Final Review Quiz

Due Dec 16 at 11:59pm **Points** 16 **Questions** 52 **Time Limit** None
Allowed Attempts Unlimited

Instructions

Submission Guidelines

This extra credit assignment has multiple-choice and numeric response questions. *This time 4 submissions are allowed (highest score kept) - it is encouraged you use these attempts to practice answering the questions as you will during the final exam (without access to other resources), however as usual, as long as the quiz is not submitted, it is automatically saved and can be resumed without counting as an additional attempt*

Also keep in mind that while this contains many important concepts and problem types, it is not exhaustive - it will be essential to review previous readings, quizzes, and other materials to ensure you are prepared for the final, which is cumulative.

Upon submission, make sure you have a record of the submission (with timestamp) on the assignment/quiz page on Canvas. If we do not have your submission in Canvas, you will **not** receive credit.

It is essential to follow these instructions to provide answers for this assignment. **Students who do not follow these guidelines will lose points.**

Take the Quiz Again

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	4,580 minutes	10.13 out of 16

Score for this attempt: **10.13** out of 16
Submitted Dec 16 at 11:30pm
This attempt took 4,580 minutes.

Question 1	**0.25 / 0.25 pts**

Consider a network with 15 nodes and answer the following questions.

If this network were a complete graph, how many edges would it have?

Correct!

105

orrect Answers

105 (with precision: 3)

Question 2

0 / 0.25 pts

Assume the graph from the previous question has 35 edges. What is the density of this graph? Answer to two decimal places.

ou Answered

0.18

orrect Answers

0.33 (with precision: 2)

Question 3

0.25 / 0.25 pts

Is this graph a tree?

- Yes
- Correct! No
- Not enough information

Question 4

0 / 0.25 pts

Is this graph complete?

- Yes
- orrect Answer — No
- ou Answered — Not enough information

Question 5

0 / 0.25 pts

Is this graph connected?

- ou Answered — Yes
- No
- orrect Answer — Not enough information

Question 6

0.25 / 0.25 pts

For the next several questions, consider an ER (Erdos-Renyi) random network with 40 nodes and a connection probability of 0.2.

How many edges do we expect this network to have?

Correct!

156

orrect Answers — 156 (with precision: 3)

Question 7

0 / 0.25 pts

What is the average node degree in this network?

ou Answered

3

orrect Answers

7.8 (with precision: 2)

Question 8

0.13 / 0.25 pts

Consider this adjacency matrix:

-	A	B	C	D
A	0	1	1	1
B	1	0	1	0
C	1	1	0	0
D	1	0	0	0

Select all of the following statements that are TRUE about this matrix and the graph it defines.

orrect Answer

- [ ] This matrix is symmetric
- [ ] This graph is directed
- [ ] This graph is weighted
- [ ] This graph contains self-loops

Correct!

- [x] This graph is connected

Question 9

0.25 / 0.25 pts

Which of the following best describes the connectivity of the graph defined by

the adjacency matrix in the previous question?

- Strongly connected
- Weakly connected
- Correct! Connected
- Unconnected

Question 10

0.25 / 0.25 pts

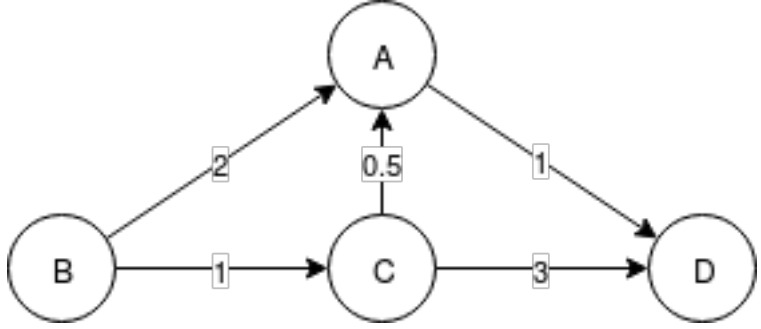
What is the clustering coefficient of node A in this graph?

- 1/6
- 1/4
- Correct! 1/3
- 1/2
- 2/3
- 3/4
- 5/6

Question 11

0.25 / 0.25 pts

Consider this graph:



What is the length of the shortest path from B to D

Correct!

2.5

orrect Answers

2.5 (with precision: 2)

Question 12

0.25 / 0.25 pts

Recall that a simple path between two nodes is not necessarily the shortest path; it has no backtracking or loops, *i.e.*, each edge in the path is visited exactly once. How many simple paths exist between B and D?

Correct!

3

orrect Answers

3 (with precision: 1)

Question 13

0.25 / 0.25 pts

Which of the following best describes the robustness of scale-free (SF) networks as compared to random and regular (grid-like) networks of similar size

- More resistant to random attack, more resistant to target attack
- Correct! More resistant to random attack, less resistant to targeted attack
- Less resistant to random attack, more resistant to targeted attack

Less resistant to random attack, less resistant to targeted attack

Question 14

0.25 / 0.25 pts

If one were seeking to disrupt a network by removing nodes and/or edges in an effort to disconnect it and/or increasing average path lengths, an "obvious" strategy is to attack the hubs. Whether it is because the hubs are hard to attack (airports?) or because the network lacks hubs (highways?), which of the following is another valid criterion for good targets to disrupt

Nodes with high clustering coefficient

Nodes with low degree

Nodes with high closeness centrality

Correct!

Nodes/edges with high betweenness centrality

Question 15

0.25 / 0.25 pts

Consider two nodes of equal degree on some network: one with high clustering coefficient and one with low clustering coefficient. All else being equal, which of the two would you intuit to be a better target if you were seeking to disrupt the network

High CC node

Correct!

Low CC node

Question 16

0 / 0.25 pts

Assume a simple contagion (SI or SIR) is spreading on a connected network. Now consider two randomly-selected nodes in the network: one with high degree and one with low degree. Which of the following is more likely to become "infected" first

orrect Answer

- High degree
- Low degree

ou Answered

- Both are equally likely

Question 17

0.25 / 0.25 pts

Which of the following would be best for modeling the spread of the common cold?

(There's a slight technicality here, I'm talking about everything we call the common cold, not any individual strain)

- SI

Correct!

- SIS
- SIR

Question 18

0.25 / 0.25 pts

Which of the following would be best for modeling the spread of chicken pox?

- SI
- SIS

Correct!

SIR

Question 19

0.25 / 0.25 pts

Which of the following would be best for modeling the spread of zombiism[1] as generally portrayed in film and TV?

Please discuss on the discussion board if you've never seen a zombie movie.

[1](n.) the condition of being a zombie

Correct!

SI

SIS

SIR

Question 20

0 / 0.25 pts

Using the language of SIR models, how do vaccines work?

You Answered

By decreasing the transmission rate (virus spread chance)

By increasing the recovery rate

By decreasing the initial outbreak size

Correct Answer

By placing some nodes directly into the resistant state

Question 21

0.25 / 0.25 pts

Consider the bow-tie structure of the web. In which component is my Tumblr about web development most likely to be? I mostly link to other resources and it's unlikely anyone is linking to my site.

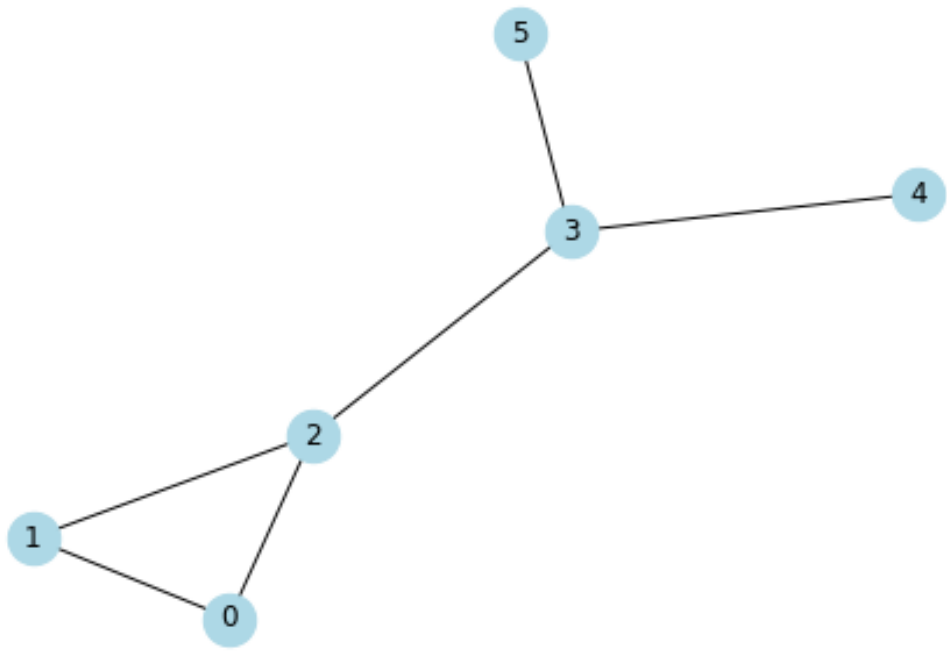
Correct!

- (•) In-component
- ( ) Central Core
- ( ) Out-Component
- ( ) Tubes
- ( ) Tendrils

Question 22

0.25 / 0.25 pts

Consider the following graph:



Which node in this graph has the highest betweenness centrality?

Correct!

3

orrect Answers

3 (with precision: 1)

Question 23

0.25 / 0.25 pts

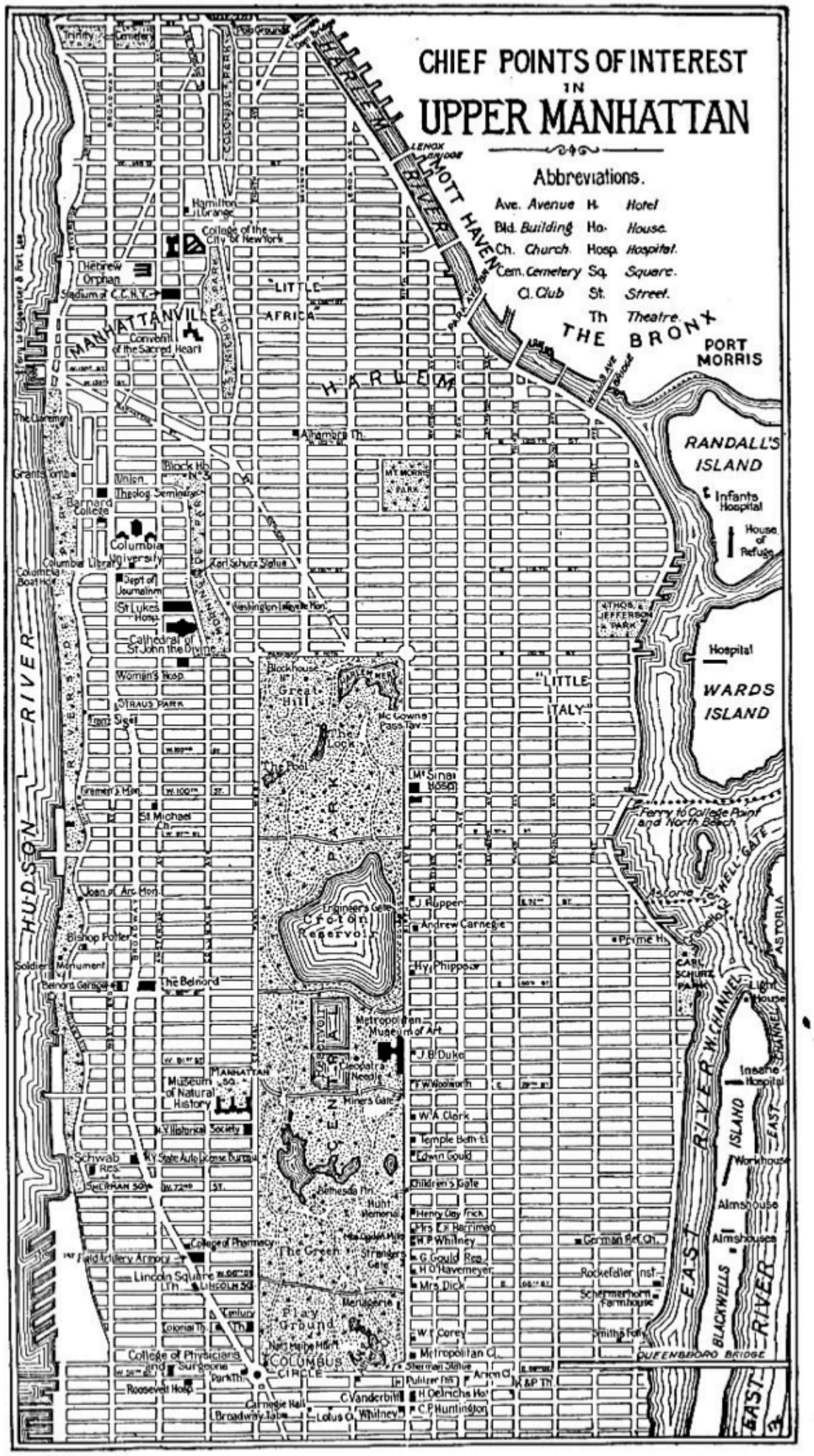
Consider a node A in a network with relatively high degree but relatively low PageRank. In general, what can we say about the nodes linking to node A?

- They are singletons
- They are sinks
- They have low PageRank (Correct!)
- They have low degree

Question 24

0.25 / 0.25 pts

Consider this surface-level road map of upper Manhattan from the 1920s:



If we were creating a network of roads from this map, we might consider using road segments as the edges, e.g. 5th ave between 12th and 13th streets. With this choice of edges, which of the following would be the best choice to make up the **nodes** of this network?

- City blocks e.g. the block between 5th-6th aves and 12th-13th streets
- Street intersections e.g. 5th ave and 12th st

Correct!

Pedestrians moving along the streets

Vehicles traveling on the roads

Question 25

0.25 / 0.25 pts

The **degree** of a node is the number of edges connected to that node. Consider the above Manhattan road map and the network described in the previous two questions. The grid-like structure of this network means that most nodes have the same degree. What is the most common degree for nodes in this network?

Correct!

4

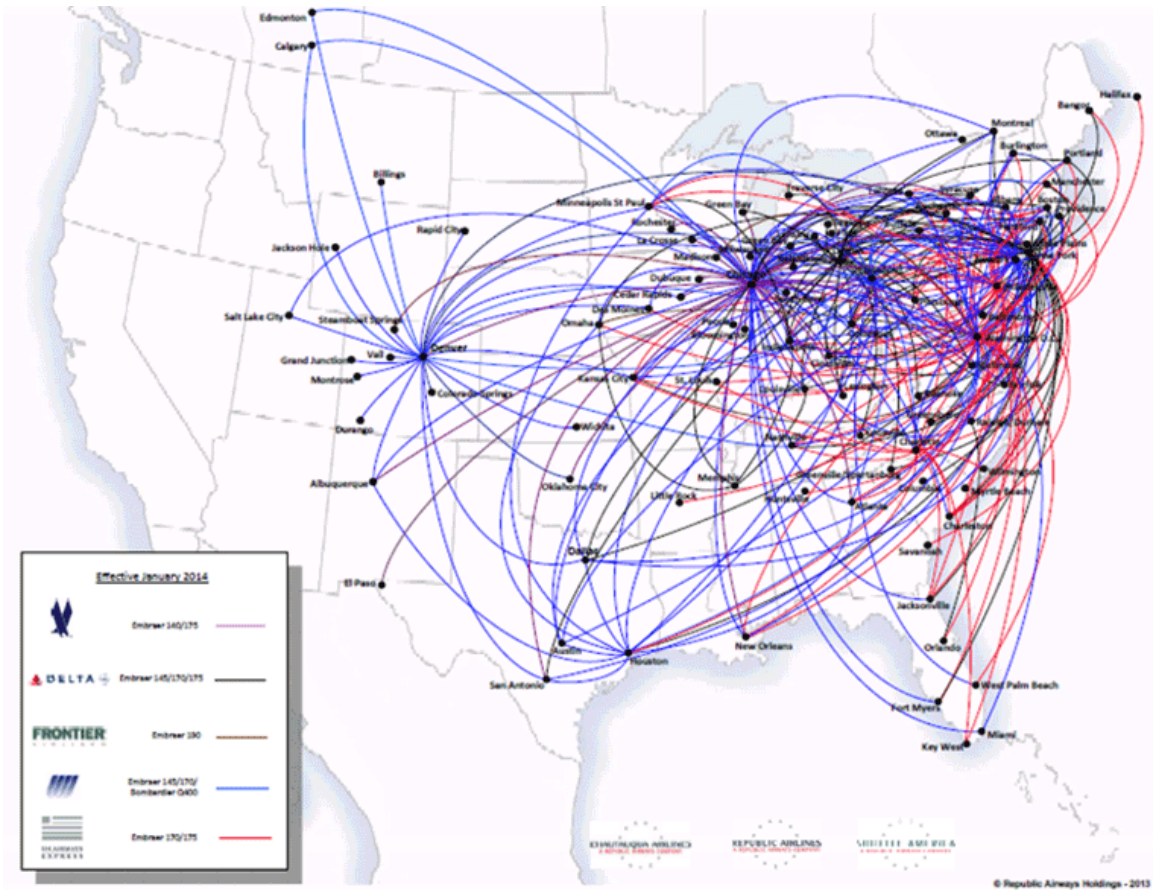
orrect Answers

4 (with precision: 1)

Question 26

0.25 / 0.25 pts

Consider this map from Republic Airways:



We've discussed air travel networks where the nodes are airports and the edges are direct flights between airports. This air travel network displays a distinguishing feature absent from the Manhattan road network from the previous questions. What is this key characteristic?

- Singleton nodes with no edges
- Multiple routes between nodes
- Nodes with more than one connected edge
- Hub nodes with many edges

Correct!

Question 27

0.25 / 0.25 pts

Recall that unless otherwise specified, the length of a path is the number of edges contained therein. Consider a connected graph *G* and two arbitrary nodes therein, *u* and *v*. Which of the following statements is **false**?

- There must exist a shortest path between u and v
- There may exist multiple shortest paths between u and v
- There must be an edge between u and v

Correct!

- There may be an edge between u and v

Question 28

0.25 / 0.25 pts

Consider a directed network of N nodes. Now consider the total in-degree, *i.e.* the sum of the in-degree over all nodes in the network. Compare this to the analogous total out-degree. Which of the following must hold true for any such network?

Total in-degree must be greater than total out-degree

Correct!

Total in-degree must be equal to total out-degree

Total in-degree must be less than total out-degree

None of these hold true in all instances

Question 29

0.25 / 0.25 pts

Consider an undirected, connected graph with N nodes. What is the maximum number of edges that graph can have?

N - 1

N

Correct!

N (N - 1) / 2

N^2

Question 30

0.25 / 0.25 pts

A graph with the maximum possible number of edges has a special name. What is such a graph called?

Correct!

Complete

Connected

Cycle

Tree

Question 31

0.25 / 0.25 pts

Consider an undirected, connected graph with N nodes. What is the **minimum** number of edges that graph can have?

Correct!

- (•) N - 1
- ( ) N
- ( ) N (N - 1) / 2
- ( ) N^2

Question 32

0 / 0.25 pts

A connected graph with the **minimum** possible number of edges has a special name. What is such a graph called?

- ( ) Complete

You Answered

- (•) Cycle

- ( ) Subgraph

Correct Answer

- ( ) Tree

Question 33

0.25 / 0.25 pts

True or False: In a tree, there exists a path from every node to every other

node.

Correct!

- (•) True
- ( ) False

Question 34

0.25 / 0.25 pts

Consider this adjacency matrix to answer the following questions. It may help if you draw this network diagram so you can refer to it without scrolling up.

	A	B	C	D	E	F
A	0	1	0	0	0	0
B	0	0	2	0	0	0
C	0	0	0	0	0	0
D	0	1	0	0	1	0
E	0	0	0	0	0	1
F	2	1	3	1	1	0

What kind of graph does this matrix define?

- ( ) Undirected, unweighted
- ( ) Directed, unweighted
- ( ) Undirected, weighted

Correct!

- (•) Directed, weighted

Question 35

0.25 / 0.25 pts

Consider the graph defined by the adjacency matrix above. How many nodes are in this graph?

Correct!

6

orrect Answers

6 (with precision: 1)

Question 36

0.25 / 0.25 pts

Consider the graph defined by the adjacency matrix above. How many edges are in this graph?

Correct!

10

orrect Answers

10 (with precision: 2)

Question 37

0.25 / 0.25 pts

Consider the graph defined by the adjacency matrix above. What is the density of this graph (ignoring edge weights)? Answer to two decimal places.

Correct!

0.33

orrect Answers

0.33 (with precision: 2)

Question 38

0.25 / 0.25 pts

Consider the graph defined by the adjacency matrix above. Are there any cycles in this graph?

Correct!

- Yes

No

Question 39

0.25 / 0.25 pts

Consider the graph defined by the adjacency matrix above. Which of the following best describes the connectivity of this graph?

Connected

Correct!

Weakly connected

Strongly connected

Unconnected

Question 40

0 / 0.25 pts

Consider the graph defined by the adjacency matrix above. What is the in-strength of node C?

You Answered

5

Correct Answers

3 (with precision: 1)

Question 41

0.25 / 0.25 pts

Consider this graph:

Which of the following would be the best guess for this graph's diameter?

- 2
- 5
- Correct! 10
- 20

Question 42

0.25 / 0.25 pts

Consider the graph from the previous question. Which of the following is the best estimate for that graph's average clustering coefficient?

- Correct! 0.01
- 0.1

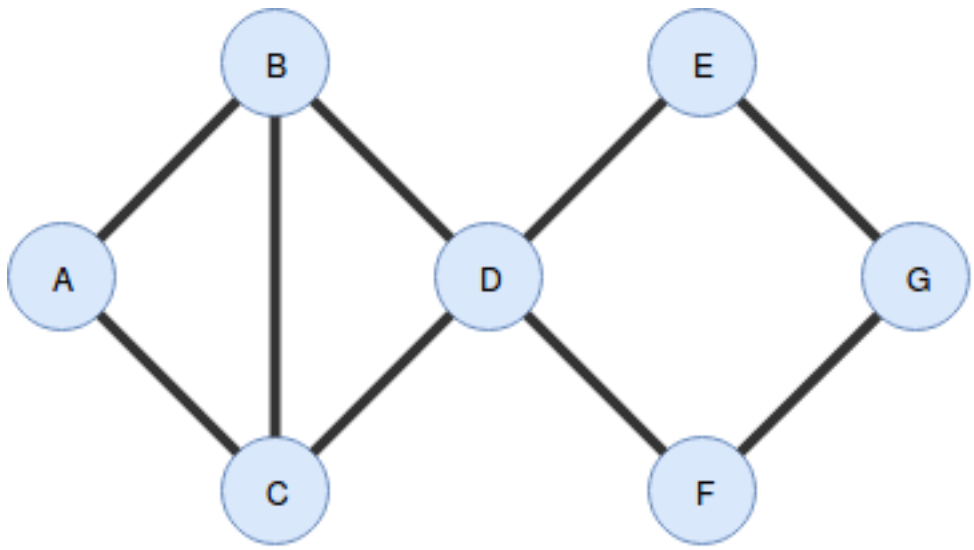
0.5

1.0

Question 43

0.25 / 0.25 pts

Use the following graph to answer the following several questions:



What is the density of this graph? Answer to two decimal places.

Correct!

0.43

orrect Answers

0.43 (with precision: 2)

Question 44

0.25 / 0.25 pts

What is the clustering coefficient for node D in this graph?

Correct!

1/6

1/4

1/3

1/2

Question 45

0 / 0.25 pts

What is the average clustering coefficient of this graph?

You Answered

0.35

Correct Answers

Between 0.36 and 0.37

Question 46

0 / 0.25 pts

What is the average shortest path length (APL) of this graph? Answer to two decimal places.

You Answered

11.14

Correct Answers

1.86 (with precision: 3)

Question 47

0 / 0.25 pts

Which of the following best describes the connectivity of this graph?

Correct Answer

Strongly connected

Weakly connected

You Answered

Connected

Unconnected

Question 48

0.25 / 0.25 pts

(Note - you can easily run this code Python to answer the following questions, however it is strongly encouraged that you ensure you know how to calculate/estimate the answer yourself, since you will not have access to Python during the quiz)

What is the output of the following code:

```
import networkx as nx
G = nx.complete_graph(87)
print(G.number_of_edges())
```

Correct!

3741

8700

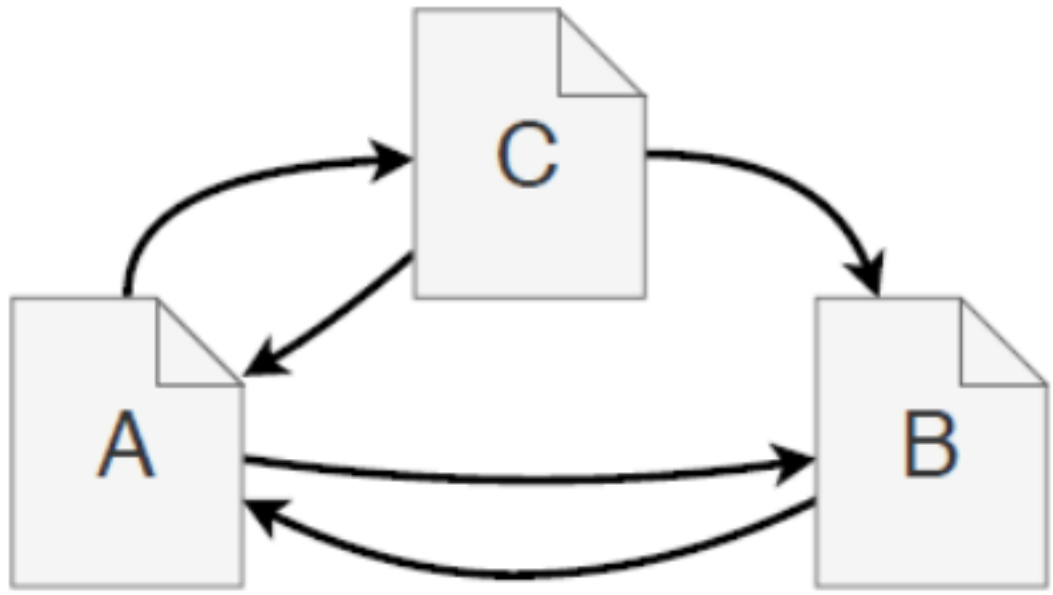
5043

2874

Question 49

0 / 1 pts

Consider the following network



Initialize the PageRank of each page with the value R_0 = 1/3.

Apply the following equation (4.1 from the textbook) without teleportation (set α = 0)

$$R_t(i) = \frac{\alpha}{N} + (1-\alpha) \sum_{j \in \text{pred}(i)} \frac{R_{t-1}(j)}{k_{out}(j)}.$$

to calculate the values of PageRank in the next iteration (t = 1).

Continue to update the values until convergence — **assume the values have converged when there is no change in the third decimal digit of each node's PageRank.**

First, what is the final PageRank value for Page A?

You Answered

0.7915

Correct Answers

0.44 (with margin: 0)

Question 50

0 / 1 pts

What is the final PageRank value for page B?

ou Answered

0.7915

orrect Answers

0.33 (with margin: 0)
0 (with margin: 0)
0 (with margin: 0)
0 (with margin: 0)

Question 51

0 / 1 pts

What is the final PageRank value for cage C?

ou Answered

0.7915

orrect Answers

0.22 (with margin: 0)
0 (with margin: 0)
0 (with margin: 0)
0 (with margin: 0)

Question 52

1 / 1 pts

True or False, PageRank is a type of centrality

Correct!

- (•) True
- ( ) False

Quiz Score: **10.13** out of 16