Abstracts

Computer Systems Engineering Theory and Applications

6th International Student Workshop

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Tomasz Miksa

Albanian weddings, chemical compounds and earth observation

Experiments performed by researchers in various scientific domains require collecting, processing, and publishing data. For example, geologists use satellite images to monitor vegetation; pharmacists simulate activity of chemical substances; while ethnographers compare folk music from all over the world. Despite different domains, researchers share the same concerns: how to ensure that data is properly managed, experiments are reproducible and results trustworthy. Ensuring this can be a complex task, especially for researchers with little technical background. The problem was also recognized by research funders who require data to be deposited in trustworthy repositories, with appropriate metadata included, very often accompanied by a data management plan. This talk will focus on common challenges faced by researchers with respect to data management and reproducibility. The participants will learn how the international community works to address them.

Mariusz Nowostawski

Security Vulnerabilities in Ethereum Smart Contracts

Ethereum is an open, global computing platform that allows the exchange of value, automated and enforced workflows and the development of general purpose applications. Smart contracts present a foundation for the computational capabilities of the Ethereum network. Motivated by the known security breaches and recurring financial losses due to smart contracts vulnerabilities, we review the security of smart contract programming and provide a comprehensive taxonomy of all known to date security issues. The talk will focus on practical applications and review of existing security tools for smart contracts.

Artur Pohoski

Risk Based Inspection

Risk Based Inspection (RBI) is a methodology used to improve the safe and reliable maintenance of petroleum refineries and other large facilities employing pressure equipment. It is fast becoming the oil and gas industry standard mechanism for risk management of equipment integrity issues. The basis of RBI is to prioritize individual items and system by considering the associated risks. These risks are combination of probability of some event during a time period of interest and the consequences associated with this event. Implementation of that program extends the operating life of equipment, on safe and cost effectively way. The main goal for this presentation is to show the fundamentals of RBI from risk assessment process, going through risk analysis to final conclusions about benefits of this module.

Anna Zakrzewska

Presentation Skills in a Nutshell; Mini Workshop

The ability to present technical information and disseminate the research outcomes is a critical skill. This mini workshop covers the key aspects of content preparation and presentation style. It is also supported by short exercises engaging the audience.

Regular lectures

Tanvir Allidina

Dynamic Map updates through communication for Autonomous Vehicles

An autonomous vehicle requires the ability to "see" its environment, be able to navigate safely, avoid obstacles and plan its path in the most efficient manner. The vehicle completely relies on its on-board sensors and other various instruments to help build a real time map. However, on-car sensors such as radars, cameras etc. can "see" only up to 300 meters (~ 7 secs if a car is moving at 100miles/hr) and will not sometimes "see" everything particularly around blind corners, obscured locations and intersections. The autonomous vehicle needs to constantly update its map with real-time data preferable both inside and outside its sensor's line of sight to be able to react in time. This paper aims at developing a formal framework to create various scenarios that require an autonomous vehicle to be able to look beyond its sensors line-of-sight and hence requires the ability to dynamically update its map with information sent from other source such as other vehicles via wireless communication.

Nicholas Ayres

The Benefits of Virtualisation within the complex automotive E/E architecture

The vehicle embedded system also known as the electronic control unit (ECU) has transformed the humble motor car making it more efficient, environmentally friendly and safer, but has led to a system which is highly complex. The modern motor vehicles electronic/electrical (E/E) architecture has become one of the most software-intensive machines we use in our day to day lives. As new technologies such as vehicle autonomy and connectivity are introduced and new features added on to existing Advanced Driver Assistance Systems (ADAS), an increase in overall complexity will no doubt continue. To address these future challenges the motor vehicle will require a radically new approach to the current E/E architecture. Virtualisation has had a resurgence and transformed data centers and facilitated huge growth in cloud storage and computing can effectively address the increasing complexity of the vehicle E/E architecture. By converting a hardware and software-based ECU into a virtual environment transforms it into a Virtualised ECU (VCU).

Mayur Damania

Control of pump operation by feedback rules derived from optimal time schedules

There are two basic concepts of optimal control of Water Distribution Systems (WDS), optimal time schedules and optimal feedback rules. Water utilities use the optimal time schedules within the predictive control schemes to control pumps, valves and treatment plants. The aim of this research is to investigate feasibility of deriving feedback rules from optimal time schedules to control pump operation (ON/OFF) and pump speed, taking into account the operational constraints and the time varying electrical tariff. The advantage of feedback rules is that they are robust with respect to uncertain demand and reduces overhead of re-calculating time based schedules. The real challenge is the derivation of rules that can be sensibly parameterised and optimised. This research investigates how to use Artificial Neural Networks (ANN) to implement feedback rules. The optimal time schedules are calculated for various initial tank levels and various demand levels. Subsequently, the optimal time schedules are used to train the ANN. This approach has been tested on a simple case study to demonstrate feasibility of a working concept.

Aleksandar Georgiev, Daniel Atanasov

Approach for social media reaction analysis

This paper presents an approach for analyzing social media reactions based on post content, taking into account both text and imagery from the post. Using Character-level CNN we extract a fixed length vector representation of any word, as well as an LSTM-based RNN to summarize post-level information from the text. The images are processed via Im2Text to produce captions which are then used for the extraction of a similar vector representation. This data is used to train a model capable of producing a relative distribution of post reactions. This model can also be used to accurately predict reaction counts of posts made by users with similar popularity and reputation. The proposed approach can account for the implicit effect of author influence, along with both the visual and textual components of the posts, and use the extracted features to accurately predict post perception.

Damian Glowacki, Milosz Dunikowski

Searching for the shortest route - analysis of routing protocols

There are many routing protocols that determine routes of data flow in computer networks. Which one guarantees the optimal route? The answer is not obvious, the choice should be made by adjusting the protocol to the type of network. The main aim of the project was to create a computer program for protocol analysis and routing algorithms operating in them. The examined protocols were RIP, OSPF and IGRP in which the algorithms for route determination BFS, Dijkstra and Bellman-Ford respectively were implemented. In addition, the Floyd-Warshall algorithm was implemented to check whether it is suitable for solving routing problems in computer networks. The analyzed aspects were routes, metrics and algorithm processing times and their behavior. The metrics were determined by parameters like number of hoops between routers, bandwidth or delays. The tests were carried out for small, medium and large networks with different number of connections.

Tomasz Kubrycht

Development of an active identification method for multiple bursts in multiple inlets DMAs

Water distribution systems are highly complex, spatially distributed networks comprising thousands of components. The water infrastructure in the UK and Europe is ageing and deteriorating gradually causing significant water losses whilst the direct replacement of pipes is costly and difficult for implementation. Leakage reduction can be achieved by coordinated action of pressure control and burst detection. One of the most well-known approaches to pressure dependent leakage is the FAVOUR test. However, despite its effectiveness and robustness the method has limitation; it has been developed for DMAs with one inlet and one burst. The current investigation aims to generalise the approach to multiple bursts and multiple inlets. Mining into historical and upcoming data facilitates creation of more accurate models and also allow identification of abnormal situations which lead to bursts. Access to real-time data from sensors enables updating of the water network model, which subsequently can be used in the fault detection studies.

Martyna Lagozna, Milosz Bialczak

American sign language recognition

What if the fast development of computer science, especially machine learning could help disabled people? In fact, it can and this is the topic to which we decided to devote our research. Deaf-mute people are the part of our society and it would be a great convenience both for them and speaking people which would allow for a better communication using technology. In this presentation we would like to share the results of our research concerning recognition of sign language. We decided to experiment with the images transformations and usage of different learning and features detecting algorithms to obtain the best quality of signs recognition. The part of our researches was also the impact of background and different hands rotations on the correctness of received results.

Rafal Leszczyk

Eco driving system using artificial intelligence

Nowadays, automotive industry is non-stop growing. Car manufactures introduce newer vehicles, which are more and more technologically advanced such as autonomous cars, electric cars, cars with ecological engines. However, optimizing fuel consumption is still a problem. During performing analysis of the rules of eco driving and parameters which affect fuel consumption, decision was made to create a system based on artificial intelligence. This systes suggests the driver to switch gear in order to reduce fuel consumption. For this purpose we used MLP network trained with dataset created by us. Conclusion of our work is description of training process and obtained results.

Adam Loch

Control optimization of stoker-fired boiler using machine learning and deep learning algorithms

In 2016 nearly 90% of all thermal energy was generated from sources powered by coal. Probably in the near future it will not be possible to change this fact. Instead, we can focus on optimizing control systems which are usually based on PID controllers. In real world, environments, where such systems run, are not perfect and can vary in time. This fact can lead to significant control problems. To minimize such behaviours we investigated the possibility of Neural Network usage.

Arun Mambazhasseri Divakaran

Thermal Analysis of Li-ion Battery module for Electric Vehicles

Thermal management systems are indispensable for the lithium-ion battery pack, especially within high power density applications. To investigate the thermal behaviour of a novel battery module with liquid cooling using tubes around the cylindrical batteries arranged in circular manner in a hexagonal module structure was presented in this paper. MATLAB tool was used to estimate the internal heat generation in a battery by considering the empirical relations of Sony 18650 batteries. The result showed that the novel design of the battery module with the cooling tube thermal management system provided good cooling efficiency in controlling the temperature within optimum operational range at 3C discharge rate. The thermal behaviour was verified using an infrared camera by discharging individual batteries at the same discharge rate. This thermal management system resulted in uniform surface cooling with the use of conduction plate and core plate.

Anahid Naghibzadeh-Jalali

Sound Event Detection with Deep Neural Networks

Sound Event detection (SED) has been studied extensively in recent years and is an emerging topic of Computational Auditory Scene Analysis (CASA) research where the focus is to implement the cocktail party effect, a phenomenon ability of the brain on selective attention. SED systems are a group of CASA machines and have the goal of recognizing one or multiple meaningful sounds within an audio signal. These systems are utilized in applications such as automated surveillance systems, military application and smart homes. The model used to implement this system in my work is Deep Neural Networks. This talk will be over the learning process of these networks and the analysis of the behaviour of different architectures of these networks on the SED task.

Karolina Polańska

Applying Monte Carlo Tree Search algorithm for Optimization of Hyperparameters of Neural Network Training

In tasks related to machine learning, right selection of hyperparameters can significantly impact training time. Often, a trivial solution cannot be constructed, and therefore, iterative search algorithms are used. Two algorithms are often used: Grid Search and Random Search.

In this paper we propose a third approach, based on our own modification of Monte Carlo Tree Search, which is usually applied to decision processes. The new algorithm is designed to work on discrete hyperparameter spaces, and uses feedback from training process to learn and adjust its subsequent outputs. The proposed solution is easy to implement, and computational needs are negligible in the scale of a typical machine learning problem. In the paper three search algorithms are compared: Grid Search, Random Search and the proposed Monte Carlo Tree Search. The search algorithms are used to train multiple neural networks using MNIST digit database. The algorithms' performance is measured and compared.

Dominika Sułot

A method to improve the quality of segmentation in hyperspectral imaging

This work attempts to tackle the problem of hyperspectral image segmentation. The main problem with this type of images is the large amount of data to be processed. In this paper, a new method has been proposed, which introduces preprocessing and postprocessing steps to improve segmentation speed and quality. Preprocessing consists of removal of noisy spectral bands followed by principal component analysis (PCA) to reduce dimensionality of the data. Two methods of noise removal were tried and compared. The preprocessed data is fed to unsupervised learning k-means algorithm for segmentation. The results are postprocessed with Blurred Labeling Segmentation algorithm. The paper presents the results obtained from the use of the entire method as well as the comparison of the significance of its various parts.

Jardar Tøn

An analysis of on-chain lightningnetwork transactions in theBitcoin blockchain

Bitcoin is a peer-to-peer electronic payment system relying on cryptography and a distributed ledger known as the blockchain. The purpose of the blockchain is to record all transactions done in the system. The information is maintained collectively by the peer-to-peer network. New transactions is added to the blockchain by spending computational power; making the transactions practically irreversible as the blockchain grows and more computational power is used, and thus removes the need for trusted third parties to verify transactions. Such a decentralized payment solution does however not scale very well. A proposed solution to help scale the Bitcoin system is payment channel networks. Such a network allows users to do transactions without them being published in the Bitcoin network, and they are therefore not included in the blockchain, which is why they are known as off-chain transactions. This allows for more transactions being done without increasing the capacity of the Bitcoin system itself. One of the already deployed networks of this type is the Lightning Network. This study focuses on information leakage for off-chain transaction through both, the Lightning network and the Bitcoin blockchain itself. We have investigated the available information on both, testnet and the mainnet of the Bitcoin, and the equivalent information harvested from the Lightnining Network peers, such that we can estimate the topology, and the usage patterns for off-chain transactions.

Adrian Urbaniak

MediaMarkt's "take what you want" contest as an example of discrete knapsack problem

MediaMarkt's "take what you want" contest is an example of practical implementation of discrete knapsack problem. How to collect as many as possible item from MediaMarkt store in limited time and capacity of trolley? Optimization is the answer. We implemented and tested three of many available algorithms to solve that client's problem. We consider simple heuristics and more complex ones like standard genetic algorithm adjusted to specify of the issue. Including formula defines weight depending on items' properties. To carry out simulation software was designed using Python programming language. Simulator allowed testing our scenarios automatically and saving test results to structured form of files to next analysis. In our presentation we would like to share with you our results and conclusions.

Szymon Wojciechowski

Approach to implement classifier based on Center of mass calculations for classes distribution in subspace projections

Each feature pair may be represented as a two-dimensional subspace of the original set. Based on the assumption that the distribution is not uniformed, it is possible to calculate different center of mass points between each pair of the classes in created subspaces. Pattern could be than treated as the points spread around the centers of mass for which corresponding angle between two points can be calculated. Obtained values can be gathered into a histogram which will represent the class distribution in generated feature. Computed representation can be transformed by applying signal processing methods, than used to calculate support vectors to create the classifier which will be named CMPAC (Center of Mass Points Analysis Classifier). Proposed method was evaluated by series of computer experiments on collection of well-known datasets.

Pawel Zyblewski

Clustering-based classifier ensemble pruning

The purpose of ensemble pruning is to reduce the number of predictive models in order to improve efficiency and predictive performance of the ensemble. In clustering-based approach, we employ a clustering algorithm to find groups of models, and then we prune each of them separately in order to increase overall diversity of the ensemble. This paper proposes two different methods for increasing ensemble's accuracy using clustering in one-dimensional space of non-pair diversity, specifically, the entropy measure E. For this purpose, a measure for a single classifier, based on the entropy measure, is introduced. In the first method, from each cluster, a model with the best predictive performance is selected to form a final ensemble. In the second approach, the multistage organization of majority voting is applied. Experimentation results for both proposed methods are illustrated and discussed.