

Graph Algorithms - Quiz

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December 8, 2022

Answers

#	Question	Answer	Explanation
1	2022-104	B	See section 1
2	2021-028	D	See section 2
3	2021-003	A	See section 3
4	2022-086	A	See section 4
5	2022-184	E	See section 5
6	2021-021	C	See section 6
7	2022-163	D	See section 7
8	2021-068	D	See section 8
9	2022-127	A	See section 9
10	2022-182	A	See section 10

1 2022-104

Using the formulas provided in the question:

$$\cos^2(x) = \frac{1}{4} (e^{2ix} + 2 + e^{-2ix})$$

Then the integral is:

$$\int \frac{1}{4} (e^{2ix} + 2 + e^{-2ix}) dx = \frac{1}{4} \left(\frac{e^{2ix}}{2i} + 2x - \frac{e^{-2ix}}{2i} \right) + c$$

2 2021-028

In the Barabási-Albert model, the nodes do not have a fitness, which is equivalent to all nodes having the same fitness.

in the book, the author states that “When all fitnesses are equal, the Bianconi-Barabási model reduces to the Barabási-Albert model”.

3 2021-003

$$A = \frac{dV}{dr} = \frac{d}{dr} \left(\frac{4}{3} \pi r^3 \right) = 4\pi r^2$$

4 2022-086

The instantaneous rate of change of pink dolphins is the derivative with time:

$$\frac{dF}{dt} = \frac{d}{dt} (-10 \cdot \ln(t+1) + 3100 \cdot e^{-0.3 \cdot t}) = -10 \cdot \frac{1}{t+1} + 3100 \cdot (-0.3) \cdot e^{-0.3 \cdot t}$$

So:

$$\frac{dF}{dt}(t=5) = -209.17771560470638 \approx -209$$

5 2022-184

Check out the code of the file `2022_184.py`, it outputs:

`Modularity = 0.2978395061728395`

There is no option close to that number, so the answer is “None of the above”.

6 2021-021

Let G be a graph with n nodes and k tree edges. Suppose that G has c connected components. In a DFS, each connected components is a tree t with n_t nodes and k_t edges, with $k_t = n_t - 1$. Therefore, the number of tree edges can be computed as:

$$e = \sum_{t=1}^c k_t = \sum_{t=1}^c (n_t - 1) = \left(\sum_{t=1}^c n_t \right) - c = n - c$$

Therefore:

$$c = n - k$$

which corresponds to option C.

7 2022-163

- A. wrong, it is proportional to $\ln(\ln(N))$, see Box 4.5;
- B. wrong, $\langle k \rangle$ is finite, see Box 4.5
- C. wrong, $\langle k^2 \rangle$ is finite, see Box 4.5
- D. Correct, tha is the equation 4.18 in Hubs Section
- E. only if all previous ones are wrong

8 2021-068

Check out the code of the file `2021_068.py`, it outputs:

`m(g(1)) = 0.48958333333333337`
`m(g(2)) = 0.41319444444444445`

The network with the smallest modularity is the 2, and it has modularity approximately equals to 0.41, thus the answer is D.

9 2022-127

- I. True;
- II. False, Scale-free networks DO follow a power-law degree distribution;
- III. False, the Barabási-Albert model do not remove links;
- IV. True;

Thus the answer is A.

10 2022-182

- I. True (the book says “small-degree nodes tend to connect to other small-degree nodes”);
- II. False, that is what is expected of a Neutral Network. The probability of connecting a node with degree k to another of degree k' is smaller than $\frac{k \cdot k'}{2 \cdot L}$;
- III. False. Take for instance the complete graph with two nodes, it has no cycle, yet it is perfectly assortative;
- IV. False, $\mu > 0$ for assortative networks;

Thus the answer is A (Only I).