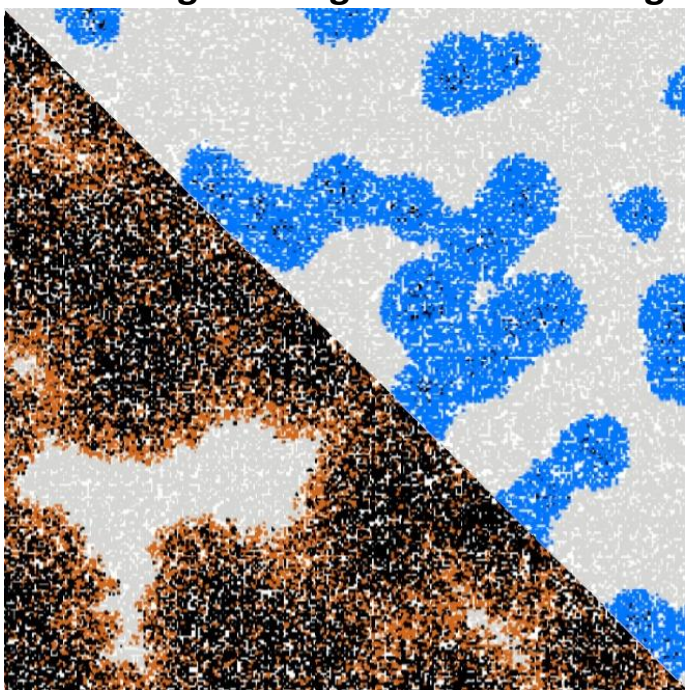
TIFX04-22-18
Improving epidemic containment strategies using machine learning



Bakgrund: Containment of epidemic outbreaks entails great societal and economic costs. Cost-effective containment strategies rely on efficiently identifying infected individuals, making the best possible use of the available testing resources. Therefore, quickly identifying the optimal testing strategy is of critical importance.
We have recently demonstrated that machine learning can be used to identify which individuals are most beneficial to test, automatically and dynamically adapting the testing strategy to the characteristics of the disease outbreak. Specifically, we have simulated an outbreak using the archetypal susceptible-infectious-recovered (SIR) model and we use data about the first confirmed cases to train a neural network that learns to make predictions about the rest of the population. Using these prediction, we managed to contain the outbreak more effectively and more quickly than with standard approaches. Furthermore, we demonstrated how this method can be used also when there is a possibility of reinfection (SIRS model) to efficiently eradicate an endemic disease.

Problembeskrivning: The project will consist in developing more advanced approaches to predict and contain epidemic spreading. The project will use the SIR model as a starting point (as in the original work), but introduce more complex epidemiological models, which might include, e.g. the disease incubation time, delays in the testing process, or even different patterns of movement of the individuals (e.g. periodic motion, and long-range travel) as well as demographic information (e.g. individual risk factors, such as age, employment, and preexisting conditions) and with spatial information (e.g. the location of the individuals, differentiating various places of aggregation, such us hospitals, markets, and schools). In the spirit of open science, we aim to provide a free Python software package, which can be readily personalized and optimized for the needs of specific users and applications.

Arbetssätt: The project will consist of computational work using Python and state-of-the-art machine learning tools such as Keras and TensorFlow. The thesis and presentation can be in Swedish.

Gruppstorlek: 4-6 studenter.

Målgrupp: F, GU-fysik, TM, E, Z, D, IT eller motsvarande.

Litteraturtips: Natali, L., Helgadottir, S., Maragò, O. M., & Volpe, G. (2021). Improving epidemic testing and containment strategies using machine learning. *Machine Learning: Science and Technology*, **2**, 035007.

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