



Name	Aitian Sun
Student ID	5007 09005

COMP5313/COMP4313 Large-Scale Networks Midterm Quiz

This is an Open Book test. However, **electronic devices (including phones, laptops, tablets, etc.) are not allowed - Please place them in your bag on the floor.** Calculators are allowed.

There are 20 multiple-choice questions in total. Each question has only one correct answer. Please **circle the letter** inside the box that corresponds to the correct answer.

Please make sure you fill in your name and Student ID correctly.

Please hand the completed quiz paper to the tutor before you leave the room.

You are allowed **50 minutes** for this quiz. Your tutor will start and stop the clock.

$$\frac{12}{20} \cdot \frac{8}{19} + \frac{8}{20} \cdot \frac{12}{19} + \frac{12}{20} \cdot \frac{7}{18} + \frac{7}{20} \cdot \frac{12}{18}$$

$$\frac{48}{190} + \frac{96}{190} + \frac{84}{360} + \frac{84}{360} = \frac{96}{200} = 0.48$$

Q1. In a homophily test based on a binary characteristic (e.g., group 1 and group 2), if a network has 20 nodes (12 in group 1 and 8 in group 2) and 5 edges, what is the expected number of inter-group edges if the links were formed randomly?

- A. 0.48
- B. 1.2
- C. 5
- ☒ D. 2.4
- E. None of the above is correct.

~~Ambiguous~~ ^{circle} allow edge to itself and repeat edges.
edge is completely random (duplicates allowed)
 $\frac{48}{20} = 2.4$
 $\frac{96}{38} \cdot \frac{48}{19} = 5$

Q2. A signed graph is balanced if and only if it contains no cycle with an odd number of positive edges.

- A. True
- ☒ B. False

Q3. What is an example of focal closure?

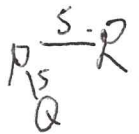
- ☒ A. Tennis introduces David to Eve
- B. Alice introduces Bob and Eve to David
- C. Alice introduces Bob to Eve
- D. Bob introduces David to tennis

Q4. Pick the right expression that complete this sentence: "The Scaled PageRank of each page converges..."

- A. ...always towards the same value.
- B. ...only for graphs that are strongly connected.
- ☒ C. ...to a value that depends on the chosen scaling factor.
- D. ...to a value that depends on the initial values.

Q5. Consider a small social network where person P satisfies the Strong Triadic Closure Property and has two friends, Q and R. The edge (P, Q) is a strong tie, and the edge (P, R) is also a strong tie. Which of the following is correct for the edge between Q and R?

- A. It is possible that there is no edge between Q and R.
- ☒ B. The edge between Q and R must exist and be a strong tie
- C. The edge between Q and R must exist and be a weak tie
- D. The edge between Q and R must exist, but could be either a strong or a weak tie



Q6. Consider a small directed network with two nodes A and B, where A has a link to B, and B has no outgoing links. If the scaling factor α for Scaled PageRank is 0.8, what is the value added to the PageRank of node A in one step due to the random jump component?

- ☒ A. 0.1
- ☒ B. 0.2
- C. 0.4
- D. 0.8
- E. None of the above is correct.

$A \rightarrow B$

$\gamma_a =$

Q7. Consider a node A that has 4 neighbours, and there are three undirected edges among A's neighbours. What is the cluster coefficient of A?

- A. 1
- B. $1/2$
- C. $1/3$
- ☒ D. $1/4$
- E. None of the above is correct.

$$\frac{3}{3 \cdot 4}$$

Q8. Consider a small undirected graph with 4 nodes (A, B, C, D) and 4 edges: (A, B), (A, C), (B, C) and (C, D). If we consider a community $S = \{A, B, C\}$, what is the number of edges within this community?

- A. 1
- B. 2
- ☒ C. 3
- D. 4
- E. None of the above is correct.



Q9. For the same graph and community $S = \{A, B, C\}$ as in the previous question, what is the sum of the degrees of nodes in community S?

- A. 4
- B. 6
- ☒ C. 7
- D. 8
- E. None of the above is correct.

$$2 + 2 + 3 = 7$$

Q10. Which of the following types of nodes causes the "Spider Trap" problem in the Bow-Tie structure of the Web?

- A. Giant SCC nodes
- ☒ B. OUT nodes
- C. IN nodes

Q11. The embeddedness of an edge is equal to the number of triangles that include the edge.

- ☒ A. True
☐ B. False

Q12. For the scaled PageRank Update Rule, given a scaling factor that is strictly between 0 and 1, it will converge to a non-zero equilibrium value even if the initial PageRank values are randomly set (e.g., may have positive, negative, and zero values).

- ☒ A. True
☐ B. False.

Q13. Consider a small directed network with three pages, A, B, and C. Page A links to B and page B links to C. If we initialize the PageRank of each page to 1/3, what is the PageRank of page A after one update by using the basic PageRank update rule?

- ☐ A. 1/3
☐ B. 1/9
☐ C. 1/6
☒ D. 0
☐ E. None of the above is correct.

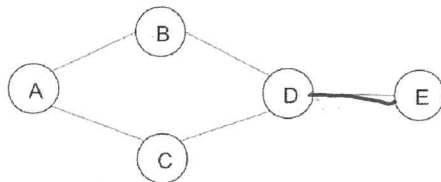
Q14. For the previous question, what will be the result if we use the scaled PageRank update rule with a scaling factor of 0.4.

- ☐ A. 0.4
☐ B. 0.6
☒ C. 0.2
☐ D. 1/3
☐ E. None of the above is correct.

Q15. Among the mechanisms underlying homophily, is social influence the tendency to form friendship with people of similar characteristics?

- ☒ A. Yes
- ☐ B. No

Q16. What is the betweenness of the edge (D,E) in the graph below?



- ☐ A. 6
- ☐ B. 5
- ☒ C. 4
- ☐ D. 3
- ☐ E. None of the above is correct.

Q17. What is the betweenness of the edge (A,C) in the graph in the previous question?

- ☐ A. 2
- ☒ B. 2.5
- ☐ C. 3
- ☐ D. 3.5
- ☐ E. None of the above is correct.

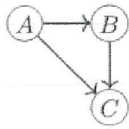
$$A-C \quad \frac{1}{2}A-D \quad \frac{1}{2}B-C \quad \frac{1}{2}E-A$$

=

Q18. Using the basic PageRank update rule, if a page has a current PageRank of 0.5 and has two outgoing links, how much PageRank does it pass to each of the pages it links to in one update step?

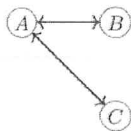
- ☐ A. 0.5
- ☒ B. 0.25
- ☐ C. 0.125
- ☐ D. 1

Q19. Is the following directed graph strongly connected or not?



- A. Yes
- ☒ B. No

Q20. What are the equilibrium PageRank values for the nodes (A,B,C) according to the Basic PageRank Update Rule? Note that, there are four directed edges in the graph A->B, B->A, A->C, C->A.



- A. (1/3, 1/3, 1/3)
- B. There is no unique set of equilibrium values
- C. (2/5, 2/5, 1/5)
- ☒ D. (1/2, 1/4, 1/4)
- E. None of the above is correct.

END OF QUIZ

$$r_a = r_b + r_c$$

$$r_b = \frac{1}{2} r_a$$

$$r_c = \frac{1}{2} r_a$$

$$1 = r_a + r_b + r_c$$

$$1 = r_a + r_a \quad r_a = \frac{1}{2}$$