotics. Finally, we show empirically that it outperforms other standard estimators in various situations.

Keywords: Multi, target, linear shrinkage, covariance estimation, general asymptotics

*Speaker

Mental Health Screening Tool for Students with Intelligent Data Analysis

Amalia-Maria Postolache*[1]

[1]Universitatea Babeş-Bolyai [Cluj-Napoca] – Mihail Kogalniceanu 1, Cluj-Napoca, Romania

Abstract

After doing extended research to understand the role of mental health in the academic context and using the domain-related knowledge I have been equipped with during my years of study, I was able to develop an application that has as its focus a mental health quiz designed for students and additional functionalities and resources meant to provide adequate assistance in helping students cope with the challenges met in the process of academic functioning. Considering the practical use of the application and what it offers, the paper discusses the intelligent analysis of the collected data, enabling further interpretation by mental health professionals.

Keywords: data analysis, performance analysis, quiz completion

*Speaker

Low Data Offline Route Time Estimation

Cristian Simionescu*[1] and Cezar Tudor*†[2]

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[2]"Gheorghe Asachi" Technical University of Iasi – Bulevardul Profesor Dimitrie Mangeron 67, Iași 700050, România, Romania

Abstract

Accurate travel time estimation is important for efficient route planning in various applications. This project presents an approach to estimate travel times between two points in a city, addressing the challenges of limited data availability and the final route estimation being done offline. Using a Gaussian mixture model, we assign weights using soft clustering to several points of interests in the city. We collect data from on various routes between our points of interest (over 23 000 routes over the course of 10 days) in a controlled manner to ensure our dataset is balanced and representative. Hexagons are introduced in the Gaussian mixture model and are similarly assigned weights using soft clustering. To calculate the average speeds for each of the four zones, we divide the collected routes into segments corresponding to the weighted hexagons. We use the associated weights of each hexagon for each zone to calculate the weighted speeds and weights for each zone across all routes. We store the average speed for each for each zone, and we use it for the estimations. To compute an estimation, we assign weights to the requested route with the help of the hexagons' weights for each zone. Using the new weighted route, we calculate the estimated time using the speed averages from the previous step. Our method can achieve a mean absolute percentage error of 12.91% when compared to standard route estimation APIs, with 10% of estimations exceeding 1.5 times the standard deviation.

Keywords: Route time estimation, gaussian mixture model

*Speaker

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