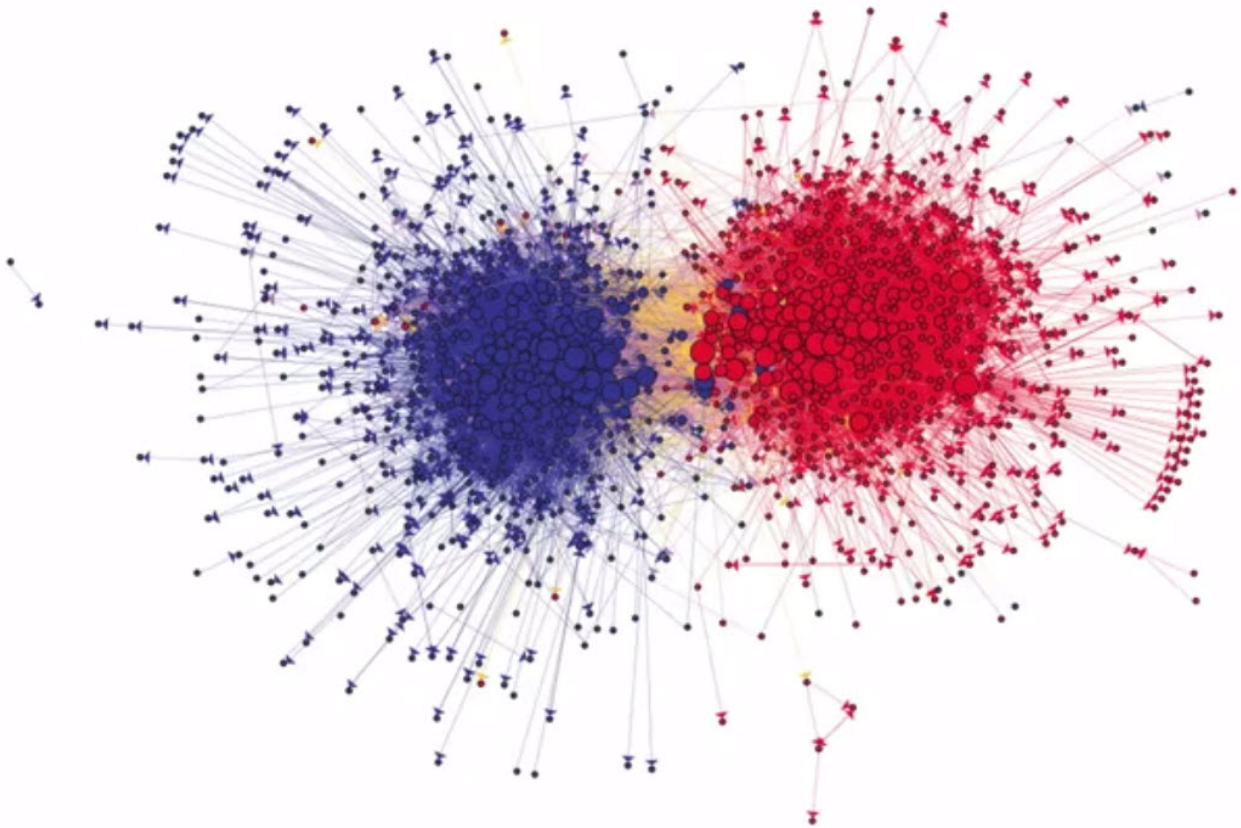
Statistical Network Analysis

Olga Klopp

MODAL'X, Université Paris Nanterre - CREST, ENSAE

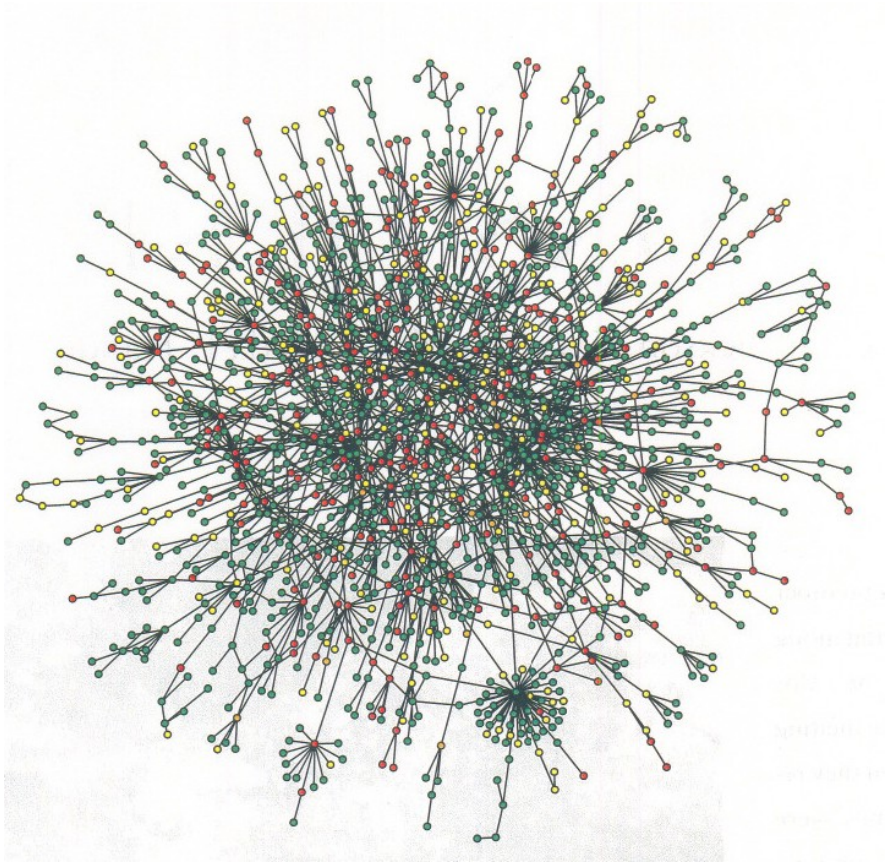
Social Political Blog Network



Problem

Bisection of the graph

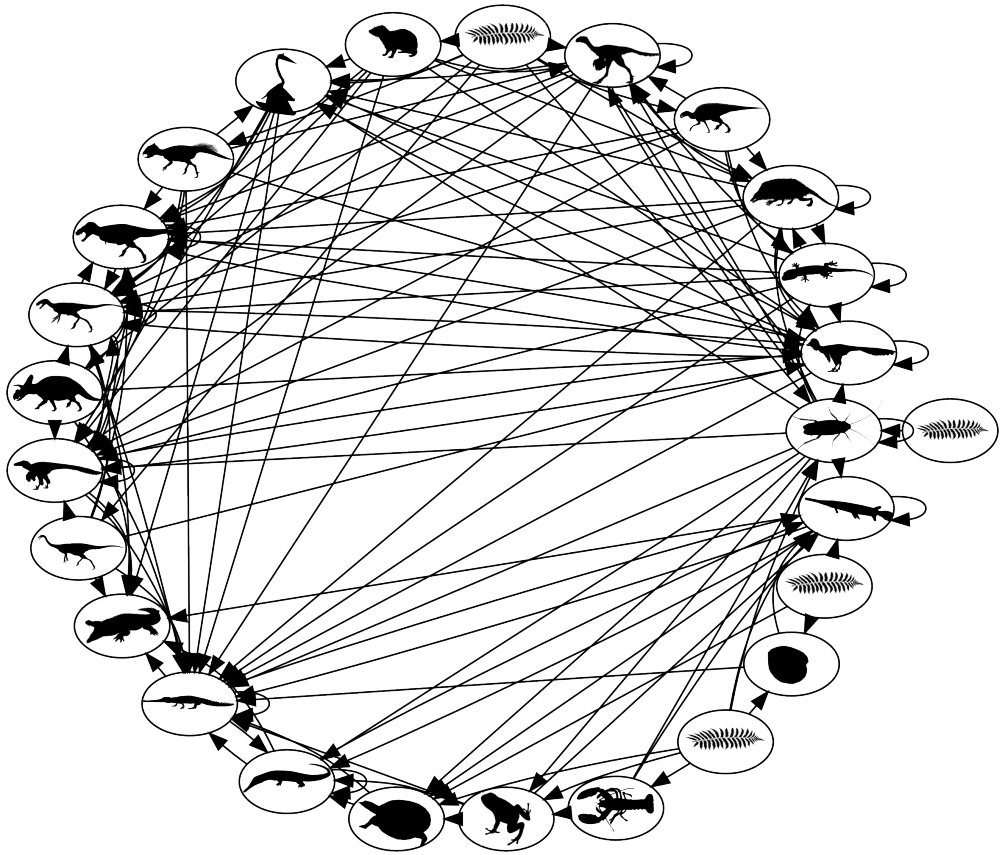
Yeast Protein-Protein Interaction



Problem

Find the hubs

Trophic Network

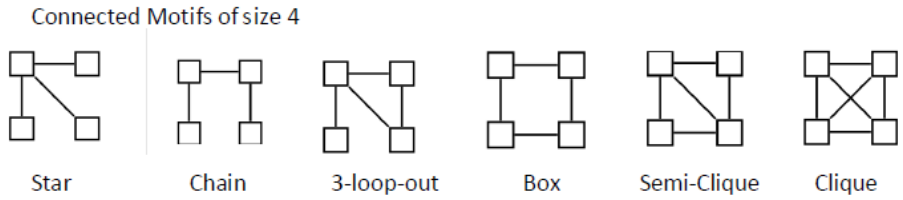


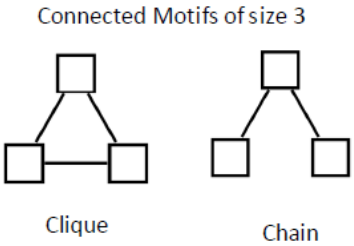
Problem

Find groups with strong connexions

Other structures...

- Determine motifs :





Motifs = recurrent and statistically significant sub-graphs or patterns.

- Detection of anomalies (e.g. detection of hacking attacks)
- ...

A null Model: Erdös-Rényi

Erdös-Rényi random graph

$\mathbb{G}(n,p)$: $(\mathbf{A}_{ij} : i < j)$ are i.i.d. Bernoulli(p) and $\mathbf{A}_{ii} = 0$.

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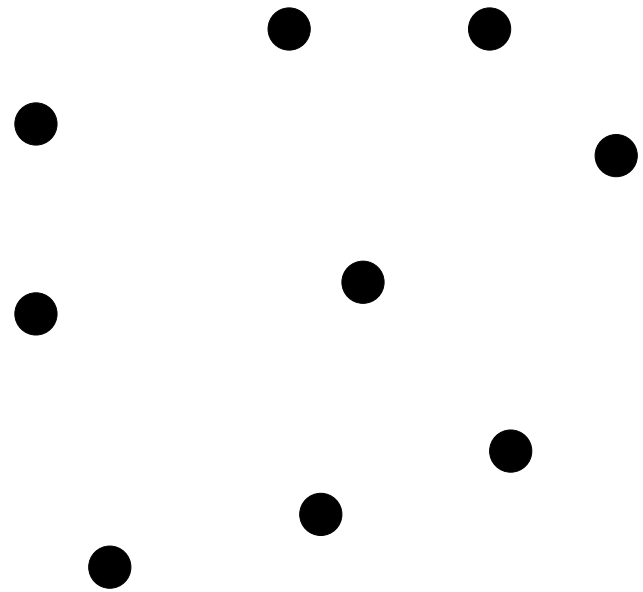

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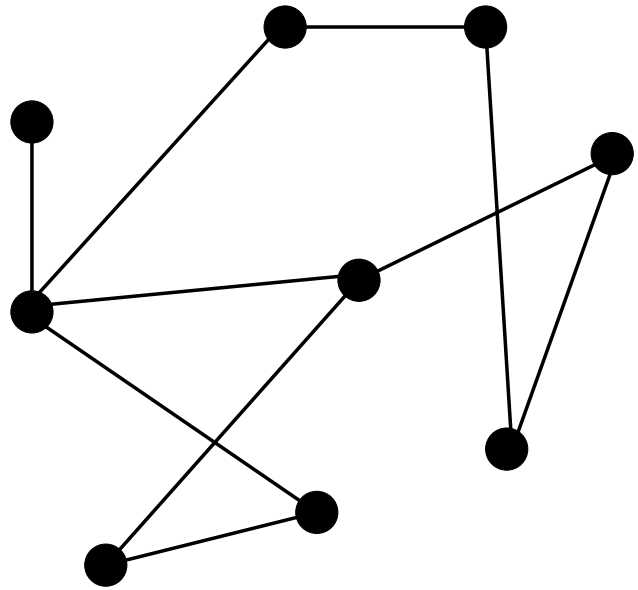
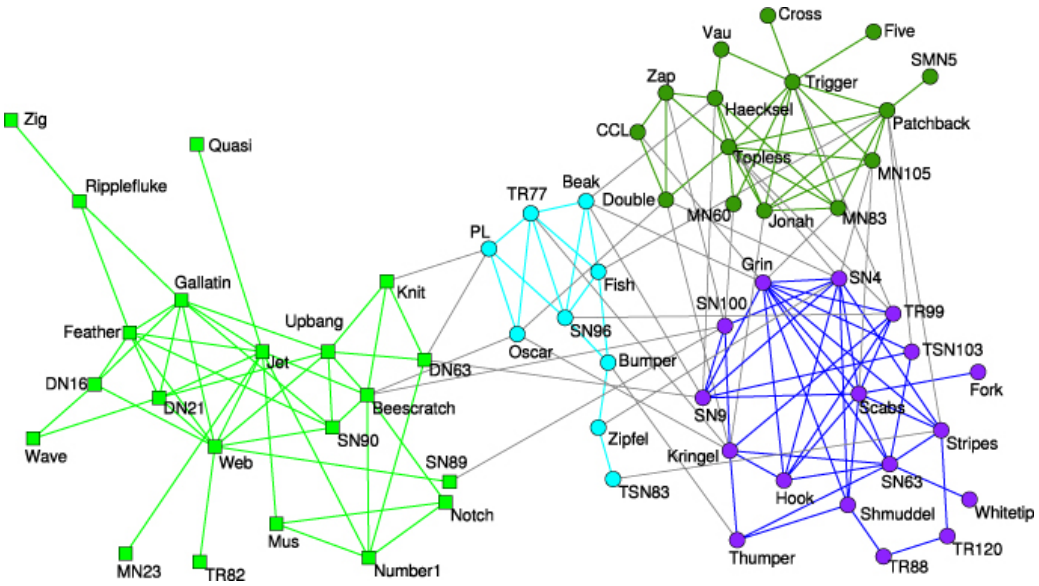


Remark: $deg(i) \sim \mathcal{B}in(n-1,p)$.

- if p is constant, the mean degree is proportional to n (**dense** case)
- if $p \approx c/n$, the mean degree is of constant order (**sparse** case)

Real world networks



Dolphine Social Network [Newman and Girvan(04)]

- heterogeneous structure
- clustering nodes that play the same role in the graph
- sparse