Guest Editorial

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Natural Language Generation with Computational Intelligence

Natural Language Generation (NLG) uses Artificial Intelligence (AI) and Natural Language Processing (NLP) techniques to build computational systems that generate reports, narratives and other kinds of texts in human languages. NLG uses analytics, AI, and NLP to obtain relevant information about non-linguistic data and to generate textual summaries and explanations of these data which help people understand and benefit from them. In this regard, NLG is a research field that addresses the data-value chain by using natural language as a tool for bridging the gap between raw data and valuable information communicated to users in a comprehensible way, adapted to their information needs. Regarding data, in the past NLG was usually applied to time-series data and databases. Nevertheless, there is now a lot of work on applying NLG to more challenging types of data, including multimodal data, images (the topic of the third paper of this special issue) and others. Regarding information communication, the traditional way of communicating the extracted relevant information has been through tabular representations and/or graphical visualizations. But many recent studies (including the first paper in this special issue) show that non-specialized users often find that textual descriptions of data are more effective than conventional tabular or graphical presentations of the same data. Furthermore, what is often most effective is a combination of texts, tables and graphs.

Within this context, Computational Intelligence (CI) and, more specifically, Soft Computing allow NLG systems to represent and deal with the imprecision and uncertainty which are inherent in human language. For example, handling vague concepts in some key tasks in the usual NLG pipeline, such as content determination, lexicalization, referring expressions generation, or linguistic realization. CI models and techniques can also help developers quickly adapt NLG systems to a new domain (which is the topic of the second paper in the special issue). NLG can also help CI systems, for example by providing explanations of why a CI system made a specific recommendation or diagnosis, took a particular control action or followed a given reasoning path (and why).

This special issue on "Natural Language Generation with Computational Intelligence" is made up of three papers devoted to recent and prominent developments in the field of NLG with CI. Eleven contributions were submitted to the special issue. All of them were revised by at least three referees and one editor. At the end, the three contributions which achieve the best score, in accordance with the referees' evaluations, were accepted for publication. Let us briefly introduce below some details about these three papers.

The first paper is entitled "Data-to-Text Generation Improves Decision-Making under Uncertainty," by D. Gkatzia, O. Lemon, and V. Rieser. It deals with analyzing empirically how NLG techniques can help in decision-making processes under uncertainty. The use case is related to weather forecasts generation and the emphasis is set on the evaluation challenge. Authors compare NLG and graphical based approaches to assist decision-making under uncertainty. As expected, the best results were reported when combining both NLG and graphics. We would like to remark that contrary to previous work on data-to-text systems, authors made a thorough research on gender effects and they observed significant differences. The combination of NLG and graphics arose as a key tool especially for women. This opens the door to future research on the interplay between uncertainty, risk-taking behavior and gender.

The second paper discusses how CI tools can support knowledge transfer among different application domains. It is entitled "Domain Transfer for Deep Natural Language Generation from Abstract Meaning Representations" and authored by N. Dethlefs. The author proposes a novel method to generalize across different domains the use of models previously learnt in a specific domain. This method is aimed at reusing knowledge models among different applications. Experimental data sets are first labelled. Then, a common semantic representation across domains is created. Then, deep learning methods are applied to extract knowledge from a source domain. This knowledge is represented in the form of lexical-syntactic constructions close to

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natural language. Moreover, it can be successfully adapted to other target domains as desired and proved experimentally with several data sets.

The third paper "Learning to Generate Descriptions of Visual Data Anchored in Spatial Relations" was authored by A. Muscat and A. Belz. Authors face the challenge of automatically generating linguistic descriptions of images. They developed a novel method with three steps. Firstly, objects in the image are identified. Secondly, spatial relations between objects are discovered. Meaningful labels are assigned paying attention to language and visual features. Thirdly, labels are mapped to natural language descriptions. The proposal was thoroughly evaluated using several NLG strategies and CI methods. A random forest model performs best in relation with learning the mapping from features to spatial relations.

Finally, as Guest Editors of this special issue, we would like to thank authors for their submissions, not only the authors of the three accepted papers but all authors who submitted a paper for this special issue. In addition, we would like to recognize the hard and great job made by the anonymous referees who supported the review process. We thank them all for their kind, valuable and outstanding cooperation, as well as for their constructive feedback.

Publication Spotlight *(continued from page 7)*

IEEE Transactions on Cognitive and Developmental Systems

Learning From Explanations Using Sentiment and Advice in RL, by S. Krening, B. Harrison, K. M. Feigh, C. L. Isbell, M. Riedl, and A. Thomaz, *IEEE Transactions on Cognitive and Developmental Systems*, Vol. 9, No. 1, March 2017, pp. 44–55.

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"In order for robots to learn from people with no machine learning expertise, robots should learn from natural human instruction. Most machine learning techniques that incorporate explanations require people to use a limited vocabulary and provide state information, even if it is not intuitive. This paper discusses a software agent that learned to play the Mario Bros. game using explanations. The authors' goals to improve learning from explanations were twofold: 1) to filter explanations into advice and warnings and 2) to learn policies from sentences without state information. The authors used sentiment analysis to filter explanations into advice of what to do and warnings of what to avoid. The authors developed object-focused advice to represent what actions the agent should take when dealing with objects. A reinforcement learning agent used object-focused advice to learn policies that maximized its reward. After mitigating false negatives, using sentiment as a filter was approximately 85% accurate. Object-focused advice performed better than when no advice was given, the agent learned where to apply the advice, and the agent could recover from adversarial advice. The authors also found the method of interaction should be designed to ease the cognitive load of the human teacher or the advice may be of poor quality."

IEEE Transactions on Emerging Topics in Computational Intelligence

Partitioning of Intelligent Buildings for Distributed Contaminant Detection and Isolation, by A. Kyriacou, S. Timotheou, M. P. Michaelides, C. Panayiotou, and M. Polycarpou, *IEEE Transactions on Emerging Topics in Computational Intelligence*, Vol. 1, No. 2, April 2017, pp. 72–86.

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"Intelligent buildings are responsible for ensuring indoor air quality for their occupants under normal operation as well as under possibly harmful contaminant events. An emerging environmental application involves the monitoring of intelligent buildings against harmful events by incorporating various sensing technologies and using sophisticated algorithms to detect and isolate such events. In this context, both centralized and distributed approaches have been proposed, with the latter having significant benefits in terms of complexity, scalability, reliability, and performance. This paper considers the automatic partitioning of the building into subsystems, which enables the distributed simulation, modeling, analysis, and management of the intelligent building while ensuring the effective detection and isolation of contaminants in the building interior. Specifically, we develop both a high-quality heuristic algorithm and an optimal mixed integer linear programming (MILP) formulation for the building partitioning problem. The MILP formulation is based on graph partitioning techniques, while the heuristic is based on matrix clustering techniques. Both approaches partition the building into subsystems while ensuring 1) maximum decoupling between the various subsystems, 2) strong connectivity between the zones of each subsystem, and 3) control of the size of the subsystems with respect to the number of allocated zones. A combination of the two approaches is also proposed for reconfiguring an initial partitioning composition in real time in order to accommodate partitioning needs that arise from dynamic system changes."