Quiz 04

Question 1. The *N*-queens problem requires you to place *N* queens on an N × N chessboard such that no queen attacks another queen. (A queen attacks any piece in the same row or column or diagonal). Here are some important facts:

- The states are any configurations where **<u>all</u>** *N* queens are on the board, one per column.
- The ***moveset*** includes all possible states generated by moving a single queen to another square in the same column. The function to obtain these states is called the ***successor*** function.
- The heuristic function ***h(state)*** is the number of **attacking** pairs of queens.

a) Consider *N*=4. How many states are there in total? Explain your answer.

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b) For each state, how many successor states are there in the moveset? Explain your answer

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c) What value will the heuristic function ***h*(*state*)** return for state *S* shown aside? Explain your answer.

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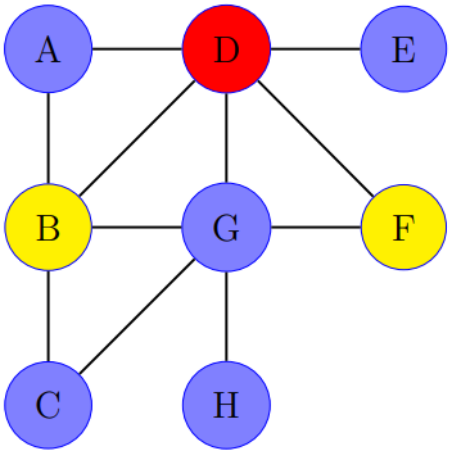
d) Use some hill-climbing variant that can lead to a solution. Draw the search tree from S (Only draw the branches that lead to a solution; for each node on the tree, write down its ***h*( )** value).

Question 2.

Let G be the simple graph shown below. The problem is to find a coloring of each vertex V using colors **red**, **blue**, and **yellow**, so that no two adjacent vertices are assigned the same color.

We model the problem with the set of variables $x_a, x_b, \ldots, x_g$, where, e.g., x_a denotes the color assigned to vertex a

- Define the state space associated with this model.
- How big is this space?
- Give an example of a solution state.
- For an arbitrary state s, define a "reasonable" neighborhood function ν(s) for s. Using these neighborhoods, provide a local path from the coloring shown below to your aforementioned solution state.



Question 3.

Consider the 4-queens problem, in which each state has 4 queens, one per column, on the board. The state can be represented in genetic algorithm as a sequence of 4 digits, each of which denotes the position of a queen in its own column (from 1 to 4).

- $Fit(n)$ = *the number of non-attacking pairs of queens*
- Let the current generation includes 4 states:

  S1 = 2341; S2 = 2132; S3 = 1232; S4 = 4321.
- Calculate the value of $Fit(n)$ for the given states and the probability that each of them will be chosen in the "selection" step.