Scale-Free Networks

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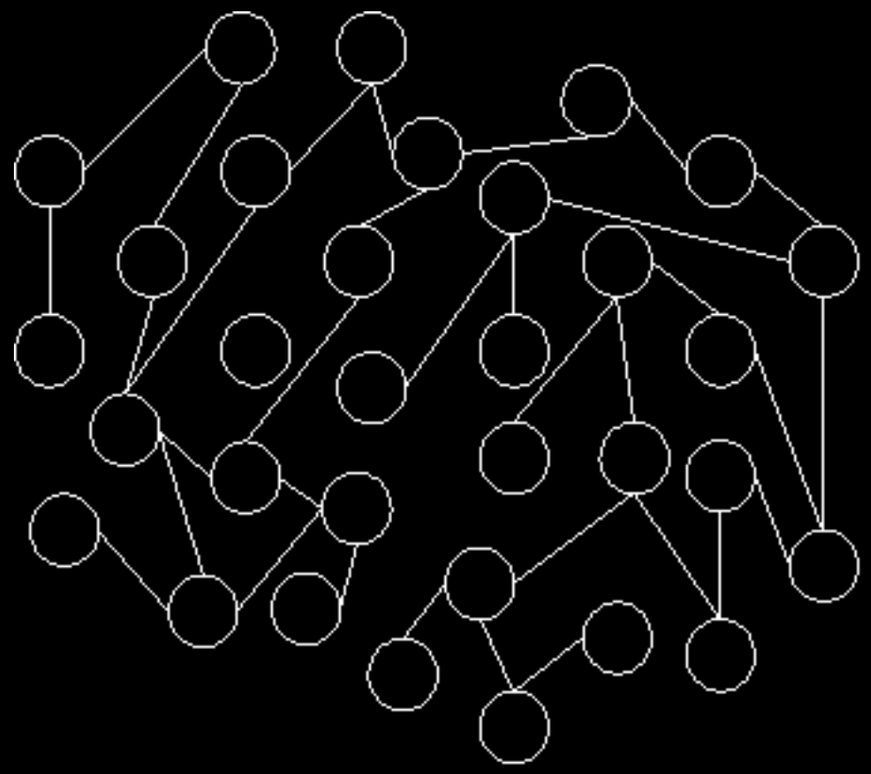
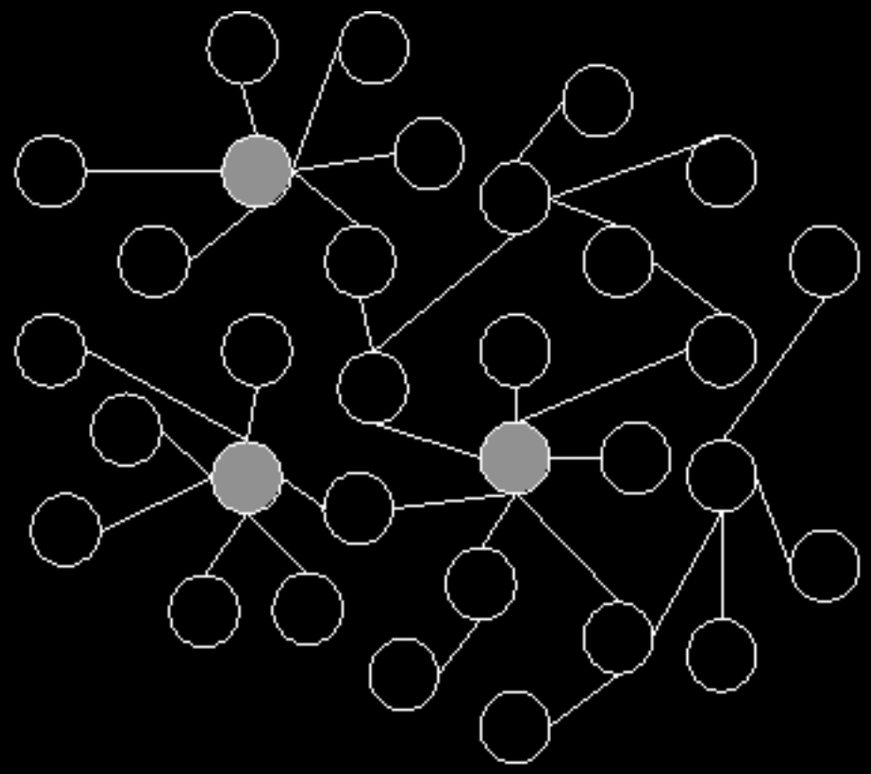
Random vs. Scale-Free



(a) Random network



(b) Scale-free network

Degree Distributions

$$Pr(k_i = x) \propto x^{-\alpha}$$

Clustering Coefficient

The proportion of the number of links in the neighborhood to the number of possible links:

$$C_i = \frac{|\{e_{jk}\}|}{k_i(k_i - 1)}$$

for all $v_j, v_k \in N_i$

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Also known as: Barack Hussein Obama, Jr., Barack Hussein Obama, President Obama, Obama
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Barack Hussein Obama II (born August 4, 1961) is the President of the United States and a former junior United States Senator from Illinois. Obama is the first African American to be elected President of the United States. He is a graduate of... more
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Place of birth: Honolulu
Country of nationality: United States
Gender: Male
Profession: Politician, Lawyer, Attorney at law, Writer, Professor, Executive, Author
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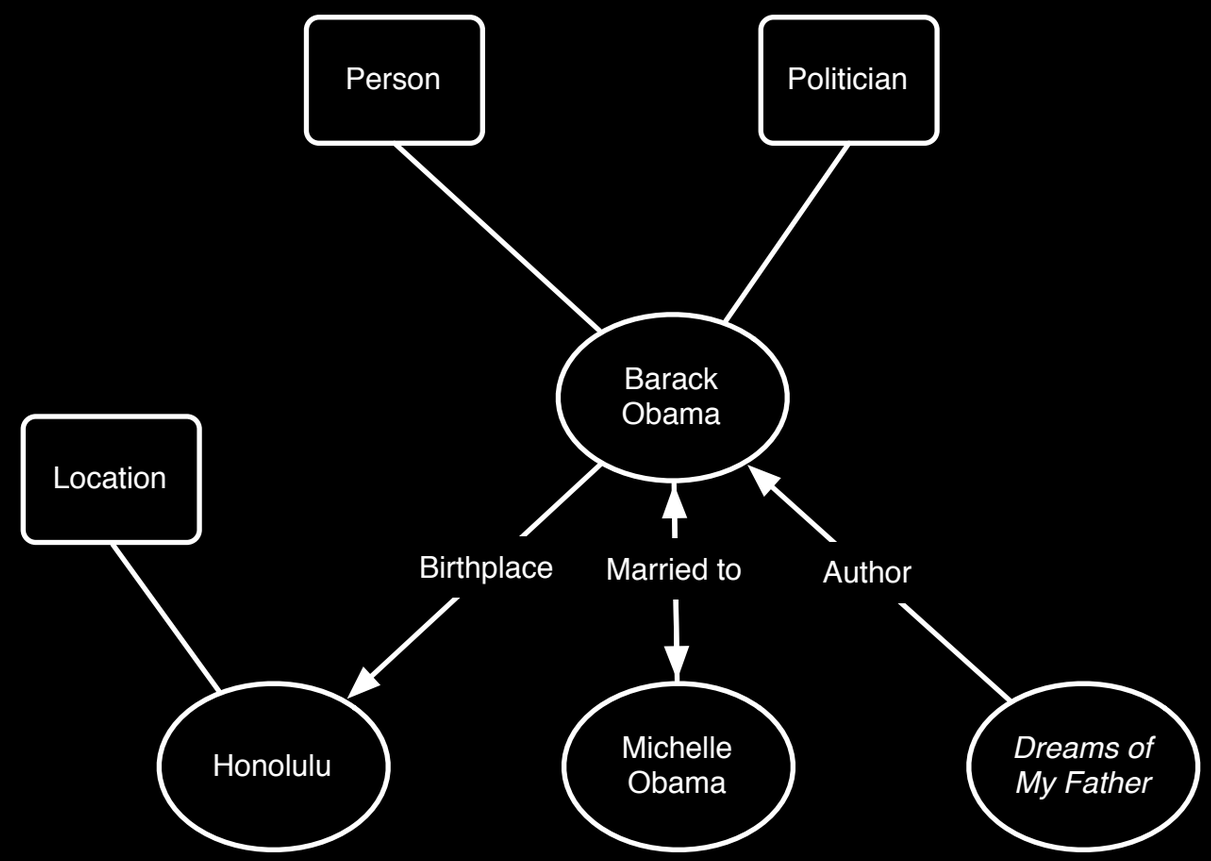
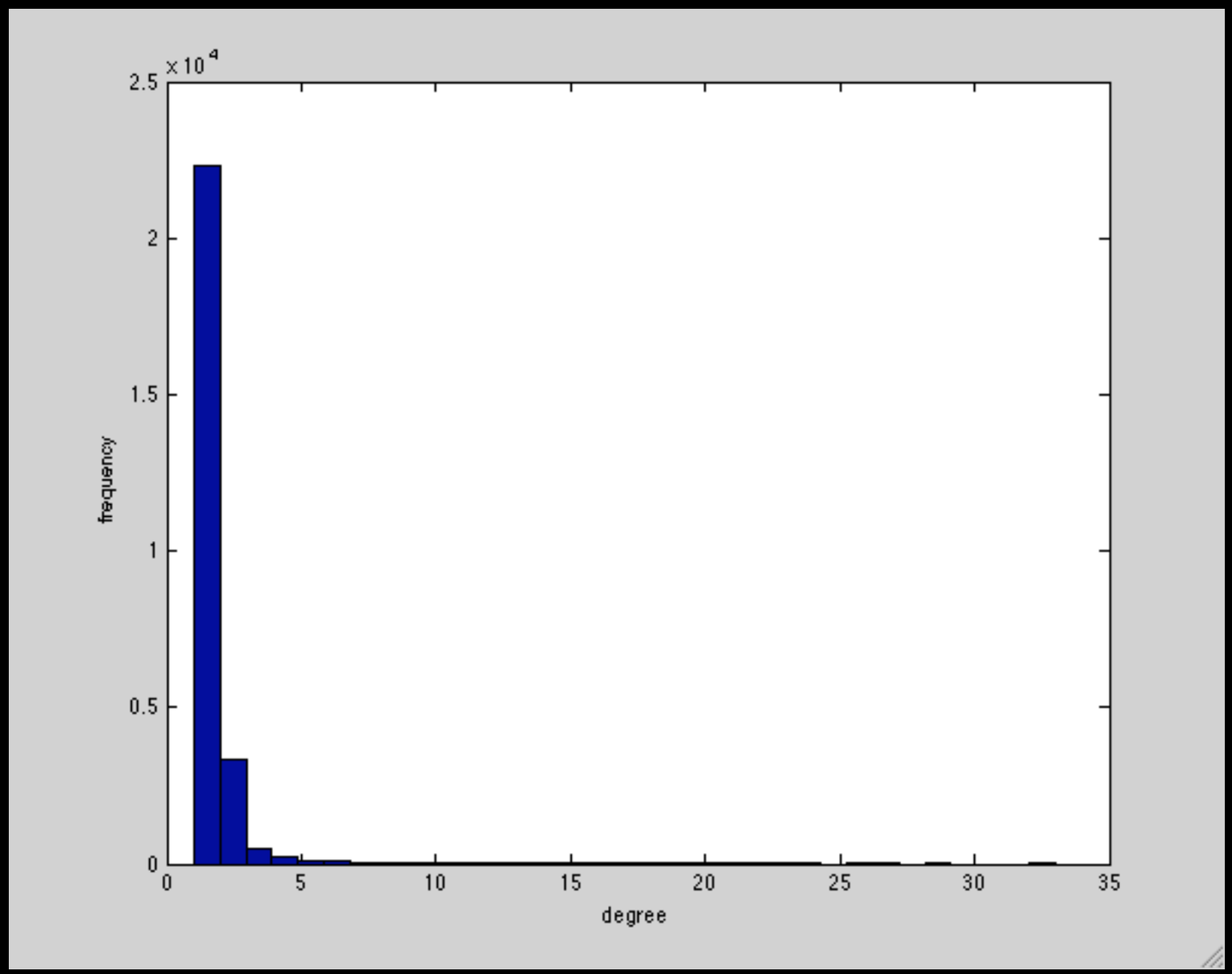

Person
Politician
Barack Obama
Location
Birthplace
Married to
Author
Honolulu
Michelle Obama
Dreams of My Father

Query

```
{
  “type”   : “/type/link”,
  “source” : “/en/barack_obama”,
  “target” : null,
  “return” : “count”
}
```

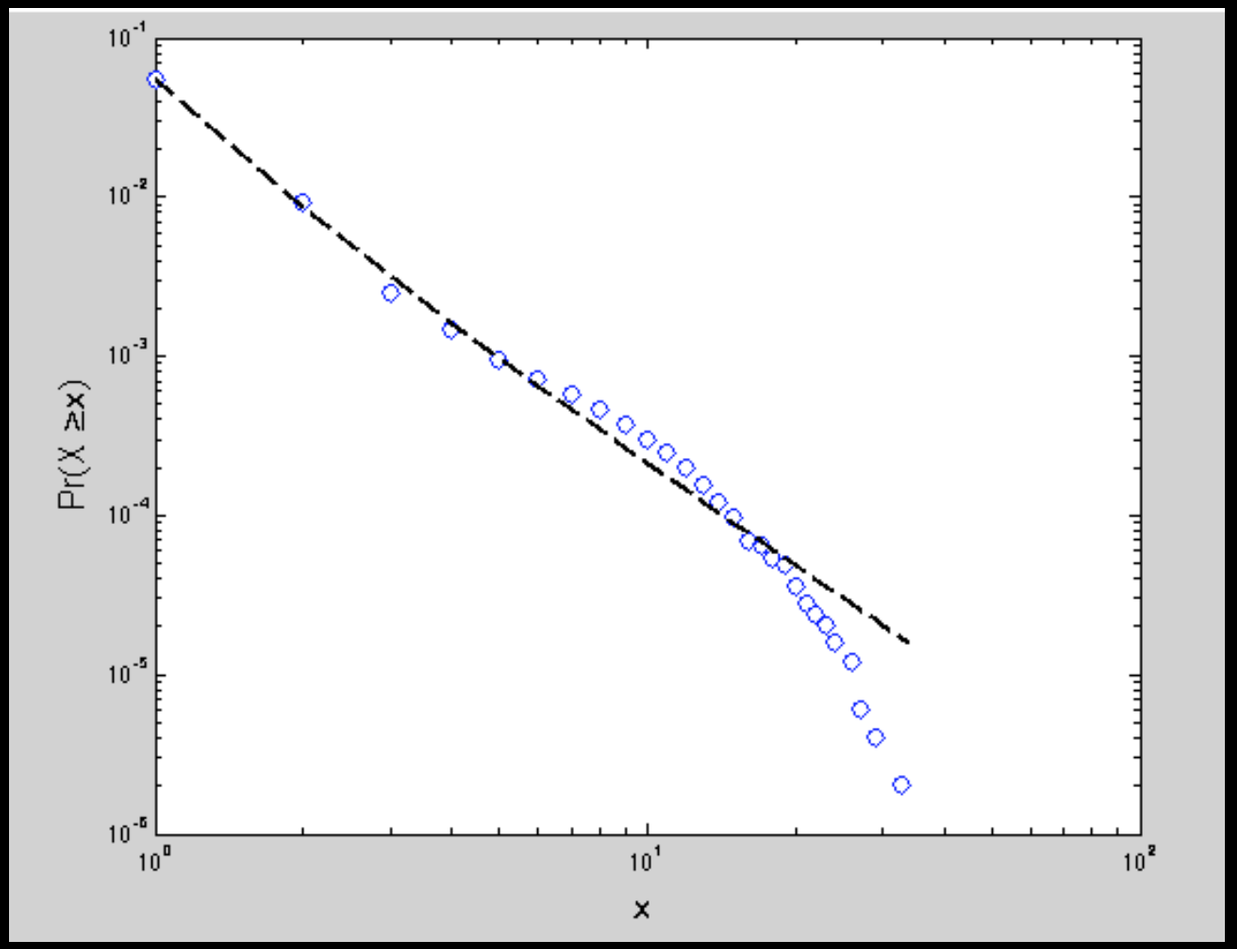
Degree Distribution



Power Law Fit

Using method described by Newman, Shalizi, Clauset using method of maximum likelihood

Continuous case is simple
Discrete case requires solving a transcendental eqn.



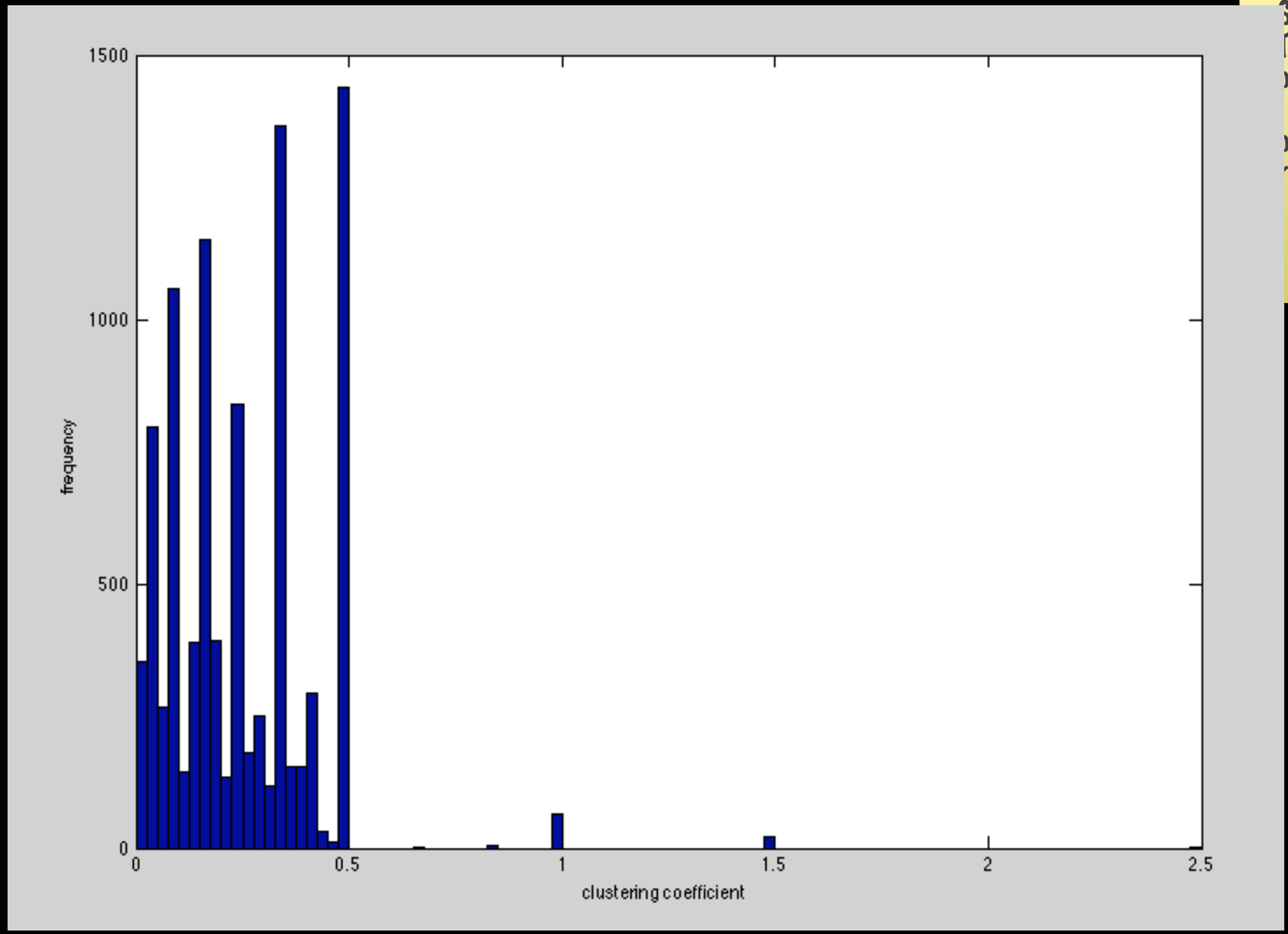
Scientific citation networks have alpha = 3.04

Social networks have

$$Pr(k_i = x) \propto x^{-\alpha}$$

where $\alpha = 3.06 \pm 0.018$ and $x_{min} = 1.0 \pm 0.1$

Clustering Coefficient

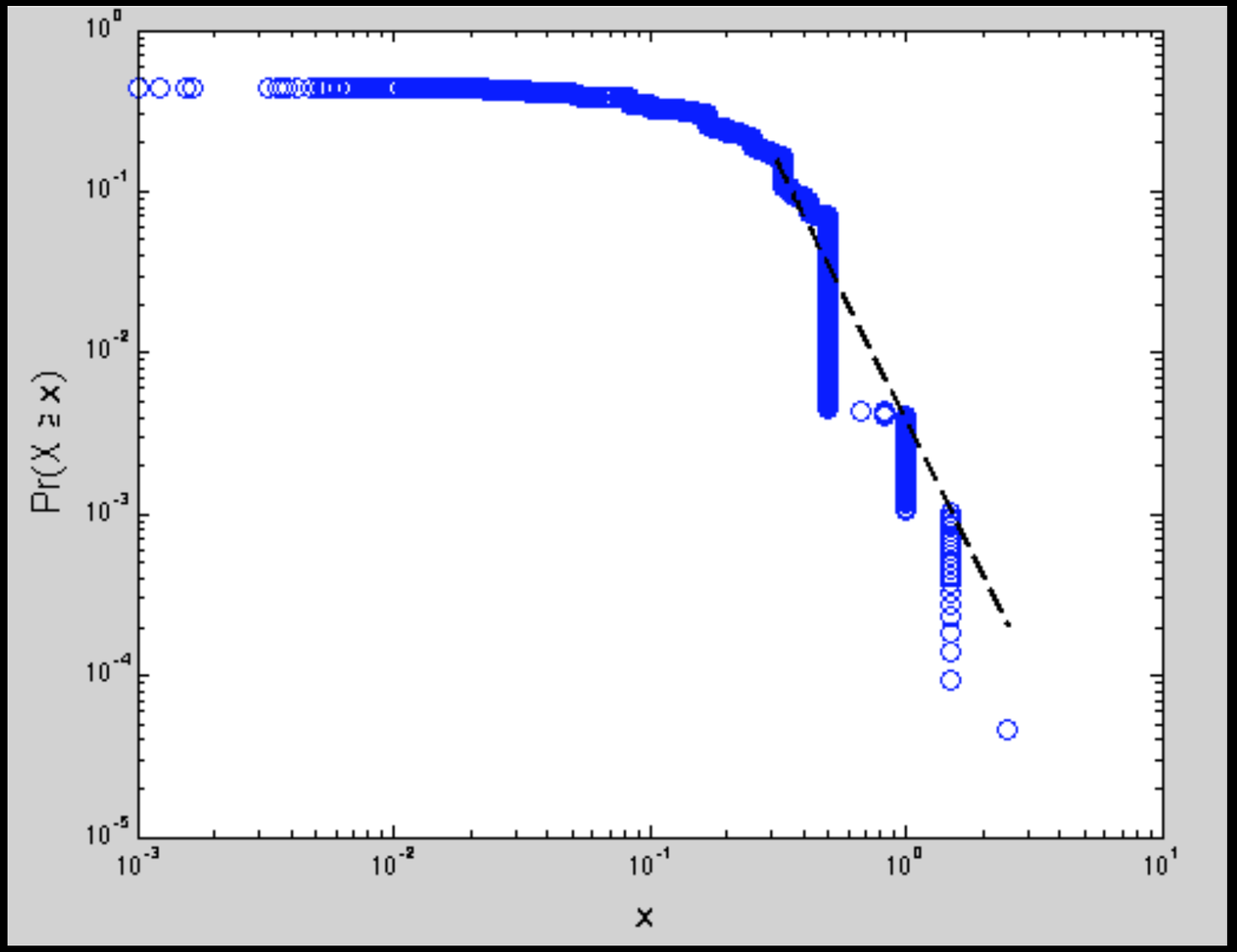


Similar to Roget's Thesaurus, email address books

but nothing terribly relevant

$$\overline{C_i} = 0.1119$$

Clustering Coefficient



$$x_{min} = 0.3 \pm 0.0, \alpha = 4.04 \pm 0.51$$

Future Work

All social networks are assortative. Information, technical networks, etc. are disassortative.

- Assortative Mixing by type and degree
- Shortest path distances
- Visualization
- Network growth

References

M.E.J Newman, 2003, "The Structure and Function of Complex Networks", SIAM Review, 45 (2).

A. Clauset, C. R. Shalizi, M.E.J. Newman, 2009, "Power-Law Distributions in Empirical Data" arXiv.org Preprint

Questions?