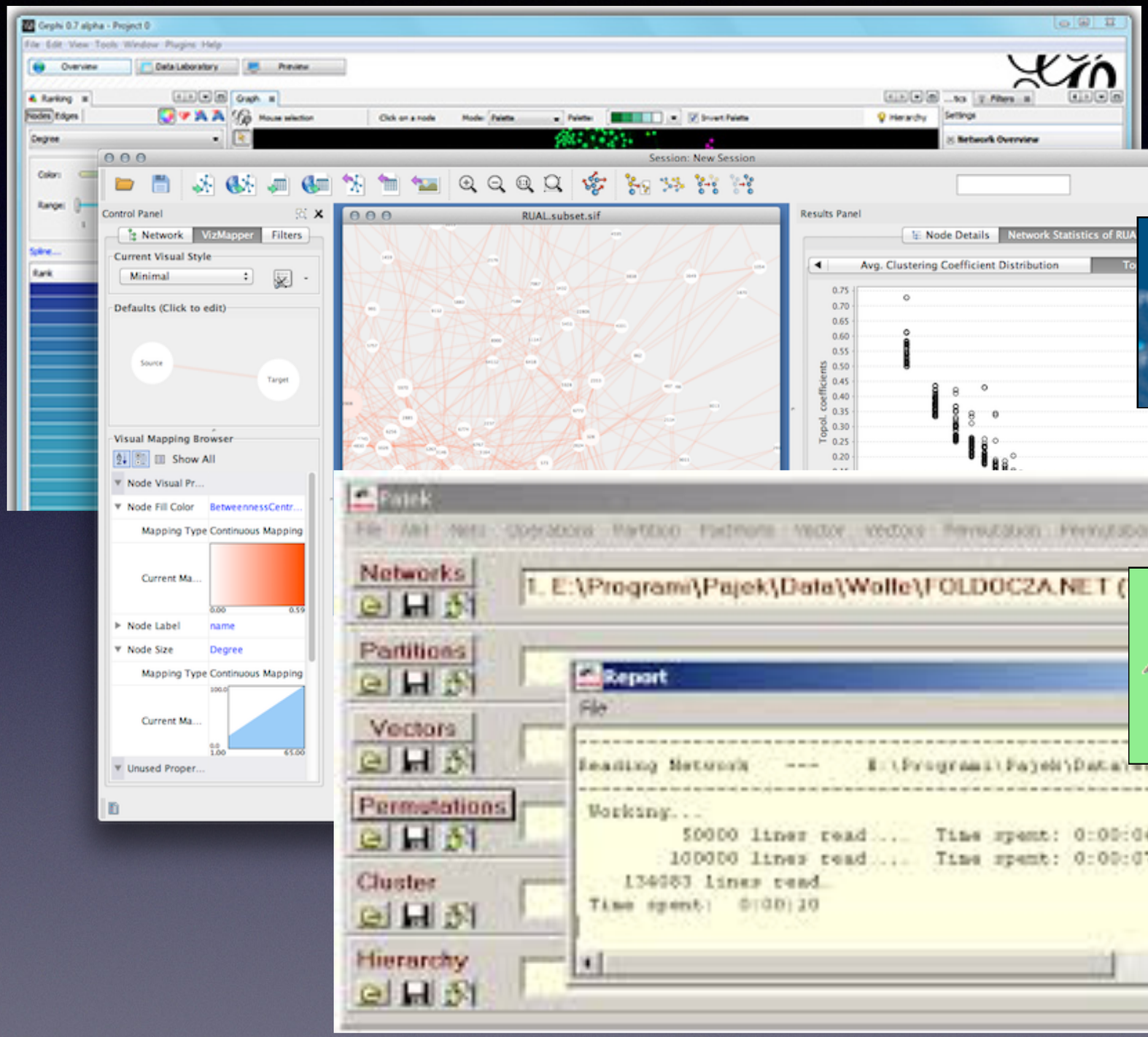
SIR on Networks

Sergi Valverde
COMPLEX DISEASES

Network Visualisation & Analysis



Gephi
makes graphs handy

Cytoscape

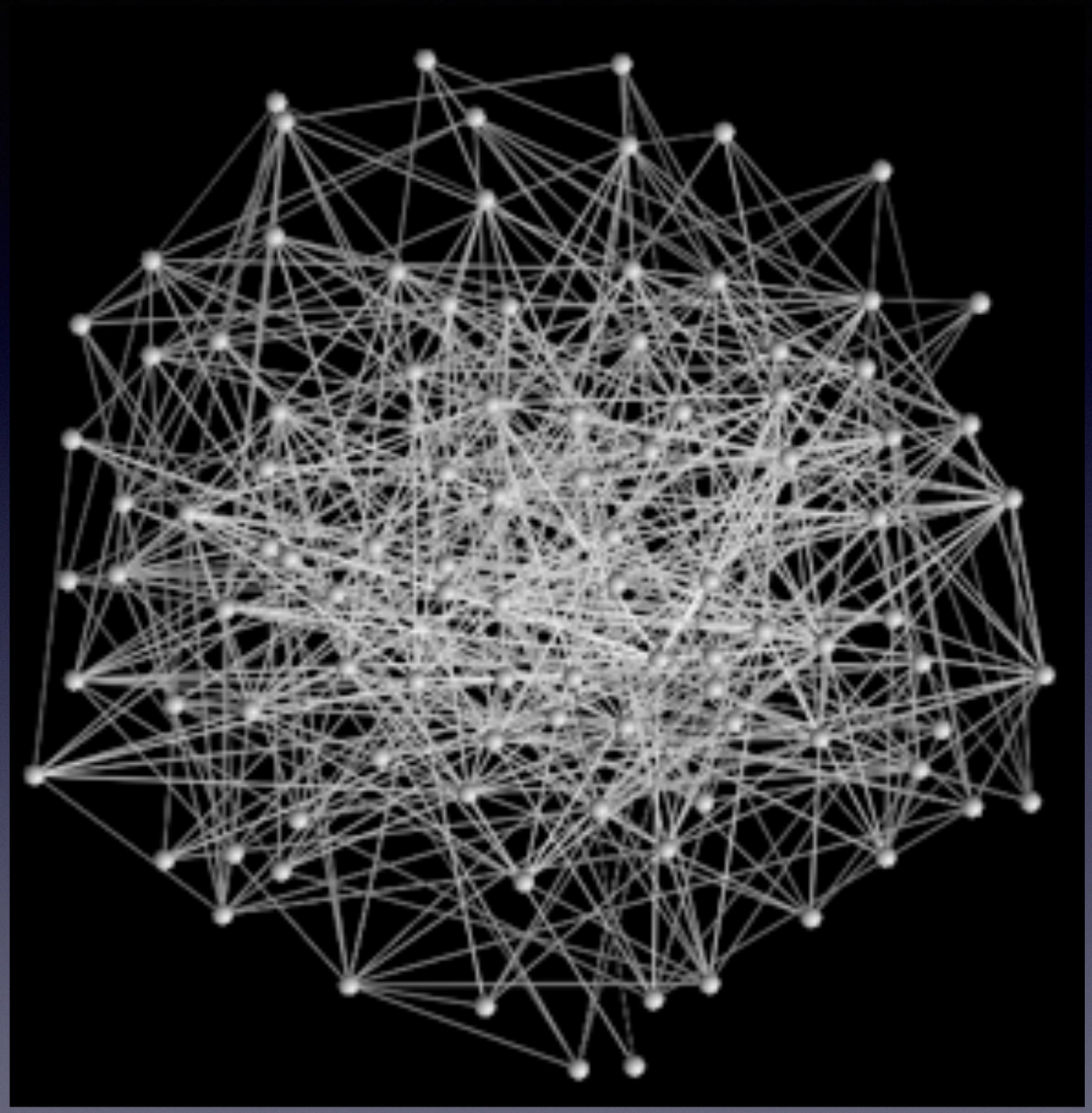
Networks / Pajek

Program for Large Network Analysis

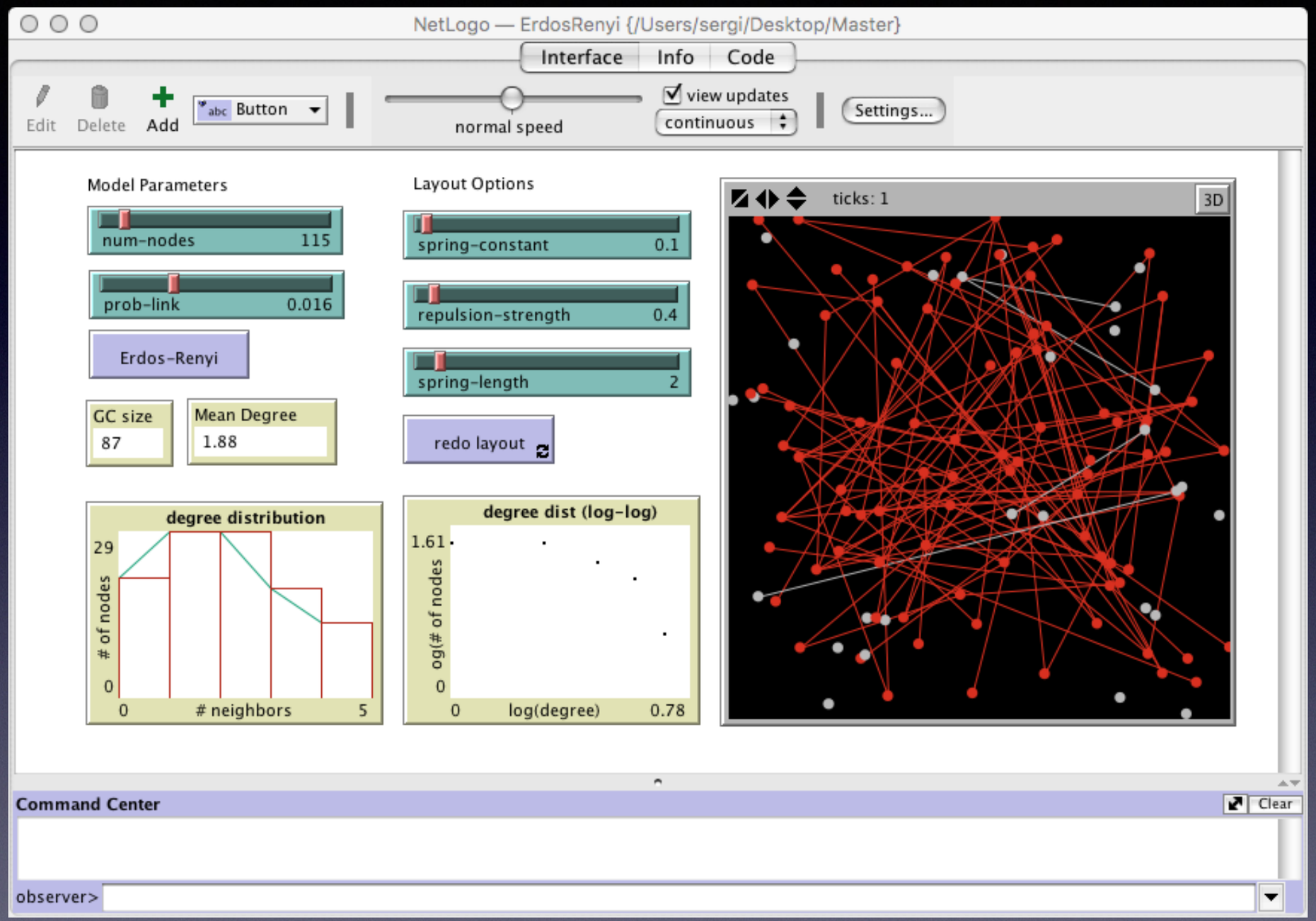
https://sites.google.com/site/introcomplexnetworks/

Random Graphs

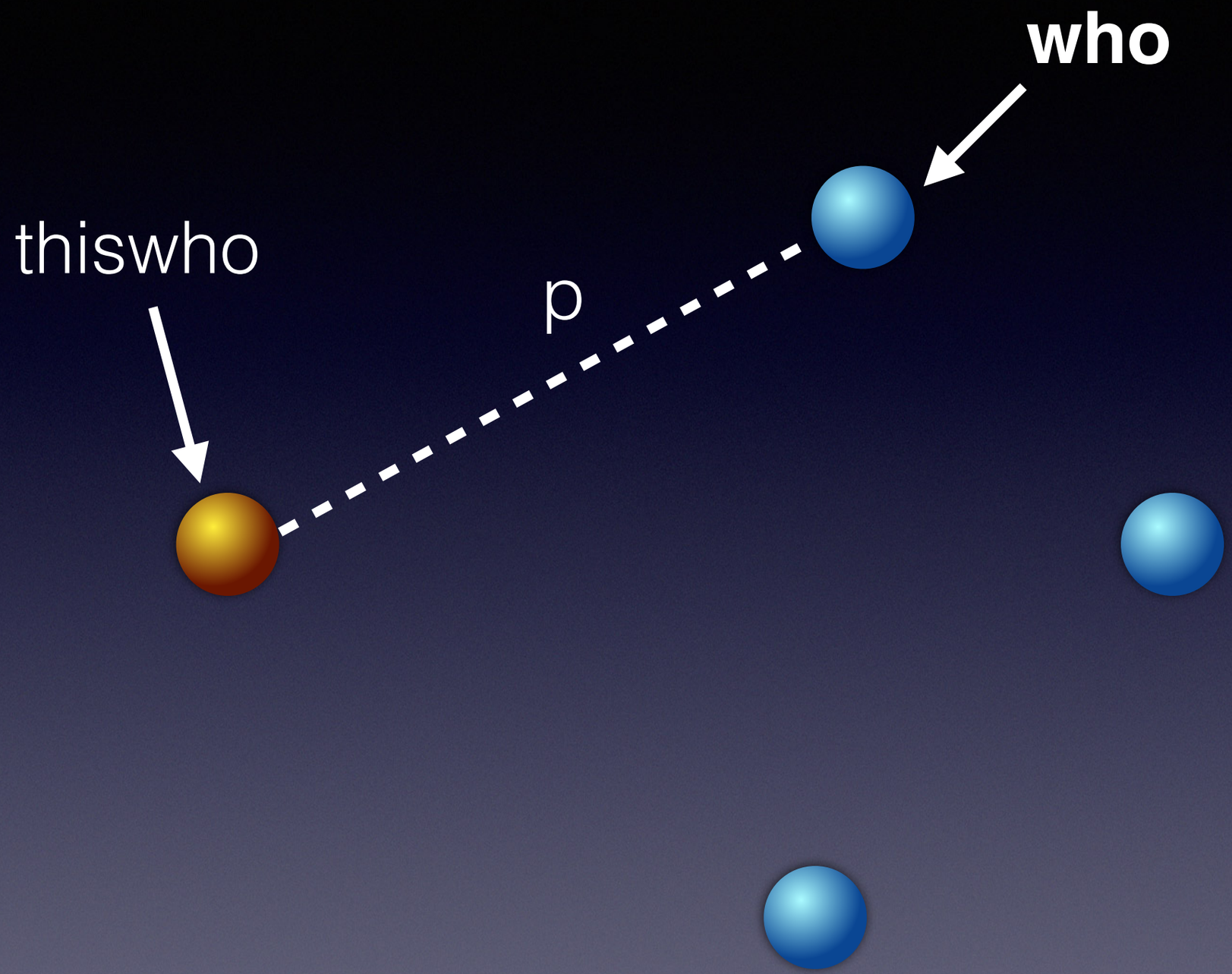
Pál Erdös
(1913-1996)



ErdosRenyi.nlogo

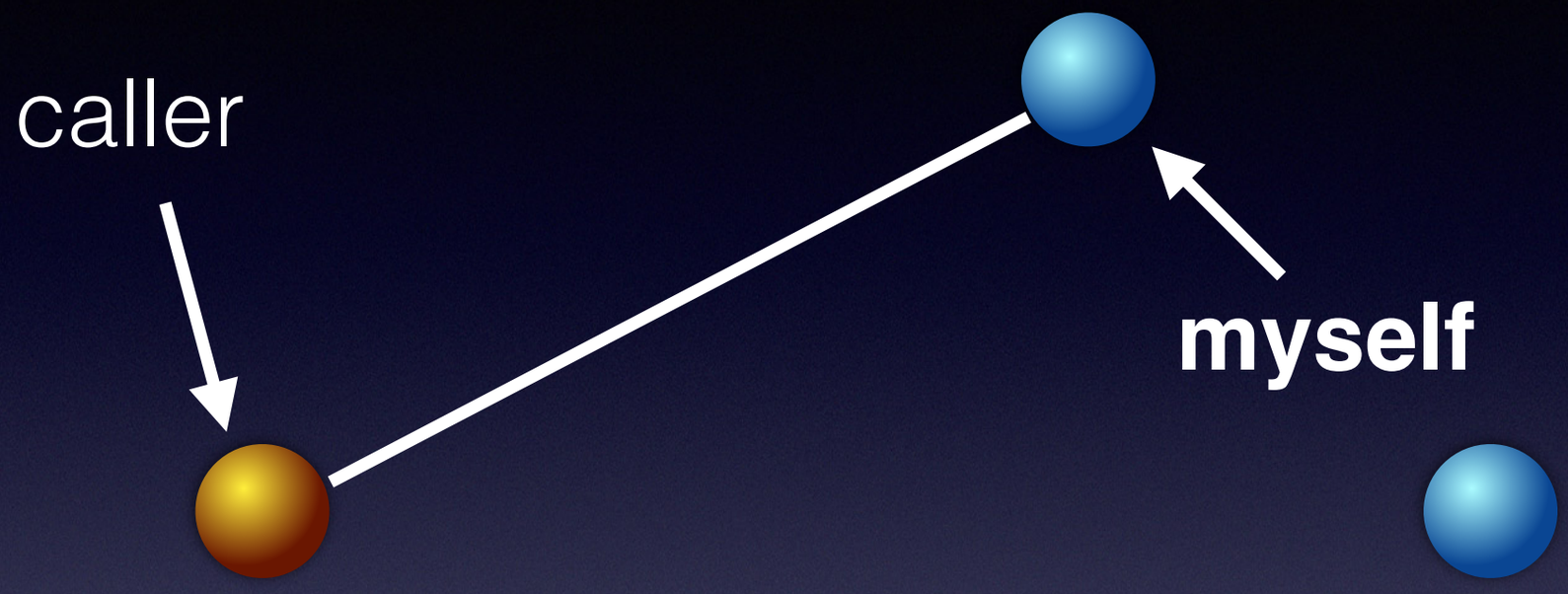


How it works?



How it works?

`create-link-with myself`

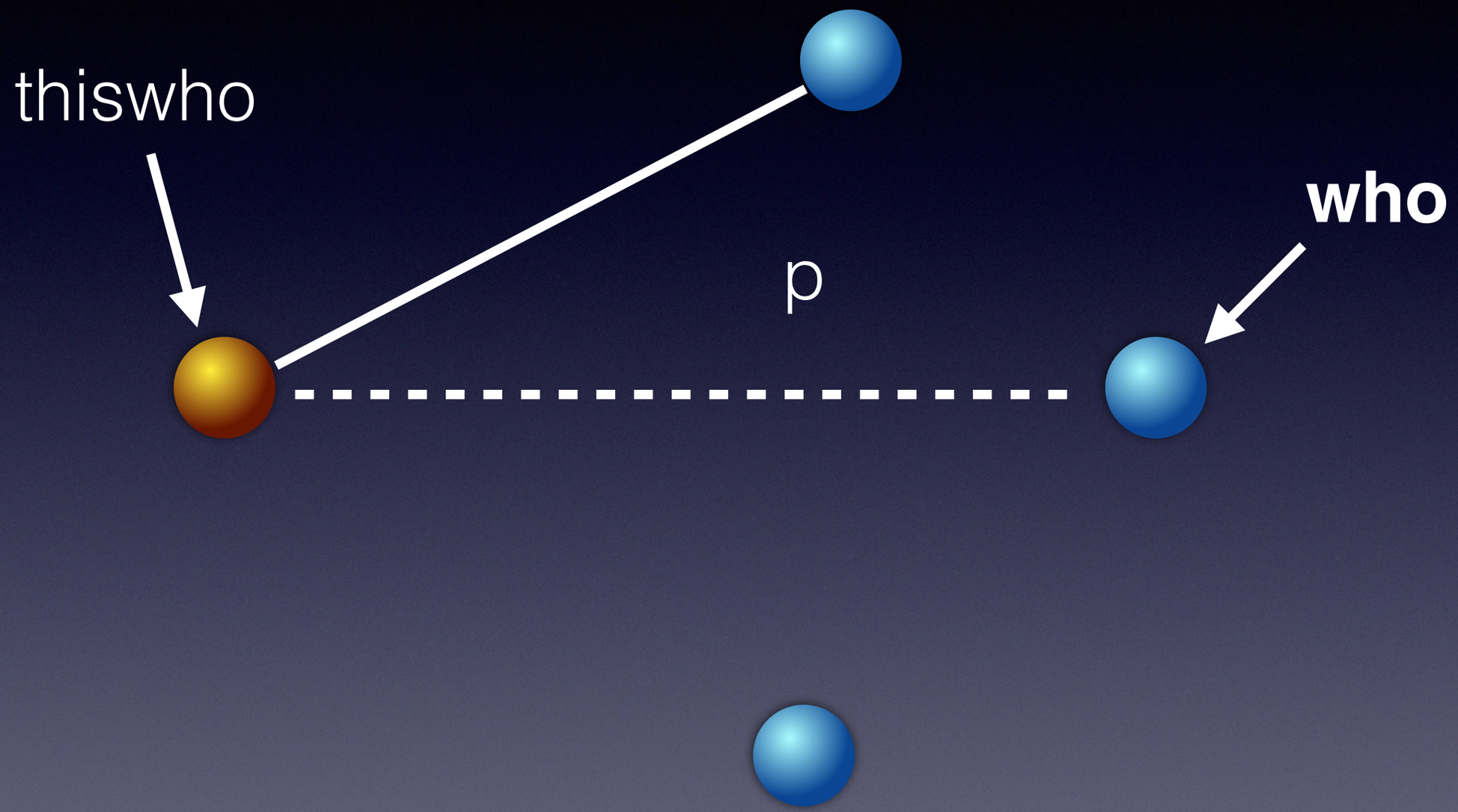


Links

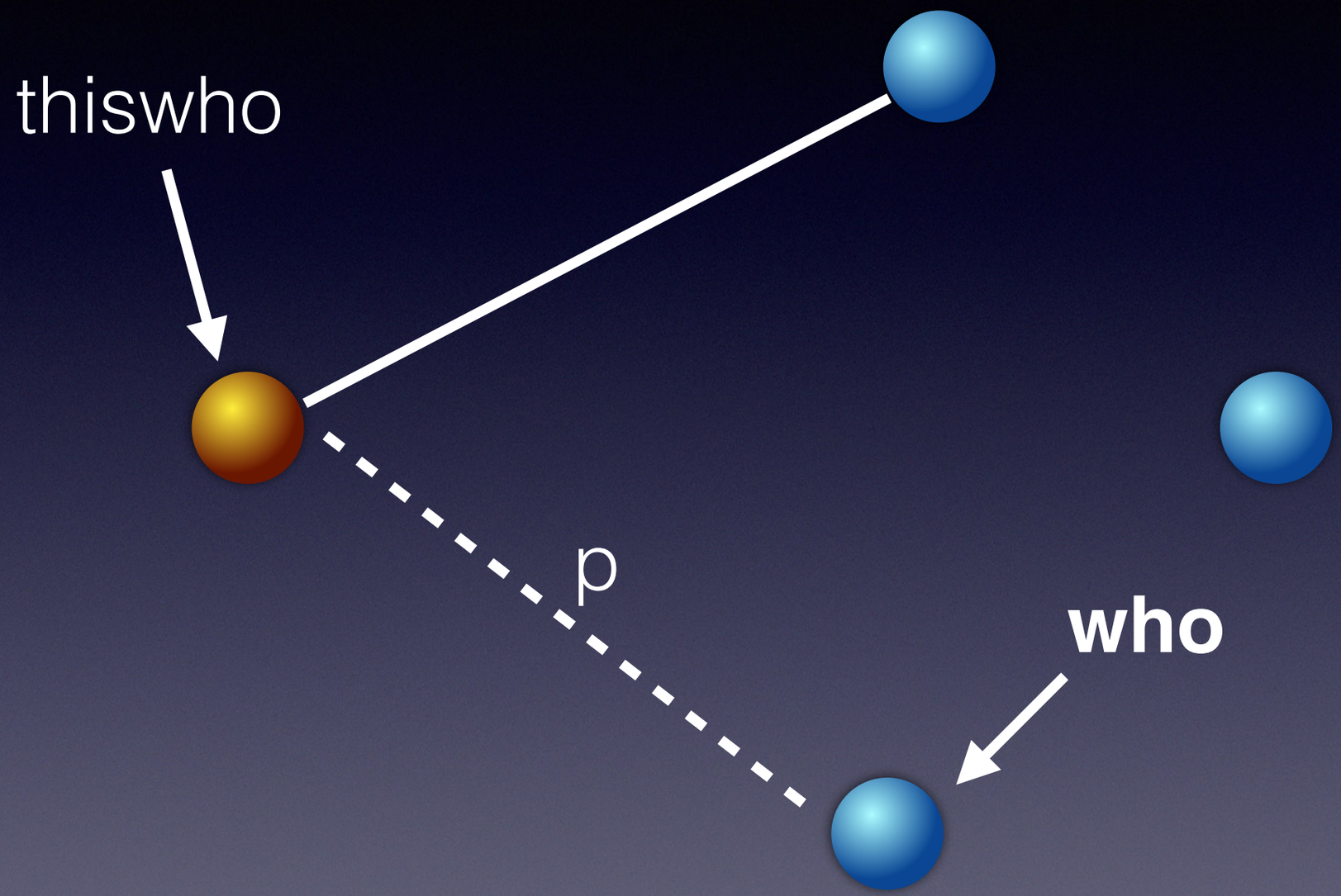
both-ends clear-links create-<breed>-from create-<breeds>-from create-<breed>-to create-<breeds>-to create-<breed>-with create-<breeds>-with create-link-from create-links-from create-link-to create-links-to create-link-with create-links-with die hide-link in-<breed>-neighbor? in-<breed>-neighbors in-<breed>-from in-link-neighbor? in-link-neighbors in-link-from is-directed-link? is-link? is-link-set? is-undirected-link? layout-radial layout-spring layout-tutte <breed>-neighbor? <breed>-neighbors <breed>-with link-heading link-length link-neighbor? link links links-own <link-breeds>-own link-neighbors link-with my-<breeds> my-in-<breeds> my-in-links my-links my-out-<breeds> my-out-links no-links other-end out-<breed>-neighbor? out-<breed>-neighbors out-<breed>-to out-link-neighbor? out-link-neighbors out-link-to show-link tie untie

How it works?

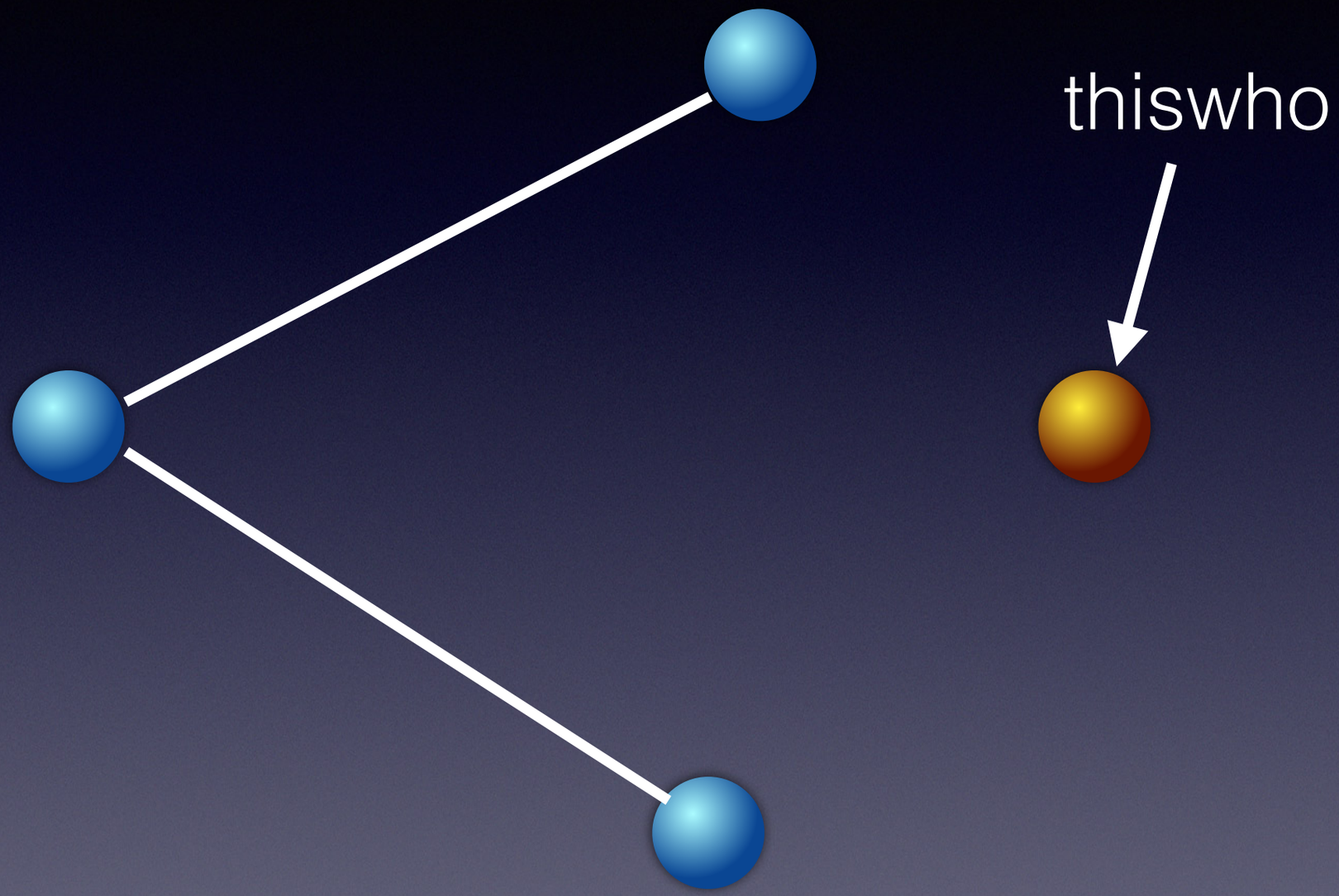
`create-link-with myself`



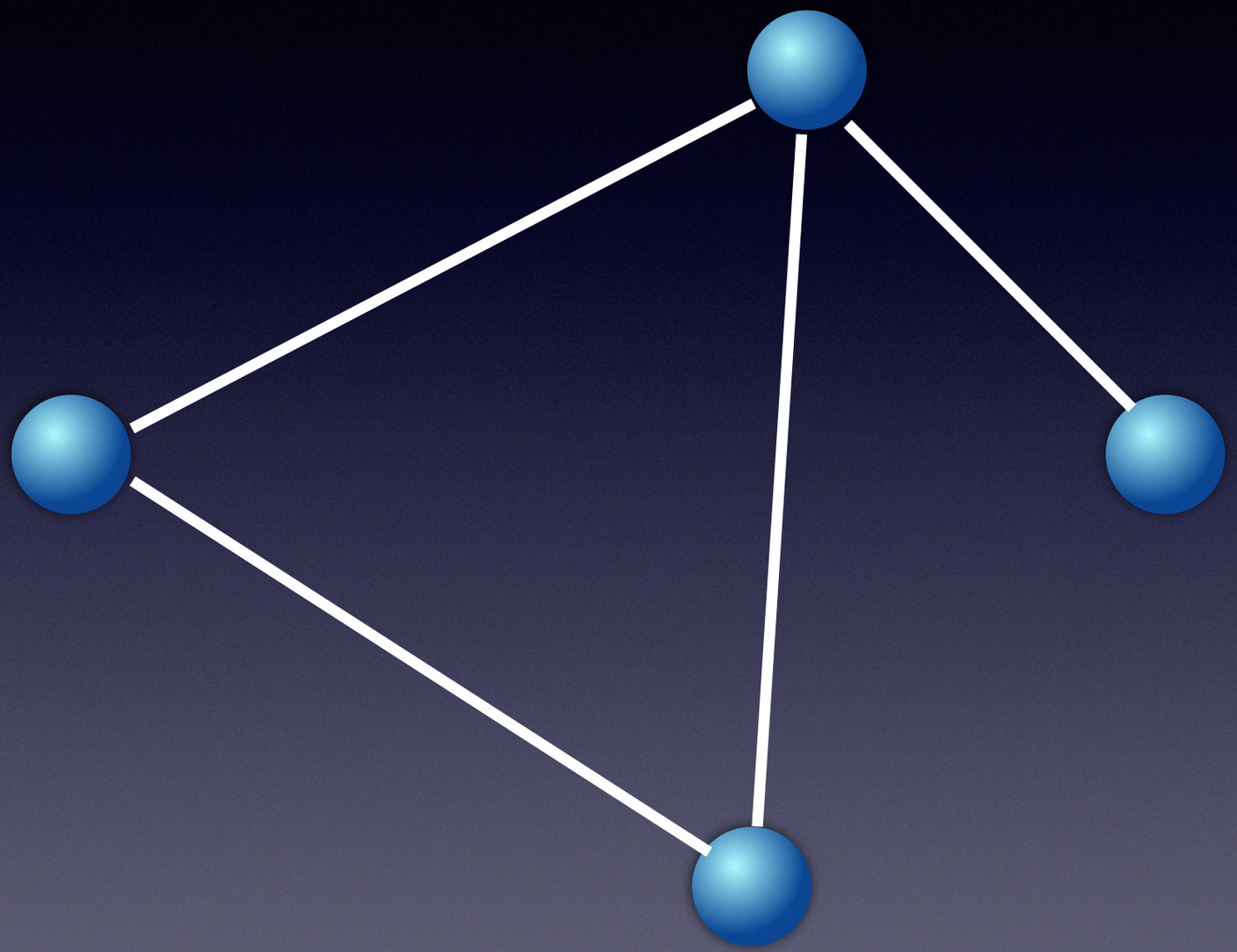
How it works?



How it works?



How it works?



NetLogo — ErdosRenyi {/Users/sergi/Desktop/Master}

Interface | Info | Code

Edit | Delete | Add | Button | normal speed | view updates | continuous | Settings...

Model Parameters

num-nodes 50

prob-link 0.020

Erdos-Renyi

GC size 12

Mean Degree 0.88

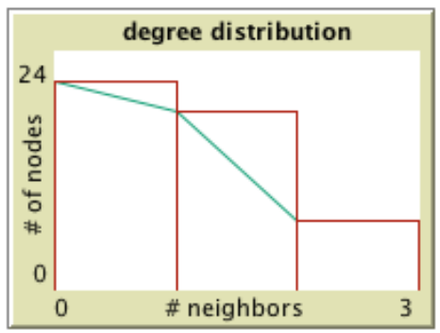
Layout Options

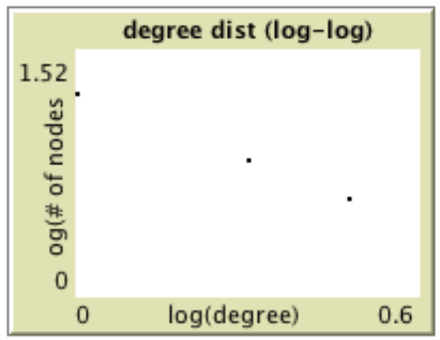
spring-constant 0.1

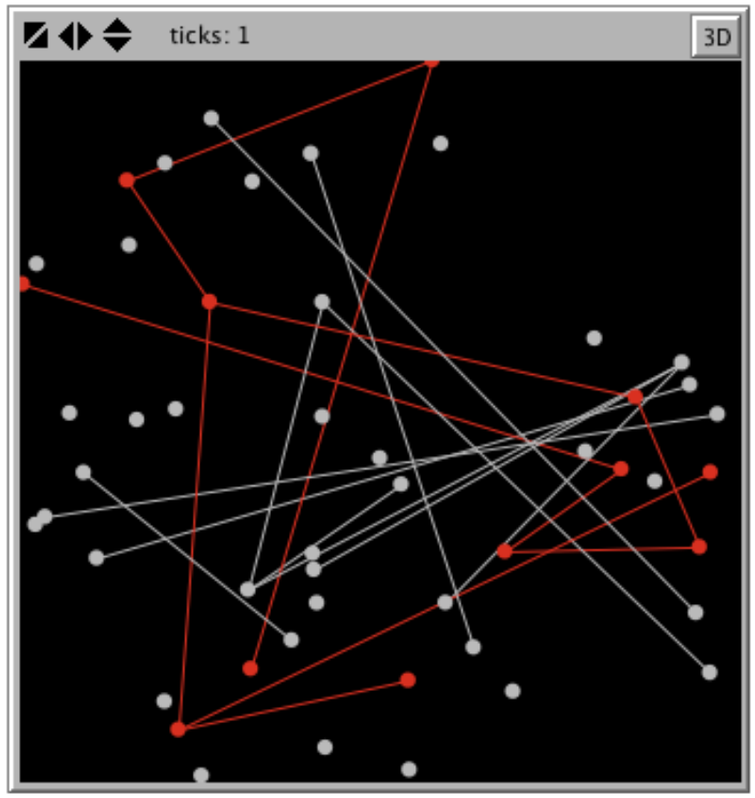
repulsion-strength 0.4

spring-length 4

redo layout







Command Center | Clear

observer>

NetLogo — ErdosRenyi {/Users/sergi/Desktop/Master}

Interface | Info | Code

Edit | Delete | Add | Button | normal speed | view updates | continuous | Settings...

Button
Slider
Switch
Chooser
Input
Monitor
Plot
Output
Note

Model Param

num-node

prob-link

Erdos-Renyi

GC size
12

Mean Degree
0.88

Layout Options

spring-constant 0.1

repulsion-strength 0.4

spring-length 4

redo layout

degree distribution
24
0
# of nodes
0
neighbors
3

degree dist (log-log)
1.52
0
log(# of nodes
0
log(degree)
0.6

ticks: 1
3D

Command Center
Clear
observer>

NetLogo — ErdosRenyi {/Users/sergi/Desktop/Master}

Interface | Info | Code

Edit | Delete | Add | Plot | normal speed | view updates | continuous | Settings...

Model Parameters

num-nodes 50

prob-link 0.020

Erdos-Renyi

GC size 12

Layout Options

spring-constant 0.1

repulsion-strength 0.4

ticks: 1 | 3D

Plot

Nam k_size

X axis label | X min 0 | X max 1000

Y axis label | Y min 0 | Y max 2

Auto scale? | Show legend?

Plot setup commands

Plot update commands

Plot pens

Color	Pen name	Pen update command
	default	

Add Pen

Cancel | Help | Apply | OK

degree

24

# of nodes

0

0 # n

10

0

0 10

Command Center | Clear

observer>

NetLogo — ErdosRenyi {/Users/sergi/Desktop/Master}

Interface | Info | Code

Edit | Delete | Add | Plot | normal speed | view updates | continuous | Settings...

Button
Slider
Switch
Chooser
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Note

Model Parame

num-nodes

prob-link

Erdos-Re

GC size
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Mean Degree
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Layout Options

spring-constant 0.1

repulsion-strength 0.4

spring-length 4

redo layout

ticks: 1 | 3D

degree distribution
24
# of nodes
0
0
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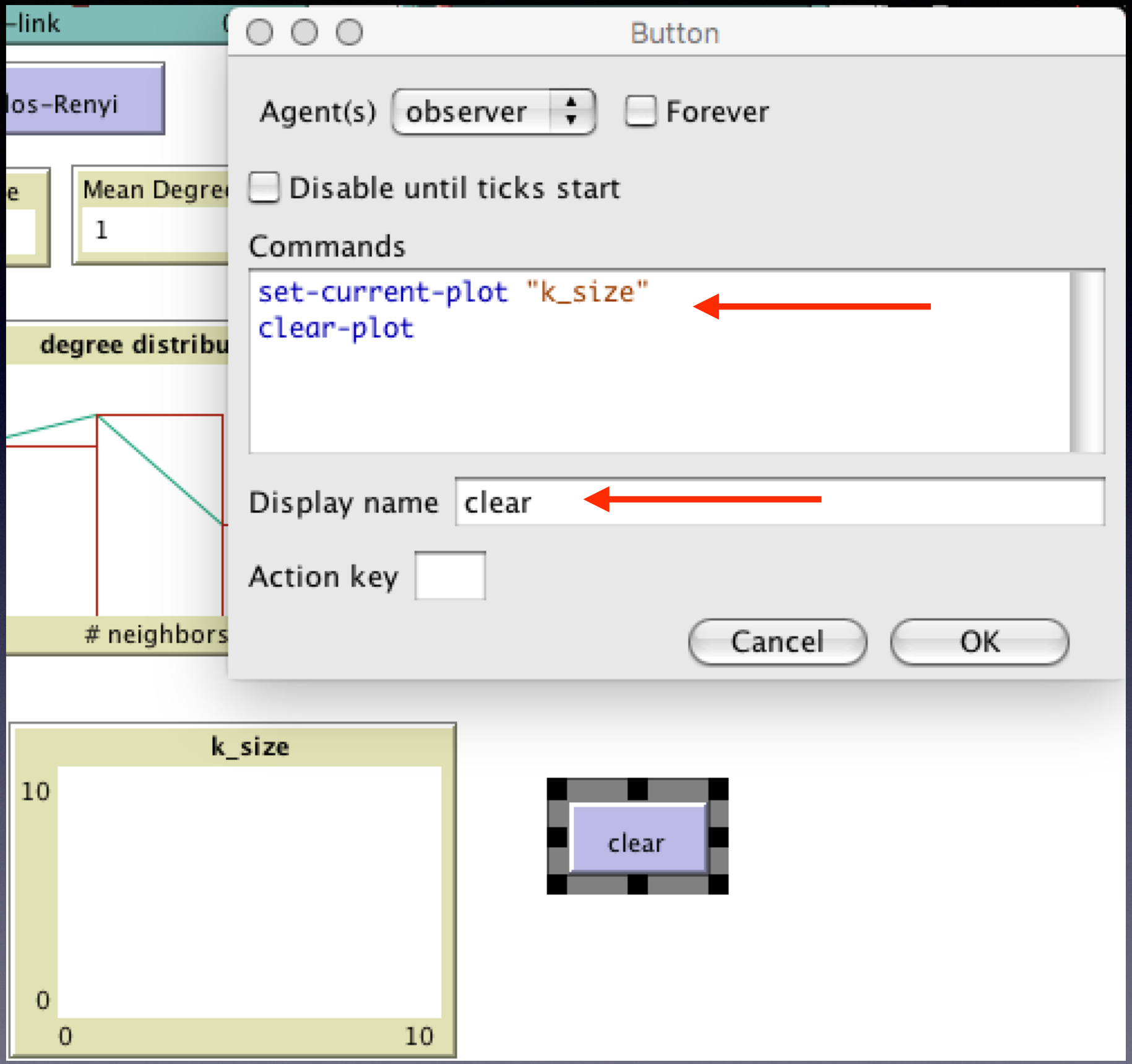
degree dist (log-log)
1.52
log(# of nodes
0
0
log(degree)
0.6

k_size
10
0
0
10

Command Center | Clear

observer>


-link
os-Renyi
e
Mean Degre
1
degree distribu
neighbors
Button
Agent(s)
observer
Forever
Disable until ticks start
Commands
set-current-plot "k_size"
clear-plot
Display name
clear
Action key
Cancel
OK
k_size
10
0
0
10
clear

NetLogo — ErdosRenyi {/Users/sergi/Desktop/Master}

Interface | Info | Code

Edit | Delete | Add | Button | normal speed | view updates | continuous | Settings...

Model Parameters

num-nodes 50

prob-link 0.020

Erdos-Renyi

GC size 14

Mean Degree 1

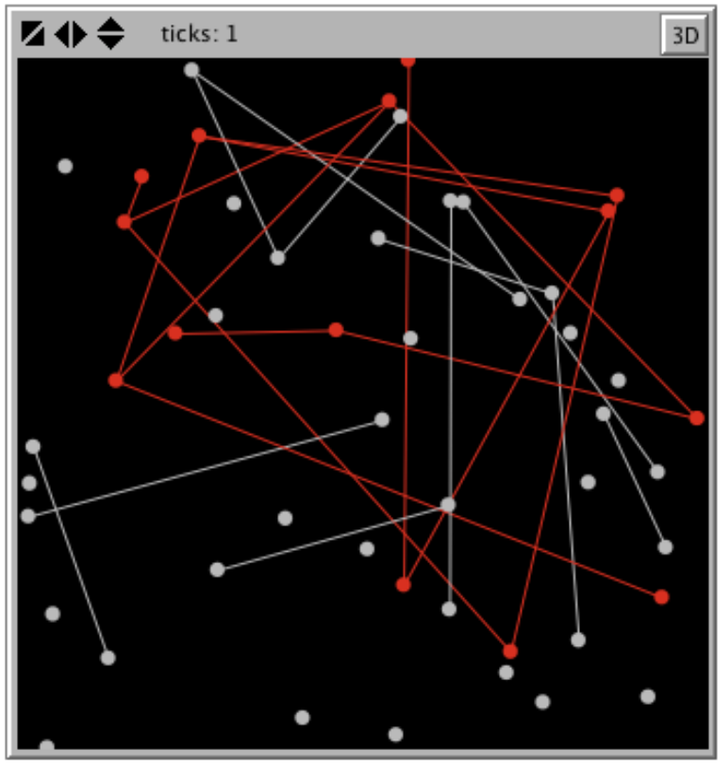
Layout Options

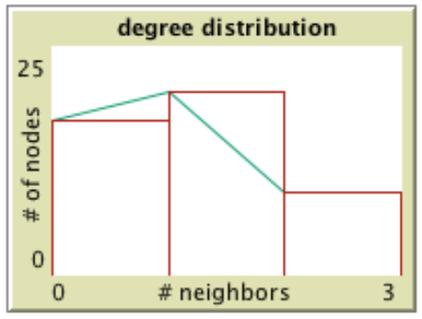
spring-constant 0.1

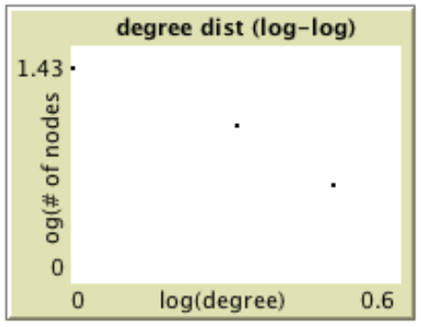
repulsion-strength 0.4

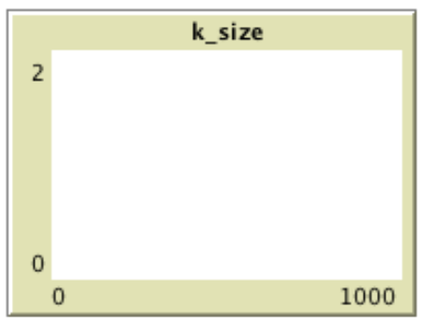
spring-length 2

redo layout









clear

Command Center

Clear

observer>

repulsion-strength 0.4

Erdos-Renyi

spring-length 2

GC size 5

96

# of nodes

0

0

Button

Agent(s) observer Forever

Disable until ticks start

Commands

```
all-random
let k 2 * (count links) / count turtles
set-current-plot "k_size"
plotxy count turtles k
```

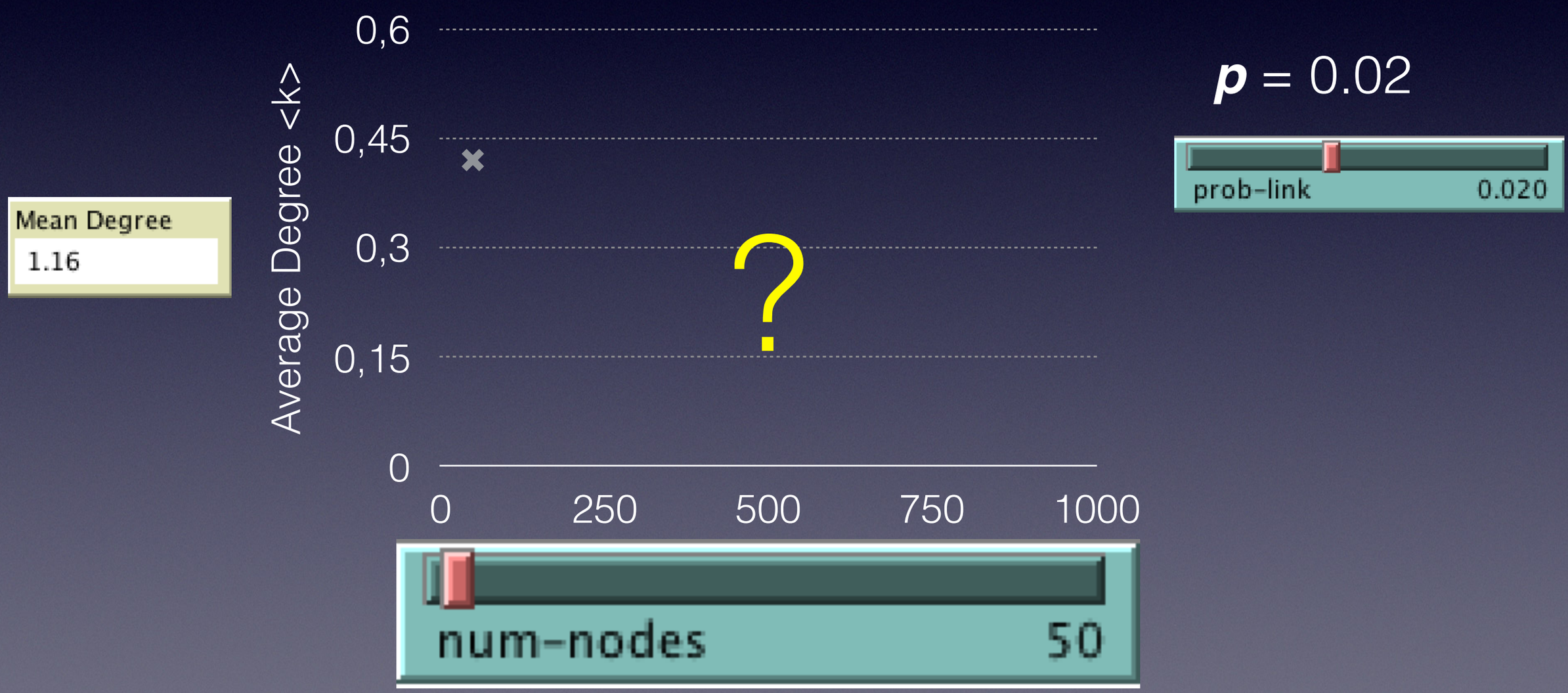
Display name Erdos-Renyi

Action key

Cancel OK

Average Degree

As the size N of the network increases, if you keep ***p***, the probability of any two nodes being connected, the same, what happens to the average degree <k>?

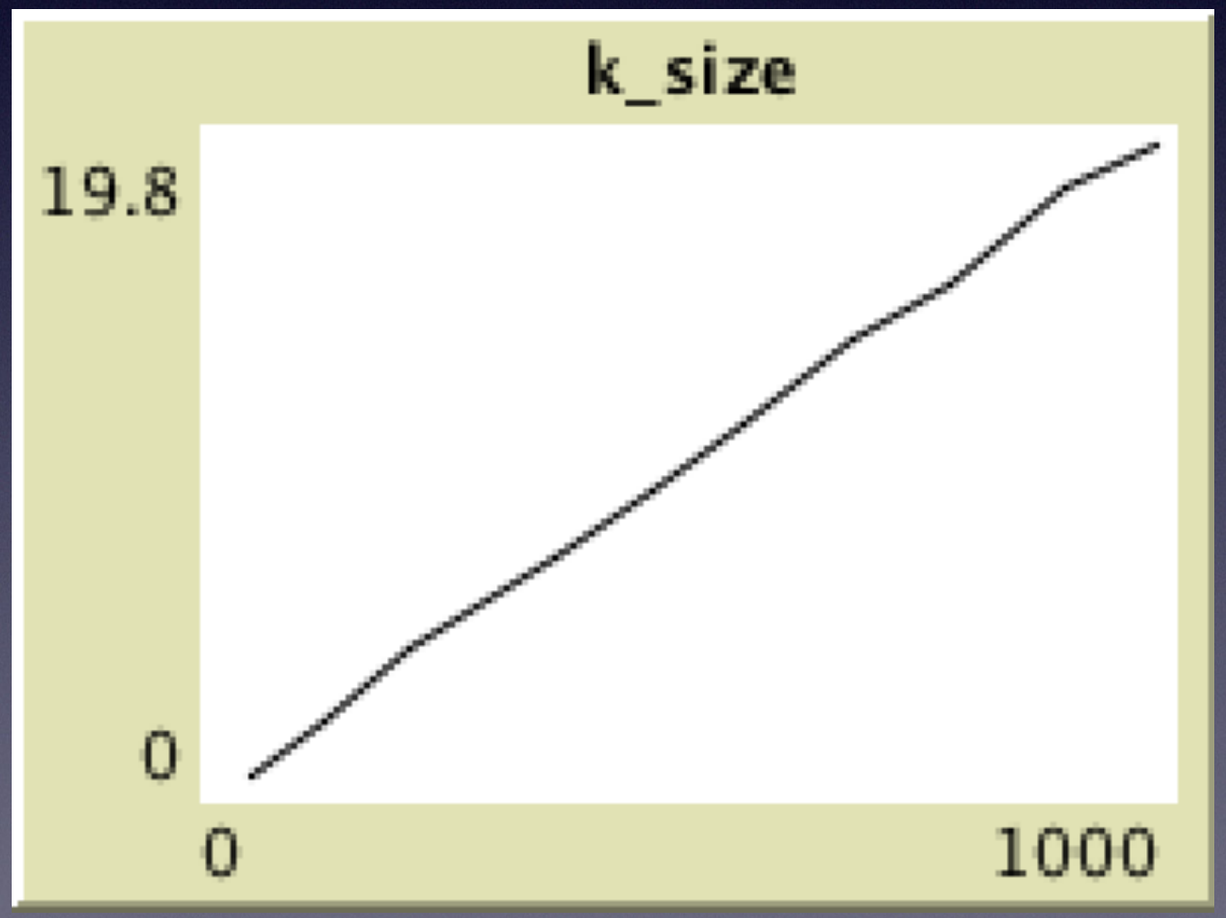


Average Degree

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 <k>?

$$\langle k \rangle = (N-1)p$$

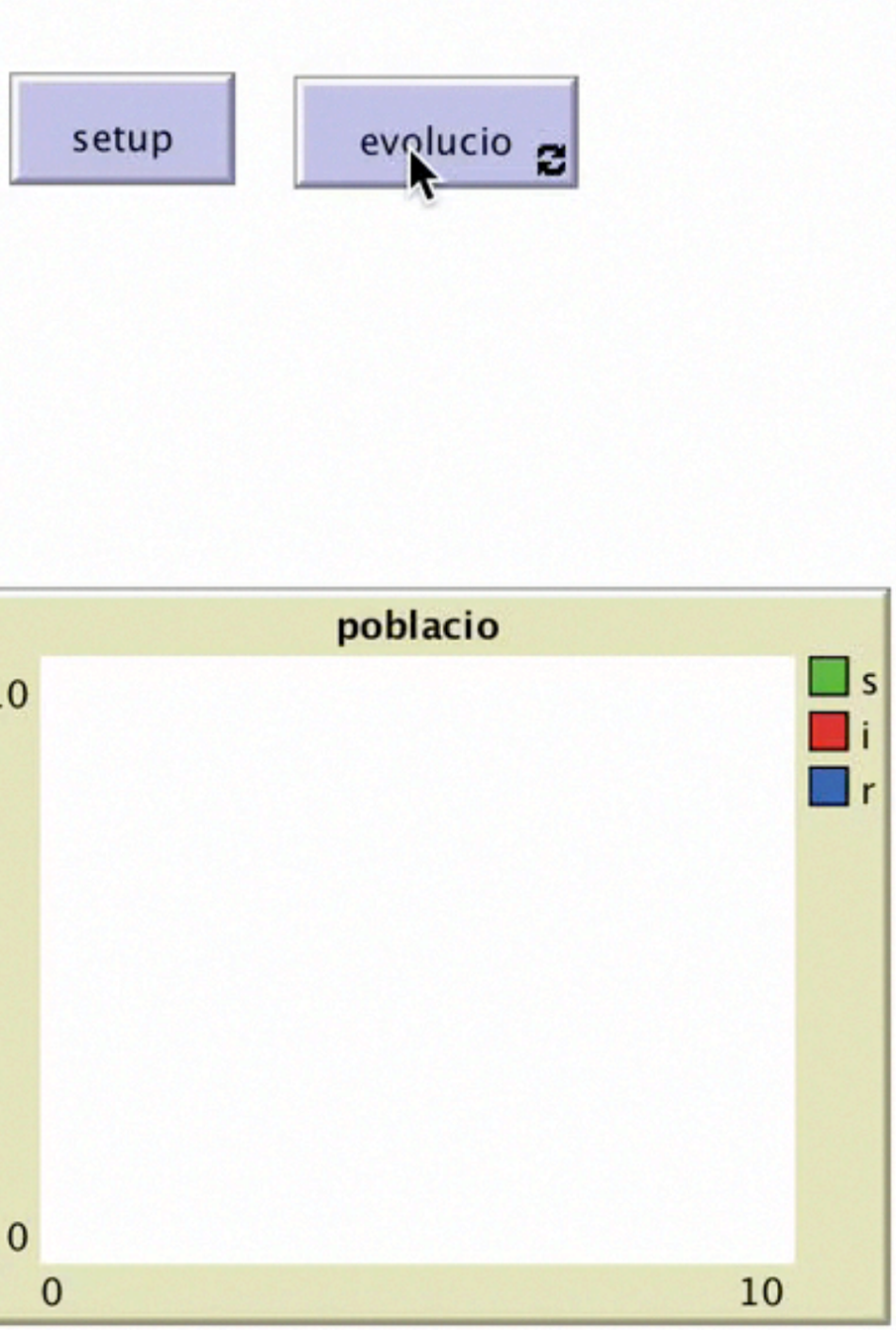
p = 0.02

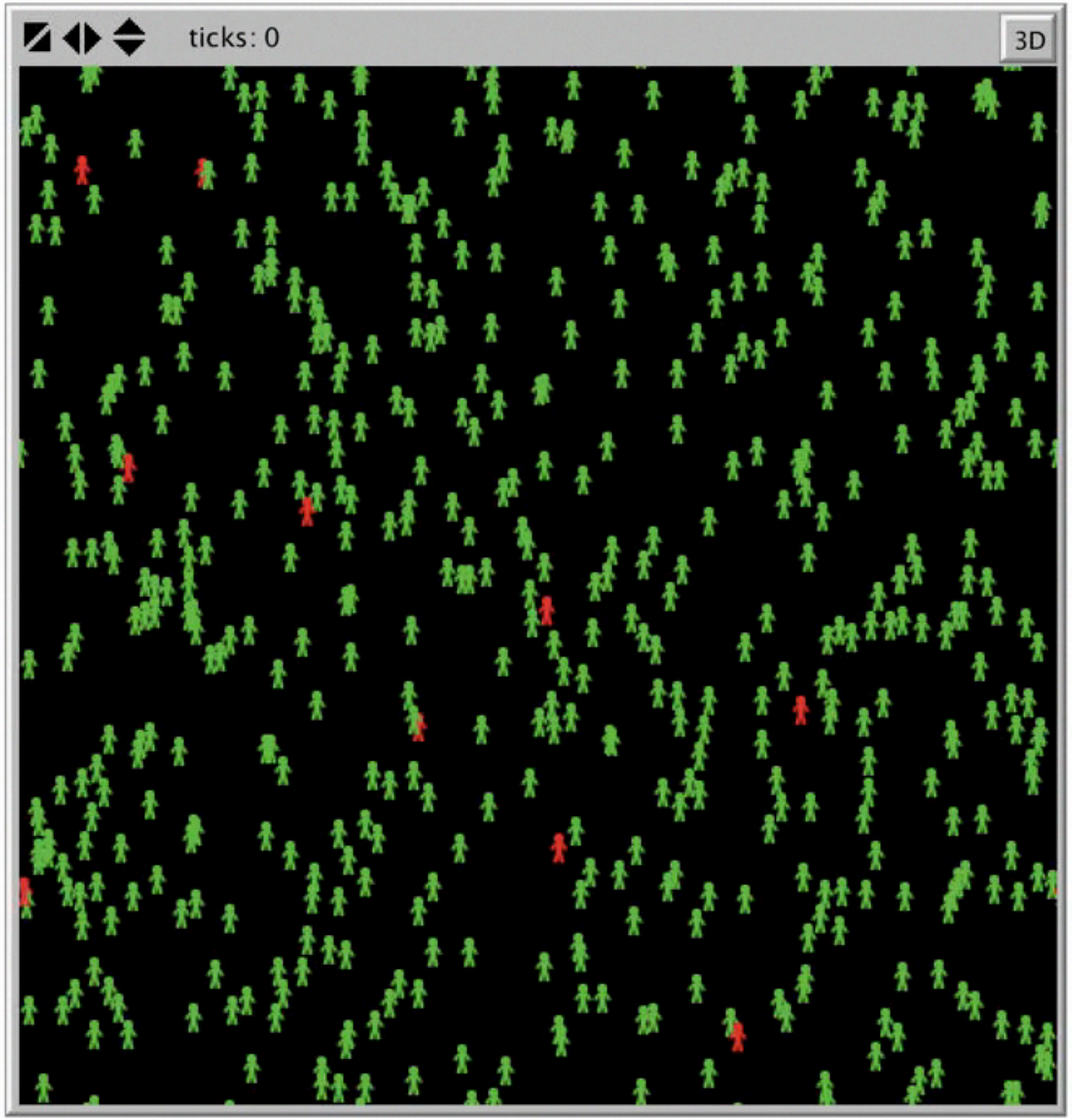


SCALE-FREE

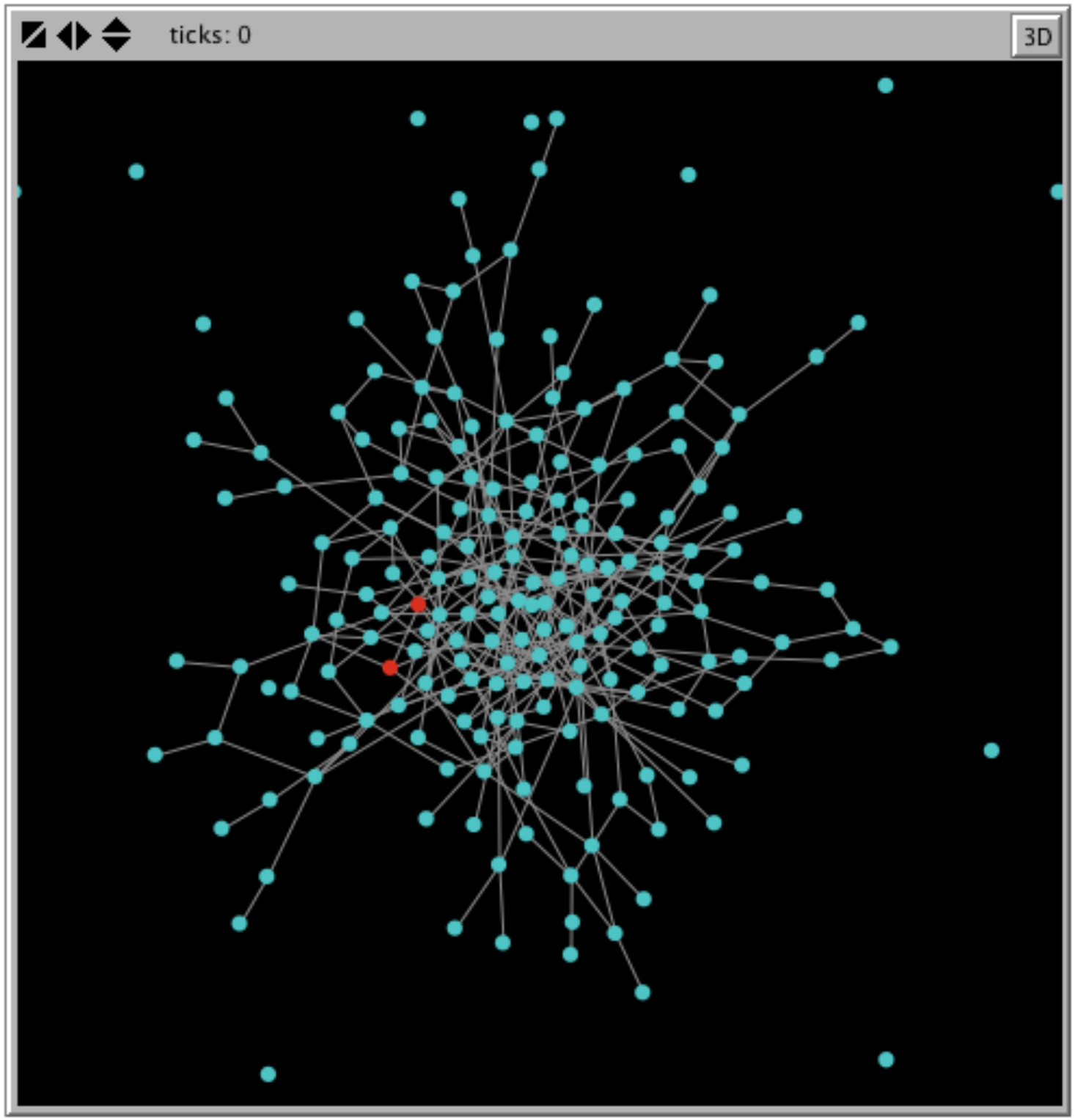
Epidemics on Networks

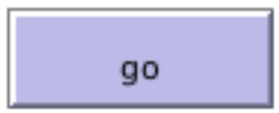
Previously…

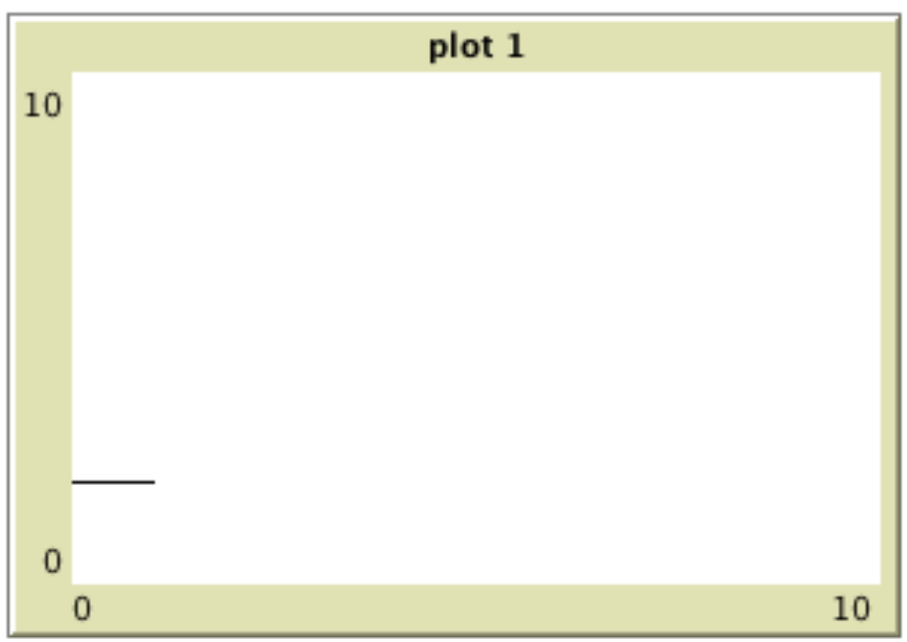




SI on Random Graphs







Project

Implement the SIR model

Study Epidemics on Random, Lattice & Scale-Free Networks

Design effective vaccination strategies for each network.