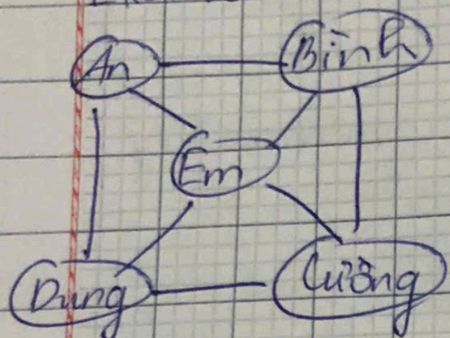
Exercise:



1. Calculate desity network.

$n = 5$, $k = 8$.

$$Density = \frac{k}{n(n-1)/2} = \frac{8}{5.4/2} = 0,8$$

$\Rightarrow$ High Density $\Rightarrow$ Network tends to connectivity strongly, information easy transmitted between actors

2. Identify:

- Degree centrality.

$$C_D(v) = \frac{deg(v)}{n-1}$$

$C_D(An) = \frac{3}{5-1} = \frac{3}{4} = 0.75$ $C_D(Dung) = \frac{3}{4} = 0,75$

$C_D(Bình) = \frac{3}{4} = 0,75$ $C_D(Em) = \frac{4}{4} = \underline{1}$

$C_D(Cường) = \frac{3}{4} = 0,75$

$\Rightarrow$ ~~Vertex~~ Actor "Em" have highest degree centrality

$\Rightarrow$ Em is the most important actor in network, ~~direct connection to all actors~~, ~~best info transfer ability~~, ~~effect all network~~

- Closeness centrality.

$$C_c(v) = \frac{1}{\sum_{t \in V/v} d_G(v,t)}$$

$$CC(v) = (n-1)\, C_c(v)$$

An	Bình	Em	Cường	Dung
0	1	1	2	1
1	0	1	1	2
1	1	0	1	1
2	1	1	0	1
1	2	1	1	0

~~$C_c(A) = \frac{1}{}$~~

$C_c(An) = C_c(Bình) = C_c(Cường) = C_c(Dung) = \frac{1}{5}$

$C_c(Em) = \frac{1}{4}$.

$CC(An) = CC(Bình) = CC(Cường) = CC(Dung)$

$= (n-1)\, C_c(v) = (5-1) \cdot \frac{1}{5} = \frac{4}{5} = 0,8$.

$CC(\cancel{Dung}\ Em) = 4 \cdot \frac{1}{4} = 1$.

mments: ⇒ Vertex "Em" has highest closeness centrality ~~the~~

~~to~~ ⇒ ~~Ver~~ "Em" has highest level.

· Between centrality

$$C_B(v) = \sum \frac{\delta_{st}(v)}{\delta_{st}}.$$

$$C'_B = \frac{C_B(v)}{(n-1)(n-2)/2}$$

A → Cường (Em) ⇒ $\delta_{st} = 3$, $\delta_{st}(Em) = 1$

Dung → Bình (Em) ⇒ $\delta_{st} = 3$, $\delta_{st}(Em) = 1$.

$$C_B(Em) = \sum \frac{\delta_{st}(Em)}{\delta_{st}} = \frac{1}{3} + \frac{1}{3} = \frac{2}{3}.$$

Normalization coef:

$(n-1)(n-2)/2 = (5-1)(5-2)/2 = 6.$

$$C'_B(Em) = \frac{C_B(Em)}{(n-1)(n-2)/2} = \frac{2/3}{6} = 0,11$$

- Comments.

- "Em" occupies 11,1% of the possible mediating roles in the graph.

- ~~"Em" is less important, not the only intermediate vertex but plays an important connecting role in the network.~~

- "Em" less important, it doesn't play an important bridging role in the network.

- Clustering Centrality

$$C_i = \frac{2|[e_{jk}]|}{k_i(k_i-1)}$$

$$\bar{C} = \frac{1}{n}\sum_{i=1}^{n} C_i$$

$$C_i(An) = \frac{2.2}{3(3-1)} = 0,67$$

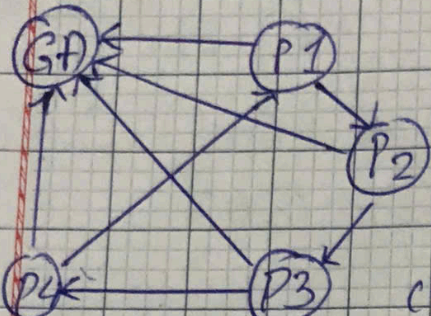
$C_i(An) = C_v(Bình) = C_i(Cường) = C_i(Dung) = 0,67$

$$C_i(Em) = \frac{2.4}{4(4-1)} = \cancel{2}\ 0,67.$$

⇒ Comments:

- The clustering coefficient (0,67) for each vertex indicates that the degree of connectivity between neighbors is similar.

(2) .



a. Density network:

$n = 5$, $h = 8$.

$$\text{Density} = \frac{h}{n(n-1)/2} = 0{,}8.$$

⇒ High density, ⇒ Network tends to connectivity strongly, information easy to transmitted between actors.

(b) - Identify input level & output level each vertex.

• ~~Input level~~ : ~~GA = 4~~.

	GA	P1	P2	P3	P4
- Input level	4	1	1	1	1.
Output level	0	2	2	2	2.

• Closeness centrality.

- Input edge:

- ~~GA~~

$$C_c(GA) = \frac{1}{\Sigma_{t \in V, t \neq v} d_G(v,t)} = \frac{1}{4}.$$

$$CC(GA) = (n-1)\, C_c(GA) = 4 \cdot \frac{1}{4} = 1.$$

$$C_c(P_1) = \frac{1}{3+2+1} = \frac{1}{6}$$

$$CC(P_1) = 4 \cdot \frac{1}{6} = \frac{4}{6} = 0{,}67.$$

$C_c(P_2) = \dfrac{1}{1+3+2} = \dfrac{1}{6}$

$CC(P_2) = 4 \cdot \dfrac{1}{6} = \dfrac{4}{6} = 0{,}67.$

$C_c(P_3) = \dfrac{1}{2+1+3} = \dfrac{1}{6} \Rightarrow CC(P_3) = 4 \cdot \dfrac{1}{6} = \dfrac{4}{6}.$

$C_c(P_4) = \dfrac{1}{3+2+1} = \dfrac{1}{6} \Rightarrow CC(P_4) = 4 \cdot \dfrac{1}{6} = \dfrac{4}{6}.$

- Output edge:

$C_c(P_1) = \cancel{1+1+} \dfrac{1}{1+1+2+3} = \dfrac{1}{7}.$

$CC(P_1) = 4 \cdot \dfrac{1}{7} = \dfrac{4}{7} = 0{,}57.$

$C_c(P_2) = \dfrac{1}{3+1+2+1} = \dfrac{1}{7}.$

$CC(P_2) = 4 \cdot \dfrac{1}{7} = \dfrac{4}{7}.$

$C_c(P_3) = \dfrac{1}{2+3+1+1} = \dfrac{1}{7}.$

$CC(P_3) = 4 \cdot \dfrac{1}{7} = \dfrac{4}{7}.$

$C_c(P_4) = \dfrac{1}{1+1+2+3} = \dfrac{1}{7}.$

$CC(P_4) = 4 \cdot \dfrac{1}{7} = \dfrac{4}{7}.$

⇒ Comments:

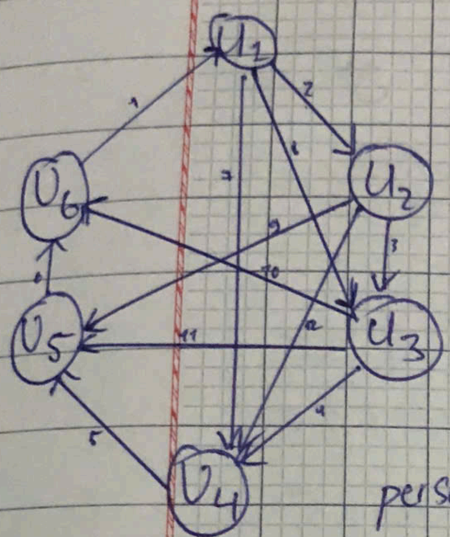
– Closeness centrality for input edges

- $CC(GĐ) = 1$ ⇒ GĐ is the intermediary receiving information from all departments.
- $CC(P_1) = CC(P_2) = CC(P_3) = CC(P_4) = 0{,}67$ ⇒ ability ~~receiving~~ to recieve information from other departments is average.

– Closseness centrality for output edge

- $CC(GĐ)$ ~~is~~ is not exist due to it don't have output edge.
- $CC(P_1) = CC(P_2) = CC(P_3) = CC(P_4) = 0{,}57$ ⇒ ability to receive information from other departments is average.

③



① Caqulate density network

$n = 6$, $k = 12$

– Density $= \dfrac{k}{n(n-1)/2} = \dfrac{12}{15} = 0{,}8$

⇒ High density ⇒ Network tends to connectivity strongly, information easy to transmitted between actors.

② Identify input & output level & find person who have the most influential

	U_1	U_2	U_3	U_4	U_5	U_6
Input level	1	1	2	3	3	2
Output level	3	3	3	1	1	1

~~– Person who have the most influence~~

– The most influential person: U_1, U_2, U_3

– The most concerned person: U_4, U_5.

③ Calculate

– Closeness Centrality:

Input:

$C_c(U_1) = \dfrac{1}{3+2+3+2+1} = \dfrac{1}{11}$

$C_c(U_2) = \dfrac{1}{1+3+4+3+2} = \dfrac{1}{13}$

$C_c(U_3) = \dfrac{1}{1+1+4+3+2} = \dfrac{1}{11}$

ge.

HÒA BÌNH

$C_c(u_4) = \frac{1}{1+1+1+3+2} = \frac{1}{8}$

$C_c(u_5) = \frac{1}{2+1+1+1+3} = \frac{1}{8}$

$C_c(u_6) = \frac{1}{2+2+1+2+1} = \frac{1}{8}$

$CC(u_1) = 5 \cdot \frac{1}{11} = \frac{5}{11} = 0{,}455$

$CC(u_2) = 5 \cdot \frac{1}{13} = \frac{5}{13} = 0{,}385$

$CC(u_3) = 5 \cdot \frac{1}{11} = \frac{5}{11} = 0{,}455$

$CC(u_4) = 5 \cdot \frac{1}{8} = \frac{5}{8} = 0{,}625$

$CC(u_5) = 5 \cdot \frac{1}{8} = \frac{5}{8} = 0{,}625$

$CC(u_6) = 5 \cdot \frac{1}{8} = \frac{5}{8} = \cancel{0{,}56}\ 0{,}625$

Output :

$C_c(u_1) = \frac{1}{1+1+1+2+2} = \frac{1}{7}$

$C_c(u_2) = \frac{1}{3+1+1+1+2} = \frac{1}{8}$

$C_c(u_3) = \frac{1}{2+3+1+1+1} = \frac{1}{8}$

$C_c(u_4) = \frac{1}{3+4+4+1+2} = \frac{1}{14}$

$C_c(u_5) = \frac{1}{2+3+3+3+1} = \frac{1}{12}$

$C_c(u_6) = \frac{1}{1+2+2+2+3} = \frac{1}{10}$

$\cancel{CC(u_1) = 5 \cdot \frac{1}{8}}$ $CC(u_1) = 5 \cdot \frac{1}{7} = \frac{5}{7} = 0{,}714$

$CC(u_2) = CC(u_3) = 5 \cdot \frac{1}{8} = \frac{5}{8} = 0{,}625$

$CC(U_4) = 5 \cdot \frac{1}{14} = \frac{5}{14} = 0{,}357$.

$CC(U_5) = 5 \cdot \frac{1}{12} = \frac{5}{12} = 0{,}41667$.

$CC(U_6) = 5 \cdot \frac{1}{10} = \frac{5}{10} = 0{,}5$

comments:

- Input level: $CC(U_3)$ has smallest distance so it has largest transmission capacity.
- Output level: $CC(U_4)$ has smallest distance so it has largest transmission capacity.