BRIGHAM AND WOMEN'S HOSPITAL
HARVARD MEDICAL SCHOOL

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Department of Medicine
Channing Division of Network Medicine

Channing Network Science Seminar

June 3rd (Friday), 2022, 11AM (ET)

Zoom link: https://us02web.zoom.us/j/579497999?pwd=cHNIWHMzWUlFUUVJTG1EeVJmY05aQT09
Meeting ID: 579 497 999
Passcode: 844168

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Emergence of functional interactions in complex systems

Abstract: We are witnessing an unprecedented boom in biological data availability, inevitably leading to a turning point, where theory can be a guiding force behind experimental design and development, similarly to what happened in physics. Molecules in our cells, genes in our genome or individuals in our societies do not serve their functions in isolation, but in concert with other nodes in their networks, as well as with environmental factors. Pairwise interactions and correlations are an important starting point, captured by network models. Yet, a sufficient understanding of cancer and complex diseases, as well as drug combinations or genetic interactions requires to consider interactions of higher order, between multiple nodes and conditions. Hindered by a combinatorial explosion, limited data availability and quality, going beyond second order in a data-driven way is extremely demanding, with only a handful of examples. The same problem arises not only in systems biology, but in neuroscience, information and infection spreading, as well as in modern quantum physics. In the talk I will show how to fight data incompleteness and biases with novel methods, leading to experimentally testable, large-scale predictions. Besides bio-physical interactions, our approach can reliably predict a broad spectrum of functional associations, including co-complex membership information, disease associations, pathway membership and (higher order) genetic interactions, toxic and synergistic drug combinations as well as organizing rules in the nervous system. I will close by highlighting future research directions in social networks and complex quantum systems.

Bio: *István Kovács is Assistant Professor in the Department of Physics and Astronomy at Northwestern University. Previously he was a postdoctoral fellow in the Network Science Institute at Northeastern University, a visiting researcher in the Center for Cancer Systems Biology at the Dana-Farber Cancer Institute and at University of Toronto, as well as at the Department of Network and Data Science of the Central European University. He received a PhD in Physics from the Eötvös Loránd University in Hungary, working at the Wigner Research Centre for Physics, during which he spent time at Semmelweis University and University of Saarbrücken, Germany. His group develops novel methodologies to predict the emerging structural and functional patterns in problems ranging from systems biology to quantum physics, in close collaboration with experimental groups.*

Hosted by Arda Halu and Yang-Yu Liu