

Assignment 0-

1) How many cliques can be formed from the graph in figure 1?

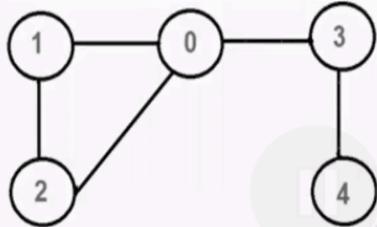


Figure 1

- 1
- 2
- 3
- 4

2) Which of the following condition is sufficient to detect cycle in a directed graph? **1 point**

- There is an edge from currently being visited node to an already visited node
- There is an edge from currently being visited node to an ancestor of currently visited node in DFS forest
- Every node is seen twice in DFS
- None of these

3) Given G is a bipartite graph, and the bipartitions of this graphs are U and V respectively. What is the relation between them?

- Number of vertices in U = Number of vertices in V
- Sum of degrees of vertices in U = Sum of degrees of vertices in V
- Number of vertices in U > Number of vertices in V
- Nothing can be said

4) Are trees bipartite?

- Yes
- No
- Yes, if they have even number of vertices
- No if they have odd number of vertices

5) Which of the following properties a simple graph does not hold?

- Must be connected
- Must be unweighted
- Must have no loops or multiple edges
- Must have no multiple edges

6) For a given graph G having 'v' vertices and 'e' edges which is connected and has no **1 point** cycles, which of the following statements is true?

- $v=e$
- $v = e+1$
- $v + 1 = e$
- $v = e-1$

7) A graph with all vertices having equal degree is known as a _____ **1 point**

- Multi Graph
- Regular Graph
- Simple Graph
- Complete Graph

8) Which of the following is true about Handshaking Lemma? **1 point**

- If the degree of a vertex is even, the vertex is called an even vertex
- The degree of a graph is the largest vertex degree of that graph
- The degree of a vertex is odd, the vertex is called an odd vertex
- The sum of all the degrees of all the vertices is equal to twice the number of edges

9) What is the maximum number of possible non-zero values in an adjacency matrix of **1 point** a simple graph with 'n' vertices?

- $(n*(n-1))/2$
- $(n*(n+1))/2$
- $n*(n-1)$
- $n*(n+1)$

10) A social network must include both _____ and _____.

- social actors; relations between them.
- real-world interactions; online interactions.
- historical data about a group; contemporary data about the same group.
- well-connected social actors; loners.

Assignment 1-

1) What is the number of edges present in a complete graph having 'n' vertices?

- $(n*(n+1))/2$
- $(n*(n-1))/2$
- n
- Information given is insufficient

2) Which of the following functions is used to remove all edges and nodes in a graph in NetworkX?

- `networkx.MultiDiGraph.clear(u, v[, (key)])`
- `networkx.MultiDiGraph.remove_edge(u, v[, (key)])`
- `networkx.MultiDiGraph.clear()`
- `networkx.MultiDiGraph.remove()`

3) What will be the output of the following Python code?

```
t = (1, 2, 4, 3, 8, 9)  
[t[i] for i in range(0, len(t), 2)]
```

[2, 3, 9]

[1, 2, 4, 3, 8, 9]

[1, 4, 8]

(1, 4, 8)

4) In which line there(s) is an error?

```
G = nx.Graph() // line 1  
G.add_node(1) // line 2  
G.add_node("Hello") // line 3  
G.add_node(2.0) // line 4
```

line 4

line 2

line 3

None of these

5) Which of the following graphs are isomorphic to each other?

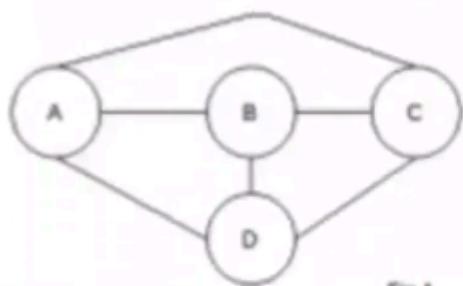


Fig 1

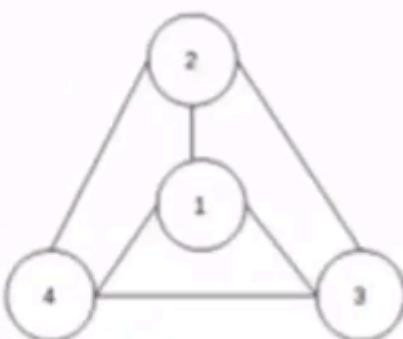


Fig 2

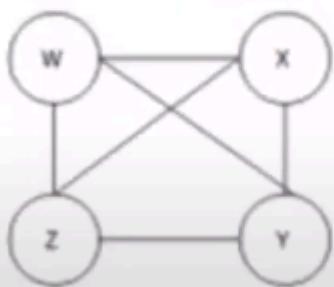


Fig 3

- Fig 1 and Fig 2
- Fig 2 and Fig 3
- Fig 1 and Fig 3

0 / 1:54 Fig 1, Fig 2 and Fig 3

- Fig 1, Fig 2 and Fig 3

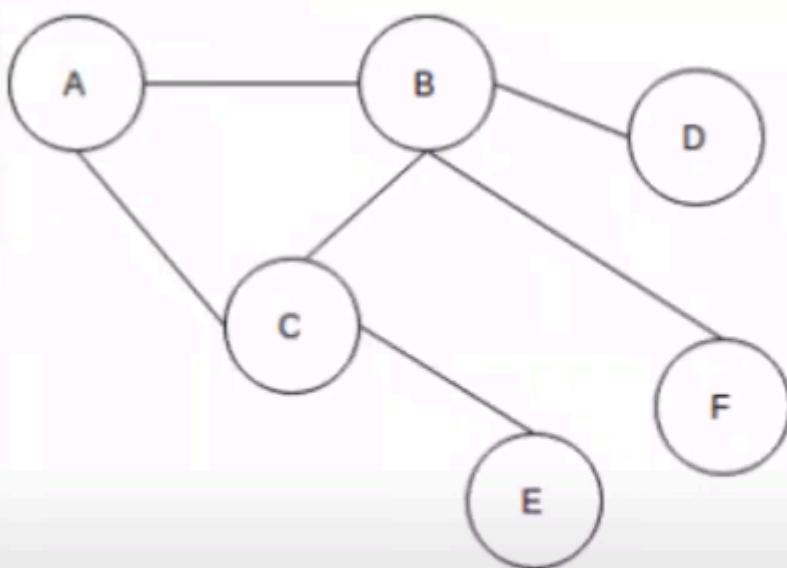
6) What is the value of the sum of minimum in-degree and maximum out-degree of a Directed Acyclic **1 point** Graph?

- Depends on a Graph
- Will always be zero
- Will always be greater than zero
- May be zero or greater than zero

7) Assuming the value of every weight to be greater than 10, in which of the following cases the shortest path of a directed weighted graph from 2 vertices 'u' and 'v' will never change?

- add all values by 10
- subtract 10 from all the values
- multiply all values by 10
- in both the cases of multiplying and adding by 10

8) In the given graph which edge should be removed to make it a Bipartite Graph



- A-C
- B-E
- C-D
- D-F

9) What will be the output of the following Python code? 1

```
1.     str1 = 'hello'
2.     str2 = ', '
3.     str3 = 'world'
4.     str1[-1:]
```

- olleh
- hello
- h
- o

10) For any two different vertices u and v of an Acyclic Directed Graph if v is reachable from u , which of the following is true? 1

-
- u is also reachable from v
- u is not reachable from v
- insufficient information

Assignment 3-

1) Road network is a _____ network whereas email network is a _____ network. 1 p

- Undirected, Directed
- Undirected, Undirected
- Directed, Directed
- Directed, Undirected

2) Which of the following is the most commonly used format for datasets? 1 p

- CSV
- GML
- GraphML
- GEFX

3) Which of the following file formats can be read using read_pajek() function? 1 p

- .net
- GraphML
- GEFX

3) Which of the following file formats can be read using read_pajek() function? 1 p

- .net
- .pajek
- .graphml
- Both .net and .pajek

4) Which of the following function is used to calculate the average of the clustering coefficients? 1 p

- nx.avg_cluster(G)
- nx.average_cluster(G)
- nx.avg_clustering(G)
- nx.average_clustering(G)

5) Gephi is written in which of the following languages?

- Python
- R
- Java
- C

6) If a simple graph G , contains n vertices and m edges, the number of edges in the Graph G' (Complement of G) is _____?

-
- $(n \cdot n - n - 2 \cdot m) / 2$
-
- $(n \cdot n + n + 2 \cdot m) / 2$
-
- $(n \cdot n - n - 2 \cdot m) / 2$
-
- $(n \cdot n - n + 2 \cdot m) / 2$

7) State True or False:

1 p

All trees with n vertices consists of $n-1$ edges.

- True
- False

8) If n is the number of nodes, what is the minimum number of edges needed to make a graph connected?

-
- C_2^n
-
- $n-1$
-
- $n/2$
-
- $3n/4$

9) What will be the diameter of a complete graph of 15 nodes?

1 point

- 1
- 10
- 15
- 12

10) For a undirected network G made of 3 nodes and 2 edges, what will be the density $\rho(G)$? 1 point

- 0.66
- 0.33
- 0.49
- 0.56

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Assignment 4-

1) Among which of the following, the individual characteristics drive the formation of links? 1 point

- Selection
- Social influence
- None of these

2) Consider the following two statements: 1 point

S1: *the neighbourhood overlap of two editors in the bipartite affiliation network of editors and articles, consisting only of edges from editors to the articles they've edited.*

S2: *measure of similarity of editors.*

Are the two statements equivalent?

- S1 is equivalent to S2
- S1 is different from S2

3) If $A = \{5, 6, 7\}$ and $B = \{6, 7, 10, 12\}$; then calculate the similarity measure between A and B .

- 0.166
- 0.33
- 0.4
- 0.5

4) Which of the following statements are/ is true?

- Homophily exists between people of similar ideas.
- Homophily exists between people of varying ideas.
- Heterophily exists between people of similar ideas.
- Heterophily exists between people of varying ideas.

5) With regards to fatman evolutionary model, which of the following is correct?

- Foci nodes are nodes among the participant nodes.
- Foci nodes are nodes added apart from the participant nodes.
- Foci nodes are not a part of the model.
- None of these

6) If `get_person_nodes(G)` assigns nodes to each person in a graph, what does the following code implement?

```
pnodes = get_person_nodes(G)
for u in pnodes:
    for v in pnodes:
        if (u != v):
            diff = abs(G.nodes[u]['name'] - G.nodes[v]['name'])
            p = 1 / (diff + 1000)
            r = random.uniform(0, 1)
            if (r < p):
                G.add_edge(u, v)
```

- Homophily
- Closure
- Social influence
- Cannot predict as information incomplete

7) Which of the following links are not possible in context to closure?

- People-people
- People-foci
- Foci-foci
- None of these

8) When plotted on a graph, the similarity measure curve is _____ after the time at which two people started a conversation than the time after which they started conversing.

- Steeper
- Slighter
- Flatter
- None of these

9) Which of the following statement is true?

1 point

S1: if two people participate in a shared focus, this provides them with an opportunity to become friends;

S2: if two people are friends, they can influence each other's choice of foci.

- S1 is true and S2 is false
- S1 is false and S2 is true
- S1 and S2 are true
- S1 and S2 are false

II

10) Considering circles as people and triangles as the corporate boards to which people belong to, what does the figure 1 denote? 1

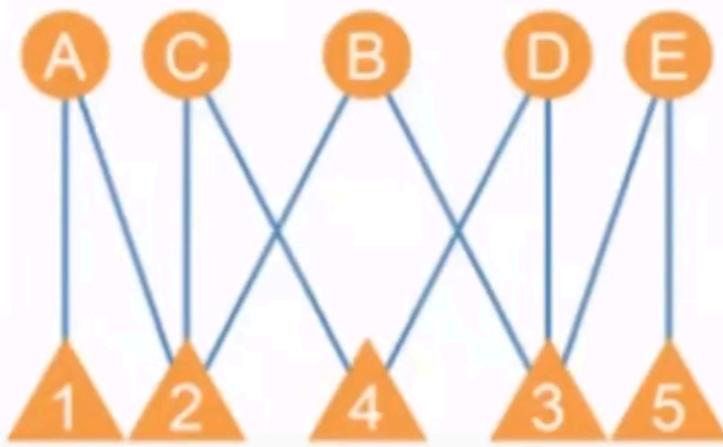


Figure 1

- Bipartite Graph
- Affiliation Graph
- Both Affiliation and Bipartite graph
- None of these

Assignment 5-

1) Which of the following is correct with respect to Schelling's model? **1 point**

- The higher the threshold, the higher the likelihood the agents will not be satisfied with their current location.
- The higher the threshold, the lower the likelihood the agents will not be satisfied with their current location.
- The lower the threshold, the higher the likelihood the agents will not be satisfied with their current location.
- The lower the threshold, the lower the likelihood the agents will not be satisfied with their current location.

2) In Schelling's model, every agent has threshold value of at least _____:

- 0
- 1
- 5
- 10

3) In the figure 1, according to Schelling's model, Find the similarity ratio for X in case A and B (up to two decimal points).

1	2	3
4	X	5
6	7	8

Case A

1	2	3
4	X	5
6	7	8

Case B

Figure 1

- A=0.42, B=0.28
- B=0.42, A=0.28
- A=0.50, B=50
- A=0.60, B=0.28

A=0.60, B=0.28

4) When can a signed graph be considered as balanced?

- It contains no cycle with an odd number of negative edges.
- It contains no cycle with an even number of negative edges.
- It contains no cycle with an odd number of positive edges.
- Incomplete Data

5) Two of my close friends hate each other, what kind of triangular relationship structure is this?

- Stable
- Unstable
- Insufficient data
- none of these

6) State True or False:

6) State True or False:

"A complete graph with 6 vertices is unbalanced if it is having all positive edges having relationship with one random edge being negative."

- True
- False
- Depends

7) In which of the following conditions, a triangular network is stable?

- It has even +ve relationships and odd -ve relationships
- It has odd + relationships and odd - relationships
- None of these

8) Which of the triangles in figure 2 does not show the social belief that 'friend of a friend is a friend'? 1 point

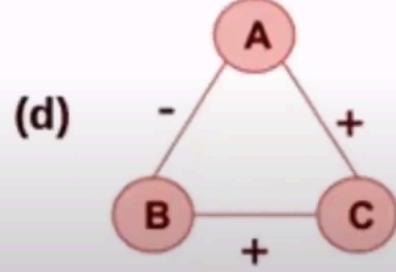
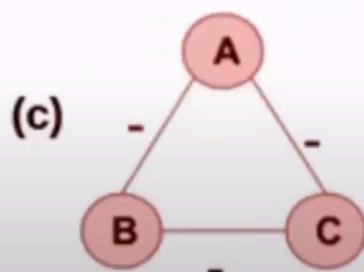
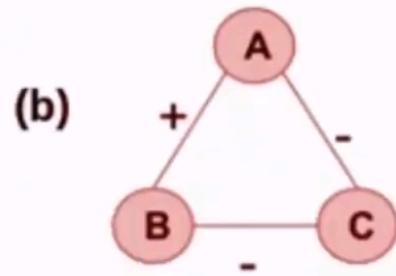
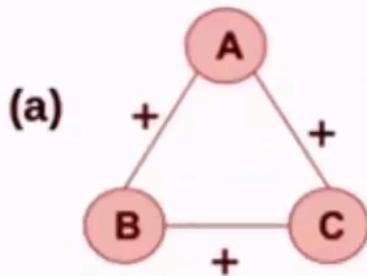


Figure 2

- a
- b
- c
- d

9) As the threshold decreases, the chances of agents being happy with their current location _____: 1 point

- Increases.
- Decreases.
- No change
- Sometimes increases sometimes decreases.



10) At more general level, Schelling model be viewed as an example of _____? **1 point**

- How characteristics that are variable and changing can become highly correlated with other characteristics that are mutable.
- How characteristics that are fixed and changing can become highly correlated with other characteristics that are mutable.
- How characteristics that are fixed and unchanging can become highly correlated with other characteristics that are mutable.
- How characteristics that are variable and unchanging can become highly correlated with other characteristics that are immutable.

Assignment 6-

1) Which of the following is a link analysis task?

- Link-based Object Classification (LOC)
- Link-based Object Ranking (LOR)
- Link prediction
- All of these

2) Which of the following statement is true regarding web graph?

- It is a directed graph
- It is an undirected graph
- It is weighted graph
- It is a signed graph

3) On which scale, Page rank is calculated?

1 point

- Logarithmic scale
- Exponential scale
- None of these
- Depends on network to network

4) What is (are) the problem(s) associated with a random surfer while calculating page rank?

- A random surfer is caught when he encounters a dangling node such as an image, pdf, data tables etc.
- A random surfer completely abandons the hyperlink method and moves to a new browser and enter the URL in the URL line of the browser.
- None of these

5) What will the following line of code return?

1 point

>> nx.pagerank(g)

- Tuple
- dictionary of tuples
- Dictionary
- List

6) Which of the following is true regarding page rank?

1 point

- The more in-links that a page i receives, the more prestige the page i has.
- The less in-links that a page i receives, the more prestige the page i has.
- The more in-links that a page i receives, the less prestige the page i has.
- None of these.

7) Let algorithm 1 denotes the equal coin distribution (A1) and algorithm 2 denotes the **1 point** random coin dropping (A2), which of the following is true?

- The nth best node according to A1 is the same as nth best node according to A2 if n is a small number.
- The nth best node according to A1 is the same as nth best node according to A2 if n is a large number.
- The nth best node according to A1 is the same as nth best node according to A2 irrespective of n's value.
- The nth best node according to A1 is never the same as nth best node according to A2.

8) What is the function of the following line of code?

```
g = add_edges(g, 0.4)
```

- Add undirected edges in graph
- Add directed edges in graph
- Incomplete information

9) How much time does naïve computation of random walk measure usually requires?

- $O(n^2)$
- $O(n)$
- $O(n^3)$
- None of these

10) Given a graph g and points on random walk, what does the function X depict?

def X(g, points):

```
t = np.array(points)
```

```
t = np.argsort(-t)
```

```
return t
```

- rank of nodes according to their edge weight
- rank of nodes according to their random walk points
- rank of nodes according to the number of times they have been visited
- None of these

Assignment 7-

1) What will be the incentive given to nodes if they chose different behaviours?

- q
- 1-q
- 0
- 1

2) State true or false:

“Homophily can never serve as a barrier to diffusion”

- True
- False

3) What are the factors which influence model diffusion?

- Payoff
- Communities
- Key people
- Cascade formation
- All the above



4) Why do people generally follow a company's page?

- learn about new products and services
- to stay up to date on company news
- connect with people similar to themselves
- to connect with people who are different to them
- All the above

5) If d is the number of neighbours and p is fraction of neighbours which adopt node A, **1 point** when can it be said that A is the better choice?

- $pda \geq (1 - p)db$
- $pda \leq (1 - p)db$
- $pda = (1 - p)db$
- $pda \leq pdb$

6) Under what condition, do we say that set of initial adopters cause a complete cascade at threshold q ? **1 point**

- If the resulting cascade of adoptions of A eventually causes every node to switch from B to A
- If the resulting cascade of adoptions of A eventually causes only some nodes to switch from B to A
- If the resulting cascade of adoptions of A eventually causes no node to switch from B to A
- None of these

7) Which of the following is an example of social reinforcement?

1 point

- A child hesitantly raises his hand in class to answer a question. The teacher praises for his efforts or a peer winks from across the room.
- A child finishes all of his chores. The parent gives access to a computer game for 20 minutes.
- All of these
- None of these

8) State true or false:

1 point

"An effective viral marketing campaign requires that marketers identify individuals with high social networking potential."

- True
- False

9) Suppose every player in a game is given a payoff a and b based on two actions, A **1 point** and B. Now, there are two friends Monika and Phoebe; Monika decides to adopt action A while Phoebe decides to adopt action B. What are the payoffs that they get?

- Monika- a, Phoebe - b
- Monika- a, Phoebe - 0
- Monika- 0, Phoebe - b
- Monika- 0, Phoebe - 0

10) Consider two actions X and Y. The payoff associated with the action X is 40 while the payoff associated with action Y is 10. In such a case, what is the threshold fraction of neighbours that should have adopted X, in order for a node to adopt the action X?

- 1/2
- 1/4
- 1/5
- 1/3

1) Which of the following statements is/are true?

- If v links to pages with high authority scores, its hub score increases.
- If page v is linked to good hubs, its authority score increases.
- If page v is linked to good hubs, its authority score decreases.
- If v links to pages with high authority scores, its hub score decreases.

2) State true or false:

“Hub and Authority are Exclusionary”

- True
- False

3) The main page of a site usually has _____ hub and _____ authority scores

- High, low
- Low, High
- High, high
- Low, Low

4) 4. What will be the page rank of nodes in figure 1?

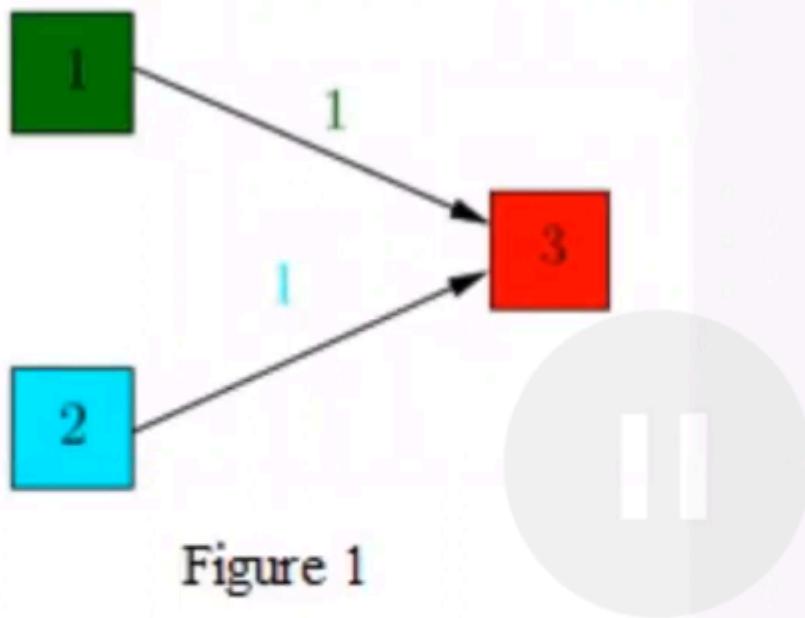


Figure 1

- Node 1: 0, Node 2: 0, Node 3: 2
- Node 1: 0, Node 2: 0, Node 3: 1
- Node 1: 0, Node 2: 0, Node 3: 0
- None of these

5) If a network of n nodes is strongly connected, how many sets of equilibrium values exist?

- 1
- $n/2$
- $\log n$
- $n/3$

6) Which of the following is/are a dangling node in figure 2?

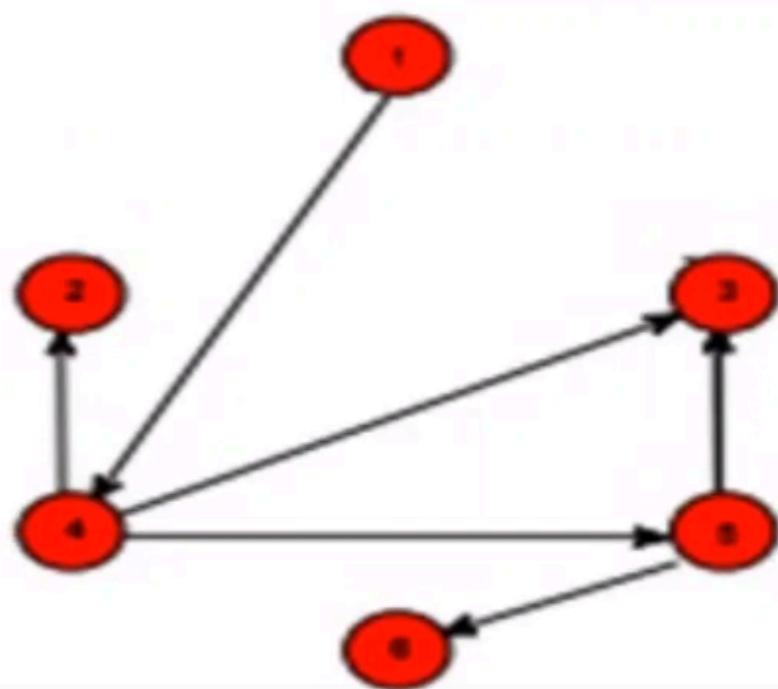


Figure 2

1

6

2

0 / 2:06 3

7) While performing k hub-authority updates in Principle of Repeated Improvement process, what will happen if we use larger and larger values of k? **1 point**

- The normalized values actually converge to limits as k goes to infinity.
- The results stabilize so that continued improvement leads to smaller and smaller changes in the values.
- None of these

8) Which of the following properties are related to Markov matrix A? **1 point**

- All entries are non-negative.
- sum of each column vector is equal to 1.
- A has an eigenvalue 1.
- Entries can be negative.

9) What happens to the magnitude of the hub and authority values with each update in hub authority computation? **1 point**

- Decrease
- Increase
- Remains constant
- None of the above

10) Which of the following is correct with respect to normalizing weights in hubs and authorities? **1 point**

- The weights are normalized to ensure that the product of their squares is 1.
- The weights are normalized to ensure that the sum of their squares is 1

/ 2:06 None of these



Assignment 9-

1) State the following statements as true or false:

"The degree d_v of vertex v is its number of incident edges"

True

False

2) Complete the following sentence:

"The degree sequence _____ specify the graph"

does not uniquely

uniquely

Depends on the graph

3) The shape of the Normal Curve is _____

Bell Shaped

Flat

Circular

Spiked

4) Normal Distribution is applied for _____

Irregular Random Variable

Continuous Random Distribution

Discrete Random Variable

Uncertain Random Variable

5) Which of the following is the ingredient in generating power law? 1

- preferential attachment
- growth over time
- Both preferential attachment and growth over time
- None of these

6) State true or false about preferential attachment? 1

"New nodes prefer to attach to well-connected nodes over less-well connected nodes"

- True
- False

7) Which of the following is true for random network and real-world network? 1 point

- Real networks are the result of a growth process that continuously increases N.
- The random network model assumes that the number of nodes, N, is fixed.
- Nodes in real networks randomly choose their interaction partners.
- In random networks new nodes tend to link to the more connected nodes.

8) Which of the following is true? 1 point

- The absence of preferential attachment leads to a growing network with a stationary but exponential degree distribution.
- The absence of growth leads to the gain of stationarity, forcing the network to converge to a complete graph.
- the absence of growth leads to the loss of stationarity, forcing the network to converge to a complete graph.
- None of these

9) Suppose $P(k)$ denotes the degree distribution of the network in figure 1, what is the value of $P(2)+P(3)$?

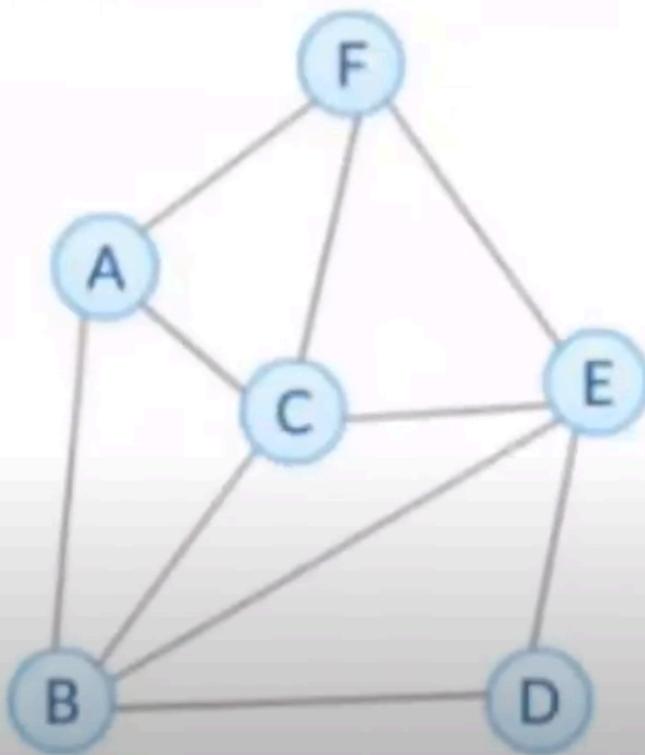


Figure 1

- 5/6
- 1/2
- 1/3
- 1/6

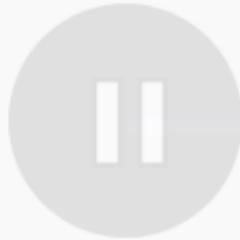
10) Which of the following curve is the sure litmus test for detecting power law in a network?

- Between $\log f(k)$ vs k
- Between $\log f(k)$ vs $f(k)$
- Between $\log f(k)$ vs $\log(k)$

Assignment 10-

1) How the number of in-links to a given page be distributed?

- Normally
- Poisson
- Binomially
- Uniformly



2) Which of the following is true? 1 point

- The number of pages with k in-links should decrease exponentially in k , as k grows large.
- The number of pages with k in-links should increase exponentially in k , as k decreases.
- The number of pages with k in-links should increase exponentially in k , as k grows large.
- The number of pages with k in-links should decrease exponentially in k , as k decreases.

3) What is the fraction of web pages having in-degree k ?

-
- k^2
- k
-
- $1/k$
- $\frac{1}{k^2}$

4) Which of the following are examples of scale-free networks? 1

- WWW
- Telephone networks
- friendship networks
- citation networks

5) State true or false for the following statement: 1

"Curves of the type where the variable on the x-axis represents rank and y-axis represents frequency have no history"

- True
- False

6) Which of the following properties differentiate spread of epidemic from spread of idea? 1

- The person has no choice
- It is an invisible process
- All of these

7) Which of the following is not an example of percolation? 1 pc

- Spread of epidemics
- Gossip-based routing
- Connectivity of unreliable networks
- Wireless nodes with Normal distribution

8) An individual node in the branching process model goes through three potential stages during the course of the epidemic. Which one of the following describes a infectious stage? 1 pc

- Before the node has caught the disease
- The node has caught the disease and has some probability of infecting each of its neighbors.
- The node has recovered from the disease.
- None of these

9) Which of the following is true related to SIS model?

1 point

- Nodes can be infected, recover, and then be infected again.
- There is a Removed state.
- After a node is done with the Infectious state, it cycles back to the Susceptible state and is ready to catch the disease again.
- All of these

10) State True or False?

1 point

"We can combine elements of the SIR and SIS models in a simple way, so that after an infected node recovers, it passes briefly through the R state on its way back to the S state."

True

False

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Assignment 11-

1) In a small world, what is the expected distance between any two random nodes? 1 point

- $O(n)$
- $O(\log n)$
- $O(\log \log n)$
- None of these

2) Why is the Milgram's experiment known as Six degrees of separation experiment? 1 point

- The result from the experiment shows that median = 6
- The result from the experiment shows that mode=6
- The result from the experiment shows that average chain length = 6.5
- None of these

3) Which of the following are false facts about large networks from the Milgram's experiment? 1 po

- Short paths are abundant
- People, acting without any sort of global "map" of the network, are effective at collectively finding the short path
- None of these

4) State True or False: 1 po

"According to Watts-Strogatz small-world network, Introducing a tiny amount of randomness—in the form of long-range weak ties is enough to make the world "small" with short paths between every pair of nodes."

- True
- False

6) State True or False: 1 po

"In a 2-D Watts-Strogatz model, for an efficient decentralised search, the ideal value of clustering exponent is 2 so that random links follow an inverse-square distribution."

- True
- False

7) The Watt-Strogatz model creates a network of nodes using which of the concept? 1 po

7) The Watt-Strogatz model creates a network of nodes using which of the concept? **1 po**

- Homophily
- Weak ties
- Both homophily and weak ties
- Neither homophily nor weak ties

8) In which of the following model, one end of each edge is rewired to another vertex independently and with probability p to a new vertex chosen randomly. **1 po**

- Watts-Strogatz model
- Milgram Model
- Both Watts-Strogatz and Milgram models
- Neither Watts-Strogatz nor Milgram model

9) The Watts-Strogatz model corresponds to the special case of Kleinberg's decentralized search model where $q = ?$ **1 po**

- 3
- 1
- 2
- 0

10) In decentralized search, the _____ ties help one to better explore a region **1 po** and the _____ ties allow one to search far away regions of the network.

- strong, strong
- weak, weak
- strong, weak

/ 1:53 weak, strong

Assignment 12-

1) In myopic search, the expected number of steps needed to reach target $E[X]$ when $\alpha=1$ is:

- O($\log^2 n$)
- O($\log n$)
- O(n)
-
- O($n^{1-\alpha}$)



2) State True or False: 1 point

"When applying the standard k-shell decomposition to uncover the core of several example social networks, the resulting "innermost" structure is most likely to represent the "core" of complex networks."

- True
- False

3) Myopic search constructs an exponentially smaller path i.e. proportional to ___? 1 point

- O($\log^2 n$)
- O($\log n$)
- O(n)
- None of these

4) Which of the following statement is True? 1 point

- Pseudo-cores are the nodes which belong to the core as well as periphery of the network.
- Pseudo-cores are the nodes which do not belong to the innermost core of the network but have equal spreading power (cascade capacity) as the innermost core.
- Pseudo-cores are the nodes which do not belong to the outermost periphery of the network but have equal spreading power (cascade capacity) as the outermost periphery.
- None of these is correct

5) What is the time complexity of core number algorithm?

- O($n \log n$)
- O($\log^2 n$)
- O($n-1$)
- O(n^2)

6) State True or False:

"The k-core subgraphs need to be necessarily connected"

- True
- False

7) Complete the following statement related to figure 1: 1 point

The graph is composed of _____ cliques (complete subgraphs) of size _____ that are connected by a node x with a degree of 2.

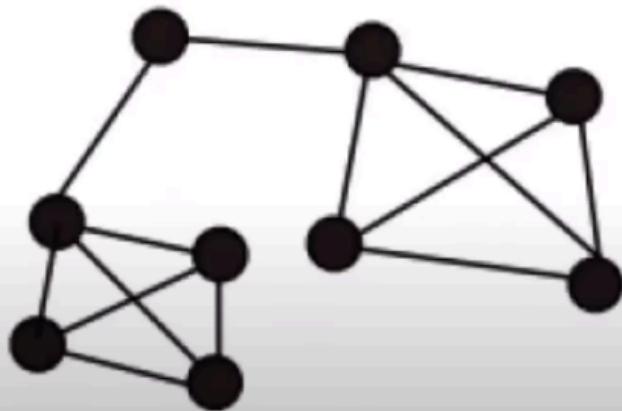


Figure 1

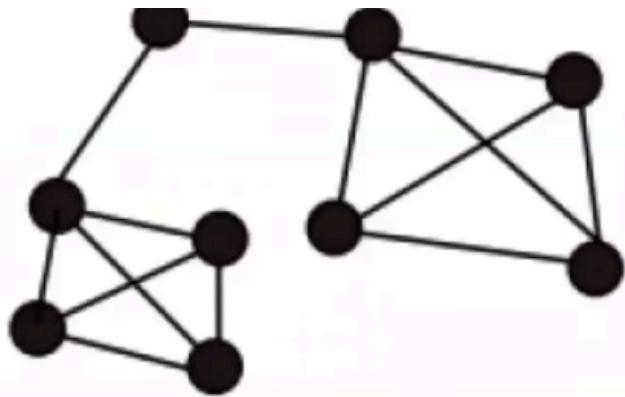


Figure 1

- Two, four
- One, three
- Two, three
- One, four

1:03 / 1:27



8) Let n_{max} and m_{max} be the number of vertices and number of edges in the degeneracy-core, how can the density of the degeneracy-core be defined?

1 point

-

$$D_{max} = m_{max} / \binom{n_{max}}{2}$$

-

$$D_{max} = n_{max} / \binom{m_{max}}{2}$$

-

$$D_{max} = m_{max} / (n_{max})$$

-

$$D_{max} = n_{max} / (m_{max})$$

9) State True or False:

1 point

"The core number algorithm is an exponential time algorithm"

- True
- False

10) If a graph fits in memory, what is the running time complexity of core decomposition **1 point** algorithm?

- $O(n+m)$
- $O(n^2)$
- $O(\log n)$
- $O(\log \log n)$