CSci 4511
Midterm 2

Name: _____

Student ID: _____

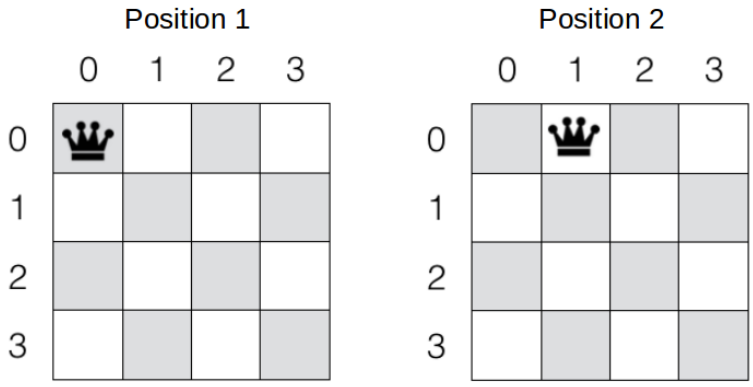
Instructions: The time limit is 75 minutes. Please write your answers in the space below. The exam is open book and notes. You may use electronic devices to ONLY look at either an e-book version or electronic notes. You may not use the internet, program/run code or any other outside resources. For all questions you must **show work**.

Problem (1) [20 points]
Draw a tree with 10 terminal states that will result in the maximum number of possible terminal states being pruned (assuming DFS is left-to-right). Use the same tree and terminal values, but rearrange the terminal values so only 50% of the terminal states are pruned.

Problem (2) [20 points]
Find the Nash equilibrium of the following payoff matrix. What are the pure strategy Pareto optimum?

(4,4)	(3.2)	(3,0)
(2,1)	(6,4)	(2,4)
(3,1)	(2,2)	(5,6)

Problem (3) [20 points]
I mentioned in-class that N-queens could be phrased as a constraint satisfaction problem. (1) Define the variables, domains and constraints for a 4-queens problem. (2) For each of the shown 4-queens positions below, assign the indicated value to the variable and then show the domains of the remaining unassigned variables that are 2-consistent (both with the assigned variable and with the other unassigned variables).



Problem (4) [20 points]
To find a heuristic you should: (1) relax the problem, (2) describe how to find the answer optimally in the relaxed situation (non-exponentially) and (3) a short description of the heuristic value of a state. You must find **two** such relaxations/heuristics for the following situation (neither can be trivial). Then state which relaxation would be better and why.

- You are going grocery shopping and need to get 20k calories, 1000% DV of iron and 1200% DV of Vitamin A while spending as little money as possible. You can assume the store has an infinite amount of each item in stock (and your shopping bag/cart can store as many items as you wish).

Problem (5) [20 points]
Answer the following questions:

- Which of the following algorithms can you control the running time of? Justify your answer. (Basic) hill-climbing, Stochastic hill-climbing, Hill-climbing with random restart, Simulated annealing, Local beam search, and Genetic algorithm.

- Below is a Monte-Carlo tree search with UCB values shown roughly above each node. Nodes that have not been visited yet have a branch/edge without a bubble. Indicate which node the next random rollout would occur at. If the next random rollout resulted in a loss, for each UCB value shown on the tree, indicate whether this value would increase, decrease or stay the same (you do not need to compute the exact value).