



Unit 13 - Week -9 : Power Laws and Rich-Get-Richer Phenomena

Course outline

Course Trailer

FAQ

Things to Note

Accessing the Portal

Week 1 - Introduction

Week 2 - Handling Real-world Network Datasets

Week 3- Strength of Weak Ties

Week4 - - Strong and Weak Relationships (Continued) & Homophily

Week 5 - Homophily Continued and +Ve / -Ve Relationships

Week 6- Link Analysis

Week 7 - Cascading Behaviour in Networks

Week 8 : Link Analysis (Continued)

Week -9 : Power Laws and Rich-

Week 9 - Assignment 1

1) In $G(1000, 0.1)$ random network, each edge will be placed with the probability

1 point

- ☐ 0.1
☐ 0.9
☐ 0.5
☐ 0.7

Accepted Answers:

0.1

2) Which of the following distributions depict a normal/bell curve?

1 point

- ☐ Weights of people in a city
☐ Heights of people in a city
☐ Intelligence quotients of people in a city
☐ All of the above

Accepted Answers:

All of the above

3) Given a random graph on 1000 nodes where each of the possible $\binom{1000}{2}$ edges is present with a probability of 0.1. Let N_1 represent the number of nodes having the least degree (i.e. 0), N_2 represent the number of nodes having the highest degree (i.e. 999) and N_3 represent the number of nodes having the median values of degrees (i.e. 499 or 500). Choose the correct statement. 1 point

- ☐
 $N_1 > N_3$ and $N_2 > N_3$
☐
 $N_1 < N_3$ and $N_2 < N_3$
☐
 $N_1 > N_3$ and $N_2 < N_3$
☐
 $N_1 < N_3$ and $N_2 > N_3$

Accepted Answers:

Get-Richer Phenomena

- Lecture 115 - Introduction to Power Law
- Lecture 116 - Why do Normal Distributions Appear?
- Lecture 117 - Power Law emerges in WWW graphs
- Lecture 118 - Detecting the Presence of Power Law
- Lecture 119 - Rich Get Richer Phenomenon
- Lecture 120 - Summary So Far
- Lecture 121 - Implementing Rich-getting-richer Phenomenon (Barabasi-Albert Model)-1
- Lecture 122 - Implementing Rich-getting-richer Phenomenon (Barabasi-Albert Model)-2
- Lecture 123 - Implementing a Random Graph (Erdos- Renyi Model)-1
- Lecture 124 - Implementing a Random Graph (Erdos- Renyi Model)-2
- Lecture 125 - Forced Versus Random Removal of Nodes (Attack Survivability)
- Quiz : Week 9 - Assignment 1
- Week 9 - Assignment 1 answers
- Feedback for week 9

Week 10 - Power law (contd..) and Epidemics

$$N_1 < N_3 \text{ and } N_2 < N_3$$

4) Given the World Wide Web (WWW) network. Let N_1 represent the number of nodes having the least degree, N_2 represent the number of nodes having the highest degree and N_3 represent the number of nodes having the median values of degrees. Choose the correct statement. **1 point**



$$N_1 > N_3 \text{ and } N_2 > N_3$$



$$N_1 < N_3 \text{ and } N_2 < N_3$$



$$N_1 > N_3 \text{ and } N_2 < N_3$$



$$N_1 < N_3 \text{ and } N_2 > N_3$$

Accepted Answers:

$$N_1 > N_3 \text{ and } N_2 < N_3$$

5) Given set $E = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. We pick a value a_1 uniformly at random from this set E . Next, we pick another value a_2 , again uniformly at random from this set E . Similarly we pick 8 more values, $a_3, a_4, \dots, a_9, a_{10}$. Look at the sum, $S = a_1 + a_2 + \dots + a_9 + a_{10}$. Which of the following sets define the range from which the sum S can have values from? **1 point**



$$\{1, 2, \dots, 9, 10\}$$



$$\{10, 11, \dots, 19, 20\}$$



$$\{1, 2, \dots, 9, 100\}$$



$$\{10, 11, \dots, 99, 100\}$$

Accepted Answers:

$$\{10, 11, \dots, 99, 100\}$$

6) Given set $E = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. We pick a value a_1 uniformly at random from this set E . Next, we pick another value a_2 , again uniformly at random from this set E . Similarly we pick 8 more values, $a_3, a_4, \dots, a_9, a_{10}$. Look at the sum, $a_1 + a_2 + \dots + a_9 + a_{10}$. Let $p(i)$ be the probability that $S = i$, i.e., the probability that the sum of these randomly chosen 10 elements is i . Which of the following is true? **1 point**



$$p(50) < p(100)$$



$$p(100) < p(50)$$



$$p(50) < p(10)$$



$$p(100) < p(10)$$

Accepted Answers:

$$p(100) < p(50)$$

7) Given set $E = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. We pick a value a_1 uniformly at random from this set E . Next, we pick another value a_2 , again uniformly at random from this set E . Similarly we pick 8 more values, $a_3, a_4, \dots, a_9, a_{10}$. Look at the sum, $a_1 + a_2 + \dots + a_9 + a_{10}$. Let $p(i)$ be the probability that $S = i$, i.e., the probability that the sum of these randomly chosen 10 elements is i . We plot i on the X-axis and $p(i)$ on the Y axis. Choose the correct statement from the following. **1 point**



The plot has very high values in the beginning but then drops.



The plot is a constant curve.



The plot is a bell shaped curve.



The plot is linear.

Accepted Answers:

Week 11- Small World Phenomenon

Week 12- Pseudocore (How to go viral on web?)

The plot is a bell shaped curve.

8) Which of the following represents the correct equation for power law?

1 point

☐

$$y = \frac{1}{x^2}$$

☐

$$y = \frac{1}{x^3}$$

☐

$$y = \frac{1}{x^4}$$

☐

All of the above

Accepted Answers:

All of the above

9) Which of the following distributions follow a power law?

1 point

☐

Telephone conversation duration

☐

Number of song downloaded from a website

☐

Number of incoming links for nodes in the web graph

☐

All of the above

Accepted Answers:

All of the above

10) Power law degree distribution in real world networks follow the characteristic equation $y = \frac{1}{k^\alpha}$. What is the value of α here?

1 point

☐

$1 < \alpha < 2$

☐

$2 < \alpha < 3$

☐

$3 < \alpha < 4$

☐

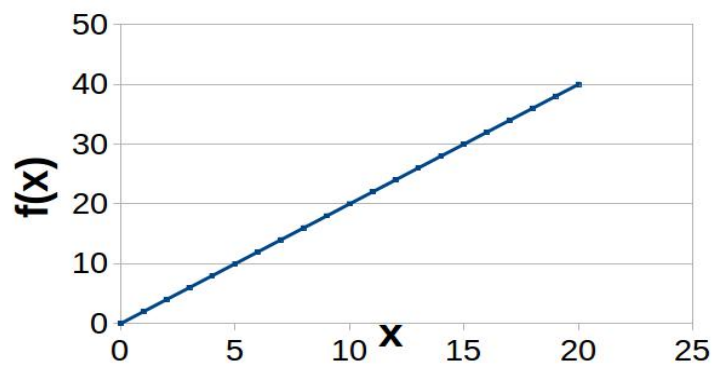
None of the above

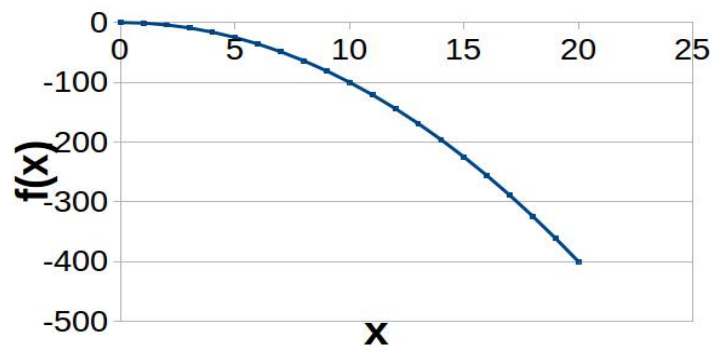
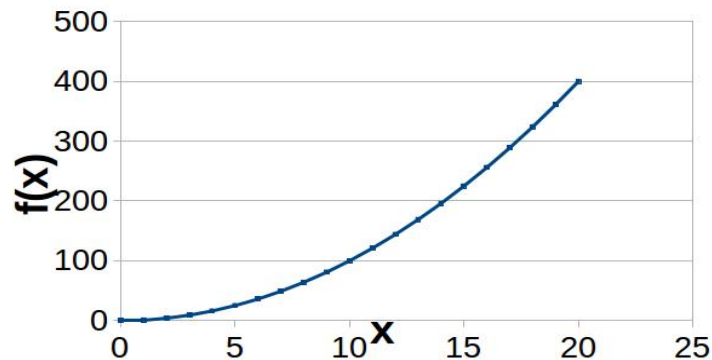
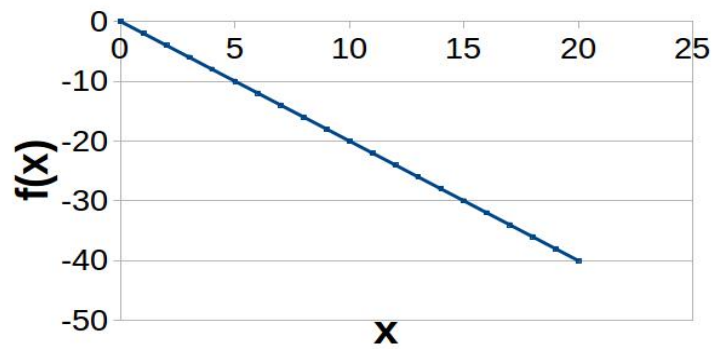
Accepted Answers:

$2 < \alpha < 3$

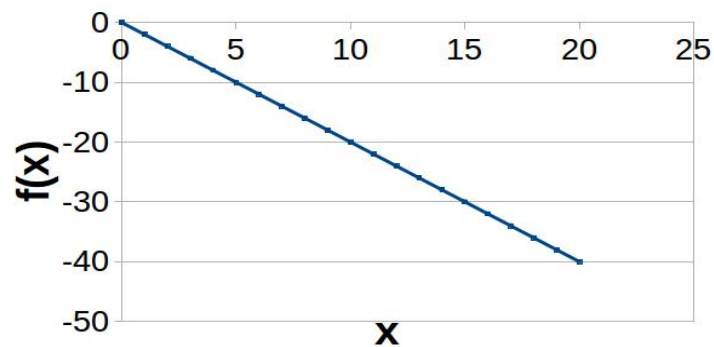
11) Consider the equation $g(k) = \frac{1}{k^2}$. Let $x = \log k$ and $f(x) = \log g(k)$. How does the plot of $f(x)$ look like?

1 point

☐




Accepted Answers:



12) How does the power law degree distribution come by in real world networks?

1 point

- ☐ By preferential attachment
- ☐ By random linking
- ☐ By uniform edge connection
- ☐ No hypothesis is found.

Accepted Answers:

By preferential attachment

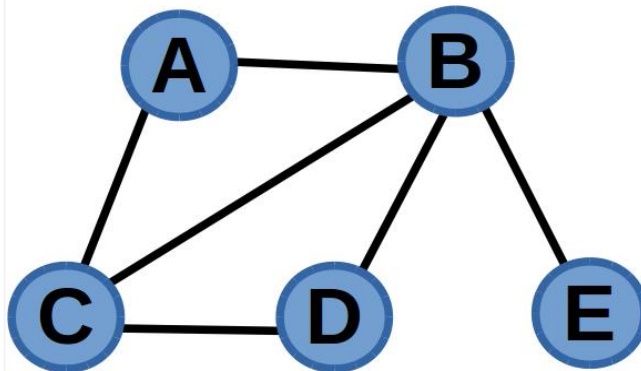
13) In the preferential attachment, a new coming node will prefer to make the connection with the node having **1 point**

- ☐ fewer friends
- ☐ More friends
- ☐ Average number of friends
- ☐ Average number of friends

Accepted Answers:

More friends

14) Given a network being generated by 'rich get richer' phenomenon. The figure below shows the snapshot of the network at time t . A new node u enters the network at time $t + 1$ and makes an edge with one of the existing nodes. What is the probability that u will make an edge with C ? **1 point**

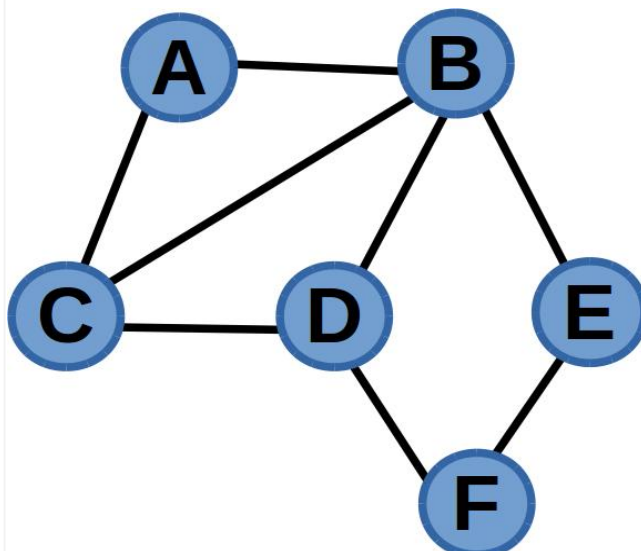


- ☐ $1/2$
- ☐ $1/5$
- ☐ $1/3$
- ☐ $1/4$

Accepted Answers:

$1/4$

15) Given a network being generated by 'rich get richer' phenomenon. The figure below shows the snapshot of the network at time t . A new node u enters the network at time $t + 1$ and makes an edge with one of the existing nodes. The probability of u making an edge with an existing node w is defined as $p(w)$. Which of the following equations is correct? **1 point**



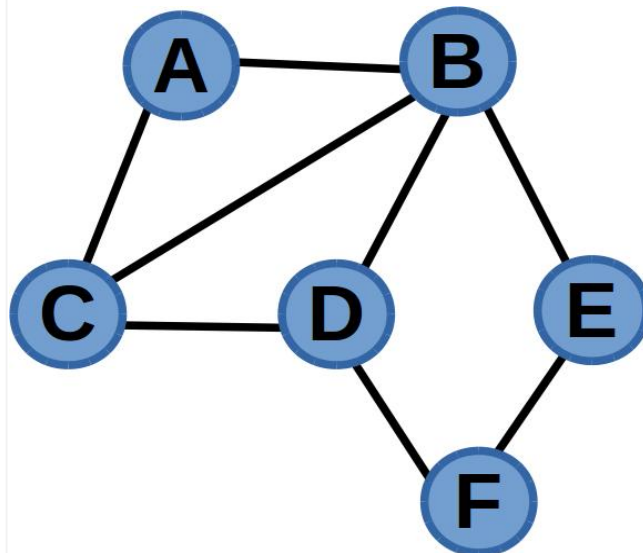
- ☐ $p(A) < p(C) < p(B)$
- ☐ $p(E) < p(D) < p(B)$

- ☐ $p(F) < p(C) < p(B)$
- ☐ All of the above

Accepted Answers:

All of the above

16 Given a network being generated by 'rich get richer' phenomenon. The figure below shows **1 point** the snapshot of the network at time t . A new node u enters the network at time $t + 1$ and makes an edge with one of the existing nodes. Which of the node it makes a link to?



- ☐ A
- ☐ B
- ☐ C
- ☐ Can't say

Accepted Answers:

Can't say

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