WORKSHOP 2009

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Correlation between human activity and social connectivity in complex networks

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SOCIAL NETWORKS

WHAT PEOPLE HAVE STUDIED

✓**P(k)** is scale-free $P(k) \approx k^{-\gamma}$
(i.e. networks of emails $P(k) \approx k^{-2}$)

✓ **MODELS**
- Preferential Attachment (Albert-Barabasi)
- Copying Mechanism (Kleinberg, Kumar et al)
- …

✓ **P(k)** influences the dynamics (i.e. percolation)

WHAT WE WANT TO STUDY

Are

SOCIAL CONNECTIVITY k_i ⟷ τ_i HUMAN ACTIVITY

related to one another?

We studied the network of email traffic with email addresses as nodes and e-mails as links, using data from IBM server log files.

SENDER	RECEIVER	size	TIME		
1566	914	5430	6858423	3	1
2214	209	1262	6858428	3	1
1458	1077	1068	6858521	3	1
1566	1779	1458	6858621	3	1
1132	1727	492115	6858664	3	2
1132	1627	492115	6858664	3	2
4432	2675	2626	6858681	3	1
2063	2734	1025	6858685	3	1
1566	1758	1129	6858688	3	1
1772	1778	2818	6858699	3	1
1727	2855	9159	6858703	3	5
4432	2675	575	6858732	3	1
1727	223	9243	6858820	3	7
1727	284	9243	6858820	3	7
1566	1434	900	6858844	3	1
1132	1715	224092	6858860	3	2

Some statistical properties of the email network:

- total number of emails 202695

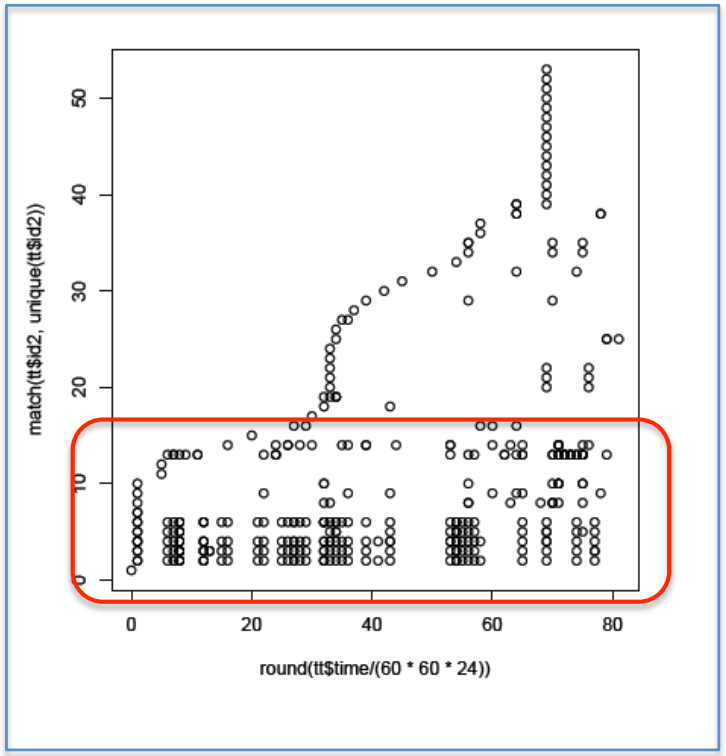
- number of vertices 2426

- total number of edges 14261

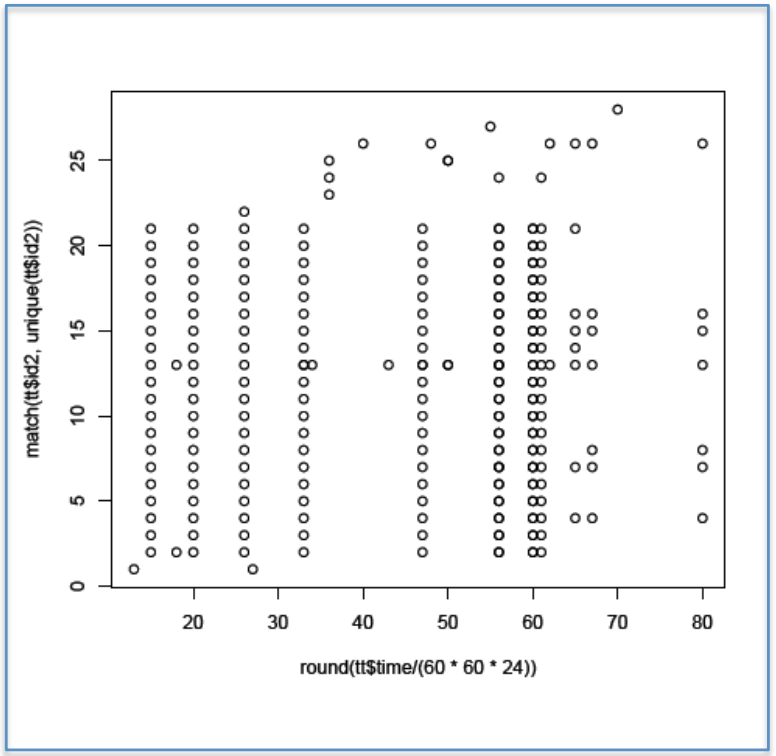
- time period under investigation
T ≈ 81 days

Are they users or machines?

Normal user



Machine-like user



We consider :

dt > 30 secs

events (emails or groups of emails sent after a dt > 30 secs) > 15

This kind of user sends the same email to several contacts at the same time.

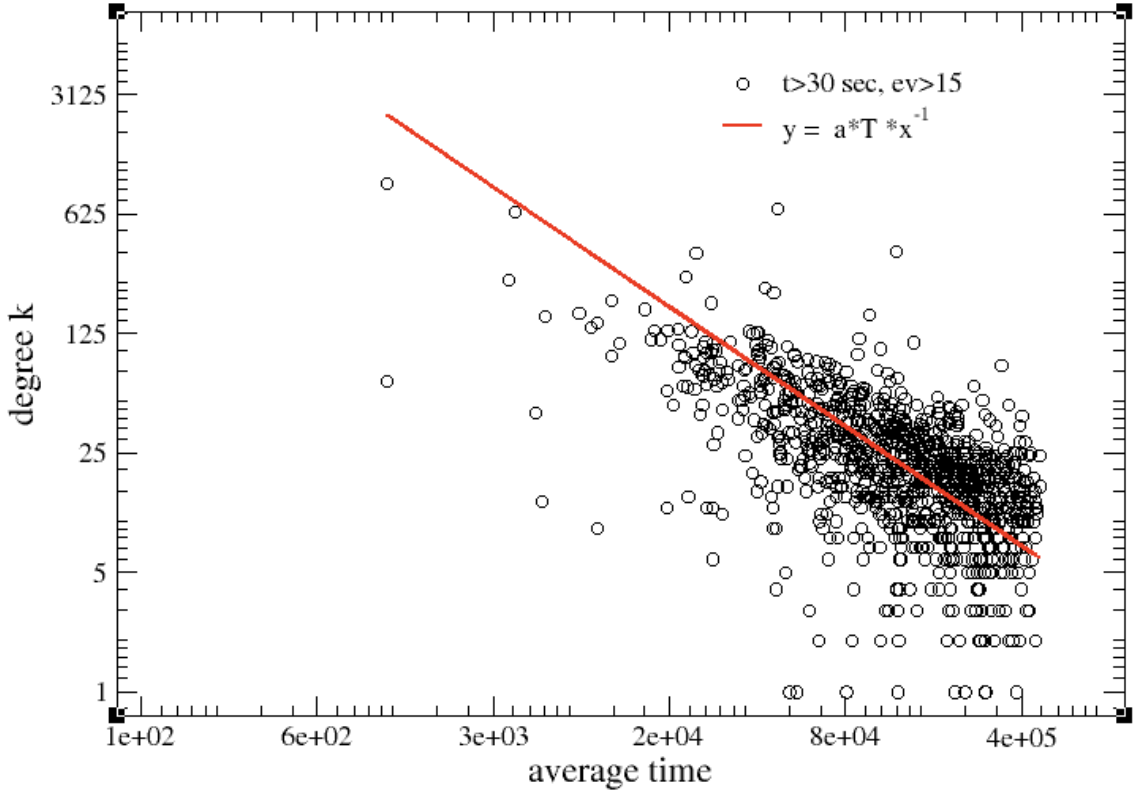
..and sometimes they never write to them again.

.. Are they actually “friends” ?

RESULTS

dt > 30 secs

events > 15



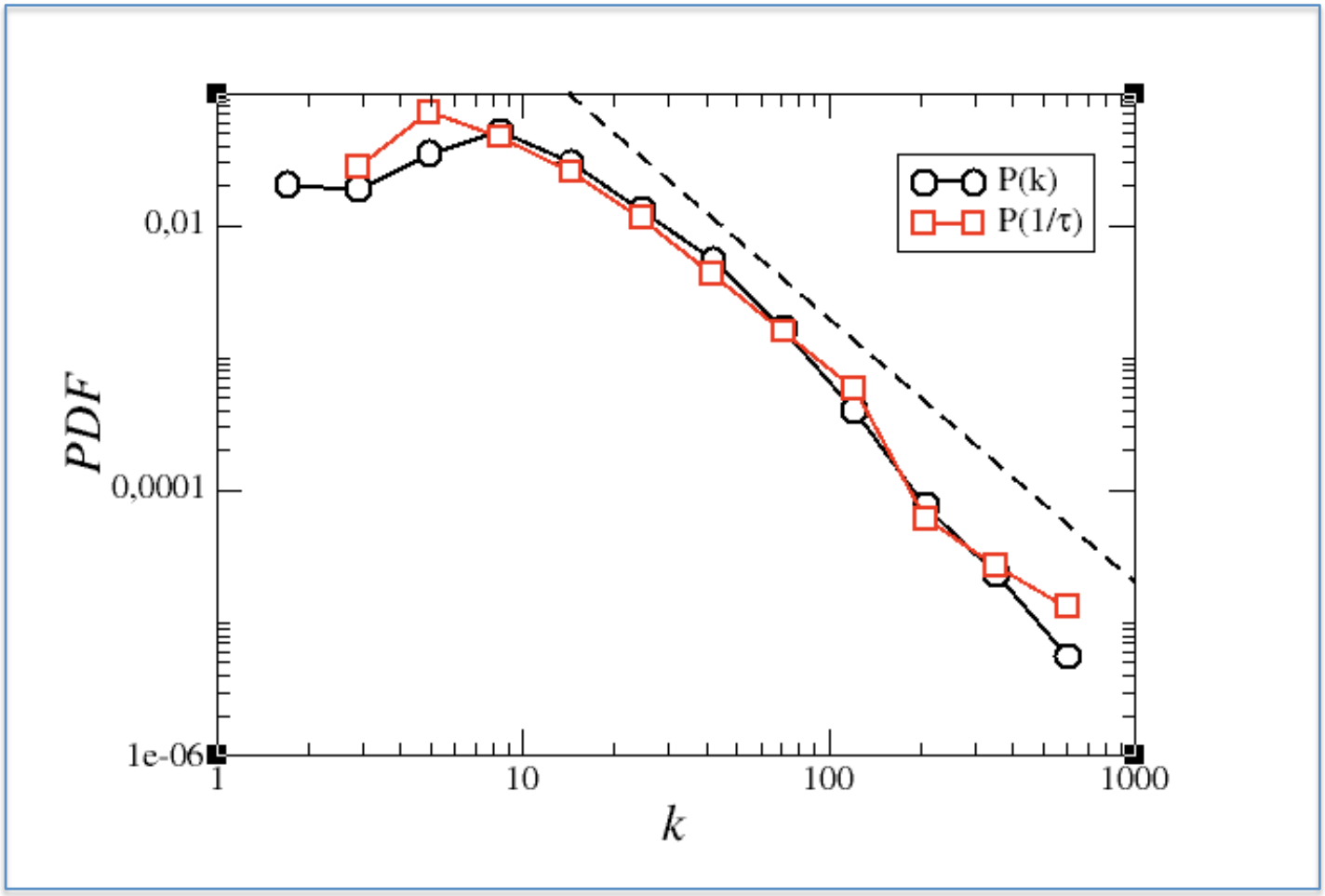
MODEL
(red line)

$$k_i \sim \alpha \frac{T}{\tau_i}$$

k_i : degree

τ_i : average time

$$k_i \sim \alpha \frac{T}{\tau_i} \longrightarrow P_k(k) \sim -\frac{\alpha T}{k^2} P_\tau\left(\frac{\alpha T}{k}\right)$$



CONCLUSIONS and PERSPECTIVES

- there is a relationship between k_i and τ_i

$$k_i \sim \alpha \frac{T}{\tau_i}$$

- $P(k) \sim k^{-2}$

The exponent -2 does not come from any social dynamics

- Try to apply the metod to some other (emails) networks