Workshop

AI Techniques: Advances, Analysis and Applications

11 November 2021, 9:00 AM – 2:30 PM

9:00 AM – 10:15 AM

The Importance of Adaptive Parameters in Optimization

Associate Professor Gregor Papa, Ph.D., Department of Computer Systems, Jožef Stefan Institute, Ljubljana, Slovenia

One of the challenges in optimization approaches with evolutionary algorithms is the proper selection of the control parameters. The control parameters allow to adjust the behaviour of the algorithms to the problem at hand. Several control parameters need to be set for a successful search of the optimum of an objective function. The choice of parameters can have a significant impact on the performance of the algorithm and need thus to be executed with care. With parameter control approach no prior training of parameters is needed. Also, the optimal parameter values change during the optimization process: e.g., at the beginning of an optimization process we typically aim for exploration, while in the later stages we want the algorithm to converge and to focus its search on the most promising regions in the search space. To present the importance of the dynamic setting of control parameters some basic theoretical aspects are outlined and followed by the presentation of some real-world cases of the use of parameter control.

10:15 AM – 10:30 PM Break

10:30 AM - 11:45 AM

Food Information Extraction and Normalization: the Past, the Present, and the Future

Tome Eftimov, Ph.D. and Gjorgjina Cenikj, Department of Computer Systems, Jožef Stefan Institute, Ljubljana, Slovenia

In the last decades, a great amount of work has been done in predictive modelling of issues related to human and environment health. This is made possible by the existence of several available biomedical vocabularies and standards, which play a crucial role for understanding health information, together with a large amount of health data. In 2019, Lancet Planetary Health noted that the focus of future improvements in our wellbeing and societies will depend on investigating the links between food systems, human health, and the environment. However, despite the large number of available resources and work done in the health and environmental domains, there is a lack of resources that can be utilized in the food and nutrition domain, as well as their interconnections. This talk will provide a summary of the past, the present and the future related to food information extraction and normalization. It will cover different NLP approaches already developed for tracing the food information in textual data,

resources that allow to make food and nutrition data interoperable, and NLP/ML pipelines for exploring relations between food and biomedical entities in order to create heterogeneous knowledge graphs. In particular, this is important during the current pandemics of COVID-19, when food provision and security, as well as healthy nutrition and environment, are tremendously needed for quick recovery and long-term sustainable development of our societies.

11:45 AM – 12:00 PM Break

12:00 PM – 1:15 PM

Some Aspects of Cluster Analysis and Applications

Professor Rudolf Scitovski, Ph.D. Department of Mathematics, J.J. Strossmayer University of Osijek, Osijek, Croatia

Clustering or grouping elements of a dataset into conceptually meaningful clusters is one of the most commonly used techniques in data mining. This is an automated process of identifying specific data groups that combine mutually similar objects, trying thereby to separate various data groups. We are going to consider the problem of partitioning a dataset $A = \{a_i \in R^n : i = 1, \ldots, m\}$ into $1 \leq k \leq m$ nonempty disjoint subsets — clusters. First, we will briefly describe hard and fuzzy spherical clustering principles by using some distance-like function, and mention some basic properties and methods for searching for an optimal partition: classical k-means and incremental algorithms, and fuzzy c-means and incremental algorithms. Also, we will briefly describe hard and fuzzy Mahalanobis (ellipsoidal) clustering principle by using the Mahalanobis distance-like function, and mention some basic properties and methods for searching for an optimal Mahalanobis partition: Mahalanobis k-means and incremental algorithms, and Mahalanobis fuzzy c-means (Gustafson–Kessel) and incremental algorithms. Also, we will present the basic principle of the Density-Based Clustering algorithm. In practical applications the most appropriate number of clusters is usually not known in advance. Therefore, various indexes have been devised in order to indicate the partition with the most appropriate number of clusters. We will mention some of the most commonly used: Calinski–Harabasz index, Davies–Bouldin index, Simplified Silhouette Width Criterion, and we also describe a new one — the Minimal Distance index. There are numerous applications of cluster analysis in almost all areas of science and other human activities. Let us mention several problems leading to real world applications: the multiple geometric objects detection problem applied to lines, circles, ellipses, and generalized circles; determining the seismic zones in an area; the temperature seasons according to temperature fluctuations; determining the optimal constituencies; color image segmentation problem. For some of them we will show actual applications.

1:15 PM – 1:30 PM Break

1:30 PM – 2:30 PM

Some Object Detection Problems and Possible Solutions using AI

Associate Professor Emmanuel Karlo Nyarko, Ph.D. Faculty of Electrical Engineering, Computer Science and Information Technology, Osijek, Croatia

One of the fundamental problems in artificial intelligence is the detection of objects of interest in images. Detecting instances of target object classes in images of complex scenes containing other objects of similar appearance in the conditions of measurement noise, occlusion and clutter is a challenging problem. Neural networks are today the method of choice for object detection. However, training of a neural network usually requires many manually annotated

training images of the target objects, which can be a heavy workload. One solution to this problem is training using synthetically generated image sets, which can be annotated automatically. Synthetic images created for training a neural network must resemble as much as possible images of real scenarios acquired by a real camera. Another problem related to object detection is detection of object parts or surfaces, which are of special interest for a particular robotic task. One such task is storing various items in storage furniture, such as bookshelves, dressers, cabinets, cupboards, nightstands etc. In order to perform such operations, a robot must be capable of detecting possible storage volumes in the storage furniture. A presentation of these problems, as well as an overview of current research efforts and results will be discussed.