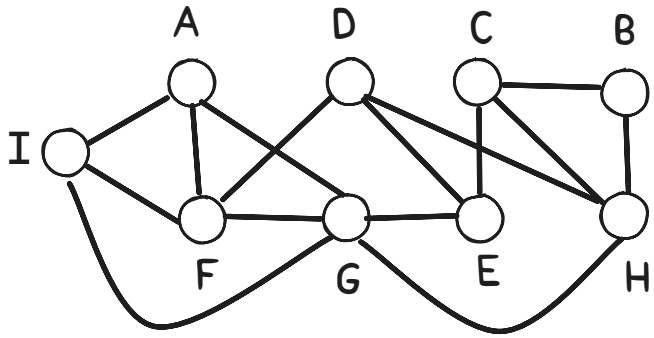
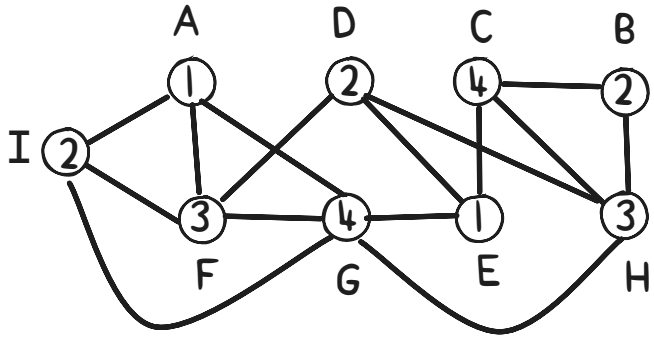
Problem 79

	A	B	C	D	E	F	G	H	I
A						X	X		X
B			X					X	
C		X			X			X	
D					X	X		X	
E			X	X			X		
F	X			X			X		X
G	X				X	X		X	X
H		X	X	X			X		
I	X					X	X		

(a) We draw the conflicts marked by X as an edge between pairs. For instance, there is an X between A and C so there we draw an edge between A and C.



(b) Minimum number of colors? AIFG is a K_4 subgraph so we need at least 4 numbers (or colors) to label the vertices so that endpoints of each edge receive different numbers (or colors). In fact 4 numbers suffice:



For instance, I is labelled 2, meaning that we put Fish I into tank 2.

(c) Putting 9 fish into 4 tanks as evenly as possible requires putting 2 fish in each tank, except one tank has 3 fish instead. Our solution to (b) already achieves this.

Problem 80

The table marks with X the compatible animal pairs:

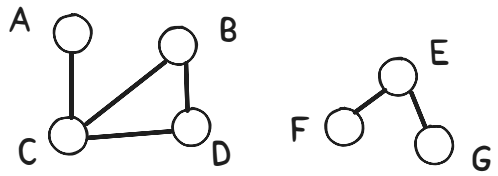
	A	B	C	D	E	F	G	H	I	J
A	x	x		x	x	x	x			
B	x	x			x	x	x		x	x
C			x		x	x	x			
D	x			x	x	x	x		x	x
E	x	x	x	x	x			x	x	
F	x	x	x	x		x	x	x	x	
G	x	x	x	x		x	x	x		
H					x	x	x	x		
I		x		x	x	x			x	
J		x		x						x

So we invert the filled and empty table cells to get a table of conflicting animal pairs:

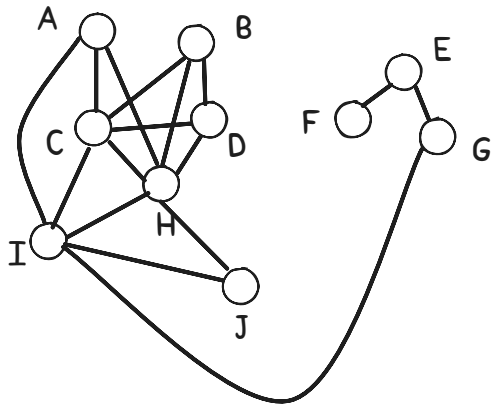
	A	B	C	D	E	F	G	H	I	J
A			X					X	X	X
B			X	X				X		
C	X	X		X				X	X	X
D		X	X					X		
E						X	X			X
F					X					X
G					X				X	X
H	X	X	X	X					X	X
I	X		X				X	X		X
J	X		X		X	X	X	X	X	

To graph these conflicts, we draw an edge between two letters (representing the animals) if there is an X between them. For instance, there is an X between A and C so there we draw an edge between A and C.

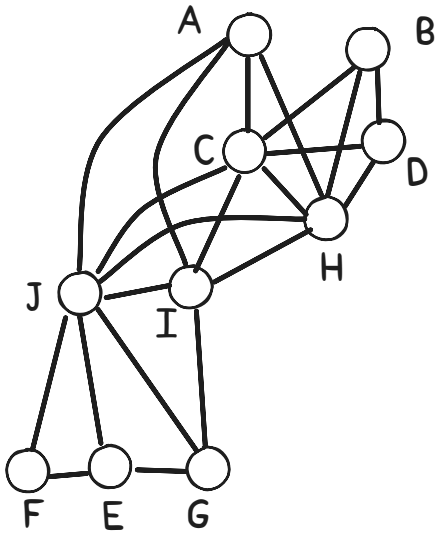
We build the graph up to A–G first:



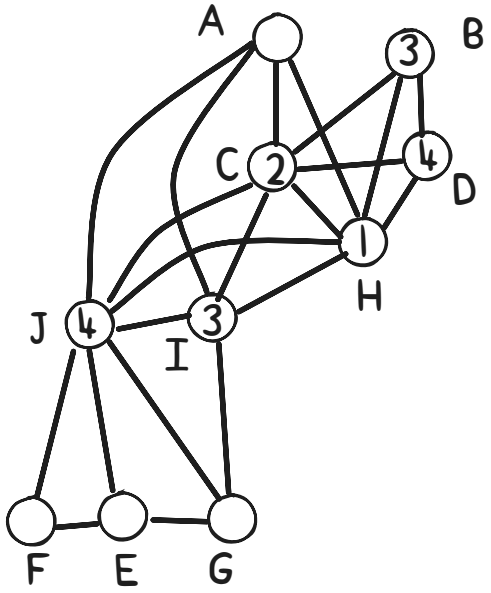
We add in most of the edges for H–J now:



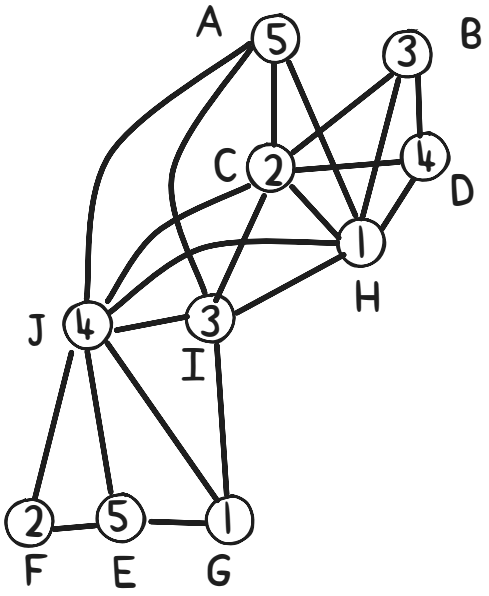
To add in all the connections for J, let's actually move the graph for E, F, G down a bit so the lines don't overlap so much:



(b): Observe that BCDH and CHIJ are K_4 graphs so we cannot do better than 4 colors (which we use numbers instead); let's first color in their vertices.



Actually ACHIJ is a K_5 subgraph so we must use at least 5 colors (numbers).



The above shows an assignment of the animals into different enclosures: for instance Animal F is assigned into enclosure 2, and E into enclosure 5, so that F and E will not conflict with each other.

(c): Yes: just let each animal be in their own enclosure (this requires 10 enclosures). Or if you want to put 2 animals into each of 5 enclosures, then we have already achieved that in the graph above.

(d): Your response here (about) is your own opinion.