Quiz

MO412 - Network Science

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July 2021

(Question 2021-003)
An interesting thing regarding derivatives and real world objects is that the derivative of a sphere's volume with respect to the radius corresponds to its total area. Considering that the volume of a sphere V can be computed as:

$$V = \frac{4}{3}\pi r^3$$

where r is the radius of the sphere, we may conclude that the total area of V is given by:

(a) $4\pi r^2$

(b) $2\pi r$

(c) $4\pi r$

(d) $\frac{3}{4}\pi r^2$

(e) None of the above.

Answer: (a) $4\pi r^2$
Solution: As expressed above the derivative of the sphere's volume with respect to the radius corresponds to its total area.

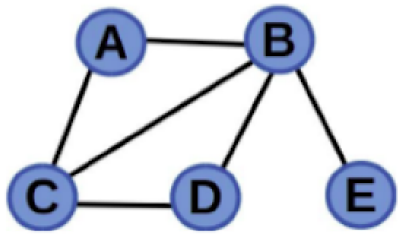
$$V = \frac{4}{3}\pi r^3$$

$$\frac{dV}{dr} = \frac{4}{3}3\pi r^2$$

$$\frac{dV}{dr} = 4\pi r^2$$

$$A = 4\pi r^2$$

(Question 2021-003)
Consider the figure below. It shows the snapshot of a network at time t. A new node U will enter the network at time $t+1$, linking to one of the existing nodes in the network under the Barabasi-Albert (BA) model. Determine which node in the network is most likely to get the link with the new node U, and also calculate the corresponding probability.



(a) Node B with probability (1/3)

(b) Node B with probability (1/4)

(c) Node C with probability (1/3)

(d) Node E with probability (1/4)

(e) None of the above

Answer: (a) Node B with probability (1/3)
Solution: The probability $\prod(k)$ that a link of the new node connects to node i depends on the degree k_i as:

$$\prod(k_i) = \frac{k_i}{\sum_j k_j}$$

$$k_A = 2,\ k_B = 4,\ k_C = 3,\ k_D = 2,\ k_E = 1$$

$$\sum_j k_j = 12$$

$$\prod(k_A) = \frac{1}{6}$$

$$\prod(k_B) = \frac{1}{3}$$

$$\prod(k_C) = \frac{1}{4}$$

$$\prod(k_D) = \frac{1}{6}$$

$$\prod(k_E) = \frac{1}{12}$$

The node in the network which is most likely to get the link with the new node U is B . B has the highest degree and the highest probability(1/3).