ETHAN.
Ethical AI for Pandemic Management.

This new project with the IEAI looks at a scenario-based approach to the design and use of ethical AI models in managing a health pandemic. In using new technologies to manage health crises, personal data is potentially collected and used to either make better-informed decisions directly or as an input for a machine-learning environment.

The collection and processing of such personal data raises many ethical questions, such as protection of private information, fairness, accountability and interpretability. This yearlong research project is a collaboration between Faculty of Informatics at TUM, Stellenbosch University and Pralexis. It aims to develop an ethical and legal framework and possible machine learning strategies to manage health pandemics such as COVID-19 or HIV.

Key research questions undertaken are: What are the socio-ethical considerations when generating and processing personal data in health-related settings in terms of privacy, fairness and agency? What are the shortcomings of current approaches? What are the elements of a legal framework for AI-based epidemic management models and how could this be used in different jurisdictions in the world? Moreover, what are possible machine learning strategies that could be applied in managing major health crises based on an ethical and legal framework acceptable within a constitutional democracy?

The group is intensively working on a simulation environment, with one group aiming at simulating a realistic long-term-social network that is the basis for the regular contacts for disease spreading. The second group is working with the help of the tool mat_sim on simulating time series of human activities (spatial mobility and encounters) based on the long-term social network but also including random encounters. Using these data, a third group simulates the disease dynamics (e.g. the state changes for each human node) over the course of time.

The team uses extensive data from the South African Western Cape government that allows for fine-tuning of simulations. They also work with publicly available data from the Paris region to allow for computing realistic scenarios for large European urban environments as well. The applied partner, Pralexis, provides the student researchers with excellent computing resources. After completing the simulations, the group will work on a detailed planning stage for developing the data scenarios and the machine learning strategies. The scenarios involve various degrees of sampling from the ground truth data corresponding to various degrees of privacy and public compliance and also techniques such as differential privacy to allow for more sophisticated forms of privacy without severely harming the ML-based analysis.

Plans for 2021

The next step for the coming year is to develop ML-strategies. One area of thought aims at investigating risk prediction applications targeted for the individual citizen based on time, space, activities and parts of the social network that will mainly be facilitated by time-series-based predictive and analytical ML techniques. The other line of thought aims at a higher level of analysis targeted at government actors to decide upon pandemic control measures. Here, the group will investigate clustering approaches that will allow for an analysis of disease dynamics at a larger scale than the individual level, but more fine grained than mere descriptive statistics. In parallel, partners at the University of Stellenbosch are working on an extensive analysis of the legal aspects of AI-based pandemic control and a wide-ranging analysis of the ethical foundations for AI-based pandemic control.

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