

Complex Networks (CS60078)



Instructor: Bivas Mitra

TAs:

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Course Directives

- Time: Mon(2:00pm-3.00pm), Tue(4.00pm-6.00pm)
- Webpage:
<http://cse.iitkgp.ac.in/~bivasm/CNT2023.html>
- Marks:
 - Midterm: 30%
 - Term project: 30%
 - Endterm: 40%

Term project

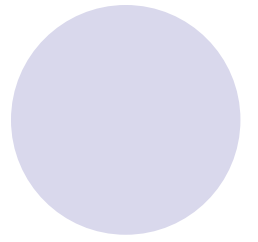
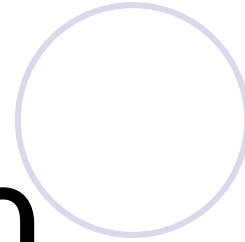
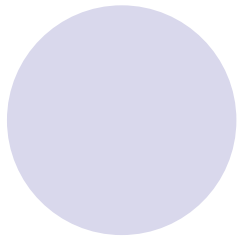


- **Term project:** A mini project (topics will be soon circulated among you).
- Form a group (of size 4)
- (i) Meet your mentor and understand the project,
- (ii) gather data (if reqd.),
- (iii) model/ analyse and experiments,
- (iv) prepare presentation and tech report (can lead to a paper)
- Evaluation – Feb & April

References

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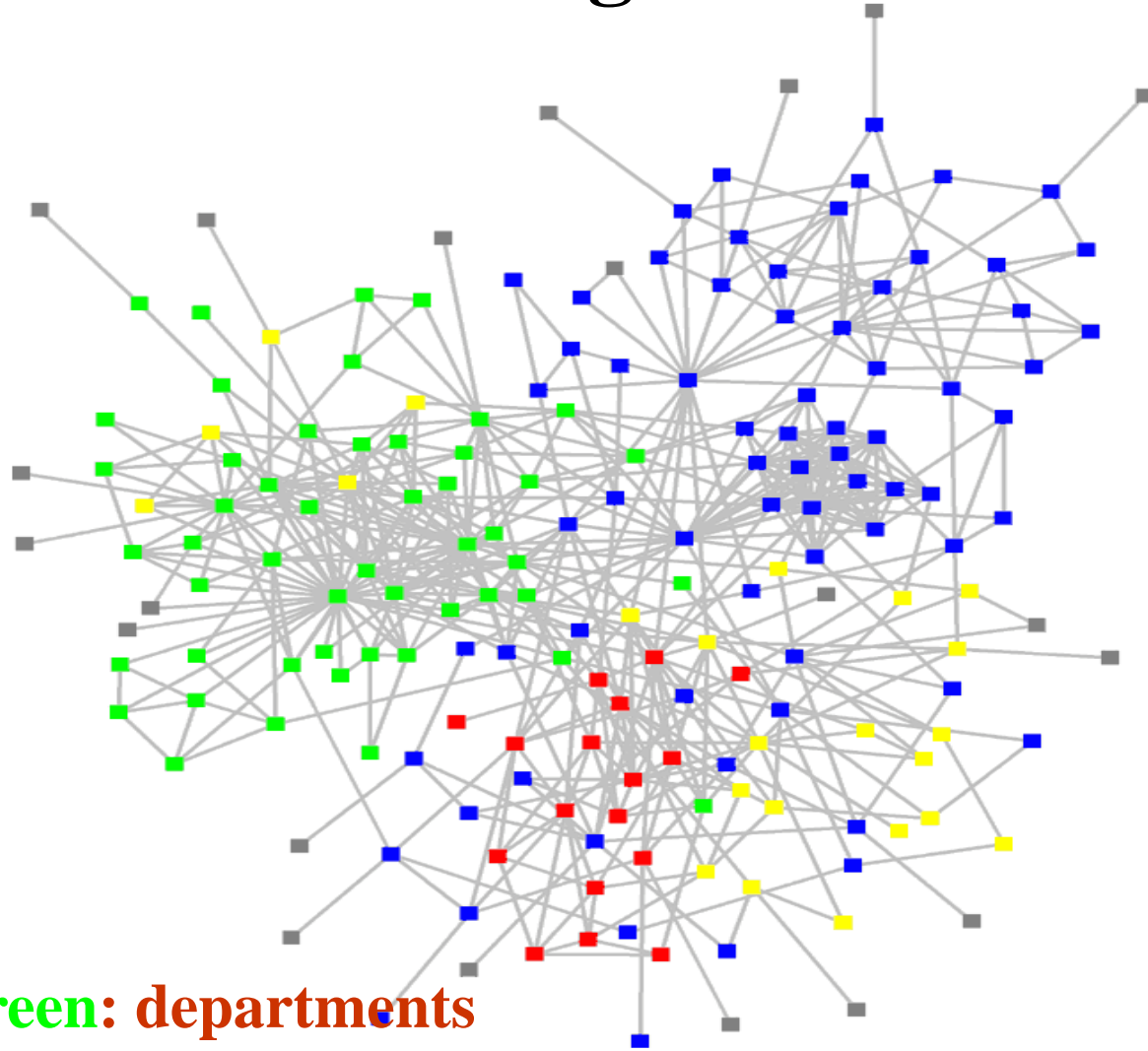
- *Networks: An Introduction*, Oxford University Press, Oxford, 2010.
- *Evolution of Networks*, Oxford University Press, Oxford, 2003.
- The structure and function of complex networks, *SIAM Review* **45**, 167-256, 2003.
- Statistical mechanics of complex networks, *Rev. Mod. Phys.*, **74**(1), 2002.



Introduction

Complex networks

Structure of an organization

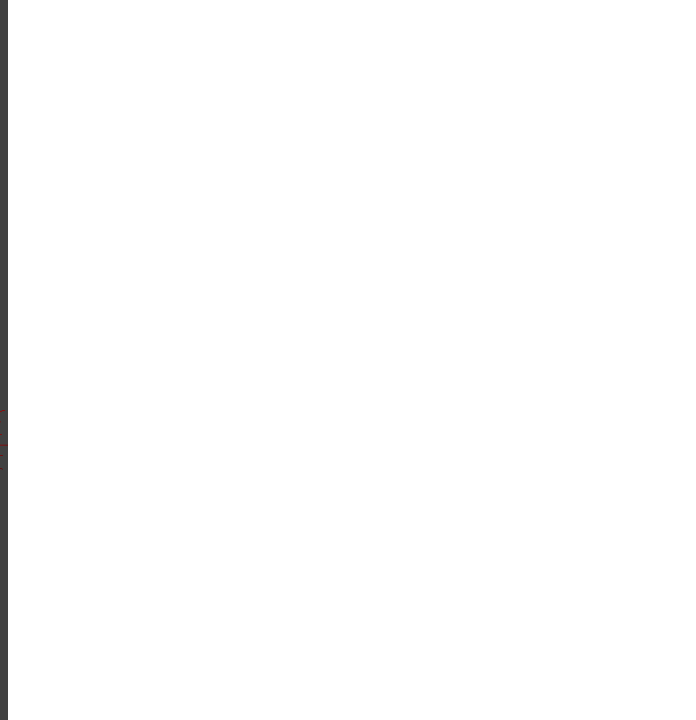
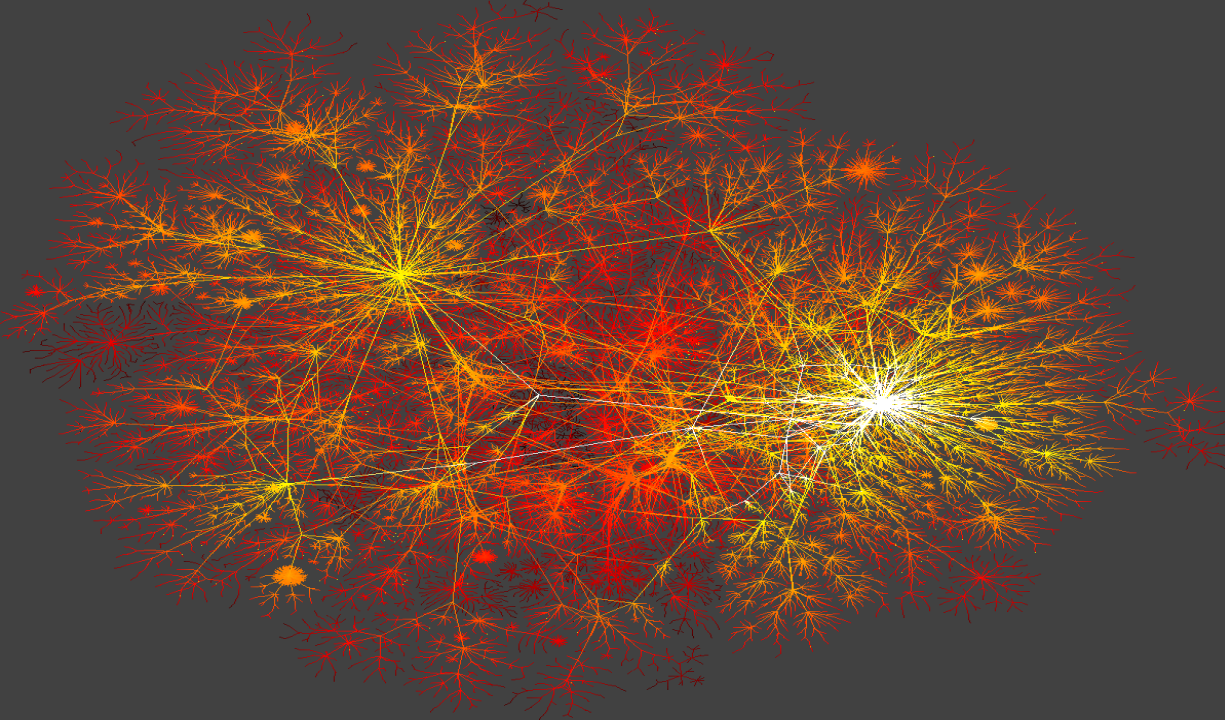
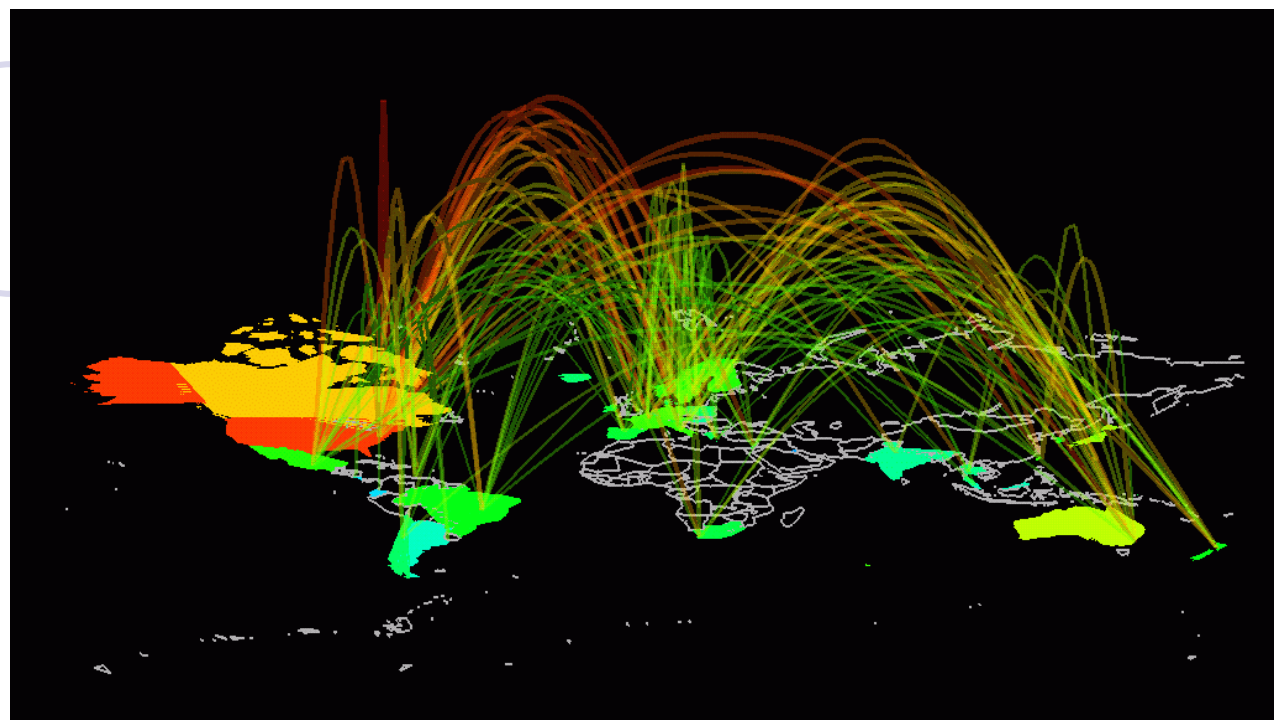


Red, blue, or green: departments

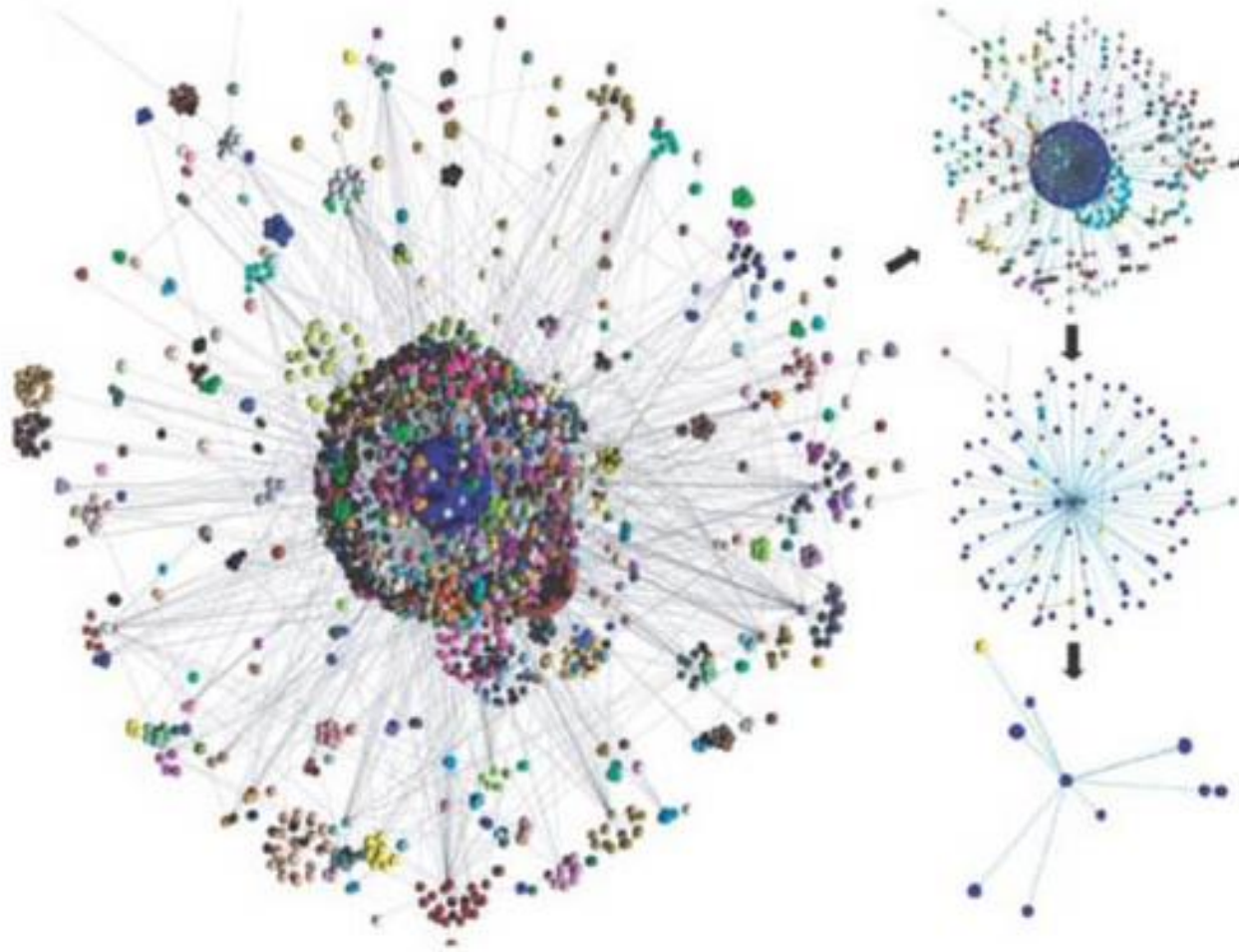
Yellow: consultants

Grey: external experts

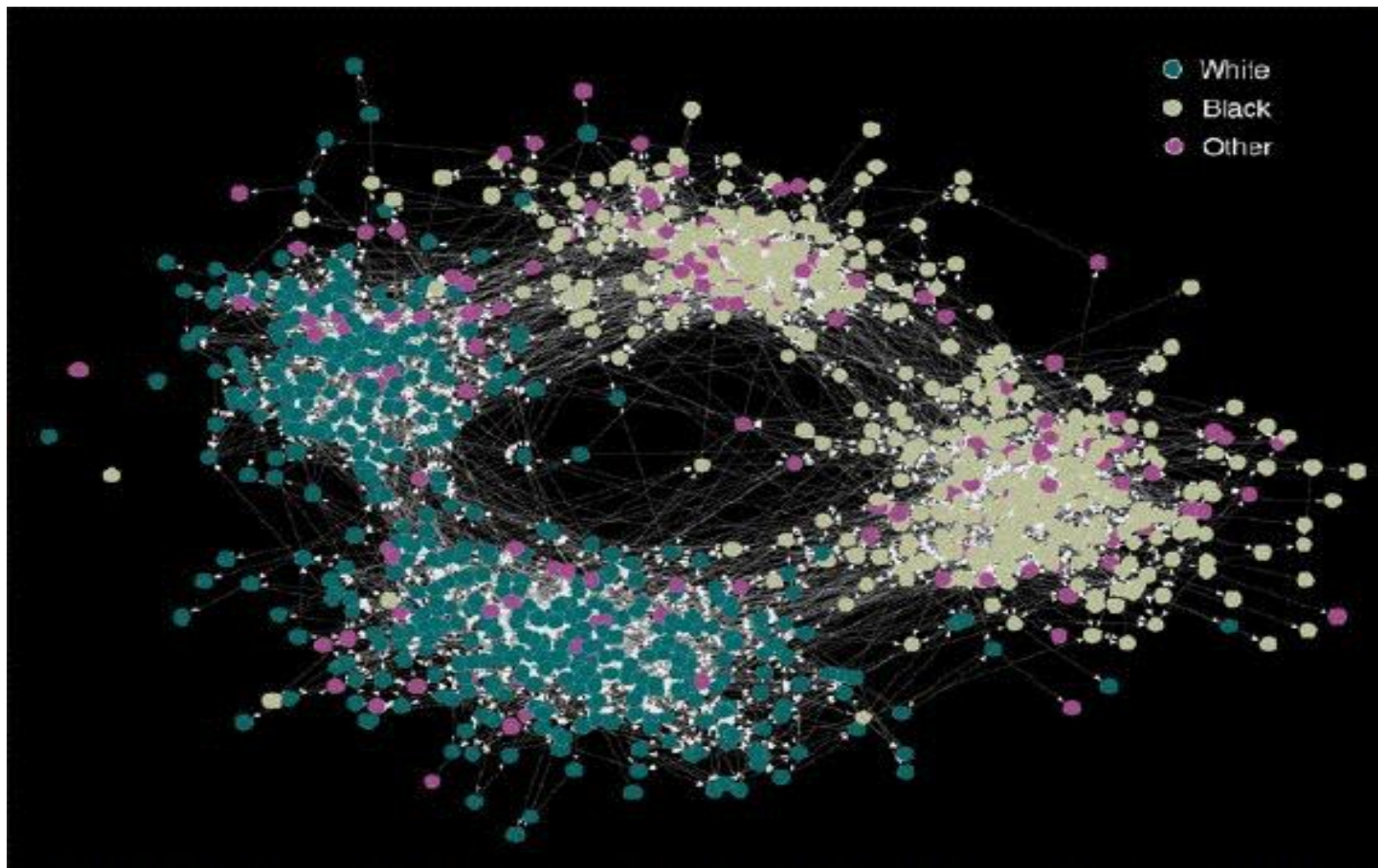
Internet



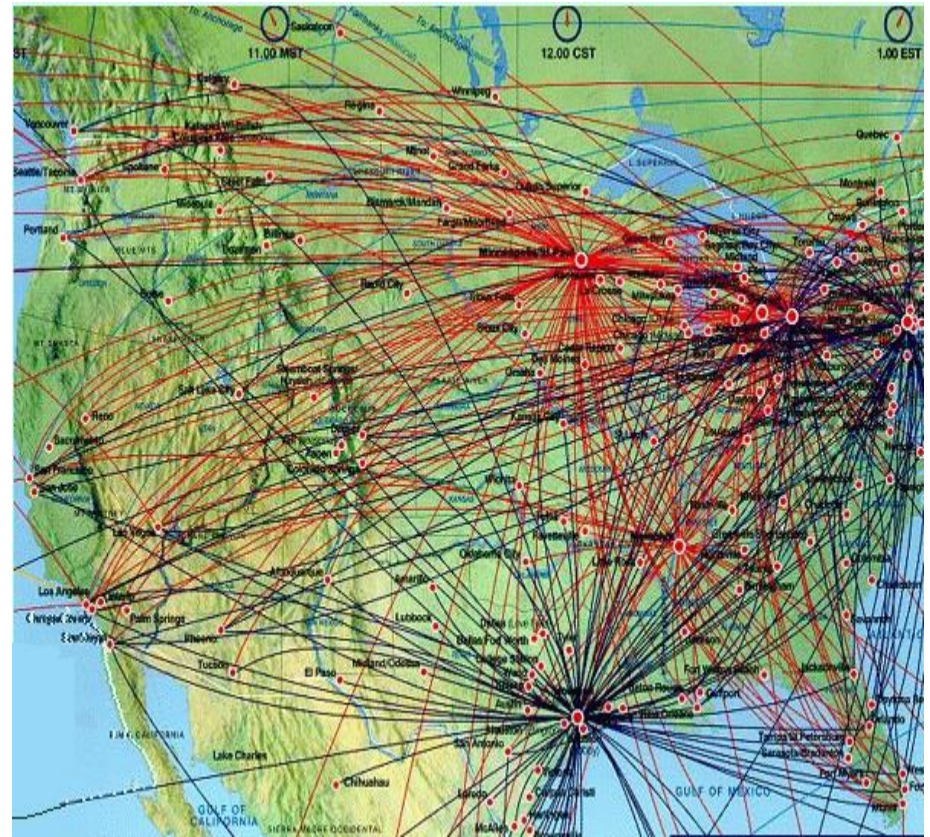
Web network



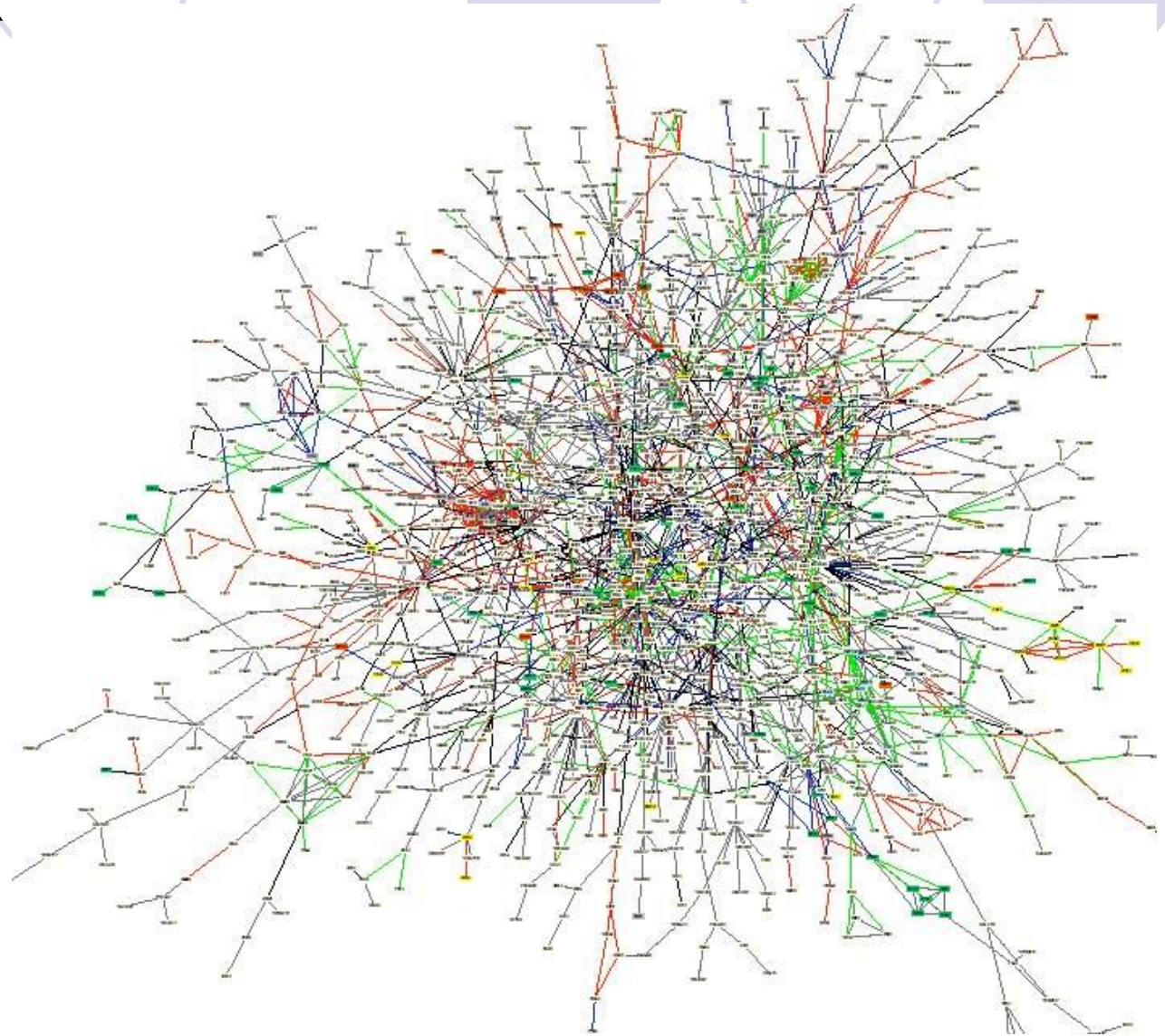
Friendship Network



Road and Airlines Network



Yeast protein-protein interaction network



Network Connectivity \neq Complexity

Network Connectivity + Dynamics = Complexity
+Scale

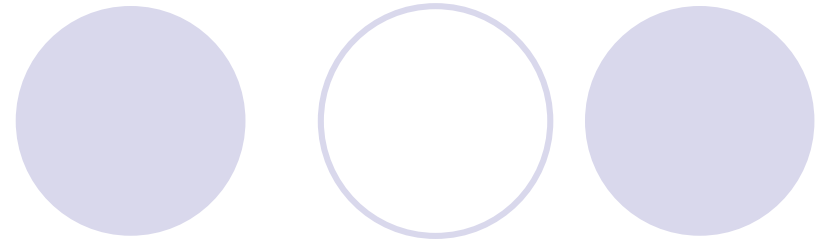
- **They have a non-trivial topological structure dynamically evolving over time**
- **Buzzwords**
 - **Heavy tail in the degree distribution**
 - **High clustering coefficient**
 - **Preferential attachment**
 - **Community structure**

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What Questions can be asked

- Do these networks display some symmetry?
- Are these networks **creation** of intelligent objects or they **have emerged**?
- How have these networks emerged
 - Underlying simple rules leading to their complex formation

2 Way Approach



- Analysis of the real-world networks
 - Degree Distribution
 - Clustering Coefficient
 - Centrality
 - Small-world effect
- Synthesis of the network by means of some simple rules
 - Preferential attachment models
 - Small-world models