UNIVERSITÀ DEGLI STUDI FIRENZE

FLORENCE center for DATA SCIENCE

ABSTRACTS

10th Seminar D^2 Seminar Series

Florence Center for Data Science 'Double' Seminar Series

Lorenzo Seidenari - Department of Information Engineering, University of Florence

Title: Predicting Multiple Future Trajectories for Safe Self-Driving Cars

Abstract: Autonomous navigating agents are becoming a reality. Pedestrians and drivers are expected to safely navigate complex urban environments along with several non-cooperating agents. Autonomous vehicles will soon replicate this capability. Agents must learn a representation of the world and must make decisions ensuring safety for themselves and others. Apart from sensing objects, knowing, and abiding traffic regulations a driving agent must plan a safe path. This requires predicting motion patterns of observed agents for a far enough future. Moreover, with the rise of autonomous cars, a lot of attention is also drawn by the explainability of machine learning models for self-driving cars. In this talk, I will go over our recent contributions in the field of self-driving systems. I will present our recent works on multimodal trajectory prediction exploiting a novel use of memory augmented neural networks. Finally, we will look at simple explainable models for driving and trajectory prediction.

Francesco Calabrò - Department of Mathematics and Applications "Renato Caccioppoli", University of Naples "Federico II"

Title: The use of neural networks for the resolution of Partial Differential Equations

Abstract:
In this talk, we present the construction of a Physics-Informed method for the resolution of stationary Partial Differential Equations. Our method relies on the construction of a Feedforward Neural Network (FNN) with a single hidden layer and sigmoidal transfer functions randomly generated, the so-called Extreme Learning Machines (ELM). We use ELM random projection networks as discrete space where to look for the solution of PDEs. Free parameters (N external weights) are fixed by imposing exactness on M (eventually located randomly) points via collocation. In order to obtain accurate solutions, we underdeterminate the collocation equations (N>M). For linear PDEs, the weights are computed by a one-step least-square solution of the linear system. The least-square solution is capable of automatically selecting the important features, i.e. the functions in the space that are more influent for the solution. This leads to a one-shot automatic method and there is no need for adaptive procedures or tuning of the parameters as done when learning in other methods based on FNN. We present results for elliptic benchmark problems both in the linear case [1] and for the resolution and construction of bifurcation diagrams of nonlinear problems [2]. The results are obtained in collaboration with Gianluca Fabiani and Costantinos Siettos.

[1] Calabrò, F., Fabiani, G., & Siettos, C. (2021). Extreme learning machine collocation for the numerical solution of elliptic PDEs with sharp gradients. Computer Methods in Applied Mechanics and Engineering, 387, 114188.

[2] Fabiani, G., Calabrò, F., Russo, L. & Siettos, C. (2021). Numerical solution and bifurcation analysis of nonlinear partial differential equations with extreme learning machines. J Sci Comput 89, 44