2) - Railway network
- Airway network across the world
- Telecom network
- Friends / contacts in social websites

3) degree centrality

$$V_1 = \frac{d(v_1)}{n-1} = \frac{2}{5-1} = 1/2 = 0.5$$

$$V_2 = \frac{3}{5-1} = 3/4 = 0.75$$

$$V_3 = 2/5-1 = 0.5$$

$$V_4 = 3/5-1 = 3/4 = 0.75$$

$$V_5 = 2/5-1 = 1/2 = 0.5$$

4) Since one country shares boundaries with all other countries, the graph has to be undirected to allow sharing boundaries.
maximum possible boundaries
$= n(n-1)/2 \Rightarrow \frac{5(4)}{2}$
where $n = 5$ countries $= 10$ boundaries

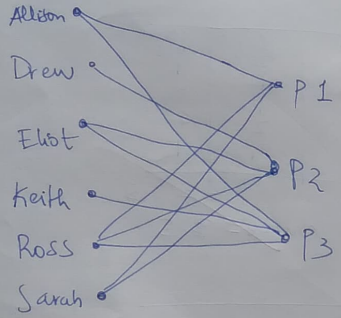
5) powerful but not central
central but not powerful
State CM among country
President of a country

6) Social network notation scheme

i) matrix notation using adjacency matrix

$$\begin{matrix} & a & b \\ a & 0 & 1 \\ b & 1 & 0 \end{matrix}$$

ii) Lines notation and node
where L represents a line $(n_1 \xrightarrow{L12} n_2)$
N represents a node

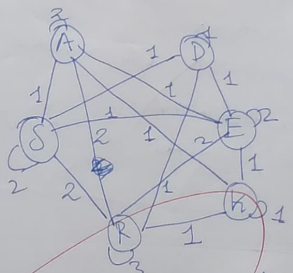


Converting to one mode Affiliation h/w having only the actors

	A	D	E	K	R	S
A	2	0	1	1	2	1
D	0	1	1	0	1	1
E	1	1	2	1	2	1
K	1	0	1	1	1	0
R	2	1	2	1	3	2
S	1	1	1	0	2	2

The connections (tie) to other actors are done on the basis of the same parties they go.

So the new one-mode affiliation network is

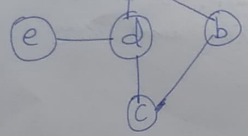


where the number on the edge gives no. of relations.

Part - A

1) - Social Network Analysis is the study of social groups which are a collection of actors (nodes) and have relationship among them (ties).
- It is used find relationship and other useful data if two find if two actor are in same groups.

8)



betweenness centrality

node	edge	with node b/w	Total no. of shortest paths	betweenness
a	bc	0	1	0/1 = 0
	cd	0	1	0
	de	0	1	0
	bd	1	2	1/2 = 0.5
	be	1	2	0.5
	ce	0	1	0

$\Sigma = 1$

for node a b/w ness = 1

b	ac	1	2	0.5
	ad	0	1	0
	ae	0	1	0
	cd	0	1	0
	ce	0	1	0
	de	0	1	0

$\Sigma = 0.5$

for node b b/wness = 0.5

Similarly since C is symmetrical to a

node c b/wness = 1

node d

d	ab	0	1	0
	ac	1	2	0.5
	ae	1	1	1
	bc	0	1	0
	be	2	2	1
	ce	1	1	1

$\Sigma = 3.5$

node d b/wness = 3.5

node e

e	ab	0	1	0
	ac	0	1	0
	ad	0	1	0
	bc	0	1	0
	bd	0	1	0
	cd	0	1	0

$\Sigma = 0$

node e b/wness = 0

node	betweenness
a	1
b	0.5
c	1
d	3.5
e	0

Closeness centrality

Distance matrix

	a	b	c	d	e	sum of distance	inverse of distance gives closeness
a	0	1	2	1	2	= 6	a 1/6 = 0.166
b	1	0	1	2	3	= 7	b 1/7 = 0.1428
c	2	1	0	1	2	= 6	c 1/6 = 0.166
d	1	2	1	0	1	= 5	d 1/5 = 0.2
e	2	3	2	1	0	= 8	e 1/8 = 0.125

7) Graph models for Social Network

i) Random graph
ii) Alpha graph
iii) Beta graph
iv) Scale graphs

i) Random graph

- the relationship(ties) between nodes are random in nature

Pros
- Any node (Actor) can be related to another node.

Cons
- does not gaurentee a relation between any pair of node since it is random.

ii) Alpha graph

- with given parameter alpha, it determines if a node is connected to another node.

Pros
- can generate a graph based on alpha parameter

Cons
- alpha value determines which two nodes have relation and may not be accurate.

iii) Beta graph

- Based on the beta parameter, it gives and estimate of relationship between two nodes

Pros
- can be used to generate better graphs than alpha.

Cons
- All 3 (random, alpha, beta) graphs are not scalable.

iv) Scale graph

- with increase and constant change in the social network, we need a graph which is dynamic

Pros
- can accomodate changes in scale dynamically unlike other graph models.

Cons
- Relationship can't be generated based on other node relations.

d) Tour is a walk in which it covers all the nodes atleast once.

$n_0 \to n_1 \to n_2 \to n_3 \to n_0 \to n_4 \to n_5 \to n_6$

$\to n_7 \to n_8 \to n_5 \to n_4 \to n_9 \to n_{10} \to n_4$

e) Nodal degree

no. of edges incident on a node

node	degree	$(d-\bar{d})^2$
n_0	3	0.449
n_1	2	0.109
n_2	2	0.109
n_3	2	0.109
n_4	3	0.449
n_5	3	0.449
n_6	2	0.109
n_7	2	0.109
n_8	2	0.109
n_9	3	0.449
n_{10}	2	0.109
n_{11}	2	0.109

$\Sigma(28)$ $\Sigma = 10.516$

f) median nodal deg $= \frac{28}{12} = 2.33$

g) variance $= \frac{\Sigma(d-\bar{d})^2}{g} = \frac{10.516}{12}$

$= 0.8763$

h) density of graph $= \frac{2L}{g(g-1)}$

where L is no. of lines

g is no. of nodes

$L = 14$, $g = 12$ $\Rightarrow \Delta = \frac{2(14)}{12(11)} = 0.21$

i) Cut-point

min no. of cuts $= 1$ /node

to make graph into subgraphs

cut node 4 makes 3 components

j) Edge connectivity

min no. of cuts of edge $= 1$

to make graph into subgraph

either cut the edges

$n_0 \to n_4$ or

$n_4 \to n_5$ or

$n_4 \to n_9$

} cutting the edge makes 2 components

there are large number of ties with each node making it difficult to store data of each person in the node.

- such complex social networks need other alternative ways for data collection.

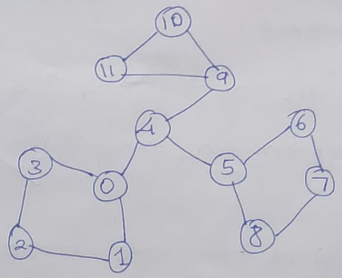
Alternatives

i) Consider to check if there is already existing databases for a part (subgraph) of the social network.

ii) Each individual part of existing databases can be combined to made the data collection of the whole social network.

iii) Considering Ebooks and online library for data collection (data bases might already have some information of the nodes)

iv) Online databases can be used to collect data of each individual node rather than doing it manually which increase the efficiency and ~~saves~~ saves time.



a) Eccentricity of node 3

it is the longest geodesic distance with node 3 and any other node.

⇒ max (g[3,j]) and $j \neq 3$

⇒ from node 3 to node 7

Eccentricity of node 3 = 5

b) Walk = collection / sequence of nodes which are adjacent.

$n_0 \to n_1 \to n_2 \to n_3 \to n_5 \to n_4 \to n_9 \to n_{10}$

dk?

c) Trial = Sequence of nodes which are adjacent and visit the ~~node~~ edges exactly once (can visit nodes multiple times)

~~(can be path)~~

$n_0 \to n_3 \to n_2 \to n_1 \to n_0 \to n_4 \to n_5$

Part - C

11) **Data collection complexities in social networks**

i) Social network is a large collection of nodes and relations.

ii) Since there are large numbe of nodes in Social networks, collection of data is also large.

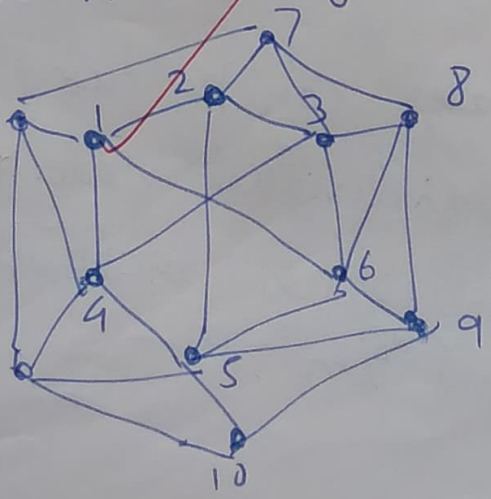
iii) when manally collecting such huge number of data becomes very hard.

iv) The efficiency for collection is very low which is 50%.

v) Since the efficiency is very less, it takes a lot of time to collect all the data.

vi) The collected data also has to be stored some where which is capable of collecting large data i.e we need large storage bases.

Eg:-



A social network of 12 nodes

SL.NO:CAA 202384

SRI SIVASUBRAMANIYA NADAR COLLEGE OF ENGINEERING

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THEORY EXAMINATIONS

Register Number	205001102		
Name of the Student	Shrijith. M.R		
Degree and Branch	BE . CSE	Semester	VII
Subject Code and Name	UCS1722 - Social network Analytics		
Assessment Test No.	Cat - 1	Date	13/9/2023

Details of Marks Obtained									
Part A		Part B				Part C			
Question No.	Marks	Question No.	(a) Marks	(b) Marks	Total Marks	Question No.	(a) Marks	(b) Marks	Total Marks
1	2	7	5			10			
2	✓								
3	2	8	6			11	9		
4	✓					12			
5	2	9	6			13	9		
6	1								
Total (A)		Total (B)				Total (C)			44/50
Grand Total (A+B+C)					Marks (In Words)				
Signature of the Faculty									

(4) ⇒ It will be an undirected graph since the border shared among the countries will be bidirectional

⇒ Maximum possible borders

$$^5C_2 = \frac{5!}{2! \times 3!} = \frac{5 \times 4 \times 3!}{2 \times 3!} = 10$$

(5) Network science for social network

* Graphical
* Sociometric
* Algebraic

(5) Case 1: Actor powerful, not central

Eg: Users in a social platform.

Case 2: Actor central, not powerful

Eg: Social media applications which are used by all users.

PART-B

(7) Graph Models

(i) Random graph model

⇒ As the name suggests, the points or nodes are connected based on certain random probability.

⇒ The points are chosen at random and are assigned to be connected with other nodes using random probability.

Pros

⇒ Randomly generated points and node connections.

⇒ Less dense graph will be created.

Cons

⇒ Not suitable for complex social network analysis.

PART - A

SSN

(1) Social Network Analysis

Social network analysis is defined as analysing of social networking in terms of graphs, nodes and edges including networking among the nodes.

(2) Global structures of Social Networks

* Graphs structure
* Sociometric structure
* Algebraic structure

(3)

Degree centrality $= \frac{d(i)}{n-1}$

$d_c(v_1) = 2/4 = 0.5$

$d_c(v_2) = 3/4 = 0.75$

$d_c(v_3) = 2/4 = 0.5$

$d_c(v_4) = 3/4 = 0.75$

$d_c(v_5) = 2/4 = 0.5$

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THEORY EXAMINATIONS

Register Number	205001085		
Name of the Student	V. Sabaarivasan		
Degree and Branch	BE CSE	Semester	VII
Subject Code and Name	UCS1702 Social Network Analysis		
Assessment Test No.	I	Date	

Details of Marks Obtained									
Part A		Part B				Part C			
Question No.	Marks	Question No.	(a) Marks	(b) Marks	Total Marks	Question No.	(a) Marks	(b) Marks	Total Marks
1	2	7				10			
2	2								
3	2	8	6			11	5		
4	2					12	8		
5	2	9	1			13			
6	2								
Total (A)		Total (B)				Total (C)			30/50
Grand Total (A+B+C)					Marks (In Words)				
Signature of the Faculty									