MASTER OF SCIENCE IN ENGINEERING

Zürcher Hochschule für Angewandte Wissenschaften
School of Engineering

Supplementary Course (EVA) at ZHAW School of Engineering

Title: AI for Anomaly Detection in Complex Systems: a Hands-On Tutorial

Short Code: rEVA_AnDet

ECTS Credits	3
Profile	Data Science (DS)
Responsible Institute /Centre	Institute of Data Analysis and Process Design (IDP)
Responsible lecturer and contact informtion	Lilach Goren Huber (gorn), Manuel Arias Chao (aria)
Type and duration of examinations	Coding project + oral presentation
Start date and duration	Semester: Spring Detail: -
Location	ZHAW ZL (Zurich Lagerstrasse)
Course type	Weekly, semester rhythm First half including frontal lectures, second half only guided work. • Contact hours: 18 (hrs) • Guided self-study: 6 (hrs) • Independent self-study: 66 (hrs)
Language of instruction	English
Short description (max. 300 characters)	The automatic detection of abnormal patterns in data is a task that finds application in a large variety of fields, with different data types. This includes fraud detection in financial or insurance data, defect detection in machines and industrial processes, disease detection in medical images, object detection for security or for autonomous driving systems, and many more. In recent years there has been a rapid development of methods for anomaly detection based on AI algorithms. In this course we will discuss the motivation to develop designated anomaly detection (AD) methods. We will study and compare different state-of-the-art, yet practice-relevant techniques for anomaly detection including the best-known machine learning and deep learning models. We will demonstrate the effectiveness of different methods using datasets of various types, including machine sensor data, financial time-series, image data and tabular data. During the course you will learn to solve and analyze practical examples of AD tasks using Machine Learning and Deep Learning python-packages. The course will focus on applying solutions and their technical understanding, rather than their theoretical proofs.

Knaa, 21.05.24

Supplementary Course (EVA) at ZHAW School of Engineering

Contents and Learning Objectives	**I. Introduction to Anomaly Detection (AD)** What is AD used for? examples of applications in machine fault detection, fraud detection, medical diagnosis with images, object detection. **II. Popular solutions to anomaly detection.** We will discuss concrete use-cases and introduce several AD methods, ranging from statistical methods, through machine leaning models and up to deep learning algorithms. We will provide Python codes that can be used and extended by the participants. **III. Hands-on anomaly detection in real data sets.** The participants will be able to use and extend the python code to explore a data set of their choice (out of a selection of data sets), visualize the data, train several AD algorithms, evaluate and compare their performance, discuss and present the outcomes in the context of a practical use-case. This will allow the participants to take a hands-on active part in a typical practical data-science modelling pipeline, closely guided by the course teachers. **IV. Optional add-ons for advanced students.** The participants will experiment with real-world challenges in AD: how to deal with data and label scarcity? How to incorporate robust solutions to problems like mislabeled and contaminated data? How to scale up AD to large connected systems? The course will span over 6 three-hour sessions. Each session will contain 2 hours of introductory course and 1 hour of guided hands-on coding. During this period, we will introduce several data sets with anomaly detection use-cases. Each participant will select one use-case to practice on, under our guidance, using the tools and methods that were introduced in the sessions. The course will be evaluated based on the quality of the use-case analysis and a 30-minute presentation of it at the end of the semester.			
Prerequisites	Basic python programming skills			
Literature	-			
Special requirements	N/A			
Offer for profiles	Aviation (Avi)	☒	Business Engineering (BE)	☒
	Computer Science (CS)	☒	Data Science (DS)	☒
	Electrical Engineering (ElE)	☒	Energy & Environment (EnEn)	☒
	Mechanical Engineering (ME)	☒	Mechatronics & Automation (MA	☒
	Medical Engineering (Med)	☒	Photonics and Laser Engineering (Pho)	☒

Knaa, 21.05.24

MASTER OF SCIENCE IN ENGINEERING

Zürcher Hochschule für Angewandte Wissenschaften

School of Engineering

Supplementary Course (EVA) at ZHAW School of Engineering

	Information and Cyber Security (ICS)	☒	Civil Engineering (CE)	☒

Knaa, 21.05.24