

Deep learning for forecasting the spread of COVID-19 epidemic in the regions of the Russian Federation taking into account economic processes

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In 2022, WHO declared an end to the COVID-19 pandemic, but we still see the COVID-19 epidemic and the emergence of new strains to this day. Data collection on COVID-19 incidence has become less complete and regular around the world.

In the works [1-3] mathematical models have been developed to describe the COVID-19 spread taking into account socio-economic factors based on the compartment and agent-based approached as well its combinations. Due to the lake of epidemic data it is necessary to use machine learning approaches to developed mathematical models of COVID-19 spread.

In this work we demonstrate neural network (NN) models for short-term forecasting of COVID-19 propagation in regions of Russian Federation based on COVID-19 and economic data. Considered models based on:

- Full-connected NN combined with Long Short-Term Memory (LSTM) [3].
- Conditional generative adversarial networks (GAN): vanilla GAN [4], Wasserstein GAN with gradient penalty [5], GAN with autoencoder [6]. In a GAN, two neural networks contest with each other in the form of a zero-sum game, where one agent's gain is another agent's loss.

The hyperparameters of neural network models were optimized by Parzen's tree estimation method [7] based on 27 time series data of COVID-19 morbidity and economic indicators.

The paper analyzes the mathematical models of machine learning among themselves and with SEIR-HCD [1] and agent-based [2] models. The conditions under which machine learning models have an advantage are obtained and discussed.

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