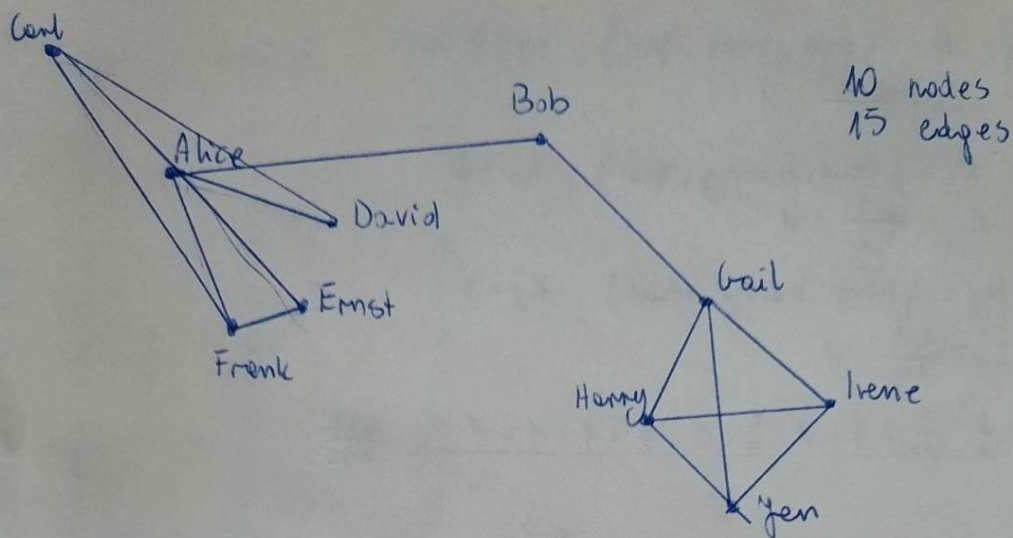LAB 1   TASK 1

10 nodes
15 edges

e) Clustering coefficient $\delta = 2$

$$C(i) = \frac{\delta \cdot (\text{number of connections between node's neighbours})}{k_i (k_i - 1)}$$

k_i - number of neighbours

- Carl : $N_C = \{$ Frank, Alice, David $\}$, $k_C = 3$

$$C_C = \frac{2 \cdot 2}{3 \cdot 2} = \frac{2}{3}$$

- Alice: $N_A = \{$ Carl, Frank, David, Ernst, Bob $\}$, $k_A = 5$

$$C_A = \frac{2 \cdot 3}{5 \cdot 4} = \frac{3}{10}$$

- David: $N_D = \{$ Carl, Alice $\}$, $k_D = 2$

$$C_D = \frac{2 \cdot 1}{2 \cdot 1} = 1$$

- Ernst: $N_E = \{$ Alice, Frank $\}$, $k_E = 2$

$$C_E = \frac{2 \cdot 1}{2 \cdot 1} = 1$$

- Frank: $N_F = \{$ Carl, Alice, Ernst $\}$, $k_F = 3$

$$C_F = \frac{2 \cdot 2}{3 \cdot 2} = \frac{2}{3}$$

- Bob : $N_B = \{$ Alice, Gail $\}$, $k_B = 2$

$$C_B = \frac{2 \cdot 0}{2 \cdot 1} = 0$$

- Gail: $N_G = \{$Bob, Harry, Irene, Jen$\}$, $k_G = 4$

$$C_G = \frac{2 \cdot 3}{4 \cdot 3} = \frac{1}{2}$$

- Harry: $N_H = \{$Gail, Irene, Jen$\}$, $k_H = 3$

$$C_H = \frac{2 \cdot 3}{3 \cdot 2} = 1$$

- Irene: $N_I = \{$Gail, Harry, Jen$\}$, $k_I = 3$

$$C_I = \frac{2 \cdot 3}{3 \cdot 2} = 1$$

- Jen: $N_J = \{$Irene, Harry, Gail$\}$, $K_J = 3$

$$C_J = \frac{2 \cdot 3}{3 \cdot 2} = 1$$

$$C_{mean} = \frac{\frac{2}{3} \cdot \frac{3}{10} + 1 + 1 + \frac{2}{3} + 0 + \frac{1}{2} + 1 + 1 + 1}{10} = \frac{107}{150}$$

f) Closeness centrality $C(v) = \frac{N-1}{\sum_y d(y,v)}$, $d(y,v)$ - shortest path from y to v

- Alice: $C_A = \frac{9}{1+1+1+1+1+2+3+3+3} = \frac{9}{16}$

- Bob: $C_B = \frac{9}{1+2+2+2+2+1+2+2+2} = \frac{9}{16}$

- Carl: $C_C = \frac{9}{1+2+1+2+1+3+4+4+4} = \frac{9}{22}$

- David: $C_D = \frac{9}{1+2+1+2+2+3+4+4+4} = \frac{9}{23}$

- Ernst: $C_E = \frac{9}{1+2+2+2+1+3+4+4+4} = \frac{9}{23}$

- Frank: $C_F = \frac{9}{1+2+1+2+1+3+4+4+4} = \frac{9}{22}$

- Gail: $C_G = \frac{9}{2+1+3+3+3+3+1+1+1} = \frac{9}{18} = \frac{1}{2}$

- Harry: $C_H = \frac{9}{3+2+4+4+4+4+1+1+1} = \frac{9}{24}$

- Irene: $C_I = \frac{9}{24}$

- Jen: $C_J = \frac{9}{24}$

Most central node: Alice and Bob

g) Betweenness centrality

$$C_B(v) = \sum_{s \neq v \neq t \in V} \frac{\sigma_{st}(v)}{\sigma_{st}}$$

ALICE

	σst	σst(v)	σst(v)/σst
BC	1	1	1
BD	1	1	1
BE	1	1	1
BF	1	1	1
BG	1	0	0
BH	1	0	0
BI	1	0	0
BJ	1	0	0
CD	1	0	0
CE	2	1	0.5
CF	1	0	0
CG	1	1	1
CH	1	1	1
CI	1	1	1
CJ	1	1	1
DE	1	1	1
DF	2	1	0.5
DG	1	1	1
DH	1	1	1
DI	1	1	1
DJ	1	1	1
EF	1	0	0
EG	1	1	1
EH	1	1	1
EI	1	1	1
EJ	1	1	1
FG	1	1	1
FH	1	1	1
FI	1	1	1
FJ	1	1	1
GH	1	0	0
GI	1	0	0
GJ	1	0	0
HI	1	0	0
HJ	1	0	0
IJ	1	0	0
			22

BOB:

	σst	σst(v)	σst(v)/σst
AC	1	0	0
AD	1	0	0
AE	1	0	0
AF	1	0	0
AG	1	1	1
AH	1	1	1
AI	1	1	1
AJ	1	1	1
CD	1	0	0
CE	2	0	0
CF	1	0	0
CG	1	1	1
CH	1	1	1
CI	1	1	1
CJ	1	1	1
DE	1	0	0
DF	2	0	0
DG	1	1	1
DH	1	1	1
DI	1	1	1
DJ	1	1	1
EF	1	0	0
EG	1	1	1
EH	1	1	1
EI	1	1	1
EJ	1	1	1
FG	1	1	1
FH	1	1	1
FI	1	1	1
FJ	1	1	1
GH	1	0	0
GI	1	0	0
GJ	1	0	0
HI	1	0	0
HJ	1	0	0
IJ	1	0	0
			20

CARL

	σst	σst(v)	σst(v)/σst
AB	1	0	0
AD	1	0	0
AE	1	0	0
AF	1	0	0
AG	1	0	0
AH	1	0	0
AI	1	0	0
AJ	1	0	0
BD	1	0	0
BE	1	0	0
BF	1	0	0
BG	1	0	0
BH	1	0	0
BI	1	0	0
BJ	1	0	0
DE	1	0	0
DF	2	1	0.5
DG	1	0	0
DH	1	0	0
DI	1	0	0
DJ	1	0	0
EF	1	0	0
EG	1	0	0
EH	1	0	0
EI	1	0	0
EJ	1	0	0
FG	1	0	0
FH	1	0	0
FI	1	0	0
FJ	1	0	0
GH	1	0	0
GI	1	0	0
GJ	1	0	0
HI	1	0	0
HJ	1	0	0
IJ	1	0	0
			0.5

DAVID

	σst	σst(v)	σst(v)/σst
AB	1	0	0
AC	1	0	0
AE	1	0	0
AF	1	0	0
AG	1	0	0
AH	1	0	0
AI	1	0	0
AJ	1	0	0
BC	1	0	0
BE	1	0	0
BF	1	0	0
BG	1	0	0
BH	1	0	0
BI	1	0	0
BJ	1	0	0
CE	2	0	0
CF	1	0	0
CG	1	0	0
CH	1	0	0
CI	1	0	0
CJ	1	0	0
EF	1	0	0
EG	1	0	0
EH	1	0	0
EI	1	0	0
EJ	1	0	0
FG	1	0	0
FH	1	0	0
FI	1	0	0
FJ	1	0	0
GH	1	0	0
GI	1	0	0
GJ	1	0	0
HI	1	0	0
HJ	1	0	0
IJ	1	0	0
			0

ERNST

	σst	σst(v)	σst(v)/σst
AB	1	0	0
AC	1	0	0
AD	1	0	0
AF	1	0	0
AG	1	0	0
AH	1	0	0
AI	1	0	0
AJ	1	0	0
BC	1	0	0
BD	1	0	0
BF	1	0	0
BG	1	0	0
BH	1	0	0
BI	1	0	0
BJ	1	0	0
CD	1	0	0
CE	2	0	0
CG	1	0	0
CH	1	0	0
CI	1	0	0
CJ	1	0	0
DF	2	0	0
DG	1	0	0
DH	1	0	0
DI	1	0	0
DJ	1	0	0
FG	1	0	0
FH	1	0	0
FI	1	0	0
FJ	1	0	0
GH	1	0	0
GI	1	0	0
GJ	1	0	0
HI	1	0	0
HJ	1	0	0
IJ	1	0	0
			0

FRANK

	σst	σst(v)	σst(v)/σst
AB	1	0	0
AC	1	0	0
AD	1	0	0
AE	1	0	0
AG	1	0	0
AH	1	0	0
AI	1	0	0
AJ	1	0	0
BC	1	0	0
BD	1	0	0
BE	1	0	0
BG	1	0	0
BH	1	0	0
BI	1	0	0
BJ	1	0	0
CD	1	0	0
CE	2	1	0.5
CG	1	0	0
CH	1	0	0
CI	1	0	0
CJ	1	0	0
DE	1	0	0
DG	1	0	0
DH	1	0	0
DI	1	0	0
DJ	1	0	0
EG	1	0	0
EH	1	0	0
EI	1	0	0
EJ	1	0	0
GH	1	0	0
GI	1	0	0
GJ	1	0	0
HI	1	0	0
HJ	1	0	0
IJ	1	0	0
			0.5

GAIL

	σst	σst(v)	σst(v)/σst
AB	1	0	0
AC	1	0	0
AD	1	0	0
AE	1	0	0
AF	1	0	0
AH	1	1	1
AI	1	1	1
AJ	1	1	1
BC	1	0	0
BD	1	0	0
BE	1	0	0
BF	1	0	0
BH	1	1	1
BI	1	1	1
BJ	1	1	1
CD	1	0	0
CE	2	0	0
CF	1	0	0
CH	1	1	1
CI	1	1	1
CJ	1	1	1
DE	1	0	0
DF	2	0	0
DH	1	1	1
DI	1	1	1
DJ	1	1	1
EF	1	0	0
EH	1	1	1
EI	1	1	1
EJ	1	1	1
FH	1	1	1
FI	1	1	1
FJ	1	1	1
HI	1	0	0
HJ	1	0	0
IJ	1	0	0
			18

HARRY

	σst	σst(v)	σst(v)/σst
AB	1	0	0
AC	1	0	0
AD	1	0	0
AE	1	0	0
AF	1	0	0
AG	1	0	0
AI	1	0	0
AJ	1	0	0
BC	1	0	0
BD	1	0	0
BE	1	0	0
BF	1	0	0
BG	1	0	0
BI	1	0	0
BJ	1	0	0
CD	1	0	0
CE	2	0	0
CF	1	0	0
CG	1	0	0
CI	1	0	0
CJ	1	0	0
DE	1	0	0
DF	2	0	0
DG	1	0	0
DI	1	0	0
DJ	1	0	0
EF	1	0	0
EG	1	0	0
EI	1	0	0
EJ	1	0	0
FG	1	0	0
FI	1	0	0
FJ	1	0	0
GI	1	0	0
GJ	1	0	0
IJ	1	0	0
			0

IRENE

	σst	σst(v)	σst(v)/σst
AB	1	0	0
AC	1	0	0
AD	1	0	0
AE	1	0	0
AF	1	0	0
AG	1	0	0
AH	1	0	0
AJ	1	0	0
BC	1	0	0
BD	1	0	0
BE	1	0	0
BF	1	0	0
BG	1	0	0
BH	1	0	0
BJ	1	0	0
CD	1	0	0
CE	2	0	0
CF	1	0	0
CG	1	0	0
CH	1	0	0
CJ	1	0	0
DE	1	0	0
DF	2	0	0
DG	1	0	0
DH	1	0	0
DJ	1	0	0
EF	1	0	0
EG	1	0	0
EH	1	0	0
EJ	1	0	0
FG	1	0	0
FH	1	0	0
FJ	1	0	0
GH	1	0	0
GJ	1	0	0
HJ	1	0	0
			0

JEN

	σst	σst(v)	σst(v)/σst
AB	1	0	0
AC	1	0	0
AD	1	0	0
AE	1	0	0
AF	1	0	0
AG	1	0	0
AH	1	0	0
AI	1	0	0
BC	1	0	0
BD	1	0	0
BE	1	0	0
BF	1	0	0
BG	1	0	0
BH	1	0	0
BI	1	0	0
CD	1	0	0
CE	2	0	0
CF	1	0	0
CG	1	0	0
CH	1	0	0
CI	1	0	0
DE	1	0	0
DF	2	0	0
DG	1	0	0
DH	1	0	0
DI	1	0	0
EF	1	0	0
EG	1	0	0
EH	1	0	0
EI	1	0	0
FG	1	0	0
FH	1	0	0
FI	1	0	0
GH	1	0	0
GI	1	0	0
HI	1	0	0
			0

Alice is the most central node.