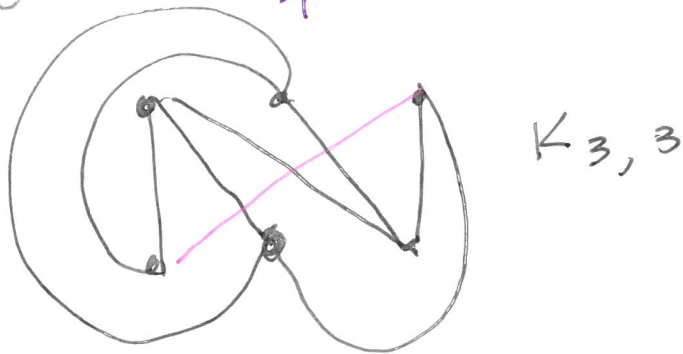
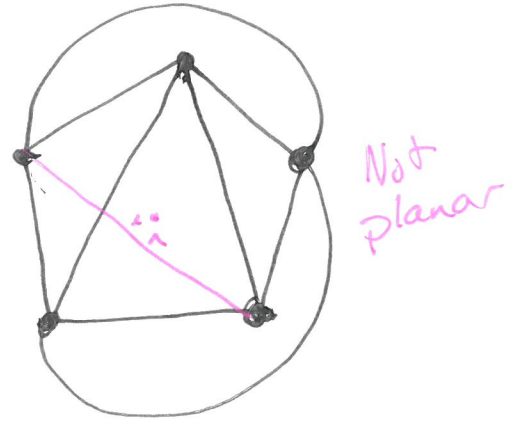
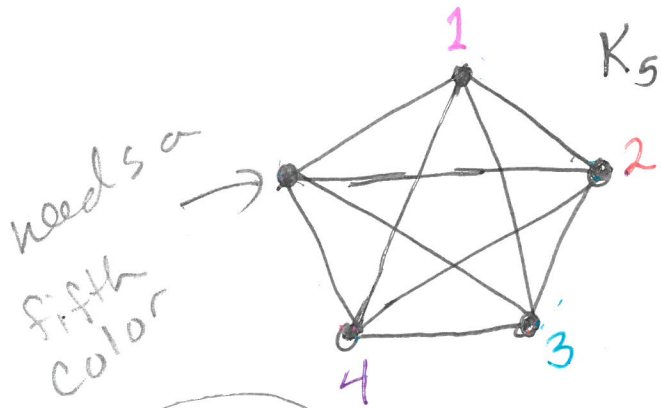
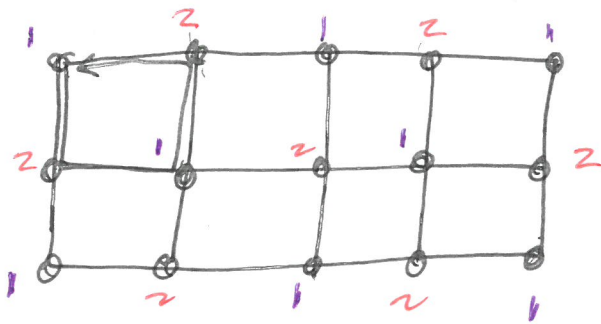


A graph that needs more than 4 colors

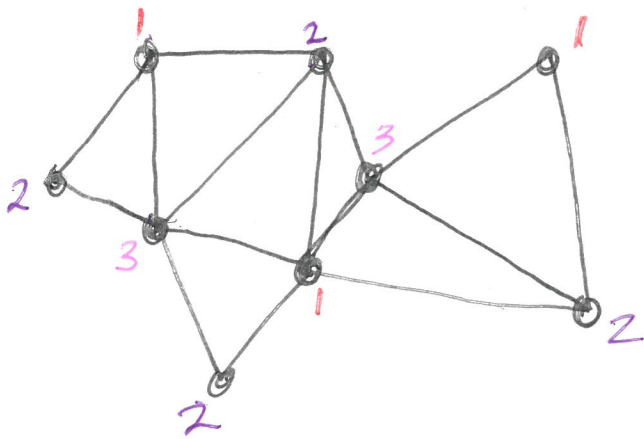




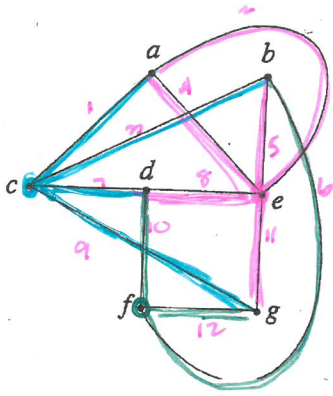
Sec. 4.4

pg 199

1-8



8.



7 vertices  
12 edges

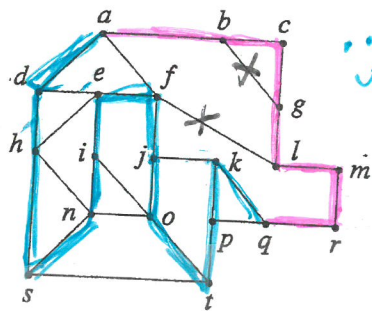
5 edges at e  
-3 :  $12 - 3 = 9$  can be used

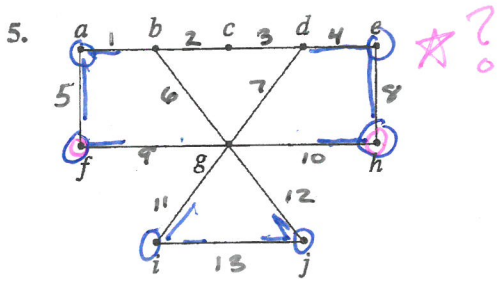
4 edges at c  
-2 :  $9 - 2 = 7$  edges can be used

3 edges at f  
-1 :  $7 - 1 = 6$  edges can be used

6 edges < 7 vertices  
No possible Hamiltonian cycle.

7.





$a, e, f, h, i, j$  are  $\text{deg } 2$   
 so I need to have edges:  
 $1, 5, 9, 4, 8, 10, 11, 13, 12$   
 in an  $H$ -cycle.  
 but, then  $g$  has 4 edges, so  
 it's not a  $H$ -cycle

$f$  and  $h$  are  $\text{deg } 2$   
 so I need to put edges  
 $5, 9, 10, 8$  in a  $H$ -cycle  
 so no other edges allowed  
 at  $g$   
 so the path can't include  
 (get to)  $i$ . so I can't  
 have an  $H$ -cycle