Feedback — HW 2 network models

You submitted this homework on **Fri 16 Nov 2012 7:18 AM PST**. You got a score of **10.00** out of **10.00**.

In this assignment you will be exploring several network models and the behavior of a viral agent diffusing in the network. The questions will have links to webpages containing the models, but if you prefer, you can download the models from those pages and run them in your NetLogo application.

Question 1

Go to the NetLogo model on Erdös-Renyi diffusion and read the description on the page of how the model works. Set **NUM-NODES** to 200. Click on SETUP-A-NEW-NETWORK. Then click on SPREAD to get it going! Observe how the infection attempts to spread through the network. Under what conditions do you expect the infection to spread to a non-trivial fraction of the nodes (check all that apply)?

Your Answer		**Score**	**Explanation**
☐ When the highest degree of any node in the network is 2.	✓	0.50	It is possible for one of the nodes to have degree 2 and for the network to still be below the percolation threshold.
☑ When the giant component emerges.	✓	0.50	If a giant component is present, then a non-trivial portion of the nodes are in the same component, meaning that the virus can travel.
☐ When the average degree is 1/2.	✓	0.50	The average degree of 1/2 is still below the percolation threshold, and there will be no giant component for the virus to infect.
☑ When the average degree is 1 or higher.	✓	0.50	The giant component emerges when the average degree in an ER graph is 1. Then a non-trivial fraction of the nodes are in the same component, allowing the virus to travel.

Total	2.00 / 2.00

Question Explanation

The agent will eventually traverse all nodes reachable from the starting point. Therefore, the larger the connected component, the more nodes it will potentially be able to infect.

Question 2

Stay with the same model of an ER random graph. Set NUM-NODES to 200 and AVERAGE-DEGREE to 2. SETUP-A-NEW-NETWORK and then 'SPREAD (repeat)', as many times as you need to in order to answer this question: What fraction of the time will a virus that randomly infects 1 individual initially spread through a significant portion of the network? Express your answer as a value between 0 and 1. Your answer needs to be accurate within 0.1.

You entered:

.78

Your Answer		Score	Explanation
.78	✓	2.00	The giant component occupies roughly 3/4ths of the network. Therefore 3/4ths of the time the virus will land in the giant component and spread.
Total		2.00 / 2.00	

Question 3

Switch to a growth and preferential attachment model. Set NUM-NODES to 200, M =

1 (each node joins the network with one edge), and INFECT-RATE = 0.15. Vary PROB-PREF between 0 and 1 (you can try inbetween values, but it's not necessary) to alternate between the random growth and preferential attachment models. Examine the plot for the number of infected individuals over time, as well as the value "time-to-90-percent" which is the number of steps until 90% of the individuals are infected. Which process generates a network through which the agent diffuses more quickly:

Your Answer		Score	Explanation
preferential attachment model	✓	2.00	The presence of hubs accelerates the diffusion process, they are both more likely to be infected early, and they have more neighbors they can subsequently infect.
Total		2.00 / 2.00	

Question Explanation

The preferential attachment model.

Question 4

Stay with the growth and preferential attachment model. Set PROB-PREF to 1 to have a network grown with preferential attachment. Observe the simulation proceeding slowly by sliding the speed slider (over the visualization window) from 'normal speed' to the 'slower' range. Which of the following holds true for the hubs.

Your Answer		Score	Explanation
☑ They are responsible for more infections because they have many contacts.	✓	0.33	
☐ They are infected later than others because they are shielded by the nodes surrounding them.	✓	0.33	
☑ They are infected earlier than other nodes	✓	0.33	

because of their exposure through many contacts.

Total		1.00 / 1.00

Question Explanation

By having a lot of contacts, hubs both have a greater chance of being infected early and of infecting many others.

Question 5

As the number of nodes in an Erdos-Renyi graph grows, the number of steps it will take for a randomly selected node to infect any other will on average scale as:

Your Answer		Score	Explanation
log(N)	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

because the average shortest path grows as log(N), this is approximately how the number of steps separating an infected and uninfected node will scale as well.

Question 6

Imagine nodes arranged in a ring (each node has two neighbors, one on the left, and one on the right), and they are arranged in a big circle. At each time step, every neighbor of an infected node becomes infected if they are not infected already. What is the average number of steps it takes for a node in the network to become infected if 1 node is infected at random.

Your Answer		Score	Explanation
N/4	✓	1.00	

Total	1.00 / 1.00

Question Explanation

The furthest away a node can be from the random infection point is N/2. Half the nodes are N/4 away. N/4 is the average.

Question 7

Which network generation process is more likely to have generated the degree distribution in the following image?

Your Answer		Score	Explanation
Erdös-Renyi	✓	1.00	
Total		1.00 / 1.00	

Question Explanation

The degree distribution is roughly bell-shaped, which means that hubs are for the most part absent.