



UNIVERSITÀ DI PISA
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE
Dottorato di Ricerca in Ingegneria dell'Informazione

Doctoral Course

“From Design to Deployment of Machine Learning Technology:

An Environment of Granular Computing”

Prof. Witold Pedrycz

University of Alberta, Canada

E-mail address: wpedrycz@ualberta.ca

Short Abstract: Machine Learning has assumed a dominant role in the design of intelligent systems and their various application domains. The objective of this course is to present current trends in the development of Machine Learning, identify challenges and discuss ways of addressing them.

Course Contents in brief:

Introductory comments

The key agenda of Machine Learning. Main concepts. Deployment of Machine Learning and fundamental quests. Challenges of Machine Learning: credibility (confidence), interpretability and explainability, privacy.

Granular Computing: a primer

Concepts, motivation, examples. Design of information granules, rule-based architectures: symbolic-subsymbolic perspective. Learning schemes.

Credibility of ML architectures and their results

Motivation. Granular embedding and Gaussian Process augmentation. Mechanisms of active learning.

Interpretability and explainability

Processes of interpretability and explainability. Inductive and deductive reasoning. Counterfactual reasoning. Local linear models. Shapley value.

Privacy in ML: a case of federated learning

Motivating factors behind federated learning: coping with data islands, average and gradient federated learning, Federated learning-based rule design, granular assessment and performance analysis.

Total # of hours of lecture: 20 hours

References:

- [1] W. Pedrycz, *An introduction to computing with fuzzy sets*, Springer, 2020.
 - [2] A. Lindholm et al. *Machine Learning. A First course for engineers and scientists*, Cambridge Univ Press, 2022.
-

CV of the Teacher

Witold Pedrycz (IEEE Life Fellow) is Professor in the Department of Electrical and Computer Engineering, University of Alberta, Edmonton, Canada. He is also with the Systems Research Institute of the Polish Academy of Sciences, Warsaw, Poland. Dr. Pedrycz is a foreign member of the Polish Academy of Sciences and a Fellow of the Royal Society of Canada. He is a recipient of several awards including Norbert Wiener award from the IEEE Systems, Man, and Cybernetics Society, IEEE Canada Computer Engineering Medal, a Cajastur Prize for Soft Computing from the European Centre for Soft Computing, a Killam Prize, a Fuzzy Pioneer Award from the IEEE Computational Intelligence Society, and 2019 Meritorious Service Award from the IEEE Systems Man and Cybernetics Society.

His main research directions involve Computational Intelligence, Granular Computing, and Machine Learning, among others.

Professor Pedrycz serves as an Editor-in-Chief of *Information Sciences*, Editor-in-Chief of *WIREs Data Mining and Knowledge Discovery* (Wiley), and Co-editor-in-Chief of *Int. J. of Granular Computing* (Springer) and *J. of Data Information and Management* (Springer).

Final Exam: method of final examination – final project

Room and Schedule

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione, Via G. Caruso 16, Pisa – Ground Floor*

Schedule:

Day1 – 19/4/2024, 13.30-18.30 (5 hours)

Day2 – 22/4/2024, 8.30-13.30 (5 hours)

Day3 – 23/4/2024, 8.30-13.30 (5 hours)

Day4 – 24/4/2024, 8.30-13.30 (5 hours)