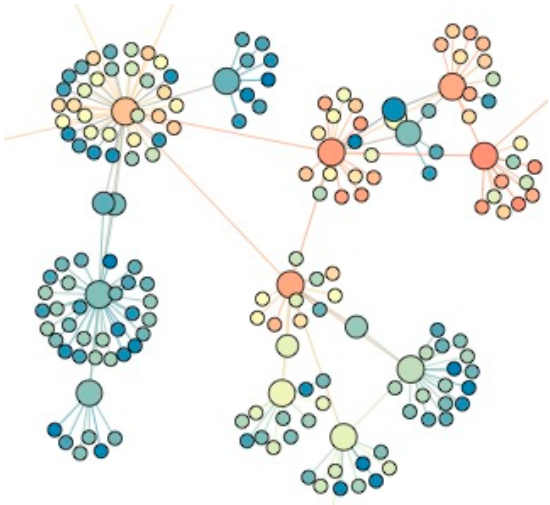


SNA 2A:
Intro to Random Graphs

Lada Adamic

school of information

Network models

- Why model?
  - simple representation of complex network
  - can derive properties mathematically
  - predict properties and outcomes

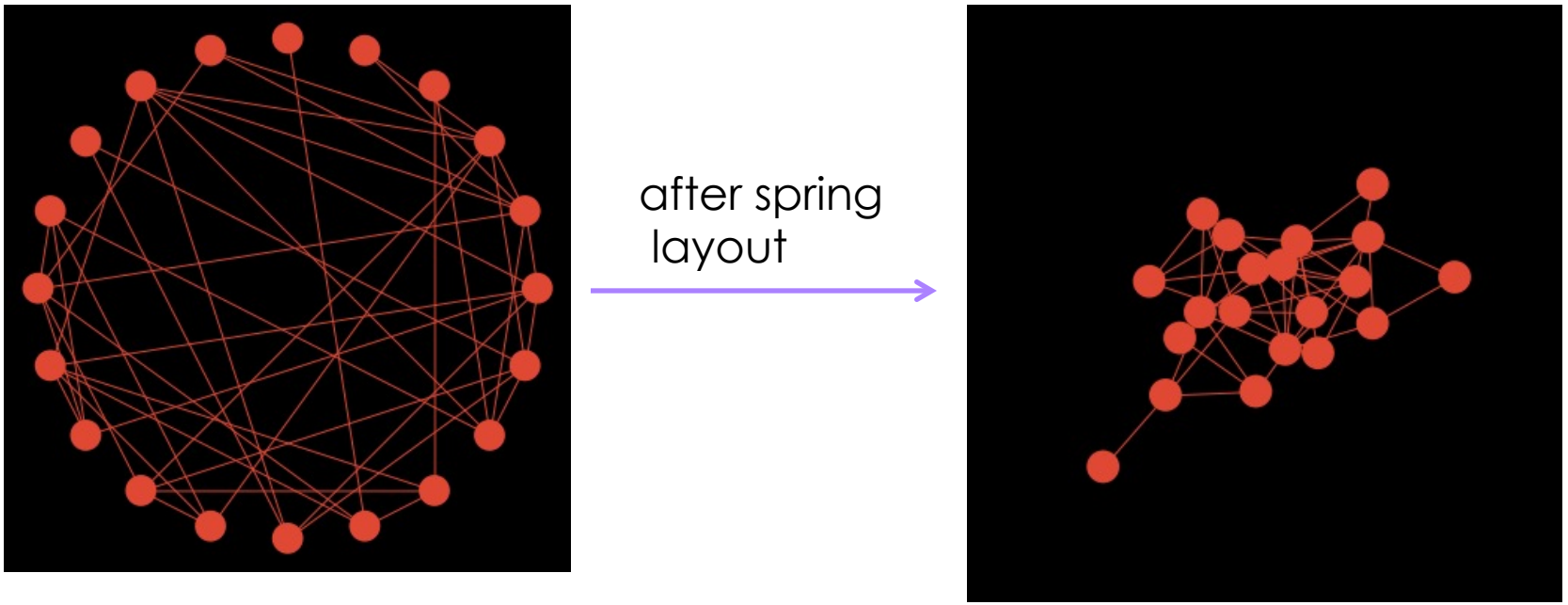
- Also: to have a strawman
  - In what ways is your real-world network different from hypothesized model?
  - What insights can be gleaned from this?

Erdös and Rényi

Erdös-Renyi: simplest network model

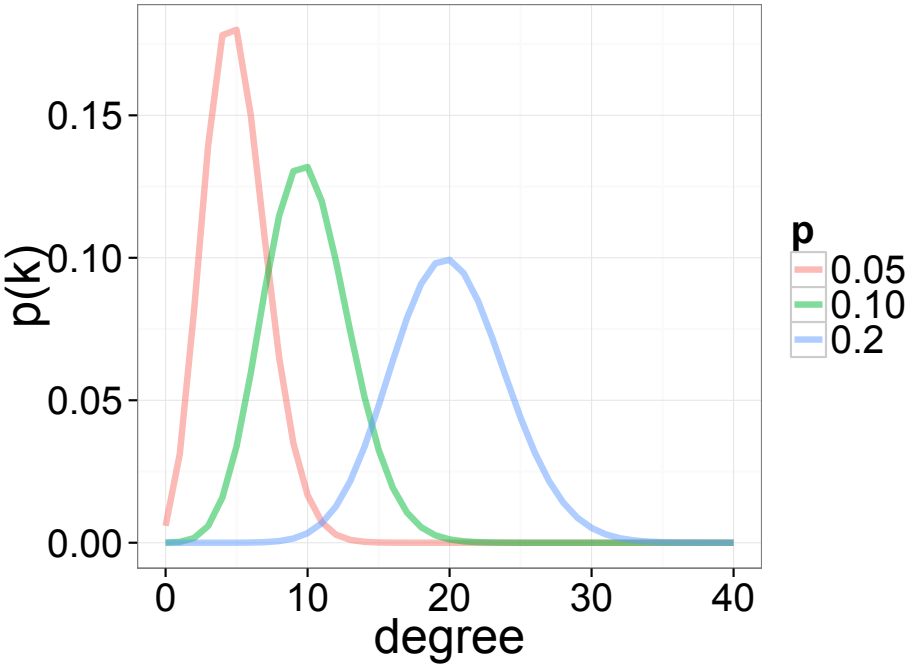
- Assumptions
  - nodes connect at random
  - network is undirected
- Key parameter (besides number of nodes N) : p or M
  - p = probability that any two nodes share and edge
  - M = total number of edges in the graph

what they look like

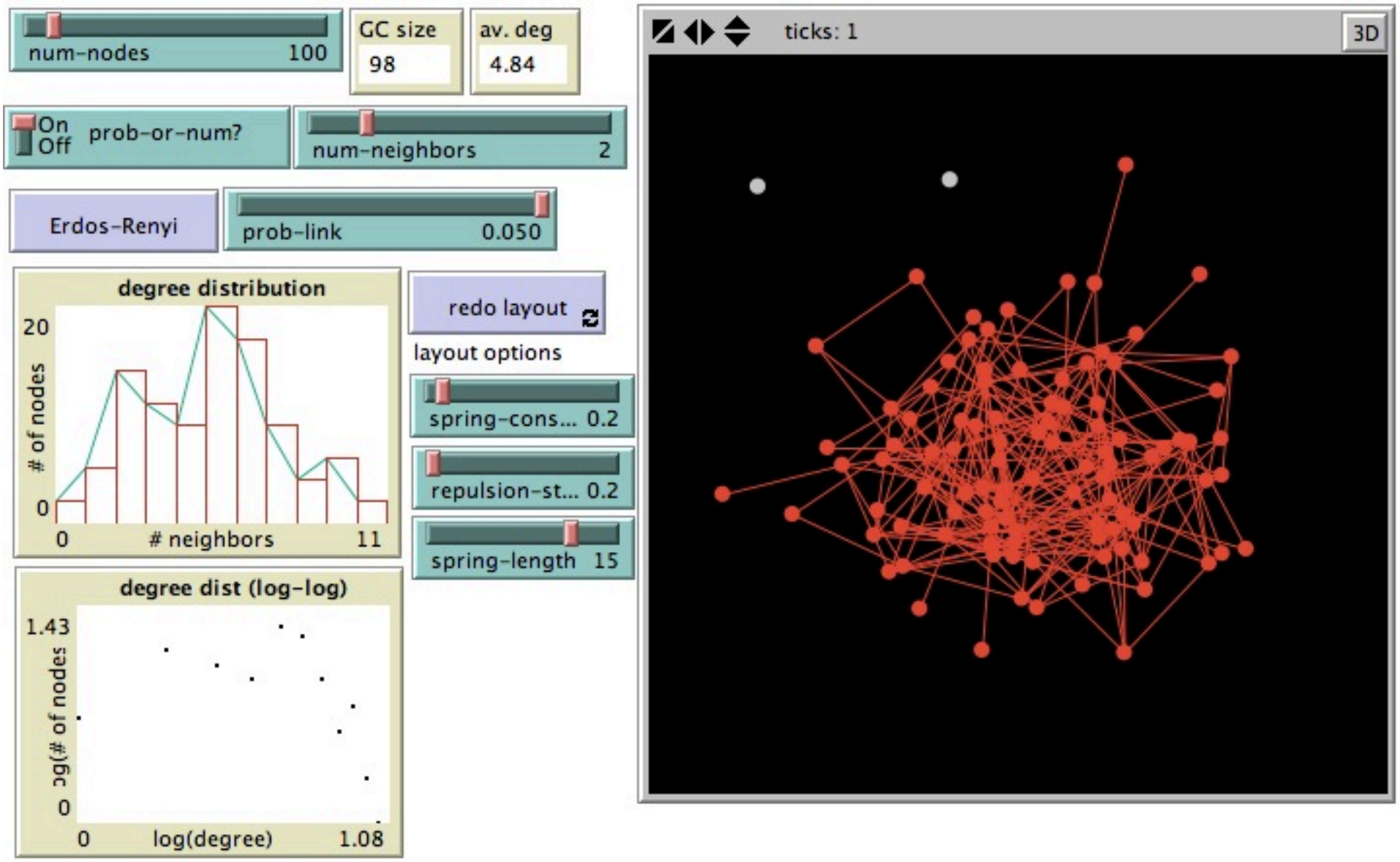


Binomial degree distribution

- (N-1,p)-model: For each potential edge we flip a biased coin
  - with probability p we add the edge
  - with probability (1-p) we don't



Can be approximated by Poisson distribution



http://ladamic.com/netlearn/NetLogo501/ErdosRenyiDegDist.html

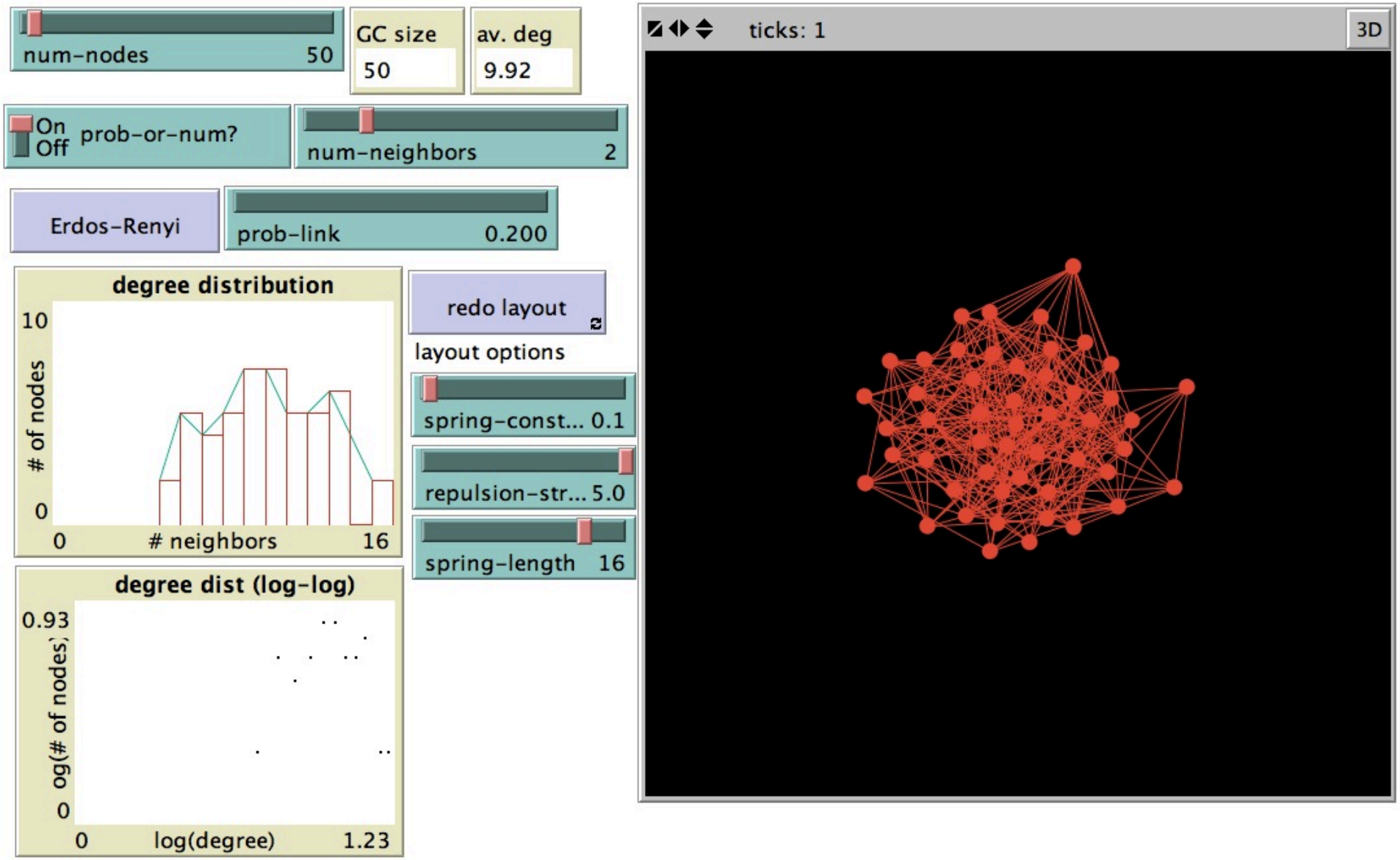
Degree distribution

- What is the probability that a node has 0,1,2,3… edges?
- Probabilities sum to 1

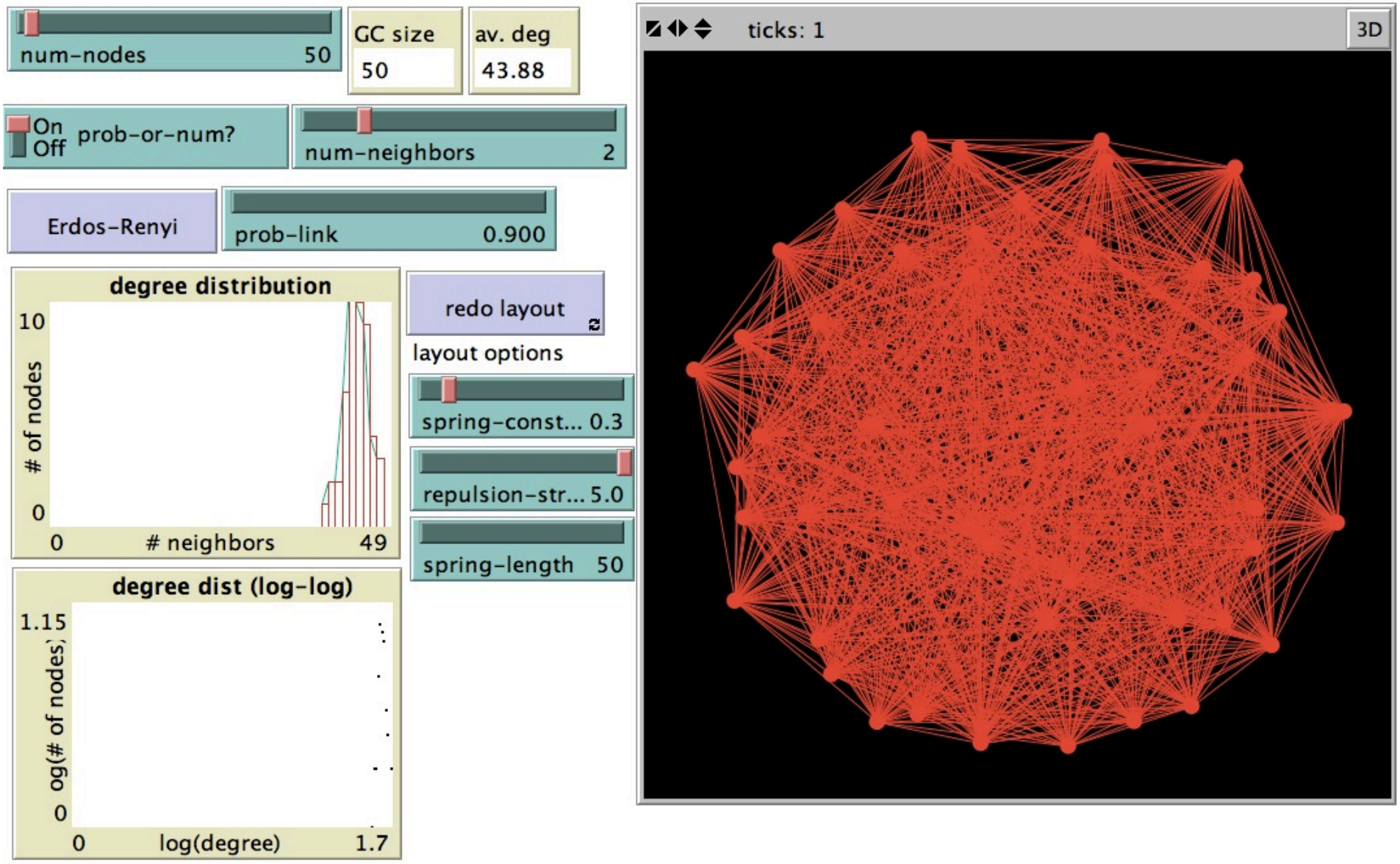
Quiz Q:

- The maximum degree of a node in a simple (no multiple edges between the same two nodes) N node graph is
  - a) N
  - b) N - 1
  - c) N / 2

N = 50, p = 0.2


num-nodes 50
GC size
50
av. deg
9.92
On
Off
prob-or-num?
num-neighbors 2
Erdos-Renyi
prob-link 0.200
degree distribution
10
# of nodes
0
0
neighbors
16
redo layout
layout options
spring-const... 0.1
repulsion-str... 5.0
spring-length 16
degree dist (log-log)
0.93
og(# of nodes)
0
0
log(degree)
1.23
ticks: 1
3D

N = 50, p = 0.9


num-nodes 50
GC size
50
av. deg
43.88
On
Off
prob-or-num?
num-neighbors 2
Erdos-Renyi
prob-link 0.900
degree distribution
10
# of nodes
0
0
neighbors
49
redo layout
layout options
spring-const... 0.3
repulsion-str... 5.0
spring-length 50
degree dist (log-log)
1.15
og(# of nodes)
0
0
log(degree)
1.7
ticks: 1
3D

Quiz Q:

- What is the approximate average degree of a graph with 100 nodes and probability p = 0.04 of an edge existing between any two nodes?
  - 1
  - 2
  - 3
  - 4

Quiz Q:

- As the size of the network increases, if you keep ***p***, the probability of any two nodes being connected, the same, what happens to the average degree
  - a) stays the same
  - b) increases
  - c) decreases

http://ladamic.com/netlearn/NetLogo501/ErdosRenyiDegDist.html

What insights does this yield? No hubs

- You don't expect large hubs in the network