Guest Editorial: Special Issue on Machine Learning Implementations

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Published online: 3 January 2019

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During the recent years, breakthroughs in machine learning have led to a human level accuracy in a number of problem domains, such as image recognition, image segmentation and audio and speech recognition. The disruption has been largely due to discoveries in deep learning, with structures such as convolutional networks or recurrent networks, and today their use is ubiquitous and several competing platforms exist for easy training and testing of deep networks.

Most modern machine learning research is devoted to improving the accuracy of prediction. However, less attention is paid to deployment of machine learning systems. Most deployments are in the cloud, with abundant and scalable resources, and a free choice of computation platform. However, in the advent of intelligent physical devices—such as intelligent robots or self-driven cars—the resources are more limited, and the latency may be strictly bounded.

To address these questions, the focus of this special issue is on machine learning implementations; including both system level topics and other research questions related to general deployment of machine learning algorithms. Of particular interest are real-world deployment strategies for successful production use.

Following our call for papers, we received altogether 28 submissions. Each manuscript was reviewed by two independent reviewers, and based on their careful evaluation, 6 papers were accepted for inclusion in this special issue. As part of the review process, the reviewers requested either minor or major revisions for all accepted papers, after which the papers were reviewed for the second time.

Along the lines of the call for papers, most accepted papers are application oriented and target concrete real world problems, as we will briefly discuss in the following.

The first article by Muhammad Bilal and Muhammad Shehzad Hanif on “High Performance Real-time Pedestrian Detection using Light Weight Feature and Fast Cascaded Kernel SVM Classification” concentrates on the challenge of rapid pedestrian detection, which is an important topic in the era of emerging self-driving vehicles and mobile machines. The authors revisit the classical cascade classified approach, which was first proposed almost 20 years ago, but is still unrivaled in terms of computational efficiency; an important factor in extremely low resource computational platforms. The authors are able to improve both the accuracy and speed of current cascade classifiers, and the proposed parallelization scheme reaches up to three times higher performance than before.

The second paper “Hand Sign Recognition for Thai Finger Spelling: an Application of Convolution Neural Network” by Pisit Nakjai and Tatpong Katanyukul describes a system-level approach for recognizing hand signs from RGB images. The complete pipeline consists of hand detection and subsequent sign classification steps, and the authors design a convolutional neural network for the classification task. The network reaches over 90% accuracy, which can be considered exceeding the state of the art for plain RGB data without external markers or gloves.

The article “Gait Verification System through Multiperson Signature Matching for Unobtrusive Biometric Authentication” by Ebenezer R. H. P. Isaac, Susan Elias, Srinivasan Rajagopalan and K. S. Easwarakumar represents a system level study to machine learning implementations. The proposed recognition pipeline transforms the gait image sequence into a gait template, designs a classifier and finally uses the result for verifying the identity against a database of identities. The authors also describe their server-based architecture for gait verification in detail, which is an important part of the system level design.

In addition, another paper studies the topic of biometric identification. The article “A New Framework for Match on Card and Match on Host Quality based Multimodal Biometric Authentication” by Mohammad Sabri, Mohammad-Shahram Moin and Farbod Razzazi presents a multimodal framework for biometric authentication. More specifically, the authors

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fuse two modalities—fingerprint and face—in order to reach higher reliability. Moreover, the implementation aspect is studied as three possible architectures: “Template on Card”, “Match on Card” and “System on Card”, representing different implementation strategies of where the actual verification is done.

The article “A Generic Intelligent Bearing Fault Diagnosis System using Compact Adaptive 1D CNN Classifier” by Levent Eren, Turker Ince and Serkan Kiranyaz studies a common problem in predictive maintenance in manufacturing industry: How to predict that an industrial component is reaching the end of its lifetime. The difficulty of this problem is that the accuracy requirement is high: poor fault detection sensitivity renders the system useless, as emerging faults are not detected early. On the other hand, poor specificity causes frequent false alarms and the users learn to ignore the predictions altogether. The authors show that a 1-dimensional convolutional network operating on preprocessed 1D sensor data can reach state of the art accuracy with significantly smaller amount of training data than competing detection frameworks. Moreover, the authors discuss real time implementation issues on both desktop hardware and embedded platforms.

The last article “Multi-output Tree Chaining: an Interpretative Modelling and Lightweight Multi-Target Approach” by Saulo Martiello Mastelini, Victor Guilherme Turrisi da Costa, Everton Jose Santana, Felipe Kenji Nakano, Rodrigo Capobianco Guido, Ricardo Cerri and Sylvio Barbon Jr. studies training of multi-target regression models predicting several numerical targets simultaneously. To this aim, they pro-

pose a tree structure to exploit the statistical dependencies between the targets. The tree chaining approach reaches prediction accuracy comparable to the state of the art, but requires significantly less computation and memory than the conventional approaches.

Collectively, these six articles cover a broad range of machine learning applications from implementation perspective. Moreover, they highlight the importance of solving also the computational challenges while designing a machine learning algorithm intended to run on a resource-limited platform with low latency. In such platforms, the recognition accuracy, execution time and memory footprint all need to be balanced in unison in order to make the complete system feasible for next generation applications such as self-driving vehicles or autonomous robots.

We would like to thank the anonymous reviewers for their careful work on the papers submitted to this special issue. In addition, we also thank all authors for contributing their work to this special edition.

Guest editors

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