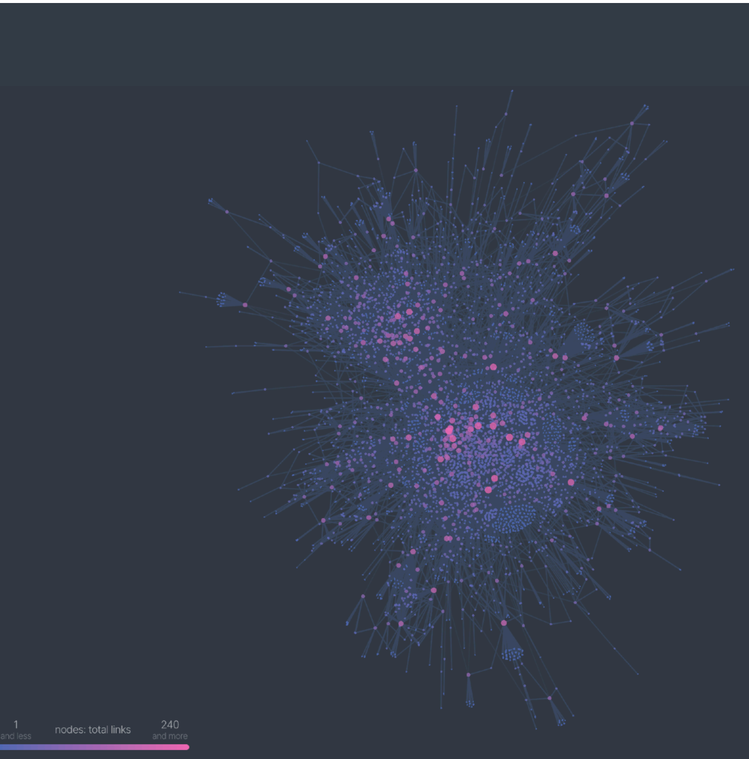
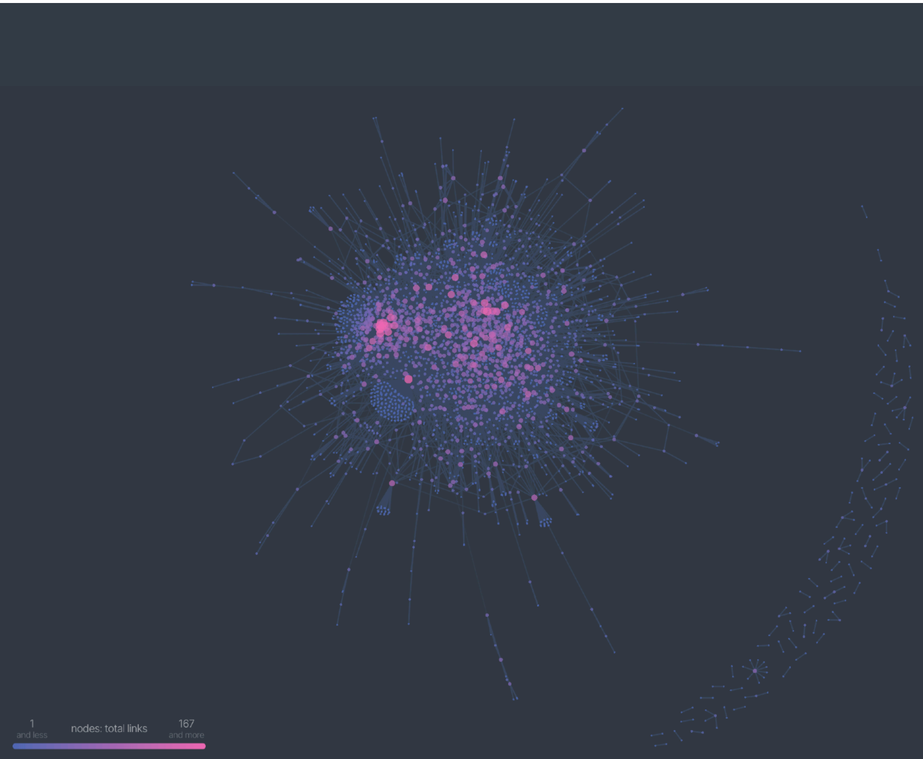
Robustness: percolation and dismantling

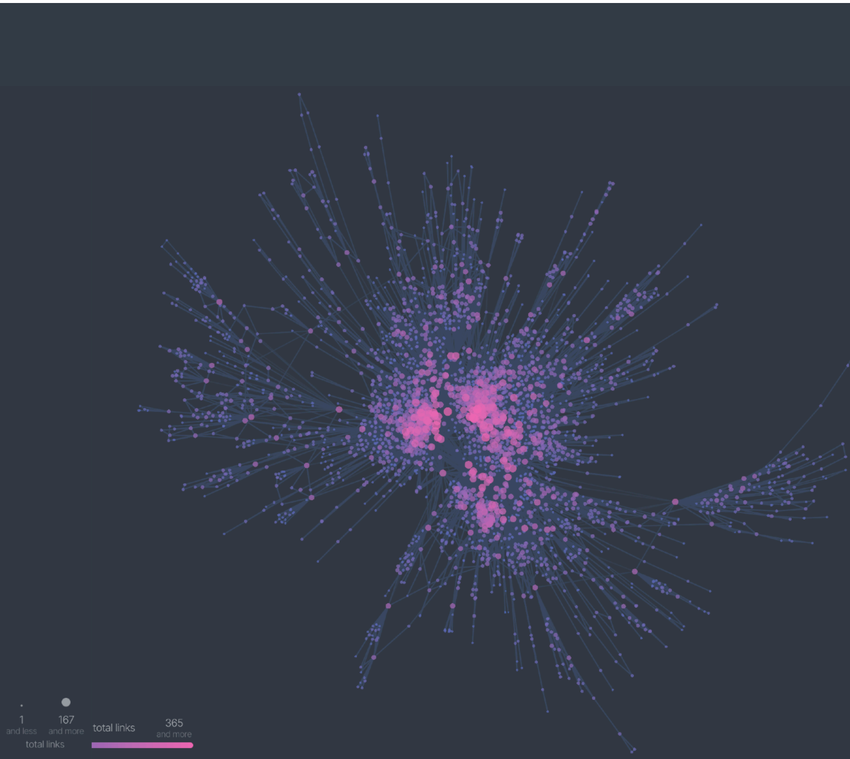
Course: Physics of Complex Networks: Structure and Dynamics



Internet

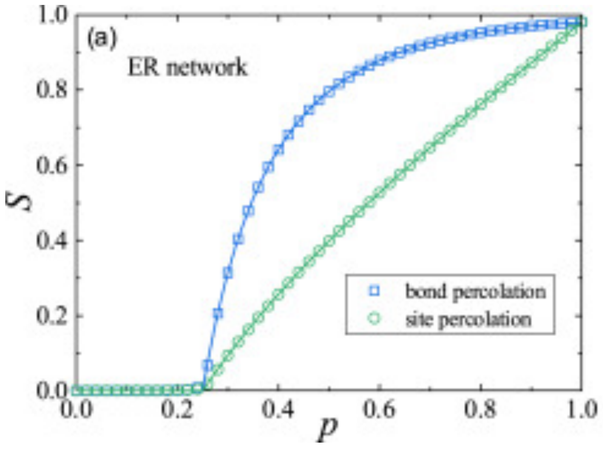


C. elegans



Air traffic

Objective: compare dismantling strategies



(1) Write the code to remove a list of nodes from a given network

- The list can be a random subset of nodes (ie, failures) → *percolation*
- The list can be a subset of ranked nodes (ie, attacks) → *optimal dismantling*

(2) Specifics for synthetic networks analysis

- Use N = 5000 (or larger); consider 20 instances of Erdos-Renyi and Barabasi-Albert with same $\langle k \rangle$
- Calculate how the relative size of the LCC change after removing a fraction p of nodes ($p \in [0,1]$)
- Compare: random failures vs degree-ranking vs betweenness-ranking attacks

Bonus: distribution of clusters size; study finite-size effects around the critical point ($N = 2^6, \ldots, 2^{15}$)

(3) Empirical systems

- Simulate random failures vs degree-based vs betweenness-based attacks for:
  - the network of protein-protein interactions for C elegans
  - the Internet network (AD 2000 snapshot)
  - the international air traffic network
- Which network is more robust to random failures?
- Which network is more robust to targeted attacks?
- How the result change if a Configuration Model (20 instances) is used instead?