Differentiating traditional and popular music by analyzing the social structure of fame: a computer simulation of fan-artist affiliation networks

Michael Frishkopf

michaelf@ualberta.ca

bit.ly/mfwiki

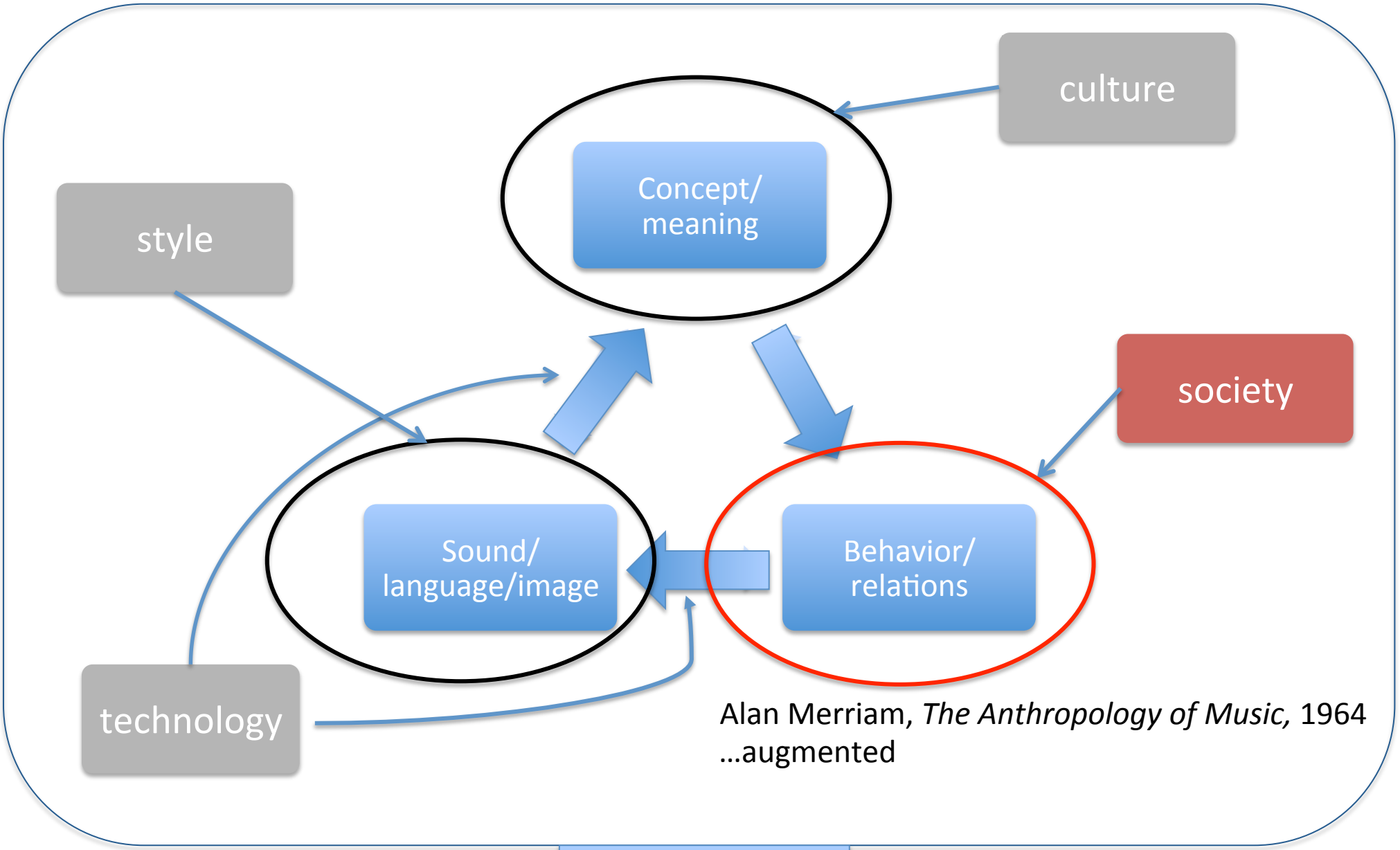
How to differentiate "traditional" and "popular" music?

- technology of production/distribution/reception?
- cultural aspects? musical meaning?
- musical sound itself?
- social aspects?
  - performative interactions
  - diffusion: dissemination and recommendation
  - fandom and fame (relations of fans to artists, songs, styles, other fans)

What is music?

Ethnomusicology takes a broad view…

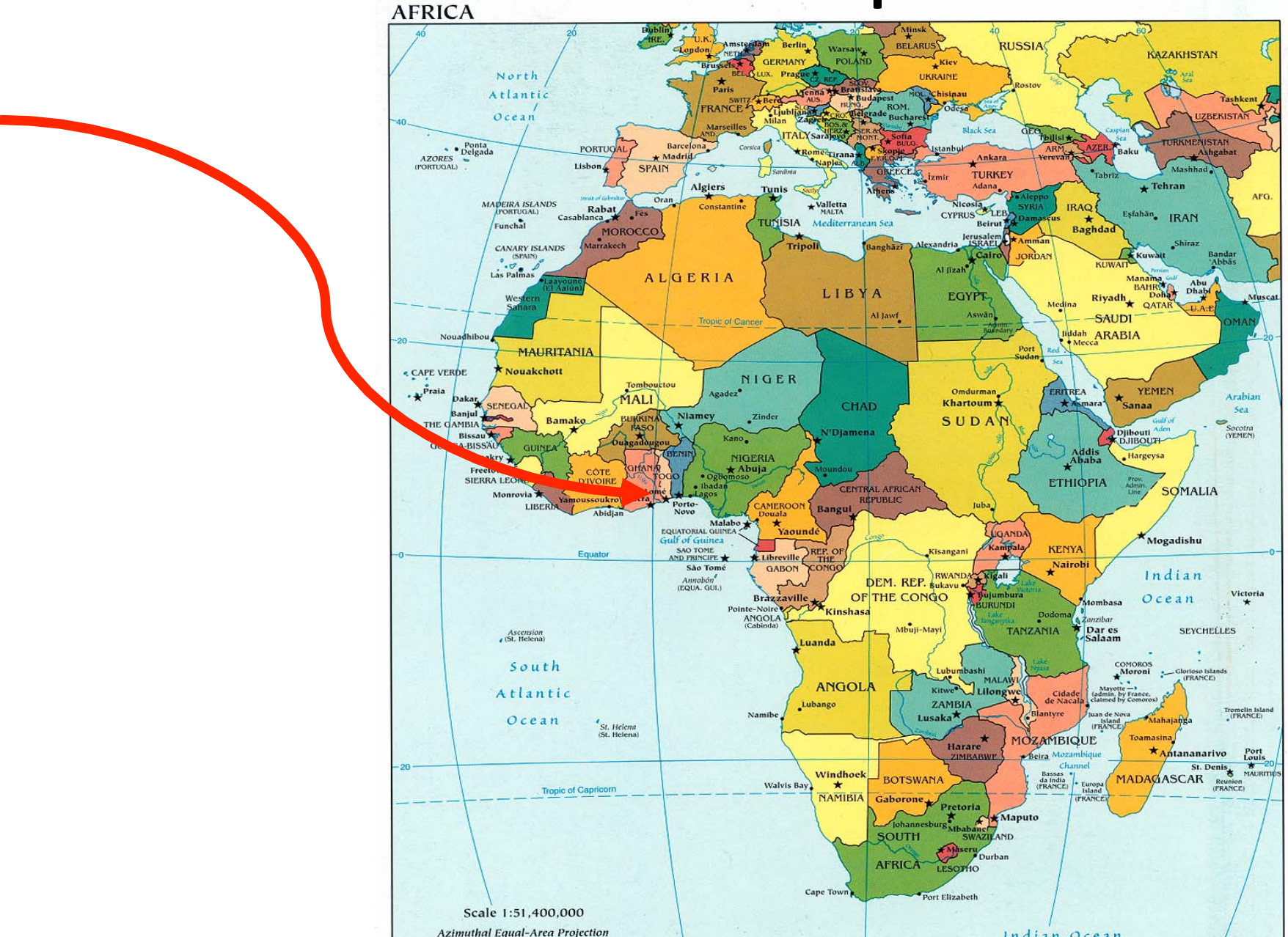
- **concept**/perception/meaning
- **behavior**/social relations
- **sound**/language/image
- **technology**
  (sound production/distribution/reception)
- **culture**
  (collectively held concepts/perceptions/meanings)
- **society** (aggregate behaviors/relations)



Alan Merriam, *The Anthropology of Music,* 1964
…augmented

Music

Let’s consider two examples from Ghana

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Guinea
Benin
Nigeria
Sierra Leone
Togo
Côte d'Ivoire
Ghana
Lagos
Liberia
Cameroon
Abidjan
Accra
Gulf of
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The other, a music video fusion of West African highlife and hiphop, known as “hiplife” and developed in Ghana’s capital, Accra.

One, traditional religious music from the Volta Region in the southeast.

Traditional music: Brekete (Volta Region)

Popular music: Hiplife (Accra)

Differentiating traditional and popular music in general

- **technology**: clear, perhaps definitional, difference (sound production/distribution/reception)
- **concept**/meaning: unclear difference
- **culture** (collective concepts/perceptions/meanings): unclear difference
- **sound**/language/image: unclear difference
- **style**: unclear difference
- **behavior**/relation: unclear difference
- **society** (behavioral/relational aggregates): we may speculate that social relations are localized for traditional music, broader for mediated music. What are the social effects of mediation?

Question

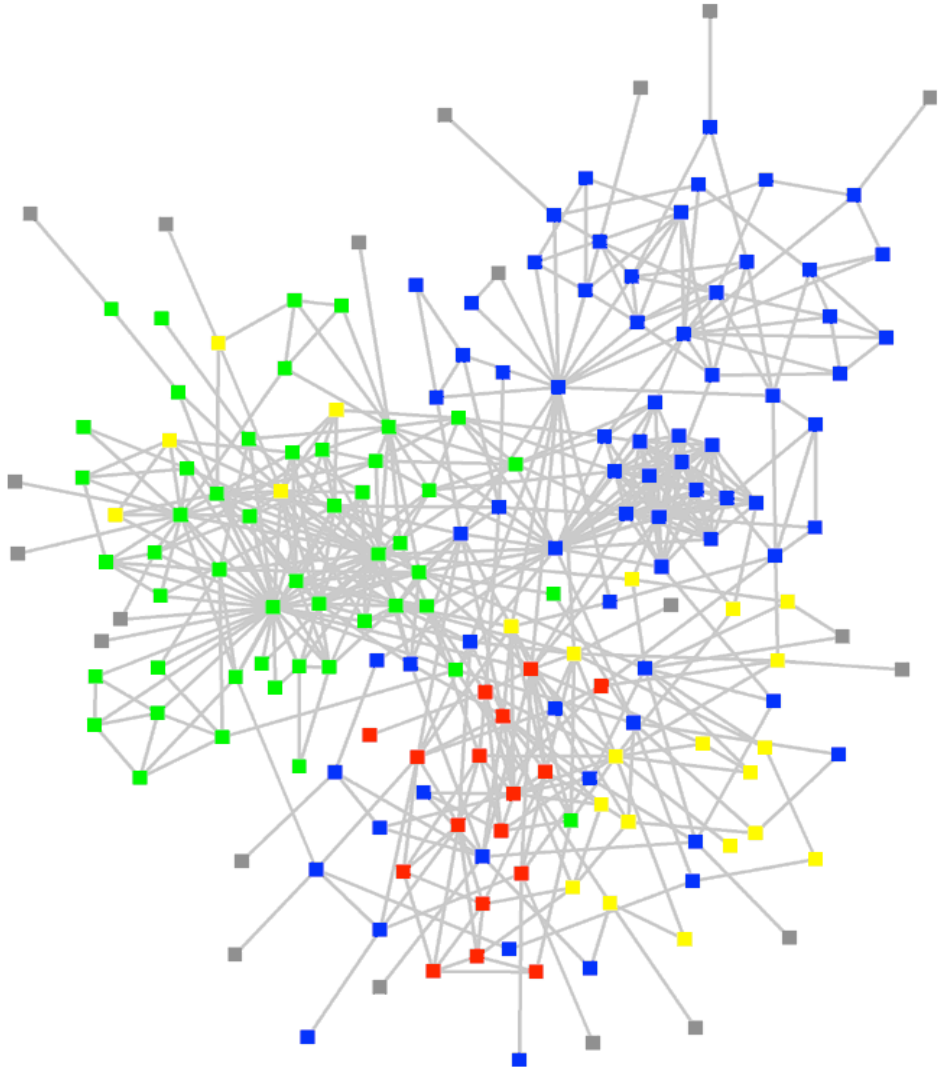
- IF the popular/traditional distinction is by definition technological…
- …THEN what are *social* consequences of this distinction?
- Specifically: what differences can be expected in the social structure of fame when media technologies (satellite, internet) remove distance limitations?

Globalization:

Technologies such as satellite and internet eliminate distance limitations in at least two ways:

- Enable musical consumption independent of physical distance, forging musical globalization
- Create globalized layers of culture and taste by which global musical demand is realized, across traditional cultural/linguistic obstacles
  - globalized culture, taste, style
  - globalized language
- Support global economic system, supporting flows of musical commodities

I consider **music society** as a network of music relations, a musical social network



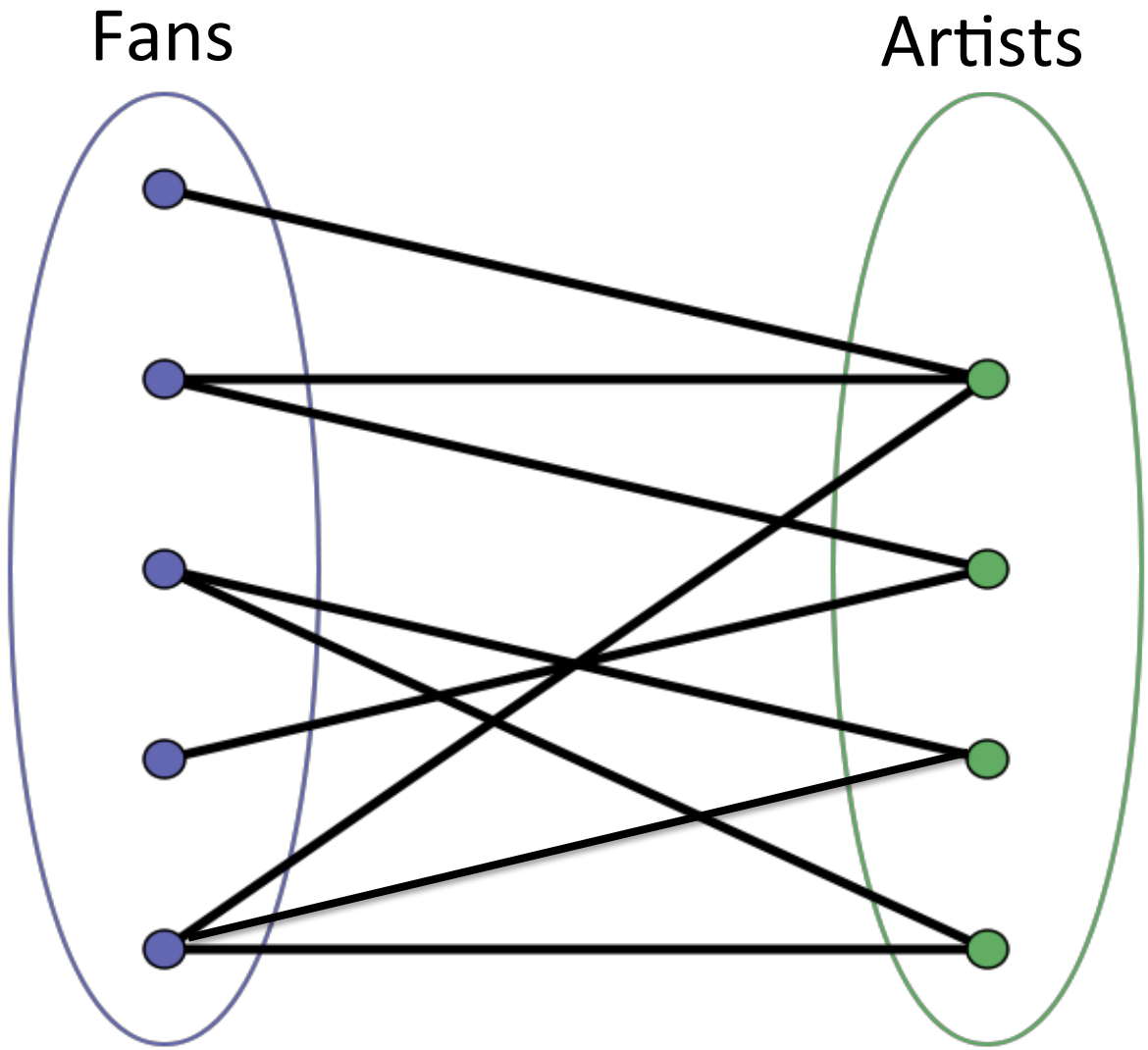
There are many *kinds* of music relation.

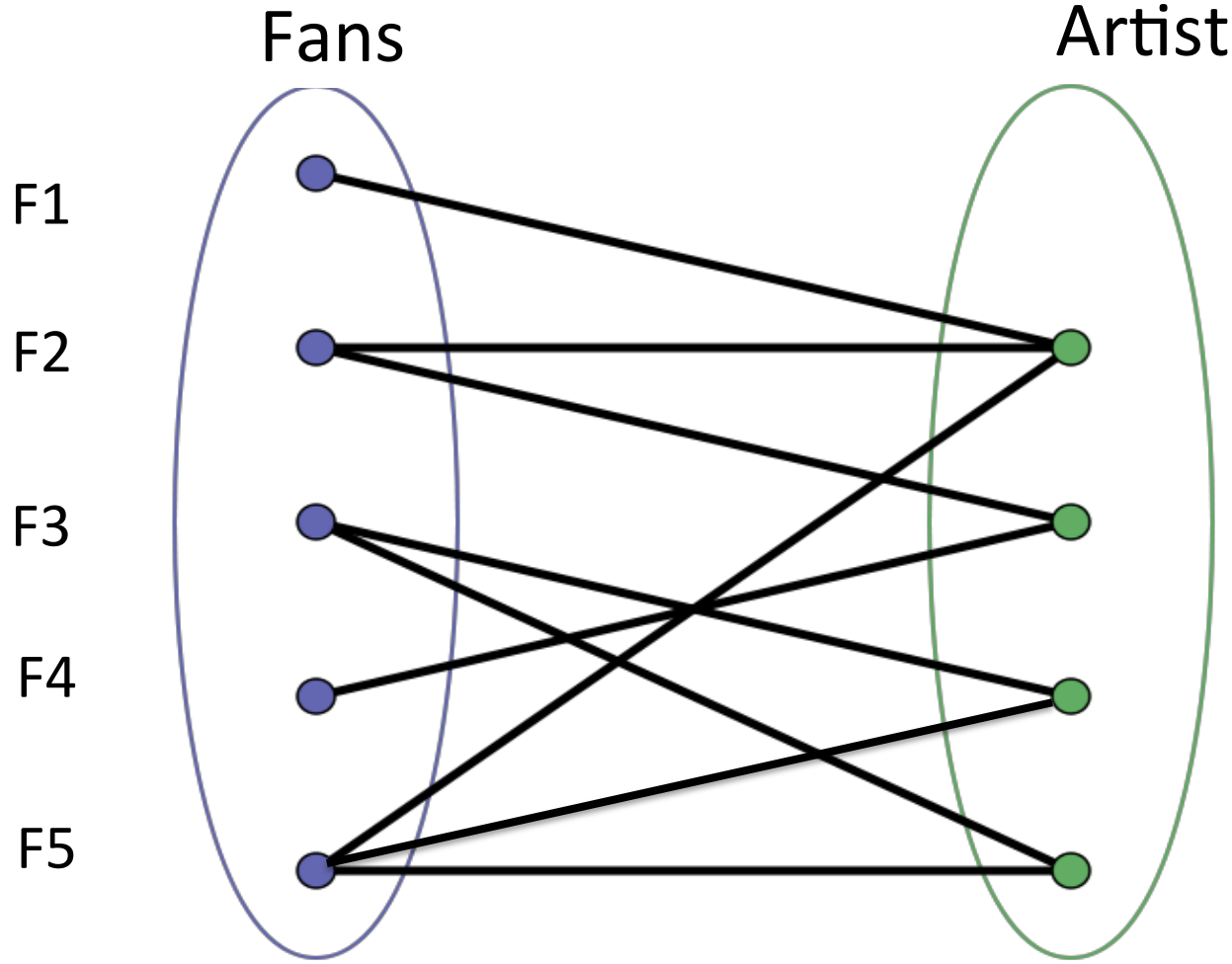
I want to focus on *one*: the fan-artist relation, one manifestation of **fame**

The social structure of fame: a musical affiliation network composed of fan-artist relations

- A 2-mode bipartite network connects fans to artists they like; artist degree = fame
- A resultant 1-mode network connects fans who like the same artists
- We reveal structure using an energy-based **graph visualization** algorithm (Kamada-Kawai)
- For large networks, we analyze **degree distribution** and **cohesive subgroups** using graph theory

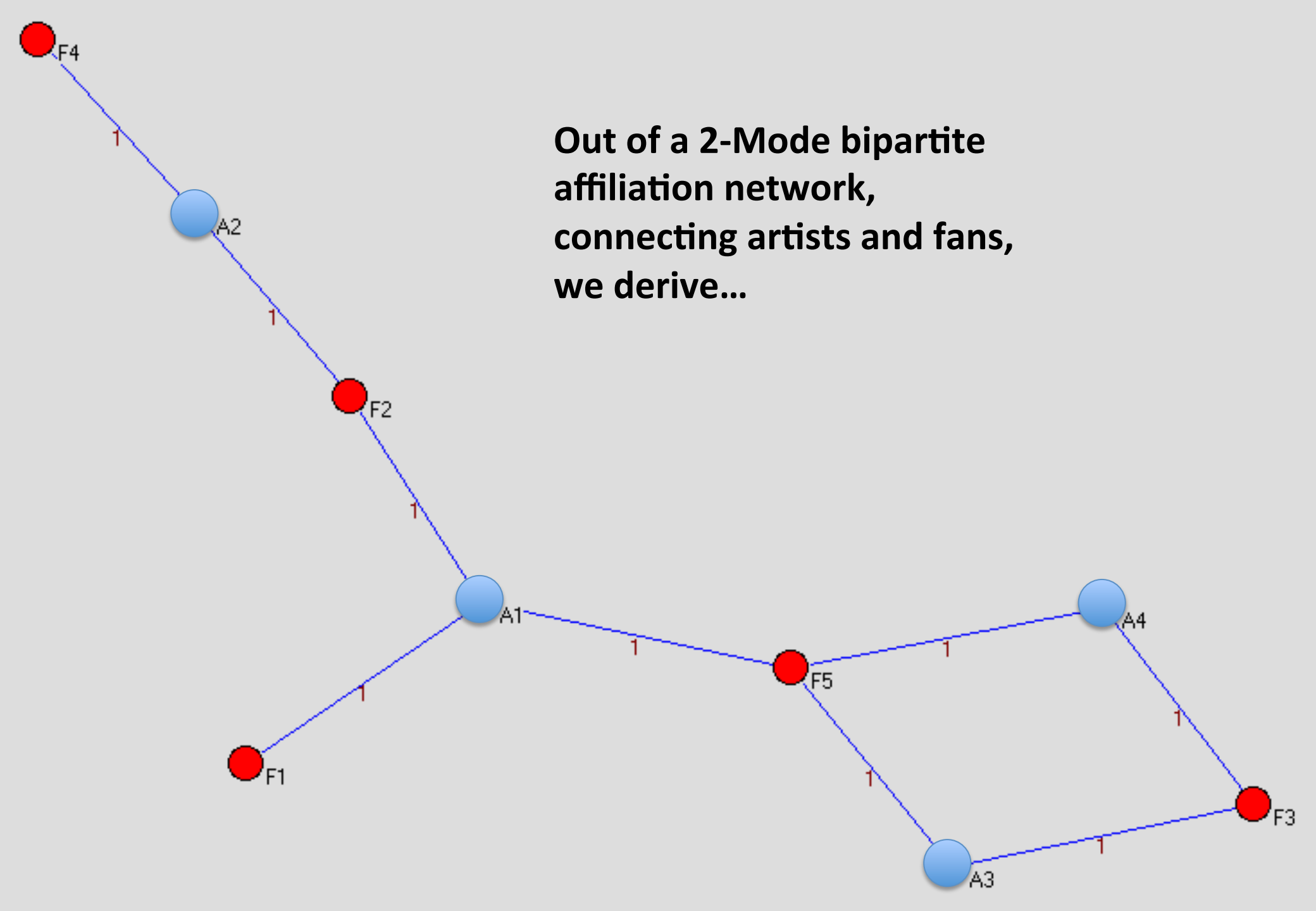
Fame as musical affiliation network: bipartite graph of fan-artist relations



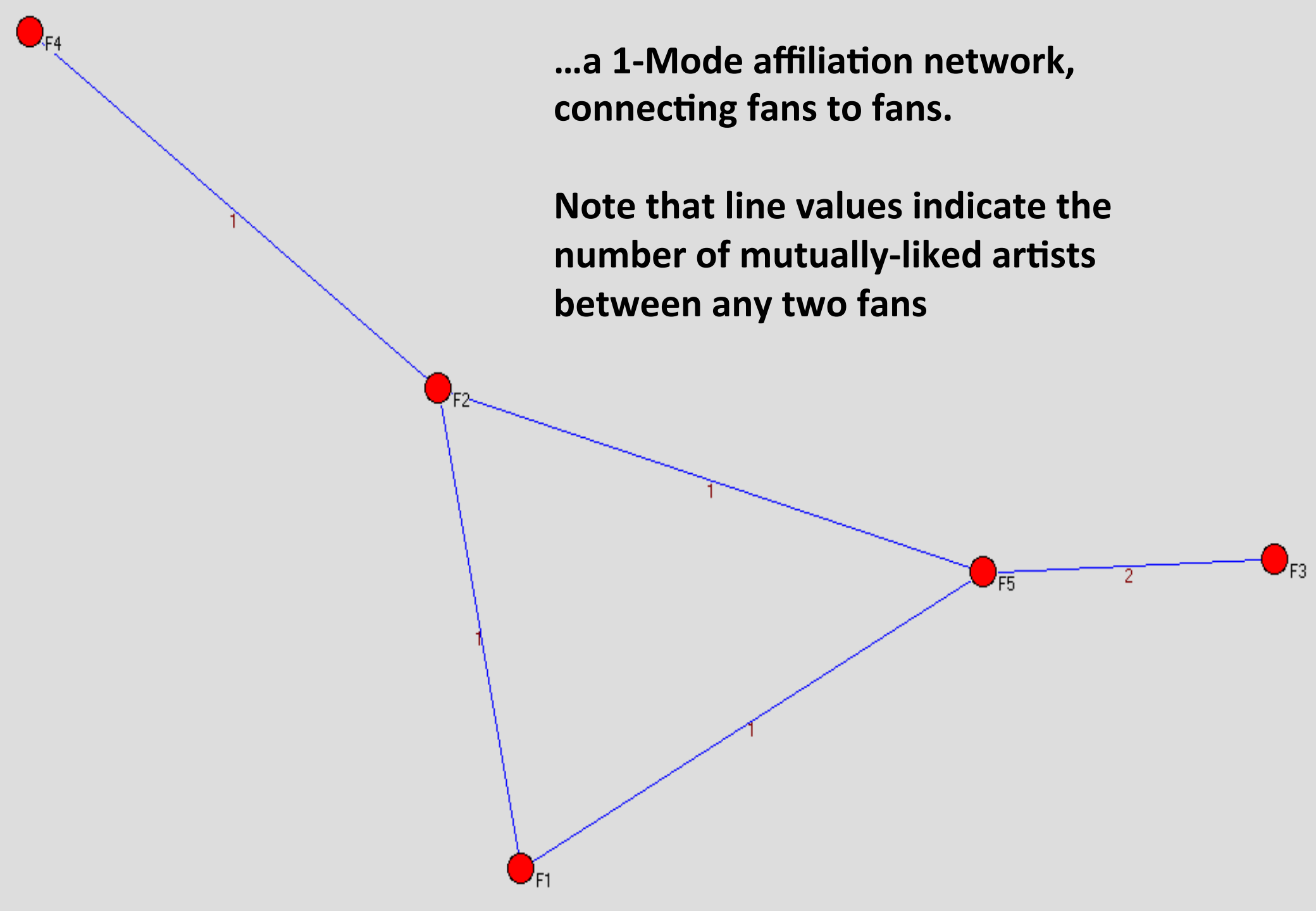


2-Mode affiliation network

	F1	F2	F3	F4	F5	DEGREE
A1	X	X			X	3
A2		X		X		2
A3			X		X	2
A4			X		X	2



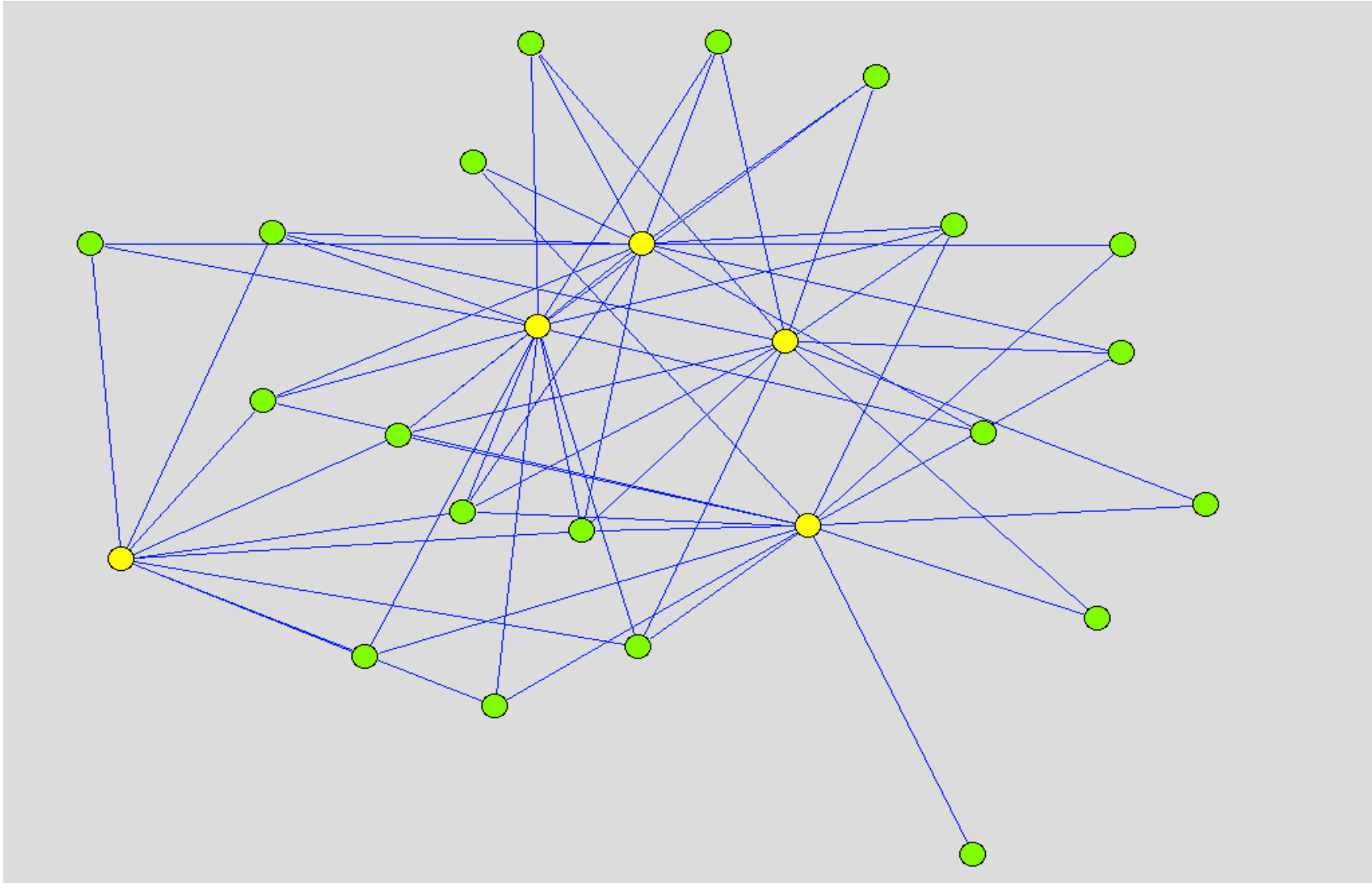
Out of a 2-Mode bipartite affiliation network, connecting artists and fans, we derive…



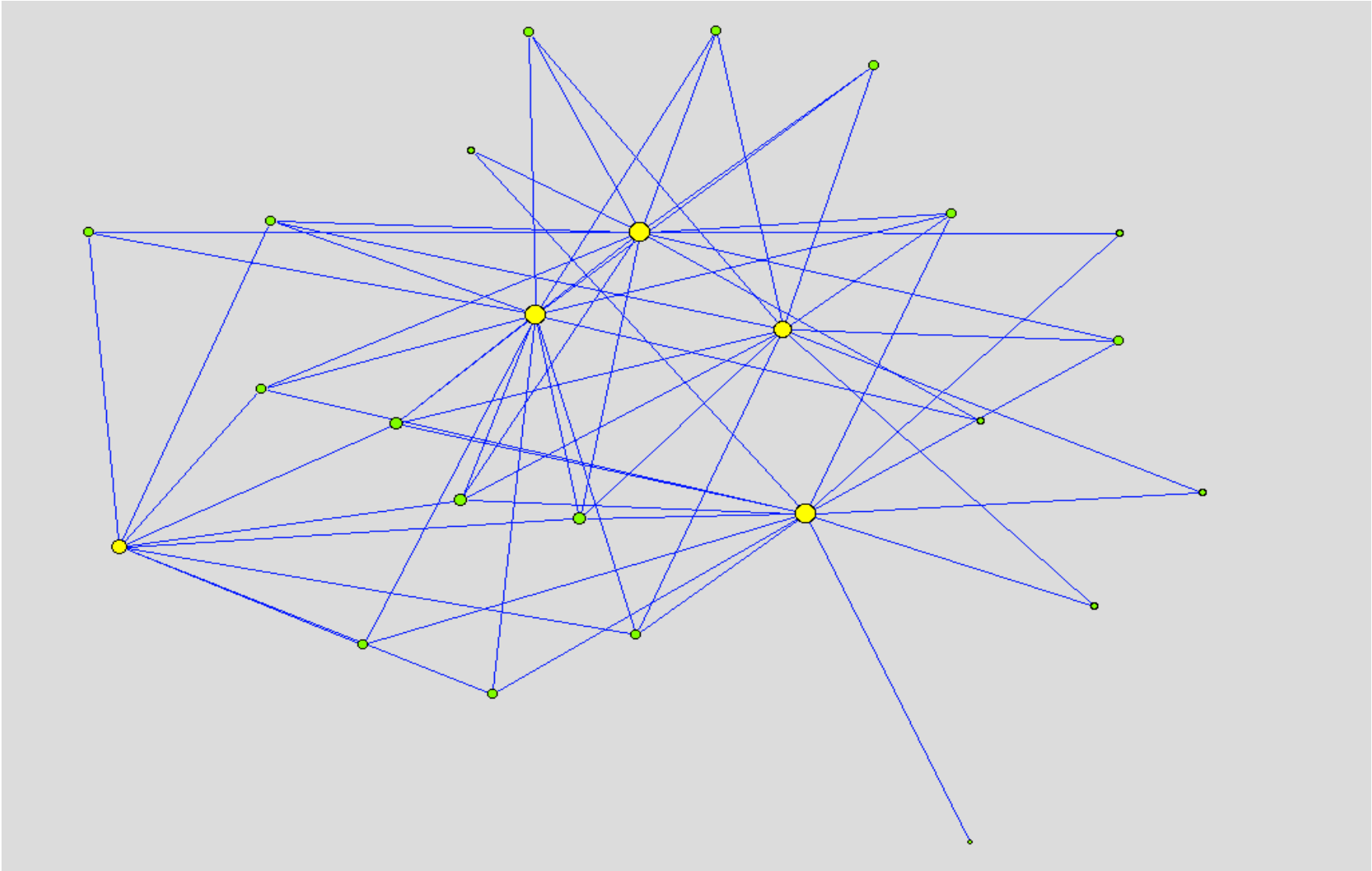
…a 1-Mode affiliation network, connecting fans to fans.

Note that line values indicate the number of mutually-liked artists between any two fans

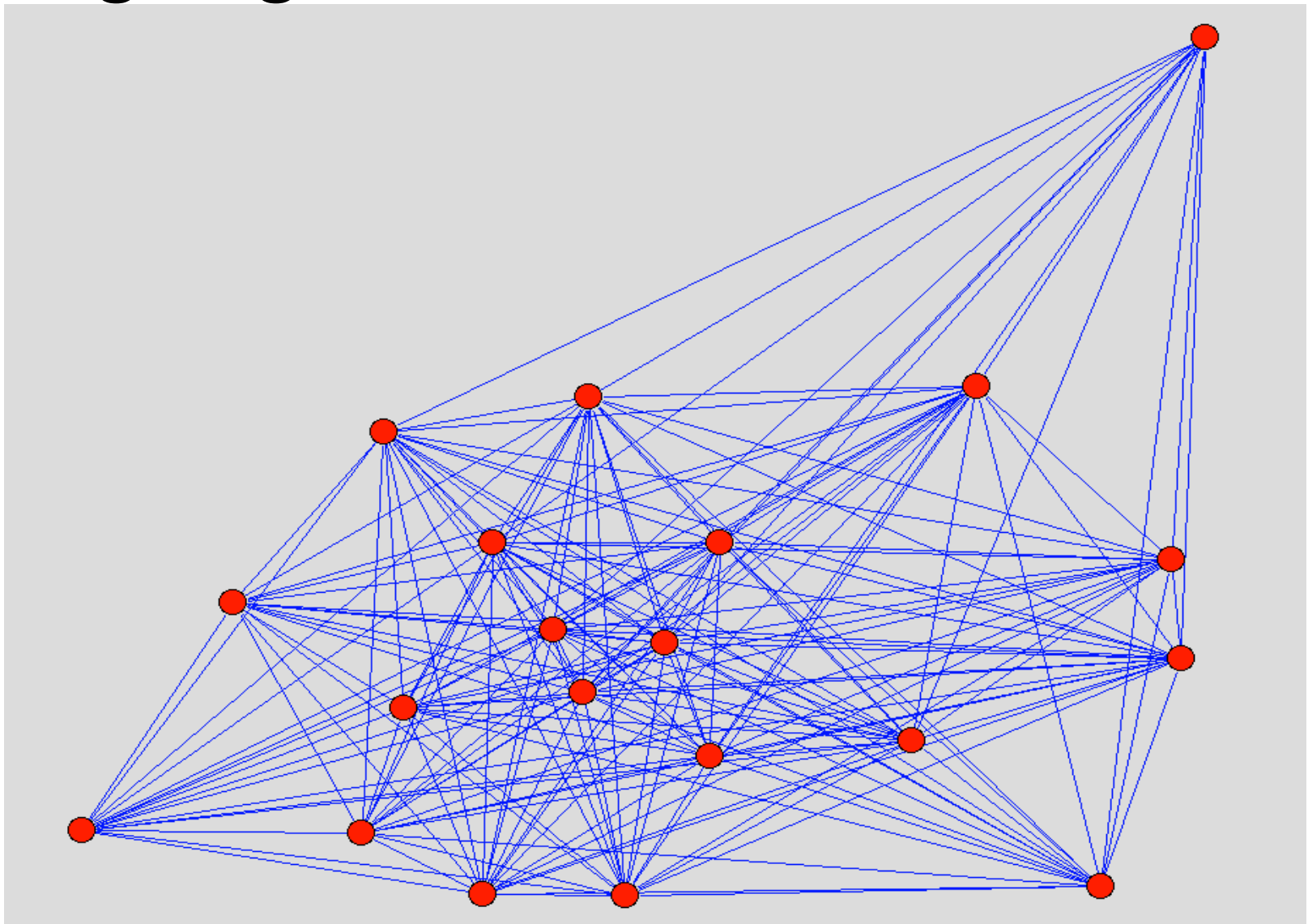
Here's a bigger example: 5 artists, 20 fans, as a 2-mode affiliation network



2-mode affiliation network
(size of node proportional to degree)



and as a 1-mode affiliation network.
Energizing takes line values into account.



How do affiliation networks form?

- intrinsic properties (e.g. aesthetic quality)
- network properties (e.g. network degree)

For example, a fan likes a singer because of the artist's….

- musical abilities in relation to fan taste (intrinsic properties of fan and artist, quasi-random)
- fame (a network property).

In this latter case, fame explains itself:
the famous get more famous.

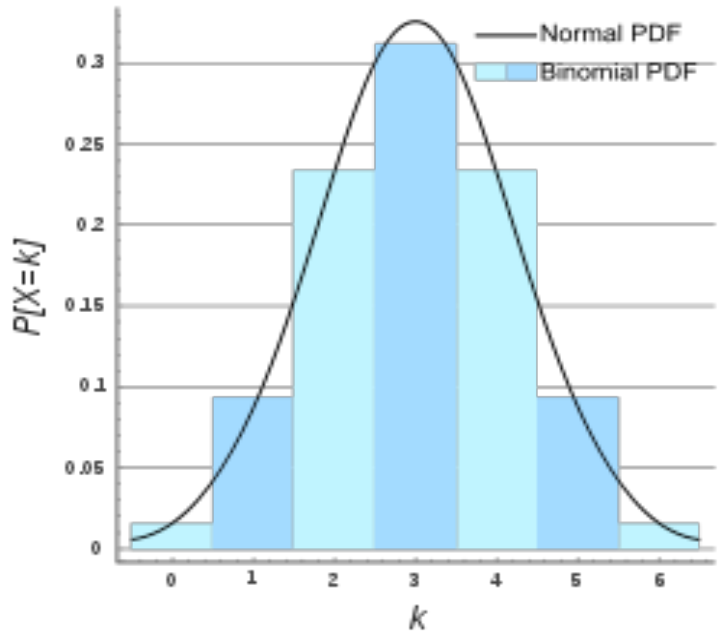
In network terms, this is called *preferential attachment*

Intrinsic vs. network basis of fame

- We may like to believe our musical choices are based on intrinsic qualities
- Traditional philosophical aesthetics locates these qualities absolutely in the artist or work ("beauty")
- Anthropology, relativizing, locates them as fan-artist matches ("taste"); selections appear quasi random
- **But preferential attachment clearly plays a role as well, because famous artists**:
  - ensure awareness (high degree; "have you heard…?")
  - arouse curiosity ("hmmm…what's so great?")
  - nucleate social groups offering identity ("I like to like what my friends like")

Degree distribution in random affiliation networks

- Taste generates quasi-random choices.
- Assuming random choices, degree distribution is binomial, close to normal.
- Such a distribution is “scaled”: the mean is also a mode:



Degree distribution in preferential attachment network

- Assume a fame network grows through incremental addition of fan-artist links
- Each fan selects an artist at random ("taste"), but weighted by degree ("fame")
- Network converges on degree distribution

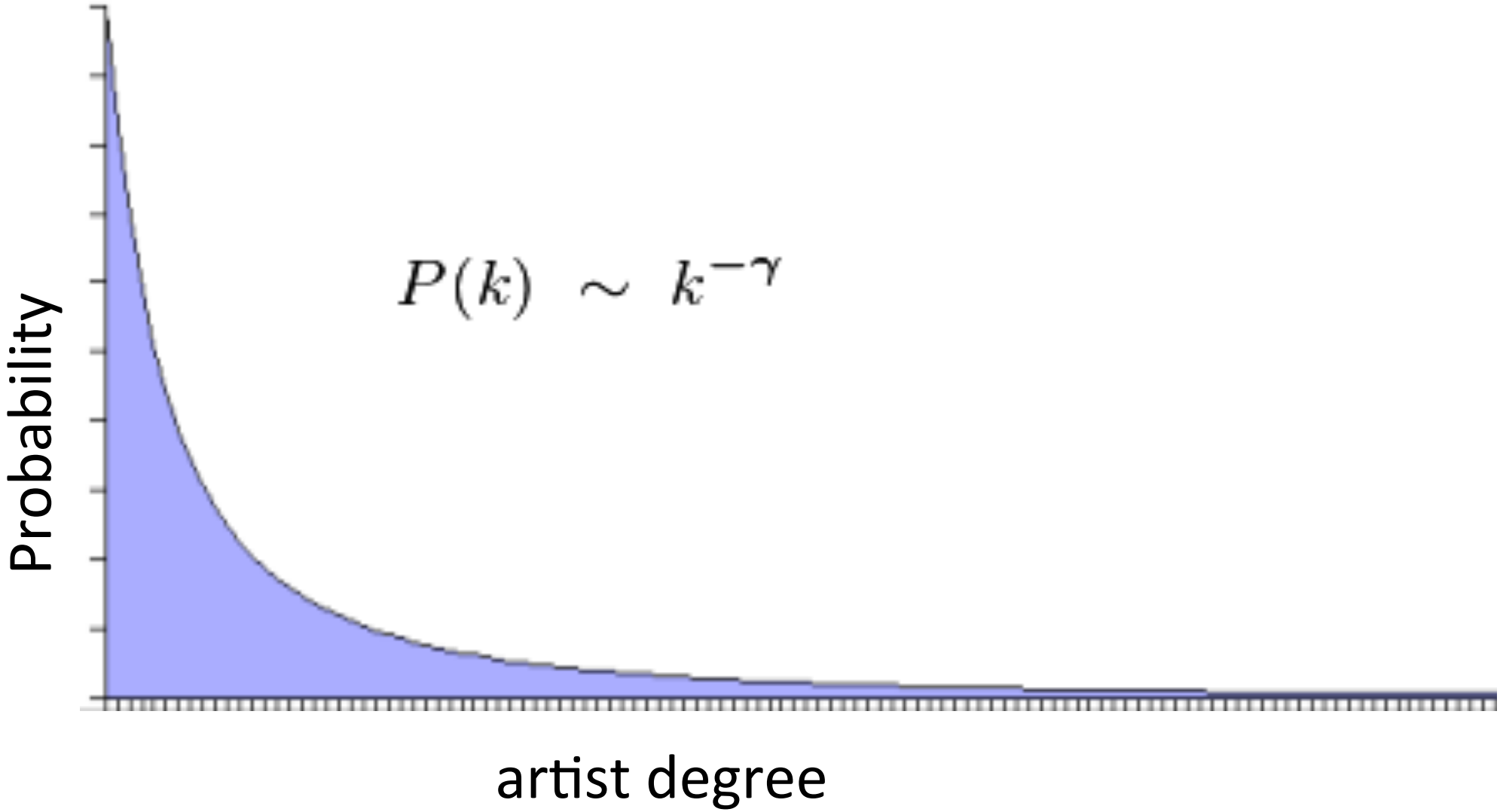
  $P(k) \sim k^{-\gamma}$ (power law): "scale free network"

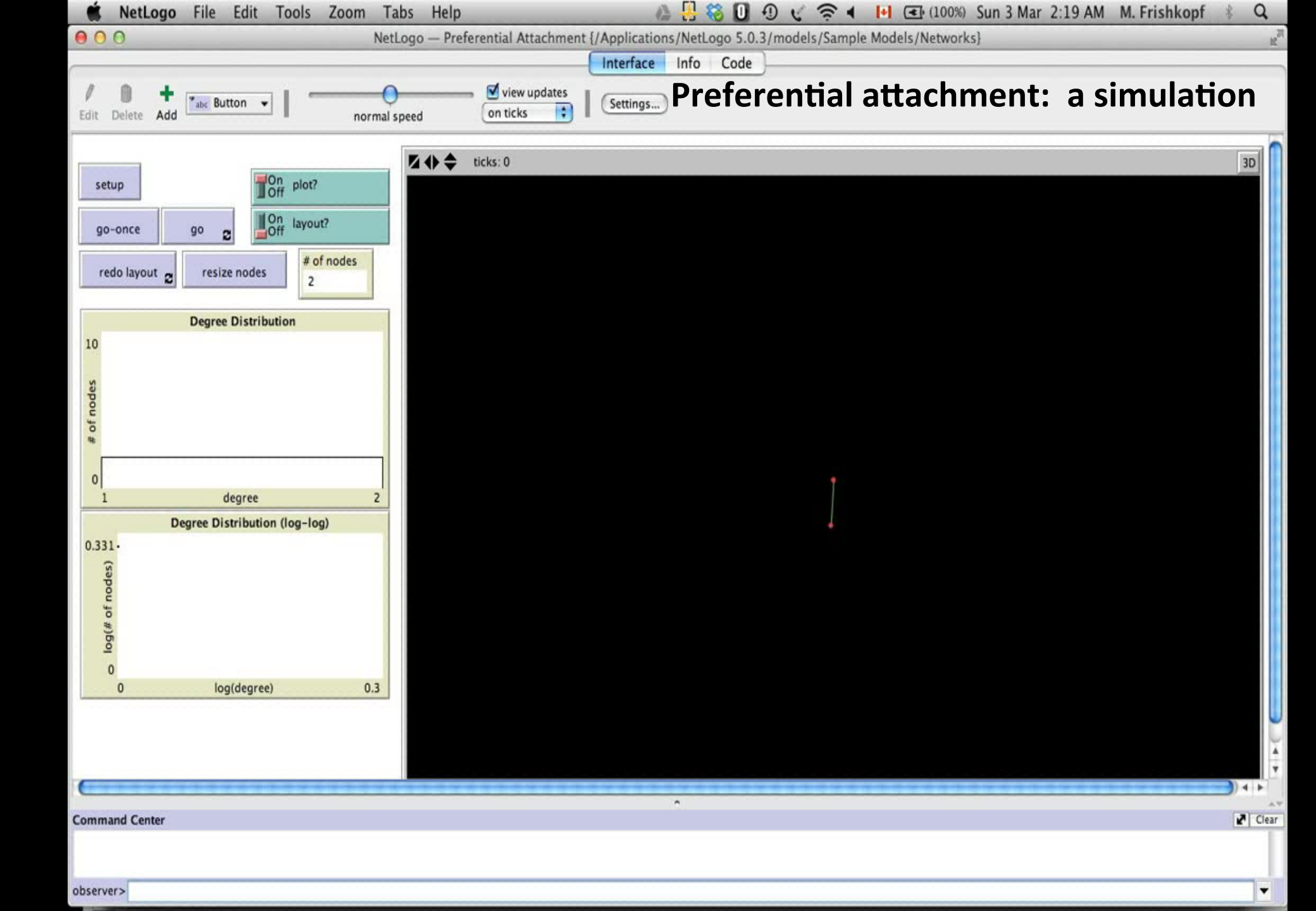
  – degree distribution exhibits a "long tail"

  – a few hub nodes (high degree), many peripheral nodes

  – "popular" nodes get more popular

Long-tail distribution characteristic of preferential attachment (scale-free networks)

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Musical fame and preferential attachment

- Popular music: technology enables distance-insensitive preferential attachment.
- Traditional music: face-to-face, oral culture precludes distance insensitive preferential attachment.
- What is the impact of distance limitations on preferential attachment?

Traditional music: distance penalties

Attachment probability weighted by D^{-R}
where D is fan-artist distance:

Factor	**Exponent: R**
2D oral diffusion	2
Culture/style difference	1
Transportation cost	1
Language difference	1
TOTAL	**5**

Thus, as a speculative estimate we expect attachment probability to fall off as D^{-5}

Simulation* initialization

- Simulate on unit sphere: avoid edge effects and emulate global reality
- Randomly populate sphere surface with artists and fans (uniform distribution)
- Compute great circle distance matrix between artists and fans

NB: Artist/fan locations are randomized only once, then reused for each set of simulation parameters.

*The R programming language was used to develop the simulation

Simulation iteration @ time slice n:

- For each fan F:
  - Compute probability distribution P for selecting each artist A:
    - proportional (factor **W**) to artist's degree at slice (n-1)
    - proportional to D^{-R} where D=distance(F,A)
  - Randomly draw from P to select an artist that F likes
  - Add artist to F's "liked" queue. Each fan can like maximum N different artists (with FIFO queuing).
- Compute artists' degree histogram at slice n
- Iterate to approximate histogram convergence
- Save resulting affiliation network

Then repeat the simulation, varying R and W

Parameters

- Number of artists: 40
- Number of fans: 1000
- Number of artists per fan on FIFO: 4
- (➔ 4000 artist selections, or average of 100 fans per artist)
- Values of R:
  - 0 (popular music: no distance penalty)
  - 5 (traditional music: distance penalties)
- Values of W:
  - 0 (no preferential attachment)
  - 5 (preferential attachment)
- Number of iterations: 500

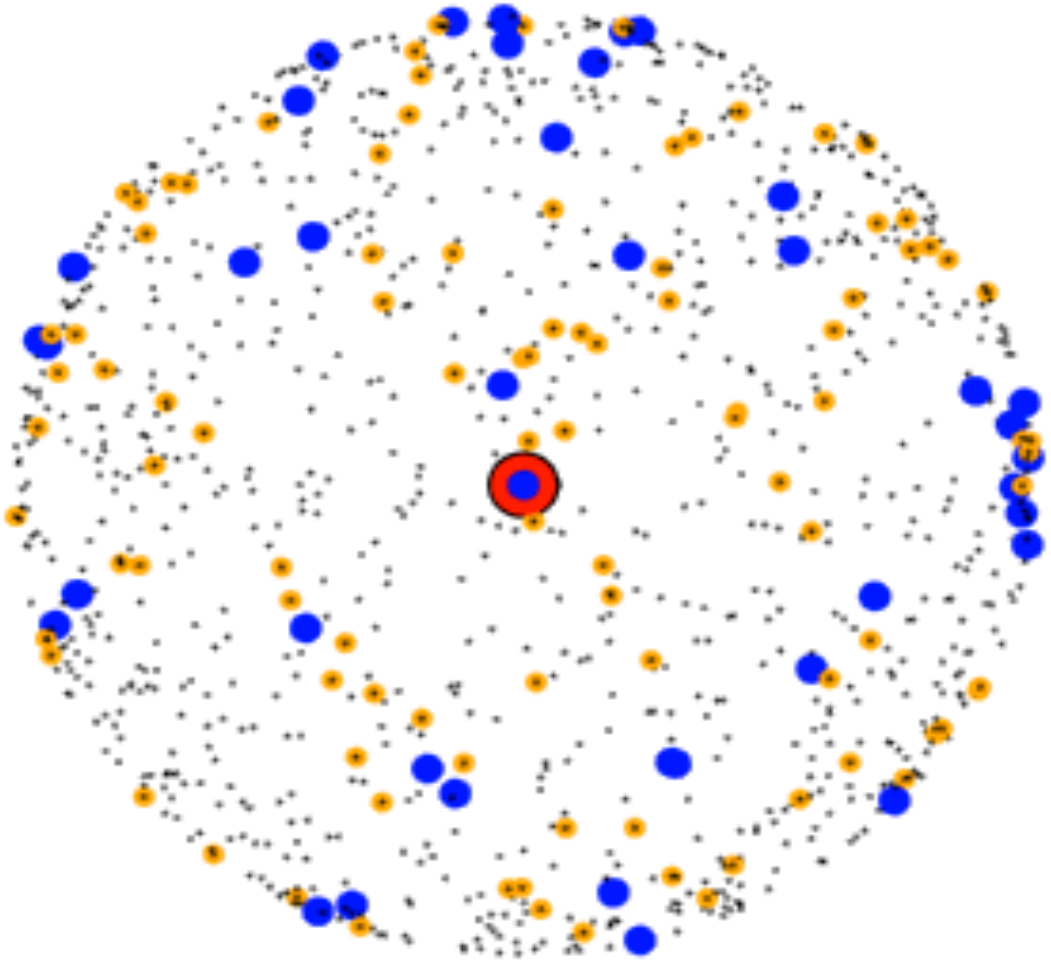
Simulation results…

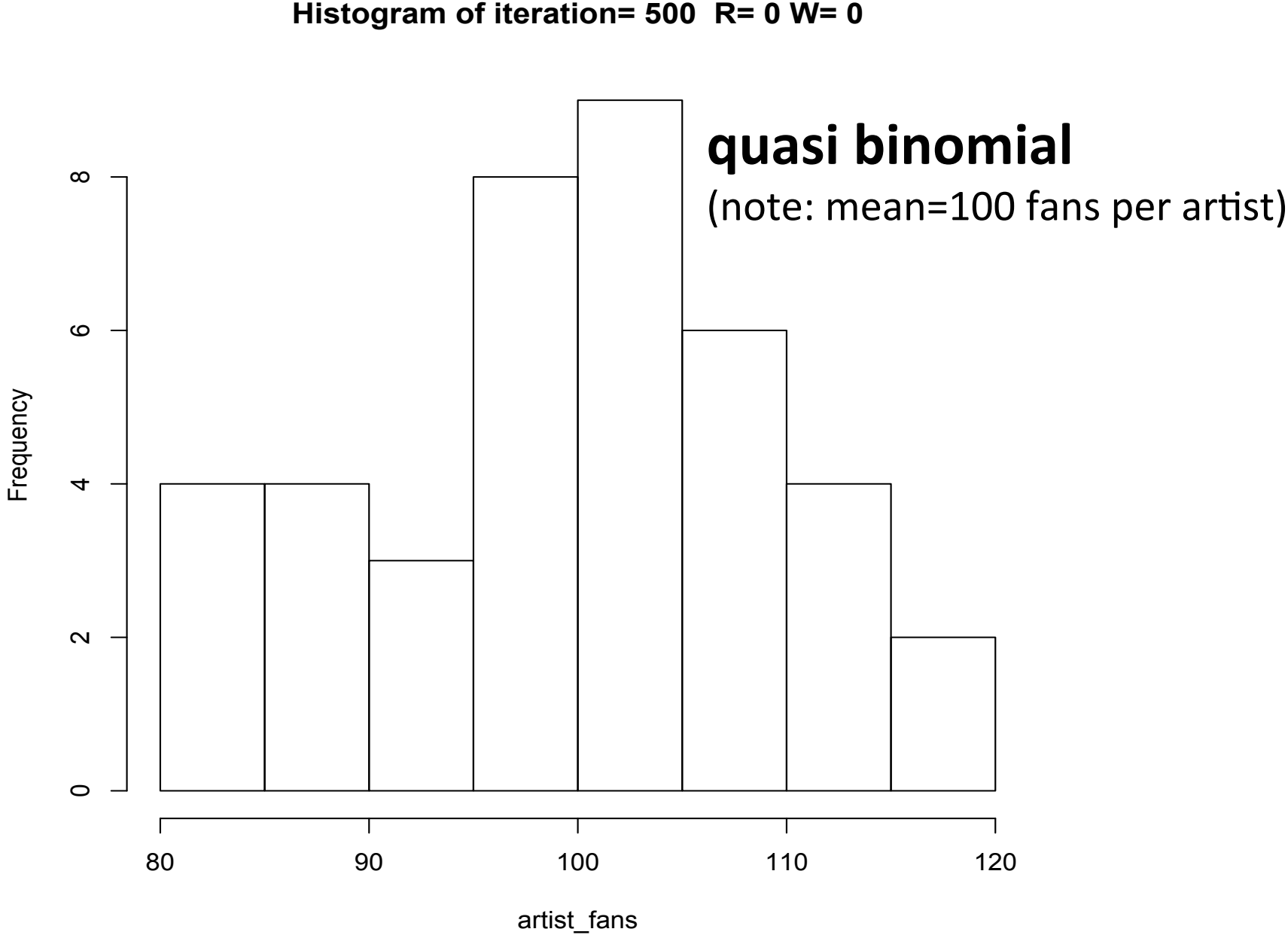
R=0 W=0:

No distance penalty, no preferential attachment.

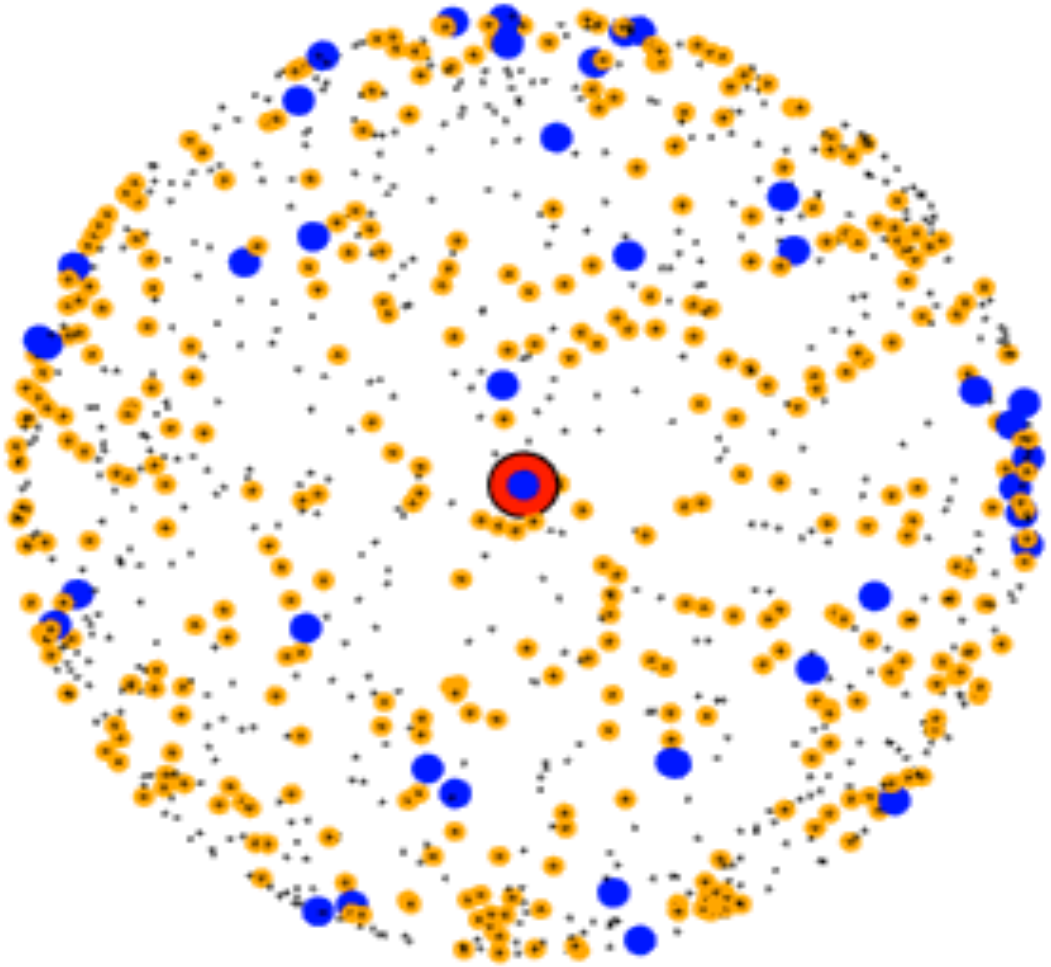
Artists in blue, fans in black

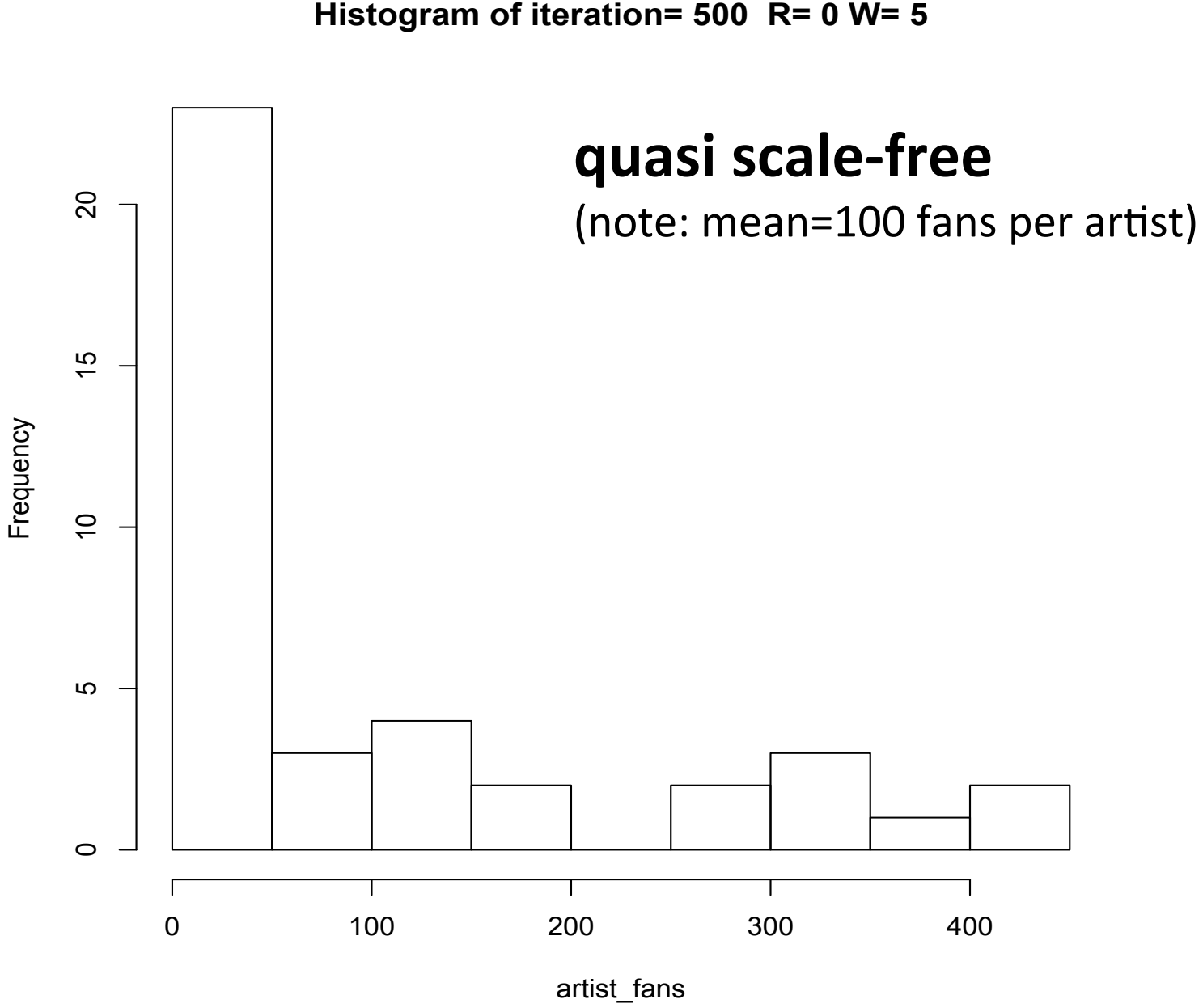
(highlighting fans of randomly selected artist in red)



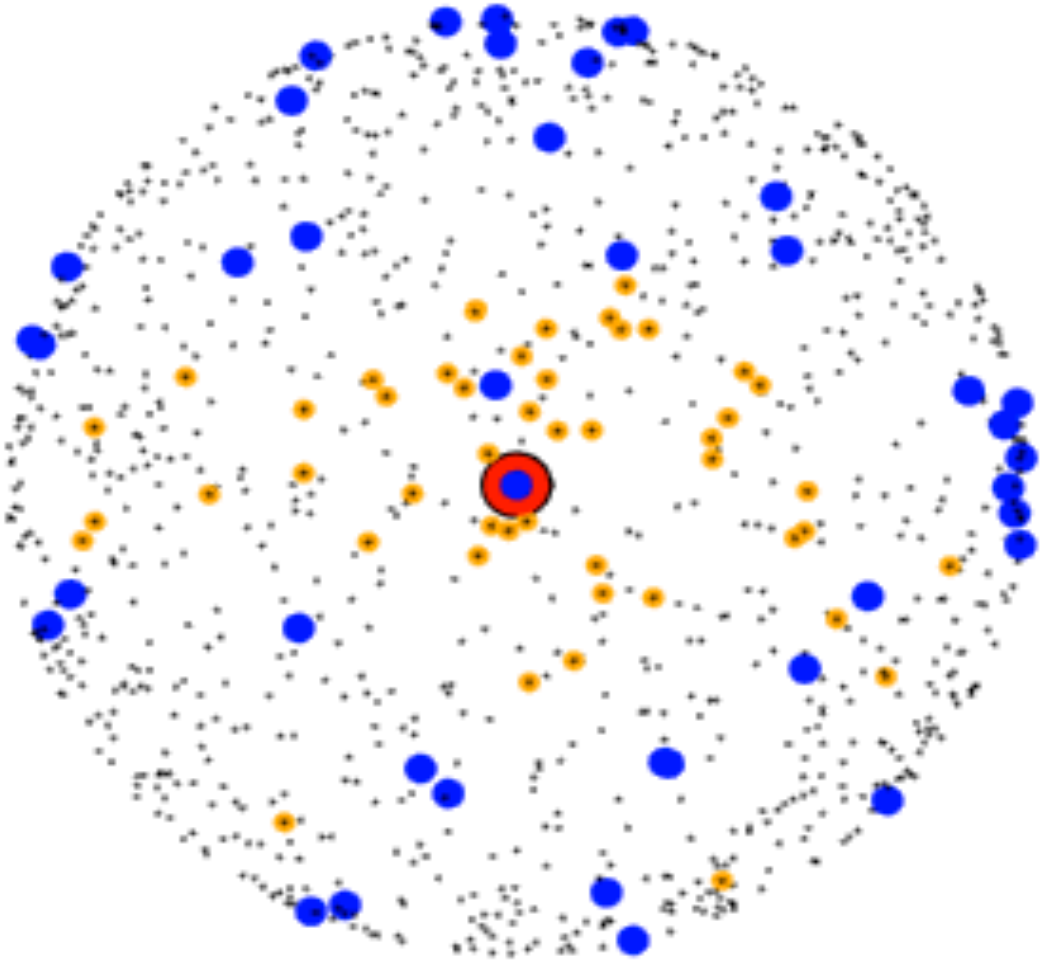

Histogram of iteration= 500 R= 0 W= 0
quasi binomial
(note: mean=100 fans per artist)
Frequency
0
2
4
6
8
80
90
100
110
120
artist_fans

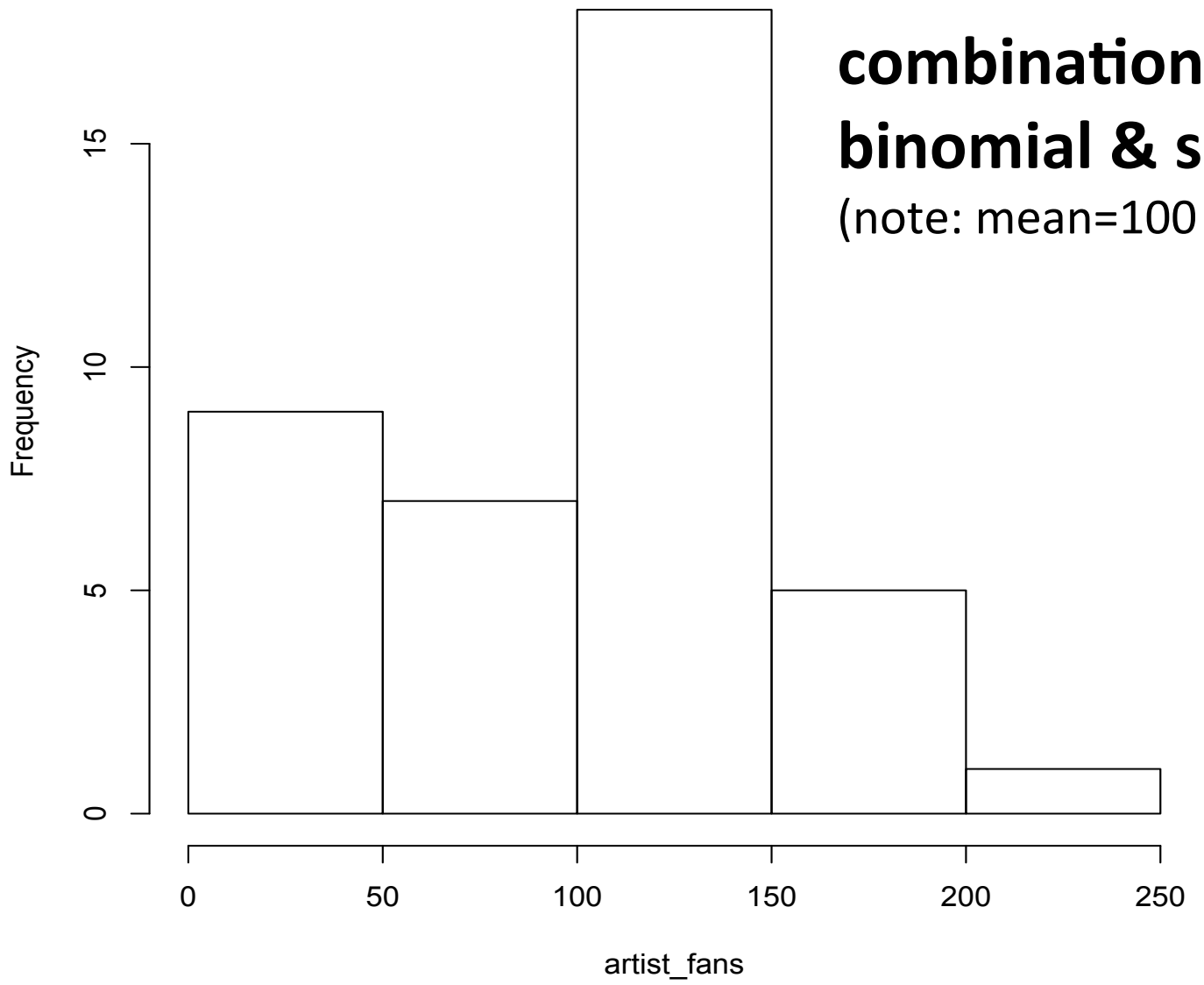
R=0 W=5:
No distance penalty, preferential attachment.
Artists in blue, fans in black
(highlighting fans of randomly selected artist in red)




Histogram of iteration= 500 R= 0 W= 5
quasi scale-free
(note: mean=100 fans per artist)
Frequency
0
5
10
15
20
0
100
200
300
400
artist_fans

R=5 W=5:
Distance penalty, preferential attachment.
Artists in blue, fans in black
(highlighting fans of randomly selected artist in red)

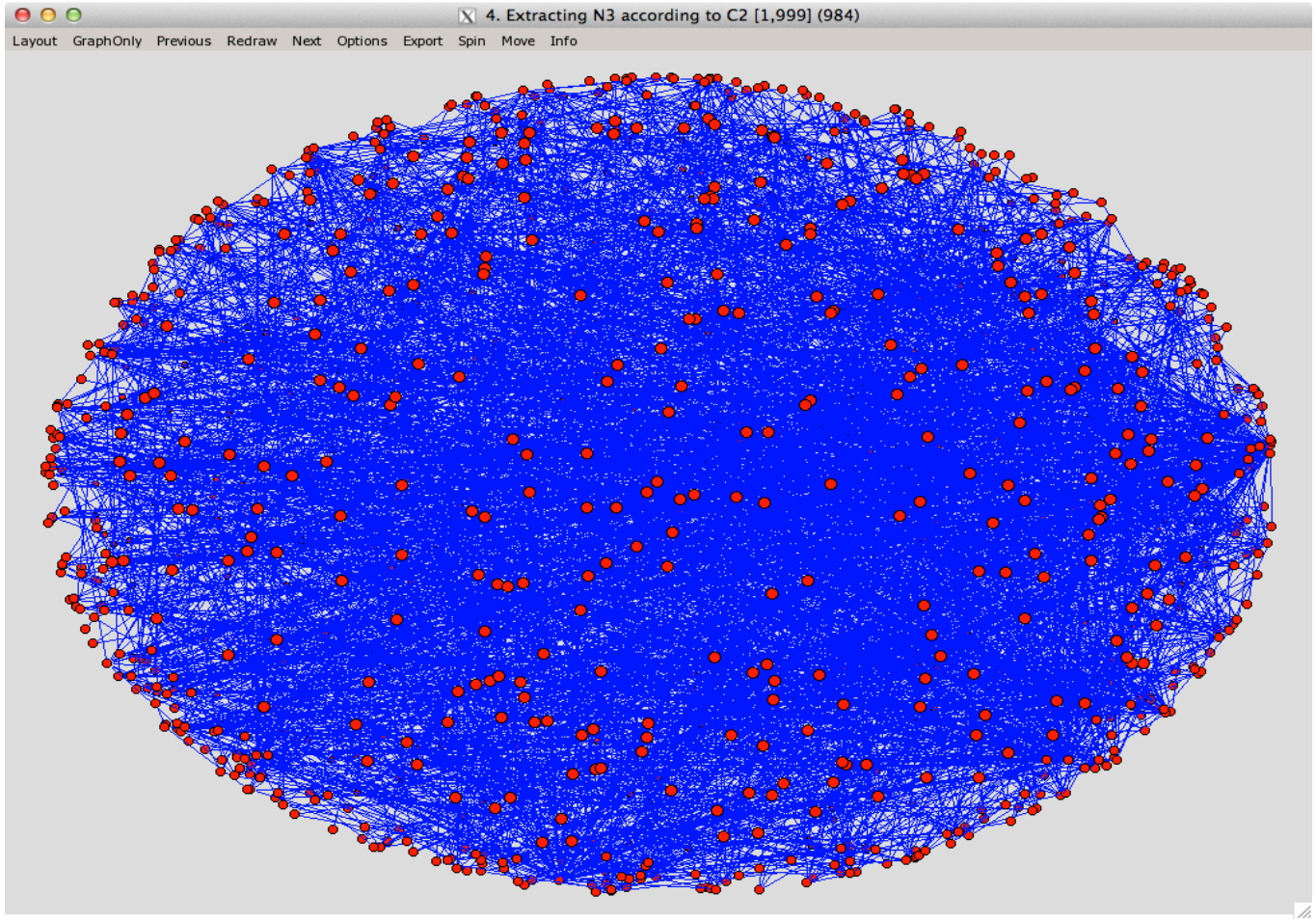



Histogram of iteration= 500 R= 5 W= 5
Frequency
0
5
10
15
0
50
100
150
200
250
artist_fans
combination:
binomial & scale-free
(note: mean=100 fans per artist)

What happens to the corresponding affiliation networks? Analysis:

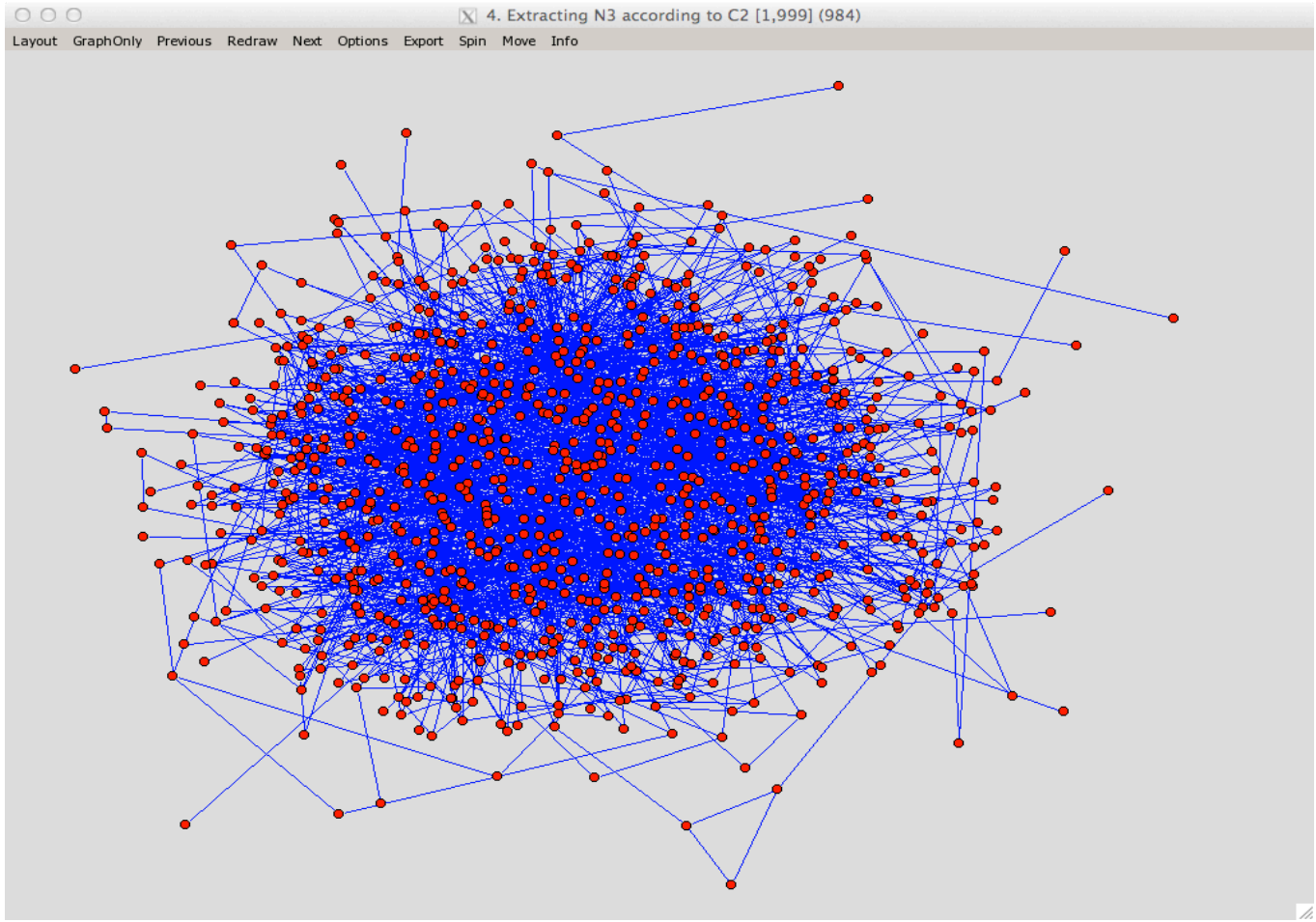
- The R simulation outputs 2-mode affiliation networks connecting artists and fans
- These are read into Pajek, a social network analysis package
- Pajek generates the 1-mode affiliation network revealing fan-fan relations.
- We remove lines with lower values, in order to examine only high value links, and drop disconnected nodes…
- We then examine the results both on the sphere, and as an energized graph…
- Qualitatively different structures emerge in each case.

R=0, W=0: on sphere (baseline)



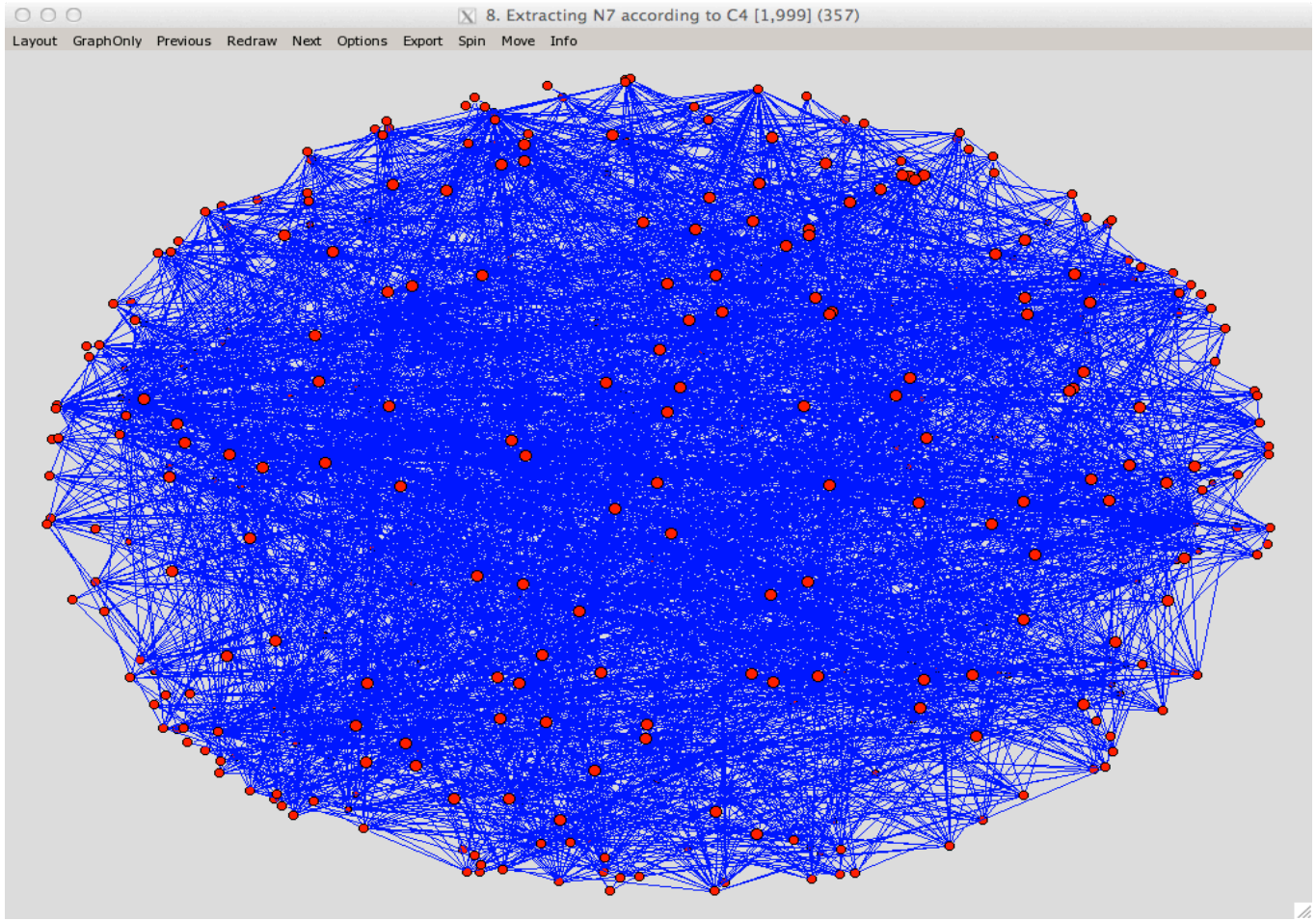
Baseline case: no preferential attachment or distance penalty.
Random structure on the sphere….

R=0, W=0: energized (baseline)



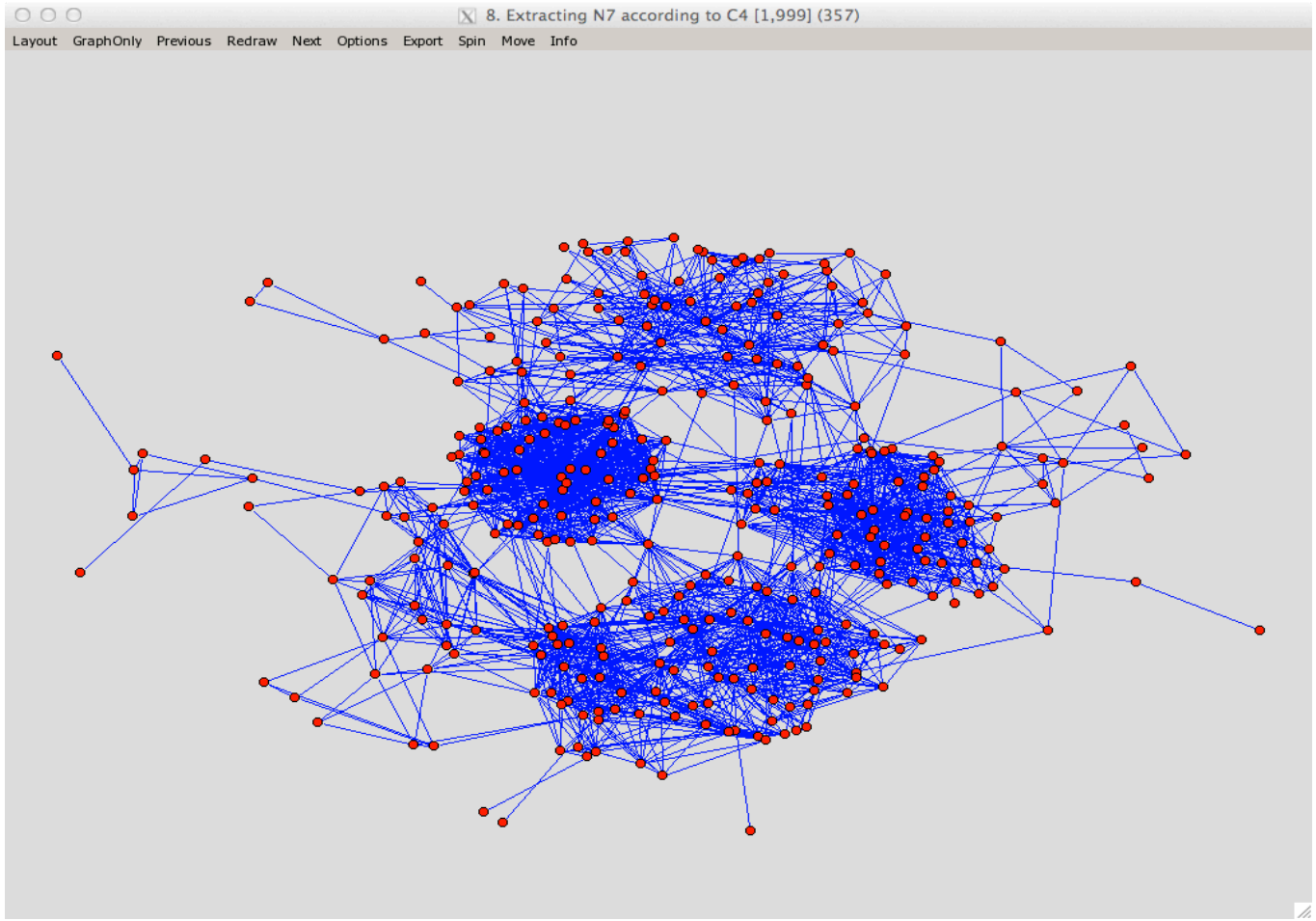
No hidden global structure either….all looks random.

R=0, W=5: on sphere (popular music)



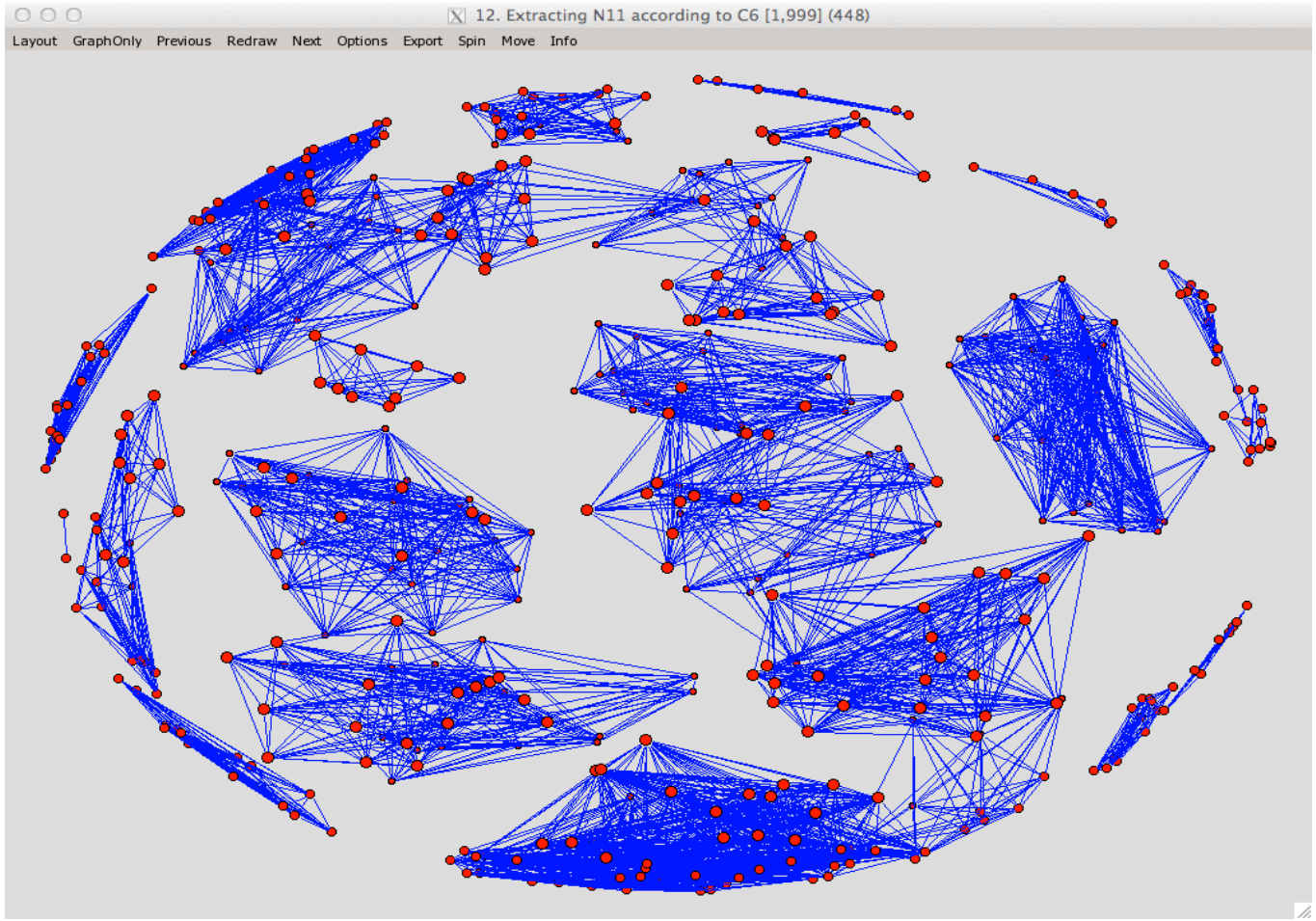
Preferential attachment with no distance penalty reveals no local structure on the sphere….

R=0, W=5: energized (popular music)



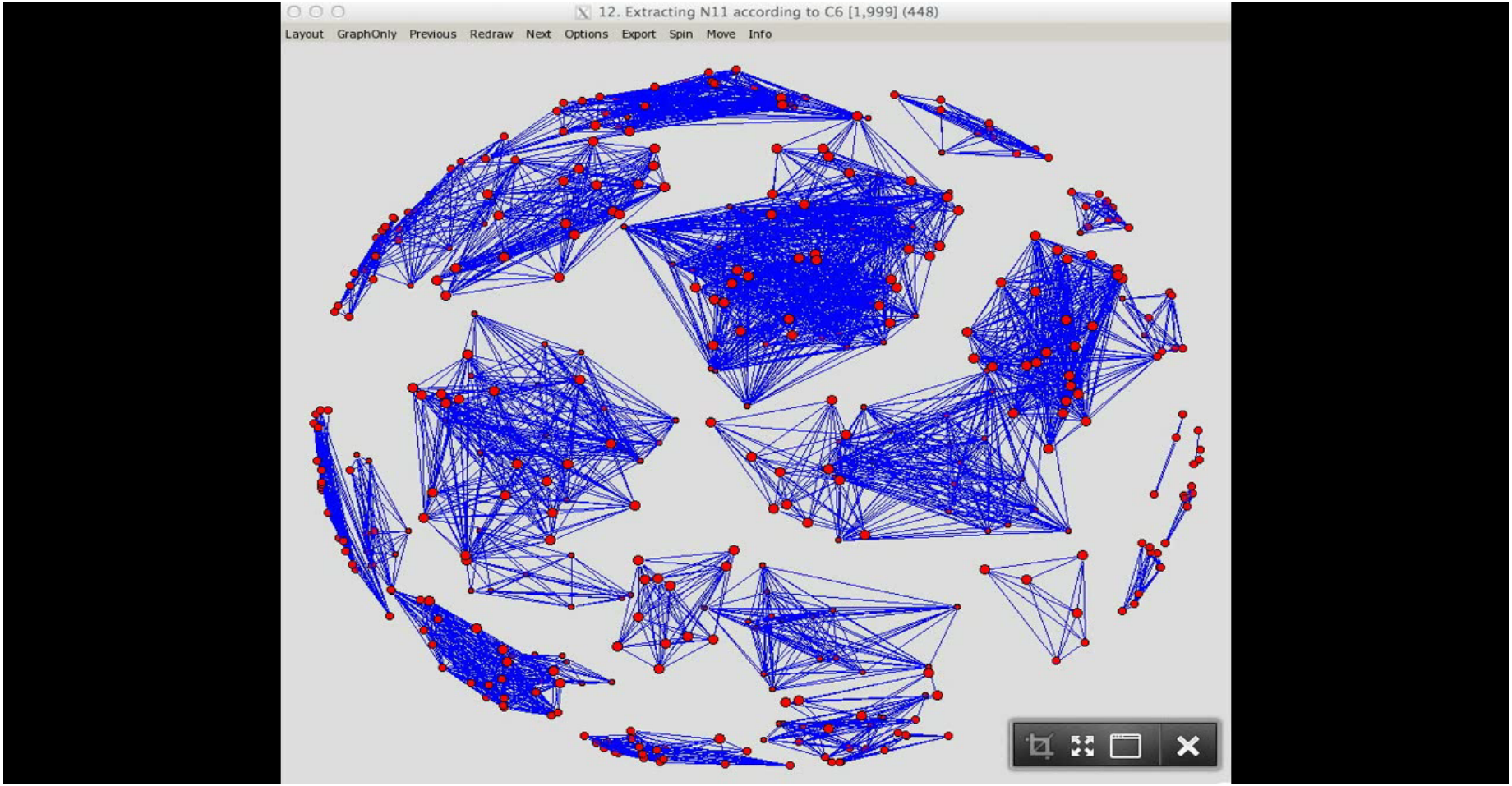
…but energizing reveals hidden global structure: clustered groups

R=5, W=5: on sphere (traditional music)



Finally, preferential attachment with distance penalty generates local structure on the sphere…as we can see in the following video.

R=5, W=5: on sphere (traditional music)



Conclusions: simulated models of popular and traditional music induce completely different kinds of affiliation network

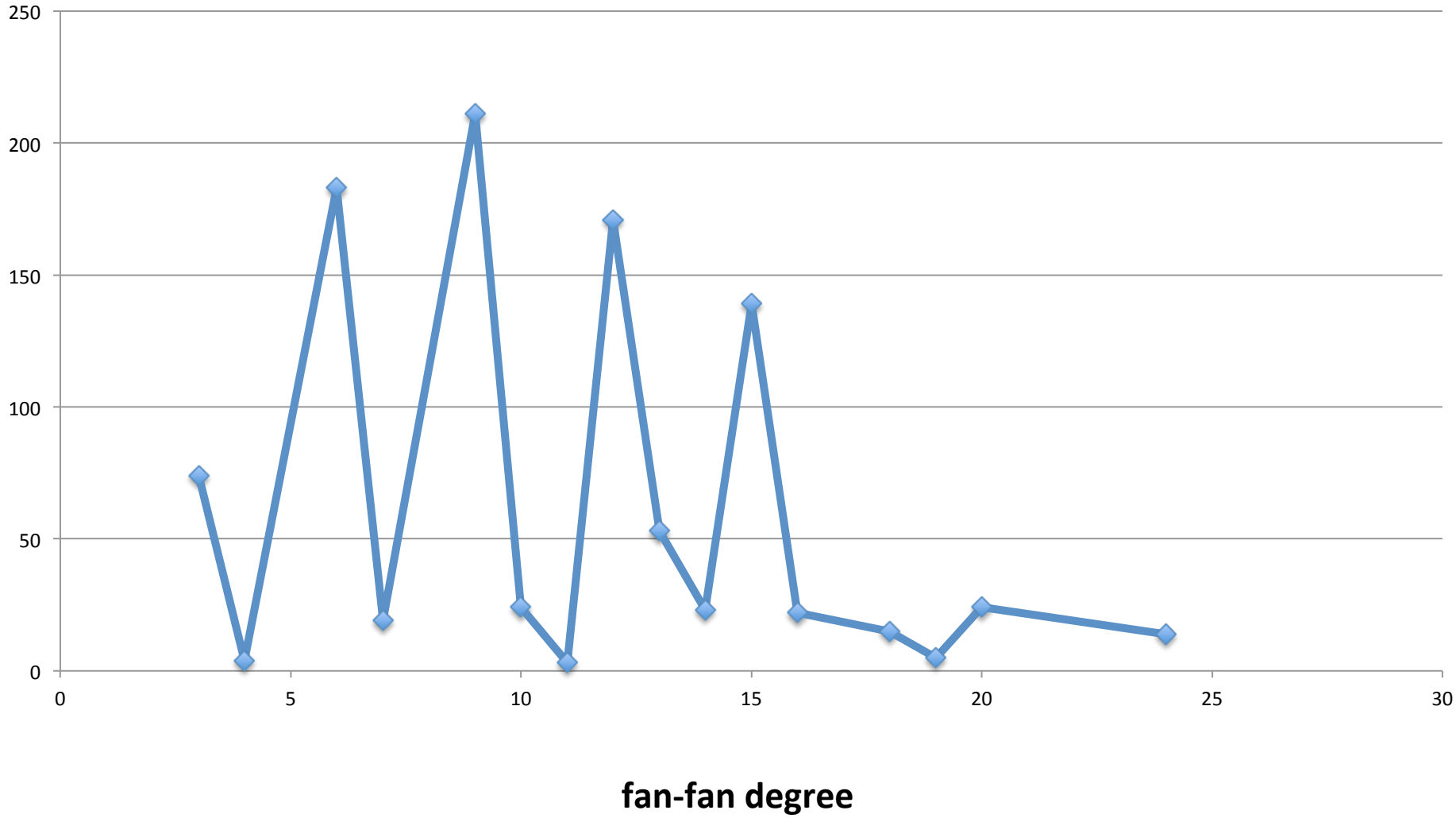
- **Popular music:** Pure preferential attachment induces scale free degree distribution, globally clustered 1-mode network
- **Traditional music:** Distance-limited preferential attachment induces combination binomial/scale-free distribution, locally clustered 1-modenetwork
- These results suggest that we seek real world data and confirm (or disconfirm) these patterns.

Future research

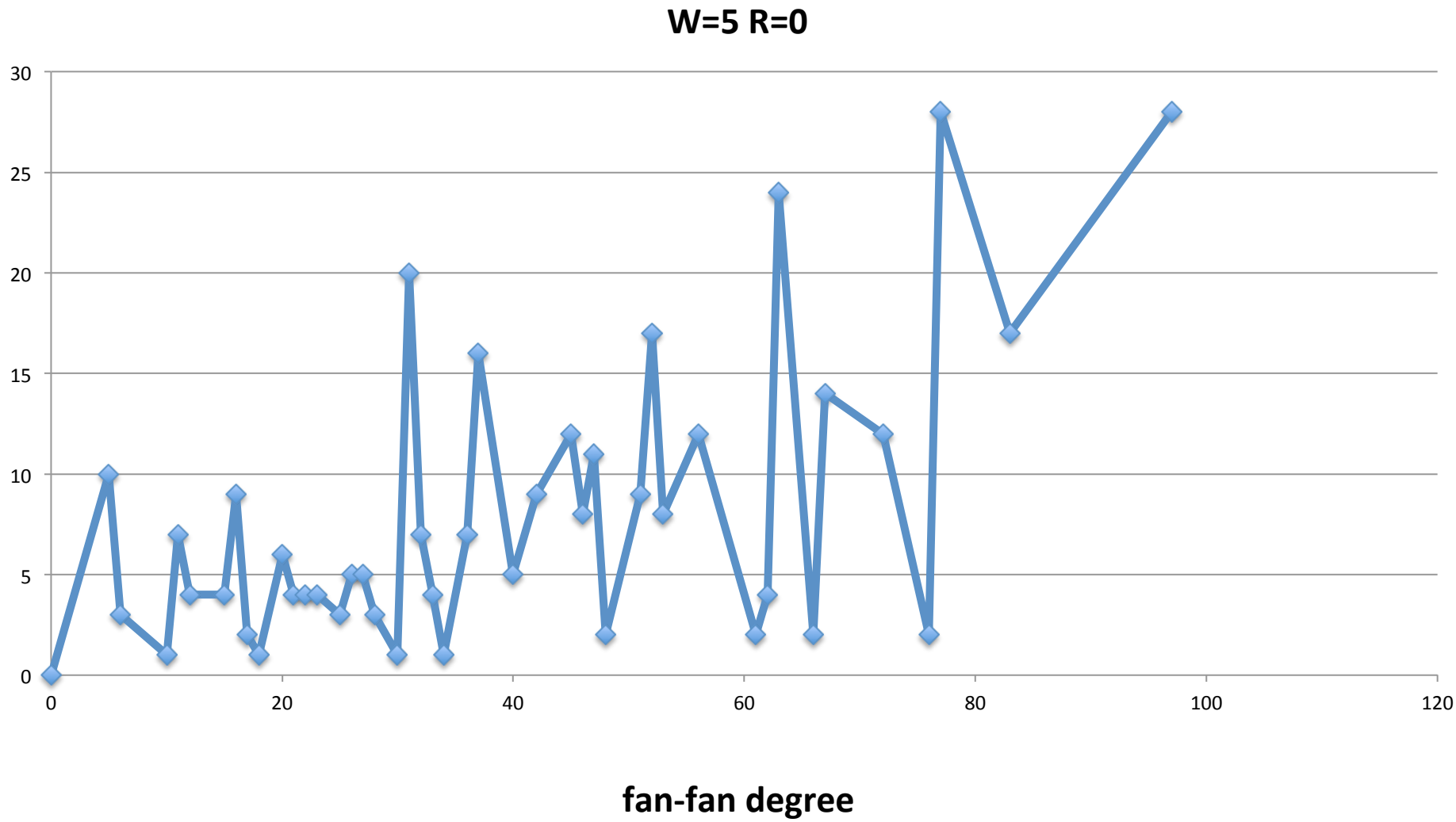
- Simulate with much larger numbers of artists and fans
- Estimate statistical reliability as a function of iterations
- Does the system enter steady state? Potential for "chaotic" behavior?
- Locate parametric "tipping points" where local shifts to global, and binomial distribution shifts to scale free
- **Estimate empirical validity of mathematical simulations by gathering real-world data!**

  (not so easy to do for traditional music, but very important…and appropriate for ethnomusicology!)

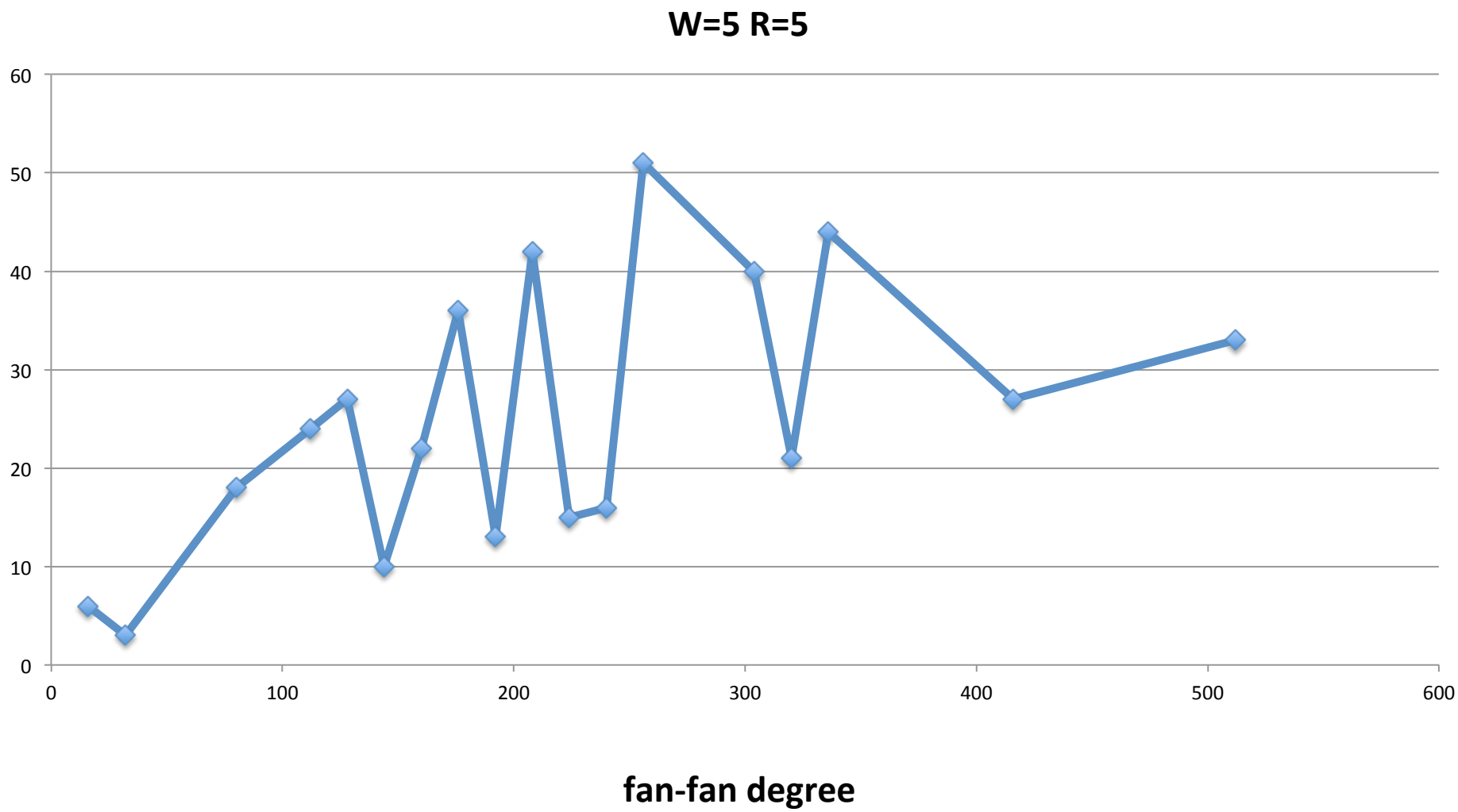
R=0, W=0: 1-mode degree distribution



R=0, W=5: 1-mode degree distribution



R=5, W=5: 1-mode degree distribution



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Appendix

Coordinate system and distance metric on sphere

- Coordinates are given in a variant of the usual latitude (-90 to +90) and longitude (-180 to +180) ranges, by instead using radians and defining latitude and longitude in terms of spherical coordinates: then the latitude range is (0 to pi), and longitude range is (0 to 2*pi). The great circle distance can be computed as follows (assuming a sphere of radius 1):
- # arccos (cos lat1 * cos lat2 + sin lat 1 * sin lat 2 * cos (lon 1 - lon 2))
- distance <- function(lat1,lon1,lat2,lon2) {acos (cos (lat1) * cos (lat2) + sin (lat1) * sin(lat2) * cos (lon1 - lon2))}

Random distribution of points on a sphere

- # To obtain points such that any small area on the sphere is expected to contain the same number of points, choose U and V to be random variates on [0,1]. Then let longitude = 2pi * U, and latitude = acos (2V-1).
- long <- 2*pi*runif()
- lat <- acos(2*runif()-1)

related question:
what accounts for fame?

- intrinsic musical properties (content begets fame)
- network properties (fame begets fame)

traditional media:

“I buy a classical record because it’s good”

Viral media: “I download a video because it’s famous”

- Gangnam style
- Harlem shake