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Predicting the Network Controllability Robustness:
A Convolutional Neural Network Approach

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Abstract
Network controllability measures how well a networked system can be controlled to a target state, and its robustness reflects how well the system can maintain the controllability against malicious attacks. The measure of network controllability is quantified by the number of external control inputs needed to recover or to retain the controllability after the occurrence of an attack. The measure of the network controllability robustness, on the other hand, is quantified by a sequence of values that record the remaining controllability of the network after a sequence of attacks. Traditionally, the controllability robustness is determined by extensive attack simulations, which are computationally time consuming. In this talk, a method for predicting the controllability robustness using a convolutional neural network (CNN) is introduced, motivated by the following observations: 1) there is no clear correlation between the topological features and the controllability robustness of a general network, 2) the adjacency matrix of a network can be regarded as a gray-scale image, and 3) the CNN technique has proved successful for many tasks in image processing. Under the new framework, a relatively large number of training data generated by simulations are used to train a CNN for predicting the controllability robustness according to the input network adjacency matrices, without performing the time-consuming conventional attack simulations. Extensive experimental studies were carried out, demonstrating that the proposed framework for predicting controllability robustness of different network configurations is accurate and reliable with very low overheads.

About the Speaker
Dr. Yang Lou received the Ph.D. degree from the Department of Electronic Engineering, City University of Hong Kong in 2017, where he has been a Postdoctoral Research Fellow since then. His research interests include complex networks and evolutionary computation.

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