Hands-on practical: Answer sheet

Performing network alignment via the Stable Marriage Algorithm

Step A. Calculate the clustering coefficient *C* for each node in both networks, using this formula:

$$C = \begin{cases} 2E / (N(N-1)) & \text{if } N > 1 \\ -1 & \text{if } N = 1 \end{cases}$$

Here, *N* is the number of neighbours and *E* is de number of edges (links) between those neighbours. To answer this question, you may copy the tables below and fill in the calculated clustering coefficients.

Correct Answer:

Network 1	
A	1/6
B	-1
C	0
D	1
E	0
F	1/3
Network 2	
1	1
2	1/6
3	1
4	0
5	-1
6	-1

Step B. Make a preference list for each node, in which the preference to the nodes in the other network is ranked. This ranking must be done based on the absolute difference in clustering coefficients (calculated in step A). So if a node in the other network has an equal clustering coefficient, it should be ranked first. In case of ties, when a node prefers two other nodes equally well, you should order those nodes by their names (*i.e.* 'A' before 'B' and '1' before '2'). To answer this question, you may copy the tables below and fill in the ranked node names.

Correct Answer:

Preferences Network 1						
A	2	4	1	3	5	6
B	5	6	4	2	1	3
C	4	2	1	3	5	6

D	1	3	2	4	5	6
E	4	2	1	3	5	6
F	2	4	1	3	5	6

Preferences Network 2						
1	D	F	A	C	E	B
2	A	C	E	F	D	B
3	D	F	A	C	E	B
4	C	E	A	F	B	D
5	B	C	E	A	F	D
6	B	C	E	A	F	D

Note that ties are colored identically

Step C. Perform the Gale-Shapley algorithm to align Network 1 and 2. Use the preferences you obtained in step B, and assume that the nodes in Network 1 and 2 are respectively male and female. Briefly write down the decision for each step of the algorithm.

Correct Answer:

Step **1**: A prefers 2; 2 is free; (A,2) become engaged
Step **2**: B prefers 5; 5 is free; (B,5) become engaged
Step **3**: C prefers 4; 4 is free; (C,4) become engaged
Step **4**: D prefers 1; 1 is free; (D,1) become engaged
Step **5**: E prefers 4; 4 is engaged to C and prefers him over E; E is rejected
Step **6**: E prefers 2; 2 is engaged to A and prefers him over E; E is rejected
Step **7**: E prefers 1; 1 is engaged to D and prefers him over E; E is rejected
Step **8**: E prefers 3; 3 is free; (E,3) become engaged
Step **9**: F prefers 2; 2 is engaged to A and prefers him over F; F is rejected
Step **10**: F prefers 4; 4 is engaged to C and prefers him over F; F is rejected
Step **11**: F prefers 1; 1 is engaged to D and prefers him over F; F is rejected
Step **12**: F prefers 3; 3 is engaged to E but prefers F over E; (F,3) become engaged; E becomes free
Step **13**: E prefers 5; 5 is engaged to B and prefers him over E; E is rejected
Step **14**: E prefers 6; 6 is free; (E,6) become engaged

Note: Other orderings of males proposing will lead to a different scenario but the same outcome!

Step D. Provide the final network alignment. To answer this question, you may copy the table below and fill in the mapping of the proteins.

Correct Answer:

A	B	C	D	E	F
2	5	4	1	6	3

Step E. The final step is to infer biological knowledge from the network alignment. Given that Network 1 has been fully experimentally verified, and that Network 2 is still provisional, which extra protein interaction could you predict in Network 2? Also explain why!

Correct Answer: In the alignment, proteins E and F map respectively to proteins 6 and 3. Since E and F interact in Network 1, there is possibly also an interaction between proteins **3 and 6** in Network 2.