



# 2020

## MAX PLANCK LECTURE

"MACHINE LEARNING FOR COVID-19 RISK  
AWARENESS FROM CONTACT TRACING"

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The Covid-19 pandemic has spread rapidly worldwide, overwhelming manual contact tracing in many countries and resulting in widespread lockdowns for emergency containment. Large-scale digital contact tracing (DCT) has emerged as a potential solution to resume economic and social activity without triggering a second outbreak. Various DCT methods have been proposed, each making trade-offs between privacy, mobility restriction, and public health.

Many approaches model infection and encounters as binary events. With such approaches, called binary contact tracing, once a case is confirmed by a positive lab test result, it is propagated to people who were contacts of the infected person, typically recommending that these individuals self-quarantine. This approach ignores the inherent uncertainty in contacts and the infection process, which could be used to tailor messaging to high-risk individuals, and prompt proactive testing or earlier self-quarantine. It also does not make use of observations such as symptoms or pre-existing medical conditions, which could be used to make more accurate risk predictions.

While methods that may use such information have been proposed, these typically require access to the graph of social interactions and/or the centralization of sensitive personal data, which is incompatible with reasonable privacy and security constraints. We use an agent-based epidemiological simulation to develop and test machine learning methods that can be deployed to a smartphone to locally predict an individual's risk of infection from their contact history and other information, while respecting strong privacy and security constraints. We use this risk score to provide personalized recommendations to the user via an app, an approach we call probabilistic risk awareness (PRA). We show that PRA can significantly reduce the spread of the disease compared to other methods, for equivalent average mobility and realistic assumptions about app adoption, and thereby save lives.

*Yoshua Bengio is recognized as one of the world's leading experts in artificial intelligence and a pioneer in deep learning. Since 1993, he has been a professor in the Department of Computer Science and Operational Research at the Université de Montréal. He is the founder and scientific director of Mila, the Quebec Institute of Artificial Intelligence, the world's largest university-based research group in deep learning. He is a member of the NeurIPS board and co-founder and general chair for the ICLR conference, as well as program director of the CIFAR program on Learning in Machines and Brains. In 2018, Yoshua Bengio ranked as the computer scientist with the most new citations, worldwide, thanks to his many publications. In 2019, he received the ACM A.M. Turing Award, "the Nobel Prize of Computing", jointly with Geoffrey Hinton and Yann LeCun for conceptual and engineering breakthroughs that have made deep neural networks a critical component of computing. In 2020 he was nominated Fellow of the Royal Society of London.*

**TUESDAY, JUNE 23<sup>RD</sup> 2020**

**GERMANY 5:30 pm**

**MONTRÉAL 11:30 am**

**CALIFORNIA 8:30 am**

**VIRTUAL EVENT**

Further information and live streaming on

<http://www.is.mpg.de/events/max-planck-lecture-2020>