

Surprise Quiz 2

Points: 25/25

Centralities



✓ **Correct** 1/1 Points

1. In a social network, node A has neighbors B, C, and D. If B and C are not connected to each other, what is the minimum possible local clustering coefficient for node A?

- ☐ 0
- ☐ 1
- ☐ 2/3
- ☐ 1/2
- ☒ 1/3

✓ **Correct** 1/1 Points

2. Consider a network with nodes A, B, C, and D, and the following adjacency matrix:

```
0 1 1 1
1 0 1 0
1 1 0 1
1 0 1 0
```

Calculate the eigenvector centrality for each node.



- ☐ A: 0.6, B: 0.3, C: 0.6, D: 0.3
- ☐ A: 0.4, B: 0.2, C: 0.4, D: 0.2
- ☐ A: 0.8, B: 0.6, C: 0.8, D: 0.6
- ☒ A: 0.5, B: 0.5, C: 0.5, D: 0.5
- ☐ A: 0.6, B: 0.3, C: 0.6, D: 0.3

✓ **Correct** 2/2 Points

3. What do centrality measures indicate?

- ☐ The number of pizzas a person can have
- ☐ Number of eigenvectors a node can have
- ☒ The most critical nodes in an infrastructure like the internet
- ☒ The most influential person in a social network
- ☒ The highest spreaders of a disease

Answer the next 4 questions based on the description below



Consider real-life scenarios involving relationships between two distinct sets of entities. Identify examples where a bipartite graph model is suitable. Choose all correct options.

✓ **Correct** 2/2 Points

4. Social Networks

- ☐ Modeling friendships between individuals.

- ☒ Representing interactions between users and movies they have watched.
- ☐ Describing relationships between employees and the projects they are working on.
- ☒ Capturing connections between research papers and the authors who contributed to them.

✓ **Correct** 2/2 Points

5. E-Commerce

- ☒ Describing the interactions between buyers and sellers in an online marketplace.
- ☐ Mapping connections between users and the articles they have read on a news website.
- ☒ Analyzing the relationship between customers and products they have purchased.
- ☐ Representing collaborations between musicians and the albums they have released.

✓ **Correct** 2/2 Points

6. Biological Networks

- ☒ Representing connections between individuals in a population based on shared genetic traits.
- ☐ Describing the relationships between proteins and the biochemical reactions they are involved in.
- ☐ Modeling interactions between species and the ecosystems they inhabit.
- ☒ Capturing relationships between genes and the biological pathways they participate in.

✓ **Correct** 2/2 Points

7. Transportation Networks

- ☐ Representing interactions between cities and the highways that connect them.
- ☒ Analyzing connections between airports and the airlines that operate flights.
- ☒ Mapping relationships between train stations and the routes of trains.
- ☐ Describing collaborations between car manufacturers and the suppliers of automotive components.

Answer the next 2 questions based on the description below



Consider the following undirected graph:

	A	B	C	D	E	F
A	0	1	1	0	0	0
B	1	0	1	0	1	0
C	1	1	0	1	0	1
D	0	0	1	0	0	1
E	0	1	0	0	0	1
F	0	0	1	1	1	0

✓ **Correct** 2/2 Points

8. Select the edges that need to be removed to transform the given graph into a spanning tree. Choose all correct options.

- ☒ Remove edge BC.
- ☐ Remove edge AC.
- ☒ Remove edge CD.
- ☒ Remove edge EF.
- ☐ Remove edge BE.

✓ **Correct** 2/2 Points

9. Select the characteristics that do NO define a spanning tree.

- ☐ The resulting tree must cover all vertices in the original graph.
- ☒ The resulting tree must have a cycle.
- ☐ The resulting tree must be acyclic.
- ☐ The resulting tree must have $|V| - 1$ edges where $|V|$ is the number of vertices in the original graph.
- ☐ The resulting tree must be connected.

Answer the next 3 questions based on the description below



Consider the following undirected graph represented by its adjacency matrix:

	A	B	C	D	E
A	0	1	1	0	0
B	1	0	0	0	1
C	1	0	0	1	1
D	0	0	1	0	0
E	0	1	1	0	0

✓ **Correct** 1/1 Points

10. Determine the number of connected components.

3

✓ **Correct** 1/1 Points

11. Identify the connected components in the graph.

☒ {A, B, C}

☒ {D}

☒ {E}

☐ {D,E}

☐ {A,C}☐ {A}☐ {C,D}

✓ **Correct** 1/1 Points

12. What is the nullity of the Laplacian matrix for the above graph? 

3

SIR Models




✓ **Correct** 1/1 Points

13. What is the primary assumption about the infectious period in the SIR model?



- ☒ It is constant for all individuals.
- ☐ It varies for each individual.
- ☐ It increases as the infection progresses.
- ☐ It decreases as the infection progresses.


✓ **Correct** 1/1 Points

14. What happens to the number of susceptible individuals over time in an SIR model as the epidemic progresses? 

- ☒ It decreases exponentially.
- ☐ It increases exponentially.

- ☐ It remains constant.
- ☐ It fluctuates randomly.

✓ **Correct** 1/1 Points


15. For an SIR model, at a steady point: 

- ☐ The transmission rate (β)
- ☐ The recovery rate (γ) is always 0
- ☒ The sum of the rates of change of the three compartments is zero.
- ☐ The basic reproduction number (R_0) is always 0

Predator Prey Model




✓ **Correct** 1/1 Points

16. For a predator-prey model, if the prey population is initially at a higher level than its carrying capacity, the system will likely: 

- ☐ Stabilize at the carrying capacity of the prey.
- ☐ Experience a predator population crash.
- ☒ Oscillate between high and low population levels.
- ☐ Lead to the extinction of both predator and prey populations.

✓ **Correct** 2/2 Points

17. In a predator-prey model, the steady points (equilibrium points) of the system are affected by various factors. Identify the correct statements 

- ☒ If the predation rate increases, the predator population's steady point decreases.
- ☐ The system always stabilizes at the carrying capacity of the prey.
- ☒ An increase in the prey's reproductive rate leads to higher predator population at steady points.
- ☒ The presence of a competing species has no impact on the stability of the steady points.



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