Hierarchies created by individuals:
The structure of directory trees

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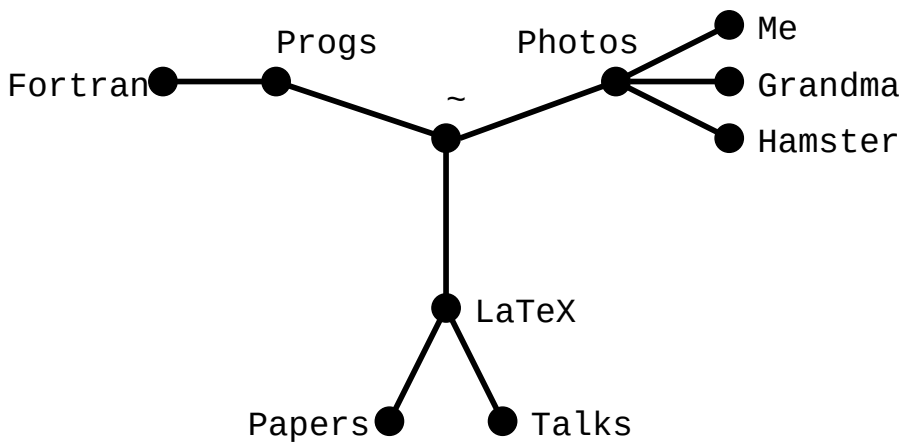
Directory trees ... what?

- tree of file folders (= directories) created by a computer user
- nodes of the tree are directories.
- a link connects a directory with its parent
- navigation by `cd` command, e.g. `cd ..` or `cd ~/Progs/`
- addition of nodes, e.g. `mkdir Fortran`



Directory trees ... why care?

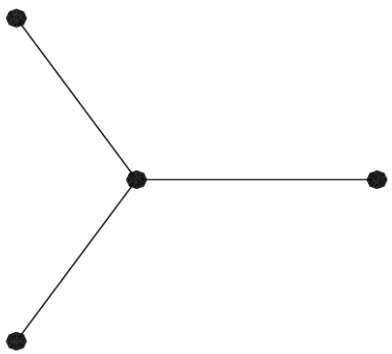
- indicate the natural (unbiased) way of organising data
- may reflect hierarchy of concepts in human minds
- possible application: improved methods for data storage / retrieval

... and especially for the statistical physicist ...

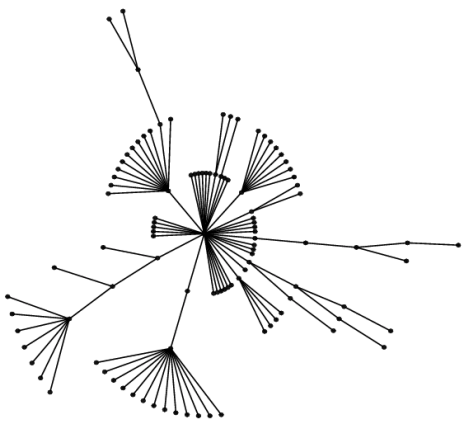
- many realizations available $\Rightarrow$ statistics
- sizes vary over orders of magnitude $\Rightarrow$ system size scaling

Data material

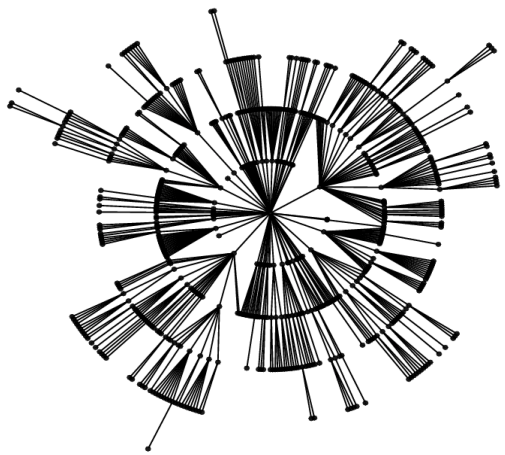
- 63 trees of sizes in the range $N = 4 \ldots 2000$
- created by faculty, postdocs, and PhD students using the UNIX / LINUX computer system at the Department of Interdisciplinary Physics of the University of the Balearic Islands.



N=4

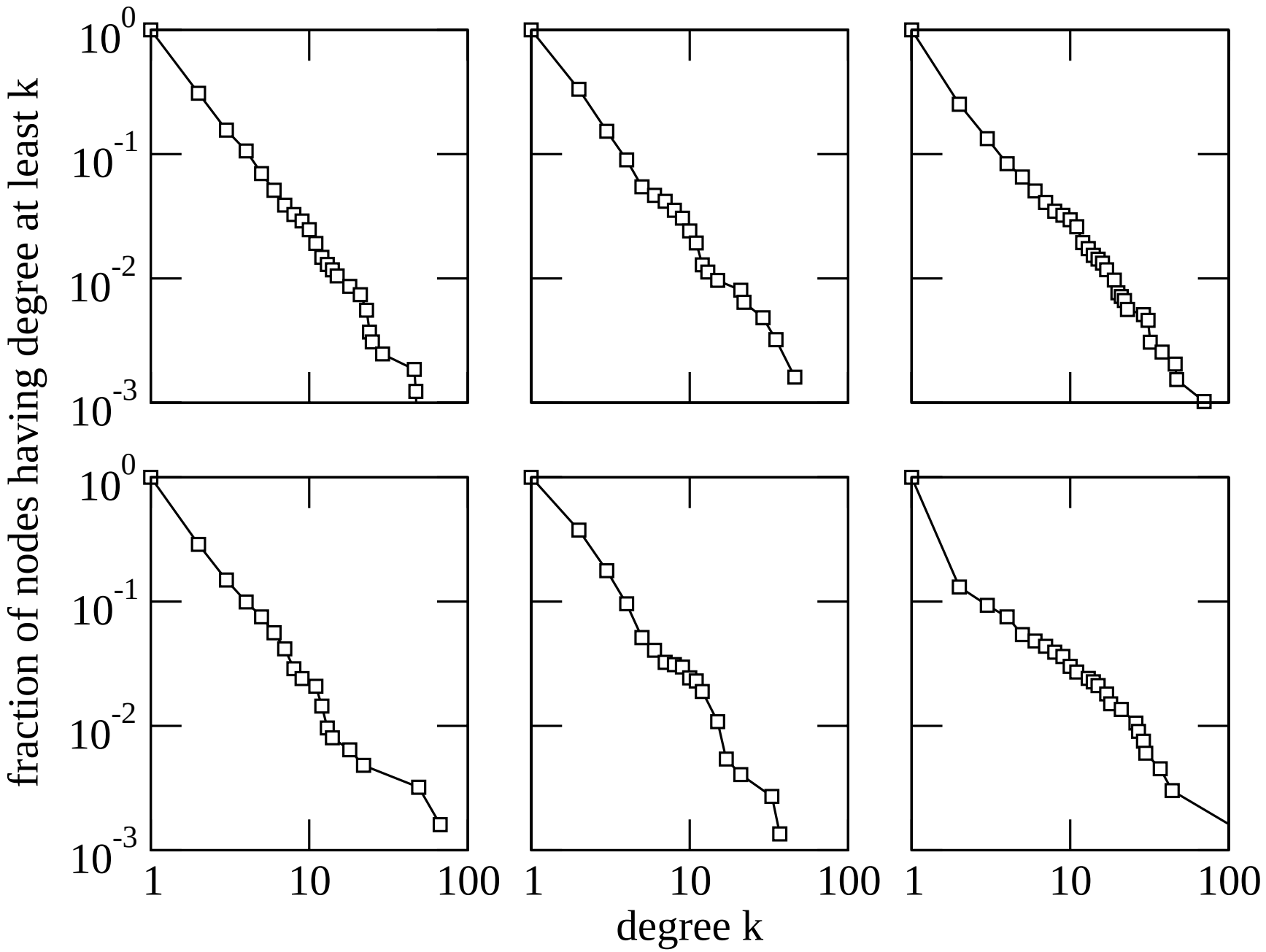


N=107

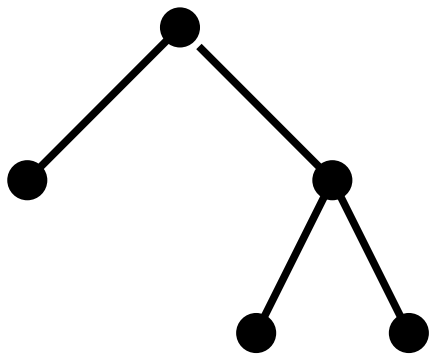


N=645

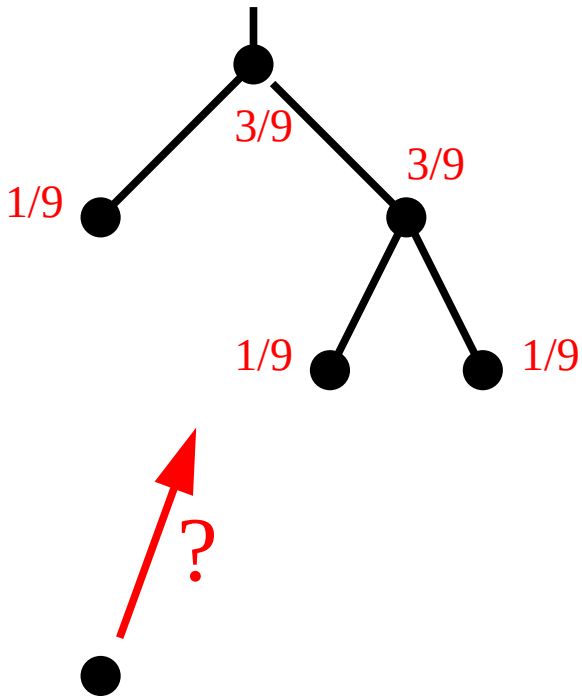
Degree distributions



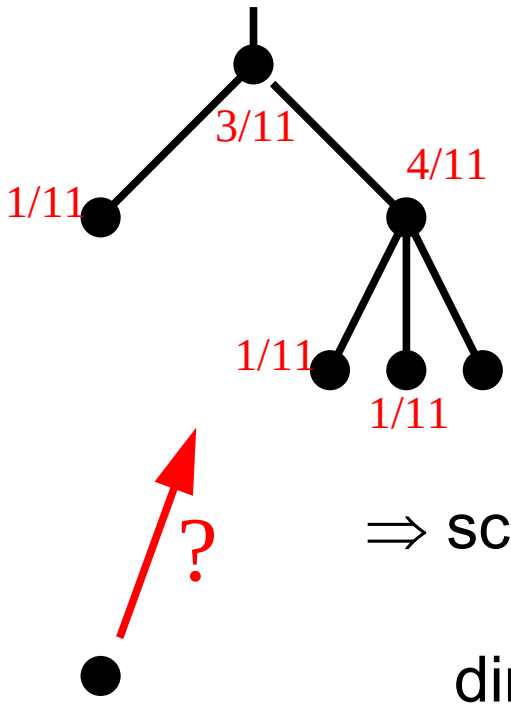
Model: preferential attachment



Model: preferential attachment



Model: preferential attachment

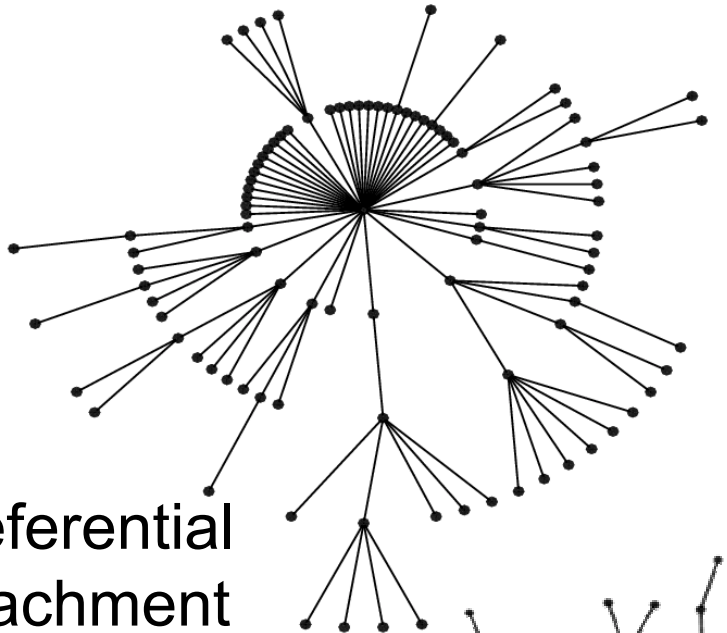


$\Rightarrow$ scale-free trees: $P(k) \sim k^{-\gamma}$

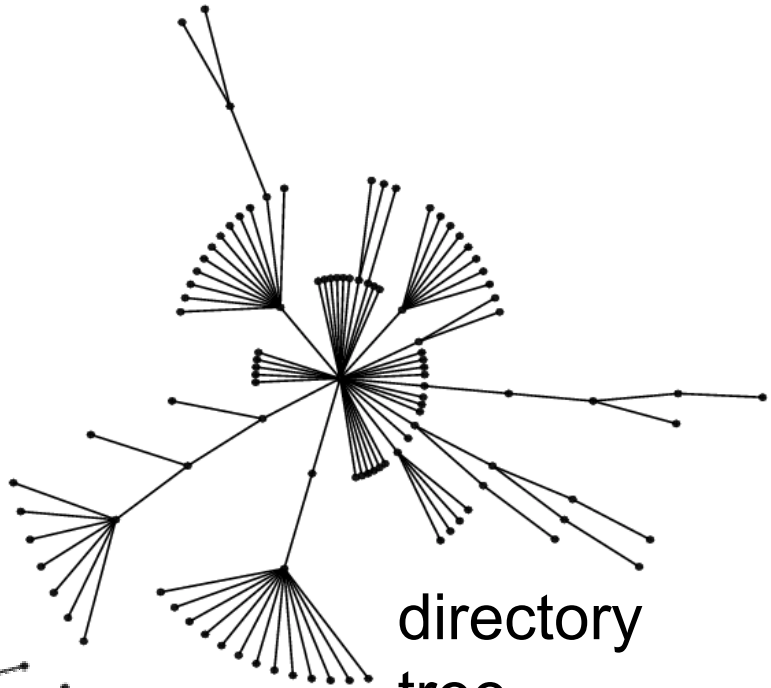
with $\gamma = 3$

directory trees $\gamma = 2.2 \ldots 2.8$

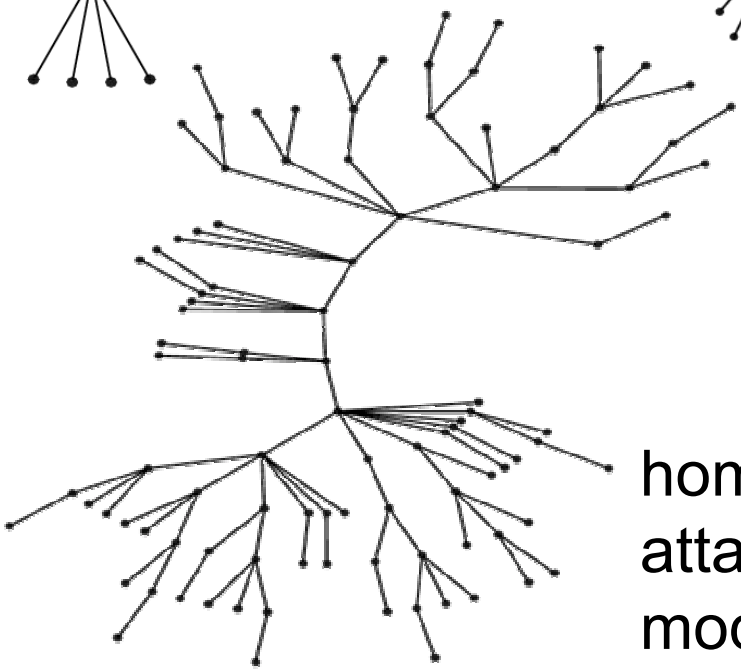
Comparing model and data



preferential attachment model

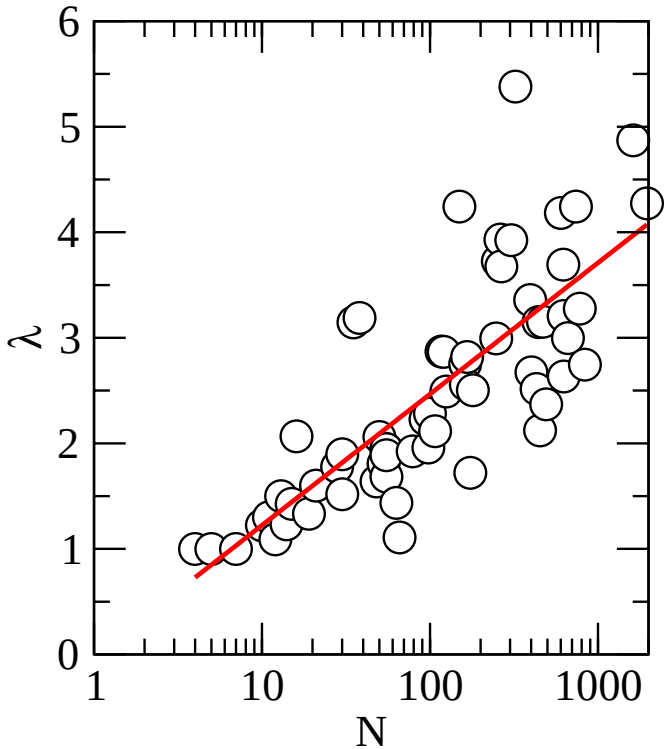


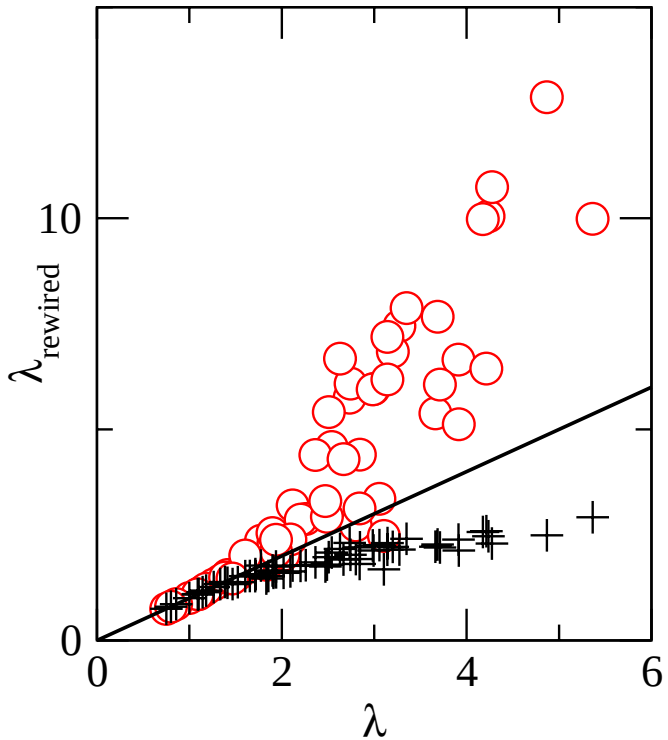
directory tree



homogeneous attachment model

Path length from root

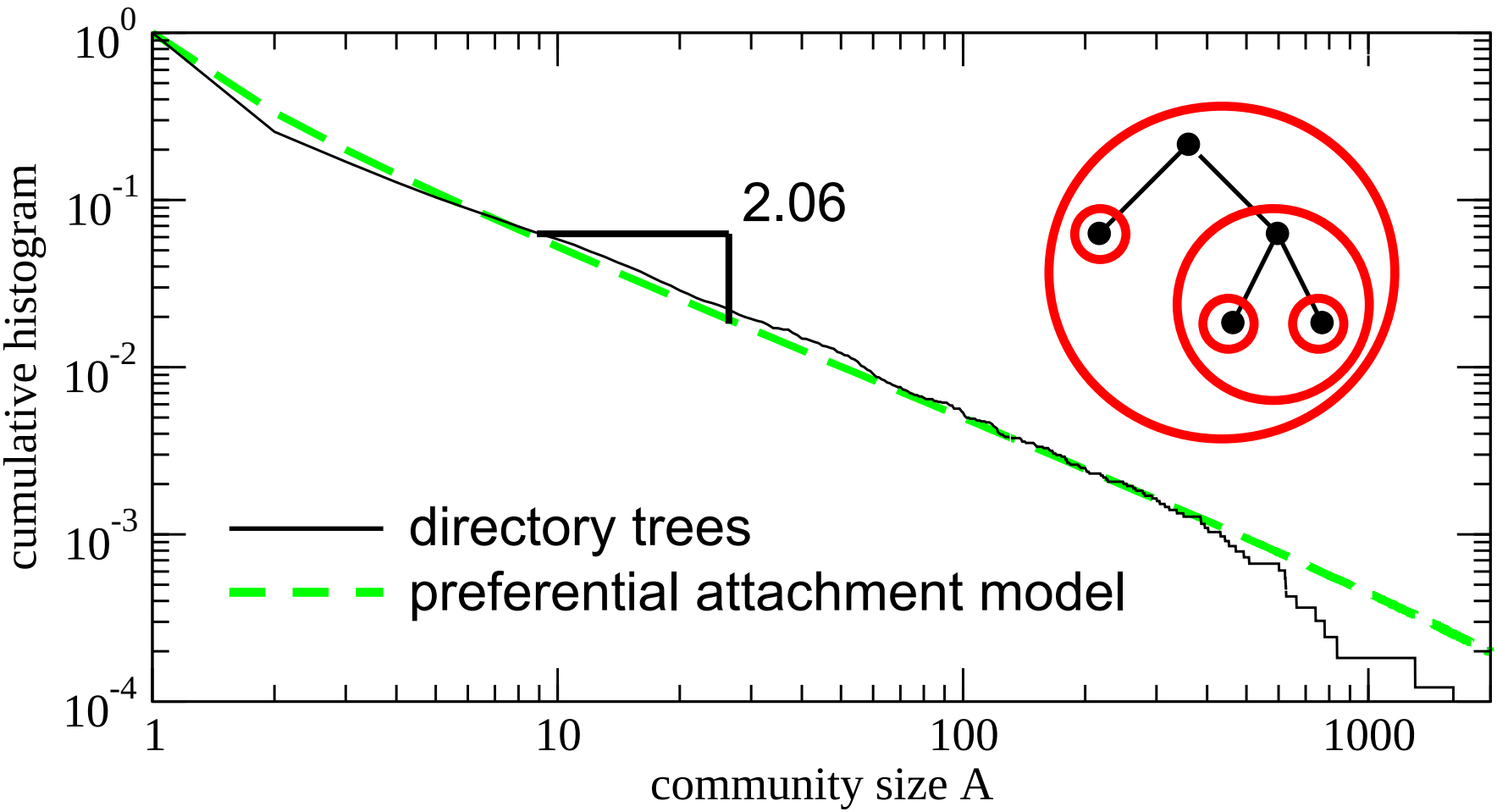




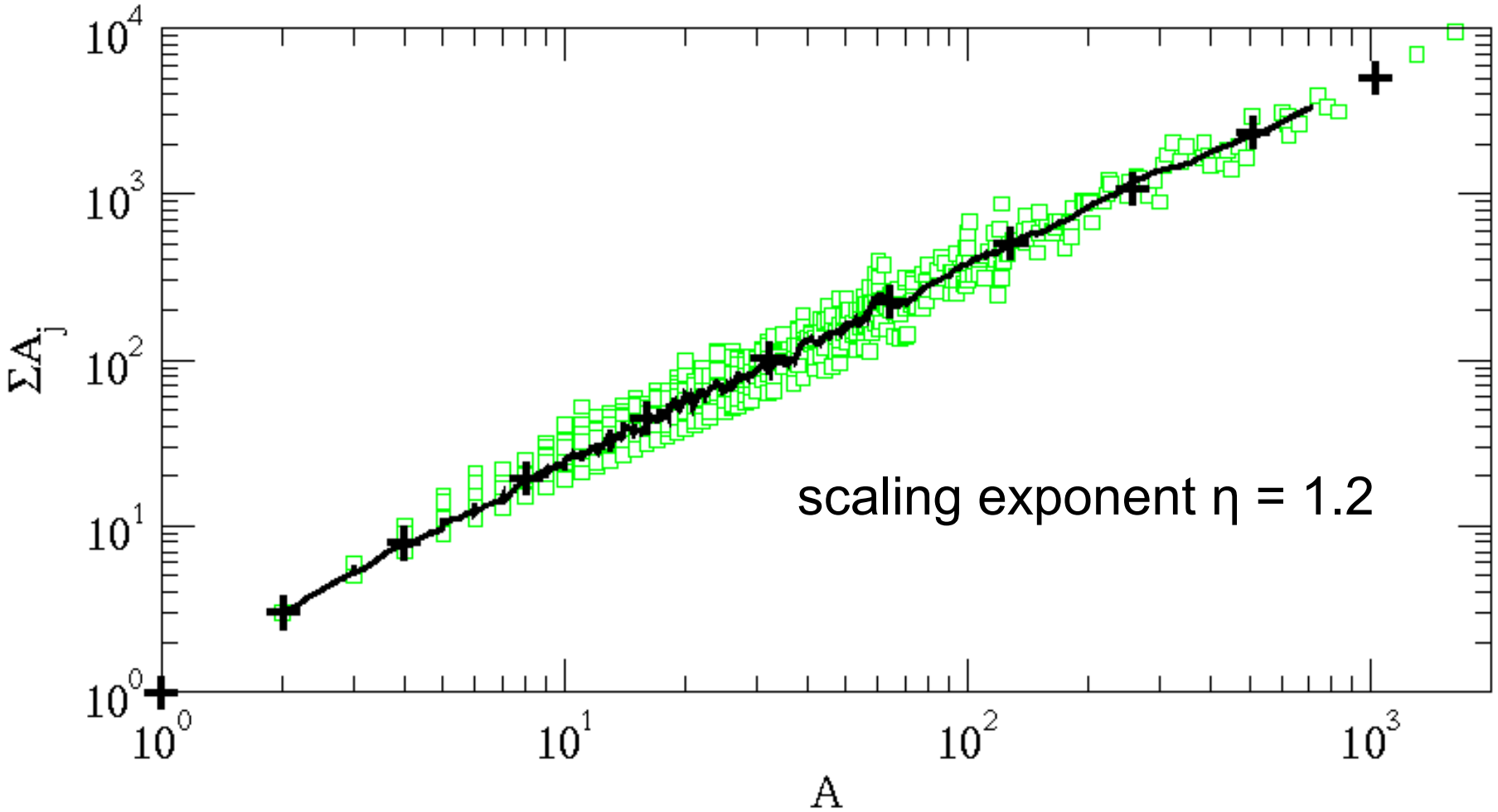
fit: $\lambda = 0.54 \ln N$

model: $\lambda^{(pref)} = 0.5 \ln N$

Community structure



Allometric scaling



Conclusions

- directory trees have interesting non-trivial structure
- scale-free degree distribution
- logarithmic increase of path length with system size
- scale-free community size distribution, exponent $\tau \approx 2$.
- allometric scaling, exponent $\eta \approx 1.2$
- all found structural properties are well explained by the preferential attachment model.

preprint http://www.arXiv.org/abs/cond-mat/0403239