applied sciences

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Editorial

Special Issue: Generative Models in Artificial Intelligence and Their Applications

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In recent years, artificial intelligence has been used to generate a significant amount of high-quality data, such as images, music, and videos. The creation of such a vast amount of synthetic data was made possible due to the improved performance of different machine learning techniques, such as artificial neural networks. Considering the increased interest in this area, new techniques for automatic data generation and augmentation have recently been proposed. For instance, generative adversarial networks (GANs) and their variants are nowadays popular techniques in this research field. The creation of synthetic data was also achieved with evolutionary-based techniques, for instance, in the context of multimedia artifacts creation. This editorial summarizes the research papers published in the context of the Special Issue (SI) "Generative Models in Artificial Intelligence and Their Applications". This Special Issue was led by two guest editors: Mauro Castelli from Universidade NOVA de Lisboa (Portugal) and Luca Manzoni from Università degli Studi di Trieste (Italy). This SI aimed at collecting new contributions in the area of generative models in artificial intelligence, focusing on their applications for addressing complex real-world problems in different domains. In the first contribution, "Daydriex: Translating Nighttime Scenes towards Daytime Driving Experience at Night" [1], the authors propose a processing pipeline to generate enhanced daytime translation focusing on road views. The key idea is to supplement the missing information in dark areas of input image frames by using existing daytime images corresponding to the input images from street view services. The second paper, "Fake It Till You Make It: Guidelines for Effective Synthetic Data Generation" [2], deals with the evaluation of various synthetic data generation methods. In more detail, the authors investigated (i) the effect of data pre-processing on the utility of the synthetic data generated, (ii) whether tuning should be applied to the synthetic datasets when generating supervised machine learning models, (iii) whether sharing preliminary machine learning results can improve the synthetic data models, and (iv) whether one utility measure (Propensity score) can predict the accuracy of the machine learning models generated from the synthetic data when employed in real life. The analysis performed by the authors allows defining some guidelines on the best strategies to follow when generating and using synthetic data. In the third contribution, "Generating Synthetic Fermentation Data of Shindari, a Traditional Jeju Beverage, Using Multiple Imputation Ensemble and Generative Adversarial Networks" [3], the authors propose a model that takes incomplete tabular fermentation data of Shindari (a traditional South Korean beverage) as input and uses multiple imputation ensembles (MIE) and generative adversarial networks (GAN) to generate synthetic fermentation data that can be used later for prediction and microbial spoilage control. To generate synthetic data, the authors remodeled the tabular GAN with skip connections and adapted the architecture of the Wasserstein GAN with a gradient penalty. Finally, they compared the performance of the proposed model with other imputation and ensemble models, demonstrating the suitability of the proposed model for the task at hand. In the fourth contribution, "Using Formal Grammars

Citation: Castelli, M.; Manzoni, L. Special Issue: Generative Models in Artificial Intelligence and Their Applications. *Appl. Sci.* **2022**, *12*, 4127. https://doi.org/10.3390/app12094127

Received: 13 April 2022
Accepted: 18 April 2022
Published: 20 April 2022

as Musical Genome" [4], Molina and coauthors explore a generative music method that can compose atonal and tonal music in different styles. To achieve this task, they relied on genetic algorithms. They assessed the outcome of a particular music specification (guitar ballad) in a controlled real-world setup. As a result, the generated music can be considered similar to human-composed music from a perceptual perspective. This result suggests the usage of the proposed method to tackle arts algorithmically. The fifth contribution, "Adversarial Data Augmentation on Breast MRI Segmentation" [5], is an application in the area of medical image analysis. The authors considered the problem of synthesizing breast MRI images from corresponding annotations and evaluates the impact of this data augmentation strategy on a semantic segmentation task. They explored variations in image-to-image translation using conditional GANs, and they studied the impact of the proposed changes on visual verisimilarity and how a U-Net segmentation model is affected by the usage of synthetic data. The results showed that the proposed model achieved sufficiently realistic-looking breast MRI images and maintained a stable segmentation score. The sixth paper of the SI, "Combinatorial Optimization Problems and Metaheuristics: Review, Challenges, Design, and Development" [6], presents a theoretical contribution in the area of metaheuristics. The authors discussed the main concepts and challenges in this area and proposed a formalism to classify, design, and code combinatorial optimization problems and metaheuristics. The proposed contributions may support the progress of the field and increase the maturity of metaheuristics as problem solvers analogous to other machine learning algorithms. The seventh paper, "Algorithmic Music for Therapy: Effectiveness and Perspectives" [7], is a study in the area of complementary medicine. It assesses the short-term effects of conventional (i.e., human-composed) and algorithmic music on the relaxation level. It also investigated whether algorithmic compositions are perceived as music and are distinguishable from human-composed music. Based on the results of a questionnaire compiled by a significant number of volunteers, the paper showed that the relaxation level obtained with the music created by the algorithms is comparable to the one achieved with preferred music. Additionally, statistical analysis showed that the relaxation level is not affected by the composer, the performer, or the existence of musical training. On the other hand, the perceived effect is related to the performer. Finally, music composed by an algorithm and performed by a human was not distinguishable from that composed by a human. The eighth contribution, "Thermal Image Generation for Robust Face Recognition" [8], describes how to create a thermal face recognition system based on the FaceNet architecture. The authors proposed a method for generating thermal images to create a thermal face database with six different attributes (frown, glasses, rotation, normal, vocal, and smile) based on various deep learning models. Using a multimodal image-to-image framework based on generative adversarial approaches, the proposed system can generate thermal imaging from visible images. Considering the rising interest in semi-supervised techniques, in the ninth paper published in this SI, "Survey on Implementations of Generative Adversarial Networks for Semi-Supervised Learning" [9], the authors reviewed the existing work in which generative models have been applied in the context of semi-supervised learning methods. They presented a quantitative and qualitative analysis of the various approaches, and they concluded that the R3-CGAN architecture is the GAN architecture producing state-of-the-art results. Finally, the tenth paper, "Generative Model Using Knowledge Graph for Document-Grounded Conversations" [10], proposes a document-grounded generative model using a knowledge graph. The authors define a model that converts knowledge sentences extracted from the given document(s) into knowledge graphs and fine-tunes the pretrained model using the graph. They validated the effectiveness of the proposed model using a comparative experiment on the well-known Wizard-of-Wikipedia dataset, showing the superior results produced by their approach.

Author Contributions: Writing: M.C. and L.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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