Opinion formation in networks of acquaintances

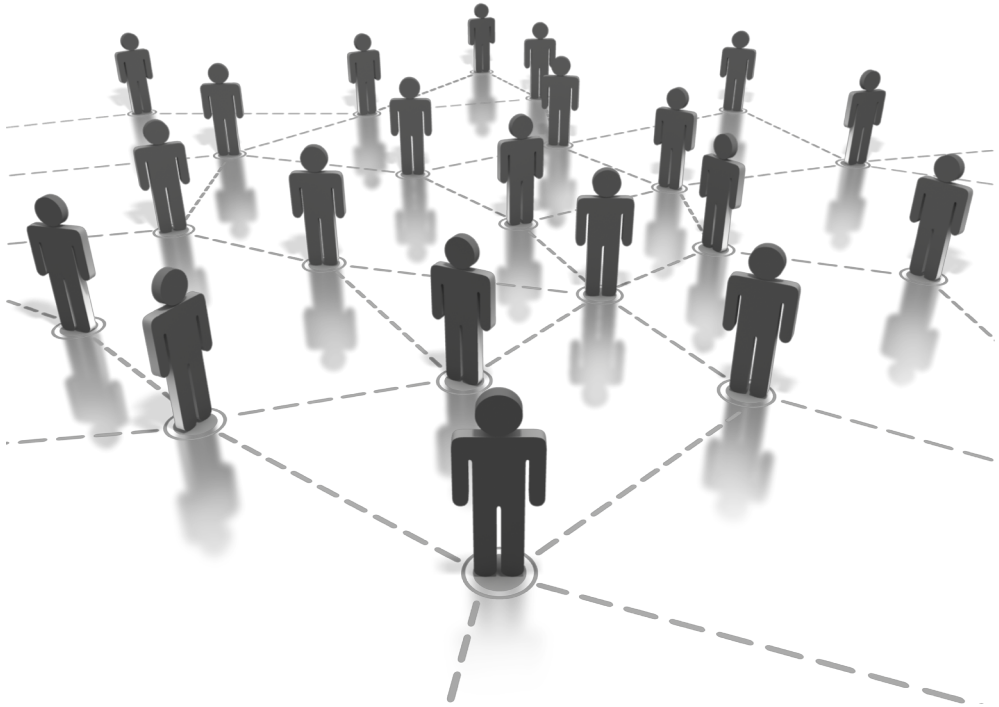
Modelling and Simulating Social Systems

December 18th, 2018

Romain Buchs & Nicolas Habisreutinger

Introduction

- Components of a network: nodes, edges
- The development of numerical analytic tools drives social science research on networks
- Communities generally become like-minded
- What is the dynamic between this development?

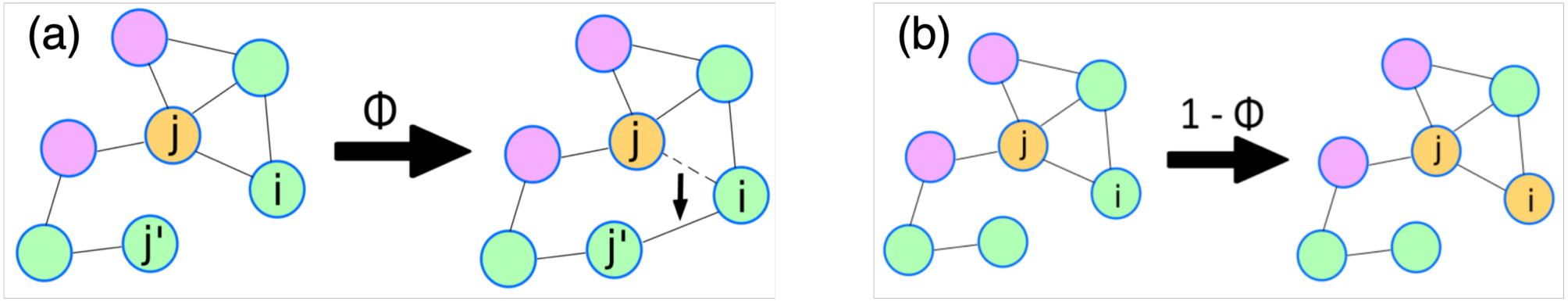


Holme and Newman model

Pick node i at random.

a) With probability Φ : Pick randomly an edge attached to node i and move the other end to a randomly picked node with opinion g_i.

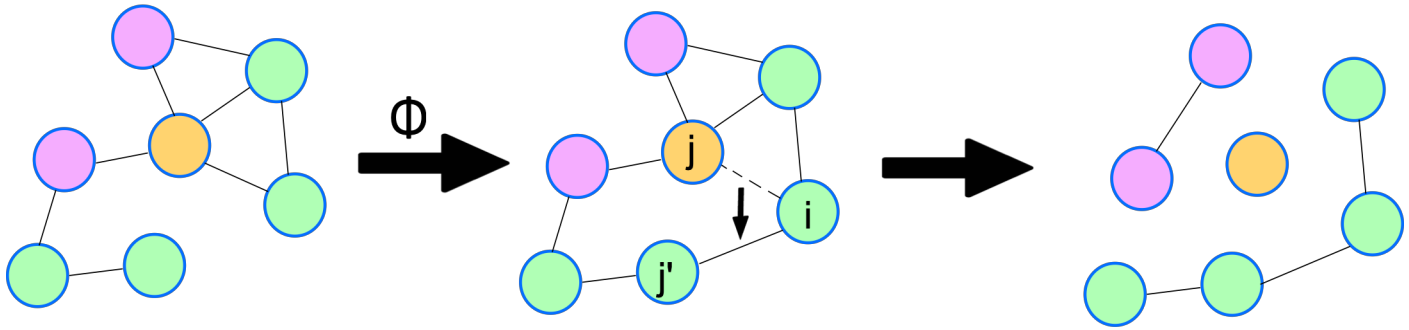
b) With probability $1 - \Phi$: Pick j, a random neighbor of node i. Change the opinion of node i, g_i, to the one of node j, g_j.



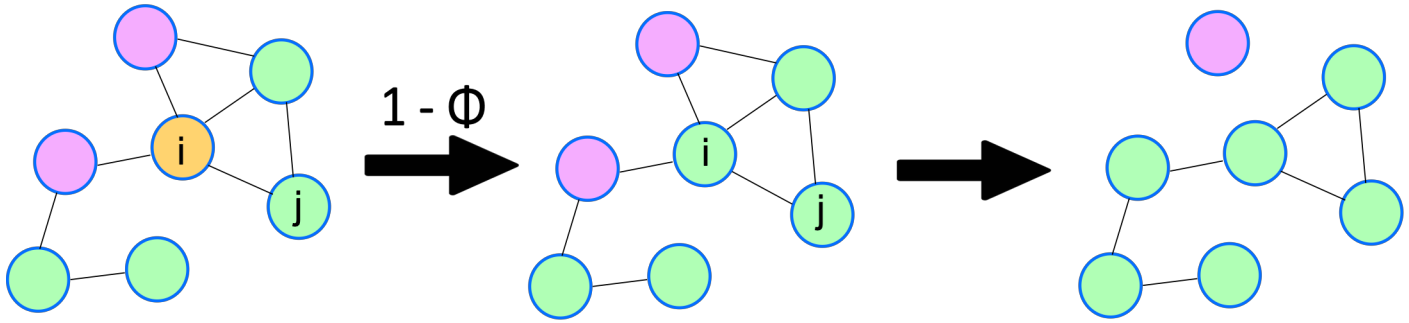
Model parameters: Average degree $\bar{k} = \frac{2M}{N}$; Mean number of people holding an opinion $\gamma = \frac{N}{G}$; and the probability Φ.

Qualitative behavior

When $\Phi \to 1$:



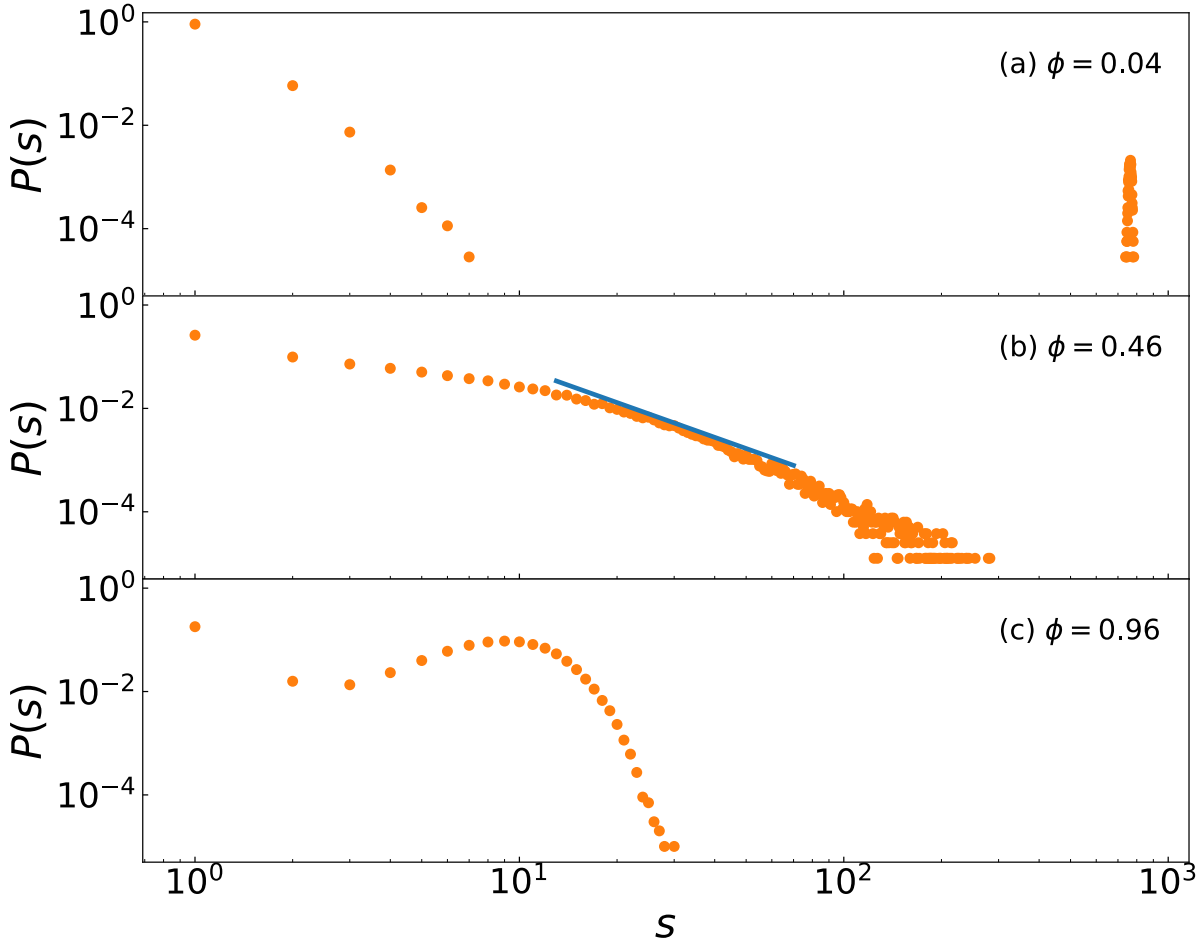
When $\Phi \to 0$:



Distribution of community sizes

- Networks with $n = 800,\ \overline{k} = 4,\ \gamma = 10$
- Transition between a regime with no giant community to one with a giant community
- At an intermediate Φ-value, the distribution of community sizes appears to follow a power law

$$P(s) \sim s^{-\alpha}$$



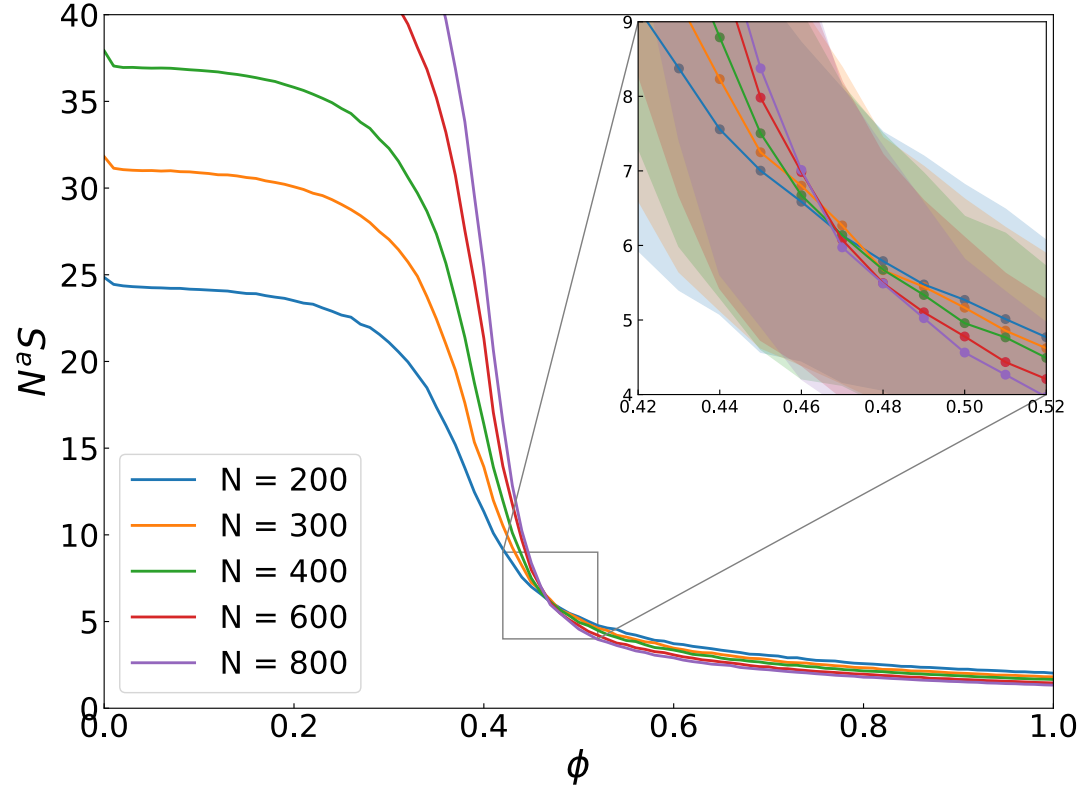
Finite size scaling

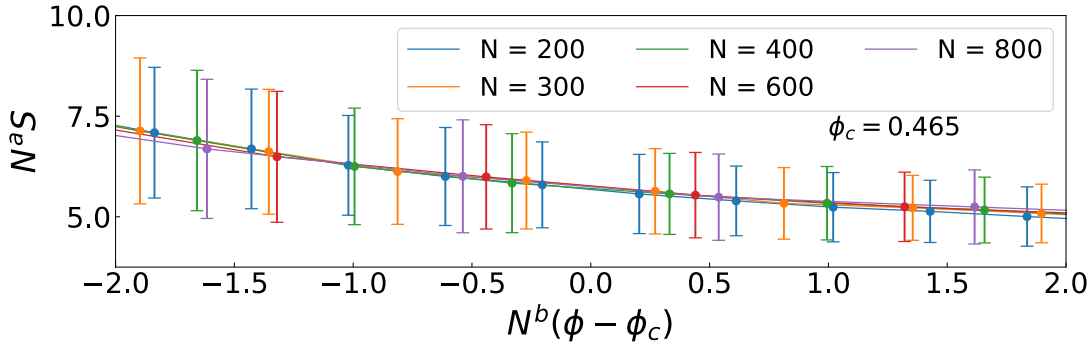
- Order parameter

$$S = \max_s s \cdot N^{-1}$$

- Assume universal scaling relation of the form:

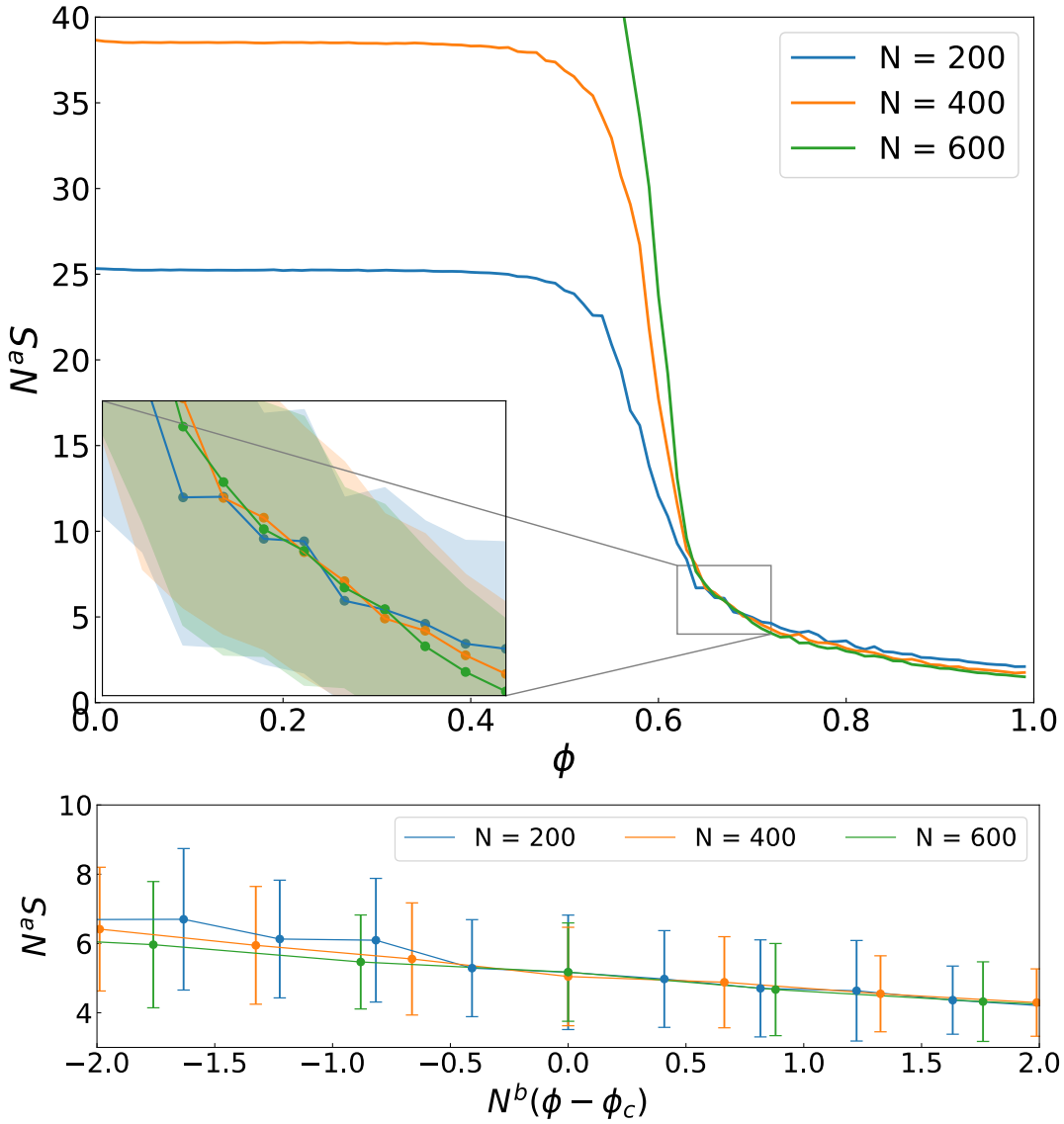
$$S = N^{-a}\,\mathrm{F}(N^b(\phi - \phi_c))$$





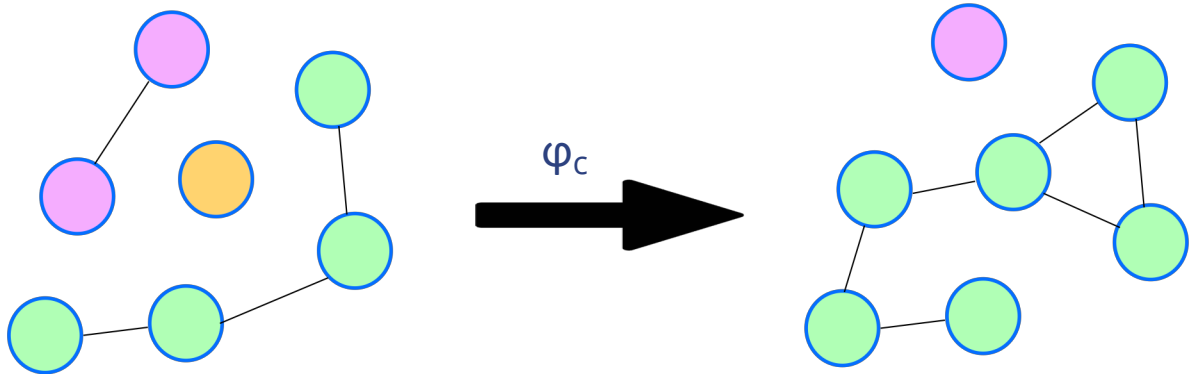
Scale-free graph

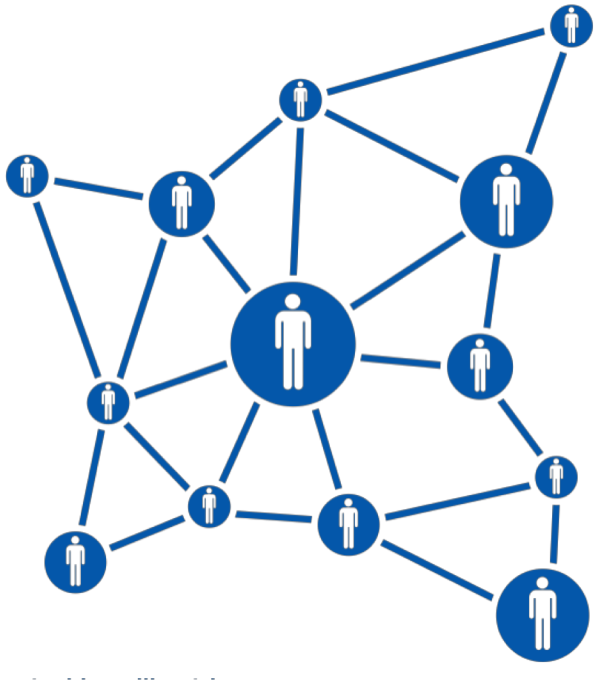
- Social networks do not have a random distribution of degrees
- Use scale-free graphs whose degree distribution follows a power law
- Holme & Kim algorithm:
  - N : the number of individuals
  - m : the number of random acquaintances to add for each new individual
  - p : the probability of adding a triangle after adding a random acquaintance.
- Here: $m = 3,\ p = 0.2$ and $\gamma = 10$



Conclusion

- The results of Holme & Newman have been reproduced





- Geographical dependence
- Non-discrete values for opinion
- Perturbation of Φ during the experiment