NetSci

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* Network Science focuses on a network representation of a system that shows how the system components are interconnected
* Complex systems have:
  + Many and heterogenous components
  + Components that interact with each other through a non-trivial network
  + Non-linear interactions between components
* Trivial Networks
  + Regular networks have the same connection pattern/structure at all nodes
  + Random networks - nodes are connected randomly. For each pair of nodes, they are connected with the same probability
* Most information systems and similar networks do not have a regular or random network structure
* Network architecture provides of a system provides valuable information about the system function, capabilities, resilience, evolution, etc
* Knowing how components are interconnected provides sufficient information about the system
* It is a good idea to design the network representation of system first, and implement after this design
* Dynamic Network - A network that changes over time
* Centrality metrics quantify the importance of a node. There are different options for importance
  + If edges are removed, which edges from what nodes would cause the most distruption
  + Central in the sense of how many nodes communicate through them
  + PageRank metric - used in first search engine by google. PageRank value of a node does not simply depend on how many other nodes point to v, but it also is based on how large the PageRank value of the connected nodes is, and how many other nodes they point to.
  + Betweenness - betweenness centrality of a node v relates to the number of shortest paths that traverse node v, considering the shortest paths across all node pairs
* It is another important problem in NetSci to discover communities - the density of the connections between nodes of the same community is much larger than the density of the connections between nodes of different communities
* There are many community detection algorithms
* Study of dynamic processes on networks - network structure remains the same, but a dynamic process is gradually unfolding on that network, like a pandemic.
* Network science focuses on real-world networks and their properties
* Network science provides a general framework to study complex networks independent of the specific application domain
* Most people are connected with each other through a path of 6 or so acquaintances
* The number of connections per node follows a power-law distribution