April 2016 Complexity Community Sharing Session

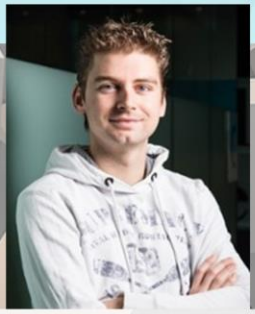
8 Apr 2016 (Fri) 11:00am-01:00pm

Seminar Room 102

(opposite Learning Hub), Blk 1 Innovation Centre, Level 1
16 Nanyang Drive, Singapore 637722

Dr. Markus Schläpfer

Dr. Rick Quax



Understanding Urban Complexity through the Lens of Mobile Phone Data

More than half of the world population now lives in cities - that is expected to further increase in the near future. This global urbanization makes it imperative to understand and predict the functioning of cities. I will discuss how society-wide mobile phone data provide new quantitative insights into the complex urban dynamics and reveal hidden regularities. I will present a simple 'hydrodynamic' model that accurately predicts the collective movements of populations in various urban regions across the world. Also, based on a recent mobile phone study in two European countries, I will show that the network of communication interactions systematically densifies as cities become larger. This supports the hypothesis that the structure of social networks underlies the generic properties of cities, as manifested in the well-known superlinear scaling of almost all socioeconomic quantities with urban population size.

Biography: *Markus Schläpfer leads the Urban Complexity project at ETH Future Cities Lab (Singapore) since 2016 and a Research Affiliate at MIT's Senseable City Lab. Prior to this, he was a Postdoctoral Fellow at the Santa Fe Institute. He received his PhD in 2010 from ETH Zurich (Switzerland) at Mechanical and Process Engineering Dept. His main research are: derivation of quantitative, predictive models for the organization of cities & its interplay with urban infrastructure networks. He grounds his research on the increasing availability of large-scale data on human activities and applies network theory and complexity science to gain a comprehensive view of the urban dynamics. In 2015, he was awarded first prize in the 'Data for Development' Challenge, a major research competition 'Big Data' with over 150 participating universities. For more information, please visit: http://web.mit.edu/schlmark/www/*

Synergy Among Variables and How to Quantify It

Quantifying synergy among stochastic variables is an important open problem in information (info) theory. Info synergy occurs when multiple sources together predict an outcome variable better than the sum of single- source predictions. It is an essential phenomenon in biology e.g. neuronal networks and cellular regulatory processes, where different info flows integrate to produce a single response, as well as statistical inference tasks e.g. feature selection in machine learning. I will explain the phenomenon and propose our new metric of synergistic entropy and synergistic information from first principles. We prove several basic & desired properties of our measure, including bounds and additivity properties. Also, we prove several important consequences of our measure, including the fact that different types of synergistic info may co-exist between the same sets of variables. We will show that the currently assumption about synergy is wrong. The new measure may be a marked step forward in the study of multivariate info theory and its applications.

Biography: *Dr Rick Quax is a postdoctoral researcher in Computational Science Faculty of Science of the University of Amsterdam. He obtained the Ph.D. in Computational Science in 2013. He is very keen in the emergence of complex, systemic behavior from the interactions of simple elements, such as human cognition from neurons and synapses, cell regulatory processes from gene-gene interactions, and social unrests and protests through person-person communication. Supervised by Prof. Peter Sloot, he formulates a theoretical framework of information processing in complex systems, more specifically, systems with complex networks of interactions.*

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