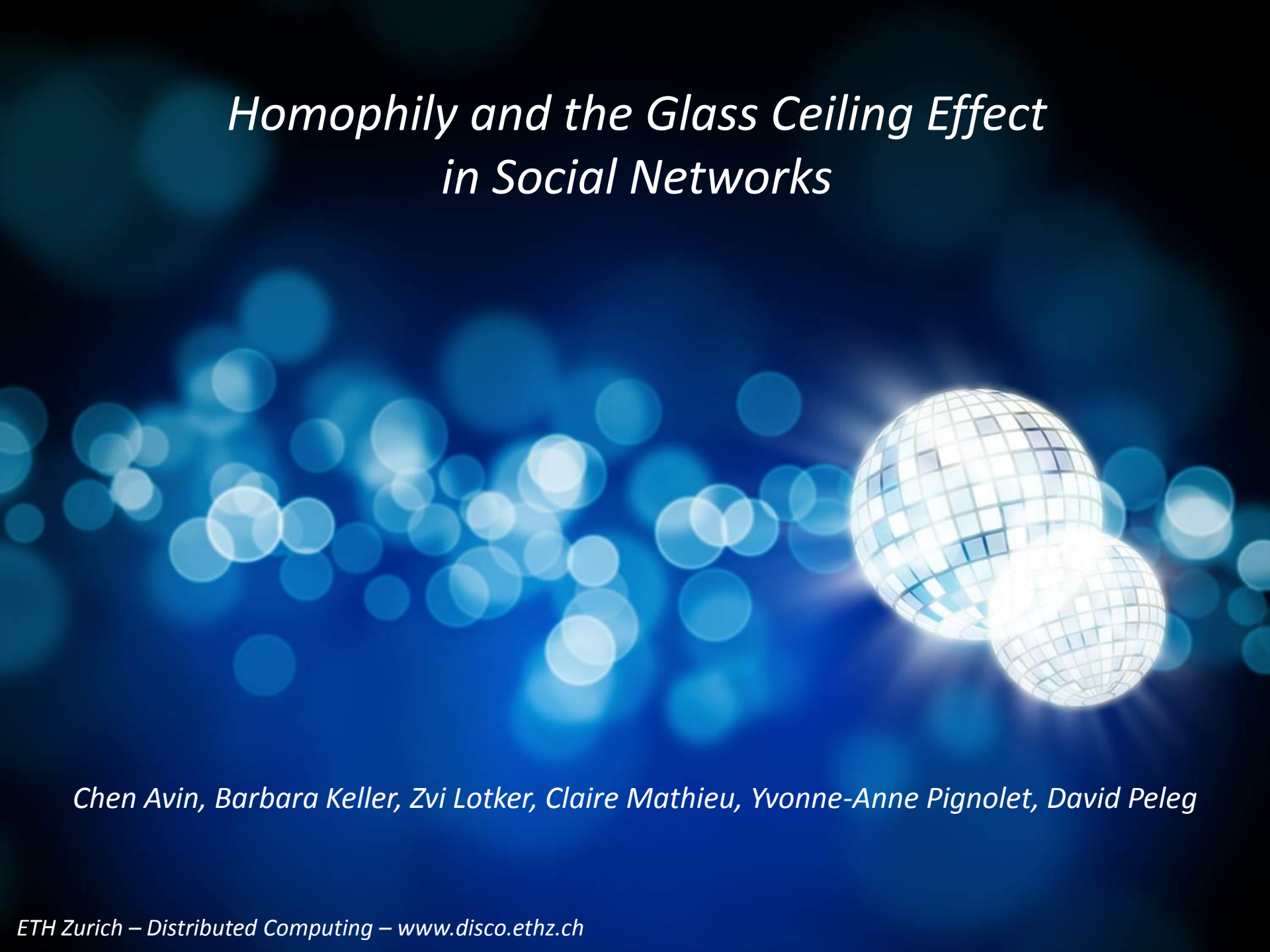
Homophily and the Glass Ceiling Effect in Social Networks



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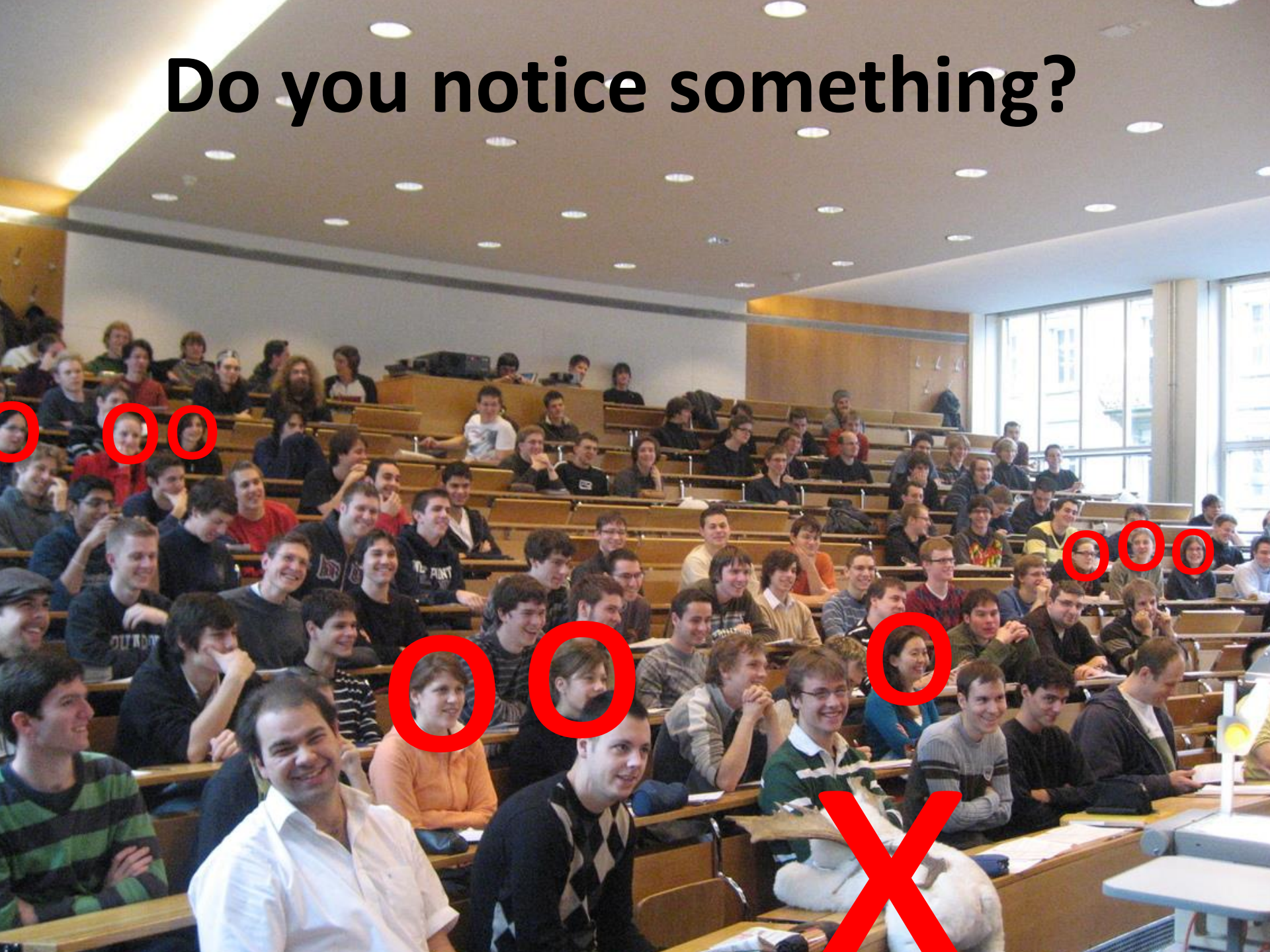
ETH Zurich – Distributed Computing – www.disco.ethz.ch

C6b
am 12.06.2009

Do you notice something?



What is happening?

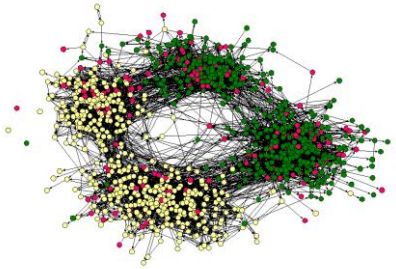
The "glass ceiling"... is the unseen, yet unbreakable barrier that keeps minorities and women from rising to the upper rungs of the corporate ladder, regardless of their qualifications or achievements.

Federal Glass Ceiling Commission, US Government (1995)

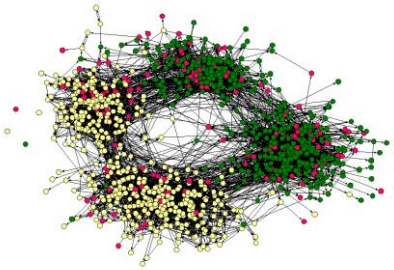
PhD Students and their Advisor

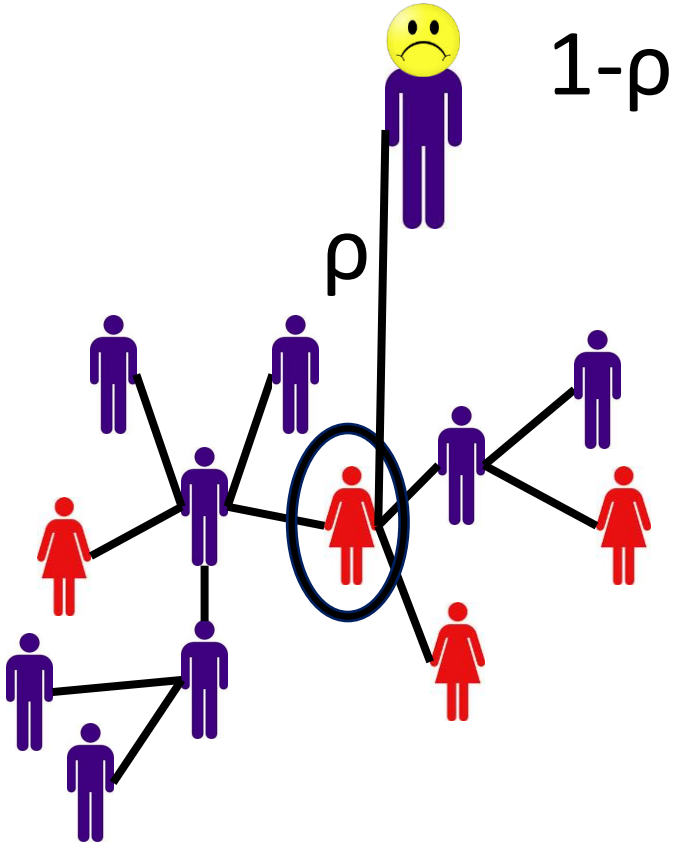
Unequal Entry Rates

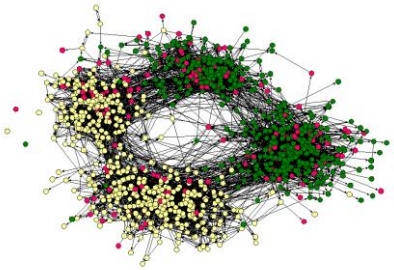
The Rich get Richer (Preferential Attachment)

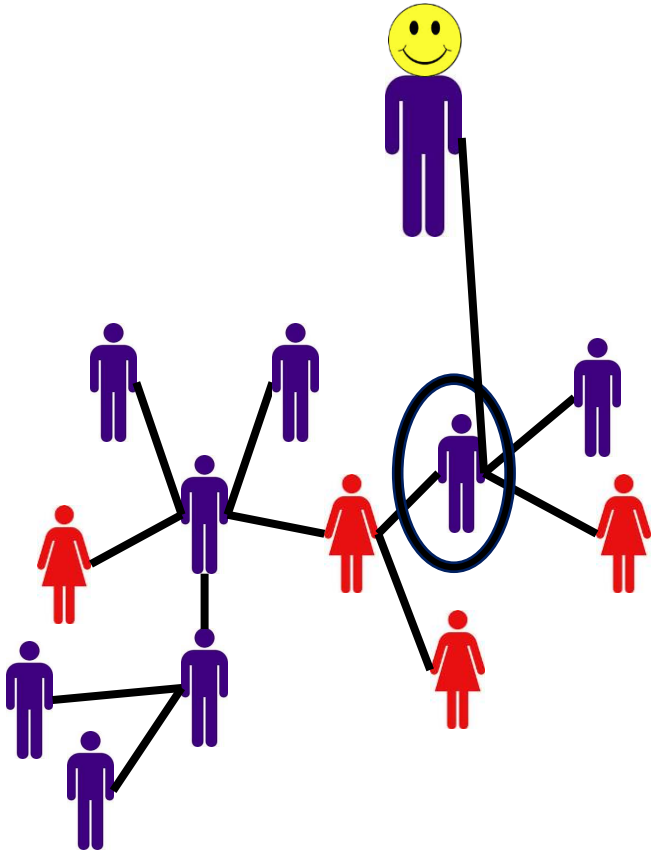


Homophily



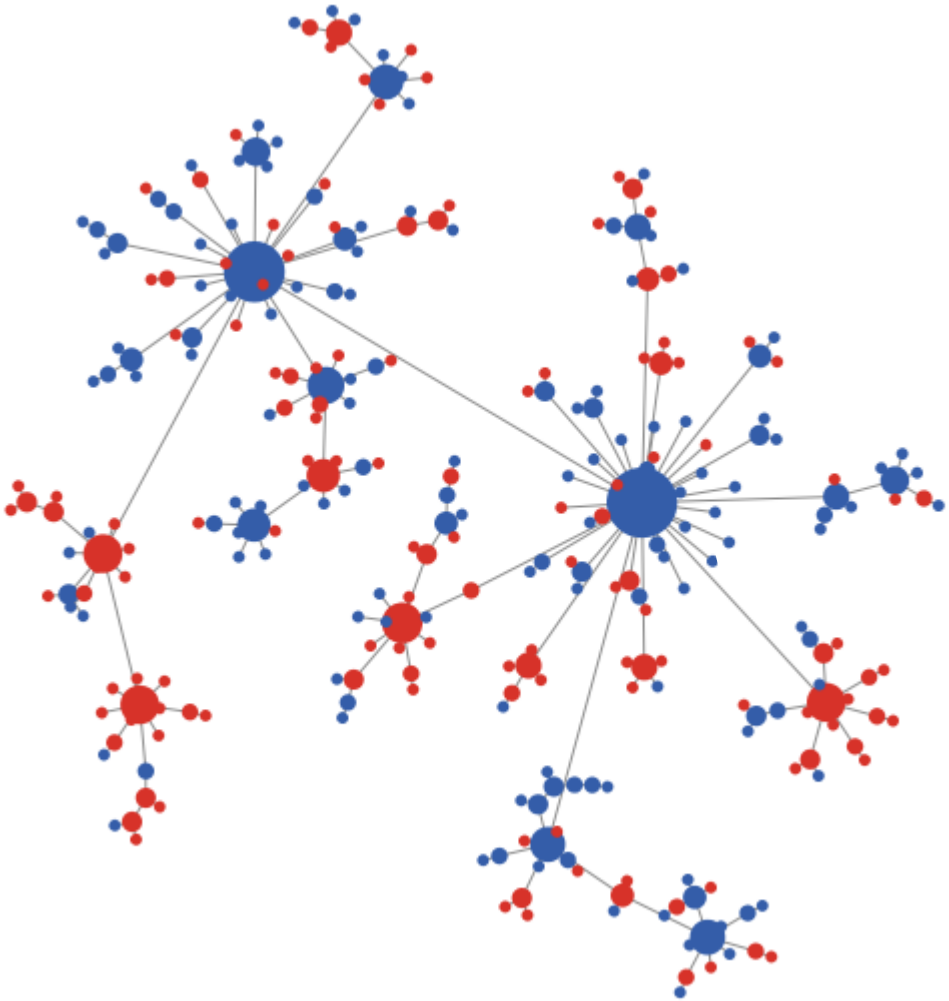

1-ρ
ρ





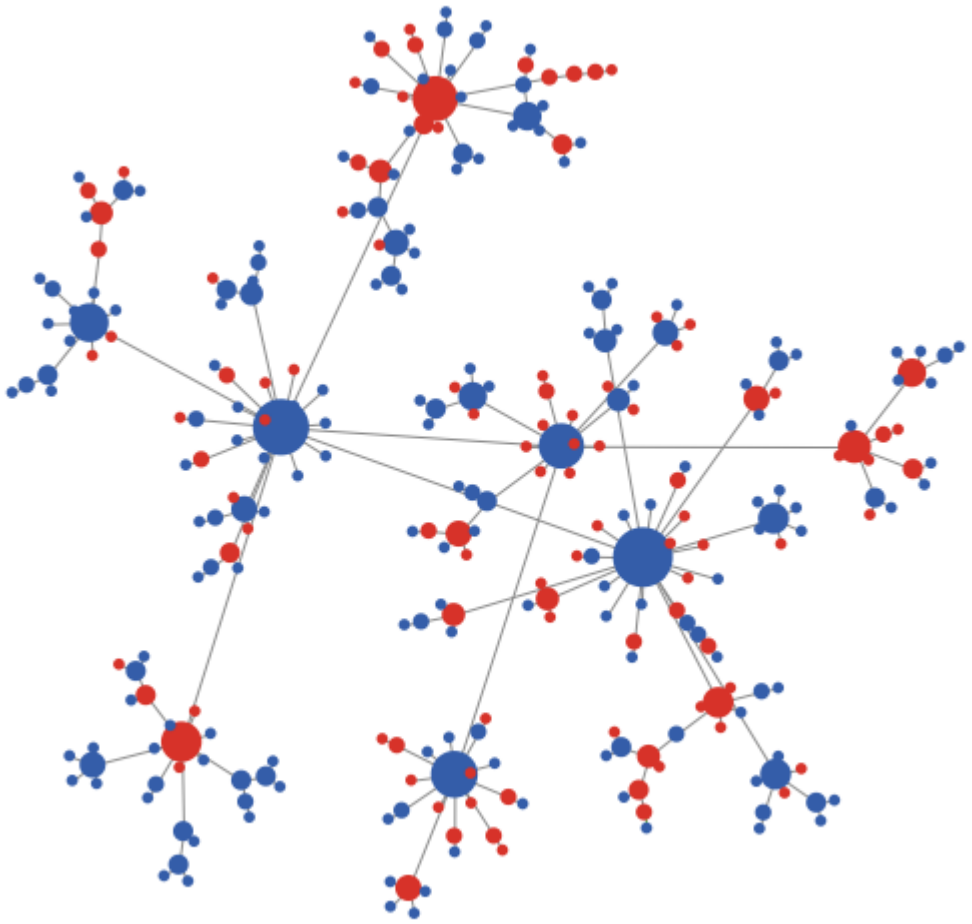
How does such a Network look like?

r = 0.5, ρ = 0.7



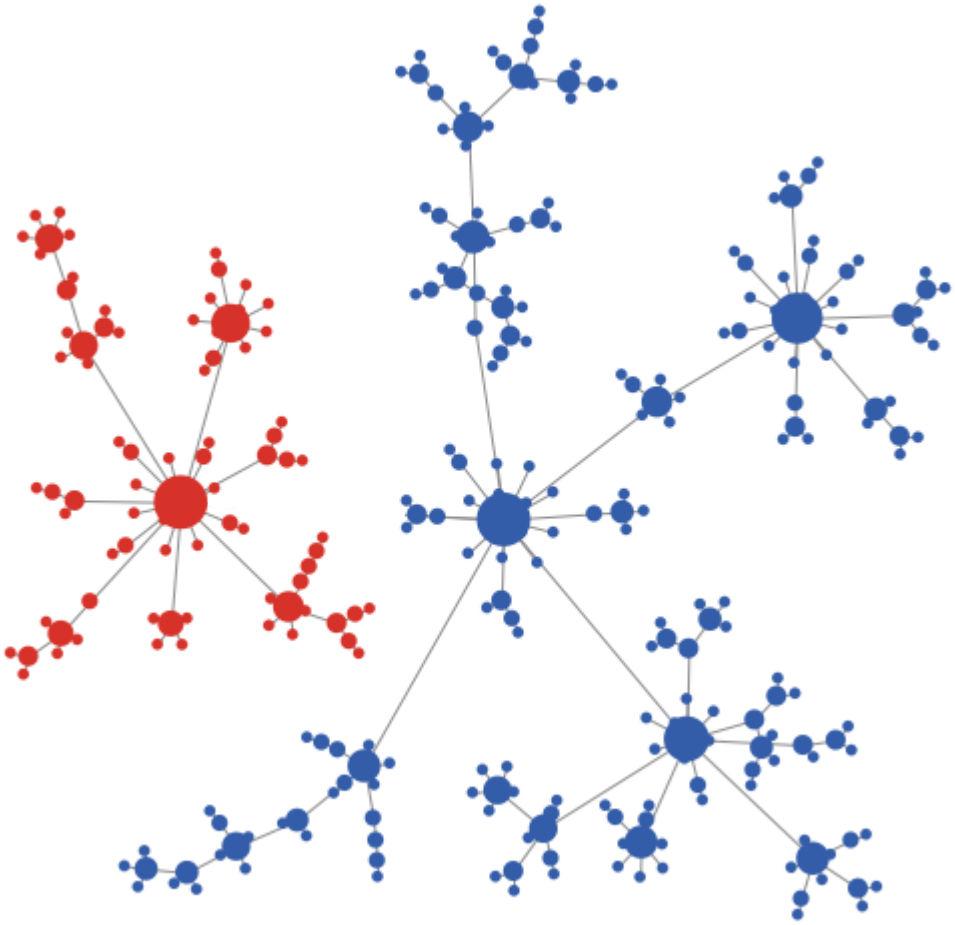
How does such a Network look like?

r = 0.3, ρ = 1



How does such a Network look like?

r = 0.3, ρ = 0



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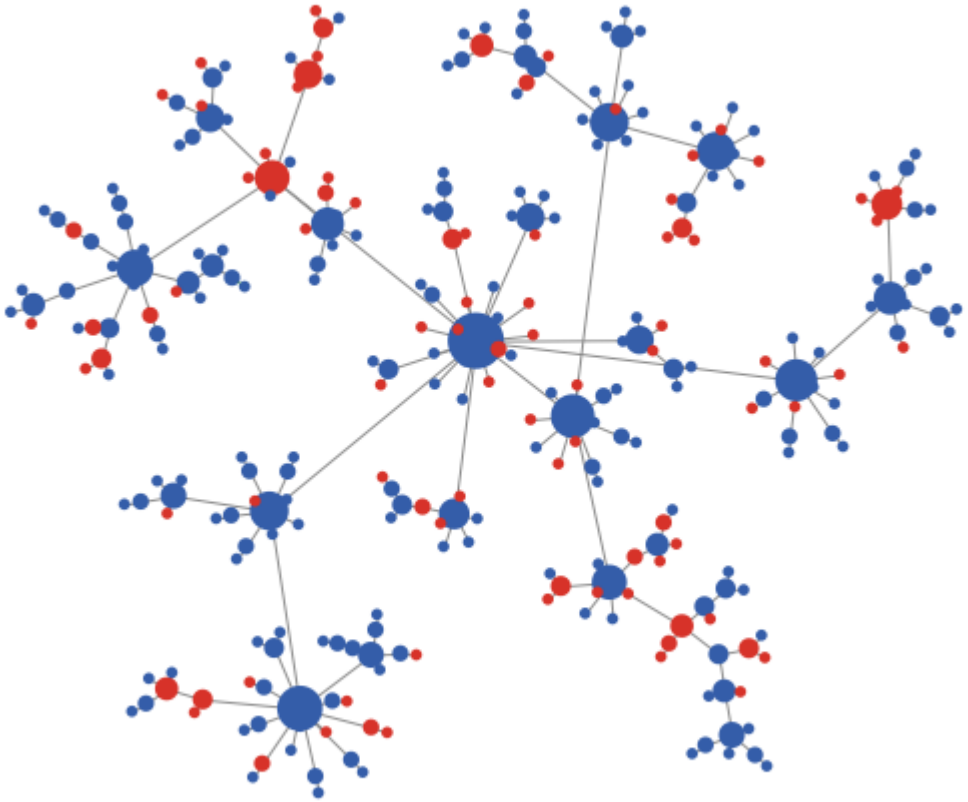


Glass Ceiling: How is it defined?

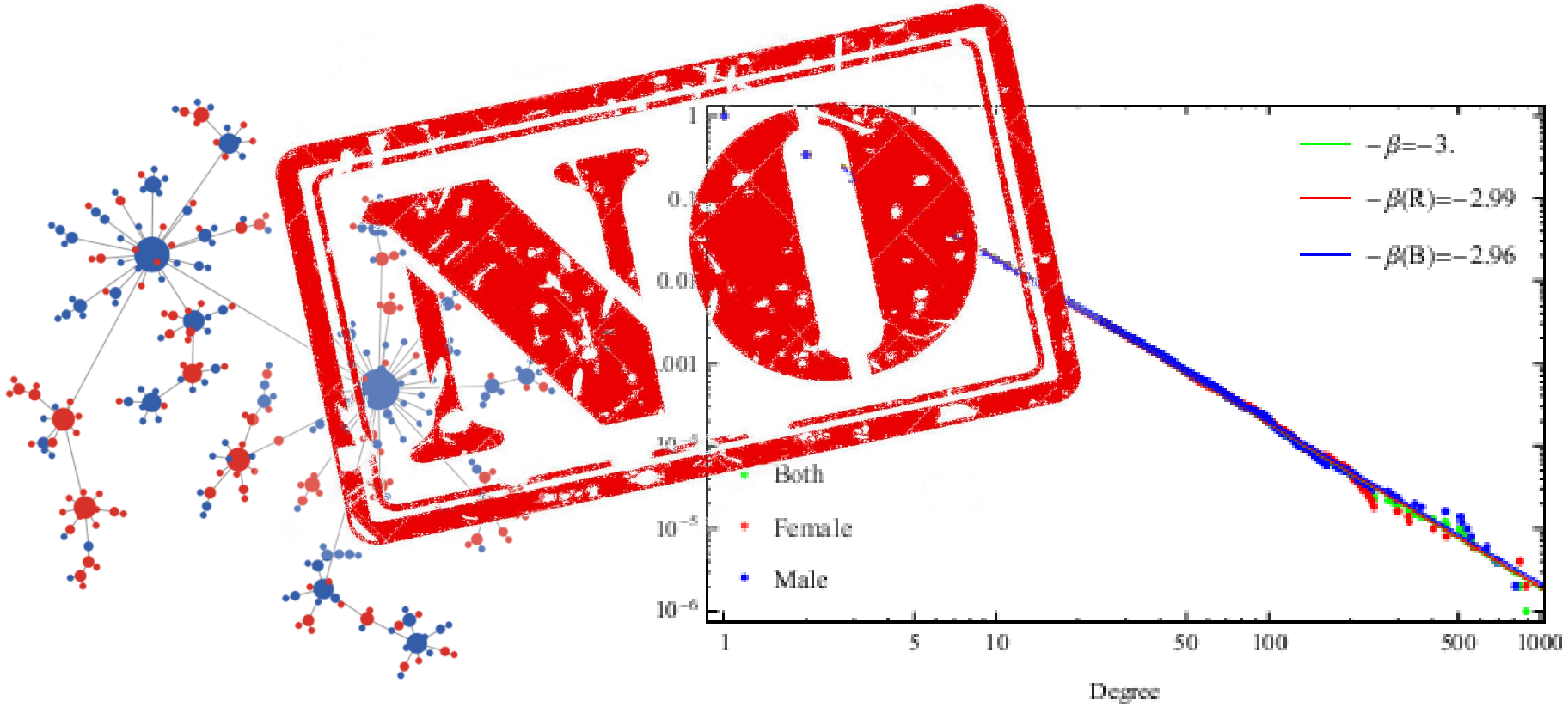
Tail glass ceiling: $G(n)$ exhibits glass ceiling effect for the red nodes if:

$$\lim_{G \to \infty} \frac{\text{top}_k(\text{R})}{\text{top}_k(\text{B})} \longrightarrow 0$$

while: $\text{top}_k(\text{B}) \to \infty$

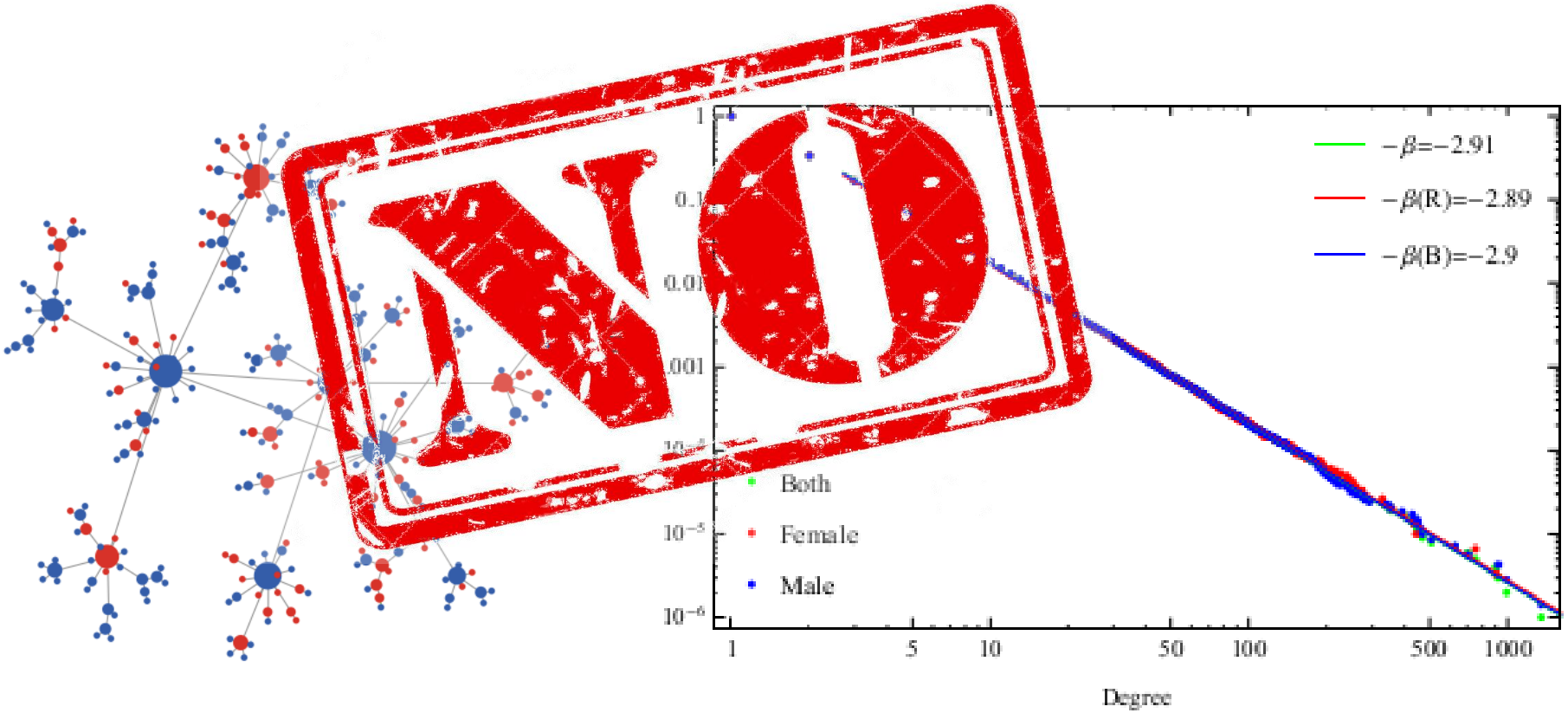
Does this Produce a Glass Ceiling?

r = 0.5, ρ = 0.7



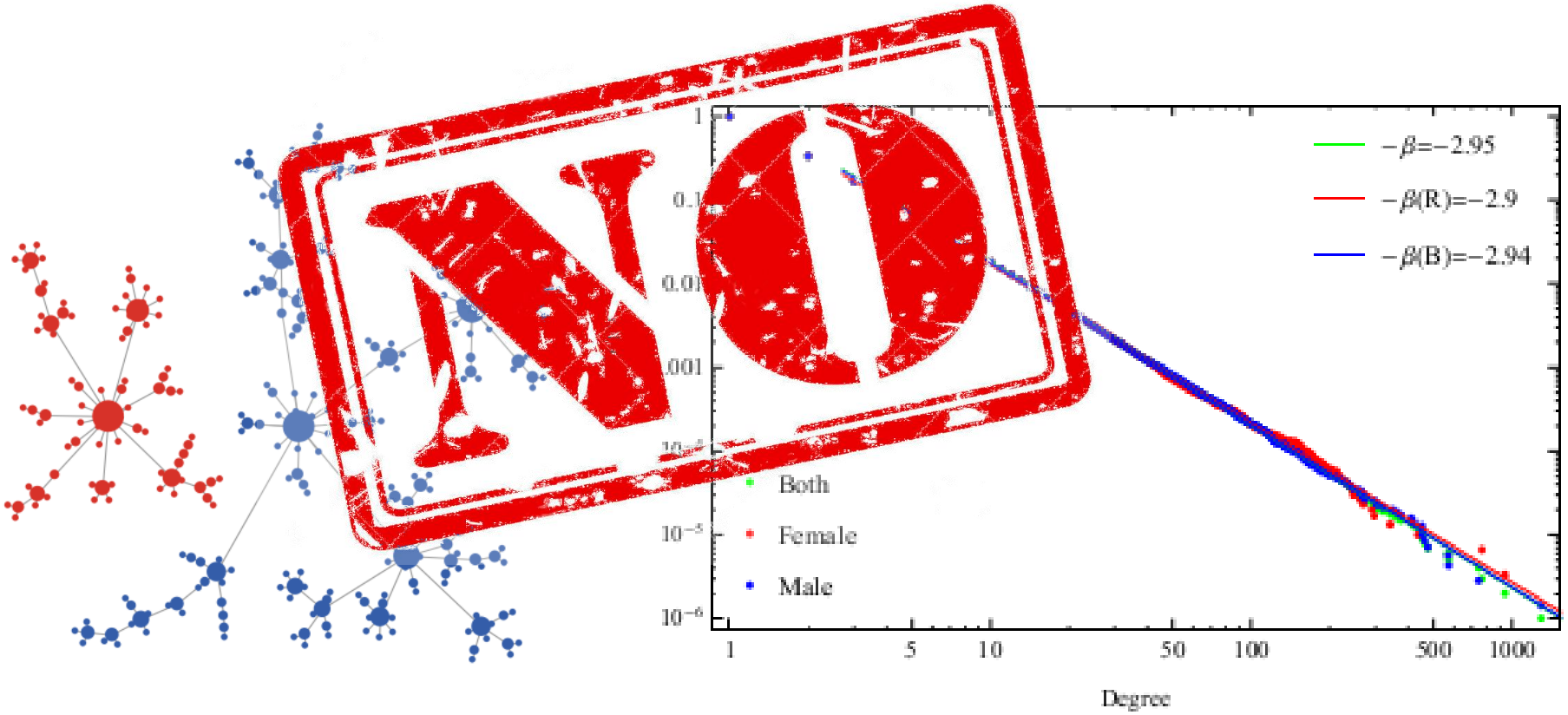
Does this Produce a Glass Ceiling?

r = 0.3, ρ = 1



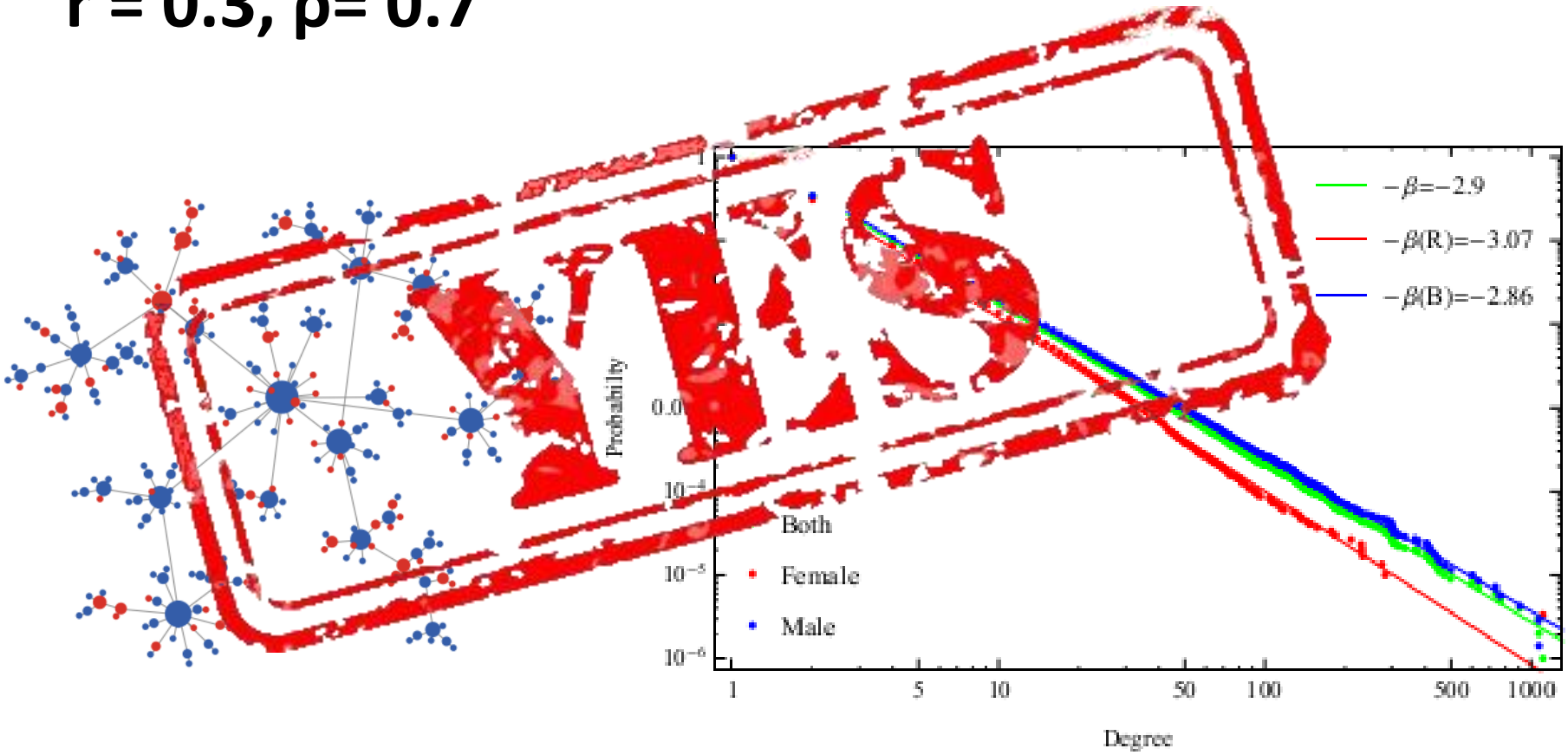
Does this Produce a Glass Ceiling?

r = 0.3, ρ = 0



Does this Produce a Glass Ceiling?

r = 0.3, ρ= 0.7



Formal Results

Theorem:

Let $0 < r < ½$ and $0 < \rho < 1$ then $G(n, r, \rho)$ exhibits a **glass ceiling** effect (for any starting condition).

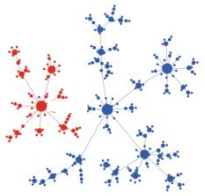
Formal Results

Theorem:

G(n, r, ρ) will **not** have glass ceiling effect in the following cases:

1. If the rate r = ½ (and for any value of ρ).

2. If ρ = 0 or ρ =1 (and for any value of r).



3. If a new vertex at time t selects its advisor uniformly at random from all nodes at time t-1 (and for any value of r and ρ).

Proof Overview

1. Fast convergence of sum of degrees of red nodes in expectation (independent of starting condition)
2. High probability convergence
3. Power law degree distribution of each gender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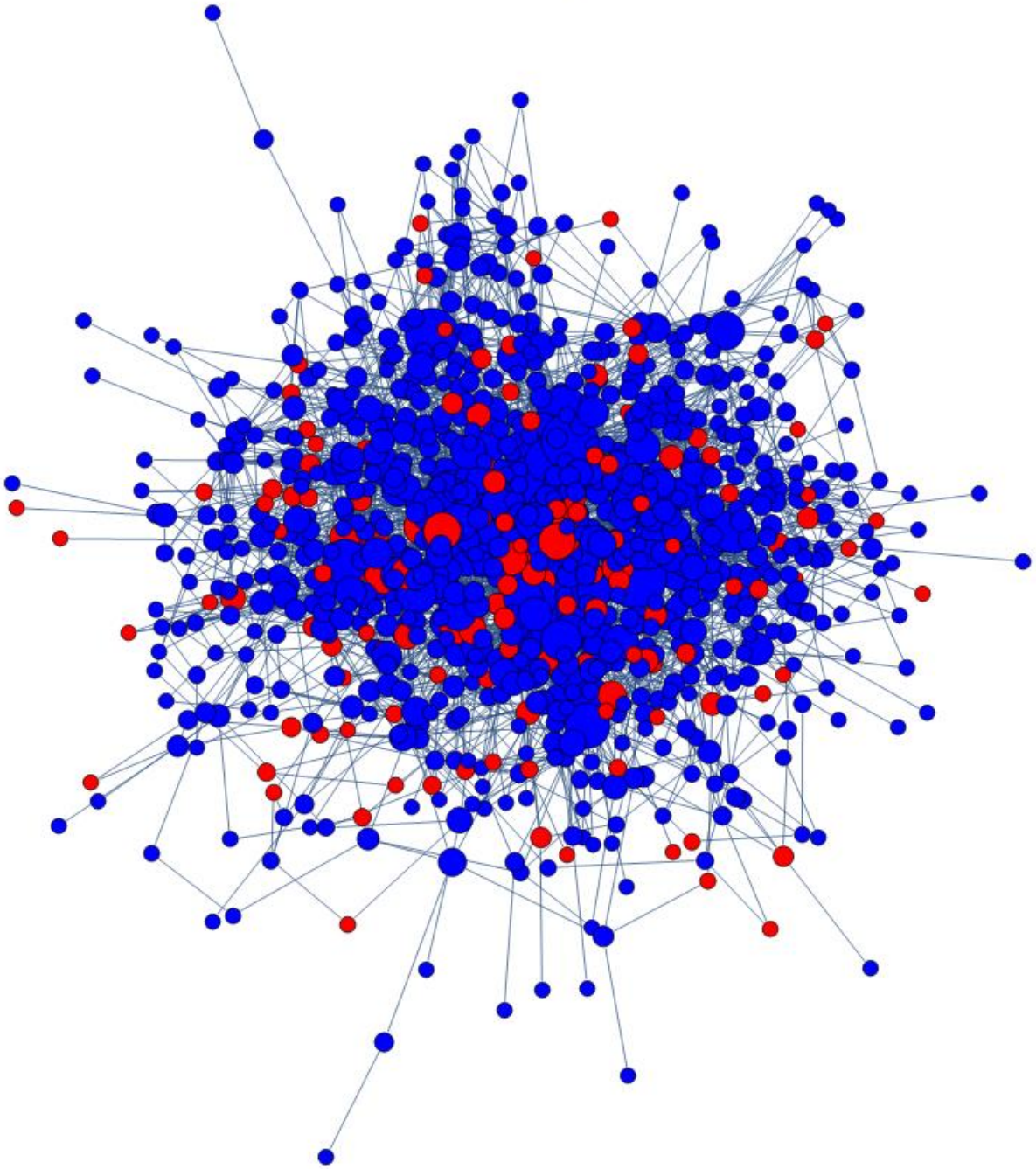
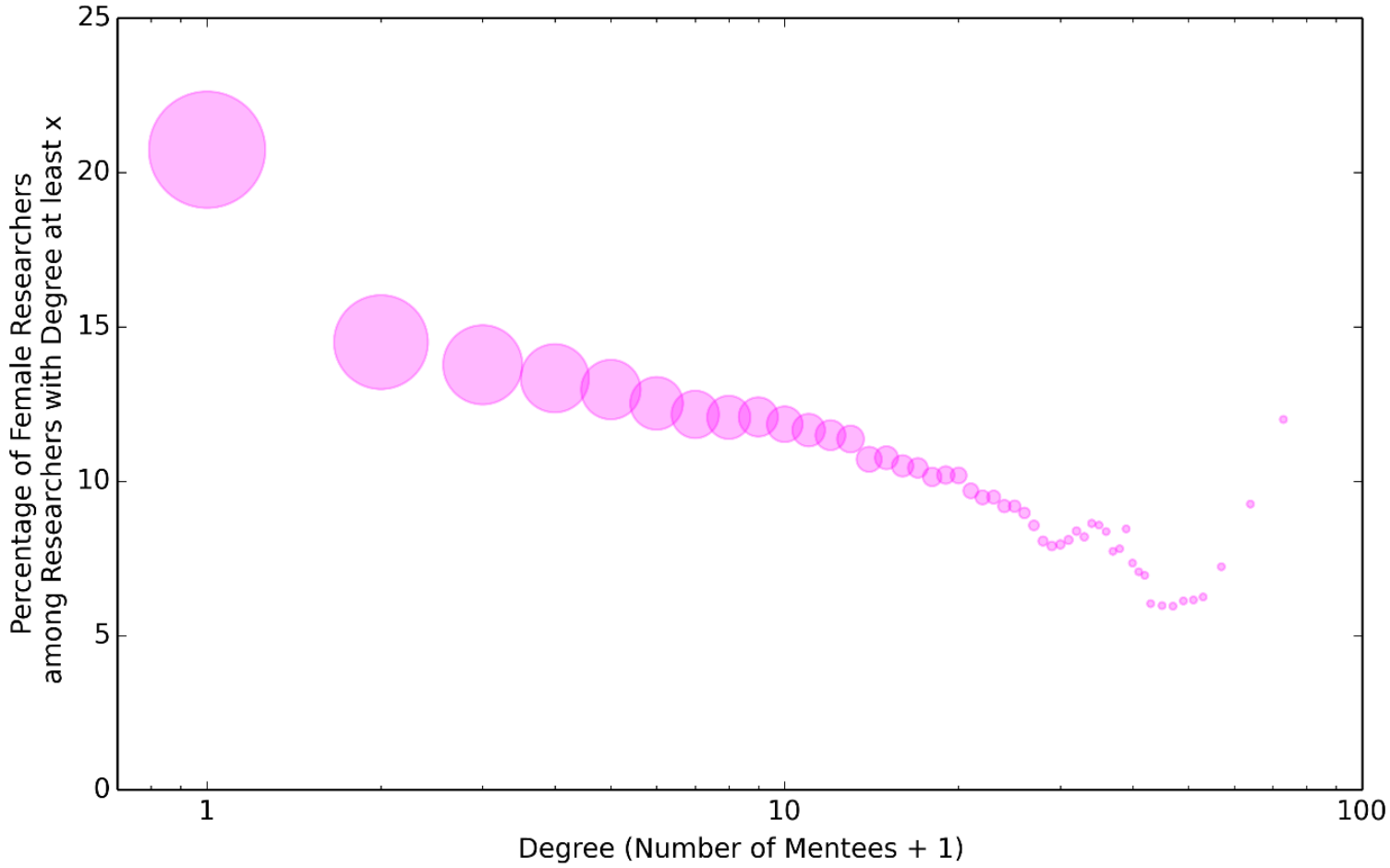
DBLP top players graph



PhD and Supervisor Network



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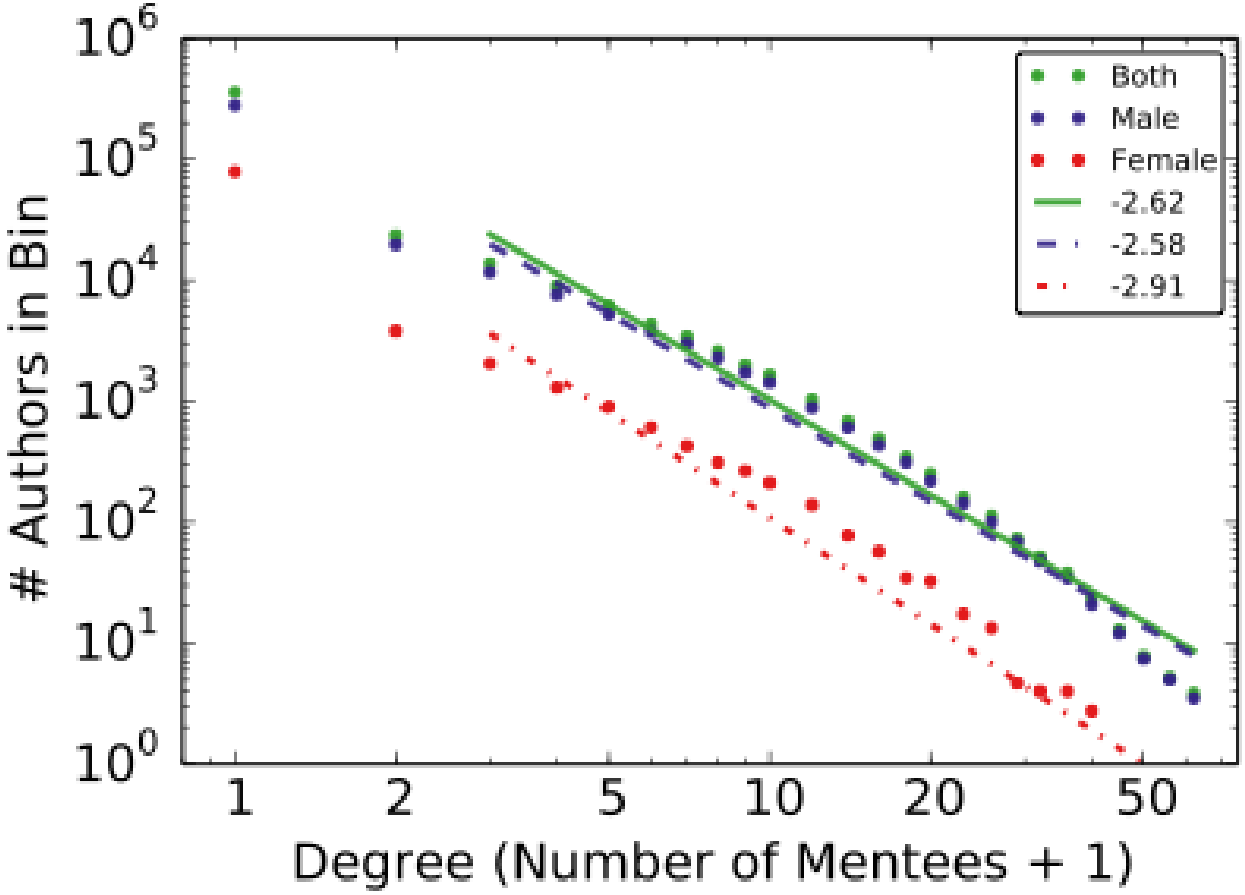

Summary

1. Definitions for glass celling effect in networks
2. Simple Mathematical model:
   - Unequal entry rate, “rich get richer”, homophily
3. Proof for glass ceiling emergence
   - three assumptions → glass ceiling
   - any two assumptions → no glass ceiling.
4. Analyzed the DBLP

Future Work

- Include nodes leaving the network
- Evaluate network with higher percentage of females

תודה רבה