Course Project Proposal

Title: Network Resilience and Vulnerability

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Description:

Perturbations are common in complex network systems like ecological system, financial markets and power grid. Usually the robustness of the system allows it to tolerate tiny and mild perturbations. However, large disastrous perturbation always threats the stability of a well-functioning network. Hence the ability of withstanding and recovering from disaster always draw the attention of researchers. Moreover, the situation becomes more sophisticated when the size and structural complexity of the whole system increases. Existing results show that, in the study of such a complicated network, the resilience and vulnerability of a network depends on multiple factors like the topology of system, propagation of influence, and the anti-disaster strategy of each components.

Motivated by this, we try to establish a mathematical model to describe the resilience of network systems based on existing literatures and apply the model to several real-world issues.

In the first step, a mathematical framework will be established. Directed graphs are used to depict the topology of the network with nodes and edges, respectively, representing network components and potential mutual interactions. We attempt to find a way to describe how perturbations and influences are propagated along the edges within the network. Together with formulas depicting each node's potential strategy and capacity of withstanding perturbation, we will be able to establish a generalized model that measures the resilience and vulnerability of complex network.

Secondly, we apply this model on real-world problems. We abstract the topology of practical systems such as public transportation under rushing hour or urban drainage network under heavy rains and decide corresponding model details from relating literatures. The resilience and vulnerability of the selected scenarios will be analyzed by simulating network's behavior under large perturbation. Results will be properly visualized they can be interpreted with reasonable explanations. In the meanwhile, the robustness of the model will be tested, and the uncertainties and variables will be discussed.

References

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